



# City of Columbia

## Armory Sports and Recreation Center Investment Grade Audit

Prepared for  
The City of Columbia

April 16, 2026

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Submittal

## Armory Sports & Recreation Center Investment Grade Audit

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## Acronyms

Acronym	Definition
ACT	Acoustical Ceiling Tile
ARC	Activities and Recreation Center
ASHRAE	American Society of Heating Refrigeration and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BAS	Building Automation System
BTU	British Thermal Unit (Measurement of Heat Energy)
CMU	Concrete Masonry Unit
CO <sub>2</sub>	Carbon Dioxide
EC	Electronically Communicated (motor)
ECM	Energy Conservation Measure
EMR	Experience Modification Rate (Safety Rating)
EPC	Energy Performance Contract (Same as ESPC)
ESPC	Energy Saving Performance Contract (Same as EPC)
FDD	Fault Detection and Diagnostics
HVAC	Heating, Ventilation, and Air Conditioning
IGA	Investment Grade Audit
IPMPV	International Performance Measurement and Verification Protocol (Measurement)
kW	Kilowatt
kWh	Kilowatt Hour
LED	Light-Emitting Diode (LED Lighting)
LOTO	Lockout/Tagout (Safety)
M&V	Measurement and Verification
NG	Natural Gas
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
RFP	Request for Proposals
RTU	Roof Top Unit - HVAC (Can Also Be Ground Mounted)
TELP	Tax Exempt Lease Purchase
VAV	Variable Air Volume (HVAC System Type)
VVT	Variable Volume and Temperature (HVAC)
WSHP	Water Source Heat Pump



Investment Grade Audit

# 1. Executive Summary



# 1. Executive Summary

## Introduction

Ameresco, Inc. (Ameresco) is pleased to present the findings and recommendations from the City of Columbia (City) Investment Grade Audit (IGA). This key deliverable will assist in leveraging Energy Performance Contracting (RSMo 8.231) as a procurement model for improving and updating facilities while reducing energy and operational costs.

The City selected Ameresco for this project in March 2025 through a competitive RFP process that solicited proposals from Energy Service Companies.

Per the Project Development Agreement with the City of Columbia, the IGA Phase identifies potential cost-saving measures, determines the cost and savings of each measure, and presents a measurement and verification (M&V) plan to validate each measure's future savings.



This IGA is for the Armory Sports and Recreation Center. The dedicated staff at the Armory has done an exceptional job with maintaining the facility, as demonstrated by the age of the heating, ventilation and air conditioning (HVAC) systems. The HVAC systems at the Armory are approximately 22 – 26 years old, while the ASHRAE rated life span for the HVAC equipment is 15 years, depending on the specific piece of equipment. *(per American Society of Heating, Refrigeration and Air-Conditioning Engineers Technical Committee 7.8 Owning & Operating Costs)*

The scope of work included in the IGA builds on work conducted with department leaders and staff, as well as multiple site visits with Ameresco engineers and verification meetings with the City staff, including Public Works. Through the verification meetings, specific Energy Conservation Measures were evaluated with the City of Columbia team.

Four facility improvement measures at the Armory were selected by the City and are included in this IGA. Three of the four facility improvement measures at the Armory are primarily capital-intensive projects focused on replacing the aged heating and cooling systems which have exceeded the useful life expectancy. The selected measures are considered deferred capital maintenance projects, in need of replacement.

By replacing end-of-life equipment at the Armory, the City will capture \$9,035 in guaranteed energy savings in year one and eliminate \$156,086 in recurring maintenance costs, based on 2024 expenditures.

There were many people involved in the verification and onsite meetings who invested time and effort in this project and assisted Ameresco through this process. We would like to thank the following individuals for their efforts including Eric Hempel, Kent Hayes, Shane Creech, Mitch Dooley, Gabe Huffington, Matt Unrein, Jim McDonald, Matthew Lue, and the staff at the Armory. We also want to thank Ben Edes at City of Columbia Utilities for assistance with the rebates.

As a result of stakeholder discussions, status checkpoints, site visits, engineering, and subcontractor bidding, this IGA presents the focused analysis of the proposed Amory project with firm-fixed costs and guaranteed energy savings for the City to review and approve, then proceed to a construction contract for implementation. Pending timely contract execution and lead times for equipment, facility improvements are scheduled to begin in October 2026 and reach completion in January 2027.

All IGA, engineering, and permitting costs are included in project implementation, along with guaranteed savings and a Measurement and Verification Plan (M&V Plan). Utilizing the RSMo 8.231 Energy Savings Performance Contracting procurement method provides many benefits to the City, including a design-build approach providing a quicker delivery of services with guaranteed energy savings provided by Ameresco.

Through this process we ensured transparency by obtaining multiple competitive bids from subcontractors for the scopes of work included. This is a common practice for Ameresco and provides risk mitigation and validation of market rates to municipalities. The City and department leaders reviewed the bids and determined which subcontractors to utilize for this project based on the bids received for the improvement measures in this phase.

The Ameresco business model provides many benefits to the City and includes risk reduction while providing transparent, firm-fixed pricing with NO change orders. Additionally, all construction contracts are held by Ameresco, not the City, thus transferring risk from the City of Columbia to Ameresco.

## City of Columbia Goals and Benefits

While the Armory upgrades are primarily capital improvement projects to replace aging infrastructure, the improvement measures directly advance the City's 2024 Climate Action and Adaptation Plan and the Strategic Plan. By modernizing the Armory, the City achieves both infrastructure reliability and significant environmental impact, with the Armory alone projected to save 76,081 kWh of electricity and 2,842 Therms of natural gas annually. This reduction is equivalent to the greenhouse gas emissions avoided, by not driving a gasoline powered passenger vehicle 1.74 million miles.

Ameresco has successfully executed multiple project phases for various Missouri partners including the State of Missouri and this initiative marks the City's first ESPC project. As a flagship project, it can serve as a powerful demonstration of how performance contracting delivers measurable value and long-term infrastructure impact.

### City of Columbia Project Goals

The City of Columbia seeks to achieve the following goals through this project:

- Leverage the ESPC statute as a means for updating facilities
- Optimize efficiency in equipment, systems, and operations
- Reduce energy consumption and operational costs
- Support sustainability goals on the path toward carbon neutrality

## City of Columbia Project Benefits

Beyond achieving core energy goals, the City will benefit from a comprehensive, turnkey facility modernization led by Ameresco. This approach delivers the following advantages for the Armory:

- **Eliminate Maintenance Backlog:** Resolves over \$2 million in deferred maintenance by replacing end-of-life HVAC and mechanical systems.
- **Ensure Financial Certainty:** Provides a firm-fixed price with NO change orders, protecting the City budget from unexpected costs.
- **Streamline Project Management:** Leverages a turnkey delivery model to minimize the demand for City staff time and internal resources.
- **Reduce Operational Costs:** Lowers ongoing O&M expenses, energy consumption, and utility demand charges.
- **Extend Asset Life:** Increases the facility’s remaining useful life and improves infrastructure resilience through modernized system reliability.
- **Optimized Building Control:** Implements an advanced Building Automation System (BAS) with automated Fault Detection Diagnostics (FDD) to improve occupant comfort and staff efficiency.
- **Enhances The Indoor Environment:** Delivers upgraded lighting, temperature control and air quality for the users and staff.
- **Mitigate Project Risk:** Minimizes construction risks in high-traffic recreation areas via Ameresco’s design-build model and rigorous safety protocols.

## Safety and Disruptions

Public safety is our top priority and our corporate safety experts oversee every phase of our work. Ameresco maintains an Experience Modification Rate (EMR) of 0.58. EMR is nationally recognized metric regarding a company’s safety record and incidents. An EMR rating of 1.0 is good and an EMR rating of 0.58 is considered excellent.



To protect the community, we will develop detailed safety plans for each facility improvement measure in partnership with City staff. While large-scale improvements may cause disturbances, we are committed to minimizing impacts and will provide the City and the public with ample notice before any critical work begins.

## Energy Conservation Measure Costs and Savings

The Energy Conservation Measures (ECMs) included in this project were developed after in-depth audits of the facility and analysis of the operation and needs, along with multiple meetings with City staff. The measures were selected because the project will modernize aging infrastructure at the Armory and reduce escalating operational costs, optimize energy performance, and enhance the indoor environment for all occupants. The following package of ECMs supports the project goals, enabling over \$2 million in critical mechanical updates.

It is also anticipated that the Armory will receive a one-time rebate in the amount of \$35,467 from the City of Columbia Utilities. Ameresco will apply for any eligible rebate as part of the design and construction process.

## Sustainability, Resilience and Promotion

In the 2019 Climate Action and Adaptation Plan, the City of Columbia expressed a commitment to creating a sustainable city, noting the goal of reducing greenhouse gas emissions. For municipal operations the targets are a 50% reduction by 2035 and 100% reduction by 2050.

**Reducing Greenhouse Gas Emissions:** The proposed Energy Conservation Measures for the Armory would reduce Carbon Dioxide (CO<sub>2</sub>) annually, by 684.45 metric tons. This reduction is equivalent to 760,300 pounds of coal burned annually.

**Energy Savings:** The proposed Energy Conservation Measures will reduce energy consumption by 76,081 kWh and 2,842 Therms, the first year and will generate \$9,035 in guaranteed first-year energy savings. Accounting for a 3.5% annual utility escalation, these measures are projected to deliver a total savings of \$174,336 over a 15-year term.

**Project Promotion and Citizen Communication:** Ameresco will support the Armory project by participating in Columbia's Interested Parties Meetings and collaborating with city staff to communicate project benefits and status through media relations and project profiles. See [Appendix A. Interested Parties Meeting](#) for more information.

The project team will be communicating program changes to Armory patrons and the general public as follows:

- Press Releases (general information)
- Signs and flyers at the Armory and information at other P&R facilities (general and specific information)
- Social Media posts on Facebook (broad information, possibly specific program information)
- Emails to program participants directly impacted by the construction (specific program information)
- Leisure Times Fall 2026 (general information)

## Proposed Energy Conservation Measures

Table 1 Proposed ECM Descriptions

Energy Conservation Measure	Description
<b>ARMORY ECM 1: Replace Gym Unit (RTU)</b>	Modernize the gym by replacing the obsolete RTU with a high-efficiency, single-zone Variable Air Volume (VAV) system to optimize energy performance and climate control
<b>ARMORY ECM 2: Replace Office Unit (RTU) and Variable Volume &amp; Temperature (VVT) Terminal Boxes</b>	Replace the end-of-life office RTU with a high-efficiency VAV system. This upgrade includes transitioning from obsolete Variable Volume & Variable Temperature (VVT) terminal boxes to modern VAV units equipped with high-efficiency motors and staged electric reheat for precise climate control.
<b>ARMORY ECM 3: Replace Ground Floor Units (These are two ground mount RTU units)</b>	Consolidate the ground floor's aging HVAC infrastructure by replacing two obsolete RTUs with a single, high-efficiency VAV system. This modernization includes upgrading legacy VVT terminal boxes to high-performance VAV units featuring EC motors and staged electric reheat for superior energy management.
<b>ARMORY ECM 4: Retrofit Existing Lighting to LED</b>	Modernize interior and exterior lighting by replacing legacy fixtures with advanced LED technology. This upgrade will reduce energy demand while enhancing visibility and safety throughout the facility.

## ECMs Investigated, Though Not Included in this Phase

Several ECMs were considered, though not ultimately included in the IGA scope for Phase 1.

The systems considered were discussed with the department leaders and staff and for various reasons, including being a lower priority for Phase 1 and return on investment considerations, the ECMs below were excluded from Phase 1 recommendations.

Ameresco is prepared to assist in further exploration of these solutions, if the City has interest in these ECMs in the future.

### The Armory

#### Water Conservation

The survey of water-consuming items at the Armory revealed that the facility is doing a good job managing water consumption and sewage. The restroom plumbing fixtures are all low-flow and retrofits to further reduce consumption would not be recommended.

#### Replace TVs and Monitors

Ameresco investigated replacing the existing televisions and computer monitors as part of the offering. Although this ECM has merit, the financial metrics do not support inclusion within the overall project. The City may choose to self-perform this ECM. There are enough savings generated from newer, higher efficiency LED TVs and monitors to justify replacement if self-performed, when there are reasons for the replacements due to failure of the existing TVs or some other remodel/reconfiguration of the spaces.

#### Replace Existing HVAC With Water Source Heat Pumps

Ameresco reviewed a full redesign of the building's HVAC system that would replace the existing gas-fired heating equipment with water source heat pumps (WSHP). This approach would require a fluid cooler to remove excess heat from the system, as well as an added heat source. After completing initial savings estimates, it was determined the building does not have enough overlapping heating and cooling demand during the shoulder seasons to make this system work efficiently. When combined with the overall return on investment, this option was not recommended. In addition, the extra equipment needed would take up valuable building space that is already being used for program activities.

#### Solar PV System

The Armory roof area is large enough to accommodate a solar array system with an approximate 71kW-DC capacity. However, current roof design and orientation would result in significantly lower production compared to a south-facing array. Due to these efficiency losses and high fixed costs relative to the system's small scale, the resulting energy would be considerably more expensive than the building's current power rates. Due to the expense of the system, Ameresco did not move forward with further engineering design and did not perform a structural analysis for the existing roof. After discussion with the City, it was decided to not include solar as an ECM in this phase. Ameresco remains available to assist, should the City wish to revisit solar options for the Armory in the future.



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## 2. Project Financials



## 2. Project Financials

### IGA Project

#### Project Summary Cost and Savings by ECM

Table 2 ECM Summary

Facility	#	Armory Sports & Recreation Center Scope Description	Total Cost	Rebate Estimate	Total Energy Savings	O&M Savings	Total Savings	Simple Payback	kWh Saved	Demand KW Saved	Energy (Therms)
Armory	1	Replace Gym RTU	\$350,696	\$8,333	\$2,688	\$23,336	\$26,024	13.2	18,668	0	1,258
Armory	2	Replace Office RTU and VVT Boxes	\$756,656	\$8,333	\$2,126	\$54,450	\$56,576	13.2	15,710	0	931
Armory	3	Replace Ground Floor RTUs	\$891,767	\$8,333	\$2,891	\$77,785	\$80,676	11.0	30,334	0	653
Armory	4	Retrofit Existing Lighting to LED	\$39,607	\$10,468	\$1,330	\$515	\$1,845	15.8	11,369	33	0
Total			\$2,038,726	\$35,467	\$9,035	\$156,086	\$165,121	12.1	76,081	33	2,842

## Financing

Project costs will be paid using funds from the City's Internal Loan fund. The internal loan will be repaid using Capital Improvement Sales Tax funds over for ten years at an interest rate of 4.412%

## Potential Rebates and Incentives

The City of Columbia Utilities offers a variety of commercial energy efficiency rebates that vary based upon the efficiency of the equipment being replaced and the overall reduction of the energy usage of the facility. The proposed improvement measures at the Armory include lighting, lighting controls, HVAC unit replacement and variable speed drives for large electric motors and all, are potentially eligible for the rebates offered. The rebate information below was provided by City of Columbia Utilities.

*Table 3 Potential Rebates*

Facility	#	Scope Description	Rebate Estimate
Armory	1	Replace Gym RTU	\$8,333
Armory	2	Replace Office RTU and VVT Boxes	\$8,333
Armory	3	Replace Ground Floor RTUs	\$8,333
Armory	4	Retrofit Existing Lighting to LED	\$10,468
<b>Total</b>			<b>\$35,468</b>

## Federal Grants and Tax Incentives

The current federal landscape for grants is in a state of flux. Ameresco's Government Affairs Department, based in Washington, DC, closely monitors all policies and federal grant funding developments that could impact our customers. We share these updates promptly, and where needed, seek clarification from Congressional or agency partners and educate these stakeholders on project or sector impacts of policy decisions made by these entities. In recent months, the Department has focused extensively on significant changes in federal grant funding policy being issued by the Trump Administration.

We are closely monitoring and watching for updates from federal agencies. Should new programs be announced or funding pauses lifted, we will move quickly to pursue those resources to offset project cost.



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# 3. Facilities Overview



## 3. Facilities Overview

### Included Facilities

Table 4 Facilities Included in IGA

Site Name	Primary Building Type	Current SF	In Scope
Armory	Recreation	21,468	X
<b>Total</b>		<b>21,468</b>	

### Utility Analysis

As part of the IGA, Ameresco performed a detailed utility billing analysis to understand the utility rates and opportunities for energy savings. The team evaluated the utility bills provided by the City of Columbia, which listed usage and cost summaries for electricity and natural gas. These were used to determine baseline utility consumption and cost.

Actual electricity energy and demand rates, rather than blended rates that combine both demand and energy, have been used to evaluate facility measure performance as customer charges from the utility can be significant and not all measures affect demand charges. The performance of ECMs based on blended rates will generally fail to deliver the projected dollar savings. Evaluating facility measures based on the current rate structures ensures the cost reduction from the reduced utility consumption use is accurate. Some retrofits will reduce both the peak electric demand (kW) and electric energy use (kWh), while others will only reduce electric energy use without significantly impacting the peak demand.

To calculate savings, Ameresco uses the rate structure that is applicable to each ECM and building, plus the associated fees for that account.

### Utility Services

Ameresco investigated the utilities and equipment at the Armory to analyze the utilities and determine which ECMs could be implemented and would yield a potential rate of return.

### Electricity

Electricity is provided through the Columbia Water and Light Department. Rate structures were found on the City’s website at <https://www.como.gov/utilities/utility-rates/>. The City provided utility billing records, as well as electrical consumption, from January 2023 through August 2025. The most recent 12 months of data were used to establish the baseline electrical usage and costs.

The facility is on the large general service electric rate for customers that exceed 25kW of demand during the summer months of June through September. This rate consists of energy and demand charges that vary between summer and non-summer months. A minimum demand charge is included each month for 25kW of demand or less. All additional demand over 25kW is charged on a per kW basis.

The baseline period reflects utility rates effective through 2025. Electricity consumption, demand, and monthly electrical charges can be seen in the following figures. The chart below graphs the consumption based on the utility bill data. Electric consumption increases during summer months (June-September) when more cooling is required.

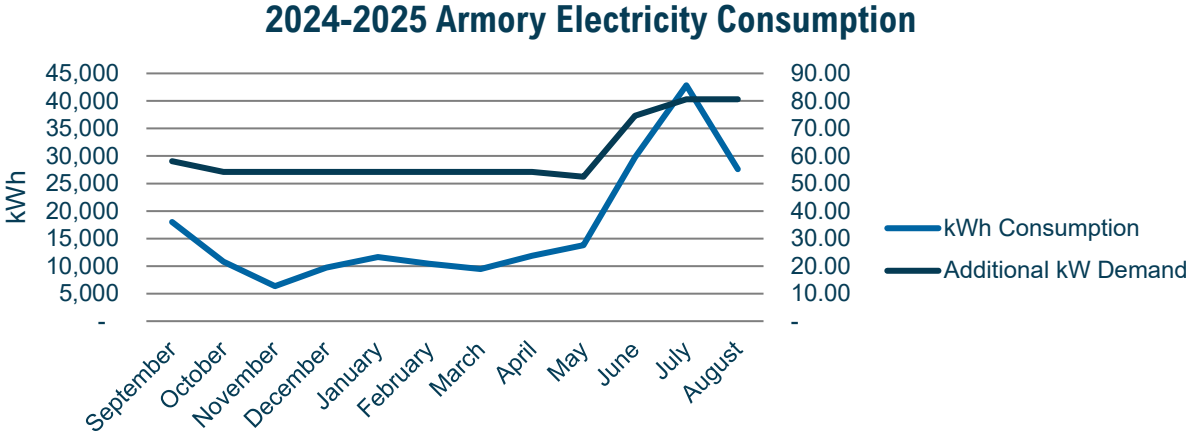


Figure 1 Armory Baseline Monthly Electricity Usage

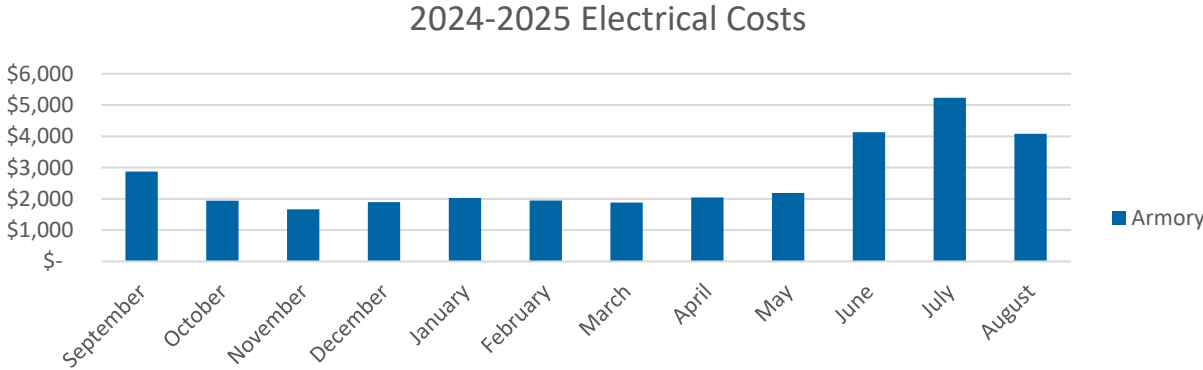


Figure 2 Baseline Monthly Electrical Costs (\$)

An increased rate for Fiscal Year 2026 has already been released and has been incorporated into the utility rate to accurately reflect future savings. Table 5 outlines the latest fee schedule, which has been used in the calculation of costs and savings for this report.

Table 5 Large General Electric Service

Item	FY2025 Charges	FY2026	Unit
<b>Total Demand:</b>			
Additional kW Summer	\$16.92	\$17.26	per kW
Additional kW Non-Summer	\$13.74	\$14.01	per kW
Electric PILOT Fee	\$1.034	\$1.034	per kW
<b>Total Energy:</b>			
Electric kWh	\$0.0570	\$0.0581	per kWh
PCA-Commercial	\$0.0174	\$0.0174	per kWh
Electric kWh Non-Summer	\$0.0496	\$0.0506	per kWh
Electric PILOT Fee	\$0.0177	\$0.0177	per kWh

To simplify the cashflow, we have calculated a weighted average rate for both the energy and demand rates for the Armory during the summer and non-summer months. These rates can be seen below, along with the energy and demand in each season.

*Table 6 Facility Baseline Energy and Demand*

Facility		Armory	
Energy	Summer	kWh	118,200
		\$/kWh	\$0.0755
		Total \$	\$8,924.10
	Non-Summer	kWh	84,120
		\$/kWh	\$0.0682
		Total \$	\$5,736.98
Average	\$/kWh	<b>\$0.0725</b>	
Additional Demand	Summer	kW	294
		\$/kW	\$17.26
		Total \$	\$5,073.06
	Non-Summer	kW	432
		\$/kW	\$14.01
		Total \$	\$6,050.36
Average	\$/kW	<b>\$15.3262</b>	

## Natural Gas

The City provided monthly billing data for 2024. In 2024, the Armory used 7,064 Therms of natural gas. The facility is on the Ameren Missouri’s general service rate. Based on the published general service rate, the facility is charged an effective delivery charge of 45.59 cents per Therm as of September 1, 2025. While we do not have the purchased gas adjustment rate as of September 1, 2025, we estimated it to be the same as in 2024. Based on available information, it is reasonable to assume that natural gas rates are currently \$1.0605/Therm.

*Table 7 Natural Gas Rates*

Time Period	Purchased Gas Adjustment	Sales Delivery Charge	Total Charge per Therm
2024	\$0.6046/Therm	\$0.3251/Therm	\$0.9279/Therm
Sept 1, 2025-Present	Estimated \$0.6046/Therm	\$0.4559/Therm	Estimated \$1.0605/Therm

The monthly consumption and cost profile can be seen in the following charts.

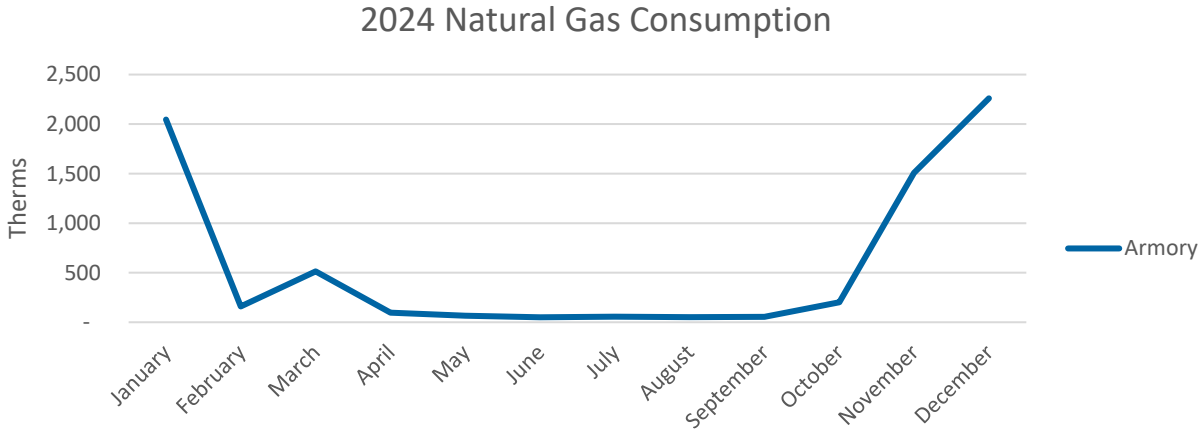


Figure 3 Baseline Monthly Natural Gas Consumption

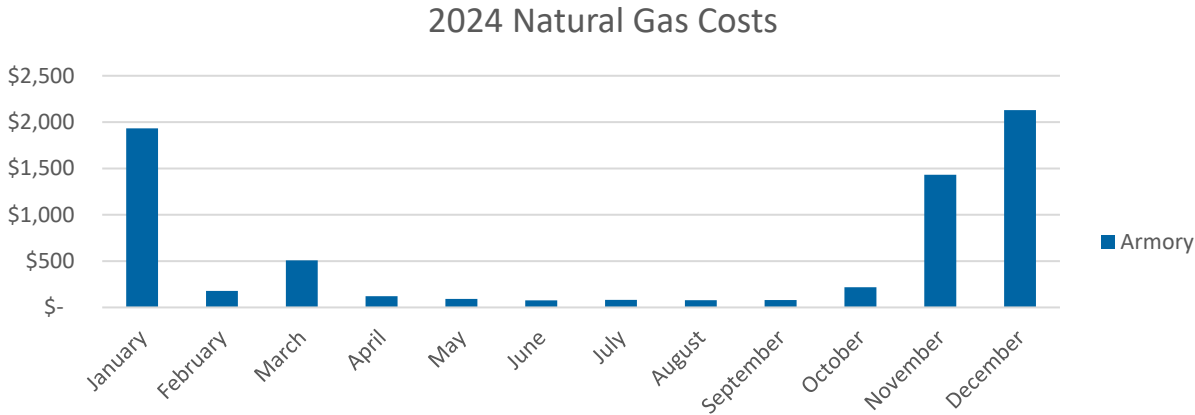


Figure 4 Baseline Monthly Natural Gas Costs

The baseline natural gas consumption and charges are shown in the table below. Total natural gas charges shown are actual billed charges from baseline period and do not reflect the September 2025 rate increases.

Table 8 Natural Gas Consumption and Charges

Facility	Account No.	Natural Gas (Therms)	Total Charges (\$)
Armory	00139199-0045782	7,064	\$6,928



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# 4. Overview of Energy Conservation Measures



## 4. Overview of Energy Conservation Measures

### ECM Summary

Table 9 ECM Summary

Facility	#	Armory Sports & Recreation Center Scope Description	Total Cost	Rebate Estimate	Total Energy Savings	O&M Savings	Total Savings	Simple Payback	kWh Saved	Demand KW Saved	Energy (Therms)
Armory	1	Replace Gym RTU	\$350,696	\$8,333	\$2,688	\$23,336	\$26,024	13.2	18,668	0	1,258
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Armory	3	Replace Ground Floor RTUs	\$891,767	\$8,333	\$2,891	\$77,785	\$80,676	11.0	30,334	0	653
Armory	4	Retrofit Existing Lighting to LED	\$39,607	\$10,468	\$1,330	\$515	\$1,845	15.8	11,369	33	0
<b>Total</b>			<b>\$2,038,726</b>	<b>\$35,467</b>	<b>\$9,035</b>	<b>\$156,086</b>	<b>\$165,121</b>	<b>12.1</b>	<b>76,081</b>	<b>33</b>	<b>2,842</b>

## Energy Conservation Measures

### Armory Sports and Recreation Center

#### ARM ECMs | Replace Building Automation System (BAS)

##### Existing Conditions

The Armory was renovated in 2000, and the current Building Automation System (BAS) was upgraded several years ago with the installation of the EcoStruxure system when parts for the previous BAS were no longer available to operate the third-floor offices.



##### Proposed Upgrade

Ameresco is recommending a new expansion to the Schneider Electric EcoStruxure system for this facility. EcoStruxure has become the standard for the Public Works department and will be expanded to all HVAC systems at the Armory. This new system will be integrated into the existing Public Works system.

The pricing for the new BAS has been blended across all the ECMs that will be tied into the system. If the City chooses to eliminate an individual ECM listed below, the pricing for that ECM may require adjustment to ensure Ameresco is providing a complete system.

#### ARM ECM 1 | Replace Gym RTU

##### Existing Conditions

The existing Rooftop Unit (RTU) that serves the gymnasium is a Carrier 48 EJ series is 22 years old. ASHRAE rated life span for the HVAC equipment is 15 years, depending on the specific piece of equipment.



The unit has gas heat and provides approximately 35 tons of cooling to the gymnasium. This RTU is what is referred to as a Constant Volume system, meaning when the unit calls for heat or cooling, the compressor, heater, and fan operate on the highest settings throughout its cycle.

The evaporator coils on this unit, which reject heat, have been smashed flat by hailstorms over the years. The fins of the coils have been combed out, but the effectiveness of the heat rejection has been compromised, resulting in a loss of efficiency.

In recent years, the unit has become problematic, with various major and minor parts failing. This has led to an increasing cost to maintain the unit. This RTU has outlived its useful lifespan.

##### Proposed Upgrade

Ameresco proposes to remove and replace the existing RTU with a Single Zone Variable Air Volume (VAV) system. The existing unit currently sits on the roof on structural steel, which will remain in place and be reused to support the new RTU. Existing equipment will be safely

disconnected, with all utilities isolated and refrigerant legally recovered and recycled prior to removal and disposal.

The new RTU will be installed and fully integrated with the new building automation system, including new exterior and limited interior ductwork, piping, electrical power, and controls. Exterior ductwork below the unit, through the roof deck, and above the ceiling will be replaced as required and transitioned into the existing ductwork within eight feet of the roof penetration. Exterior ductwork will be insulated per ASHRAE 90.1. Extensions and modifications required to piping, conduit, and controls will be provided as necessary. Duct-mounted smoke detectors and required interlock wiring will be installed in accordance with applicable codes. Existing gym interior ductwork to remain.

Roof patching and restoration will be included as required to maintain existing warranty and a weather-tight roof system following removal and replacement of ductwork and equipment. All new RTUs will be screened from visibility at adjacent grade levels in accordance with architectural and code requirements.

The unit will be integrated into the Schneider Electric EcoStruxure BAS to allow for centralized monitoring, control, and optimization of HVAC performance.

The RTU is physically located above the office area. The ductwork comes into the building above these offices and turns to feed the gym. Acoustical ceiling tile (ACT) ceilings in the office will be temporarily opened as required to remove and replace equipment. Upon completion of work, affected ceiling areas will be restored with new ceiling tiles to match the current ceiling systems.

New equipment will be screened from view at adjacent grade levels. Any exposed natural gas piping will be painted safety yellow using high zinc-oxide paint suitable for exterior conditions. Pipe supports will utilize approved metal support systems, with wood blocking not permitted.

The new unit, upon a call for heat or cooling, adjusts the compressor, heater, and fan speed downward to more effectively provide comfort for the occupants, while reducing overall energy consumption. In addition, with the reduction of operational speeds, the wear items within the unit will last longer due to reduced wear.

### Impact to Building Occupants

Ameresco proposes to complete this work during normal hours. Construction activities will be coordinated with the City staff to minimize disruption and maintain safe building operations and work will be clearly separated from occupied areas, using barriers and signage as needed. Contractors will follow established safety procedures, including safe lifting practices and proper use of protective equipment. Fire and life-safety systems will remain operational, and required smoke detection and safety interlocks will be verified as part of the installation. During the physical removal and replacement of the RTU, the gym and affected office area will need to be isolated from the employees and patrons due to safety reasons.

Ameresco expects the unit replacement to take five to seven days due to necessary ductwork modifications above the ceiling. While the total project spans a week, the actual system

### Benefits to the City

- Proactive capital improvement measure that avoids emergency replacement
- Increased energy efficiency for the new unit
- Reduced operations and maintenance expenditures
- Improved indoor air quality with superior moisture removal, improving comfort conditions for the users and staff

shutdown is limited to approximately eight hours. During this eight-hour window, the gymnasium will not receive conditioned air. Once installed, the unit will operate in manual mode until final programming is completed.

Noise will be kept to a minimum when possible and heavy demolition will be coordinated with Parks and Recreation. The power to the existing equipment will be made safe via Occupational Safety and Health Administration (OSHA) and lockout/tagout (LOTO) procedures. Ameresco requires all hoisting equipment and rigging to be inspected per OSHA and American Society of Mechanical Engineers (ASME) standards along with proof of crane operator certification.

**Savings Summary**

*Table 10 Armory ECM 1 – Savings Summary*

Electric Savings (kWh)	Electric Demand Savings (kW)	Heating Savings (Therms)
18,668	0	1,258

**Energy Savings**

To calculate the savings for these units, the operation of the existing equipment was modeled based on equipment data, information about the space, occupancy, and local weather data. An annual model of average hourly dry bulb temperature for a given day of every month was produced from a data set of approximately 25 years of 15-minute weather data sourced from the nearest airport. From the weather data, a load model could be predicted based on ambient conditions for the average day each month.

Once the occupancy data is layered in, the control methods, such as night-time setbacks and demand control ventilation, as well as equipment efficiency changes, could be used to calculate both the baseline and new operation. Between the baseline and new, only parameters that would be specifically affected were changed to produce an apples-to-apples comparison. The resulting load profile is illustrated in the figure below. Finally, the model was indexed to actual utility data to ensure the savings were realistic.

**Operational and Maintenance Savings**

Ameresco calculated maintenance savings associated with this measure using the data we received from the City for the year 2024 along with maintenance agreement expenditures from years 2023 through 2025.

**ARM ECM 2 | Replace Office RTU and VVT Boxes**

**Existing Conditions**

The existing RTU that serves the office is a Carrier 48 TC series and this unit is 22 years old. The unit has gas heat and provides approximately 12 tons of cooling to the two-story office section at the front of the facility. This RTU is a Constant Volume system, meaning when the unit calls for heat or cooling, the compressor, heater, and fan operate on the highest settings throughout its cycle. Connected to the ductwork are Variable Volume and Temperature (VVT) boxes that regulate airflow to adjust temperatures within the spaces.



The current system design keeps the RTU running at full speed continuously. When a connected zone or office reaches its setpoint, the supply damper in the VVT box closes, and the separate bypass damper opens to dump conditioned air into the ceiling plenum, where it is drawn back to the RTU. This approach is highly inefficient for delivering conditioned air to spaces. Another design issue with VVT systems is the heating and cooling controller polls all connected zones for demand, then responds to the highest call—providing either heating or cooling—regardless of other zones’ needs. This often results in occupant discomfort.

The ASHRAE rated life span for the HVAC equipment is 15 years, depending on the specific piece of equipment. In recent years, the unit and VVT system have become problematic, with various major and minor parts failing. This has led to an increased cost to maintain the unit and system components. This RTU has outlived its useful lifespan. The old controller for the VVT has failed and been replaced with a more modern Schneider Building Automation System.

### Proposed Upgrade

This measure includes removal of the existing office Constant Volume RTU and existing VAV / VVT terminal units, followed by installation of a new RTU, traditional VAV system, and a new BAS. Existing equipment will be safely disconnected, with all utilities isolated and refrigerant legally recovered and recycled prior to removal and disposal.

The new RTU will be installed and fully reconnected to building systems, including ductwork, piping, electrical power, and controls. Required ductwork modifications below the roof will be provided to accommodate the new RTU configuration and pressure requirements, along with piping, conduit, and controls being extended or modified as necessary. Duct-mounted smoke detectors and required interlock wiring will be installed in accordance with applicable codes.

Existing VAV / VVT boxes will be replaced with new VAV terminal units to improve zoning, comfort, and system control. New VAV boxes will include electric heating coils as indicated on the drawings included in the appendices, and all required power will be provided.

The new unit, upon a call for heat or cooling, adjusts the compressor, heater, and fan speed downward to more effectively provide comfort for the occupants, while reducing overall energy consumption.

ACT ceilings will be temporarily opened as required to remove and replace VAV equipment. Upon completion of work, affected ceiling areas will be restored with new ceiling tiles to match client standard ceiling systems.

A new BAS will be provided for all HVAC systems within the facility. The BAS will be Schneider Electric EcoStruxure and will include full integration of the RTU and VAV systems to allow for centralized monitoring, control, and optimization of HVAC performance. For HVAC zones calling

### Benefits to the City

- Mitigates the potential for emergency system replacement by renewing aged infrastructure
- Significant increased energy efficiency. Eliminates bypass waste
- Reduced operations and maintenance expenditures
- Improvement to occupant comfort. Eliminates conflict of demand where the unit must choose between heating / cooling for the conditioned spaces

for heat while cooling is being provided, the VAV boxes will be supplied with a small amount of electric heating to maintain space temperature.

Any exposed natural gas piping will be painted safety yellow using high zinc-oxide paint suitable for exterior exposure. Pipe supports will utilize approved metal support systems, with wood blocking not permitted. Under normal use, the ASHRAE rated life span for the HVAC equipment is 15 years.

### Impact to Building Occupants

Ameresco proposes to complete this work during normal hours. Construction activities will be coordinated with the City staff to minimize disruption and maintain safe building operations and clearly separated from occupied areas using barriers and signage as needed. Contractors will follow established safety procedures, including safe lifting practices and proper use of protective equipment. Fire and life-safety systems will remain operational, and required smoke detection and safety interlocks will be verified as part of the installation.

Ameresco anticipates a shutdown of roughly four to six weeks to remove and replace the unit, install the VAV boxes, and program the BAS.

While the unit and boxes are being replaced, the areas served with conditioned air will be dormant. Noise will be kept to a minimum when possible and heavy demolition will be coordinated with the City for public and staff communication. The power to the existing equipment will be made safe via OSHA and LOTO procedures. Ameresco requires all hoisting equipment and rigging to be inspected per OSHA and ASME standards along with proof of crane operator certification.

### Savings Summary

*Table 11 Armory ECM 2 – Savings Summary*

Electric Savings (kWh)	Electric Demand Savings (kW)	Heating Savings (Therms)
15,710	0	931

### Energy Savings

To calculate the savings for these units, the operation of the existing equipment was modeled based on equipment data, information about the space, occupancy, and local weather data. An annual model of average hourly dry bulb temperature for a given day of every month was produced from a data set of approximately 25 years of 15-minute weather data sourced from the nearest airport. This model was then used to produce an equivalent load to what the building would see, incorporating envelope losses, outside air, and internal loads. From that, a one-week model was extrapolated to allow for a 7-day schedule to account for different occupancy throughout the week.

Once the occupancy data was layered in, the control method and equipment efficiency changes could be used to calculate both the baseline and new operation. Between the baseline and new, only parameters that would be specifically affected were changed to produce an apples-to-apples comparison. The resulting load profile is illustrated in the figure below. Finally, the model was indexed to actual utility data to ensure the savings were realistic.

## **Operational and Maintenance Savings**

Ameresco calculated maintenance savings associated with this measure using the expenditures for the year 2024 along with maintenance agreement expenditures from years 2023 through 2025.

### **ARM ECM 3 | Replace Ground Floor RTUs**

#### **Existing Conditions**

The ground floor of the Armory is fed by two separate RTUs located on the north side of the facility. These units are the Carrier 48TJ series. They provide roughly 40 tons of cooling from each unit. Combined, these two units are oversized by approximately 10 tons. This can lead to humidity and space temperature issues. Both units are Constant Volume. As described previously, this type of design is very inefficient and has increased occupant comfort issues.

The manufacture dates of the existing units are 1999 and 2000. Under normal use, the ASHRAE rated life span for the HVAC equipment is 15 years, depending on the specific piece of equipment.

The evaporator coils on these units, which reject heat, have been smashed flat by hailstorms over the years. The fins of the coils have been combed out, but the effectiveness of the heat rejection has been compromised, resulting in a loss of efficiency.

In recent years, these units have become problematic, with various major and minor parts failing. This has led to an increased cost to maintain the units. These RTUs have outlived their useful lifespan.



#### **Proposed Upgrade**

This measure includes removal of the existing ground floor RTUs and replacement with a single, new ground-mounted VAV RTU serving the combined load. Existing units will be safely disconnected, with all utilities isolated and refrigerant legally recovered and recycled prior to removal and disposal.

The new ground-mounted RTU will be installed on a modified concrete equipment pad. A new equipment curb will be constructed to support the RTU and provide proper elevation and interface with ductwork and utilities. Existing fencing surrounding the equipment area will be removed and replaced with new fencing utilizing slats to screen the units and to accommodate the new RTU configuration and maintain site security. New exterior ductwork will be insulated per ASHRAE 90.1

The new RTU will be fully integrated with existing building systems, including ductwork, piping, electrical power, and controls. Required ductwork modifications will be provided to accommodate the new unit configuration, and all piping, conduit, and controls will be extended or modified as necessary. Duct-mounted smoke detectors and required interlock wiring will be installed in accordance with applicable codes. Any unused openings in the existing foundation resulting from equipment removal will be infilled with Concrete Masonry Units (CMU) and painted to match existing conditions.

Four new VAV terminal units will be installed to improve zone and comfort control. The new VAV boxes will include electric heating coils as indicated and will be provided with all required electrical power. The new unit, upon a call for heat or cooling, will adjust the compressor, heater, and fan speed downward to more effectively provide comfort for the occupants, while reducing overall energy consumption. For HVAC zones calling for heat while cooling is being provided, the VAV boxes will be supplied with a small amount of electric heating to maintain space temperature. New thermostats compatible with the Schneider Electric EcoStruxure system will be installed, and associated ductwork will be modified as required to accommodate the new terminal units and additional system pressure.

Any exposed natural gas piping will be painted safety yellow using high zinc-oxide paint suitable for exterior exposure. Pipe supports will utilize approved metal support systems, with wood blocking not permitted.

### Impact to Building Occupants

Ameresco proposes to complete this work during normal hours. Construction activities will be coordinated with the owner to minimize disruption and maintain safe building operations and clearly separated from occupied areas using barriers and signage as needed. Contractors will follow established safety procedures, including safe lifting practices and proper use of protective equipment. Fire and life-safety systems will remain operational, and required smoke detection and safety interlocks will be verified as part of the installation. The ceilings will be opened to allow installation of the VAV boxes, electrical, and BAS wiring. Wiring for the heat in the VAV boxes and BAS will be run above the ceilings to a central location for the controller. Ameresco anticipates a shutdown of roughly two to three weeks to remove and replace the units, install the VAV boxes, and program the BAS. This work can be staged so the entire area is not down for the entire time, but there may be times with no heating, cooling, and ventilation, as the units will be turned off. Minimal temporary HVAC is included for sensitive storage areas. Ameresco anticipates four to six weeks to remove and replace the unit, install the VAV boxes, and program the BAS.

While the units and boxes are being replaced, the areas served with conditioned air will be dormant. Noise will be kept to a minimum when possible and heavy demolition will be coordinated with the City for public and staff communication. The power to the existing equipment will be made safe via OSHA procedures. Ameresco requires all hoisting equipment and rigging to be inspected per OSHA and ASME standards along with proof of crane operator certification.

### Savings Summary

Table 12 Armory ECM 3 – Savings Summary

Electric Savings (kWh)	Electric Demand Savings (kW)	Heating Savings (Therms)
30,334	0	653

### Benefits to the City

- Eliminate end of life risk avoiding emergency replacement (26 year old units)
- Corrective right-sizing eliminating 10 tons of waste
- Replaces two units with one ground mount unit cutting future maintenance liabilities in half
- Increased energy and operational efficiency for the new unit
- Improved temperature control and comfort for the users and occupants

### **Energy Savings**

To calculate the savings for these units, the combined operation of both existing units was modeled based on equipment data, information about the space, occupancy, and local weather data. An annual model of average hourly dry bulb temperature for a given day of every month was produced from a data set of approximately 25 years of 15-minute weather data sourced from the nearest airport. This model was then used to produce an equivalent load the building would see, incorporating envelope losses, outside air, and internal loads. From that, a one-week model was extrapolated to allow for a 7-day schedule to account for different occupancy throughout the week.

Once the occupancy data was layered in, the control method, VAV performance, and equipment efficiency changes could be used to calculate both the baseline and new operation. Between the baseline and new, only parameters that would be specifically affected were changed to produce an apples-to-apples comparison. The resulting load profile is illustrated in the figure below.

Finally, the model was indexed to actual utility data to ensure the savings were realistic.

### **Operational and Maintenance Savings**

Ameresco calculated maintenance savings associated with this measure using the expenditures for the year 2024 along with maintenance agreement expenditures from years 2023 through 2025.

## **ARM ECM 4 | Retrofit Existing Lighting to LED**

### **Existing Conditions**

The Armory is roughly 21,468 square feet in size and contains a variety of different lighting fixtures. The facility was originally designed in 1938, and the most recent renovation was performed in 2000. Most of the existing light fixtures utilize lower efficiency T-8 tubes that were standard at the time of the renovation.

As part of this IGA, Ameresco completed an extensive audit of the Armory to establish a sound scope of work and energy baseline. Of the 238 fixtures documented in this audit, Ameresco identified only 26 fixtures that have previously been upgraded to LED.

### **Proposed Upgrade**

Ameresco proposes completing a comprehensive LED upgrade throughout the Armory. Existing lamps and ballasts will be removed and replaced with new, line-voltage LED lamps and fixtures to improve energy efficiency and reduce maintenance requirements. All removed lamps and ballasts will be legally recycled in accordance with applicable regulations.

In areas identified as over lit, de-lamping will be performed by selectively removing lamps to reduce excessive illumination while maintaining required lighting levels.

The existing emergency lighting scheme will be maintained, with emergency fixtures replaced by LED units equipped with integral battery backup to ensure continued life-safety compliance.

### **Benefits to the City**

- Annual energy and operational savings
- Enhanced life safety and reliability
- Standardized color temperatures and optimized illumination levels significantly improves the environment for users and staff
- Annual O&M savings due to the longer lifespan of newer LEDs (from 15,000 hours to 50,000 hours)

Four occupancy sensors will be installed in single restrooms, closets with lighting, and utility rooms. Sensor locations will be coordinated to ensure detection of typical occupant movement within each space, providing reliable automatic lighting control and additional energy savings. Gymnasium lighting is currently LED and therefore excluded.

The LED upgrade includes both fixture retrofits and full fixture replacements.

*Table 13 Armory ECM 4 – Lighting Upgrade Building Summary*

Building	Square footage	Fixtures Audited	Fixtures in Scope	% in Scope
Armory	21,468	238	212	89%

For all the areas listed in the table above, Ameresco will:

1. Take pre-construction power readings for M&V as part of this IGA.
2. Procure and install 4000K fixtures and lamps in all buildings.
3. For new lamps, LEDs, and bar kits Ameresco will:
  - a. Remove all existing lamps and ballasts.
  - b. Properly dispose of existing lamps and ballasts.
  - c. Replace the existing lamps with line voltage/bypass LED lamps.
  - d. Clean the existing lenses.
  - e. Report any damaged or corroded wiring to the City.
4. For downlight, sconce, and retrofit kits Ameresco will:
  - a. Remove the existing lamps, ballasts, and lenses.
  - b. Properly dispose of the existing lamps, ballasts, and lenses.
  - c. Install the appropriate LED retrofit kit solution.
  - d. Report damaged or corroded wiring to the City.
5. Take post-construction wattage measurements as described in the M&V section after construction is completed.
6. Update the fixture quantities to reflect the as-built quantities. Modifications may be made due to minor changes or clarifications that may occur during construction.
7. Update the service fee based on M&V measurements and as-built quantities.

### Impact to Building Occupants

Ameresco proposes completing this work during normal business hours and will work with the City to identify times and sequencing by zone that minimize disruption. Ameresco will coordinate lighting upgrades with ceiling-related work to reduce rework and overall impact and will coordinate specific work locations with the City and building users. Electrical circuits will need to be turned off while upgrades are performed; in many spaces, this can be accomplished by switching off power at the local light switch. In some general access areas, lighting circuits will need to be deenergized at the main electrical panel. This approach has been discussed with City staff. In some cases, the City may be responsible for relocating equipment, furniture, or supplies where it is not possible for work to be performed safely around existing items.

### Savings Summary

*Table 14 Armory ECM 4 – Savings Summary*

Electric Savings (kWh)	Electric Demand Savings (kW)	Heating Savings (Therms)
11,369	33	0

### Energy Savings

Ameresco calculated the savings for this measure from the difference between the existing and proposed fixture or lamp wattages. Ameresco audited the spaces to determine the current fixture types and wattages based on information available on site and typical wattages for the fixture type. Run hours were assigned based on space type and shared with the City. These burn hour assumptions were finalized with input from the City. This allowed baseline usage to be calculated for the lighting. Hours of operation by space type can be found below.

New LED lamps or retrofit kits were selected for each of the spaces, along with their rated wattage. Using the fixture wattage and run hours, the energy consumption of the proposed lights was calculated. The annual electric kWh savings were calculated based on the difference between the baseline and proposed fixtures.

*Table 155 Armory ECM 4 – Lighting Operational Hours*

ASHRAE Space Type	Effective Annual Operation Hours
Fitness Room	2600
Life Safety - 5	5
Hallway	2860
Storage - Room	260
Electrical/Mechanical	208
Multipurpose	2600
Life Safety	8760
Classroom	2080
Locker Room	2600
Housekeeping	520
Stairwell	8760
Office - Private < 250 Sq. Ft	2080
Restroom	2600
Break Room	2080
Gymnasium - General	2600
Office - Open < 250 Sq. Ft	2600
Restroom - Private	780
Conference	1560
Exterior	4380
Exterior	4380

### Operational and Maintenance Savings

Ameresco calculated maintenance savings associated with this measure using the current cost of replacement materials and the expected lifespan of the fixtures, lamps, and ballasts to determine the number of replacements that would be needed each year. Only the material savings were accounted for, not the labor time staff will also save with fewer fixture and lamp changes.

## Measurement and Verification

The long-term effectiveness of a comprehensive energy efficiency project relies on creating a precise and effective Measurement & Verification (M&V) Plan. The primary goal is to establish a cost-efficient strategy that accurately quantifies and confirms the results of ECMs. Ameresco follows industry-standard M&V protocols, which have been designed to ensure reliable and consistent measurement practices.

For this project, Ameresco utilized the International Performance Measurement and Verification Protocol (IPMVP) to guide the development of M&V procedures for each ECM. The descriptions of M&V options provided herein are based on summaries and excerpts from the IPMVP.

The protocols offer several key advantages:

- Clarify the role of verification in energy contracts and project execution
- Outline methods with different levels of accuracy and expense to verify both baseline and project installation conditions, as well as ongoing energy savings
- Detail approaches for calculating savings across an entire facility, for specific technologies, or using stipulated values
- Ensure procedures are consistent, unbiased, widely accepted, and dependable

Typically, the process for determining energy savings in these plans involves comparing energy consumption before and after the installation of ECMs. The calculation is straightforward:

$$\text{Energy Savings} = \text{Baseline Energy Use} - \text{Post-Retrofit Energy Use} \pm \text{Adjustments}$$

IPMVP protocols define four distinct M&V options (Options A through D) tailored to various performance contract requirements. They also offer recommended practices for establishing baselines and verifying results after retrofits. The proposed M&V option and methodology for each ECM is described as part of that ECM’s description.

## Baseline Performance Parameters

*Table 166 M&V Baseline Performance Parameters by ECM*

ECM	Baseline Performance Parameters
Armory ECMs 1, 2 & 3	The rooftop unit’s performance parameters – including design flow, efficiency, horsepower, etc. – were determined through equipment data, occupancy data, visual inspections, manufacturer specifications, and engineering assumptions.
Armory ECM 4	Fixture quantities, wattage, and operating hours were determined through a combination of a facility lighting audit, field surveys, manufacturer data, and industry standards. Power level for a sample set of existing fixtures will be measured one time pre-construction on fixture types that have a quantity of 50 or greater. Measurements follow 80/20 statistical confidence and precision criteria.

## Post-Installation Performance Parameters

Table 17 M&V Post-Installation Performance Parameters by ECM

ECM	Post-Installation Performance Parameters
Armory ECMs 1, 2 & 3	Performance will be verified during start-up and commissioning to confirm that the equipment is installed and functioning as intended. Proper integration with the BAS will also be verified, as applicable. The post installation performance parameters include equipment efficiency and operations, along with the delivered functional capability of the Scope of Services, as documented during the commissioning and construction closeout process.
Armory ECM 4	Power level for a sample set of newly installed fixtures will be spot measured one time post-construction on fixture types that have a quantity of 50 or greater. Measurements will follow 80/20 statistical confidence and precision criteria. Fixture count will be determined by visual confirmation during the commissioning and construction closeout process. Operating hours will not be measured and will be the same as the baseline performance parameters, unless an occupancy sensor is installed. Interactive effects are not measured.

## Performance Assurance Activities

Table 18 M&V Performance Assurance Activities

ECM	Performance Assurance Activities
Armory ECMs 1, 2 & 3	The ECM will be checked to confirm the equipment is installed, functioning, and being controlled as intended. After all items are installed, commissioned, and documented, the corresponding Guaranteed Savings will be deemed achieved and documented in the M&V Report.
Armory ECM 4	The ECM will be checked to confirm that fixtures were installed as stated in the Scope of Services and are performing as specified. One-time pre- and post-installation measurements of fixture wattages will be performed, as described above. Fixture quantities will be updated to reflect as-built conditions. Energy savings will be updated with measured wattage values and documented in the M&V Report.

## Commissioning and Training

Commissioning and training activities associated with each ECM are designed to ensure optimal performance, integration, and long-term value of each implemented measure. For each ECM, Ameresco oversees a thorough commissioning process that includes the verification of installation quality, system functionality, and adherence to project specifications. This process also involves performance testing to confirm that energy savings and operational objectives are met.

### Completion

Substantial completion for ECMs will occur when the replacement/upgrade is installed and operational. Ameresco will confirm proper installation and programming of all ECMs. The City will inspect the ECMs to confirm Substantial Completion and the remaining punch list. Measures should meet or exceed the stated operational performance specifications.

### Documentation

An O&M manual will be submitted to the City after Substantial Completion is accepted, before the Post-Installation Completion Report is delivered. The O&M manual will include cutsheets for all products installed, as well as as-built information.

### Training

Ameresco provides comprehensive training sessions for City facilities staff, focusing on the operation, maintenance, and troubleshooting of newly installed systems and equipment. Training is tailored to the specific technologies introduced under each ECM, ensuring the City's personnel are equipped to manage and maintain the improvements effectively, thereby supporting the sustainability and resilience goals of the City of Columbia.

Training for most measures will include up to two hours of classroom time and up to two hours of field training time. Training for less complex ECMs may take less time and only be performed as field training. The training will typically consist of the manufacturer's representative reviewing the O&M manuals and cutsheets for the product installed. Training will occur after Substantial Completion, before the Post-Installation Completion Report is delivered.

## Operations and Maintenance

A well-designed and properly executed maintenance program is a crucial element to long-term system performance and savings. To maximize the savings and equipment performance, the measures should be maintained under an ongoing, structured service program for the life of the contract, and ideally beyond. Ameresco has a vested interest in the equipment performance and maintenance required to realize all possible improvements that form the basis of our guarantee. Typically, the equipment and systems Ameresco proposes can be maintained and serviced by a variety of service entities, including maintenance personnel currently employed by the City of Columbia and/or a combination of service providers.

*Table 19 Operations and Maintenance Summary*

Description	Operations Responsibilities	Maintenance Responsibilities
Armory ECM 1: Replace Gym RTU	The City will assume operational responsibility for the installed measure as a continuation of current practice.	Periodic maintenance is required to keep the RTUs operating at peak performance. Filters must be replaced on a quarterly schedule. The condenser coils should be cleaned at least once per year. More frequent cleanings may be required if airborne debris such as Cottonwood droppings are clogging the condenser coils. All motors should be checked to ensure they are not drawing more ampacity than is stated on their nameplate. Dampers should be cleaned and lubricated at least once per year. Additional periodic maintenance is scheduled within the operating manuals.
Armory ECM 2: Replace Office RTU and VVT Boxes	The City will assume operational responsibility for the installed measure as a continuation of current practice.	Periodic maintenance is required to keep the RTUs operating at peak performance. Filters must be replaced on a quarterly schedule. The condenser coils should be cleaned at least once per year. More frequent cleanings may be required if airborne debris such as Cottonwood droppings are clogging the condenser coils. All motors should be checked to ensure they aren't drawing more ampacity than the is stated on their nameplate. Dampers should be cleaned and lubricated at a minimum of once per year. Additional periodic maintenance is scheduled within the operating manuals.
Armory ECM 3: Replace Ground Floor RTUs	The City will assume operational responsibility for the installed measure as a continuation of current practice.	Periodic maintenance is required to keep the RTUs operating at peak performance. Filters must be replaced on a quarterly schedule. The condenser coils should be cleaned at least once per year. More frequent cleanings may be required if airborne debris such as Cottonwood droppings are clogging the condenser coils. All motors should be checked to ensure they aren't drawing more ampacity than the is stated on their nameplate. Dampers should be cleaned and lubricated at a minimum of once per year. Additional periodic maintenance is scheduled within the operating manuals.

Description	Operations Responsibilities	Maintenance Responsibilities
<p>Armory ECM 4: Retrofit Existing Lighting to LED</p>	<p>Operational tasks will be minimal due to the automated nature of the lighting components and will only require that some building occupants turn lights on and off as needed and report non-functional light fixtures to the appropriate service response contact. Ameresco recommends random sampling operational inspections of installed lighting fixtures to identify any failed lamps or ballasts and change them, as required.</p>	<p>This will involve providing the labor for maintaining the equipment. Typical maintenance tasks include, but are not limited to, cleaning the lenses and reflective surfaces of the fixtures.</p> <p>As part of the continuation of current practice, The City will provide the labor and material for replacement of all components installed as part of this ECM .</p>

### Warranties

Ameresco will provide a one-year warranty on workmanship for the project from the start of the performance period. Trane will furnish a one-year factory warranty covering the entire Rooftop Unit, in addition to extended warranties consisting of a three-year parts-only warranty for the complete unit and a five-year parts-only warranty for compressors. Warranty documentation will be included in the Operations and Maintenance (O&M) manuals provided to the City.

### Transition to City Maintenance

Following the successful commissioning and handover of the new equipment, the City will incorporate these assets into its standard facility management protocols, providing the necessary labor and materials for all future repairs and replacements.

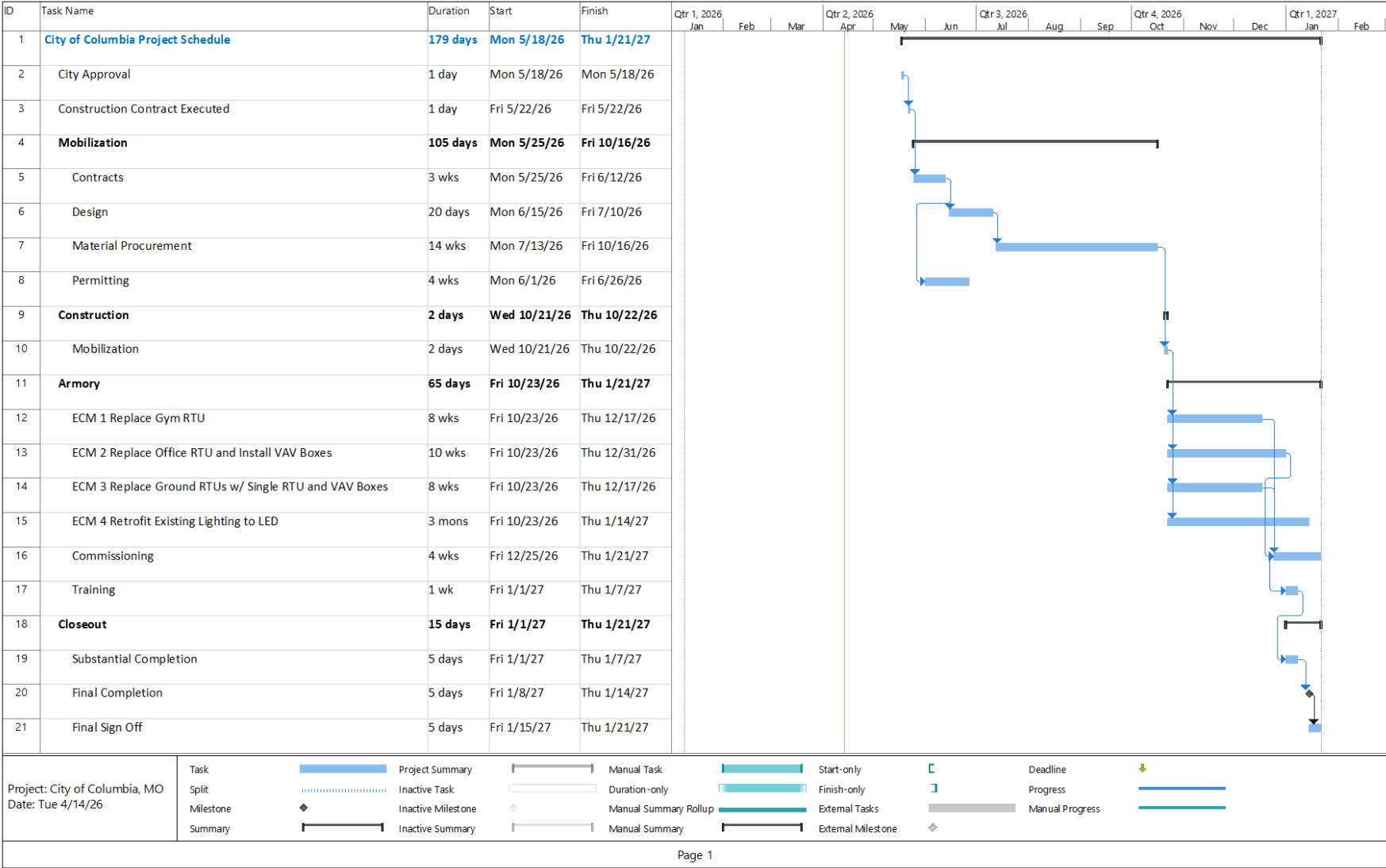


Investment Grade Audit

# 5. Project Schedule



# 5. Project Schedule



Investment Grade Audit

# Appendices



# Appendices

- Appendix A. Interested Parties Meeting
- Appendix B. Equipment Cutsheets
- Appendix C. Lighting
- Appendix D. Subcontractor Scope of Work & Drawings

Investment Grade Audit

# Appendix A: Interested Parties Meeting

# Armory Sports and Recreation Center

Year Built: 1938 | Square Feet: 21,469

Replace Heating, Cooling, Controls Systems, and Lighting



**Why:** The HVAC units are at the end of their useful life. Units are 22-26 years old. The average rated life span of these units is 15 years.

## Benefits:

- Ensures infrastructure reliability
- Improves comfort and indoor air quality for users and staff
- Reduces operating and maintenance costs - 2024 O&M cost of \$156,086
- 1<sup>st</sup> Year guaranteed energy savings of \$9,035
- Reduction of 76,081 kWh and 2,842 Therms annually
- Reduces carbon dioxide (CO<sub>2</sub>) by 684.45 metric tons annually

CO<sub>2</sub> reduction is equivalent to greenhouse gas emissions avoided by not:



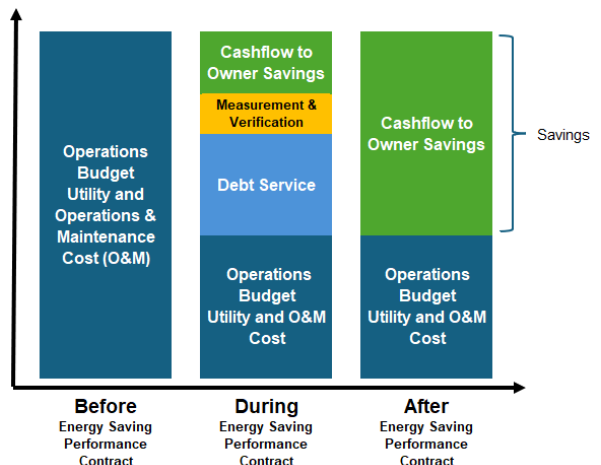
Driving a gasoline powered vehicle 1.74 million miles



Burning 760,300 pounds of coal annually

## Construction:

- Estimate start date – 10/01/2026
- Construction length – 8 to 10 weeks
- Safety is the highest priority. Safety and communication plans are currently in development.





# City of Columbia

## Armory Sports and Recreation Center Investment Grade Audit

Prepared for

Interested Parties Meeting  
The City of Columbia

April 21, 2026

## Acronyms

Acronym	Definition
ACT	Acoustical Ceiling Tile
ARC	Activities and Recreation Center
ASHREA	American Society of Heating Refrigeration and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BAS	Building Automation System
BTU	British Thermal Unit (Measurement of Heat Energy)
CO <sub>2</sub>	Carbon Dioxide
ECM	Energy Conservation Measure
EMR	Experience Modification Rate (Safety Rating)
EPC	Energy Performance Contract (Same as ESPC)
ESPC	Energy Saving Performance Contract (Same as EPC)
FDD	Fault Detection and Diagnostics
HVAC	Heating, Ventilation, and Air Conditioning
IGA	Investment Grade Audit
IPMPV	International Performance Measurement and Verification Protocol (Measurement)
kW	Kilowatt
kWh	Kilowatt Hour
LED	Light-Emitting Diode (LED Lighting)
LOTO	Lockout/Tagout (Safety)
M&V	Measurement and Verification
NG	Natural Gas
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
RFP	Request for Proposals
RTU	Roof Top Unit - HVAC (Can Also Be Ground Mounted)
TELP	Tax Exempt Lease Purchase
VAV	Variable Air Volume (HVAC System Type)
VVT & VVVT	Variable Volume & Variable Temperature (HVAC)
WSHP	Water Source Heat Pump



Investment Grade Audit

# Summary



# 1. Summary

## Introduction

The City selected Ameresco for this project in March 2025 through a competitive RFP process that solicited proposals from Energy Service Companies.

This Investment Grade Audit (IGA) is for the Armory Sports and Recreation Center. The dedicated staff at the Armory has done an exceptional job with maintaining the facility, as demonstrated by the age of the heating, ventilation and air conditioning (HVAC) systems. The HVAC systems at the Armory are approximately 22 – 26 years old. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) rated life span for the HVAC equipment is 15 years, depending on the specific piece of equipment.

The scope of work included in the IGA builds on work conducted with department leaders and staff, as well as multiple site visits with Ameresco engineers and verification meetings with the city staff. Through the verification meetings, specific Energy Conservation Measures were evaluated with the City of Columbia team.

Four facility improvement measures at the Armory were selected by the city and are included in this IGA. Three of the four facility improvement measures at the Armory are primarily capital-intensive projects focused on replacing the aged heating and cooling systems which have exceeded the useful life expectancy. The heating, ventilation and air conditioning systems at the Armory are approximately 22 - 26 years old and the selected measures are considered capital maintenance projects, in need of replacement.

By replacing end-of-life equipment at the Armory, the city will capture \$9,035 in guaranteed energy savings in year one and eliminate \$156,086 in recurring maintenance costs, based on 2024 expenditures.

Pending timely contract execution and lead times for equipment, facility improvements are scheduled to begin in fall of 2026 and reach completion by year-end.

## City of Columbia Goals and Benefits

While the Armory upgrades are primarily capital improvement projects to replace aging infrastructure, the improvement measures directly advance the City's Climate Action and Adaptation Plan and the Strategic Plan. By modernizing the Armory, the city achieves both infrastructure reliability and significant environmental impact, with the Armory alone projected to save 76,081 kWh of electricity and 2,842 Therms of natural gas annually. This reduction is equivalent to the greenhouse gas emissions avoided, by not driving a gasoline powered passenger vehicle 1.74 million miles.



## City of Columbia Project Goals

The City of Columbia seeks to achieve the following goals through this project:

- Leverage the state statute as a means for updating facilities
- Optimize efficiency in equipment, systems, and operations
- Reduce energy consumption and operational costs
- Support sustainability goals on the path toward carbon neutrality

## City of Columbia Project Benefits

Beyond achieving core energy goals, the city will benefit from a comprehensive, turnkey facility modernization led by Ameresco. This approach delivers the following advantages for the Armory:

- **Eliminate Maintenance Backlog:** Replacing end-of-life HVAC and mechanical systems.
- **Reduce Operational Costs:** Lowers ongoing O&M expenses, energy consumption, and utility demand charges.
- **Extend Asset Life:** Increases the facility's remaining useful life and improves infrastructure resilience through modernized system reliability.
- **Optimized Building Control:** Implements an advanced Building Automation System (BAS) with automated Fault Detection Diagnostics (FDD) to improve occupant comfort and staff efficiency.
- **Enhances The Indoor Environment:** Delivers upgraded lighting, temperature control and air quality for the users and staff.
- **Mitigate Project Risk:** Minimizes construction risks in high-traffic recreation areas via Ameresco's design-build model and rigorous safety protocols.

## Safety and Disruptions

Public safety is our top priority and our corporate safety experts oversee every phase of our work. Ameresco maintains an excellent Experience Modification Rate (EMR) of 0.64. EMR is nationally recognized metric regarding a company's safety record and incidents. An EMR rating of 1.0 is good and an EMR rating of 0.64 is considered excellent.



To protect the community, we will develop detailed safety plans for each facility improvement measure in partnership with City staff. While large-scale improvements may cause occasional disturbances, we are committed to minimizing impacts and will provide the city and the public with ample notice before any critical work begins.

## Energy Conservation Measure Costs and Savings

The Energy Conservation Measures included in this project were developed after in-depth audits of the facility and analysis of the operation and needs, along with multiple meetings with City staff. The measures were selected because the project will modernize aging infrastructure at the Armory and reduce escalating operational costs, optimize energy performance, and enhance the indoor environment for all occupants. The following package of Energy Conservation Measures supports the project goals, enabling over \$2 million in critical mechanical updates.

### Sustainability, Resilience and Promotion

In the 2019 Climate Action and Adaptation Plan, the City of Columbia expressed a commitment to creating a sustainable city, noting the goal of reducing greenhouse gas emissions. For municipal operations the targets are a 50% reduction by 2035 and 100% reduction by 2050.

**Reducing Greenhouse Gas Emissions:** The proposed Energy Conservation Measures for the Armory would reduce Carbon Dioxide (CO<sub>2</sub>) annually, by 684.45 metric tons. This reduction is equivalent to 760,300 pounds of coal burned annually.

**Energy Savings:** The proposed Energy Conservation Measures will reduce energy consumption by 76,081 kWh and 2,842 Therms, the first year and will generate \$9,035 in guaranteed first-year energy savings. Accounting for a 3.5% annual utility escalation, these measures are projected to deliver a total savings of \$174,336 over a 15-year term.

**Project Promotion and Citizen Communication:** Ameresco will support the Armory project by participating in Columbia’s Interested Parties Meeting(s) and collaborating with city staff to communicate project benefits and status through media relations and project profiles.

## Proposed Energy Conservation Measures

*Table 1 Proposed ECM Descriptions*

Energy Conservation Measure	Description
<b>ARMORY ECM 1: Replace Gym Unit (RTU)</b>	Modernize the gym by replacing the obsolete RTU with a high-efficiency, single-zone Variable Air Volume (VAV) system to optimize energy performance and climate control
<b>ARMORY ECM 2: Replace Office Unit (RTU) and Variable Temperature Terminal (VVVT) Boxes</b>	Replace the end-of-life office RTU with a high-efficiency VAV system. This upgrade includes transitioning from obsolete Variable Volume & Variable Temperature (VVVT) terminal boxes to modern VAV units equipped with high-efficiency motors and staged electric reheat for precise climate control.
<b>ARMORY ECM 3: Replace Ground Floor Units (These are 2 ground mount RTU units)</b>	Consolidate the ground floor's aging HVAC infrastructure by replacing two obsolete RTUs with a single, high-efficiency VAV system. This modernization includes upgrading legacy VVVT terminal boxes to high-performance VAV units featuring EC motors and staged electric reheat for superior energy management.
<b>ARMORY ECM 4: Retrofit Existing Lighting to LED</b>	Modernize interior and exterior lighting by replacing legacy fixtures with advanced LED technology. This upgrade will reduce energy demand while enhancing visibility and safety throughout the facility.

## Project Summary Cost and Savings

Facility #	Armory Sports & Recreation Center Scope Description	Total Cost	Rebate Estimate	Total Energy Savings	O&M Savings	Total Savings	Simple Payback	kWh Saved	Demand KW Saved	Energy (Therms)
Armory 10	Replace Gym RTU	\$350,696	\$8,333	\$2,688	\$23,336	\$26,024	13.2	18,668	0	1,258
Armory 11	Replace Office RTU and VVT Boxes	\$756,656	\$8,333	\$2,126	\$54,450	\$56,576	13.2	15,710	0	931
Armory 12	Replace Ground Floor RTUs	\$891,767	\$8,333	\$2,891	\$77,785	\$80,676	11.0	30,334	0	653
Armory 13	Retrofit Existing Lighting to LED	\$39,607	\$10,468	\$1,330	\$515	\$1,845	15.8	11,369	33	0
<b>Total</b>		<b>\$2,038,726</b>	<b>\$35,467</b>	<b>\$9,035</b>	<b>\$156,086</b>	<b>\$165,121</b>	<b>12.1</b>	<b>76,081</b>	<b>33</b>	<b>2,842</b>

## Potential Rebates and Incentives

The City of Columbia Utilities offers a variety of commercial energy efficiency rebates that vary based upon the efficiency of the equipment being replaced and the overall reduction of the energy usage of the facility. The proposed improvement measures at the Armory include lighting, lighting controls, HVAC unit replacement and variable speed drives for large electric motors and all, are eligible for the rebates offered. The rebate information below was provided by City of Columbia Utilities.

Table 1 Potential Rebates

Facility #	Scope Description	Rebate Estimate
Armory 1	Replace Gym RTU	\$8,333
Armory 2	Replace Office RTU and VVT Boxes	\$8,333
Armory 3	Replace Ground Floor RTUs	\$8,333
Armory 4	Retrofit Existing Lighting to LED	\$10,468
<b>Total</b>		<b>\$35,468</b>



Investment Grade Audit

# Appendix B: Equipment Cutsheets



# Trane Precedent Packaged Rooftop

## Unit Overview - YZK120A3S0H\*

Application	Unit Size	Supply Fan		External Dimensions (in.)			Operating Weight	Elevation
		Airflow	Total Static Pressure	Height	Width	Length		
DX Cooling / Gas Heat	10 Ton	4200 cfm	1.888 in H2O	50.875 in	63.125 in	99.625 in	1713.0 lb	0.00 ft

## Unit Features

<b>Unit Efficiency</b>	Ultra High Efficiency
<b>Refrigerant</b>	R-454B Refrigerant
<b>EER @ AHRI</b>	12.50
<b>IEER @ AHRI</b>	20.30
<b>Hinged Service Access/Filters</b>	Hinged Access Panels with 2-in MERV 13
<b>Through the Base Provisions</b>	Electric
<b>Disconnect / Circuit Breaker</b>	Non-Fused Disconnect Switch
<b>Convenience Outlet</b>	Powered 15A Convenience Outlet



## Unit Electrical

<b>Voltage</b>	208-230/60/3
<b>MCA</b>	57.00 A
<b>MOP</b>	80.00 A
<b>Condenser Fan FLA</b>	6.30 A
<b>Evaporator Fan FLA</b>	11.00 A
<b>Compressor 1 RLA</b>	31.30 A
<b>Compressor 2 RLA</b>	0.00 A
<b>Compressor Power</b>	7.36 kW
<b>System Power</b>	10.03 kW

## Controls

<b>Unit Controls</b>	Symbio 700
<b>Communications Option</b>	Advanced Controls and BACnet BAS
<b>System Monitoring Controls 1</b>	Condensate Overflow Switch
<b>SupplyFan/Drive/MotorType</b>	Multiple Zone VAV with Standard Motor
<b>Smoke Detector</b>	Return Air
<b>Low Ambient</b>	Low Ambient

## Cooling Section

	Capacity
<b>Entering Dry Bulb</b>	80.00 F
<b>Entering Wet Bulb</b>	67.00 F
<b>Ambient Temp</b>	95.00 F
<b>Leaving Coil Dry Bulb</b>	58.63 F
<b>Leaving Coil Wet Bulb</b>	58.00 F
<b>Leaving Unit Dry Bulb</b>	60.99 F
<b>Leaving Unit Wet Bulb</b>	58.90 F
<b>Saturated Discharge Temperature</b>	114.79 F
<b>Saturated Suction Temperature</b>	50.87 F
	<b>Gross Total</b> 115.36 MBh
	<b>Gross Latent</b> 20.78 MBh
	<b>Gross Sensible</b> 94.58 MBh
	<b>Net Total</b> 108.60 MBh
	<b>Net Sensible</b> 87.81 MBh
	<b>Net Sensible Heat Ratio</b> 80.86 %
	<b>Fan Motor Heat</b> 3.64 MBh
	<b>Refrig Charge-Circuit 1</b> 10.0 lb

## Heating Section

<b>Heating</b>	High Gas Heat
<b>Input Heating Capacity</b>	240.00 MBh
<b>Output Heating Capacity</b>	194.40 MBh
<b>Heating EAT</b>	68.00 F
<b>Heating LAT</b>	110.62 F
<b>Heating Temp Rise</b>	42.62 F
<b>Heating Stages</b>	2



### Fan Section

Indoor Fan Data		Indoor Fan Performance	
<b>Airflow Application</b>	Horizontal	<b>Airflow</b>	4200 cfm
<b>Design ESP</b>	1.200 in H2O	<b>Supply Motor Horsepower</b>	4.600 hp
<b>Component SP</b>	0.688 in H2O	<b>Total Supply Motor Operating Power</b>	3.023 hp
<b>Heat SP</b>	0.000 in H2O	<b>Indoor RPM</b>	1662 rpm
<b>Total SP</b>	1.888 in H2O	Outdoor Fan Data	
<b>Indoor Fan Drive Type</b>	Variable Direct	<b>Outdoor Fan Drive Type</b>	Direct
<b>Indoor Fan Quantity</b>	1	<b>Outdoor Fan Quantity</b>	1
<b>Indoor Fan Type</b>	BC Plenum	<b>Outdoor Fan Type</b>	Propeller
		Filters	
		<b>1st Filter Size and Qty</b>	3 - 18 x 18 x 2
		<b>2nd Filter Size and Qty</b>	3 - 24 x 18 x 2

### Field Installed Accessories

<b>Roof curb</b>	18" Full Perimeter Knockdown Curb
<b>Barometric relief</b>	yes
<b>Fresh air selection</b>	Low Leak Economizer, Dry Bulb, Horiz
<b>Temperature sensor</b>	yes

### Acoustics

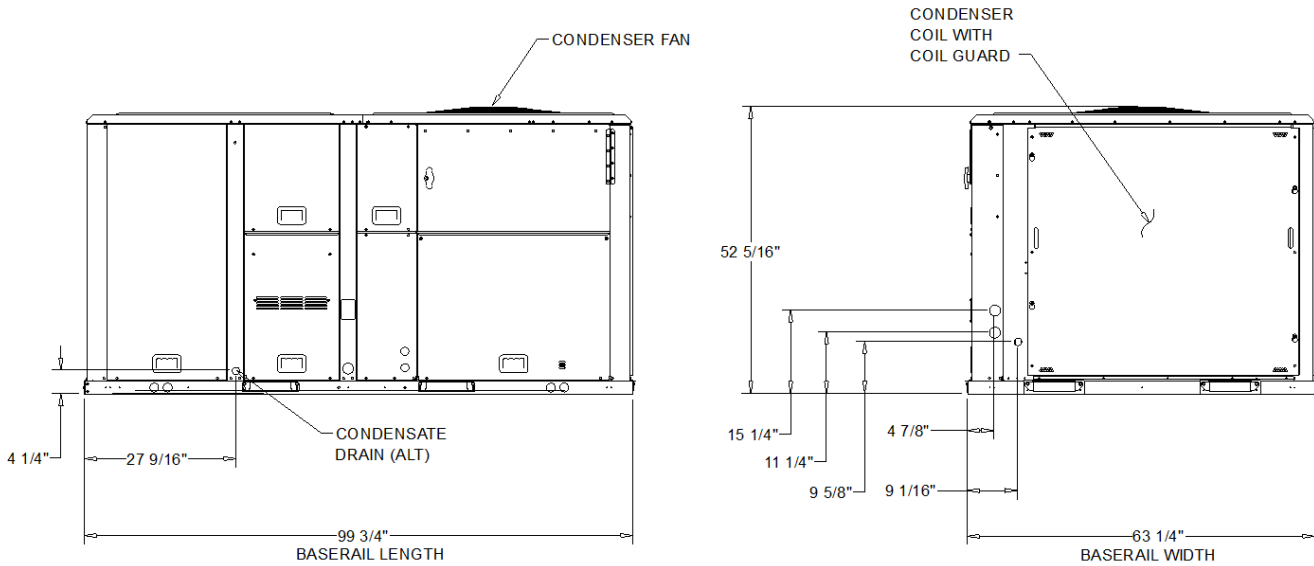
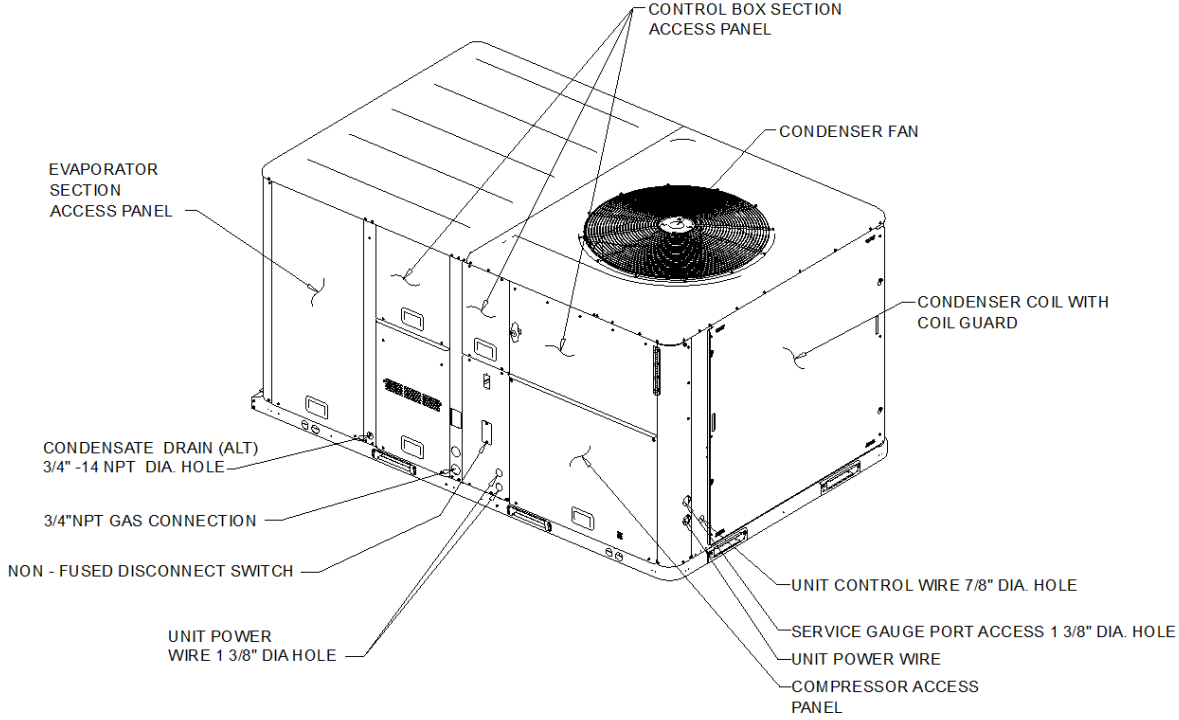
Sound Path	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Ducted Discharge	87 dB	89 dB	79 dB	75 dB	70 dB	67 dB	68 dB	67 dB
Ducted Inlet	83 dB	80 dB	75 dB	66 dB	64 dB	61 dB	60 dB	59 dB
Outdoor Noise	88 dB	89 dB	90 dB	87 dB	84 dB	80 dB	75 dB	67 dB

Note:Ducted Discharge/Ducted Inlet prediction data conform to AHRI 260

### Warranty

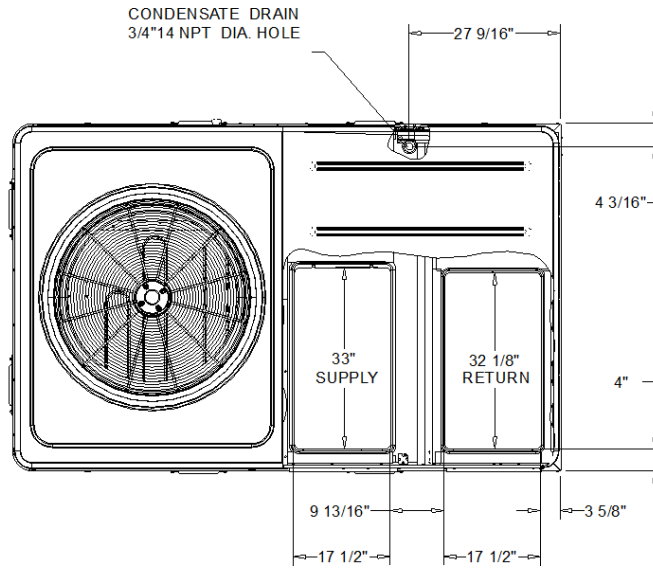
<b>Labor (first year)</b>	1st Yr Labor Whole Unit
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- NOTES:  
 1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.  
 2. VERIFY WEIGHTS, CONNECTIONS, AND ALL DIMENSIONS WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION

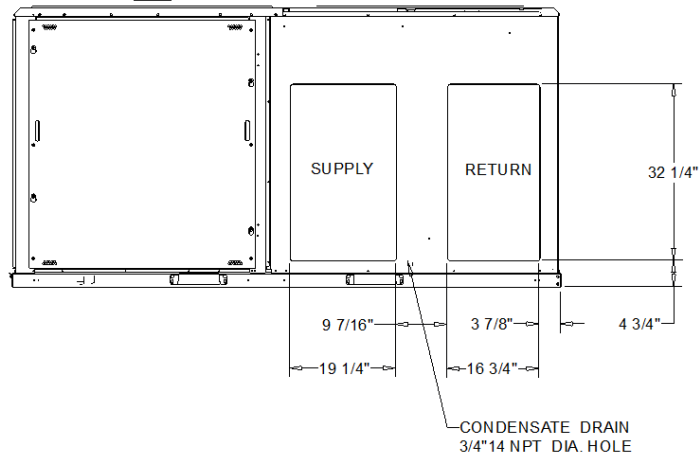


DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

DIMENSION DRAWING



PLAN VIEW OF DOWNFLOW OPENINGS



HORIZONTAL AIR FLOW OPENING

DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

DIMENSION DRAWING

**NOTES:**

1. APPROX. INSTALLED WEIGHT INCLUDES ALL SELECTED OPTIONS AND ACCESSORIES.
2. CORNER WEIGHTS ARE FOR BASE UNIT ONLY AND DO NOT INCLUDE OPTIONS OR ACCESSORIES.
3. WEIGHT INCLUDES BOTH FACTORY AND FIELD INSTALLED ACCESSORY.

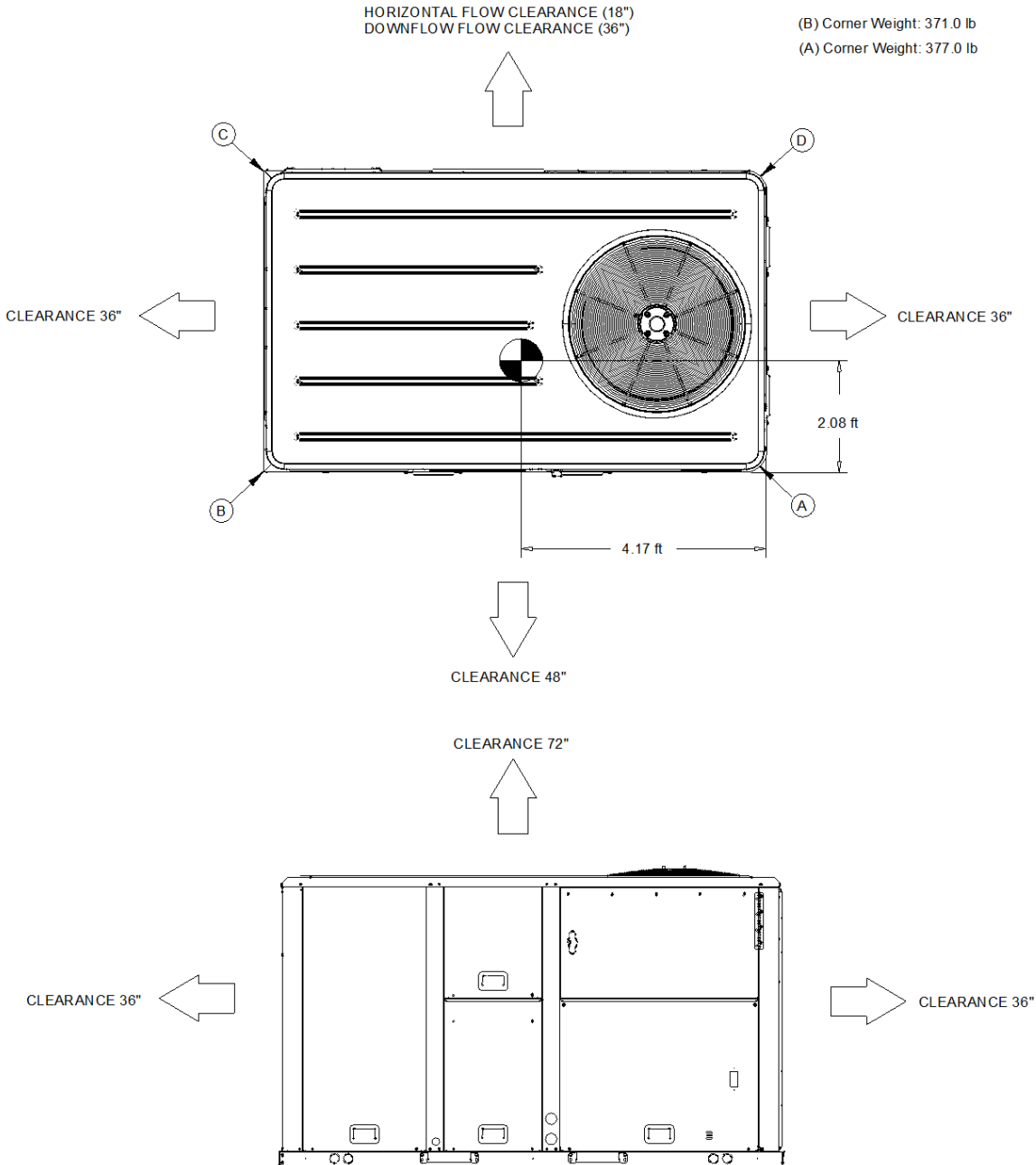
Approximate Installed Weight: 1,713.0 lb

(B) Corner Weight: 371.0 lb

(C) Corner Weight: 246.0 lb

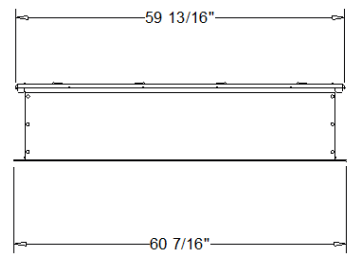
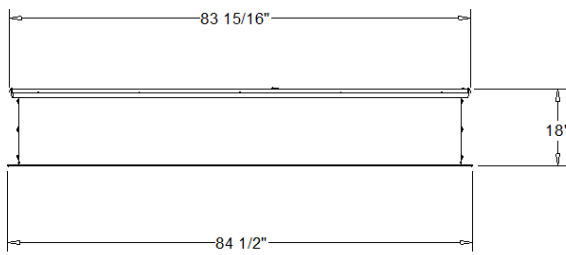
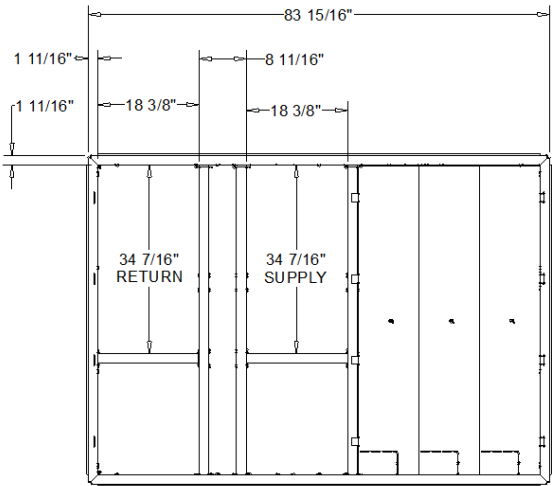
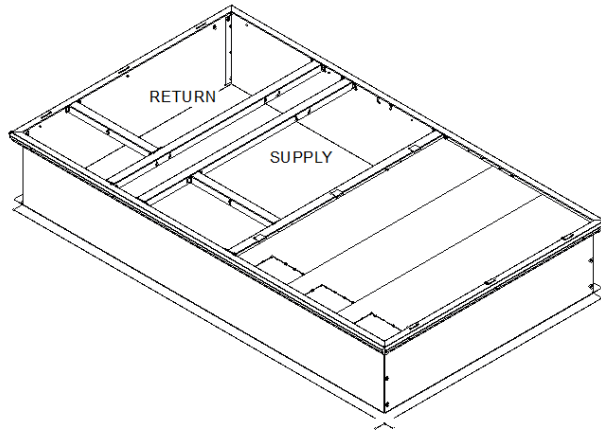
(A) Corner Weight: 377.0 lb

(D) Corner Weight: 251.0 lb

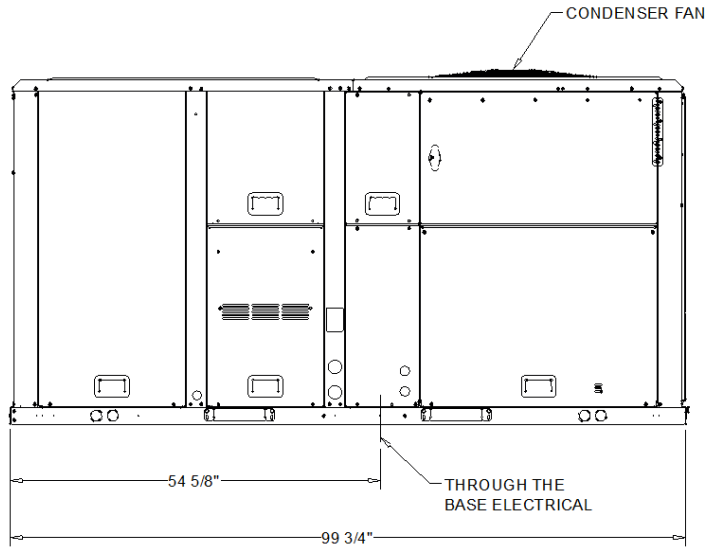
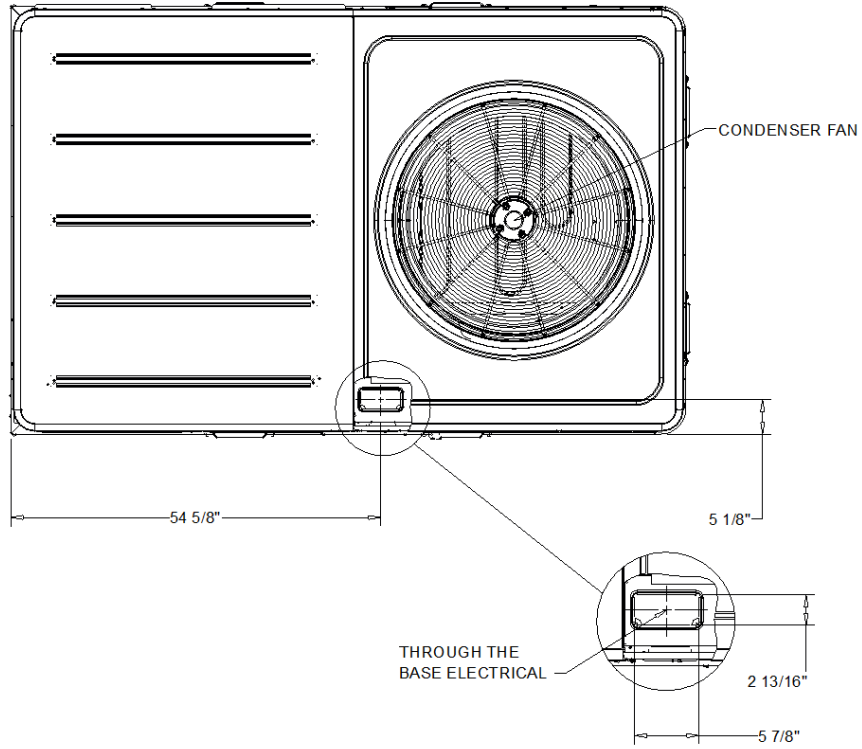


**DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY**

**WEIGHTS AND CLEARANCES**

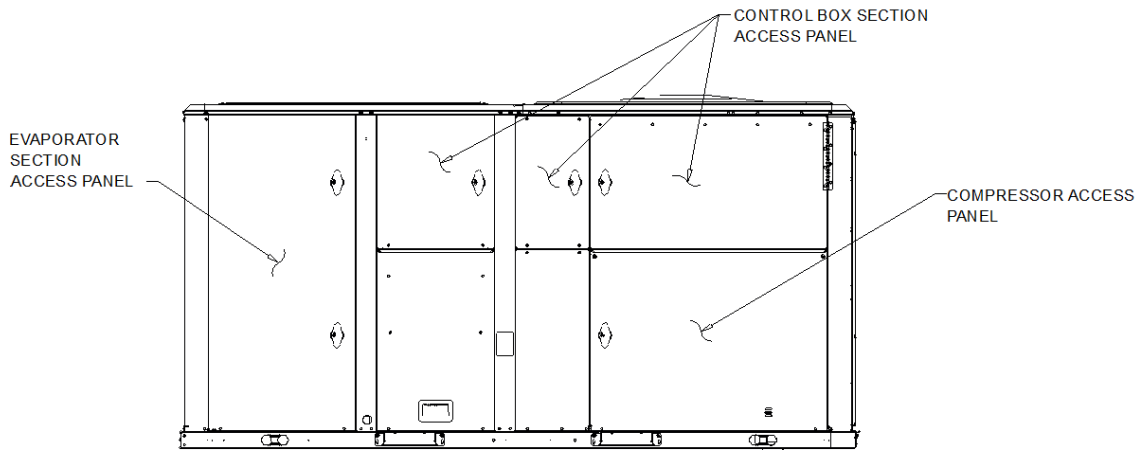
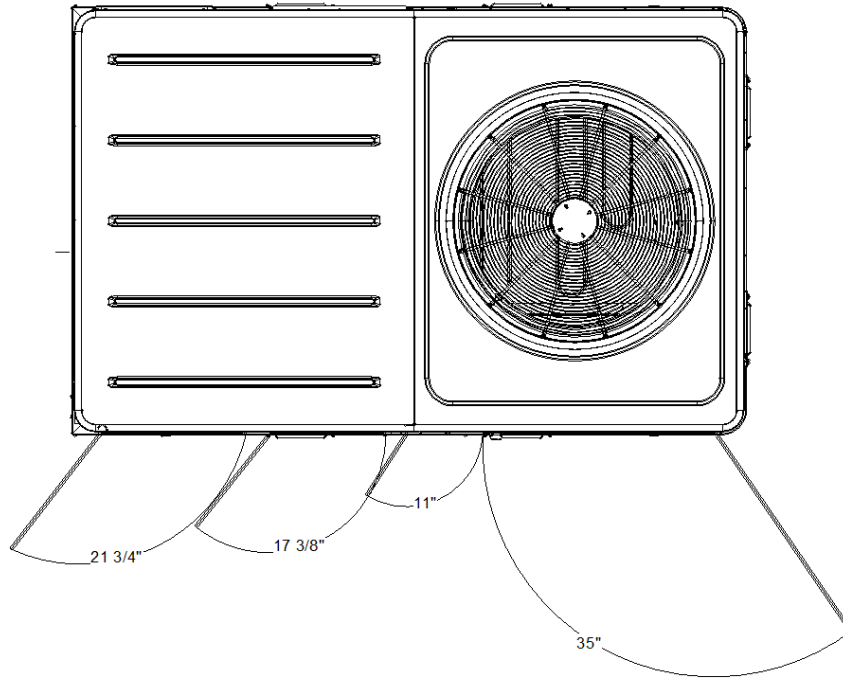


ROOF CURB (FIELD ACCESSORY)  
 DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



**THROUGH-THE-BASE ELECTRICAL (OPTION)**

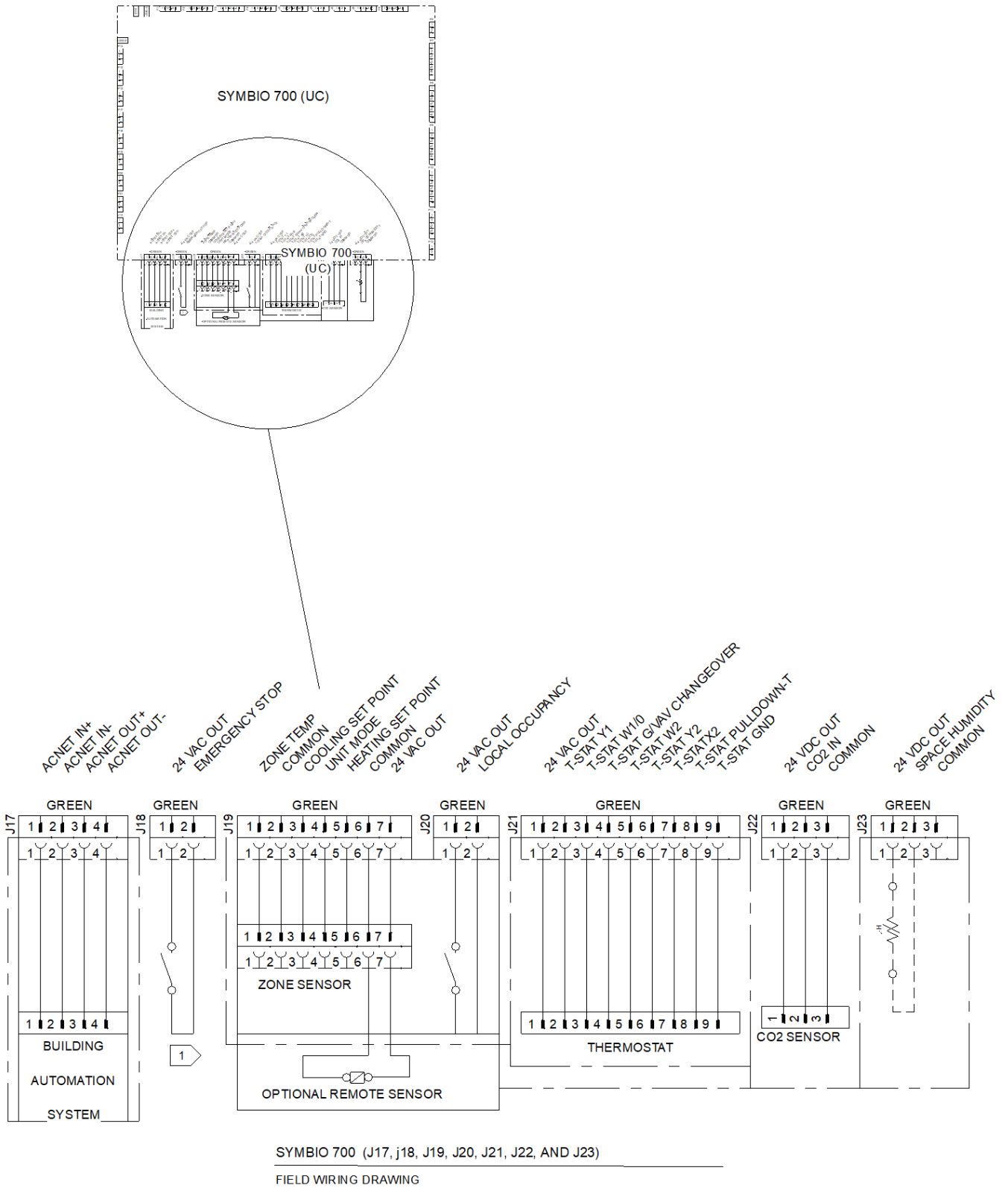
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



SWING DIAMETER FOR HINGED DOOR(S) (OPTION)

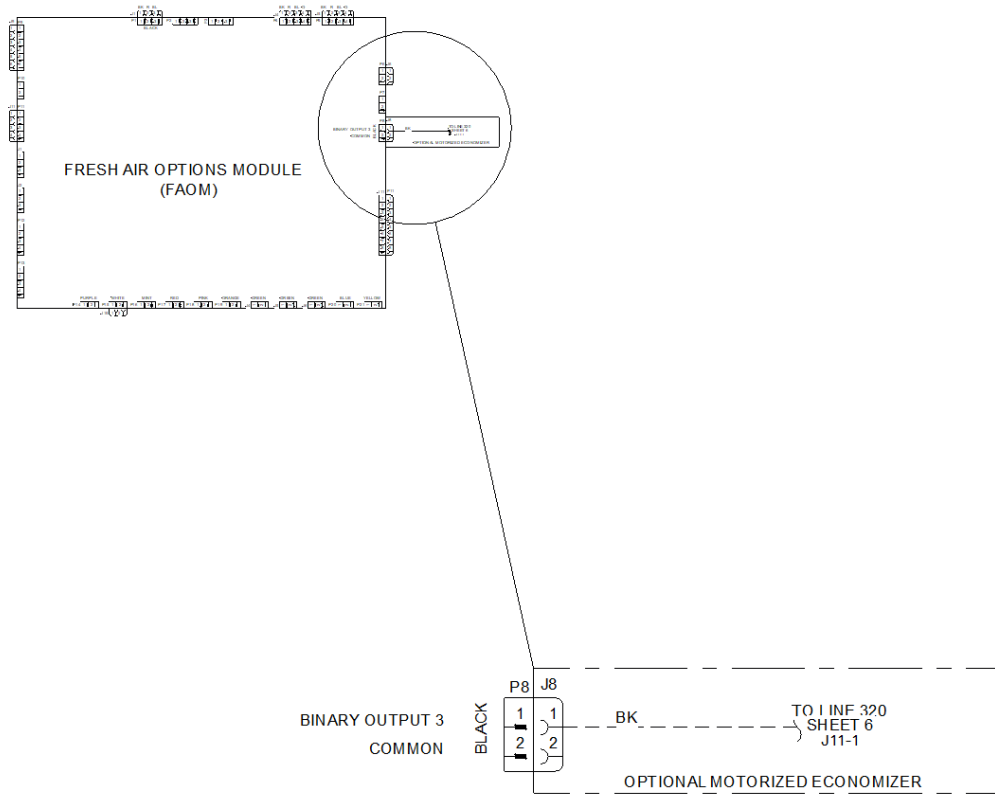
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION



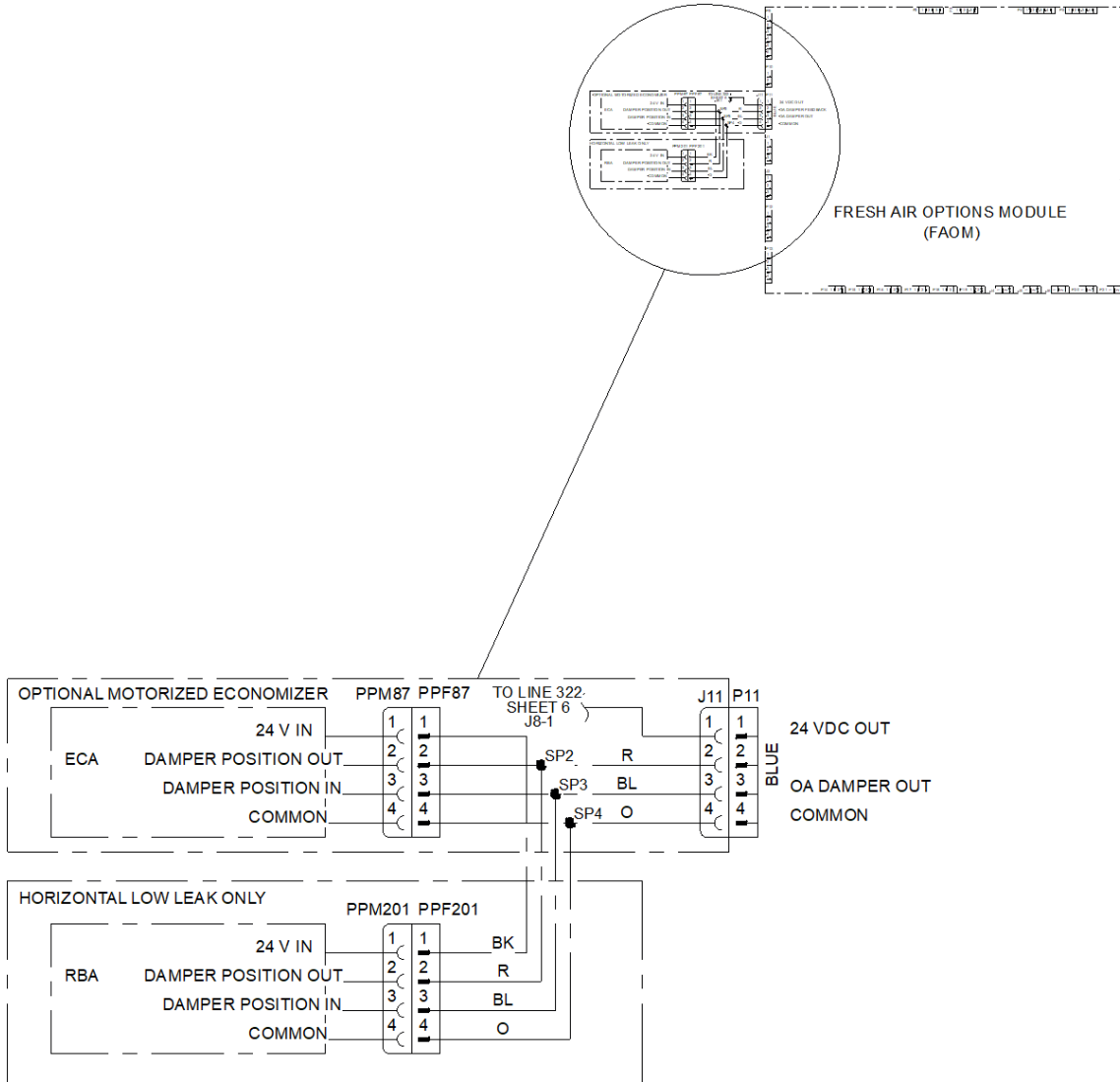


NOTES:  
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER (J8)  
FIELD WIRING DRAWING (INDOOR OPTION MODULE)

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER WITH HORIZONTAL LOW LEAK ONLY (J11)  
 FIELD WIRING DRAWING (FRESH AIR OPTIONS MODULE)



### **General - eFlex**

- Packaged rooftop unit cooling capacities, heating capacities, and efficiencies are certified to the following standards:
  - 3 to 5 ton units: AHRI Standard 210/240.
  - 6 to 25 ton units: AHRI Standard 340/360.
- Convertible airflow.
- Symbio controls operating range between 0.0 F and 125.0 F in cooling mode standard from the factory.
- Factory assembled, internally wired, fully charged with R-454B, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory.
- Colored and numbered wiring internal to the unit for simplified identification.
- Units cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners
- Unit shall be furnished with a leak detection system from the factory. The leak detection system shall consist of one or more refrigerant detection sensors. When the system detects a leak, the unit controller shall initiate mitigation actions.

### **Casing**

- Zinc coated, heavy gauge, galvanized steel.
- Weather resistant pre-painted metal with galvanized substrate.
- Meets ASTM B117, 672 hour salt spray test.
- Removable single side maintenance access panels.
- Lifting handles in maintenance access panels (can be removed and reinstalled by removing fasteners while providing a water and air tight seal).
- Exposed vertical panels and top covers in the indoor air section insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material.
- Base pan shall have no penetrations within the perimeter of the curb other than the raised 1 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.
- Base of the unit insulated with 1/8 inch, foil-faced, closed-cell insulation.
- Unit base provisions for forklift and/or crane lifting on three sides of unit.

### **Hail Guards**

- Provides condenser coil protection.

### **Powered or Unpowered Convenience Outlet**

- Powered GFCI, 120V/15A, 2 plug, convenience outlet or unpowered GFCI, 120V/20A, 2 plug, convenience outlet.
- When convenience outlet is powered, a service receptacle disconnect will be available.
- Convenience outlet is powered from the line side of the disconnect or circuit breaker, and therefore will not be affected by the position of the disconnect or circuit breaker.
- Available to order when through-the-base electrical with disconnect switch or circuit breaker option is ordered.

### **Microchannel Coils**

- Optimal heat transfer performance due to flat, streamlined tubes with small ports, and metallurgical tube-to-fin bond.
- Reduce system refrigerant charge by up to 50% leading to better compressor reliability.
- Compact all-aluminum microchannel coils reduce the unit weight.
- Recyclable all aluminum coils All aluminium construction minimizes galvanic corrosion.
- Strong aluminum brazed structure provides better fin protection.
- Flat streamlined tubes more dust resistant and easy to clean.
- Coils leak tested at the factory to ensure the pressure integrity.



### **Compressors - eFlex**

- All units have variable speed compressor matched with variable frequency drive that modulates the speed of the compressor motor and provides several compressor protection functions.
- Permanent magnet motor with voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- Crankcase heaters sized to minimize the amount liquid refrigerant present in the oil sump during offcycles are standard on all compressors
- Single variable speed compressors in 12.5 and 15 ton units. Manifoldded variable and fixed speed compressors in 17.5 to 25 ton units
- Variable speed modulation to 15 Hz equating to 25 percent or less of full capacity
- Control of the eFlex system is integrated with the Symbio 700 unit controller to ensure optimal equipment reliability and performance.

### **Filters**

- Two inch pleated media filters shall be available on all models.

### **Frostat**

- Utilized as a safety device.
- Opens to prevent freezing temperatures on evaporator coil.
- Temperature will need to rise to 50°F before closing.
- Utilized in low airflow or high outside air applications (cooling only).

### **Gas Heating Section**

- The heating section shall have a progressive tubular heat exchanger with corrosion-resistant aluminized steel tubes and burners as standard on all models.
- Stainless steel heat exchanger with 409 stainless steel tubes and 439 stainless steel burners shall be optional.
- Induced draft combustion blower shall be used to pull the combustion products through the firing tubes.
- Heater shall use a direct spark ignition (DSI) system.
- On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition.
- After three unsuccessful ignition attempts, entire heating system shall be locked out until manually reset at the thermostat/zone sensor.
- Units shall be suitable for use with natural gas or propane (field-installed kit).

### **Heat Exchanger**

- Compact cabinet features a tubular heat exchanger in low, medium and high heat capacities.
- Corrosion-resistant aluminized steel tubes and burners are standard on all models.
- Induced draft blower to pull the gas mixture through the burner tubes.
- Direct spark ignition and a flame sensor as a safety device to validate the flame.

### **Indoor Fan - eFlex**

- Direct drive plenum fan design.
- Plenum fan design - backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor.
- Supply fan speed adjustments can be made using the Symbio 700 or Mobile App.
- Motors are thermally protected.
- Variable speed direct drive motors are high efficiency.

### **Roof Curb**

- Designed to mate with the unit's downflow supply and return.
- Provide support and a water tight installation when installed properly.
- Shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb.
- Curb shall be shipped knocked down for field assembly.
- Shall include wood nailer strips.



### **Through-the-Base Electrical with Disconnect Switch**

- 3-pole, molded case, disconnect switch with provisions for through-the-base electrical connections.
- Disconnect switch installed within unit in a water tight enclosure.
- Wiring provided from the switch to the unit high voltage terminal block.
- Switch cULus agency recognized.

**Note:** *Disconnect switch sized per NEC and cULus guidelines but will not be used in place of unit overcurrent protection.*

### **Low Leak Economizer**

- This accessory meets the low leak requirements for ASHRAE 90.1, IECC, and CA Title 24 standards (4 cfm/ ft<sup>2</sup>@ 1" wg exterior air/return air). This option allows for 100% outdoor air supply from 0% to 100% modulating dampers and comes standard with barometric relief. It can be paired with powered exhaust for additional building pressure relief. This option can be paired with or without fault detection and diagnostics (FDD) to meet the current mandatory CA Title 24 requirements. The economizers come with four control options: dry bulb, reference enthalpy, comparative enthalpy, or differential dry bulb.



# Trane Precedent Packaged Rooftop

## Unit Overview - YZK300A3S0H\*

Application	Unit Size	Supply Fan		External Dimensions (in.)			Operating Weight	Elevation
		Airflow	Total Static Pressure	Height	Width	Length		
DX Cooling / Gas Heat	25 Ton	10000 cfm	1.304 in H2O	66.000 in	87.000 in	123.000 in	2733.0 lb	0.00 ft

## Unit Features

<b>Unit Efficiency</b>	Ultra High Efficiency
<b>Refrigerant</b>	R-454B Refrigerant
<b>EER @ AHRI</b>	11.00
<b>IEER @ AHRI</b>	20.00
<b>Hinged Service Access/Filters</b>	Hinged Access Panels with 2-in MERV 13
<b>Through the Base Provisions</b>	Electric
<b>Disconnect / Circuit Breaker</b>	Non-Fused Disconnect Switch
<b>Convenience Outlet</b>	Powered 15A Convenience Outlet
<b>Refrigeration Systems Option</b>	Modulating Hot Gas Reheat (HGRH)



## Unit Electrical

<b>Voltage</b>	208-230/60/3
<b>MCA</b>	114.00 A
<b>MOP</b>	150.00 A
<b>Condenser Fan FLA</b>	2.60 A
<b>Evaporator Fan FLA</b>	11.00 A
<b>Compressor 1 RLA</b>	43.30 A
<b>Compressor 2 RLA</b>	32.30 A
<b>Compressor Power</b>	19.78 kW
<b>System Power</b>	25.65 kW

## Controls

<b>Unit Controls</b>	Symbio 700
<b>Communications Option</b>	Advanced Controls and BACnet BAS
<b>System Monitoring Controls 1</b>	Condensate Overflow Switch
<b>SupplyFan/Drive/MotorType</b>	Single Zone VAV with Oversized Motor
<b>Smoke Detector</b>	Return Air
<b>Low Ambient</b>	Low Ambient

## Cooling Section

		Capacity
<b>Entering Dry Bulb</b>	80.00 F	
<b>Entering Wet Bulb</b>	67.00 F	<b>Gross Total</b> 282.92 MBh
<b>Ambient Temp</b>	95.00 F	<b>Gross Latent</b> 65.03 MBh
<b>Leaving Coil Dry Bulb</b>	59.58 F	<b>Gross Sensible</b> 217.88 MBh
<b>Leaving Coil Wet Bulb</b>	57.80 F	<b>Net Total</b> 270.90 MBh
<b>Leaving Unit Dry Bulb</b>	61.25 F	<b>Net Sensible</b> 205.87 MBh
<b>Leaving Unit Wet Bulb</b>	58.46 F	<b>Net Sensible Heat Ratio</b> 75.99 %
<b>Saturated Discharge Temperature</b>	121.69 F	<b>Fan Motor Heat</b> 5.07 MBh
<b>Saturated Suction Temperature</b>	54.26 F	<b>Refrig Charge-Circuit 1</b> 16.6 lb

## Reheat Section

		Capacity
<b>Hot Gas Reheat</b>	Modulating Hot Gas Reheat (HGRH)	
<b>Entering Dry Bulb (in HRGH)</b>	73.00 F	<b>Dehumidification/Hot Gas Reheat</b> 223.17 MBh
<b>Entering Wet Bulb (in HRGH)</b>	64.00 F	<b>Reheat Mode Leaving Unit Temp</b> 54.85 F
<b>Evap Coil LAT DB (HGRH)</b>	54.85 F	<b>Leaving Unit Dew Point in HGRH</b> 52.68 F
<b>Evap Coil LAT WB (HGRH)</b>	53.56 F	<b>Reheat Coil Temperature Rise</b> 20.42 F
<b>Ambient DB (in HGRH)</b>	70.00 F	<b>Reheat Mode Moisture Removal</b> 12.04 gph
		<b>Reheat Coil LAT (HGRH)</b> 75.27 F
		<b>Reheat Coil LWB (HGRH)</b> 61.39 F



### Heating Section

<b>Heating</b>	High Gas Heat
<b>Input Heating Capacity</b>	400.00 MBh
<b>Output Heating Capacity</b>	324.00 MBh
<b>Heating EAT</b>	68.00 F
<b>Heating LAT</b>	97.82 F
<b>Heating Temp Rise</b>	29.82 F

### Fan Section

Indoor Fan Data		Indoor Fan Performance	
<b>Airflow Application</b>	Horizontal	<b>Airflow</b>	10000 cfm
<b>Design ESP</b>	0.750 in H2O	<b>Supply Motor Horsepower</b>	4.600 hp
<b>Component SP</b>	0.554 in H2O	<b>Total Supply Motor Operating Power</b>	6.216 hp
<b>Heat SP</b>	0.000 in H2O	<b>Indoor RPM</b>	1711 rpm
<b>Total SP</b>	1.304 in H2O	<b>Outdoor Fan Data</b>	
<b>Indoor Fan Drive Type</b>	Variable Direct	<b>Outdoor Fan Drive Type</b>	Direct
<b>Indoor Fan Quantity</b>	2	<b>Outdoor Fan Quantity</b>	2
<b>Indoor Fan Type</b>	BC Plenum	<b>Outdoor Fan Type</b>	Propeller
		<b>Filters</b>	
		<b>1st Filter Size and Qty</b>	4 - 20 x 24 x 2
		<b>2nd Filter Size and Qty</b>	4 - 20 x 30 x 2

### Field Installed Accessories

<b>Roof curb</b>	18" Full Perimeter Knockdown Curb
<b>Barometric relief</b>	yes
<b>Fresh air selection</b>	Low Leak Economizer, Dry Bulb, Horiz
<b>Temperature sensor</b>	yes
<b>Horizontal Conversion Panel</b>	yes

### Acoustics

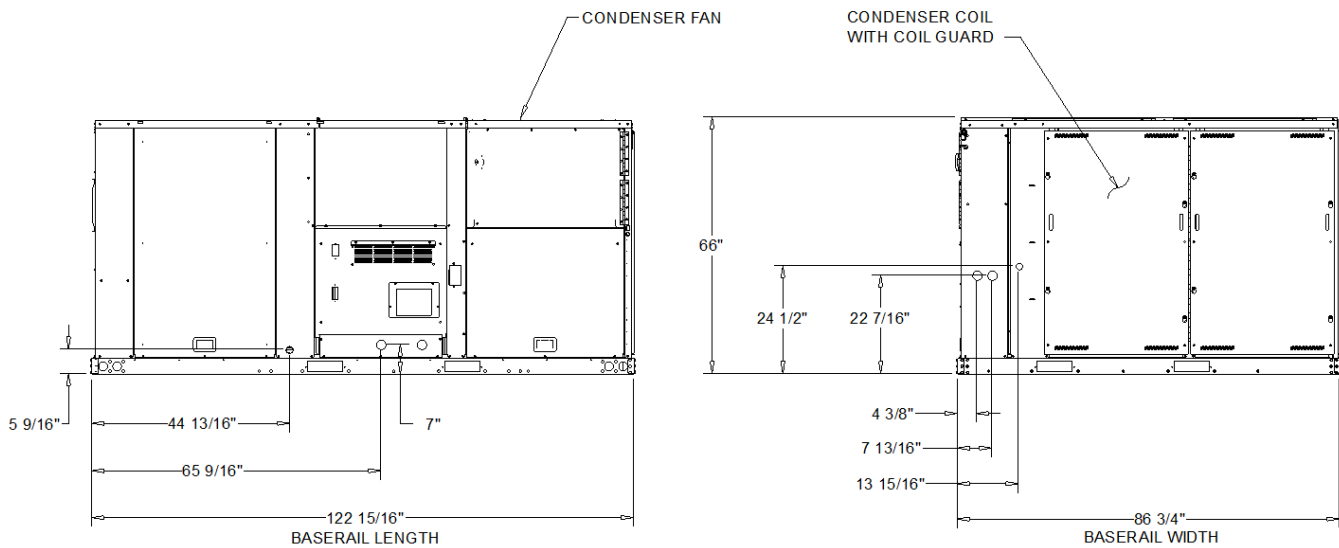
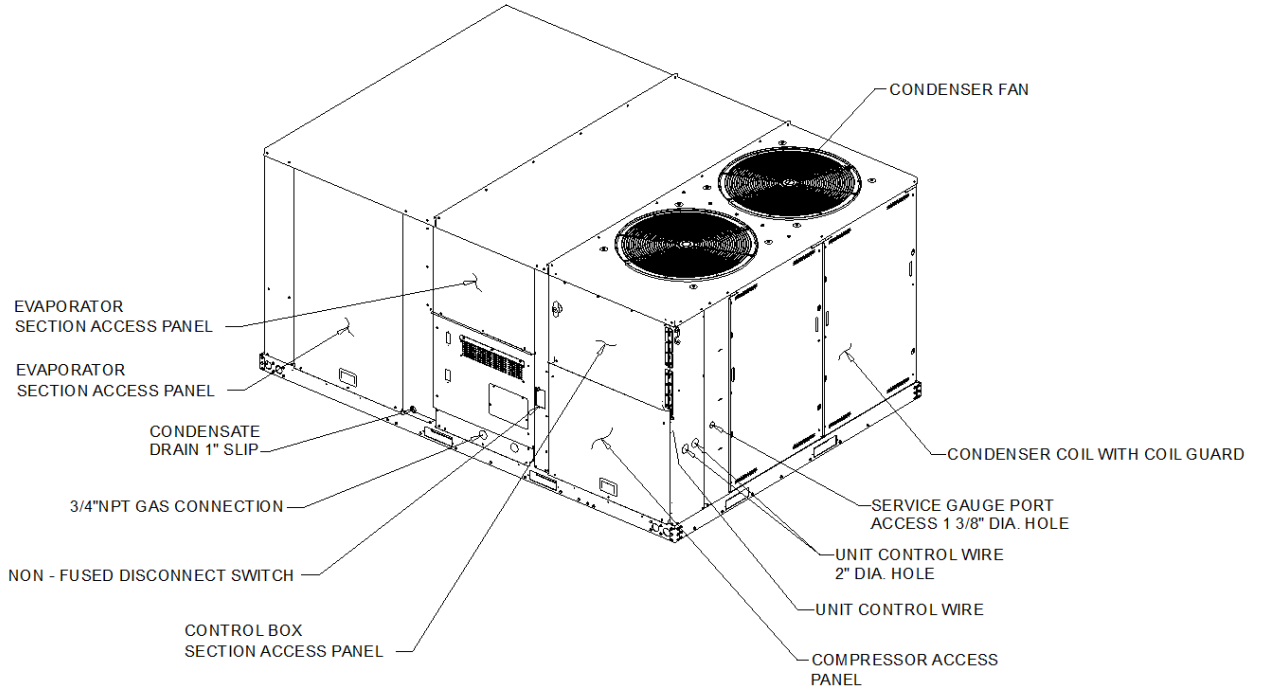
Sound Path	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Ducted Discharge	90 dB	96 dB	84 dB	79 dB	75 dB	69 dB	69 dB	67 dB
Ducted Inlet	87 dB	85 dB	76 dB	70 dB	65 dB	62 dB	63 dB	61 dB
Outdoor Noise	96 dB	92 dB	93 dB	91 dB	89 dB	84 dB	81 dB	75 dB

Note: Ducted Discharge/Ducted Inlet prediction data conform to AHRI 260

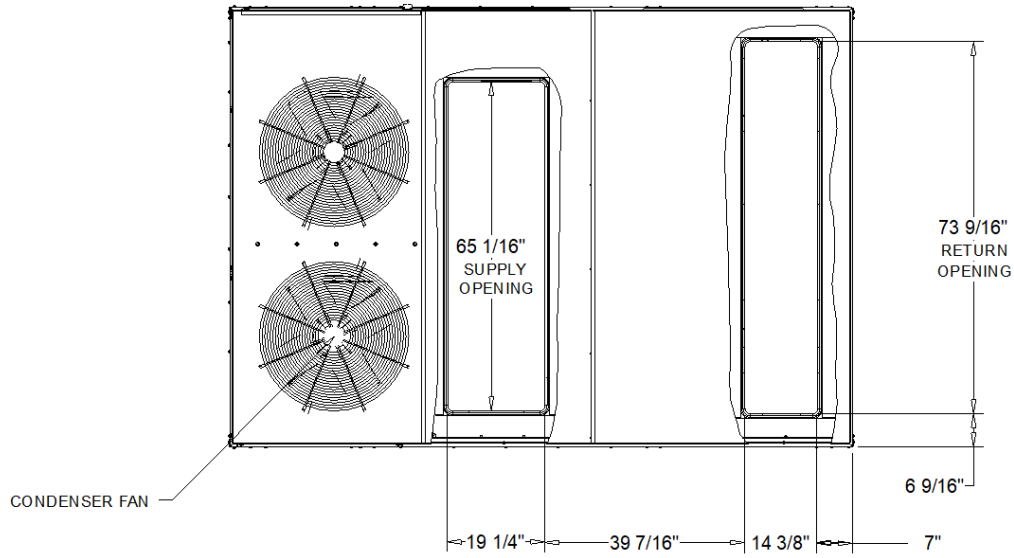
### Warranty

<b>Labor (first year)</b>	1st Yr Labor Whole Unit
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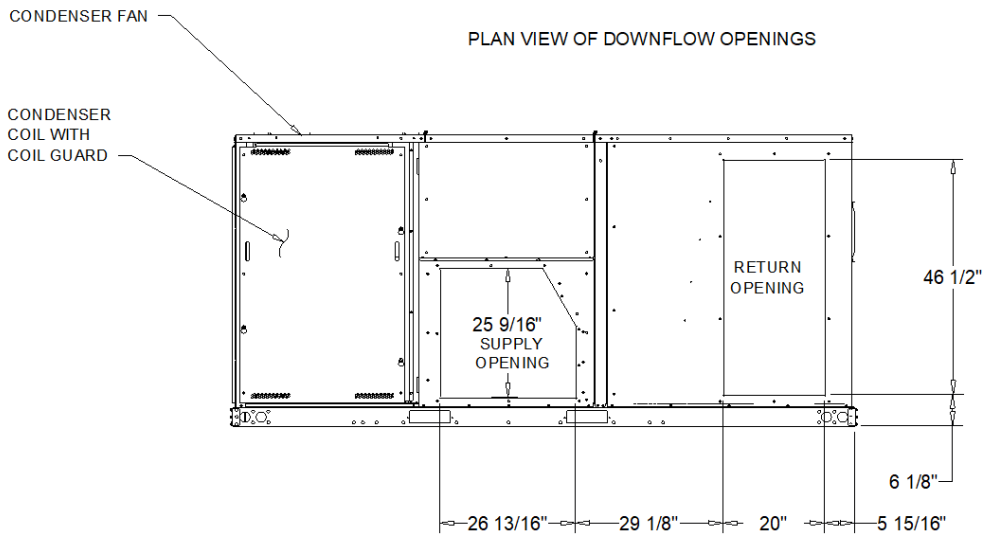
NOTES:  
 1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.  
 2. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION



DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY  
 DIMENSION DRAWING



PLAN VIEW OF DOWNFLOW OPENINGS



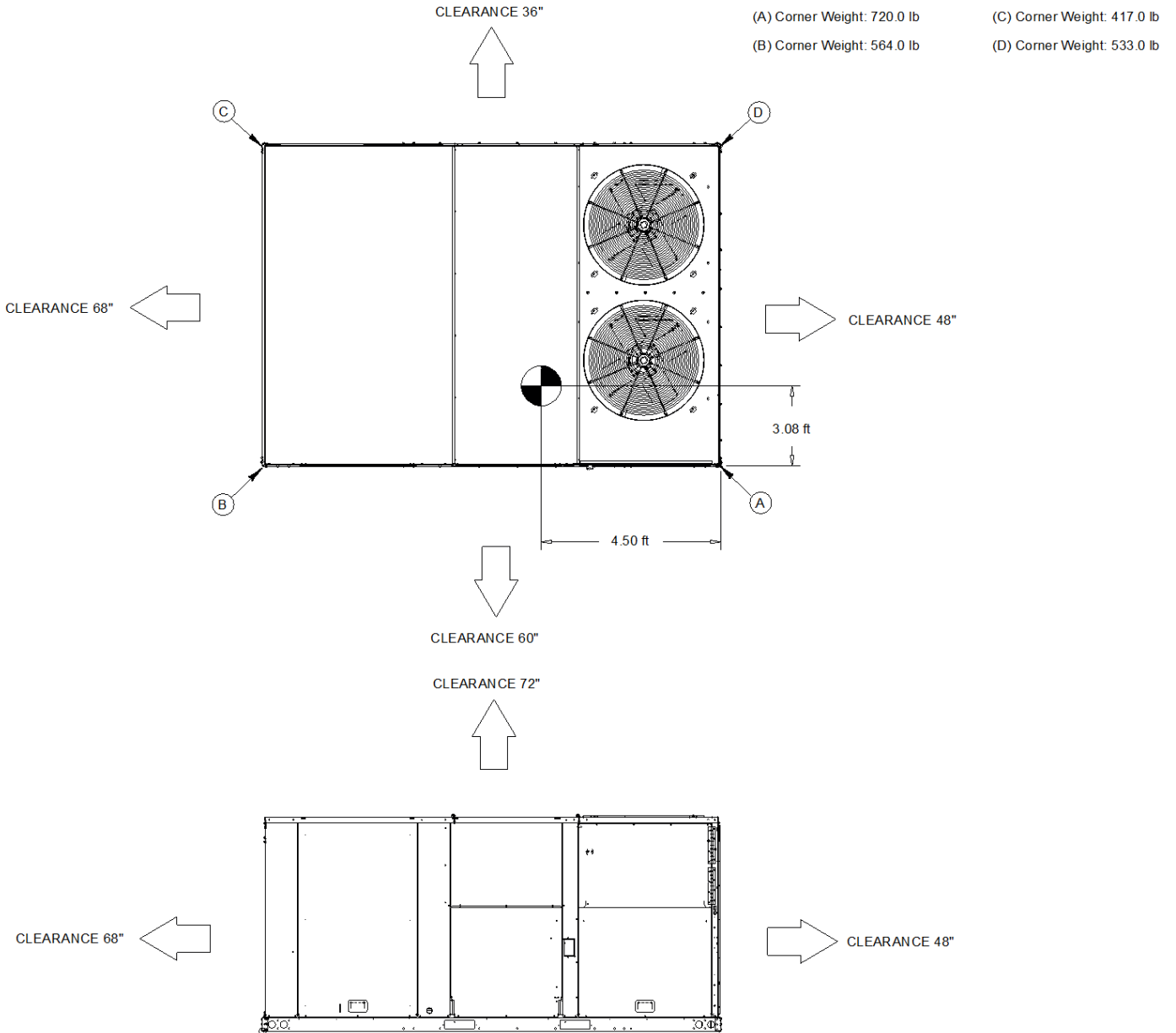
HORIZONTAL AIR FLOW OPENING

DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY  
 DIMENSION DRAWING

- NOTES:
1. APPROX. INSTALLED WEIGHT INCLUDES ALL SELECTED OPTIONS AND ACCESSORIES.
  2. CORNER WEIGHTS ARE FOR BASE UNIT ONLY AND DO NOT INCLUDE OPTIONS OR ACCESSORIES.
  3. WEIGHT INCLUDES BOTH FACTORY AND FIELD INSTALLED ACCESSORY.

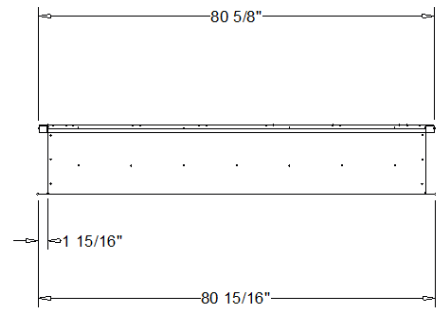
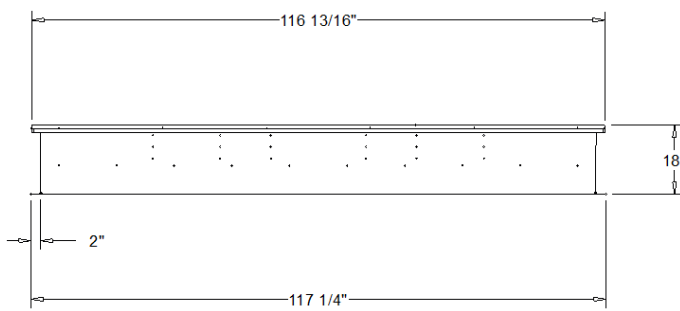
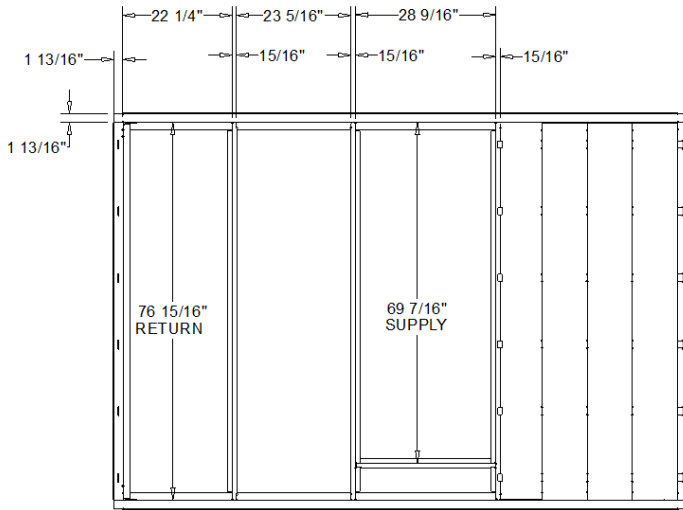
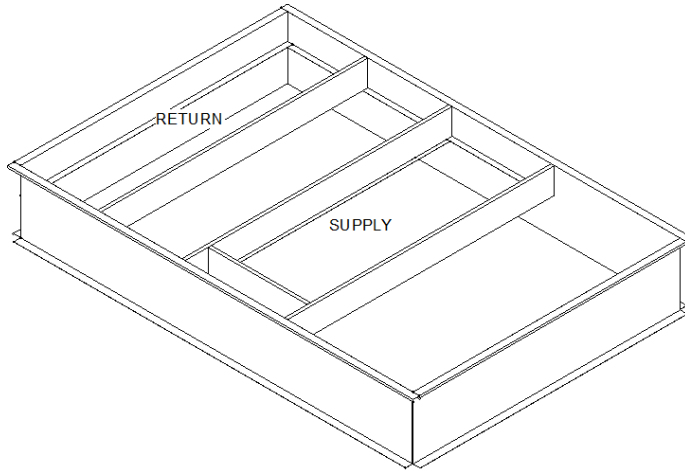
Approximate Installed Weight: 2,733.0 lb

- |                             |                             |
|-----------------------------|-----------------------------|
| (A) Corner Weight: 720.0 lb | (C) Corner Weight: 417.0 lb |
| (B) Corner Weight: 564.0 lb | (D) Corner Weight: 533.0 lb |

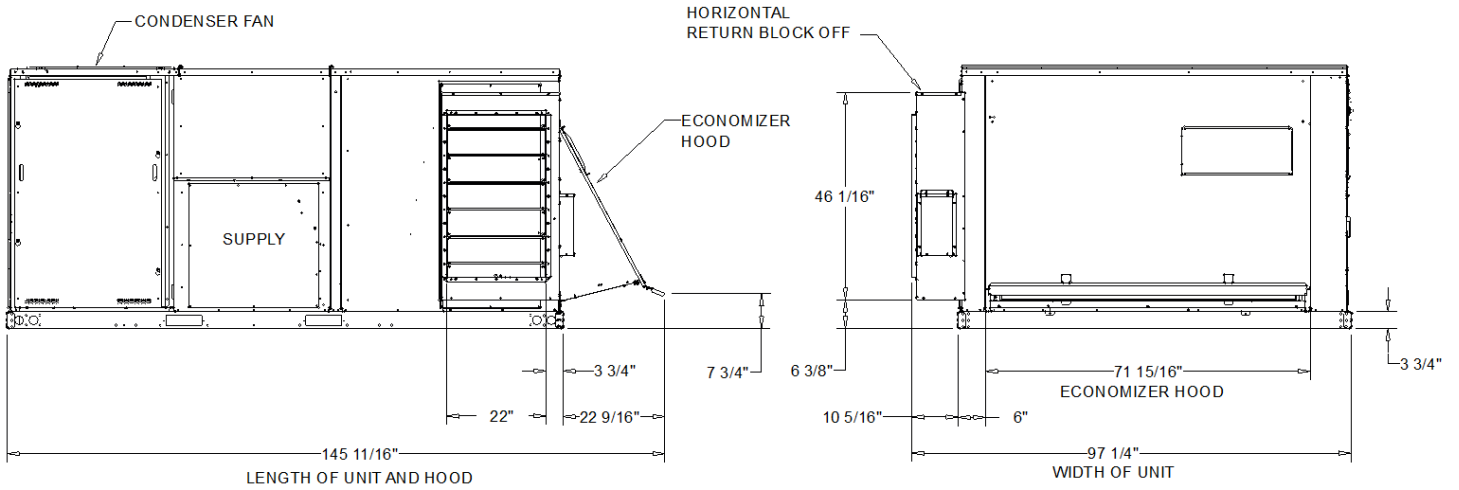
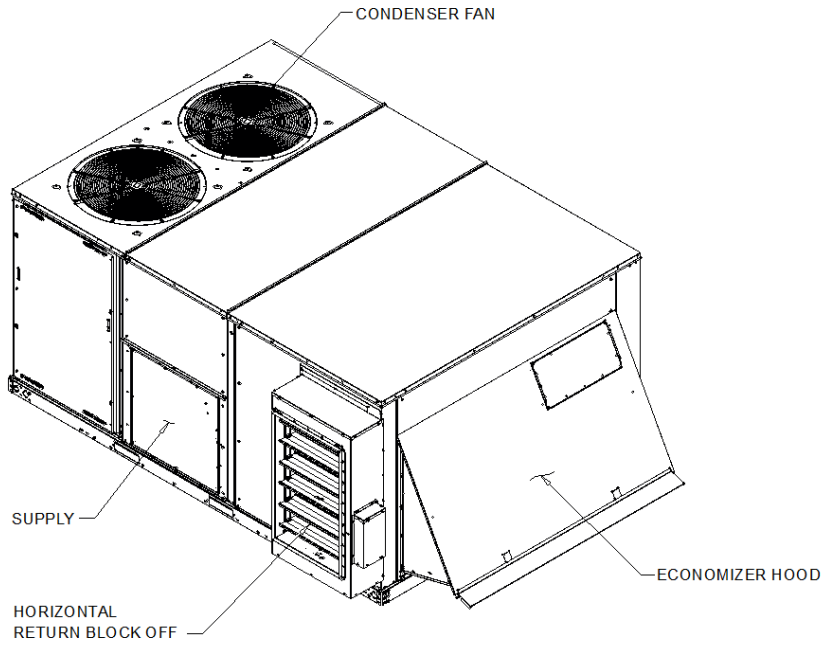


DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

WEIGHTS AND CLEARANCES

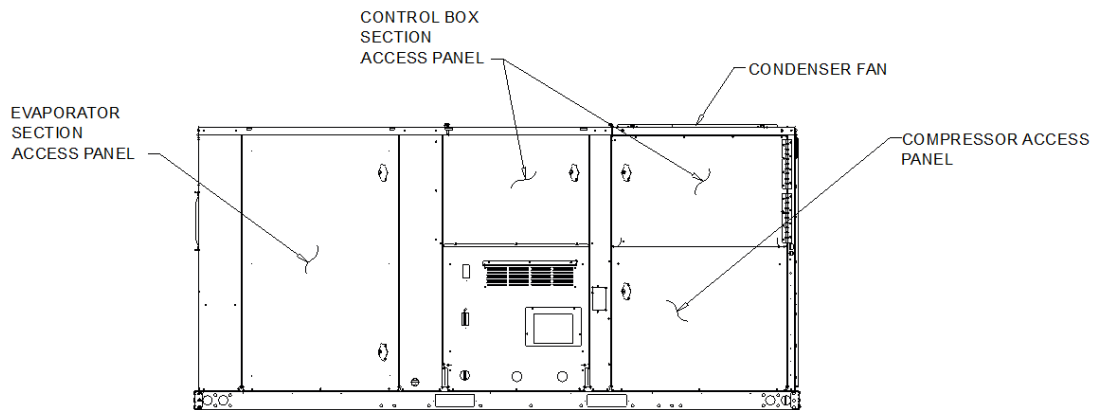
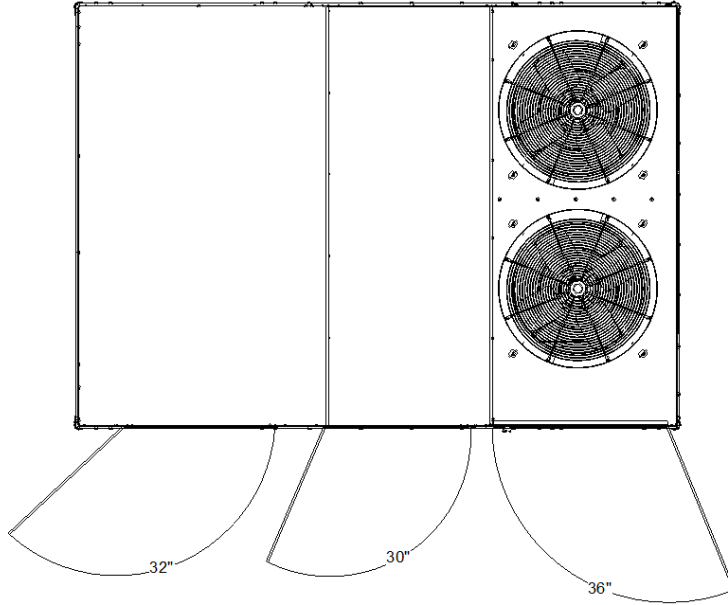


DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



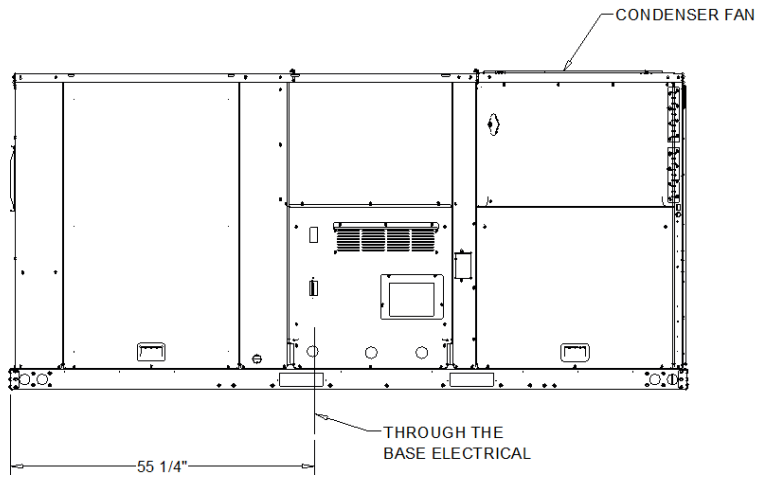
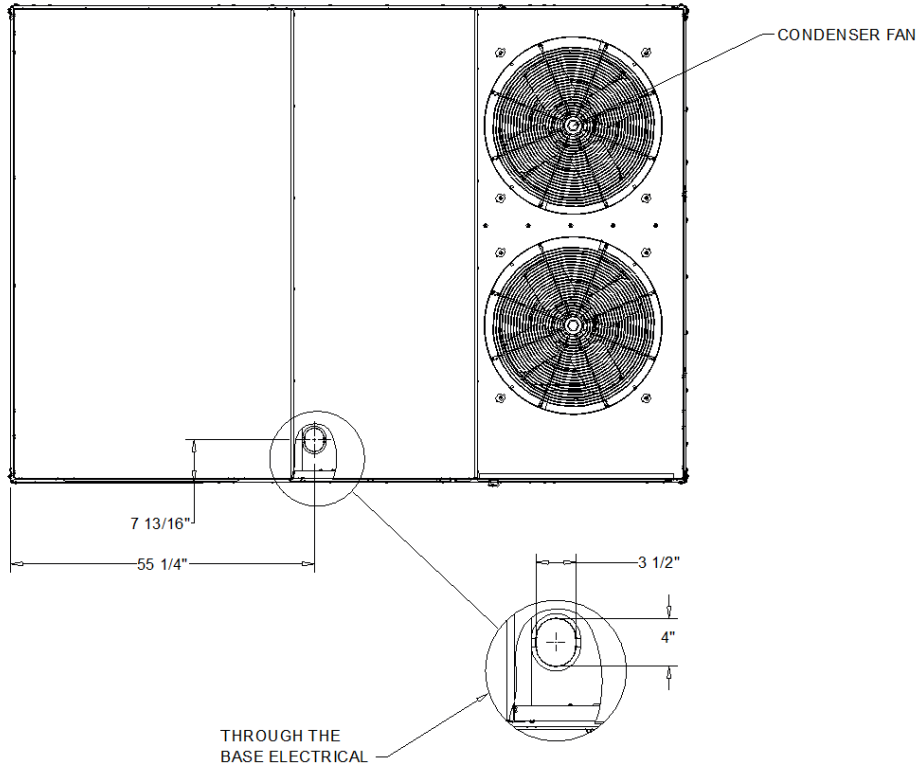
**LOW LEAK ECONOMIZER AIR DAMPER (FIELD ACCESSORY)**

DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



SWING DIAMETER FOR HINGED DOOR(S) (OPTION)

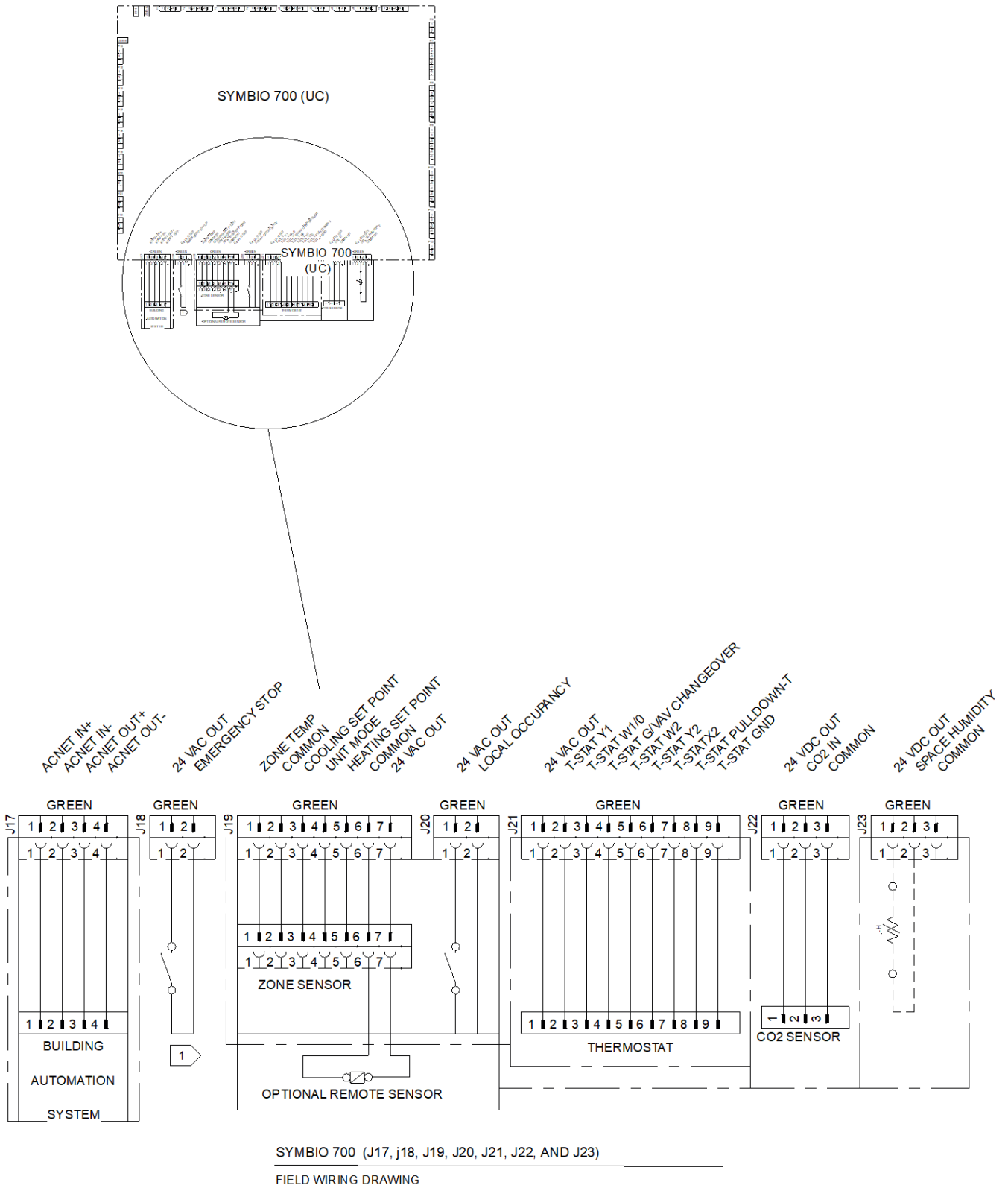
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



**THROUGH-THE-BASE ELECTRICAL (OPTION)**

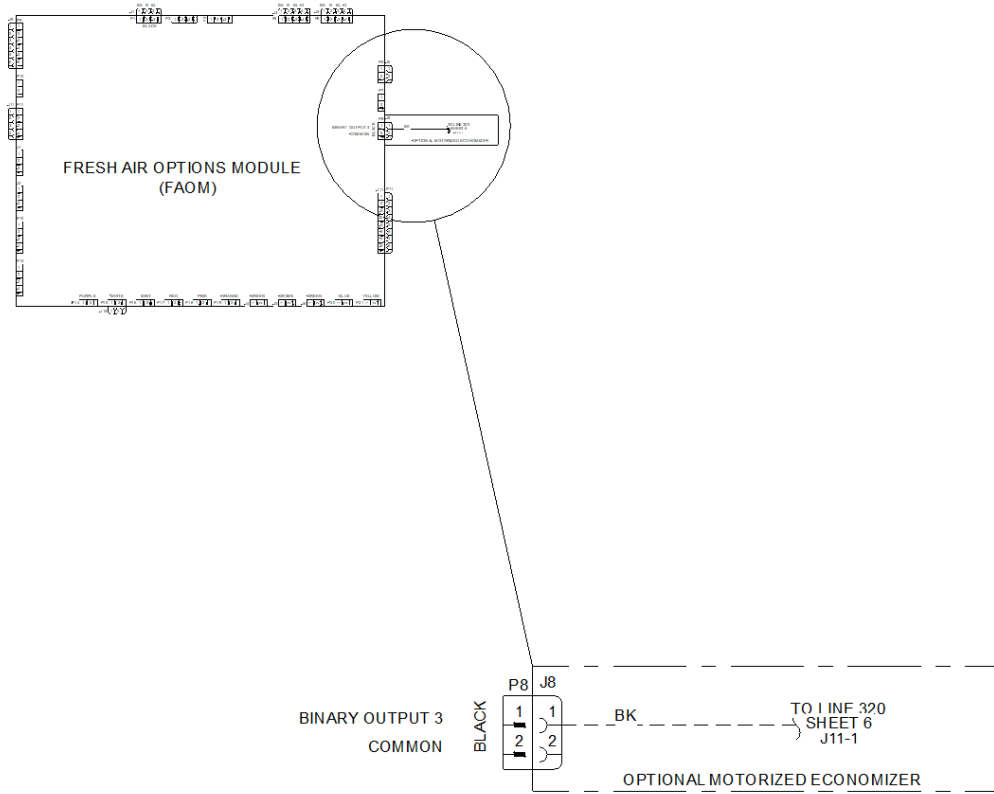
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION



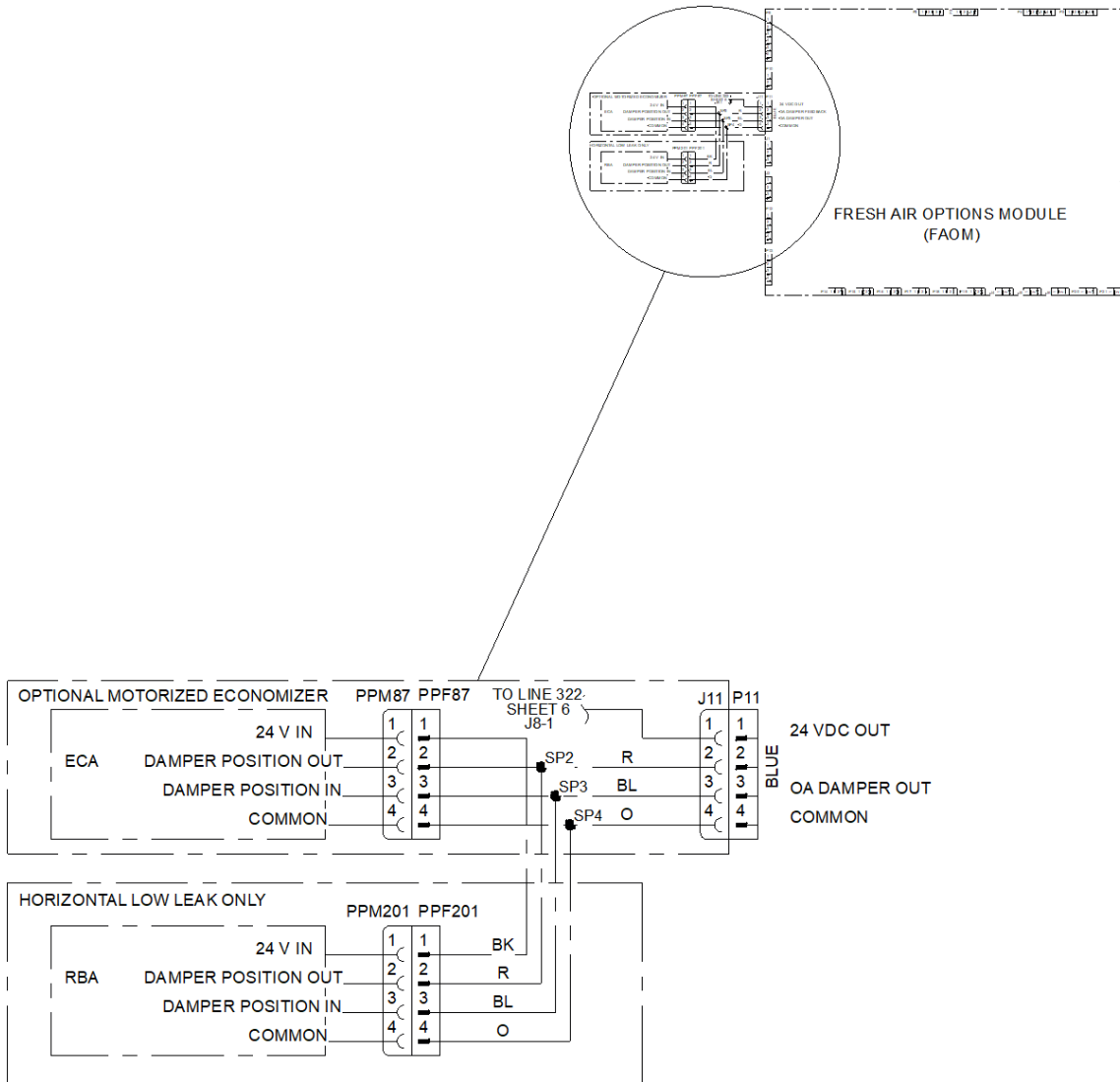


NOTES:  
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER (J8)  
FIELD WIRING DRAWING (INDOOR OPTION MODULE)

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER WITH HORIZONTAL LOW LEAK ONLY (J11)  
 FIELD WIRING DRAWING (FRESH AIR OPTIONS MODULE)



### **General - eFlex**

- Packaged rooftop unit cooling capacities, heating capacities, and efficiencies are certified to the following standards:
  - 3 to 5 ton units: AHRI Standard 210/240.
  - 6 to 25 ton units: AHRI Standard 340/360.
- Convertible airflow.
- Symbio controls operating range between 0.0 F and 125.0 F in cooling mode standard from the factory.
- Factory assembled, internally wired, fully charged with R-454B, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory.
- Colored and numbered wiring internal to the unit for simplified identification.
- Units cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners
- Unit shall be furnished with a leak detection system from the factory. The leak detection system shall consist of one or more refrigerant detection sensors. When the system detects a leak, the unit controller shall initiate mitigation actions.

### **Casing**

- Zinc coated, heavy gauge, galvanized steel.
- Weather resistant pre-painted metal with galvanized substrate.
- Meets ASTM B117, 672 hour salt spray test.
- Removable single side maintenance access panels.
- Lifting handles in maintenance access panels (can be removed and reinstalled by removing fasteners while providing a water and air tight seal).
- Exposed vertical panels and top covers in the indoor air section insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material.
- Base pan shall have no penetrations within the perimeter of the curb other than the raised 1 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.
- Base of the unit insulated with 1/8 inch, foil-faced, closed-cell insulation.
- Unit base provisions for forklift and/or crane lifting on three sides of unit.

### **Hail Guards**

- Provides condenser coil protection.

### **Powered or Unpowered Convenience Outlet**

- Powered GFCI, 120V/15A, 2 plug, convenience outlet or unpowered GFCI, 120V/20A, 2 plug, convenience outlet.
- When convenience outlet is powered, a service receptacle disconnect will be available.
- Convenience outlet is powered from the line side of the disconnect or circuit breaker, and therefore will not be affected by the position of the disconnect or circuit breaker.
- Available to order when through-the-base electrical with disconnect switch or circuit breaker option is ordered.

### **Microchannel Coils**

- Optimal heat transfer performance due to flat, streamlined tubes with small ports, and metallurgical tube-to-fin bond.
- Reduce system refrigerant charge by up to 50% leading to better compressor reliability.
- Compact all-aluminum microchannel coils reduce the unit weight.
- Recyclable all aluminum coils All aluminium construction minimizes galvanic corrosion.
- Strong aluminum brazed structure provides better fin protection.
- Flat streamlined tubes more dust resistant and easy to clean.
- Coils leak tested at the factory to ensure the pressure integrity.



### **Compressors - eFlex**

- All units have variable speed compressor matched with variable frequency drive that modulates the speed of the compressor motor and provides several compressor protection functions.
- Permanent magnet motor with voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- Crankcase heaters sized to minimize the amount liquid refrigerant present in the oil sump during offcycles are standard on all compressors
- Single variable speed compressors in 12.5 and 15 ton units. Manifoldded variable and fixed speed compressors in 17.5 to 25 ton units
- Variable speed modulation to 15 Hz equating to 25 percent or less of full capacity
- Control of the eFlex system is integrated with the Symbio 700 unit controller to ensure optimal equipment reliability and performance.

### **Frostat**

- Utilized as a safety device.
- Opens to prevent freezing temperatures on evaporator coil.
- Temperature will need to rise to 50°F before closing.
- Utilized in low airflow or high outside air applications (cooling only).

### **Gas Heating Section**

- The heating section shall have a progressive tubular heat exchanger with corrosion-resistant aluminized steel tubes and burners as standard on all models.
- Stainless steel heat exchanger with 409 stainless steel tubes and 439 stainless steel burners shall be optional.
- Induced draft combustion blower shall be used to pull the combustion products through the firing tubes.
- Heater shall use a direct spark ignition (DSI) system.
- On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition.
- After three unsuccessful ignition attempts, entire heating system shall be locked out until manually reset at the thermostat/zone sensor.
- Units shall be suitable for use with natural gas or propane (field-installed kit).

### **Heat Exchanger**

- Compact cabinet features a tubular heat exchanger in low, medium and high heat capacities.
- Corrosion-resistant aluminized steel tubes and burners are standard on all models.
- Induced draft blower to pull the gas mixture through the burner tubes.
- Direct spark ignition and a flame sensor as a safety device to validate the flame.

### **Indoor Fan - eFlex**

- Direct drive plenum fan design.
- Plenum fan design - backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor.
- Supply fan speed adjustments can be made using the Symbio 700 or Mobile App.
- Motors are thermally protected.
- Variable speed direct drive motors are high efficiency.

### **Roof Curb**

- Designed to mate with the unit's downflow supply and return.
- Provide support and a water tight installation when installed properly.
- Shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb.
- Curb shall be shipped knocked down for field assembly.
- Shall include wood nailer strips.

### **Through-the-Base Electrical with Disconnect Switch**

- 3-pole, molded case, disconnect switch with provisions for through-the-base electrical connections.
- Disconnect switch installed within unit in a water tight enclosure.
- Wiring provided from the switch to the unit high voltage terminal block.
- Switch cULus agency recognized.



**Note:** *Disconnect switch sized per NEC and cULus guidelines but will not be used in place of unit overcurrent protection.*

**Low Leak Economizer**

- This accessory meets the low leak requirements for ASHRAE 90.1, IECC, and CA Title 24 standards (4 cfm/ ft<sup>2</sup>@ 1" wg exterior air/return air). This option allows for 100% outdoor air supply from 0% to 100% modulating dampers and comes standard with barometric relief. It can be paired with powered exhaust for additional building pressure relief. This option can be paired with or without fault detection and diagnostics (FDD) to meet the current mandatory CA Title 24 requirements. The economizers come with four control options: dry bulb, reference enthalpy, comparative enthalpy, or differential dry bulb.



# Trane Precedent Packaged Rooftop

## Unit Overview - YZK300A3S0H\*

Application	Unit Size	Supply Fan		External Dimensions (in.)			Operating Weight	Elevation
		Airflow	Total Static Pressure	Height	Width	Length		
DX Cooling / Gas Heat	25 Ton	10000 cfm	1.244 in H2O	66.000 in	87.000 in	123.000 in	2700.0 lb	0.00 ft

## Unit Features

<b>Unit Efficiency</b>	Ultra High Efficiency
<b>Refrigerant</b>	R-454B Refrigerant
<b>EER @ AHRI</b>	11.00
<b>IEER @ AHRI</b>	20.00
<b>Hinged Service Access/Filters</b>	Hinged Access Panels with 2-in MERV 13
<b>Through the Base Provisions</b>	Electric
<b>Disconnect / Circuit Breaker</b>	Non-Fused Disconnect Switch
<b>Convenience Outlet</b>	Powered 15A Convenience Outlet



## Unit Electrical

<b>Voltage</b>	208-230/60/3
<b>MCA</b>	114.00 A
<b>MOP</b>	150.00 A
<b>Condenser Fan FLA</b>	2.60 A
<b>Evaporator Fan FLA</b>	11.00 A
<b>Compressor 1 RLA</b>	43.30 A
<b>Compressor 2 RLA</b>	32.30 A
<b>Compressor Power</b>	19.78 kW
<b>System Power</b>	25.65 kW

## Controls

<b>Unit Controls</b>	Symbio 700
<b>Communications Option</b>	Advanced Controls and BACnet BAS
<b>System Monitoring Controls 1</b>	Condensate Overflow Switch
<b>SupplyFan/Drive/MotorType</b>	Multiple Zone VAV with Oversized Motor
<b>Smoke Detector</b>	Return Air
<b>Low Ambient</b>	Low Ambient

## Cooling Section

	Capacity
<b>Entering Dry Bulb</b>	80.00 F
<b>Entering Wet Bulb</b>	67.00 F
<b>Ambient Temp</b>	95.00 F
<b>Leaving Coil Dry Bulb</b>	59.58 F
<b>Leaving Coil Wet Bulb</b>	57.80 F
<b>Leaving Unit Dry Bulb</b>	61.25 F
<b>Leaving Unit Wet Bulb</b>	58.46 F
<b>Saturated Discharge Temperature</b>	98.48 F
<b>Saturated Suction Temperature</b>	44.61 F
	<b>Gross Total</b> 282.92 MBh
	<b>Gross Latent</b> 65.03 MBh
	<b>Gross Sensible</b> 217.88 MBh
	<b>Net Total</b> 270.90 MBh
	<b>Net Sensible</b> 205.87 MBh
	<b>Net Sensible Heat Ratio</b> 75.99 %
	<b>Fan Motor Heat</b> 5.07 MBh
	<b>Refrig Charge-Circuit 1</b> 16.0 lb

## Heating Section

<b>Heating</b>	High Gas Heat
<b>Input Heating Capacity</b>	400.00 MBh
<b>Output Heating Capacity</b>	324.00 MBh
<b>Heating EAT</b>	68.00 F
<b>Heating LAT</b>	97.82 F
<b>Heating Temp Rise</b>	29.82 F



Job Name: City of Columbia - Armory  
 Prepared For:  
 Unit Tag: RTU-3-4 VS  
 Quantity: 1

**Fan Section**

Indoor Fan Data		Indoor Fan Performance	
<b>Airflow Application</b>	Horizontal	<b>Airflow</b>	10000 cfm
<b>Design ESP</b>	0.750 in H2O	<b>Supply Motor Horsepower</b>	4.600 hp
<b>Component SP</b>	0.494 in H2O	<b>Total Supply Motor Operating Power</b>	6.077 hp
<b>Heat SP</b>	0.000 in H2O	<b>Indoor RPM</b>	1701 rpm
<b>Total SP</b>	1.244 in H2O	Outdoor Fan Data	
<b>Indoor Fan Drive Type</b>	Variable Direct	<b>Outdoor Fan Drive Type</b>	Direct
<b>Indoor Fan Quantity</b>	2	<b>Outdoor Fan Quantity</b>	2
<b>Indoor Fan Type</b>	BC Plenum	<b>Outdoor Fan Type</b>	Propeller
		Filters	
		<b>1st Filter Size and Qty</b>	4 - 20 x 24 x 2
		<b>2nd Filter Size and Qty</b>	4 - 20 x 30 x 2

**Field Installed Accessories**

<b>Roof curb</b>	18" Full Perimeter Knockdown Curb
<b>Barometric relief</b>	yes
<b>Fresh air selection</b>	Low Leak Economizer, Dry Bulb, Horiz
<b>Temperature sensor</b>	yes
<b>Horizontal Conversion Panel</b>	yes

**Acoustics**

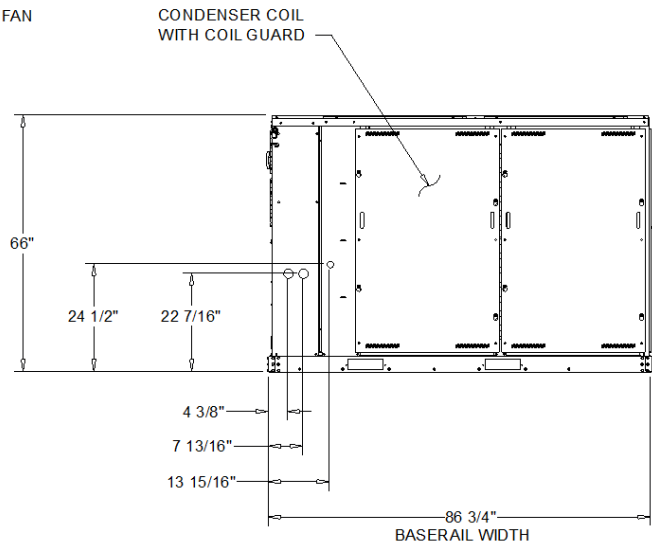
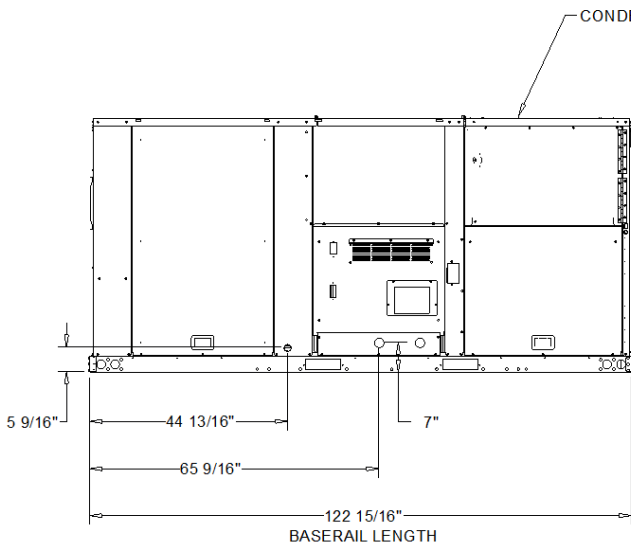
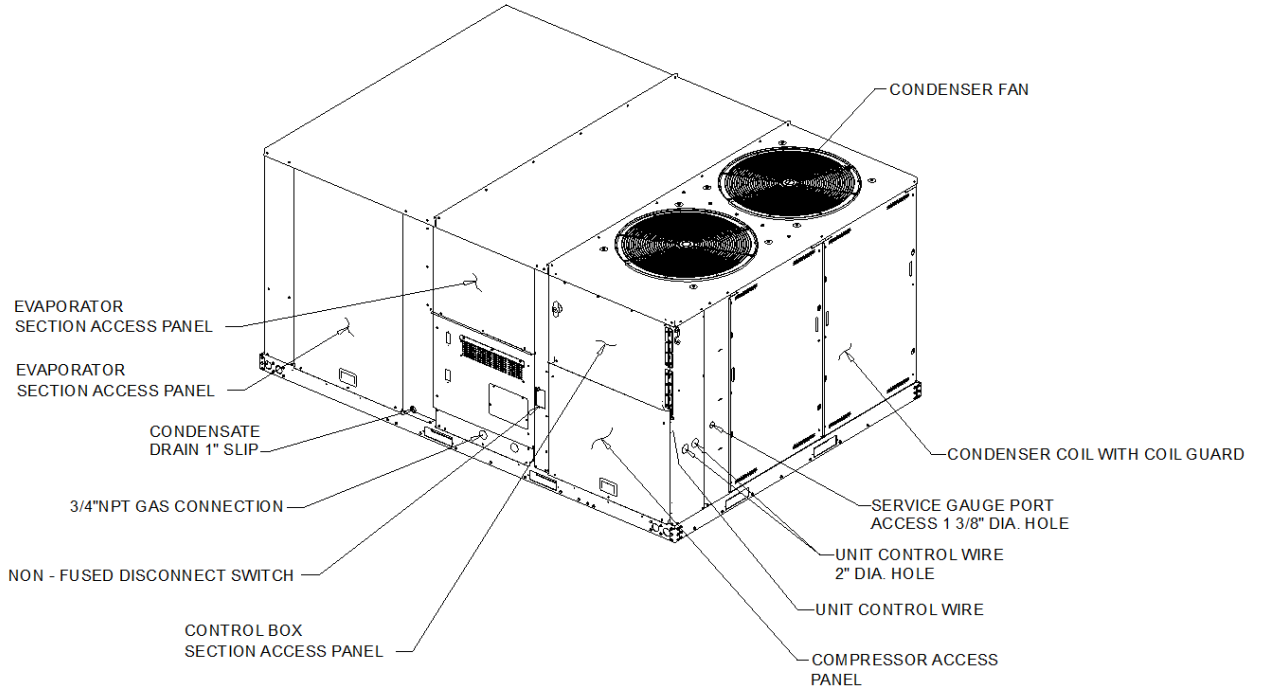
Sound Path	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Ducted Discharge	90 dB	96 dB	84 dB	78 dB	75 dB	69 dB	69 dB	67 dB
Ducted Inlet	87 dB	85 dB	76 dB	70 dB	65 dB	62 dB	63 dB	61 dB
Outdoor Noise	96 dB	92 dB	93 dB	91 dB	89 dB	84 dB	81 dB	75 dB

Note:Ducted Discharge/Ducted Inlet prediction data conform to AHRI 260

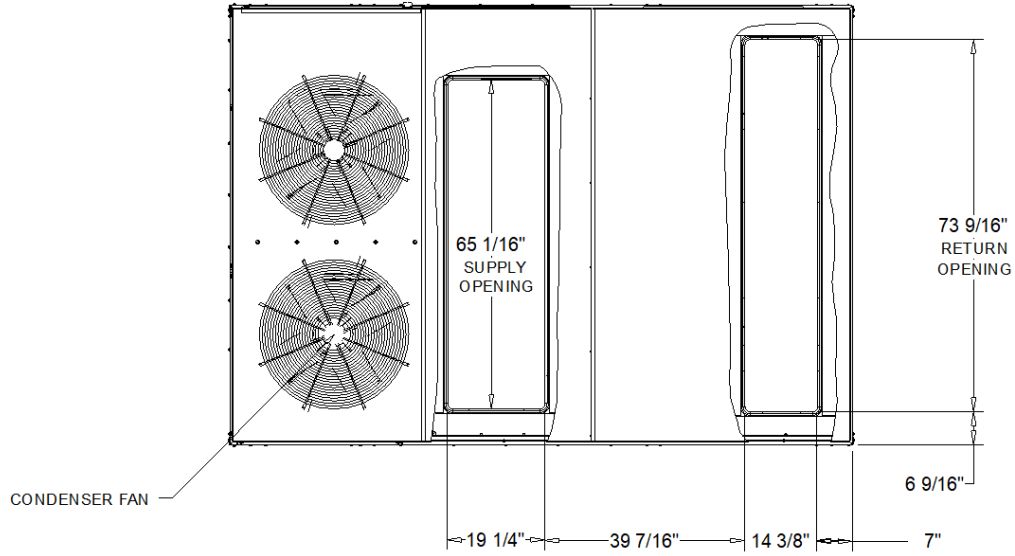
**Warranty**

<b>Labor (first year)</b>	1st Yr Labor Whole Unit
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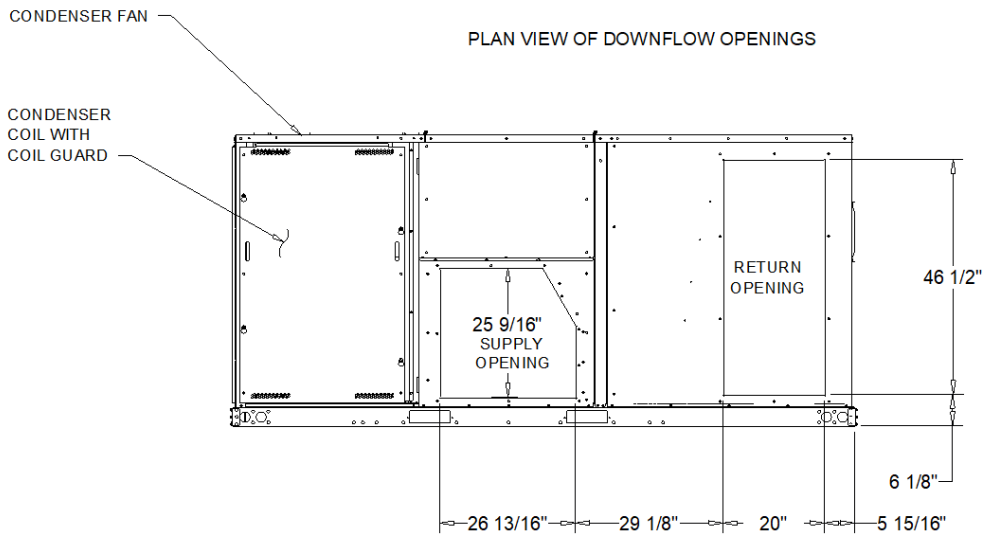
NOTES:  
 1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.  
 2. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION



DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY  
 DIMENSION DRAWING



PLAN VIEW OF DOWNFLOW OPENINGS



HORIZONTAL AIR FLOW OPENING

DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY  
 DIMENSION DRAWING



- NOTES:  
1. APPROX. INSTALLED WEIGHT INCLUDES ALL SELECTED OPTIONS AND ACCESSORIES.  
2. CORNER WEIGHTS ARE FOR BASE UNIT ONLY AND DO NOT INCLUDE OPTIONS OR ACCESSORIES.  
3. WEIGHT INCLUDES BOTH FACTORY AND FIELD INSTALLED ACCESSORY.

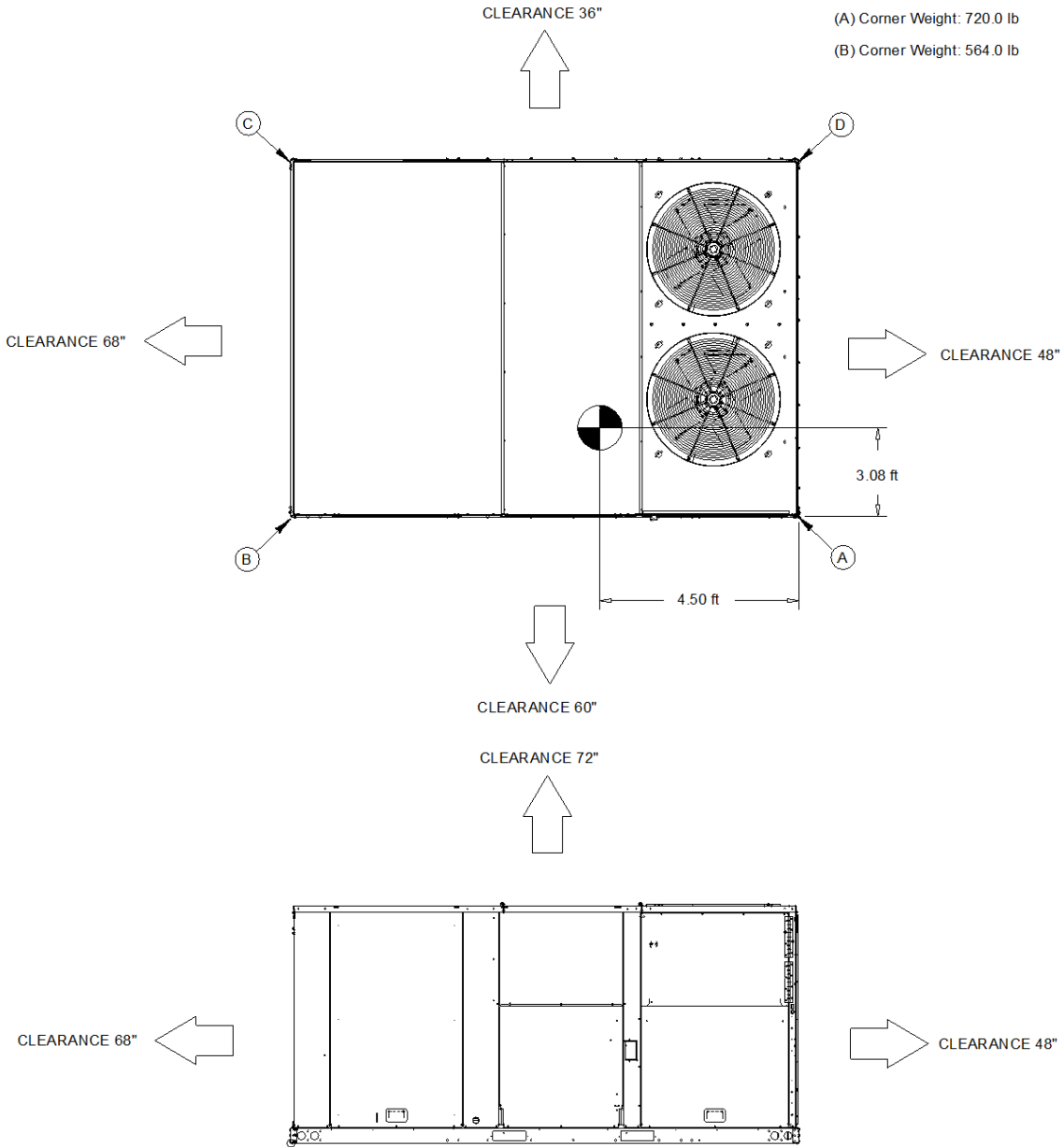
Approximate Installed Weight: 2,700.0 lb

(A) Corner Weight: 720.0 lb

(C) Corner Weight: 417.0 lb

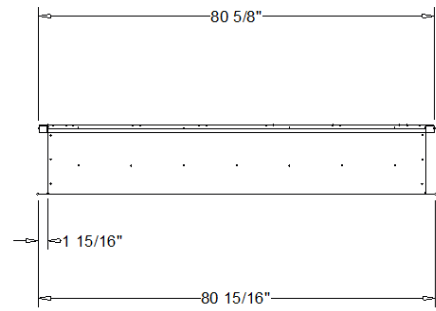
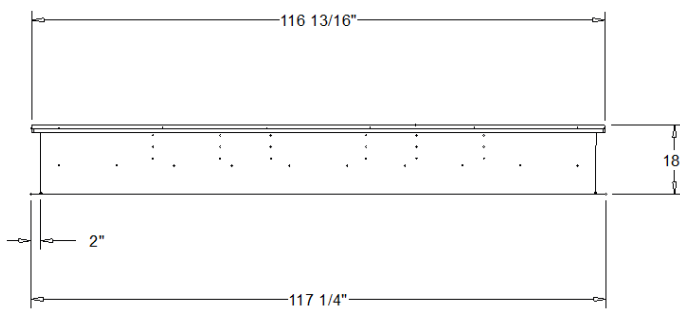
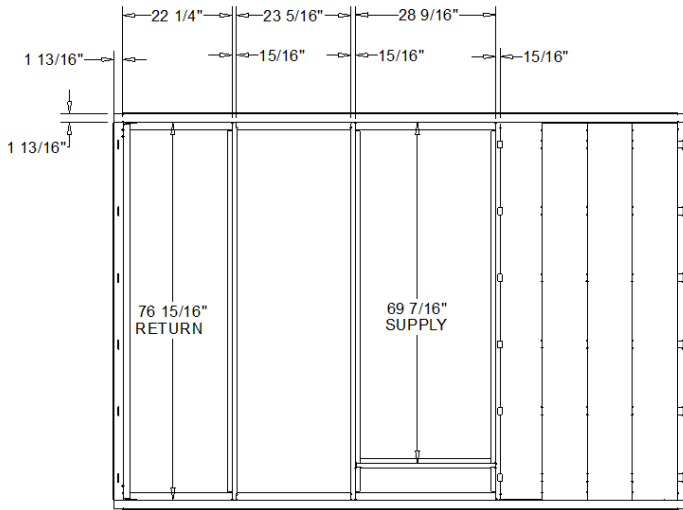
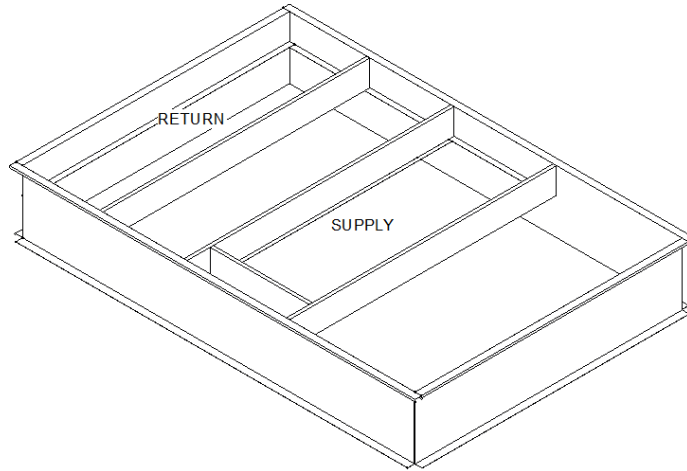
(B) Corner Weight: 564.0 lb

(D) Corner Weight: 533.0 lb



DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

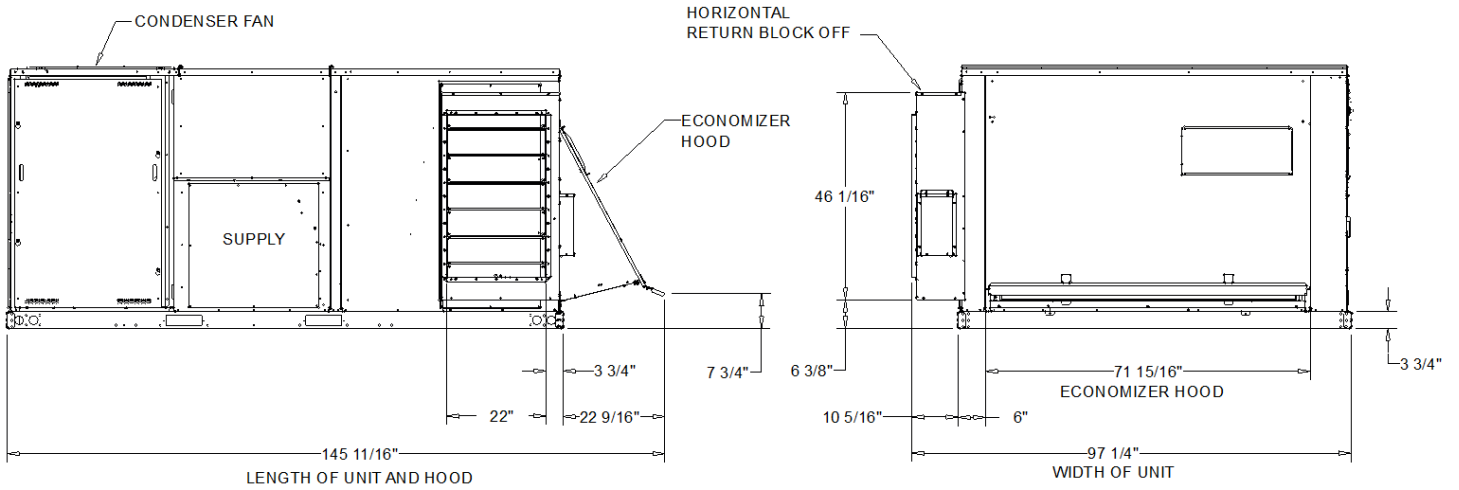
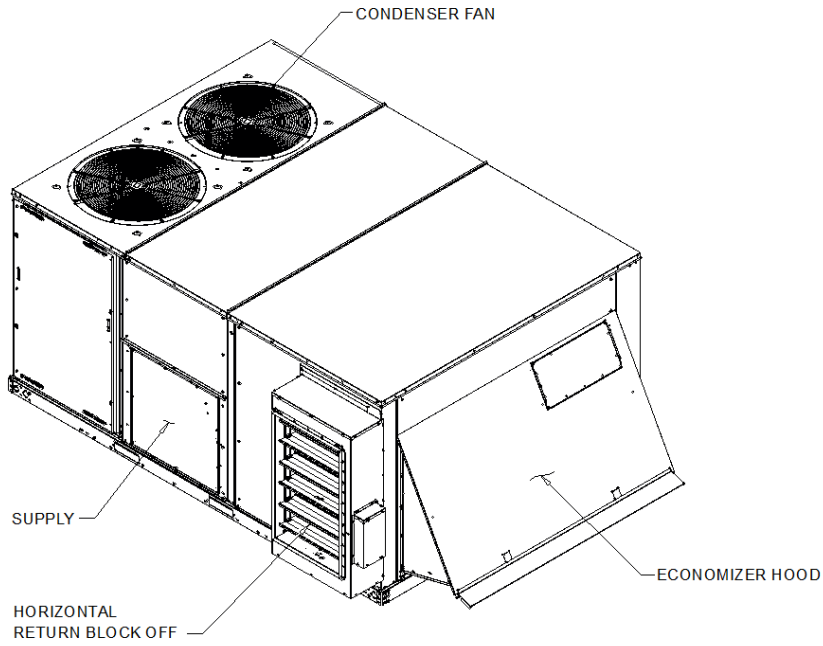
WEIGHTS AND CLEARANCES



DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

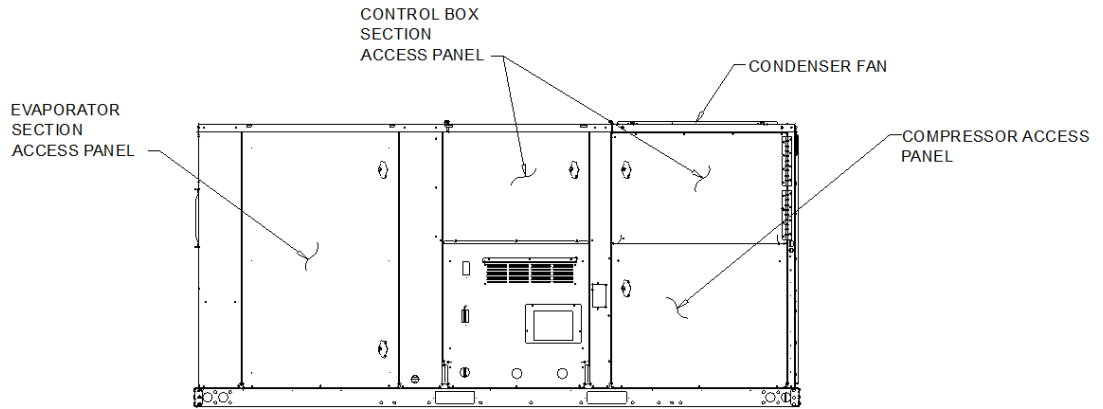
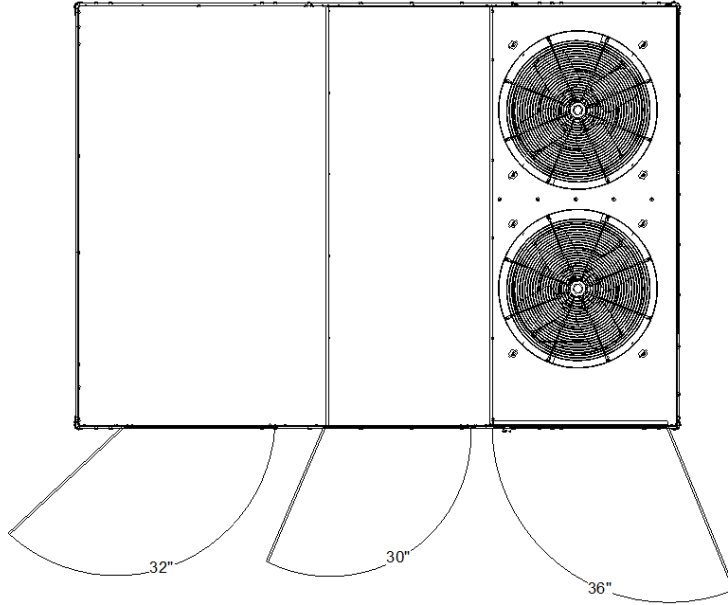


Job Name: City of Columbia - Armory  
Prepared For:  
Unit Tag: RTU-3-4 VS  
Quantity: 1



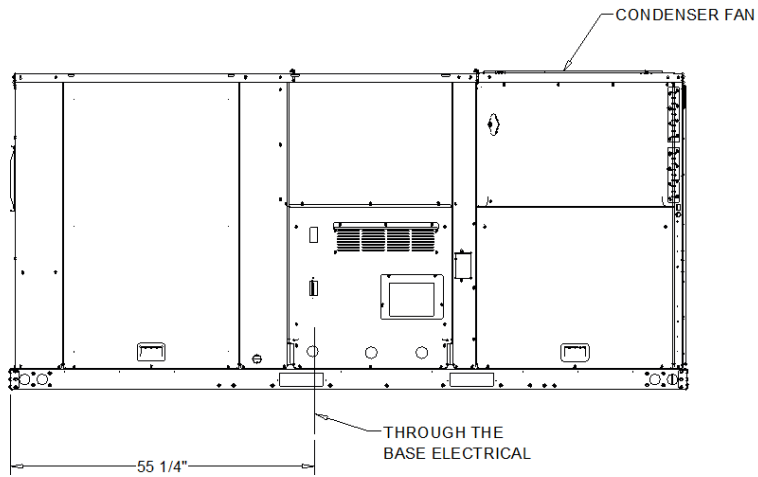
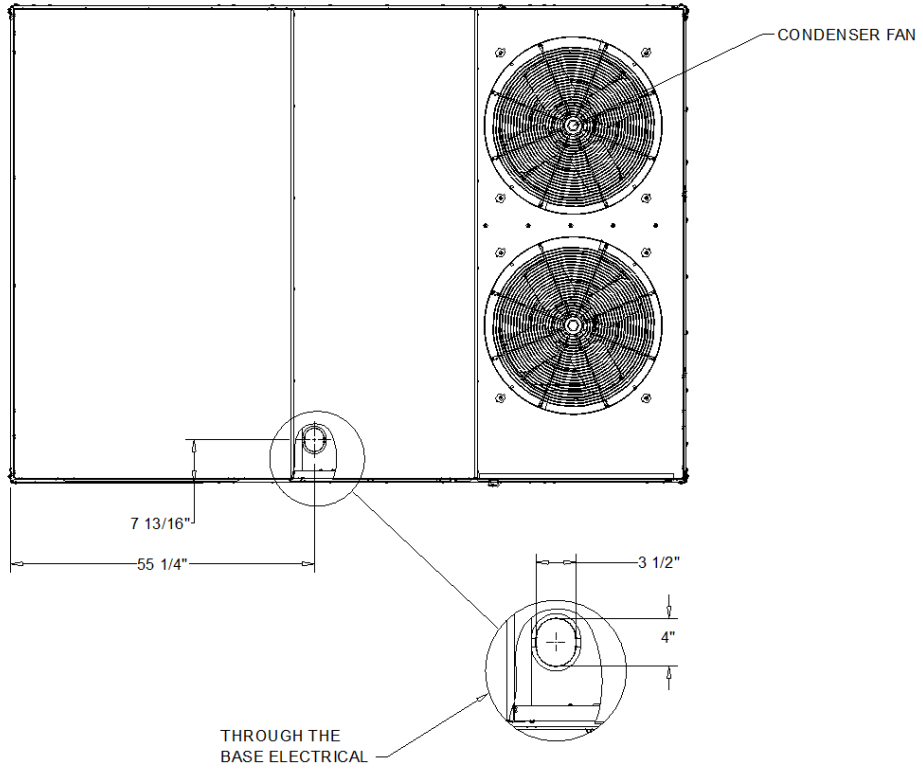
LOW LEAK ECONOMIZER AIR DAMPER (FIELD ACCESSORY)

DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



SWING DIAMETER FOR HINGED DOOR(S) (OPTION)

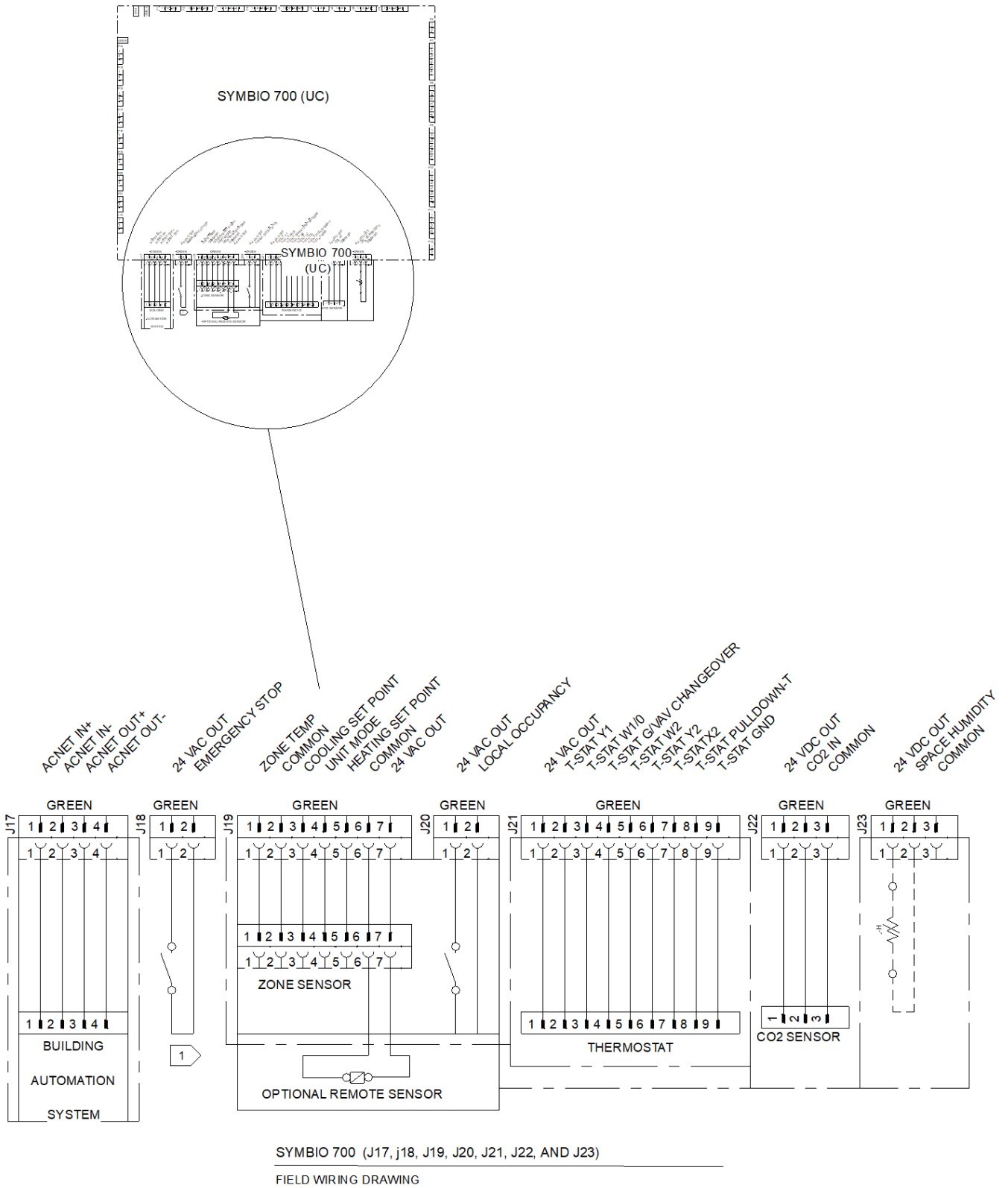
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY



**THROUGH-THE-BASE ELECTRICAL (OPTION)**

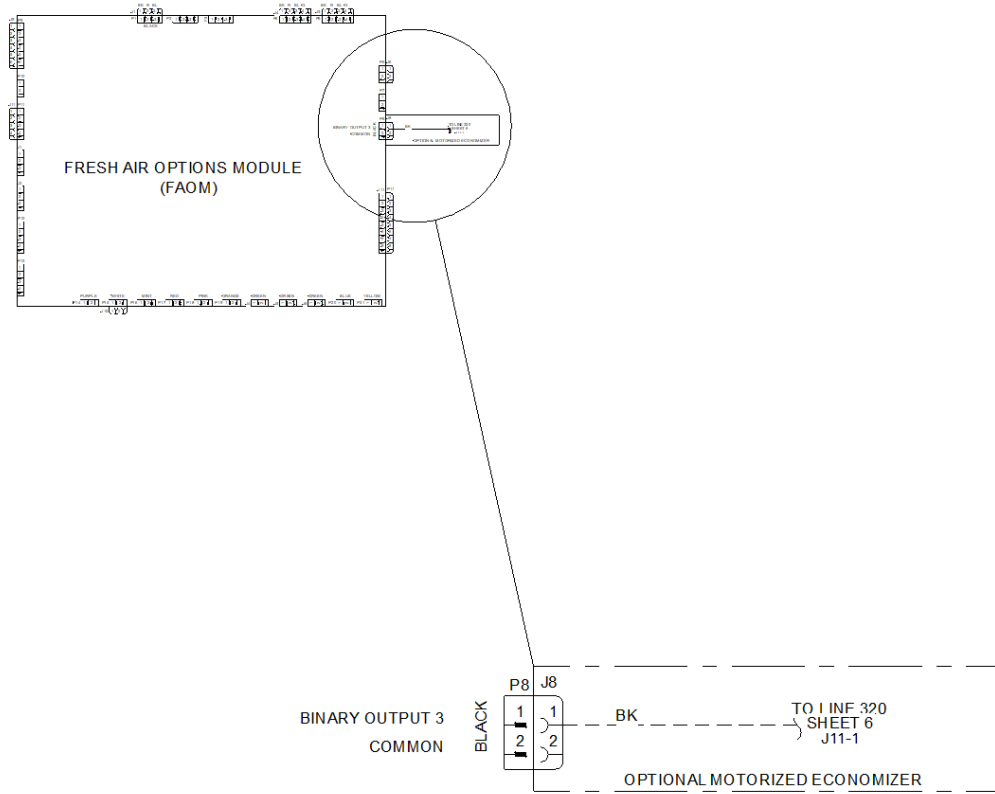
DX COOLING / GAS HEAT ULTRA HIGH EFFICIENCY

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION



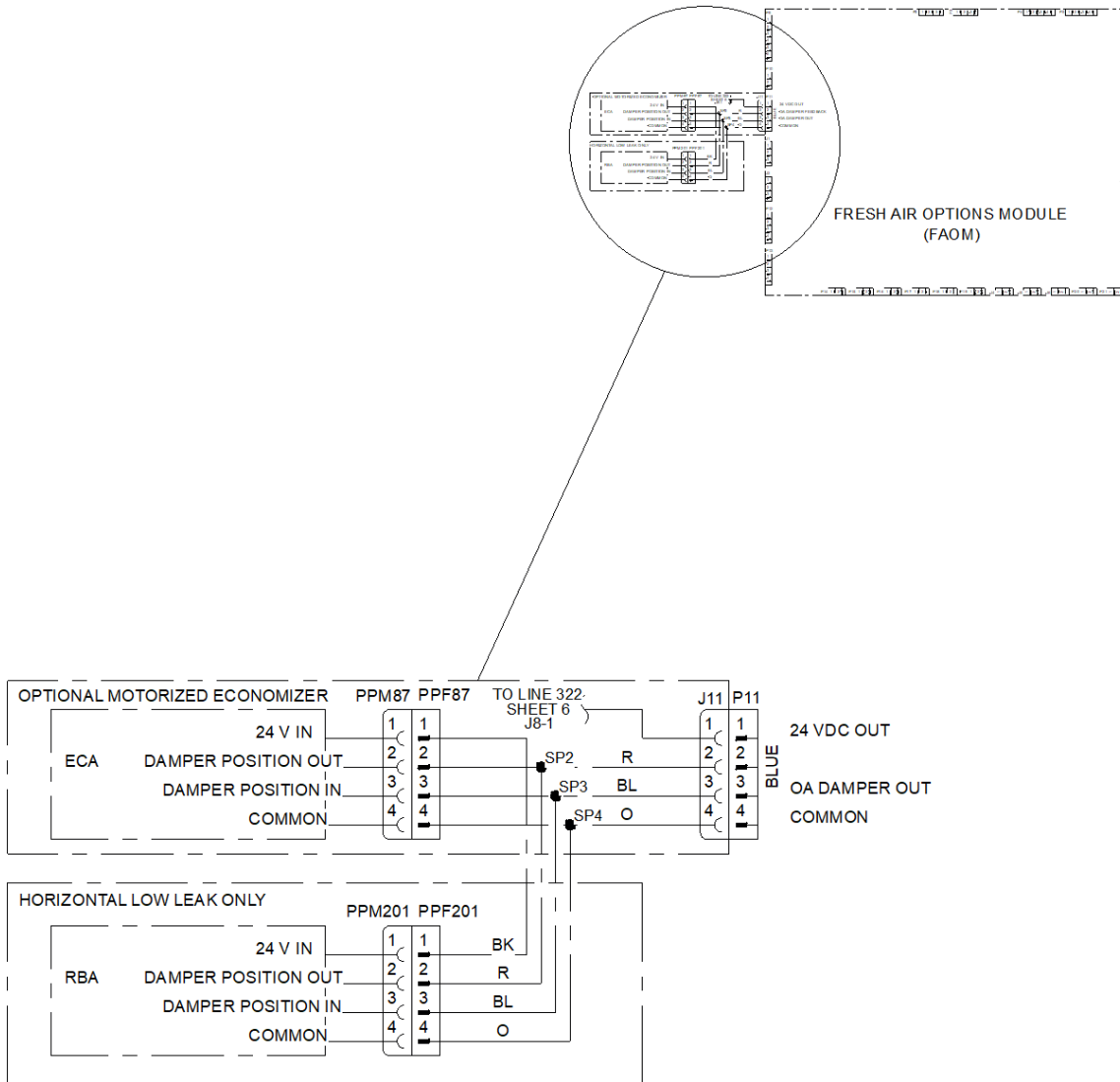


NOTES:  
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER (J8)  
FIELD WIRING DRAWING (INDOOR OPTION MODULE)

NOTES:  
 1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH  
 INSTALLER DOCUMENTS BEFORE INSTALLATION



OPTIONAL MOTORIZED ECONOMIZER WITH HORIZONTAL LOW LEAK ONLY (J11)  
 FIELD WIRING DRAWING (FRESH AIR OPTIONS MODULE)



### **General - eFlex**

- Packaged rooftop unit cooling capacities, heating capacities, and efficiencies are certified to the following standards:
  - 3 to 5 ton units: AHRI Standard 210/240.
  - 6 to 25 ton units: AHRI Standard 340/360.
- Convertible airflow.
- Symbio controls operating range between 0.0 F and 125.0 F in cooling mode standard from the factory.
- Factory assembled, internally wired, fully charged with R-454B, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory.
- Colored and numbered wiring internal to the unit for simplified identification.
- Units cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners
- Unit shall be furnished with a leak detection system from the factory. The leak detection system shall consist of one or more refrigerant detection sensors. When the system detects a leak, the unit controller shall initiate mitigation actions.

### **Casing**

- Zinc coated, heavy gauge, galvanized steel.
- Weather resistant pre-painted metal with galvanized substrate.
- Meets ASTM B117, 672 hour salt spray test.
- Removable single side maintenance access panels.
- Lifting handles in maintenance access panels (can be removed and reinstalled by removing fasteners while providing a water and air tight seal).
- Exposed vertical panels and top covers in the indoor air section insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material.
- Base pan shall have no penetrations within the perimeter of the curb other than the raised 1 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.
- Base of the unit insulated with 1/8 inch, foil-faced, closed-cell insulation.
- Unit base provisions for forklift and/or crane lifting on three sides of unit.

### **Hail Guards**

- Provides condenser coil protection.

### **Powered or Unpowered Convenience Outlet**

- Powered GFCI, 120V/15A, 2 plug, convenience outlet or unpowered GFCI, 120V/20A, 2 plug, convenience outlet.
- When convenience outlet is powered, a service receptacle disconnect will be available.
- Convenience outlet is powered from the line side of the disconnect or circuit breaker, and therefore will not be affected by the position of the disconnect or circuit breaker.
- Available to order when through-the-base electrical with disconnect switch or circuit breaker option is ordered.

### **Microchannel Coils**

- Optimal heat transfer performance due to flat, streamlined tubes with small ports, and metallurgical tube-to-fin bond.
- Reduce system refrigerant charge by up to 50% leading to better compressor reliability.
- Compact all-aluminum microchannel coils reduce the unit weight.
- Recyclable all aluminum coils All aluminium construction minimizes galvanic corrosion.
- Strong aluminum brazed structure provides better fin protection.
- Flat streamlined tubes more dust resistant and easy to clean.
- Coils leak tested at the factory to ensure the pressure integrity.



### **Compressors - eFlex**

- All units have variable speed compressor matched with variable frequency drive that modulates the speed of the compressor motor and provides several compressor protection functions.
- Permanent magnet motor with voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- Crankcase heaters sized to minimize the amount liquid refrigerant present in the oil sump during offcycles are standard on all compressors
- Single variable speed compressors in 12.5 and 15 ton units. Manifoldd variable and fixed speed compressors in 17.5 to 25 ton units
- Variable speed modulation to 15 Hz equating to 25 percent or less of full capacity
- Control of the eFlex system is integrated with the Symbio 700 unit controller to ensure optimal equipment reliability and performance.

### **Frostat**

- Utilized as a safety device.
- Opens to prevent freezing temperatures on evaporator coil.
- Temperature will need to rise to 50°F before closing.
- Utilized in low airflow or high outside air applications (cooling only).

### **Gas Heating Section**

- The heating section shall have a progressive tubular heat exchanger with corrosion-resistant aluminized steel tubes and burners as standard on all models.
- Stainless steel heat exchanger with 409 stainless steel tubes and 439 stainless steel burners shall be optional.
- Induced draft combustion blower shall be used to pull the combustion products through the firing tubes.
- Heater shall use a direct spark ignition (DSI) system.
- On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition.
- After three unsuccessful ignition attempts, entire heating system shall be locked out until manually reset at the thermostat/zone sensor.
- Units shall be suitable for use with natural gas or propane (field-installed kit).

### **Heat Exchanger**

- Compact cabinet features a tubular heat exchanger in low, medium and high heat capacities.
- Corrosion-resistant aluminized steel tubes and burners are standard on all models.
- Induced draft blower to pull the gas mixture through the burner tubes.
- Direct spark ignition and a flame sensor as a safety device to validate the flame.

### **Indoor Fan - eFlex**

- Direct drive plenum fan design.
- Plenum fan design - backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor.
- Supply fan speed adjustments can be made using the Symbio 700 or Mobile App.
- Motors are thermally protected.
- Variable speed direct drive motors are high efficiency.

### **Roof Curb**

- Designed to mate with the unit's downflow supply and return.
- Provide support and a water tight installation when installed properly.
- Shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb.
- Curb shall be shipped knocked down for field assembly.
- Shall include wood nailer strips.

### **Through-the-Base Electrical with Disconnect Switch**

- 3-pole, molded case, disconnect switch with provisions for through-the-base electrical connections.
- Disconnect switch installed within unit in a water tight enclosure.
- Wiring provided from the switch to the unit high voltage terminal block.
- Switch cULus agency recognized.



**Note:** *Disconnect switch sized per NEC and cULus guidelines but will not be used in place of unit overcurrent protection.*

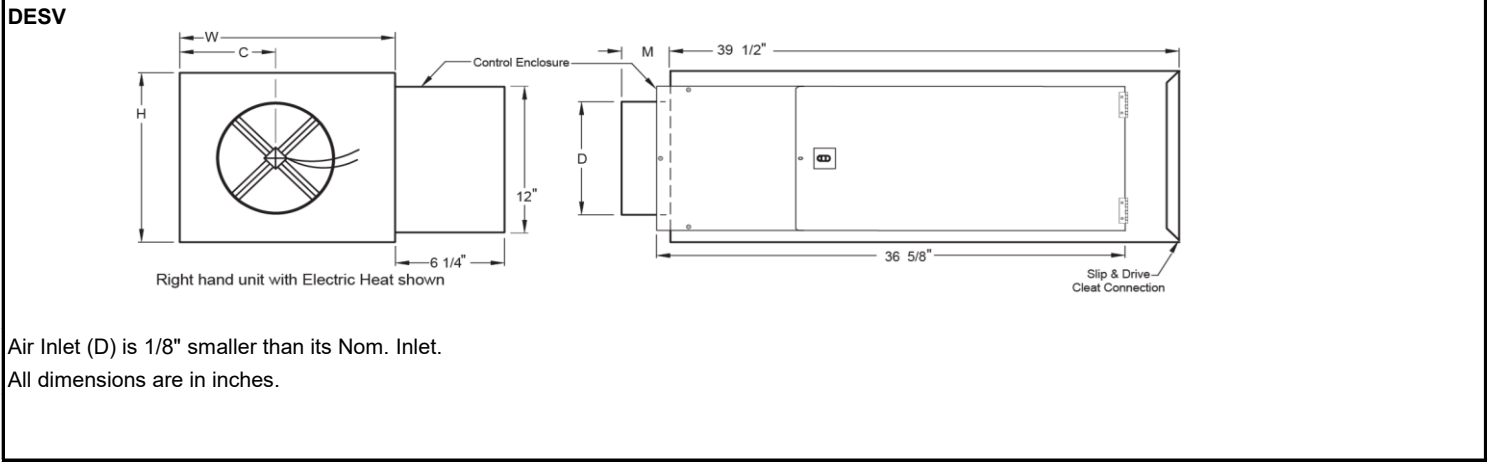
**Low Leak Economizer**

- This accessory meets the low leak requirements for ASHRAE 90.1, IECC, and CA Title 24 standards (4 cfm/ ft<sup>2</sup>@ 1" wg exterior air/return air). This option allows for 100% outdoor air supply from 0% to 100% modulating dampers and comes standard with barometric relief. It can be paired with powered exhaust for additional building pressure relief. This option can be paired with or without fault detection and diagnostics (FDD) to meet the current mandatory CA Title 24 requirements. The economizers come with four control options: dry bulb, reference enthalpy, comparative enthalpy, or differential dry bulb.

# DESV

## Single Duct Terminal Unit, Direct Digital Control, Pressure Independent

**Main Product** **DESV-1**



Unit-Size	CFM Range	Nom. Inlet	F	C	W	H	Air Inlet Collar (M)
16	0 - 4000	16" Dia.	-	13 1/2"	24"	18"	3 3/8"

**General Description** **DESV-1**

- Standard construction uses G40 22-gauge galvanized steel housing, and optional construction uses G40 20-gauge galvanized steel housing.
- Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal CFM at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor.
- Digital control packages can be factory mounted by Titus.
- Unit in accordance with UL-1996
- Model DESV can be installed horizontally, vertically, or at any angle. Operation is not affected by position.
- Gauge tees for CFM measurement.

**Option Schedule** **DESV-1**

ID	Quantity	Tag	UNIT SIZE	MAX PRIMARY CFM	MIN PRIMARY CFM
2	1	VAV - ARC SCR	16	0	0
6	1	VAV- ARM SCR	16	0	0

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 Architect  
 Engineer  
 Contractor  
 Designation



Date 12/11/2025  
 Office Triangle Sales  
 Preparer Joe Marin  
 Version 2014.0.594

**Option Schedule (continued) DESV-1**

**SENSOR CODE 3 - AEROCROSS**  
**UNIT CONFIG 3 -ELECT. HEAT UNIT**  
**LINER OPTION J - 1/2" EcoShield (Matte)**  
**CASING CONFIG 0R -STD 22GA RH**  
**DIGITAL CONTROLLER FMA -GENERIC FMA FOR BIDDING ONL**  
 DO NOT RELEASE  
**ACTUATOR TYPE 0000 -NONE**  
**CONTROL ACC1 00 -NONE**  
**CONTROL ACC2 00 -NONE**  
**CONTROL ACC3 00 -NONE**  
**UNIT ACC1 Z -24V W/ELECTRIC HEAT X-FORMER**  
**UNIT ACC2 0 -NONE**

**UNIT ACC3 0 -NONE**  
**UNIT ACC4 0 -NONE**  
**UNIT ACC5 0 -NONE**  
**WATER COIL 000 -NONE**  
**ELECTRIC HEAT TYPE L43-277V, 1 PH, 0-10V / 0-20MA**  
**KW 3**  
**ELEC COIL ACC1 0 -NONE**  
**ELEC COIL ACC2 0 -NONE**  
**ELEC COIL ACC3 0 -NONE**  
**ELEC COIL ACC4 0 -NONE**

ID	Quantity	Tag	UNIT SIZE	MAX PRIMARY CFM	MIN PRIMARY CFM
4	1	VAV- ARM SCR	16	0	0

**SENSOR CODE 3 - AEROCROSS**  
**UNIT CONFIG 3 -ELECT. HEAT UNIT**  
**LINER OPTION J - 1/2" EcoShield (Matte)**  
**CASING CONFIG 0R -STD 22GA RH**  
**DIGITAL CONTROLLER FMA -GENERIC FMA FOR BIDDING ONL**  
 DO NOT RELEASE  
**ACTUATOR TYPE 0000 -NONE**  
**CONTROL ACC1 00 -NONE**  
**CONTROL ACC2 00 -NONE**  
**CONTROL ACC3 00 -NONE**  
**UNIT ACC1 Z -24V W/ELECTRIC HEAT X-FORMER**  
**UNIT ACC2 0 -NONE**

**UNIT ACC3 0 -NONE**  
**UNIT ACC4 0 -NONE**  
**UNIT ACC5 0 -NONE**  
**WATER COIL 000 -NONE**  
**ELECTRIC HEAT TYPE L63-208V, 3 PH, 0-10V / 0-20MA**  
**KW 3**  
**ELEC COIL ACC1 0 -NONE**  
**ELEC COIL ACC2 0 -NONE**  
**ELEC COIL ACC3 0 -NONE**  
**ELEC COIL ACC4 0 -NONE**

**Accessories DESV-1**

**Lynergy SCR Electric Heater**

The Lynergy Comfort Control SCR electric heater is an electronic, time proportional electric heater, which utilizes silent, rapid responding solid-state relays. The solid-state relays are controlled by the Lynergy Comfort Controller. The Lynergy Comfort Controller accepts one of several input signal types to provide superior control and flexibility. The order code determines the input signal jumper position the Lynergy heater will be set to when shipped. Jumpers can be changed in the field.

**Project** Ameresco - City of COMO /  
**Architect**  
**Engineer**  
**Contractor**  
**Designation**



**Date** 12/11/2025  
**Office** Triangle Sales  
**Preparer** Joe Marin  
**Version** 2014.0.594

**Accessories (continued)**

**DESV-1**

**Selected Liner: 1/2" EcoShield Insulation**

Insulation Characteristics:

Material: Natural Fiber Duct Liner

Thickness: 1/2 inch

R-Value: 2.0 ft<sup>2</sup> °F h/Btu @ 75°F

Density: 3.0 lbs/ft<sup>3</sup>

Flame Spread: less than 25

Smoke Density: less than 50

Mold Growth: None

Code Compliances:

NFPA 90A & 90B - Appliances

NFPA 255 - Flame / Smoke Spread (25/50)

UL 723 - Flame / Smoke Spread (25/50)

ASTM C 411 - Operating Temperature Limits

ASTM E84 - Flame / Smoke Spread (25/50)

ASTM C 1071 - Maximum Air Velocity

ASTM C 739 - Corrosion Resistance

ASTM G 21 - Fungi Resistance

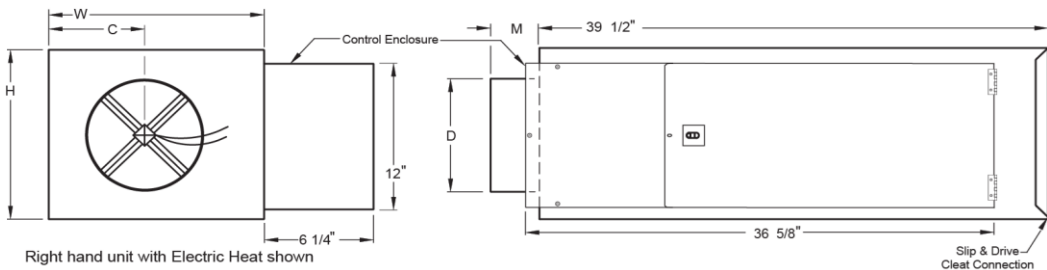
ASTM G 22 - Bacteria Resistance

# DESV

## Single Duct Terminal Unit, Direct Digital Control, Pressure Independent

**Main Product** **DESV-1 (2)**

**DESV**



Right hand unit with Electric Heat shown

Air Inlet (D) is 1/8" smaller than its Nom. Inlet.  
 All dimensions are in inches.

Unit-Size	CFM Range	Nom. Inlet	F	C	W	H	Air Inlet Collar (M)
16	0 - 4000	16" Dia.	-	13 1/2"	24"	18"	3 3/8"

**General Description** **DESV-1 (2)**

- Standard construction uses G40 22-gauge galvanized steel housing, and optional construction uses G40 20-gauge galvanized steel housing.
- Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal CFM at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor.
- Digital control packages can be factory mounted by Titus.
- Unit in accordance with UL-1996
- Model DESV can be installed horizontally, vertically, or at any angle. Operation is not affected by position.
- Gauge tees for CFM measurement.

**Option Schedule** **DESV-1 (2)**

ID	Quantity	Tag	UNIT SIZE	MAX PRIMARY CFM	MIN PRIMARY CFM
1	1	VAV - ARC stage	16	0	0
5	1	VAV- ARM staged	16	0	0

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 Architect  
 Engineer  
 Contractor  
 Designation



Date 12/11/2025  
 Office Triangle Sales  
 Preparer Joe Marin  
 Version 2014.0.594

**Option Schedule (continued) DESV-1 (2)**

<p><b>SENSOR CODE</b> 3 - AEROCROSS  <b>UNIT CONFIG</b> 3 -ELECT. HEAT UNIT  <b>LINER OPTION</b> J - 1/2" EcoShield (Matte)  <b>CASING CONFIG</b> 0R -STD 22GA RH  <b>DIGITAL CONTROLLER</b> FMA -GENERIC FMA FOR BIDDING ONL          DO NOT RELEASE  <b>ACTUATOR TYPE</b> 0000 -NONE  <b>CONTROL ACC1</b> 00 -NONE  <b>CONTROL ACC2</b> 00 -NONE  <b>CONTROL ACC3</b> 00 -NONE  <b>UNIT ACC1</b> Z -24V W/ELECTRIC HEAT X-FORMER  <b>UNIT ACC2</b> 0 -NONE</p>	<p><b>UNIT ACC3</b> 0 -NONE  <b>UNIT ACC4</b> 0 -NONE  <b>UNIT ACC5</b> 0 -NONE  <b>WATER COIL</b> 000 -NONE  <b>ELECTRIC HEAT TYPE</b> E43-277V, 1 PH 3 STEP  <b>KW</b> 3  <b>ELEC COIL ACC1</b> 0 -NONE  <b>ELEC COIL ACC2</b> 0 -NONE  <b>ELEC COIL ACC3</b> 0 -NONE  <b>ELEC COIL ACC4</b> 0 -NONE</p>
--	--

ID	Quantity	Tag	UNIT SIZE	MAX PRIMARY CFM	MIN PRIMARY CFM
3	1	VAV- ARM staged	16	0	0

<p><b>SENSOR CODE</b> 3 - AEROCROSS  <b>UNIT CONFIG</b> 3 -ELECT. HEAT UNIT  <b>LINER OPTION</b> J - 1/2" EcoShield (Matte)  <b>CASING CONFIG</b> 0R -STD 22GA RH  <b>DIGITAL CONTROLLER</b> FMA -GENERIC FMA FOR BIDDING ONL          DO NOT RELEASE  <b>ACTUATOR TYPE</b> 0000 -NONE  <b>CONTROL ACC1</b> 00 -NONE  <b>CONTROL ACC2</b> 00 -NONE  <b>CONTROL ACC3</b> 00 -NONE  <b>UNIT ACC1</b> Z -24V W/ELECTRIC HEAT X-FORMER  <b>UNIT ACC2</b> 0 -NONE</p>	<p><b>UNIT ACC3</b> 0 -NONE  <b>UNIT ACC4</b> 0 -NONE  <b>UNIT ACC5</b> 0 -NONE  <b>WATER COIL</b> 000 -NONE  <b>ELECTRIC HEAT TYPE</b> E63-208V, 3 PH 3 STEP  <b>KW</b> 3  <b>ELEC COIL ACC1</b> 0 -NONE  <b>ELEC COIL ACC2</b> 0 -NONE  <b>ELEC COIL ACC3</b> 0 -NONE  <b>ELEC COIL ACC4</b> 0 -NONE</p>
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**Project** Ameresco - City of COMO /  
**Architect**  
**Engineer**  
**Contractor**  
**Designation**



**Date** 12/11/2025  
**Office** Triangle Sales  
**Preparer** Joe Marin  
**Version** 2014.0.594

**Accessories**

**DESV-1 (2)**

**Selected Liner: 1/2" EcoShield Insulation**

Insulation Characteristics:

Material: Natural Fiber Duct Liner

Thickness: 1/2 inch

R-Value: 2.0 ft<sup>2</sup> °F h/Btu @ 75°F

Density: 3.0 lbs/ft<sup>3</sup>

Flame Spread: less than 25

Smoke Density: less than 50

Mold Growth: None

Code Compliances:

NFPA 90A & 90B - Appliances

NFPA 255 - Flame / Smoke Spread (25/50)

UL 723 - Flame / Smoke Spread (25/50)

ASTM C 411 - Operating Temperature Limits

ASTM E84 - Flame / Smoke Spread (25/50)

ASTM C 1071 - Maximum Air Velocity

ASTM C 739 - Corrosion Resistance

ASTM G 21 - Fungi Resistance

ASTM G 22 - Bacteria Resistance

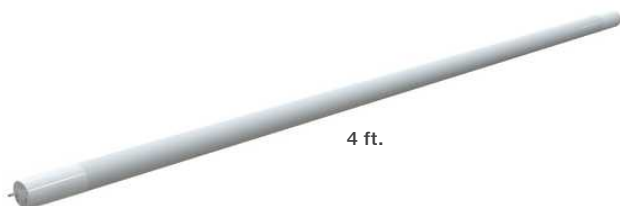
Investment Grade Audit

# Appendix C: Lighting

PROJECT NAME: \_\_\_\_\_ CAT. #: \_\_\_\_\_  
 NOTES: \_\_\_\_\_ FIXTURE SCHEDULE: \_\_\_\_\_

## 4 FT. BYPASS T8 TUBES

Single/Double Ended Power  
UL TYPE-B Series



### PRODUCT DESCRIPTION:

Offering the versatility of single or double ended wiring options in one product SKU, this LED UL Type-B T8 lamp is an easy retrofit into most common linear fluorescent fixtures with shunted or non-shunted lamp holders (see re-lamping examples provided). In addition to flexible installation features that save installers time and money, the Single Ended/Double-Ended LED T8 lamp consumes up to 50% less energy than standard fluorescent tubes, providing facilities with long-term operational savings

### FEATURES:

- 9.5W, 1600-1650 lumens
- Highly Efficient: 168 to 173 lumens per watt
- Easy retrofit into most common linear fluorescent fixtures
- Simple ballast bypass (Type B)
- Single and double ended wiring installation
- Dimming Capable with separate LED module
- Suitable for enclosed fixture
- Suitable for dry and damp locations
- 5 year limited warranty
- Rated Lifetime @ L70: 50,000 Hours

### Ordering Information

FAMILY	WATTAGE	LAMP TYPE	OPERATION	LENGTH	COLOR TEMPERATURE	CONSTRUCTION
L = Linear Tube	9.5 = 9.5W	T8 = T8 Tube	SDE = Single-Ended/ Double-Ended	4 = 4ft	30 = 3000K* 35 = 3500K 40 = 4000K 50 = 5000K	-CG = Inner Coated Glass

\*NOTE: 3000K item is special order only.

### Stocked Items

ORDER CODE	MODEL NUMBER	DLC PRODUCT ID	DLC CLASSIFICATION	DLC PRIMARY USE
111270	L9.5T8SDE435-CG	S-3690PX	Standard	Internal Driver/Line Voltage (UL Type B) Lamps
111271	L9.5T8SDE440-CG	S-WH3YDX		
111272	L9.5T8SDE450-CG	S-4H7JDB		

### Accessories (sold separately)

ORDER CODE	MODEL NUMBER	DESCRIPTION	IMAGE
110343	T8B-BBU-S	Battery Back Up for Type B Linear	



**5-year standard warranty** (further details available at [www.maxlite.com/warranties](http://www.maxlite.com/warranties))

Phone: 1-800-555-5629

Fax: 973-244-7333

Web: [www.maxlite.com](http://www.maxlite.com)

E-mail: [info@maxlite.com](mailto:info@maxlite.com)

PLM# 801

Rev: 07/23/24

© 2024 Specifications subject to change without notice.

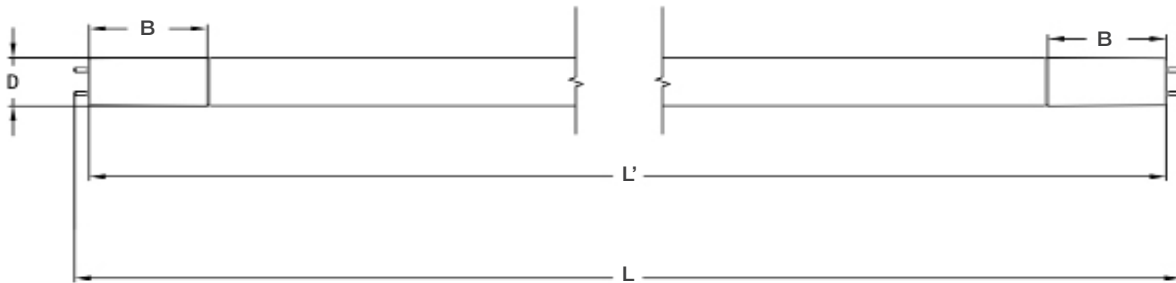
## 4 FT. BYPASS T8 TUBES Single/Double Ended Power UL TYPE-B Series

### Specifications

	L9.5T8SDE4xx-CG
Length	4 ft.
Base	G13
Nominal Wattage (W)	9.5W
Lumens Delivered (lm)	1600-1650 lm
Nominal Efficacy (lm/W)	168-173 lm/W
Equivalency	32W Fluorescent
Color Temperature (K)	3000K, 3500K, 4000K, 5000K
CRI	≥ 80
Calculated L70 Lumen Maintenance	≥ 50,000 hours
Dimming Technology	0-10V Dimming with External Dimming Module
Dimming Range	10-100%
Input Voltage	120-277V AC, 50/60 Hz
Power Factor	≥ 0.9
Diffuser	Inner Coated Glass
Beam Angle	210°
Surge Protection	2.5 KV
Operating Temperature	-4°F to 113°F (-20°C to 45°C)
Certifications	DLC 5.1, cULus listed, FCC, Rohs Complaint, NSF/ANSI 2 - Food Equipment
Qualifications	DLC Standard
Environment	Damp and Dry Locations
Warranty	5 Years warranty. Check <a href="http://maxlite.com/warranties">maxlite.com/warranties</a> for details

### Product Dimensions

PRODUCT	L	L'	B	D
L9.5T8SDE4xx-CG	47.7 in	47.2 in	1.97 in	1.01 in

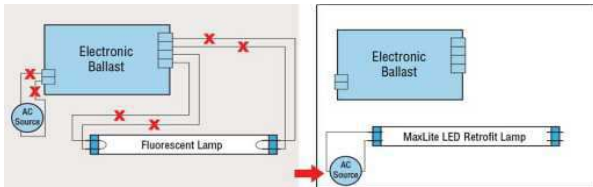


# 4 FT. BYPASS T8 TUBES

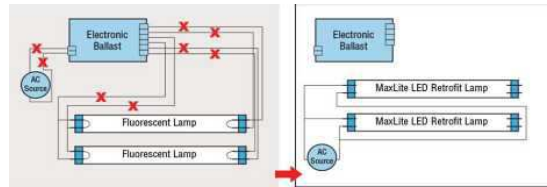
Single/Double Ended Power  
UL TYPE-B Series

## Single-Ended Wiring Diagram:

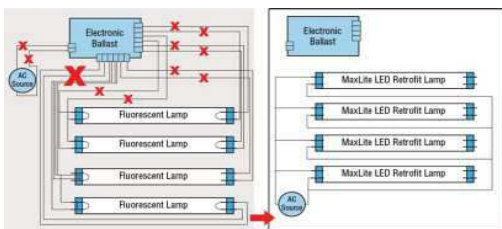
Retrofit with 1 lamp



Retrofit with 2 lamp

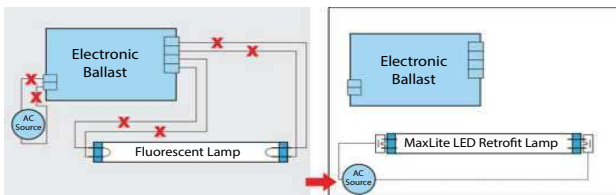


Retrofit with 3/4 lamp

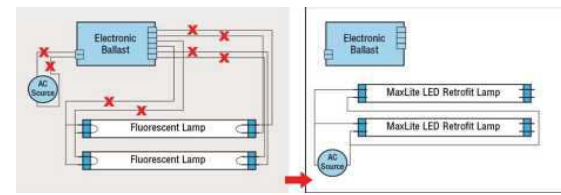


## Double-Ended Wiring Diagram:

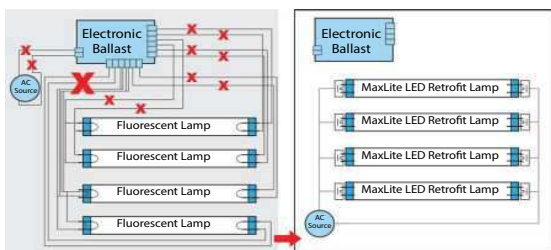
Retrofit with 1 lamp



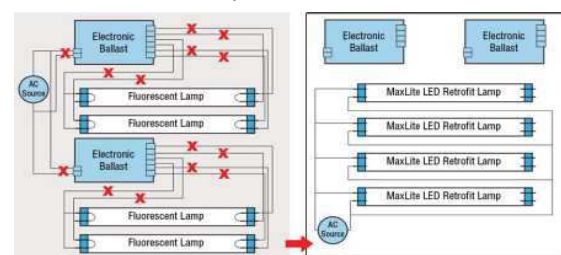
Retrofit with 2 lamp



Retrofit with 3 lamp



Retrofit with 3/4 lamp and 2 ballast



## FCC Statement

This device complies with part 15 of the FCC Rules, Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE																					
Room Information			Existing Conditions							Proposed Solution							Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings
1	Fitness Room	Fitness Room	TROFFER, SUSPENDED MOUNT (MULTI POINT), 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	10	0	56	0.6	2600	1456	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	10	0	32	0.32	2600	832	0.2	624	-19	\$ 16.640
2	Fitness Room	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A
3	Hallway (Elec Panel)	Hallway	STANDARD STRIP, SURFACE MOUNT, 1X8, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	56	0.1	2860	160	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	32	0.032	2860	92	0.0	69	-2	\$ 1.830
4	Storage	Storage - Room	STANDARD STRIP, SUSPENDED MOUNT (MULTI POINT), 1X8, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	56	0.1	260	29	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	32	0.064	260	17	0.0	12	0	\$ 0.333
5	Kiln/ Electrical	Electrical/Mechanical	STANDARD STRIP, SUSPENDED MOUNT (MULTI POINT), 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	4	0	28	0.1	208	23	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	4	0	16	0.064	208	13	0.0	N/A	N/A	\$ 0.266
6	Game Room/ Multipurpose	Multipurpose	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2600	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2600	140	0.0	105	-3	\$ 0.832
7	Game Room/ Multipurpose	Multipurpose	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	4	0	28	0.1	2600	291	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	4	0	16	0.064	2600	166	0.0	125	-4	\$ 3.328
8	Game Room/ Multipurpose	Multipurpose	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	3	3	56	0.2	2600	1472	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	3	3	32	0.096	2600	841	0.1	631	-19	\$ 4.992
9	Game Room/ Multipurpose	Multipurpose	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	19	0	56	1.1	2600	2766	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	19	0	32	0.608	2600	1581	0.5	1186	-36	\$ 31.616
10	Game Room/ Multipurpose	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	2	0	8	0.0	8760	140	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	140	N/A	0	0	N/A
11	Game Room/ Multipurpose	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, EXTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A
12	Gymnastics/ Boxing Room	Fitness Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	10	0	56	0.6	2600	1456	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	10	0	32	0.32	2600	832	0.2	624	-19	\$ 16.640
13	Gymnastics/ Boxing Room	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A
14	Classroom	Classroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	12	0	56	0.7	2080	1398	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	12	0	32	0.384	2080	799	0.3	599	-18	\$ 15.974
15	Classroom	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A
16	Storage (No Access)	Storage - Room	STANDARD STRIP, SUSPENDED MOUNT (MULTI POINT), 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	3	0	28	0.1	260	22	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	3	0	16	0.048	260	12	0.0	9	0	\$ 0.250
17	Storage	Storage - Room	VAPOR TIGHT, SURFACE MOUNT, 1X4, CLEAR LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	260	15	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	260	8	0.0	N/A	N/A	\$ 0.166
18	Storage	Storage - Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	10	0	56	0.6	260	146	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	10	0	32	0.32	260	83	0.2	N/A	N/A	\$ 1.664
19	Storage	Storage - Room	TROFFER, SUSPENDED MOUNT (MULTI POINT), 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	4	0	56	0.2	260	58	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, LENS ALLOWANCE, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902 Other: (1) TBD	4	0	32	0.128	260	33	0.1	25	-1	\$ 0.666
20	Storage	Storage - Room	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), 1X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	1	0	56	0.1	260	15	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, MOLDED LENS ALLOWANCE 1' X 4', 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902 Other: (1) TBD	1	0	32	0.032	260	8	0.0	6	0	\$ 0.166
21	Storage (Partial Access)	Storage - Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	4	0	28	0.1	260	29	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	4	0	16	0.064	260	17	0.0	12	0	\$ 0.333

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE																						
Room Information			Existing Conditions							Proposed Solution								Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings	
22	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC/DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2860	140	0.0	N/A	N/A	\$ 0.915	
23	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	2860	160	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	2860	92	0.0	N/A	N/A	\$ 1.830	
24	Hallway	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
25	Women's Locker Room	Locker Room	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), 1X4, PRISMATIC LENS, 1 - LFIX/35 LED FIXTURE, 35W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120/277V, EMERGENCY BACK-UP	2	2	35	0.1	2600	613	SKIP, EXISTING LED FIXTURE	N/A	0	2	35	0	N/A	613	N/A	0	0	N/A	
26	Women's Locker Room	Locker Room	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), PRISMATIC LENS, 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	8	0	28	0.2	2600	582	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, MOLDED LENS ALLOWANCE 1' X 4', 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	8	0	16	0.128	2600	333	0.1	N/A	N/A	\$ 6.656	
27	Women's Locker Room	Locker Room	DOWNLIGHT, RECESSED MOUNT, 6", FROSTED LENS, 1 - PLV18 FLUORESCENT LAMP(S), 18W, G23 PIN BASE, BALLAST FACTOR = 1.05, RATED LIFE = 12000HR, 120/277V, WET LISTED	4	0	18.9	0.1	2600	197	RETRO, 6" DOWNLIGHT RETROFIT, SELECTABLE OUTPUT & CCT (9W/40K), COMBINATION DIMMING (0-10V), WHITE FINISH, WHITE TRIM, WET LISTED, 1200 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Retrofit: (1) (0) KT-RDLED24PS-6A-9CSF-CDIM	4	0	9.5	0.038	2600	99	0.0	N/A	N/A	\$ 3.467	
28	Women's Locker Room	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
29	Custodial (Elec Panel)	Housekeeping	STANDARD STRIP, SUSPENDED MOUNT (MULTI POINT), 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	28	0.0	520	15	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	16	0.016	520	8	0.0	6	0	\$ 0.166	
30	Men's Locker Room	Locker Room	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), 1X4, PRISMATIC LENS, 1 - LFIX/35 LED FIXTURE, 35W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120/277V, EMERGENCY BACK-UP	2	2	35	0.1	2600	613	SKIP, EXISTING LED FIXTURE	N/A	0	2	35	0	N/A	613	N/A	0	0	N/A	
31	Men's Locker Room	Locker Room	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), PRISMATIC LENS, 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	4	0	28	0.1	2600	291	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, MOLDED LENS ALLOWANCE 1' X 4', 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	4	0	16	0.064	2600	166	0.0	N/A	N/A	\$ 3.328	
32	Men's Locker Room	Locker Room	DOWNLIGHT, RECESSED MOUNT, 6", FROSTED LENS, 1 - PLV18 FLUORESCENT LAMP(S), 18W, G23 PIN BASE, BALLAST FACTOR = 1.05, RATED LIFE = 12000HR, 120/277V, WET LISTED	2	0	18.9	0.0	2600	98	RETRO, 6" DOWNLIGHT RETROFIT, SELECTABLE OUTPUT & CCT (9W/40K), COMBINATION DIMMING (0-10V), WHITE FINISH, WHITE TRIM, WET LISTED, 1200 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Retrofit: (1) (0) KT-RDLED24PS-6A-9CSF-CDIM	2	0	9.5	0.019	2600	49	0.0	N/A	N/A	\$ 1.733	
33	Men's Locker Room	Locker Room	DOWNLIGHT, RECESSED MOUNT, 6", 1 - LFIX/15 LED FIXTURE, 15W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V	4	0	15	0.1	2600	156	RETRO, 6" DOWNLIGHT RETROFIT, SELECTABLE OUTPUT & CCT (9W/40K), COMBINATION DIMMING (0-10V), WHITE FINISH, WHITE TRIM, 1200 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Retrofit: (1) (0) KT-RDLED24PS-6A-9CSF-CDIM	4	0	9.5	0.038	2600	99	0.0	N/A	N/A	\$ 5.943	
34	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC/DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2860	140	0.0	N/A	N/A	\$ 0.915	
35	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	2860	160	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	2860	92	0.0	N/A	N/A	\$ 1.830	
36	Hallway	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A	
37	Data Closet	Electrical/Mechanical	STANDARD STRIP, SURFACE MOUNT, 1X8, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	56	0.1	208	12	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	32	0.032	208	7	0.0	N/A	N/A	\$ 0.133	

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE																						
Room Information			Existing Conditions							Proposed Solution								Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings	
38	Fire Riser	Electrical/Mechanical	STANDARD STRIP, SUSPENDED MOUNT (MULTI POINT), 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	3	0	28	0.1	208	17	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	3	0	16	0.048	208	10	0.0	N/A	N/A	\$ 0.200	
39	Stairwell	Stairwell	WRAP AROUND, SURFACE MOUNT, 1X4, PRISMATIC LENS, 1 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	14	0.0	8760	123	RETRO, 1 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (1) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	8	0.008	8760	70	0.0	53	-2	\$ 1.402	
40	Stairwell	Stairwell	WRAP AROUND, SURFACE MOUNT, 1X4, PRISMATIC LENS, 1 - F32T8 FLUORESCENT LAMP(S), 32W, G13 PIN BASE, BALLAST FACTOR = 0.88, RATED LIFE = 24000HR, 120/277V, EMERGENCY BACK-UP	1	1	28.16	0.0	8760	247	RETRO, 1 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (1) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	8	0.008	8760	70	0.0	N/A	N/A	\$ 0.973	
41	Stairwell	Stairwell	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	42	0.0	8760	368	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	24	0.024	8760	210	0.0	158	-5	\$ 4.205	
42	Stairwell	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
43	Stairwell	Stairwell	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	8760	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	16	0.016	8760	140	0.0	105	-3	\$ 2.803	
44	Private Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	56	0.1	2080	491	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	32	0.032	2080	280	0.0	210	-6	\$ 1.331	
45	Private Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	56	0.1	2080	233	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	32	0.064	2080	133	0.0	100	-3	\$ 2.662	
46	Custodial (Elec Panel)	Housekeeping	WRAP AROUND, SUSPENDED MOUNT (MULTI POINT), PRISMATIC LENS, 1X4, 1 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	1	0	14	0.0	520	7	RETRO, 1 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, MOLDED LENS ALLOWANCE 1' X 4', 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (1) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	8	0.008	520	4	0.0	3	0	\$ 0.083	
47	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	1	16	0.016	2860	140	0.0	105	-3	\$ 0.915	
48	Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC /DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2860	140	0.0	N/A	N/A	\$ 0.915	
49	Hallway	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
50	Men's Restroom	Restroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 1 - LFIX/55 LED FIXTURE, 55W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120/277V, EMERGENCY BACK-UP	1	1	55	0.1	2600	482	SKIP, EXISTING LED FIXTURE	N/A	0	1	35	0	N/A	482	N/A	0	0	N/A	
51	Men's Restroom	Restroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	28	0.0	2600	73	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	16	0.016	2600	42	0.0	31	-1	\$ 0.832	
52	Men's Restroom	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A	
53	Women's Restroom	Restroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	2600	146	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	2600	83	0.0	N/A	N/A	\$ 1.664	
54	Women's Restroom	Life Safety - 5	EMERGENCY, 2 HEAD, UNIVERSAL MOUNT, LED	1	0	4	0.0	5	0	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	0	N/A	0	0	N/A	
55	Women's Restroom	Restroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 1 - LFIX/55 LED FIXTURE, 55W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120/277V	1	0	55	0.1	2600	143	SKIP, EXISTING LED FIXTURE	N/A	0	0	35	0	N/A	143	N/A	0	0	N/A	

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE																						
Room Information			Existing Conditions							Proposed Solution								Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings	
56	Hallway/ Entry	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	2	2	42	0.1	2860	736	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	2	2	24	0.048	2860	420	0.0	N/A	N/A	\$ 2.746	
57	Hallway/ Entry	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	3	0	42	0.1	2860	360	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	3	0	24	0.072	2860	206	0.1	N/A	N/A	\$ 4.118	
58	Hallway/ Entry	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, EXTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
59	Reception Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	42	0.0	2080	368	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	1	1	24	0.024	2080	210	0.0	N/A	N/A	\$ 0.998	
60	Reception Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	42	0.1	2080	175	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	24	0.048	2080	100	0.0	N/A	N/A	\$ 1.997	
61	Reception Office	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A	
62	Computer Lab	Classroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	56	0.1	2080	491	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	1	1	32	0.032	2080	280	0.0	N/A	N/A	\$ 1.331	
63	Computer Lab	Classroom	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	3	0	56	0.2	2080	349	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	3	0	32	0.096	2080	200	0.1	N/A	N/A	\$ 3.994	
64	Game Room	Break Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	56	0.1	2080	491	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	1	1	32	0.032	2080	280	0.0	N/A	N/A	\$ 1.331	
65	Game Room	Break Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	4	0	56	0.2	2080	466	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	4	0	32	0.128	2080	266	0.1	200	-6	\$ 5.325	
66	Small Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2860	140	0.0	N/A	N/A	\$ 0.915	
67	Private Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2080	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-5-500-AC /DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2080	140	0.0	105	-3	\$ 0.666	
68	Private Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	2080	116	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	2080	67	0.0	N/A	N/A	\$ 1.331	
69	Gym	Gymnasium - General	HIGH BAY, SURFACE MOUNT, 1X4, 6 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, WIRE GUARD	20	0	84	1.7	2600	4368	FIXTURE, LINEAR HIGHBAY, SELECTABLE OUTPUT & CCT (155W/40K), CHAIN MOUNT, WHITE FINISH, 2.5KV SURGE, LLLC WITH PIR SENSOR PHOTOCONTROL NODE, EXISTING	Fixture: (1) (0) KT-HBLEDD113-1.5F-840-VDIM-P /G2 Other: (1) KTSL-FC3-12V-PKO-PIR Mounting: (1) KT-HBLEDD-WG-5-KIT /G2	20	0	115	2.3	2600	5980	-0.6	N/A	N/A	\$ 49.920	
70	Gym	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, WIRE GUARD	2	0	8	0.0	8760	140	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	140	N/A	0	0	N/A	
71	Gym	Life Safety	EXIT SIGN, SURFACE MOUNT, WHITE/RED, 2 - LFIX/2 LED FIXTURE, 2W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, NON FUNCTIONAL, WIRE GUARD	1	0	4	0.0	8760	35	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	35	N/A	0	0	N/A	
72	Private Office	Office - Private < 250 Sq. Ft	TROFFER - FLAT PANEL, RECESSED MOUNT, 2X4, FROSTED LENS, 1 - LFIX/50 LED FIXTURE, 50W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120/277V	1	0	50	0.1	2080	104	SKIP, EXISTING LED FIXTURE	N/A	0	0	35	0	N/A	104	N/A	0	0	N/A	

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE																					
Room Information			Existing Conditions							Proposed Solution							Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings
73	Private Office	Office - Private < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 4 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	56	0.1	2080	233	RETRO, 4 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (4) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	32	0.064	2080	133	0.0	100	-3	\$ 2.662
74	Open Office	Office - Open < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	6	0	42	0.3	2600	655	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	6	0	24	0.144	2600	374	0.1	281	-9	\$ 7.488
75	Small Hallway	Hallway	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	28	0.0	2860	245	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC/DF-IP Disconnect: (2) 873-902	1	1	16	0.016	2860	140	0.0	105	-3	\$ 0.915
76	Storage	Storage - Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	2	0	28	0.1	260	15	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	2	0	16	0.032	260	8	0.0	6	0	\$ 0.166
77	Open Office	Office - Open < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	3	0	42	0.1	2600	328	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	3	0	24	0.072	2600	187	0.1	N/A	N/A	\$ 3.744
78	Open Office	Office - Open < 250 Sq. Ft	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, EMERGENCY BACK-UP	1	1	42	0.0	2600	368	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, EM BACK-UP, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Driver: (1) (0) KT-EMRG-LED-500-AC/DF-IP Disconnect: (2) 873-902	1	1	24	0.024	2600	210	0.0	N/A	N/A	\$ 1.248
79	Storage (Elec Panel)	Storage - Room	STANDARD STRIP, SURFACE MOUNT, 1X4, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	28	0.0	260	7	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	16	0.016	260	4	0.0	N/A	N/A	\$ 0.083
80	Storage	Storage - Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	42	0.0	260	11	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	24	0.024	260	6	0.0	N/A	N/A	\$ 0.125
81	Storage	Storage - Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	28	0.0	260	7	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	16	0.016	260	4	0.0	3	0	\$ 0.083
82	Break Room	Break Room	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V, MISSING OR DAMAGED LENS	1	0	42	0.0	2080	87	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, LENS ALLOWANCE, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902 Other: (1) TBD	1	0	24	0.024	2080	50	0.0	37	-1	\$ 0.998
83	Restroom	Restroom - Private	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 2 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	1	0	28	0.0	780	22	RETRO, 2 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (2) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	1	0	16	0.016	780	12	0.0	9	0	\$ 0.250
84	Conference Room	Conference	TROFFER, RECESSED MOUNT, 2X4, PRISMATIC LENS, 3 - LTB-T84/14 LED LAMP(S), 14W, G13 PIN BASE, BALLAST FACTOR = 1, RATED LIFE = 50000HR, 120/277V	9	0	42	0.4	1560	590	RETRO, 3 LAMP, 8W, 4FT, T8 LED TUBE, DOUBLE ENDED, 1650 LUMENS, 4000K, 120-277V, 10-YEAR WARRANTY	Lamp: (3) (0) KT-LED8T8-48G-840-DX2 Disconnect: (1) 873-902	9	0	24	0.216	1560	337	0.2	N/A	N/A	\$ 6.739
85	Conference Room	Life Safety	EXIT SIGN COMBO, SURFACE MOUNT, WHITE/RED, 2 - LFIX/4 LED FIXTURE, 4W, BALLAST FACTOR = 1, RATED LIFE = 70000HR, 120V, INTERIOR, FUNCTIONAL	1	0	8	0.0	8760	70	SKIP, LIFE SAFETY PRODUCT	N/A	0	0	4	0	N/A	70	N/A	0	0	N/A
86	Front Door Building Mounted	Exterior	WALLPACK, WALL MOUNT, TYPE 3, 1 - HPS70 HIGH PRESSURE SODIUM LAMP(S), 70W, E26 MEDIUM BASE, BALLAST FACTOR = 1.18, RATED LIFE = 24000HR, 120/277V, PHOTOCELL, BRONZE	1	0	82.6	0.1	4380	362	FIXTURE, WALL PACK, FULL CUTOFF, SELECTABLE OUTPUT & CCT (15W/30K), BRONZE FINISH, EXISTING PHOTOCELL, LLLC PHOTOCONTROL NODE, 2050 LUMENS, 3000K, 120-277V, 10-YEAR WARRANTY	Fixture: (1) (0) WPC28U-WCSBPCCR Other: (1) CN-RTPCT	1	0	15	0.015	4380	66	0.0	N/A	N/A	\$ 2.433
87	Side Door Building Mounted	Exterior	WALLPACK, WALL MOUNT, TYPE 3, 1 - HPS70 HIGH PRESSURE SODIUM LAMP(S), 70W, E26 MEDIUM BASE, BALLAST FACTOR = 1.18, RATED LIFE = 24000HR, 120/277V, PHOTOCELL, BRONZE	1	0	82.6	0.1	4380	362	FIXTURE, WALL PACK, FULL CUTOFF, SELECTABLE OUTPUT & CCT (15W/30K), BRONZE FINISH, EXISTING PHOTOCELL, LLLC PHOTOCONTROL NODE, 2050 LUMENS, 3000K, 120-277V, 10-YEAR WARRANTY	Fixture: (1) (0) WPC28U-WCSBPCCR Other: (1) CN-RTPCT	1	0	15	0.015	4380	66	0.0	N/A	N/A	\$ 2.433
88	Building Mounted	Exterior	FLOOD, YOKE MOUNT, WIDE, 1 - MH400 METAL HALIDE LAMP(S), 400W, E39 MOGUL BASE, BALLAST FACTOR = 1.15, RATED LIFE = 15000HR, 120/277V, PHOTOCELL, GREY	1	0	460	0.5	4380	2015	FIXTURE, AREA LIGHT, SELECTABLE OUTPUT & CCT (140W/30K), TYPE 3 DISTR., TRUNNION MOUNT, BRONZE FINISH, 277-480V, 10KV SURGE, CONTROLS READY WITH PHOTOCONTROL NODE, 17950 LUMENS, 3000K, 277-480V, 10-YEAR WARRANTY	Fixture: (1) (0) KT-ALED140PSHV-M2-OSA-NM-8CSB-VDIM / 3PN Mounting: (1) KT-ALED-TM-1-KIT	1	0	140	0.14	4380	613	0.0	N/A	N/A	\$ 5.840

CITY OF COLUMBIA - ARMORY LIGHTING LINE BY LINE

Room Information			Existing Conditions							Proposed Solution							Annual Savings				
Index	Area	Room Type	Existing Fixture	Total Quantity	EM Quantity	Fixture Wattage	Existing kW	Existing Burn Hours	Existing kWh	Proposed Scope of Work	Proposed Part Numbers	Total Quantity	EM Quantity	Fixture Wattage	Proposed kW	Proposed Burnhours	Proposed kWh	kW Savings	kWh Savings	Heating Penalty (Therms)	O&M Savings
89	Back Door Building Mounted	Exterior	WALLPACK, WALL MOUNT, TYPE 3, 1 - HPS70 HIGH PRESSURE SODIUM LAMP(S), 70W, E26 MEDIUM BASE, BALLAST FACTOR = 1.18, RATED LIFE = 24000HR, 120/277V, PHOTOCELL, BRONZE	1	0	82.6	0.1	4380	362	FIXTURE, WALL PACK, FULL CUTOFF, SELECTABLE OUTPUT & CCT (15W/30K), BRONZE FINISH, EXISTING PHOTOCELL, LLLC PHOTOCONTROL NODE, 2050 LUMENS, 3000K, 120-277V, 10-YEAR WARRANTY	Fixture: (1) (0) WPC28U-WCSBPCCR Other: (1) CN-RTPCT	1	0	15	0.015	4380	66	0.0	296	-9	\$ 2.433
90	Building Mounted	Exterior	FLOOD, YOKE MOUNT, WIDE, 1 - MH400 METAL HALIDE LAMP(S), 400W, E39 MOGUL BASE, BALLAST FACTOR = 1.15, RATED LIFE = 15000HR, 120/277V, PHOTOCELL, GREY	1	0	460	0.5	4380	2015	FIXTURE, AREA LIGHT, SELECTABLE OUTPUT & CCT (140W/30K), TYPE 3 DISTR., TRUNNION MOUNT, BRONZE FINISH, 277-480V, 10KV SURGE, CONTROLS READY WITH	Fixture: (1) (0) KT-ALED140PSHV-M2-OSA-NM-8CSB-VDIM / 3PN Mounting: (1) KT-ALED-TM-1-KIT	1	0	140	0.14	4380	613	0.0	1402	-43	\$ 5.840
91	Side Door Building Mounted	Exterior	WALLPACK, WALL MOUNT, TYPE 3, 1 - HPS70 HIGH PRESSURE SODIUM LAMP(S), 70W, E26 MEDIUM BASE, BALLAST FACTOR = 1.18, RATED LIFE = 24000HR, 120/277V, PHOTOCELL, BRONZE	1	0	82.6	0.1	4380	362	FIXTURE, WALL PACK, FULL CUTOFF, SELECTABLE OUTPUT & CCT (15W/30K), BRONZE FINISH, EXISTING PHOTOCELL, LLLC PHOTOCONTROL NODE, 2050 LUMENS, 3000K, 120-277V, 10-	Fixture: (1) (0) WPC28U-WCSBPCCR Other: (1) CN-RTPCT	1	0	15	0.015	4380	66	0.0	296	-9	\$ 2.433

Investment Grade Audit

# Appendix D: Subcontractor Scope of Work & Drawings

# CoMo Scope

## Subcontractor Scope of Services and Checklist

Date: **10/15/25**

Walk thru notes, scope deletions - Addendum 3

Corrected ECM/FIM Numbering - Addendum 2

Owners Comments Incorporated - Addendum 1

Line	Description	Notes
<b>General Conditions - Applies to ALL items listed</b>		
1	<b>General Notes</b>	
2	ALL construction will meet Site class D, default site class per 1613.3.2.	
3	All construction will meet current codes, see website for individual trades =====>	<a href="https://library.municode.com/mo/columbia/codes/code_of_ordinances?nodeId=COORCOMI">https://library.municode.com/mo/columbia/codes/code_of_ordinances?nodeId=COORCOMI</a>
4	Equipment per ICC 2024	
5	<b>HVAC</b>	
6	Building HVAC will be high efficiency VAV or CV Heat Pump RTUs, NG heat	
7	Install VAV boxes with electric reheat as required and shown on drawings	Electric reheat will be 2 stage at a minimum
8	Install new ductwork as required to serve all areas	
9	Follow SMACNA guidelines for duct construction and installation based upon system static pressure	
10	All new rectangular duct to be lined with 1" FG insulation, per SMACNA standards	
11	Seal all ductwork joints and connections	
12	Install new diffusers as required, Titus TMS or equal	
13	Install new return grills, Titus 23 series or equal	
14	Ensure penetrations through fire rated assemblies receive a fire damper	
15	If fire alarm system is upgraded as part this project, dampers will be combo fire/smoke	typed into fire alarm system
15a	If panel doesn't have space and functionality to expand, upgrade panel and provide programming	applies to lines 15-17, 22-24, 346, 363,386
16	Provide start up and commissioning of any new eqpt under direction of Ameresco	
17	provide assistance to 'dial in' equipment for maximum efficiency and scheduling requirements	provide 4 hours of assistance labor per system installed
18		
19	Exposed ductwork in areas without ceilings	
20	ductwork to be exposed spiral, unpainted	
21	Grilles to be Titus 301RL, double deflection, integral damper, size for NC30 or less	
22	Install smoke detectors in units as required by code, interlock with FA system	
23	Install smoke dampers as required per code	
24	Interlock smoke dampers with fire alarm system and AHUs	
25		
26	<b>Piping</b>	
27	NG piping will be Sch 40 CS pipe, size for 2# delivery, reduce at units	
28	150# MI fittings	
29	2 1/2" and larger will be welded	
30	Each piece of equipment will have a dirt leg, lubricated plug valve and a union	
31	Gas pressure to units will be 2#	
32	provide NG pressure regulator, Sprague or equal	
33	extend vent terminating with a U bend with bug screen pointing down, 14" above roof	
34	Unions will be provided each piece of eqpt and at all sides of control valves	
35	NG piping will be supported by MiFab supports or equal	
36	wolmanized blocks are not acceptable	
37		
38	<b>Hydronic Piping</b>	
38a	When dissimilar piping materials are joined together, dielectric separation is required	applies to lines 38-42, 52-58
39	2 1/2" and larger piping will be schedule 40 CS pipe	
40	Welded fittings	Vic joints are not acceptable
41	2" and smaller piping will be L type copper,	
42	sweat or Pressfit joints are acceptable	
43		
44	<b>Condensate Piping</b>	
45	Indoors - Type M copper	
46	sweat of ProPress copper fittings	
47	insulate all condensate with 1/2" Armaflex	
48	Outdoors - Sch40 PVC	Route to within 3' of roof drain or scupper
49	glue joints	
50	Roof supports identical to NG piping supports	
51		
52	Valving at terminal units (FCU, FTU, etc.)	
53	install fixed flow hose kits at each unit, X BRAND or equal	
54	kit to include supply and return ball valves	
55	supply side strainer	
56	SS braided hoses on supply and return	
57	control valve that is compatible with new BAS, floating point	
58	PT ports for manual reading	
59		
60	All pipe penetrations through rated assemblies will be sealed using a UL/FM rated assembly	Per ASTM E814 / UL 1479
61		
62	Provide Test and Balance for all systems performed by a NEBB or AABC certified technician	
63	All NG piping will be painted safety yellow per code	
64		
65	<b>HVAC Controls</b>	
65a	Armory, Schnieder Electric EcoStruxure is City Standard - Lines 66-72- 373-374, 396, 421, 451	Brian Schepers, P.E., VP, GM, Central MO, 2414 Hyde Park Rd, Jeff City, BSchepers@c-group.com
66	Provide new BAS for buildings where indicated	Electrician may be required to provide 120v outlets for control devices
67	GUI interface, provide separate computer if required	
68	Control Points required for each unit shall meet CoMo standards for monitored points	
69	system status, status, discharge temp, RA temp, space temp, timeclock	
70	if unit has BacNet controller, pull in all available points and provide graphics	
71	Install E&S module over DDC system	
72	All controllers and systems will be BacNet compatible	
73		
74	<b>Insulation</b>	
75	Reinsulate any piping or duct that are damaged by the new installations	
76	insulate heating hot water supply and return with 1/2" Armaflex for 1 1/2" dia pipe and smaller	
77	2" and larger, 1/2" FG, SSL, Zeston fittings	
78	Insulate all valves and strainers	
79	Duct insulation, see specific notes for type and thickness	
80	duct wrap, 1 1/2" thick FG, stick pins, wrap vapor tight	

Exhibit A

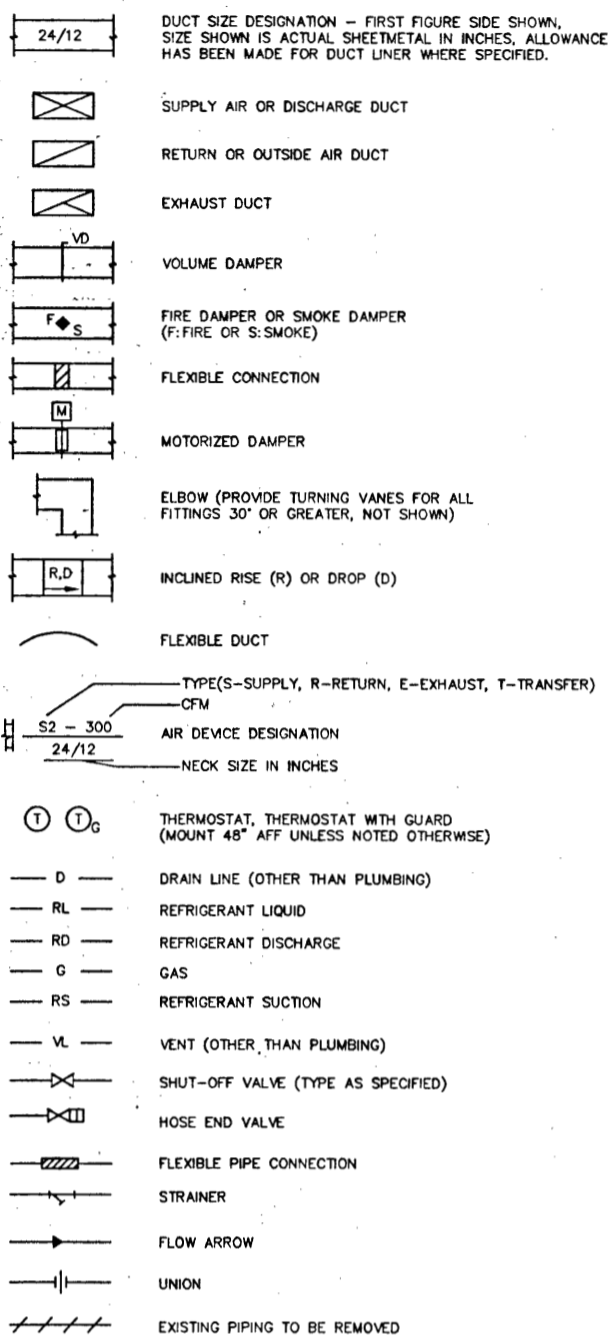
81	rigid board, 1" thick, stick pins, wrap vapor tight	
82	Any exterior piping that has insulation will be covered with exterior grade jacketing.	lines 343, 360, 383
83		
84		
85	<b>Electrical</b>	
86	All installations will conform with current, NECA standards and local codes	
87	All wall or floor penetrations through rated assemblies will be sealed using a UL/FM rated assembly	Per ASTM E814 / UL 1479
88		
89	Power for any work described herein will be properly sized per NECA and current engineering standards	
90	if required, remove and replace any or all conduit and wiring improperly sized for new eqpt	
91		
92		
93	<b>General Construction</b>	
94	Remove and replace ceiling grid and tiles as required to facilitate installation of HVAC systems	
95	grid and tile will match existing	
96	ceiling tiles may be reused if in acceptable condition, if not, replace with similar tile	
97	Provide installation and removal of floor protection for all areas of construction	
98	Ram Board or equal	
99	Provide jobsite clean up for all areas of construction	
100	three days per week, minimum	
101	Provide concrete pads as required for new ground mounted HVAC equipment	
102	design and install per engineering standards and local codes	
103		
103a	<b>Roofing</b>	
103b	Roof repairs, alterations, will be compliant with roofing material manufacturer, maintain roof warranty	Armory - Watkins Roofing Inc, Lines 60, 87, 337-345, 354-360, 401-402
104		
105		
106	<b>Armory</b>	
107	<b>ECM 1 - Replace Gym RTU</b>	
108	All RTUs will be screened from visibility at adjacent grade level	
109	Remove existing RTU	
110	disconnect and make safe all services to units (elect, power, etc)	
111	pump down and legally recover and recycle refrigerant from all units	
112	legally dispose of existing units	
113		
114	Install new RTU	
115	Reconnect all services feeding RTUs (piping, duct, power, etc.)	
116	provide any ductwork modifications required below the roof to connect to new RTU configuration	
117	extend all piping, conduit and controls to match new RTU configuration	
118	install duct mounted smoke detectors and interlock wiring as required by code	tinner to provide unit and tube installation, electrician to install head and wiring
119	Any NG piping exposed to the elements will be painted safety yellow	
120	paint to have high zinc oxide content	
121	Any NG piping that requires supports will use B-Line DB5 supports or equal	
122	wolmanized blocks are not acceptable	
123		
124		
125	<b>ECM 2 - Replace Office RTU and Install VAV Boxes</b>	
126	Remove existing RTU and VVVT boxes	
127	disconnect and make safe all services to units (elect, power, etc)	
128	pump down and legally recover and recycle refrigerant from all units	
129	legally dispose of existing units	
130		
131	Install new RTU	
132	Reconnect all services feeding RTUs (piping, duct, power, etc.)	
133	provide any ductwork modifications required below the roof to connect to new RTU configuration	
134	extend all piping, conduit and controls to match new RTU configuration	
135	install duct mounted smoke detectors and interlock wiring as required by code	tinner to provide unit and tube installation, electrician to install head and wiring
136	Any NG piping exposed to the elements will be painted safety yellow	
137	paint to have high zinc oxide content	
138	Any NG piping that requires supports will use B-Line DB5 supports or equal	
139	wolmanized blocks are not acceptable	
140		
141	Replace existing VVVT boxes with new VAV boxes	
141a	All new VAV/FTU boxes will be installed in a manor to make them servicable by technicians	Lines 369, 393, 409, if you can't service it, relocate surrounding interferences
142	New VAV boxes to have electric heat (see drawings)	
143	provide power to new VAV boxes	
144		
145	Provide new BAS system for all HVAC within facility	
146	BAS shall be Schnieder ECO Structure	
147		
148	<b>ECM 3 - Replace Ground Floor RTUs w/Single RTU and Install VAV Boxes</b>	
149	Remove existing RTUs	
150	disconnect and make safe all services to units (elect, power, etc)	
151	pump down and legally recover and recycle refrigerant from all units	
152	legally dispose of existing units	
153		
154	Install new ground mount RTU, combining two units into one	
155	Reconnect all services feeding RTUs (piping, duct, power, etc.)	
156	provide any ductwork modifications required below the roof to connect to new RTU configuration	
157	extend all piping, conduit and controls to match new RTU configuration	
158	install duct mounted smoke detectors and interlock wiring as required by code	tinner to provide unit and tube installation, electrician to install head and wiring
159	Any NG piping exposed to the elements will be painted safety yellow	
160	paint to have high zinc oxide content	
161	Any NG piping that requires supports will use B-Line DB5 supports or equal	
162	wolmanized blocks are not acceptable	
163	Any unused openings in the foundation will be infilled with CMU and painted to match existing	
164		
165	Install Four new VAV boxes as shown on drawings	
166	New VAV boxes to have electric heat (see drawings)	
167	provide power to new VAV boxes	
168	Install new thermostats - Schnieder ECO System	
169	modify ductwork as required to accommodate new boxes	

**Exhibit A**

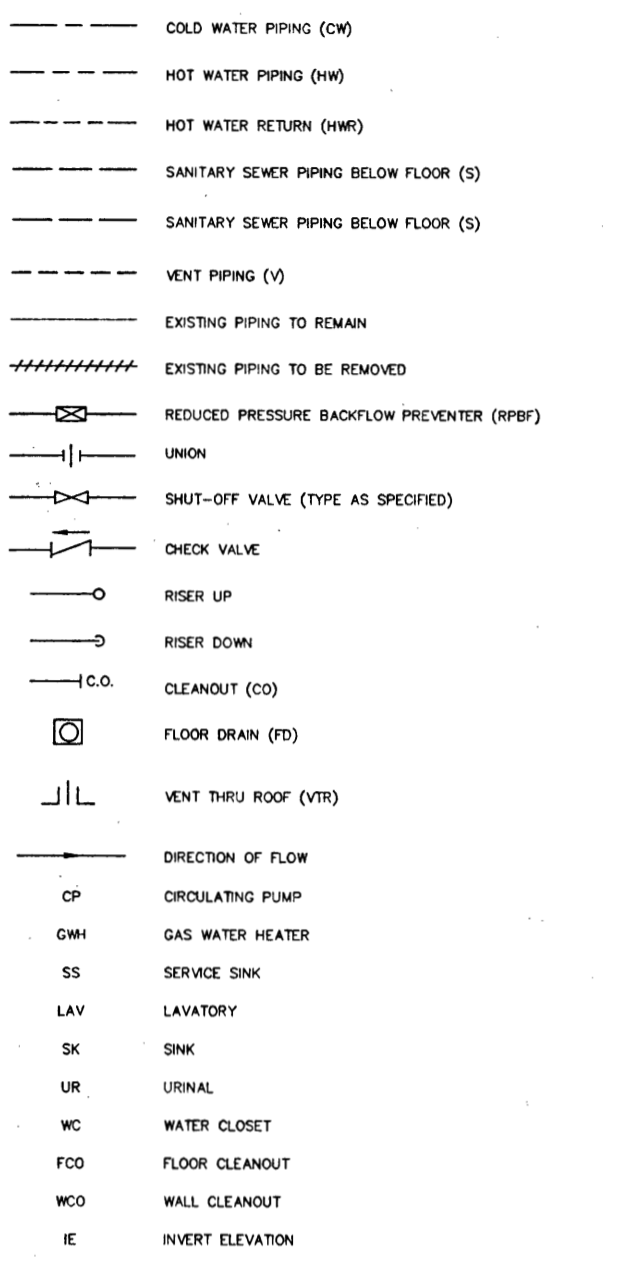
170		
171		
172	<b>ECM 4 - Lighting Retrofits</b>	
173	Retrofit lighting fixtures per schedule	
174	new lamps to be LED, line voltage	Keystone Type B, power select, color select lamps
175	remove existing ballasts	
176	Repalce Gym lighting with high bay LED fixtures	Keystone Linear high bay
177		
178	Legally recycle old lamps and ballasts	
179	Downlight (remove lamps) in areas that are overlit	Maintain IES illumination standards
180	Maintain emergency lighting scheme, replacing existing with LED with integral batteries	
181		
182	Install Occupancy Sensors in the following locations	may require minor drywall patching and painting
183	Offices, restrooms, closets with lighting, utility rooms	
184	sensor locations to be placed where motion common to space use will be detected	read = wall mount may may be fine for restroom but office requires remote, ceiling mounted device
185		

- Notes
- 1 **ECMs and FIMs shall be priced separately as stand alone prices. The City will determine which ECMs are to be accepted.**
  - 2 The words "install", "provide" or "furnish" mean the specified contractor shall provide and install said item.
  - 3 All installations shall conform to current code regardless of what scope may be written or shown
  - 4 Where an "x" is shown under two (or more) disciplines, those disciplines shall coordinate amongst themselves to insure the costs are included to fully complete that item of work.
  - 5 Items described above or shown on accompanying drawings will be considered to be on both
  - 6 If Ameresco inadvertently forgot an item of work shown on the drawings, the trade responsible shall include said item in their pricing. Notify Ameresco prior to bid and an addendum will be published.
  - 7 If an item is inadvertently forgotten by all parties, the responsible trade shall be required to furnish and install said item. There will be no extras issued to cover said costs.
  - 8 In the items above, Ameresco reserves the sole right to determine the responsible party. The responsible party is compelled to provide item as described
  - 9 The use of the abbreviation "etc." means that the contractor shall provide and install items that are usual and customary for a similar installation.
  - 10 In the statement above, Ameresco shall be the sole determiner of the interpretation of the words "usual" and "customary".
  - 11 All work shall conform to the latest and most stringent governing code authority accepting jurisdiction over this project.
  - 12 During roof repairs/patching the Roofing Contractor will insure NO moisture enters the building. Moisture infiltration & subsiquent damage shall be the sole responsibility of Roofing Contractor.
  - 13 Any control modifications such as but not limited to VFDs, mechanical contractor shall provide appropriate taps in piping and ductwork for control contractors pressure/flow sensors.
  - 14 Demolition performed shall include the complete removal of all associated devices including but not limited to; hangers, hanger rod, unistrut, anchoring devices, angle iron, etc.
  - 15 No extra costs will be allowed for field coordination issues (read = If you have to relocate or redesign your work due interference with other trades, it's on you, not Ameresco)
  - 16 Ameresco shall decide which trade takes precedent in Note 13.
  - 17 In the items above, it Ameresco inadvertently used the word 'will', it shall mean 'shall' in a contractual context.

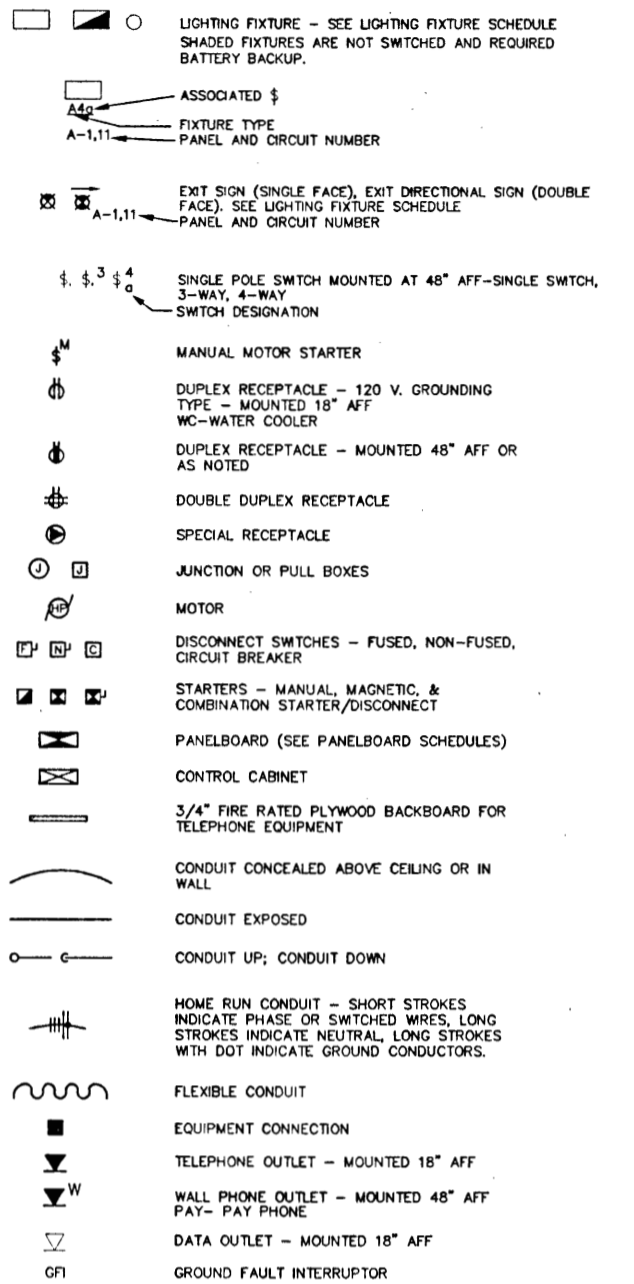
**H.V.A.C. SYMBOLS**



**PLUMBING SYMBOLS**



**ELECTRICAL SYMBOLS**

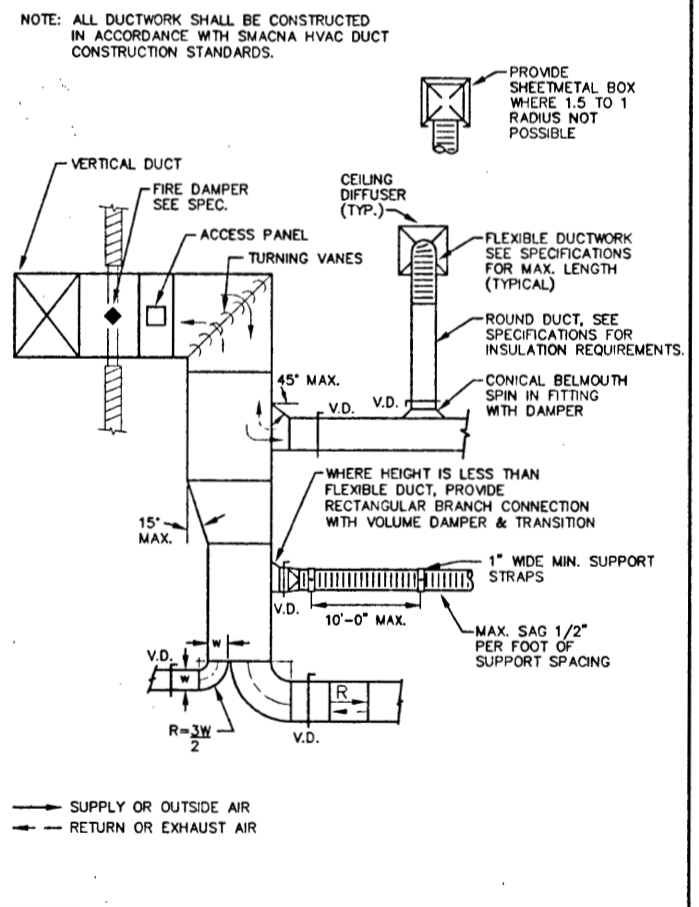
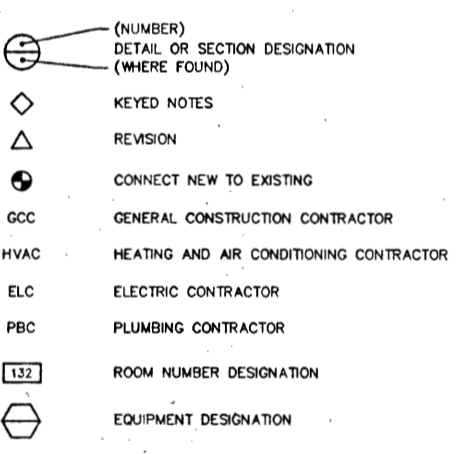


**EQUIPMENT DATA SCHEDULE**

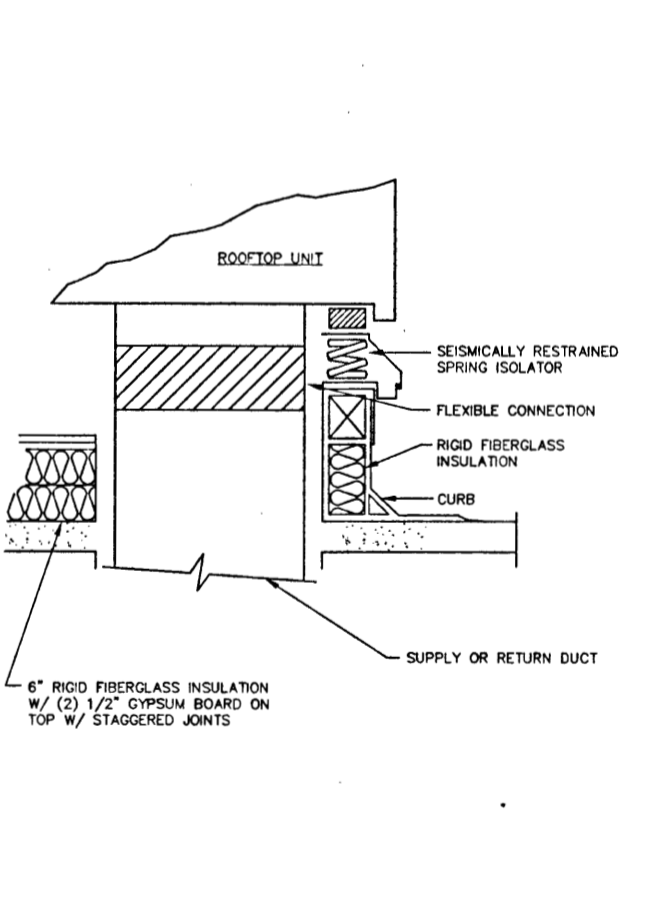
MARK	EQUIPMENT	BY	MOTOR OR EQUIPMENT DATA			STARTER DATA			DISCONNECT DATA			REMARKS
			HP (AMPS)	VOL. PHASE SPEED	EQUIPMENT LOCATION	BY	ACCESSORIES	TYPE	SIZE	BY	TYPE	
RTU-1	ROOFTOP UNIT	HVAC	5 HP	208/3/1	ROOF	HVAC	PWCP		ELC	F	100A	71.1 MCA, 90 MOP
RTU-2	ROOFTOP UNIT	HVAC	15 HP	208/3/1	ROOF	HVAC	PWCP		ELC	F	400A	185 MCA, 225 MOP
RTU-3	AIR HANDLING UNIT	HVAC	3 HP	208/3/1	GRADE	HVAC	PWCP		ELC	F	200A	96 MCA, 150 MOP
RTU-4	AIR HANDLING UNIT	HVAC	10 HP	208/3/1	GRADE	HVAC	PWCP		ELC	F	200A	142 MCA, 175 MOP
EF-1	EXHAUST FAN	HVAC	1/8	20/60/1	ROOF	ELEC		MAN	HVAC			

- ① ACCESSORIES**
  - HOA - HAND-OFF AUTO SWITCH MAINTAINED
  - HLO - HIGH-LOW OFF SELECTOR SWITCH
  - P(+) - PILOT LIGHT, (COLOR)
  - SS - START-STOP PUSHBUTTON MAINTAINED CONTACT SELECTOR SWITCH OR PUSHBUTTON
  - SSM - START-STOP MOMENTARY CONTACT
  - TDR - TIME DELAY RELAY
  - T - THERMOSTAT
  - O/N - ON-OFF SELECTOR SWITCH
- ② STARTER TYPE**
  - MAN - MANUAL SNAPSWITCH TYPE STARTER
  - AFC - ADJUSTABLE FREQUENCY CONTROLLER
  - COMB - COMBINATION STARTER W/ FUSIBLE DISCONNECT SWITCH
  - MAG - MAGNETIC (CONTACTOR)
  - PF - PLUG FUSE SWITCH
  - TSS - TWO SPEED STARTER
  - FVNS - FULL VOLTAGE NONREVERSING STARTER
  - FVRS - FULL VOLTAGE REVERSING STARTER
  - RVNS (+) - REDUCED VOLTAGE NONREVERSING STARTER
  - (PT) - PART WINDING
  - (YD) - WYE-DELTA STARTER
  - (AT) - AUTOTRANSFORMER
  - SSS - SOLID STATE STARTER
  - PWCP - PREWired CONTROL PANEL
- ③ DISCONNECT TYPE**
  - F - FUSIBLE
  - N - NONFUSIBLE
  - CB - CIRCUIT BREAKER
  - WP - WEATHERPROOF
  - S - SNAP-SWITCH
  - R - RECEPTACLE

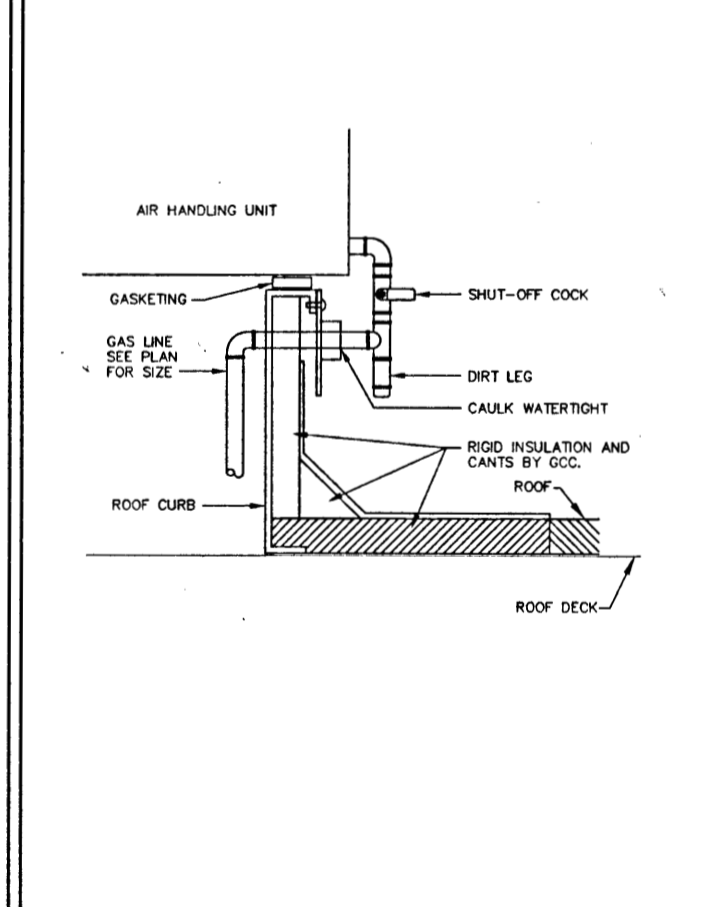
**GENERAL SYMBOLS**



**1 TYPICAL DUCTWORK INSTALLATION DETAIL**  
EHP-1 SCALE NONE



**2 ROOFTOP UNIT MOUNTING DETAIL**  
EHP-1 SCALE NONE



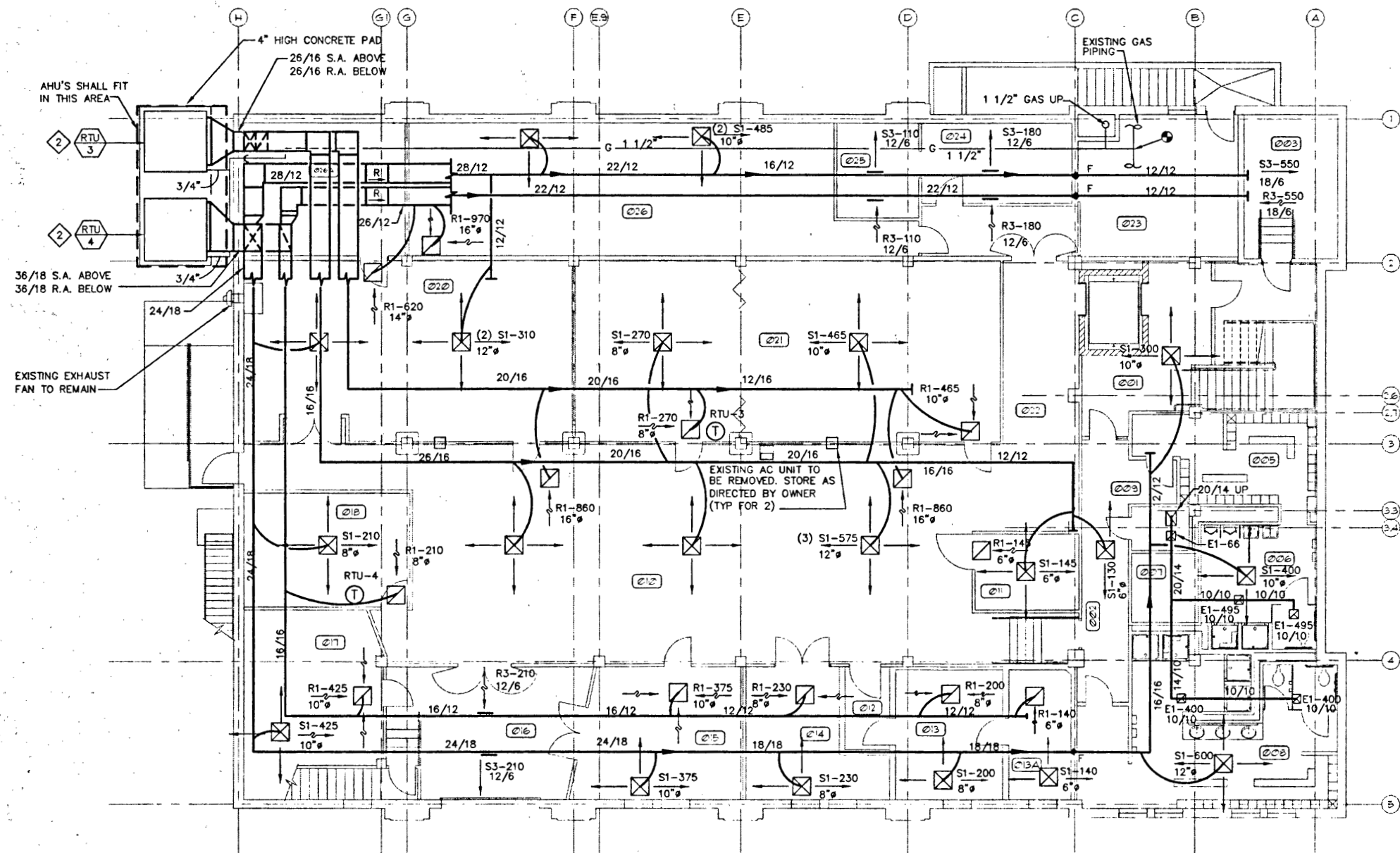
**3 GAS PIPING THRU CURB DETAIL**  
EHP-1 SCALE NONE

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 Engineers/Architects/Planners  
 Surveyors/Construction Managers  
 5300 Oakland Ave. St. Louis 90 63110 (314) 501-4221

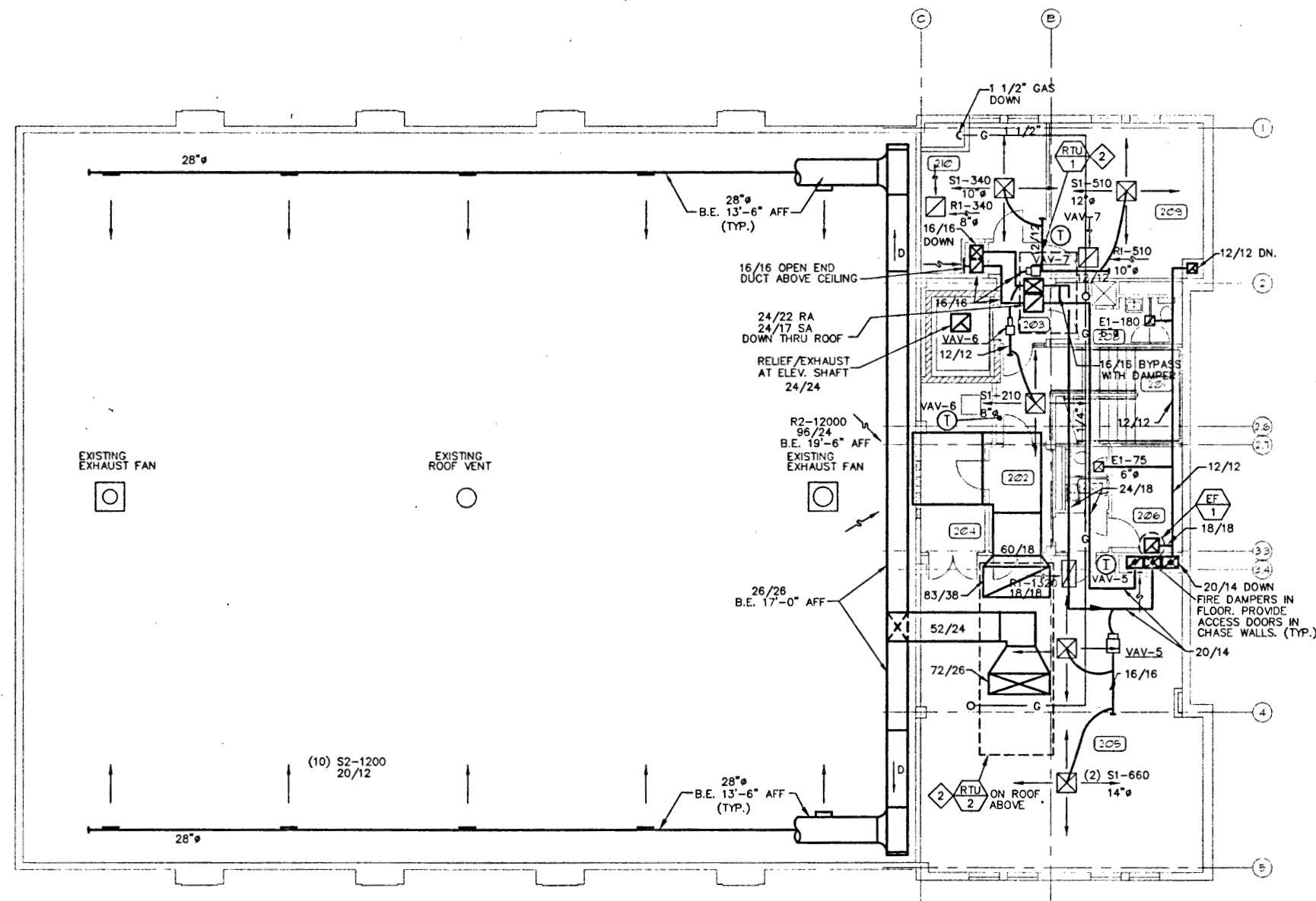
CITY OF COLUMBIA  
 RENOVATION OF EXISTING ARMOY BUILDING  
 701 EAST ASH STREET  
 COLUMBIA, MISSOURI

SYMBOLS, DETAILS AND EQUIPMENT DATA

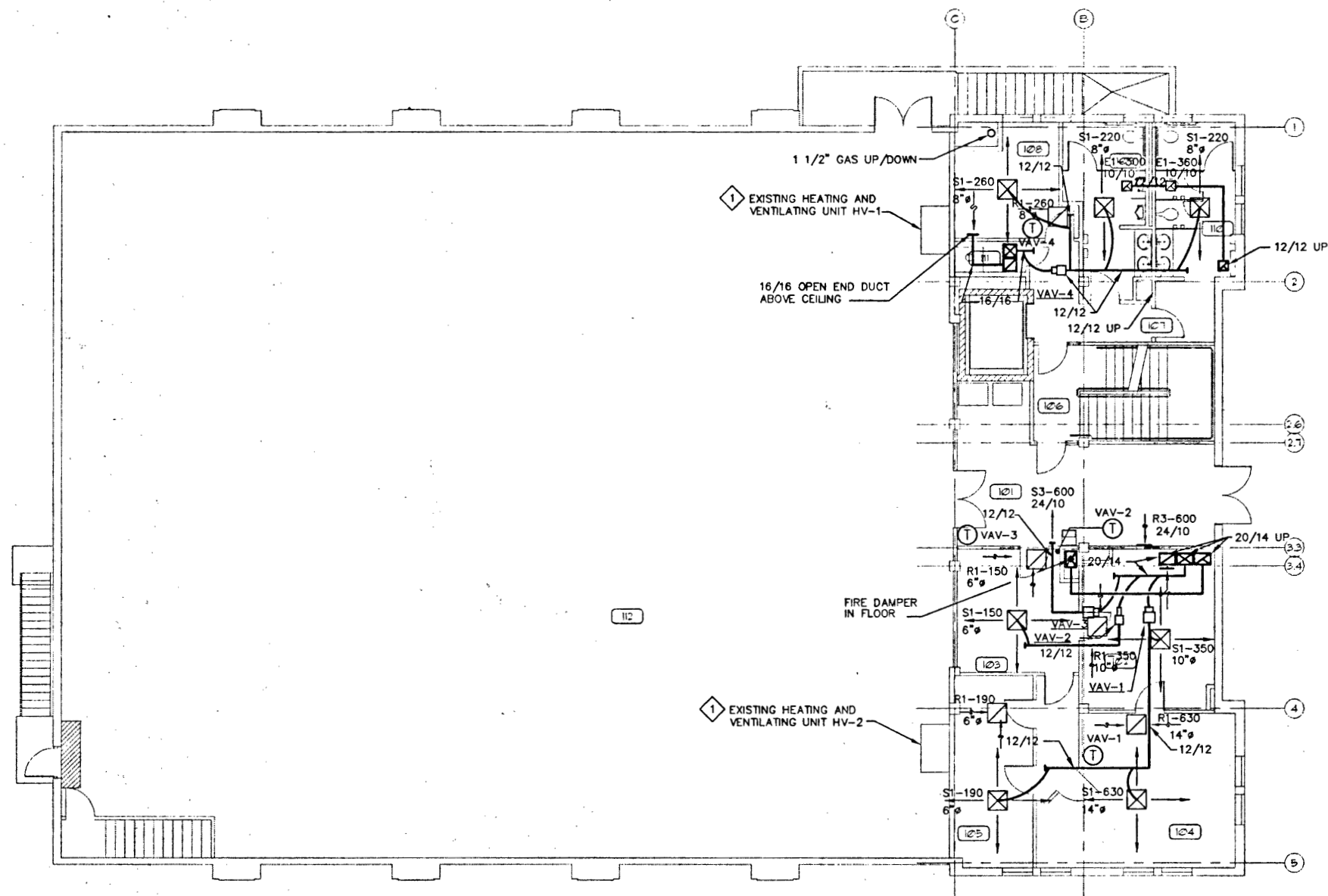
DATE: 04/01/93  
 DESIGNED: TRJ  
 DRAWN: DRB  
 CHECKED: ETK  
 JOB NO. 9132B  
 SHEET 8 OF 16



**GROUND FLOOR PLAN**  
SCALE: 1/8" = 1'-0"



**SECOND FLOOR PLAN**  
SCALE: 1/8" = 1'-0"



**FIRST FLOOR PLAN**  
SCALE: 1/8" = 1'-0"

**KEYED NOTES: (THIS SHEET ONLY)**

- ◇ EXISTING EQUIPMENT TO BE MODIFIED UNDER BASE BID, SEE SPECIFICATIONS
- NEW AIR CONDITIONING SYSTEMS, SEE ALTERNATE BID

**BASE BID**

THE EXISTING STEAM BOILER, RADIATORS, HEATERS, GYM HEATING AND VENTILATION UNITS, PIPING, VALVES, CONTROLS AND ACCESSORIES SHALL REMAIN.  
THE EXISTING GYM HEATING AND VENTILATION UNITS CONTROLS SHALL BE SERVICED AND MADE OPERATIONAL.  
NEW TOILET EXHAUST SYSTEM SHALL BE PROVIDED.

**ADD ALTERNATE**

THE EXISTING STEAM BOILER, RADIATORS, HEATERS, GYM HEATING AND VENTILATION UNITS, PIPING, VALVES, CONTROLS AND ACCESSORIES SHALL BE REMOVED.  
NEW GAS HEAT/ELECTRIC COOLING ROOFTOP UNITS SHALL BE PROVIDED FOR THE FOLLOWING AREAS INCLUDING DUCTWORK, GRILLES, REGISTERS, DIFFUSERS, DAMPERS, INSULATION, CONTROLS, GAS PIPING, VALVES, SUPPORTS, HANGERS, CUTTING, ROUGH PATCHING AND ETC. TO PROVIDE FOR COMPLETE AND OPERATIONAL SYSTEMS.

NO.	DATE	REVISION

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**CITY OF COLUMBIA**  
RENOVATION OF EXISTING ARMORY BUILDING  
701 EAST ASH STREET  
COLUMBIA, MISSOURI

**HEATING AND VENTILATING FLOOR PLANS AND DETAILS**



DATE: 04/01/99  
DESIGNED: TRM  
DRAWN: DRB  
CHECKED: ETK  
JOB NO. 9130B  
SHEET 9 OF 16



**GENERAL NOTES: (THIS SHEET ONLY)**

FOR ELECTRICAL SYMBOL LEGEND AND EQUIPMENT DATA SCHEDULE  
REFERENCE DRAWING EHP-1.

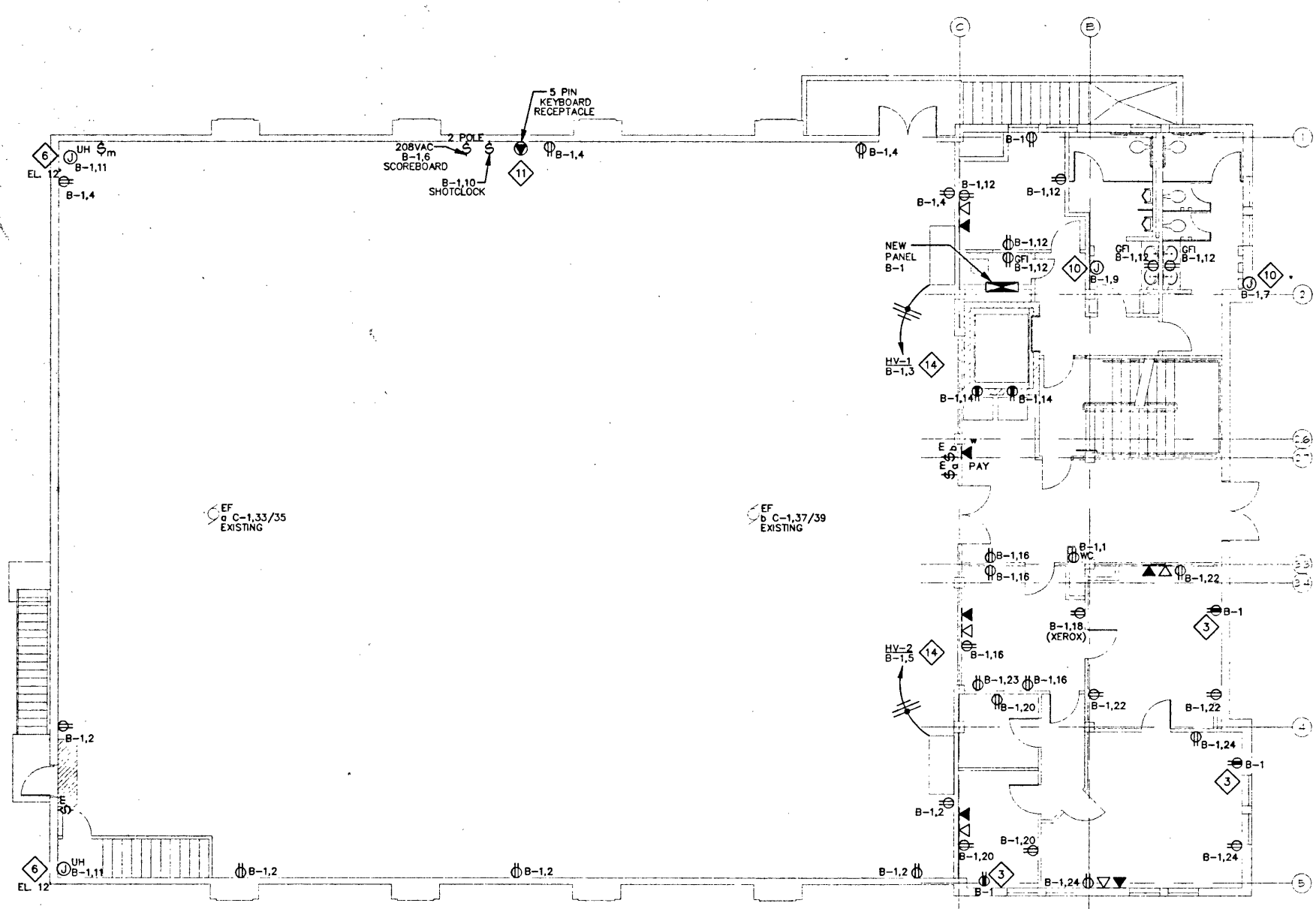
ELC SHALL BE RESPONSIBLE FOR THE VERIFICATION AND REINSTALLATION OF ALL EXISTING MISCELLANEOUS LOADS WHICH ARE TO REMAIN IN USE, BUT HAVE NOT BEEN IDENTIFIED BY PROJECT DOCUMENTS.

PHONE/DATA JACKS: ELC SHALL BE RESPONSIBLE FOR THE INSTALLATION OF ALL JACKS AND RACEWAYS TO CEILING. ALL WIRING WILL BE INSTALLED BY OTHERS.

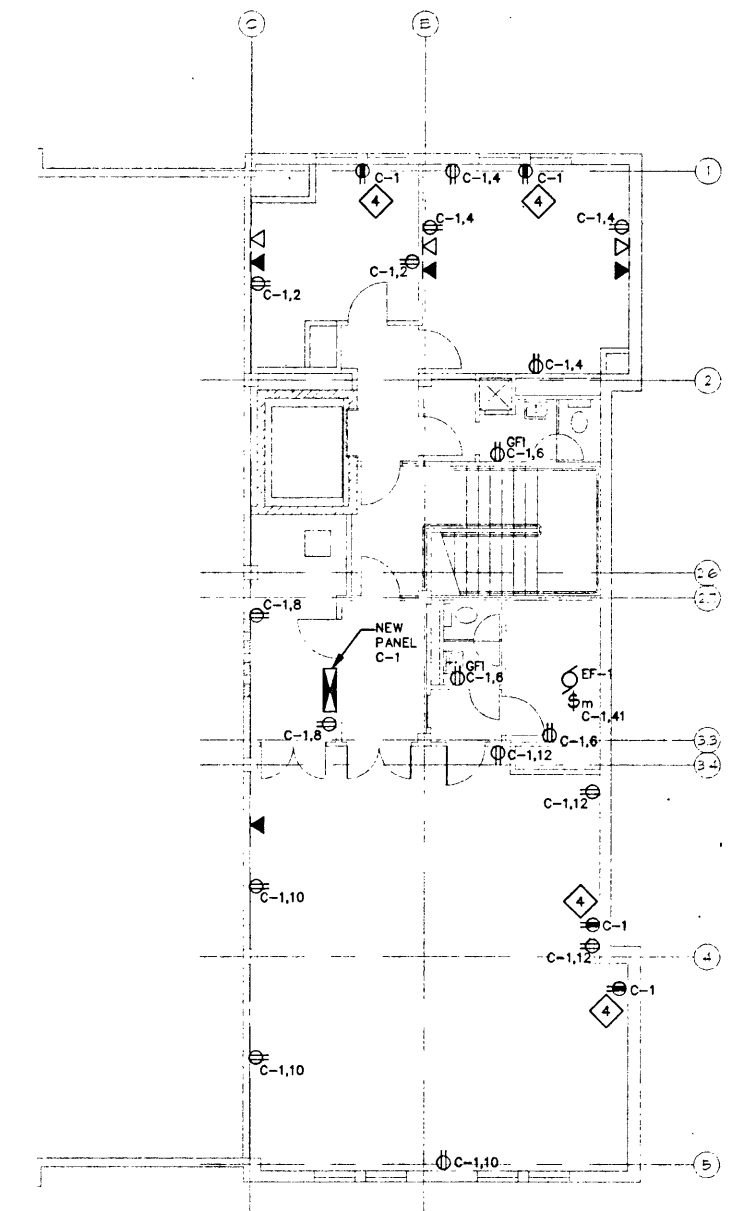
DEVICE LOCATIONS HAVE BEEN SHOWN AS NEW. ELC MAY VERIFY EXISTING LOCATIONS AND REUSE RECESSED BOXES IF PRACTICABLE. (ALL DEVICES SHALL BE REPLACED.) WHERE NEW LOCATIONS ARE REQUIRED ON EXISTING WALLS, SURFACE MOUNTED RACEWAY SHALL BE USED BETWEEN CEILING AND SURFACE MOUNTED BOXES AS WELL AS LATERAL RUNS BETWEEN BOXES. REFER TO ARCHITECTURAL DRAWINGS FOR NEW WALL LOCATIONS.

**KEYED NOTES: (THIS SHEET ONLY)**

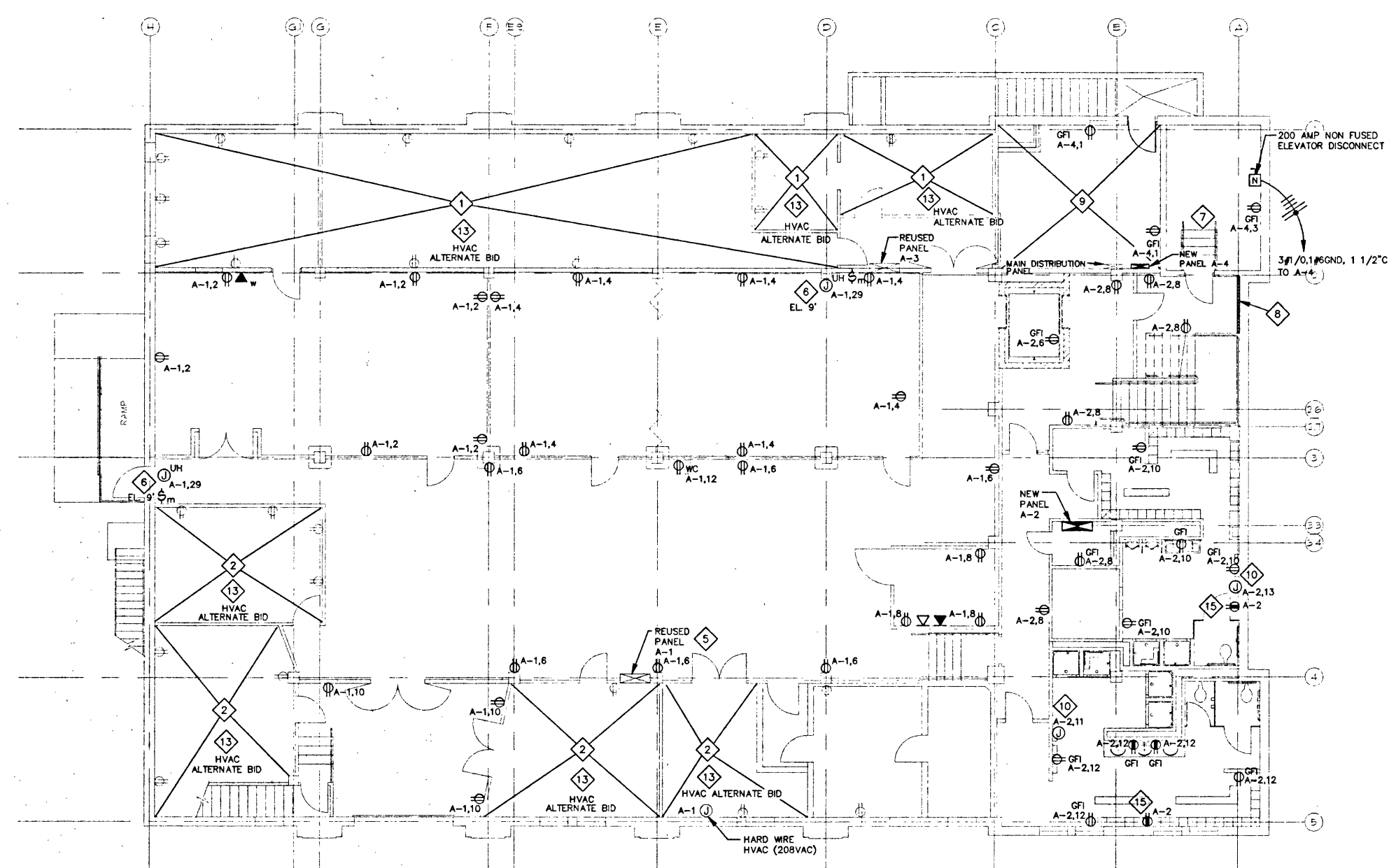
- 1 NO ARCHITECTURAL WORK IN THIS AREA. EXISTING LIGHTING, RECEPTACLES AND SPACE HEATERS ARE TO REMAIN IN PLACE. CONTRACTOR SHALL VERIFY/HOMERUN CIRCUITS SUCH THAT EXISTING DISTRIBUTION PANEL A-3 IS THE SOURCE FOR ALL POWER REQUIREMENTS IN THIS AREA.
- 2 NO ARCHITECTURAL WORK IN THIS AREA. EXISTING LIGHTING, RECEPTACLES AND SPACE HEATERS ARE TO REMAIN IN PLACE. CONTRACTOR SHALL VERIFY/HOMERUN CIRCUITS SUCH THAT EXISTING DISTRIBUTION PANEL A-1 IS THE SOURCE FOR ALL POWER REQUIREMENTS IN THIS AREA.
- 3 DEDICATED AIR CONDITIONER WALL MOUNT RECEPTACLE: ELC SHALL BE RESPONSIBLE FOR THE VERIFICATION OF VOLTAGE AND LOAD REQUIREMENTS BASED ON EXISTING A/C EQUIPMENT. RECEPTACLES SHALL BE CIRCUITED BACK TO POWER PANEL C-1 AS SHOWN. ELC SHALL BE RESPONSIBLE FOR CONDUCTOR AND BREAKER SIZING AS NEEDED TO SATISFY ALL "NEC" AND LOAD REQUIREMENTS. BREAKER SPACE HAS BEEN ALLOCATED IN THE POWER PANEL FOR ELC'S USE.
- 4 DEDICATED AIR CONDITIONER WALL MOUNT RECEPTACLE: ELC SHALL BE RESPONSIBLE FOR THE VERIFICATION OF VOLTAGE AND LOAD REQUIREMENTS BASED ON EXISTING A/C EQUIPMENT. RECEPTACLES SHALL BE CIRCUITED BACK TO POWER PANEL C-1 AS SHOWN. ELC SHALL BE RESPONSIBLE FOR CONDUCTOR AND BREAKER SIZING AS NEEDED TO SATISFY ALL "NEC" AND LOAD REQUIREMENTS. BREAKER SPACE HAS BEEN ALLOCATED IN THE POWER PANEL FOR ELC'S USE.
- 5 ELC SHALL RE-CIRCUIT EXISTING PANEL A-1, AS SHOWN ON THE SCHEDULE, TO ALLOW FOR NEW LOADS. ELC SHALL DETERMINE EXISTING CIRCUIT CONFIGURATIONS AS NEEDED TO RE-TERMINATE ON RESERVED BREAKERS.
- 6 ELC SHALL INSTALL NEW UNIT HEATER OUTLET TO MATCH EXISTING, AND CIRCUIT AS SHOWN.
- 7 ELC TO ROUTE 20AMP, 120V, GFI CIRCUIT TO ELEVATOR CONTROL PANEL FROM PANELBOARD A-4,40. ROUTE PHONE LINE TO ELEVATOR CONTROL PANEL FROM PHONE DEMARK, AND PROVIDE 2 RACEWAYS WITH PULL WIRES AND JUNCTION BOXES BETWEEN ELEVATOR EQUIPMENT ROOM AND ELEVATOR SHAFT.
- 8 ELC TO INSTALL 4'x8' SHEET OF 3/4" PLYWOOD FOR PHONE EQUIPMENT BEING INSTALLED BY OTHERS.
- 9 ELC SHALL RECONNECT EXISTING BOILER ROOM LOADS TO POWER PANEL A-4. LOADS SHALL INCLUDE BUT NOT BE LIMITED TO BOILER, CONDENSATE PUMP, FEEDWATER TANK, ASSOCIATED CONTROLS, ETC.
- 10 ELC SHALL PROVIDE JUNCTION BOX FOR HAND DRYERS WITH 30AMP CIRCUIT AS SHOWN. BOX ELEVATION SHALL BE COORDINATED WITH ARCHITECTURAL PLANS.
- 11 ELC SHALL INSTALL SCOREBOARD AND SHOT CLOCK (B-1.6,10)POWER, NEW 5 PIN RECEPTACLE AND LOCAL SWITCHES TO MATCH EXISTING.
- 12 ELC SHALL BE RESPONSIBLE FOR ROUTING PANEL RISERS OUT OF PUBLIC VIEW. EXPOSED RACEWAYS IN JANITOR'S CLOSETS AND ABOVE LAY-IN CEILING WILL BE ACCEPTABLE.
- 13 ADDITIONAL WALL CEILING DEMOLITION WILL BE CAUSED BY THE APPROVAL OF THE HVAC ALTERNATE BID. ELC SHALL BE RESPONSIBLE FOR THE TEMPORARY REMOVAL AND REINSTALLATION OF ALL RECEPTACLES, LIGHTING, AND ASSOCIATED WIRING NEEDED TO INSTALL THE HVAC DUCT.
- 14 HV UNITS SHOULD HAVE INTEGRAL DISCONNECT SWITCHES. ELC TO VERIFY AND INSTALL MANUAL MOTOR STARTERS IF REQUIRED.
- 15 DEDICATED AIR CONDITIONER WALL MOUNT RECEPTACLE: ELC SHALL BE RESPONSIBLE FOR THE VERIFICATION OF VOLTAGE AND LOAD REQUIREMENTS BASED ON EXISTING A/C EQUIPMENT. RECEPTACLES SHALL BE CIRCUITED BACK TO POWER PANEL A-2 AS SHOWN. ELC SHALL BE RESPONSIBLE FOR CONDUCTOR AND BREAKER SIZING AS NEEDED TO SATISFY ALL "NEC" AND LOAD REQUIREMENTS. BREAKER SPACE HAS BEEN ALLOCATED IN THE POWER PANEL FOR ELC'S USE.



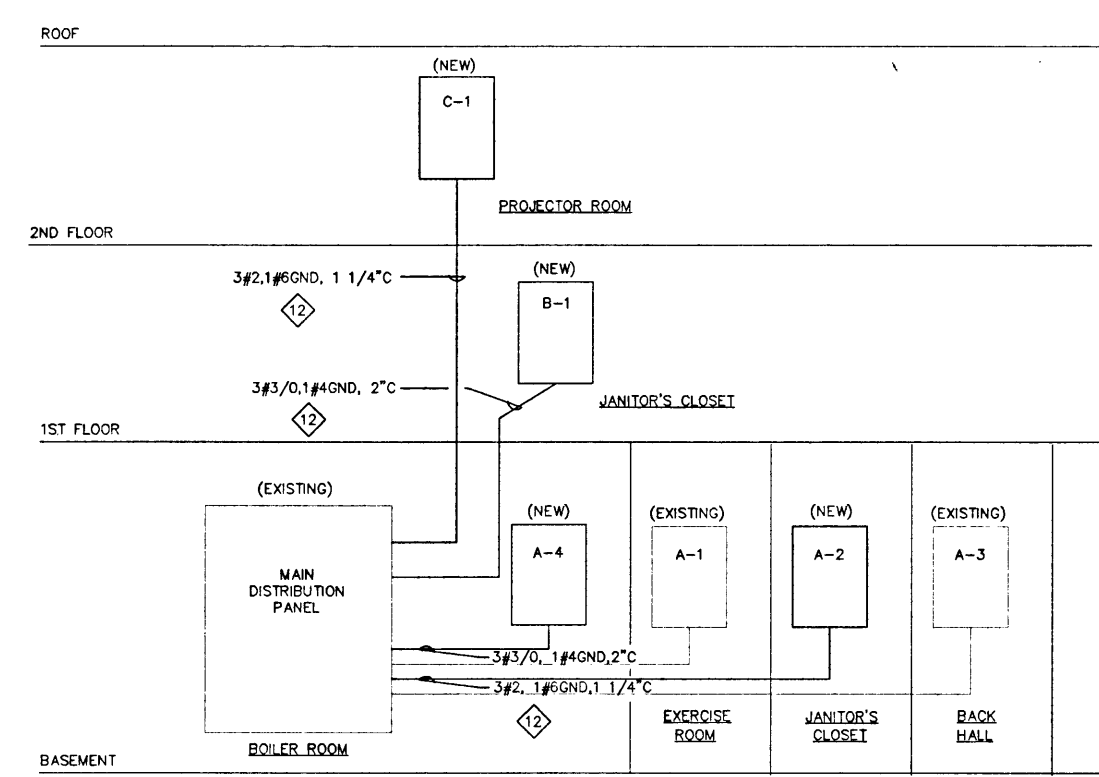
**FIRST FLOOR POWER PLAN**  
SCALE: 1/8" = 1'-0"



**SECOND FLOOR POWER PLAN**  
SCALE: 1/8" = 1'-0"



**GROUND FLOOR POWER PLAN**  
SCALE: 1/8" = 1'-0"



**RISER DIAGRAM**  
SCALE: NONE

REFERENCE: ELECTRICAL SYMBOLS LEGEND IS LOCATED ON DRAWING EHP-1.

NO. DATE REVISION

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CITY OF COLUMBIA  
RENOVATION OF EXISTING ARMOY BUILDING  
701 EAST ASH STREET  
COLUMBIA, MISSOURI



DATE: 4/1/99  
DESIGNED: GLO  
DRAWN: JUC  
CHECKED: GLO  
JOB NO. 9730  
SHEET 15 OF 15

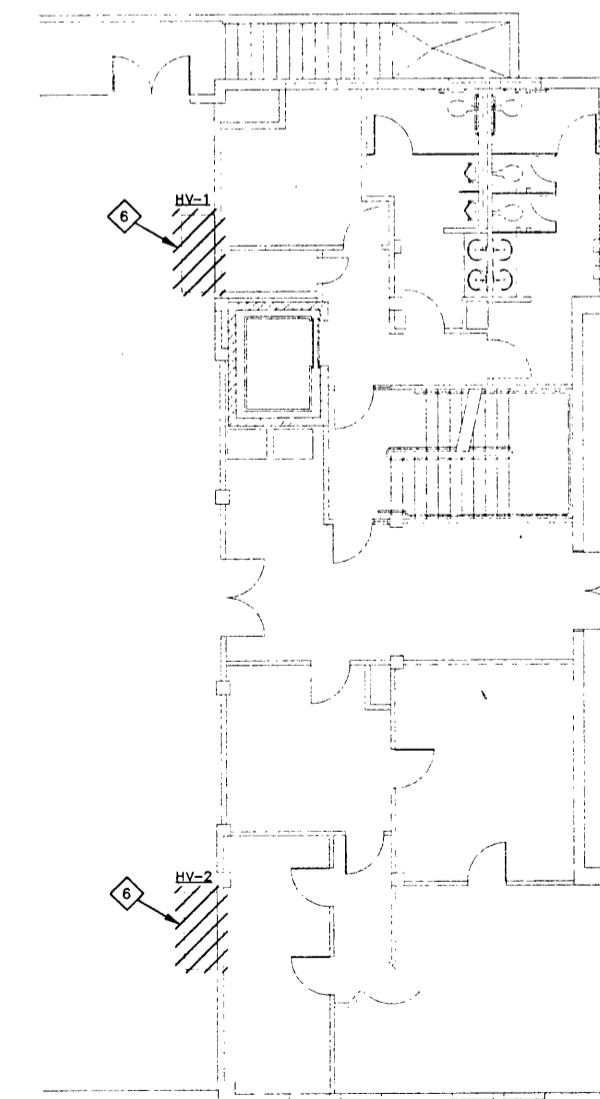
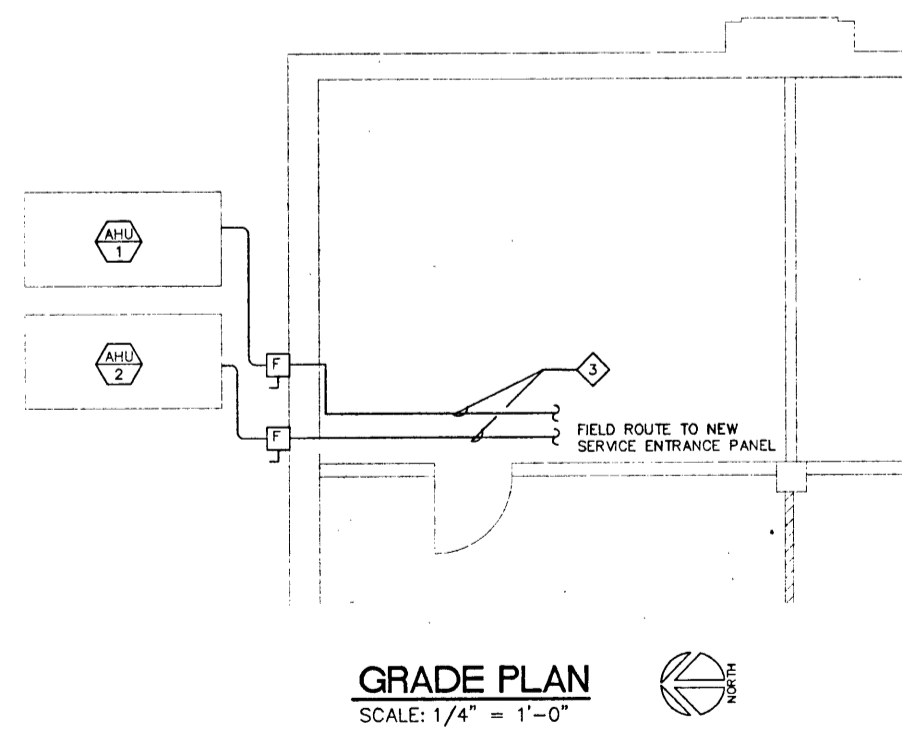
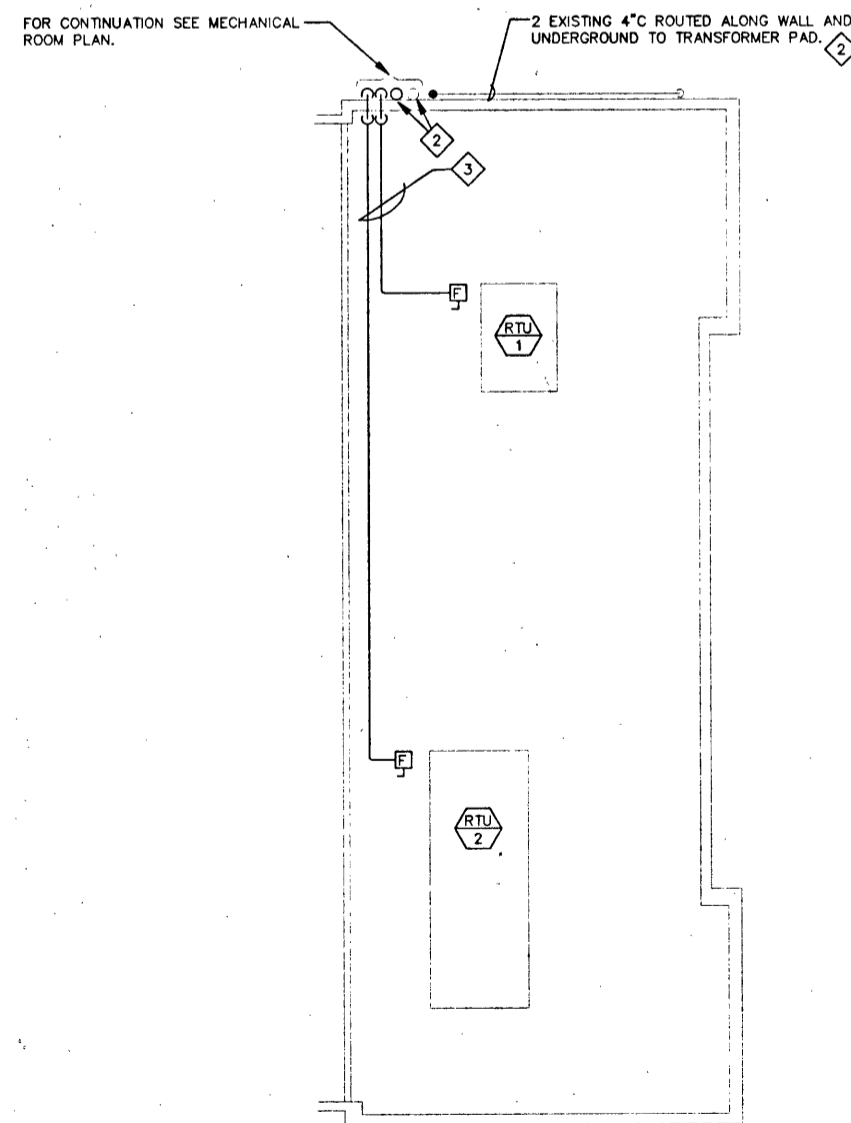
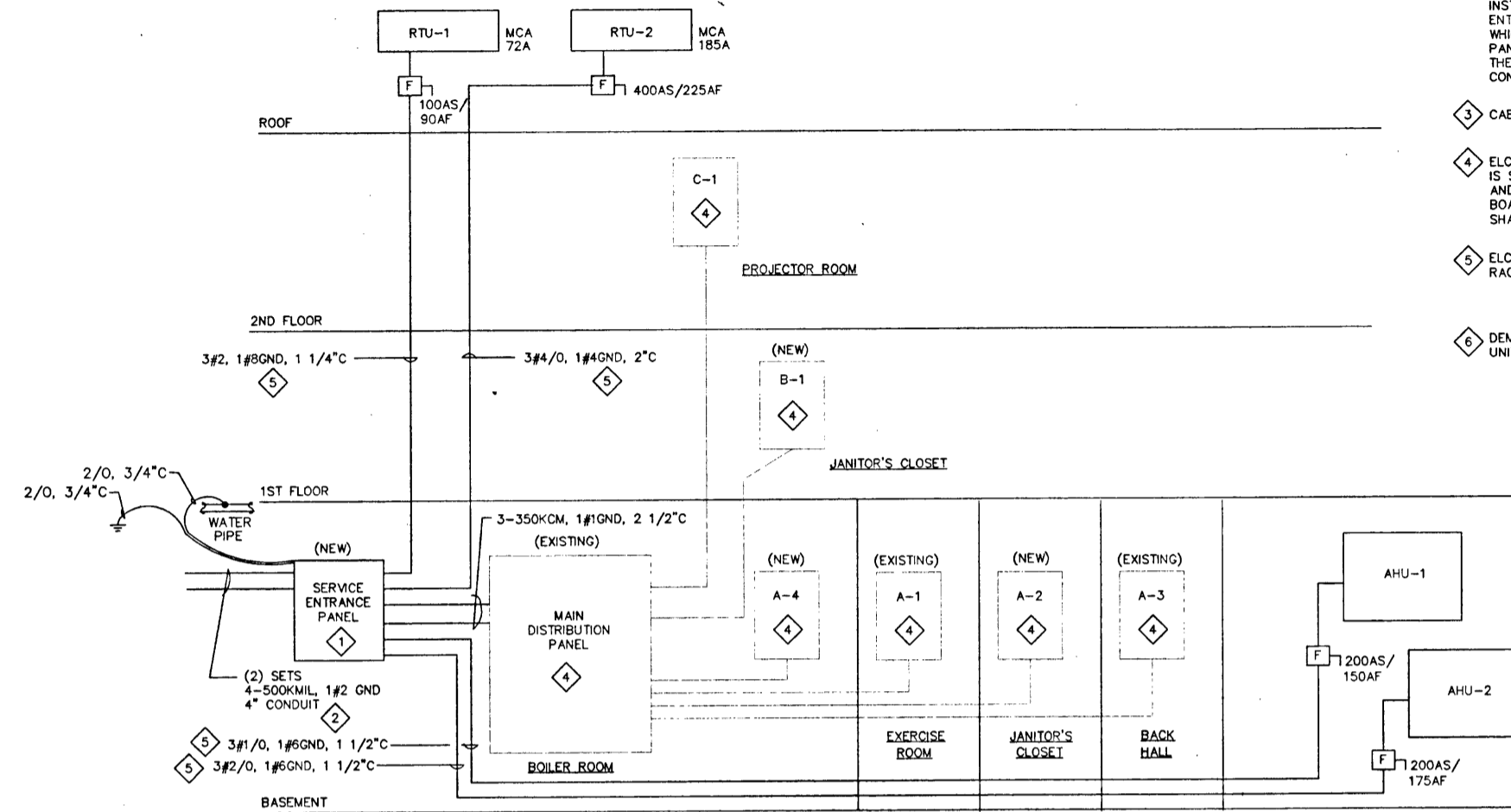
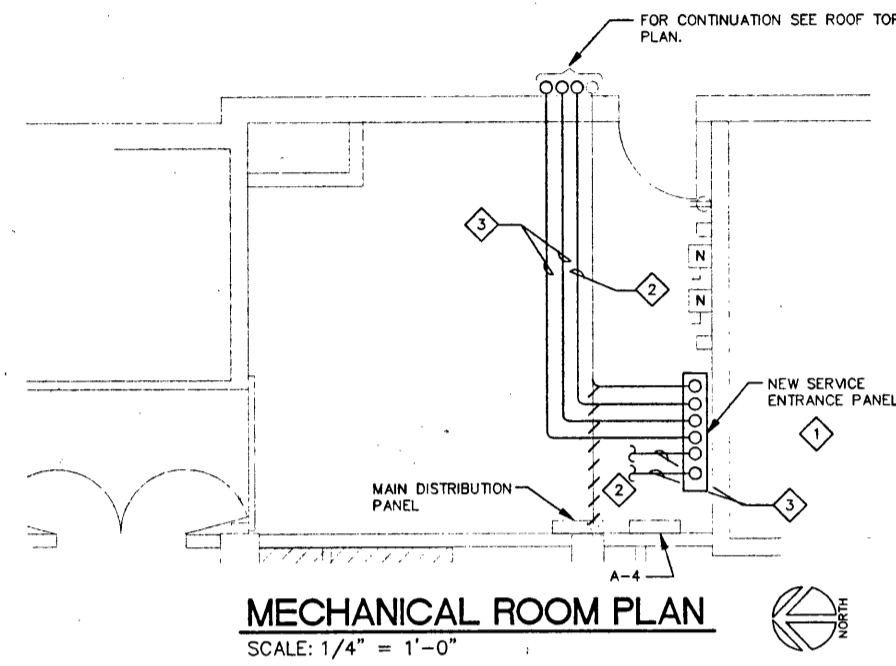
DATE: 4/1/99  
DRAWING: 51

**GENERAL NOTES: (THIS SHEET ONLY)**

ELC SHALL BID ALL WORK SHOWN ON THIS DRAWING AS AN ALTERNATE TO THE BASE BID.  
 ELC SHALL BE RESPONSIBLE FOR ALL LIGHTING, RECEPTACLE AND WIRING MODIFICATIONS CAUSED BY THE ADDITIONAL WALL DEMOLITION ASSOCIATED WITH THE HVAC ALTERNATE. REFERENCE ELECTRICAL DWGS E1,E2,E3 AND ARCHITECTURAL DEMO DWG D1 FOR EFFECTED LOCATIONS.

**KEYED NOTES: (THIS SHEET ONLY)**

- 1 ELC TO PURCHASE AND INSTALL NEW FUSIBLE SERVICE ENTRANCE PANEL. SEE PANEL SCHEDULE, "NEW SERVICE ENTRANCE PANEL".
- 2 ELC TO REPLACE EXISTING 8-350KCMIL SERVICE ENTRANCE CONDUCTORS WITH 8-500 KCMIL CONDUCTORS. THE TWO EXISTING 4IN CONDUITS FROM THE TRANSFORMER PAD TO THE BUILDING EXTERIOR SHALL BE REUSED. ELC SHALL INSTALL ONE NEW 4IN CONDUIT FROM BUILDING EXTERIOR TO NEW SERVICE ENTRANCE PANEL. ELC SHALL ALSO MODIFY THE EXISTING 4IN CONDUIT WHICH RUNS FROM BUILDING EXTERIOR TO THE EXISTING MAIN DISTRIBUTION PANEL, SUCH THAT IT IS ROUTED TO THE NEW SERVICE ENTRANCE PANEL. THESE CONDUITS SHALL THEN BE USED TO ROUTE NEW SERVICE ENTRANCE CONDUCTORS.
- 3 CABLE AND CONDUIT SIZED AS SHOWN ON RISER DIAGRAM.
- 4 ELC SHALL BE RESPONSIBLE FOR ENSURING PANELBOARD INTERRUPTING CAPACITY IS SUFFICIENT FOR AVAILABLE FAULT BASED ON NEW UTILITY TRANSFORMER KVA AND IMPEDANCE. UL LISTED SERIES RATINGS MAYBE UTILIZED. IF EXISTING PANELBOARDS ARE NOT SUFFICIENT TO SAFELY INTERRUPT AVAILABLE FAULTS THEN ELC SHALL REPLACE THEM.
- 5 ELC SHALL BE RESPONSIBLE FOR ROUTING RTU RISERS OUT OF PUBLIC VIEW. EXPOSED RACEWAY IN JANITOR'S CLOSETS AND ABOVE LAY-IN CEILING WILL BE ACCEPTABLE.
- 6 DEMO POWER AND CONTROL WIRING ASSOCIATED WITH EXISTING HEATING AND VETILLATION UNITS HV-1 AND HV-2.



REFERENCE: ELECTRICAL SYMBOLS LEGEND IS LOCATED ON DRAWING EHP-1.

NO. DATE REVISION

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CITY OF COLUMBIA  
 RENOVATION OF EXISTING ARMORY BUILDING  
 701 EAST ASH STREET  
 COLUMBIA, MISSOURI

DATE: 4/1/99  
 DESIGNED: GLO  
 DRAWN: GLO  
 CHECKED: GLO  
 JOB NO. 9738  
 SHEET 16 OF 16

DWG. P. 9738B/CAD/7/3/99-4  
 DATE: 4/1/99  
 DMS/SCALE: 1

## Ameresco, Inc.

1 S. Wacker, Suite 2275  
Chicago, IL 60606

## City of Columbia Primary Point of Contact

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Senior Account Executive  
P: 913.515.4858  
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