Springfield Campus HVAC Replacements
Information Commons West
RTU #1, #2, #3E, #3W, #4, and #8

Ozarks Technical Community College
1001 E. Chestnut Expressway
Springfield, Missouri 65802

Specifications Manual

February 28, 2020

00001 - TITLE PAGE

OWNER:

Ozarks Technical Community College
1001 E. Chestnut Expressway
Springfield, Missouri 65802

OWNER'S REPRESENTATIVE:

Raymond Wade
College Director Facilities
Ozarks Technical Community College
933 E. Central Avenue
Springfield, Missouri 65802
Phone: 417-447-4801
Fax: 417-447-4804

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SECTION 00090 – INSTRUCTION TO BIDDERS

General: To be considered. Bids must be made in accordance with these **Instructions to Bidders**.

Project: **HVAC Replacements- Information Commons West (ICW) #1, #2, #3E, #3W, #4 and #8**

Project Site Address: **Ozarks Technical Community College**
Springfield Campus
1001 E. Chestnut Expressway
Springfield, Missouri 65802

Schedule:

Pre Bid-Date and Time: Thursday, March 12, 2020 at 2:00 p.m.

Bid-Date and Time: Thursday, March 19, 2020 at 2:00 p.m.

Intended Award Date: Tuesday, April 14, 2020

Expected Construction Start Date (Site Staging Only): Monday, May 18, 2020

Expected Construction Start Date: Saturday, May 23, 2020

Intended Substantial Completion Date: Monday, May 25, 2020

Intended Final Completion Date: Friday, June 5, 2020

Receipt of Bids: All Bids for the project shall be made upon the form provided by the Owner and/or Engineer. Bids shall be hand delivered to Ozarks Technical Community College, Springfield, Missouri until **2:00 p.m.**, local time, on **Thursday, March 19, 2020** in the College Facilities Office, located at 933 E. Central Street, Springfield, Missouri, enclosed in a sealed envelope addressed and marked **OTC HVAC Replacements- Information Commons West (ICW) #1, #2, #3E, #3W, #4 and #8 at Springfield Campus**. This envelope shall also bear the name of the bidder. Bids shall include all freight, overhead and profit, and any other miscellaneous charges relating to the work. The Owner is a tax-exempt entity.

Qualifications of Bidders: Each Bidder shall file with the Owner concurrent with submission of their Bid, the following additional qualification information:

1. A Bid Proposal (Section 00410)
2. E-Verify Affidavit (Section 00440)
3. Non- collusion Affidavit (Section 00450)

Contract Documents: Construction Documents are available for download at: https://services.otc.edu/adminservices/architect/#1536258266860-b9c9ae32-9752

Bid Security: Each bid shall be accompanied with a bid security consisting of a bid bond, certified check, or cashier's check on a solvent bank for 5% of the base bid amount. Bid security shall be made payable without condition to the Owner.

Bid security will be retained by the Owner to whom an award is being considered until either (a) the contract has been executed and bonds have been furnished, (b) the specific time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

The owner reserves the right to reject any and all bids and to waive all informalities in bids. No bids may be withdrawn for a period of 60 days subsequent to the specified time for receipt of bids.

Bidding Procedure: Bids shall be submitted as per this "Invitation to Bid" on forms furnished by the Owner and/or Architect. A minimum of one original sealed submittal of all requested forms is required at the time of Bid.

Include Bid Proposal and Bid Security along with E-Verify Affidavit and Non-collusion Affidavit.

Bids shall be submitted with all appropriate blank spaces completed. Numbers shall be stated both in writing and in figures. In case of any discrepancy in the lump sum amount, the amount as expressed in written words shall govern. The signatures shall be without interlineation, alteration, or erasure, unless initialed by the Bidder. Bids shall not contain any recapitulation for the work to be done. If the Bidder is a corporation, the Bid shall contain the legal name of the corporation and shall be signed by a duly authorized officer, and the corporate seal affixed; if a partnership, it shall be signed by one of the partners authorized to execute documents and shall give the names of and addresses of all partners.

Submission of Bids: Bids shall be received at the address and time stated above and opened publically.

Bidder shall be responsible for actual delivery of his Bid to the address indicated. It shall not be sufficient to show that the bid was mailed in time to be received before the scheduled closing time for receipt of bids.

Any bids received **after the time and date stated** shall be returned unopened.

Oral, telephonic, telegraphic, or electronic Bids are **invalid and will not** receive consideration.

The Owner reserves the right to reject any and all proposals and/or award the work to other than the low bidder, as it bests serves its interest.

Modification or Withdrawal of Bids: A bid may not be modified, withdrawn or cancelled by the Bidder during a period of sixty (60) days following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting his Bid.

Examination: Contractors will not be given extra compensation for conditions, which can be determined by examining the site, this set of documents, and any other information herein after referenced.

Questions during the bidding process shall be submitted in writing to Ozarks Technical Community College, Office of the College Director of Facilities Attn: Rick Taylor, 933 E. Central Avenue, Springfield, MO 65802 or fax to (417) 447-4804 to the attention of Rick Taylor.

Performance Bond and Payment Bond: A performance bond and payment bond for the full amount of the contract will be required of the successful bidder.

Prevailing Wage Scale: The minimum prevailing wage rates as determined by Missouri Division of Labor Annual Wage Order No. 26 (Greene County) shall be paid. The Contractor must pay employees wages and benefits equal to or greater than the established scale. The Contractor will be required to submit certified payroll information, on a periodic basis, and a final payroll Affidavit form at close out of this project.

E-Verify: Bidder shall furnish an affidavit and documentation affirming the company is enrolled in and participates in E-Verify/Basic Pilot and an affidavit stating the business does not knowingly employ illegal aliens. Example is included in Section 00440 – E-Verify Affidavit.

MBE/WBE Goals: The Owner desires Minority Business Enterprise/Women Business Enterprise (MBE/WBE) participation in this Project. Every feasible effort shall be made to include these enterprises as subcontractors.

Sales Tax Exemption: Bidders are hereby instructed to submit bids not including sales tax according to the provisions of Section144.062 RSMo. The selected contractor will receive a Missouri Tax Exemption letter from the Owner to use in purchasing materials on a tax-free basis. It will be the responsibility of the contractor to provide the documentation to any subcontractor. This document will be used solely for purchase of materials being directly incorporated into or consumed in the construction of the work under this contract.

Temporary Services: Electrical, sanitary, potable water, and phone services are available.

Insurance: The successful bidder shall, at all times during the term of the Service Agreement and any extension(s), at Contractor's sole cost and expense, obtain and **maintain the following policies of insurance, naming the Owner Parties as "additional insured's"** using Insurance Services Office, Inc.'s additional insured form CG 20 26 11 85, or its equivalent, which shall provide the Owner Parties are additional insured's with respect to liability arising out of Contractor's ongoing and completed operations and providing that no such insurance be cancelled, non-renewed or materially changed without at least thirty (30) days written notice to Owner by certified mail to Owner's notice address specified herein. All policies of insurance required of Contractor under this Agreement shall be obtained from reputable insurers licensed to do business in the State of Missouri and have an A.M. Best rating of at least A-VIII. A legally enforceable Certificate of Insurance on all insurance policies required of Contractor under this Agreement, shall be deposited with Owner promptly on or before the commencement of the term of this Agreement.

Commercial General Liability – with a limit of not less than $2,000,000 ($5,000,000 if any portion of the services to be performed by Contractor hereunder involves or affects in any way the roof of any building) for each occurrence and a $2,000,000 ($5,000,000 if any portion of the services to be performed by Contractor hereunder involves or affects in any way the roof of any building) general aggregate limit.

a) An endorsement that includes property damage coverage for property in the care, custody or control of the Contractor.
b) In the instances where Contractor's services include the use of "pollutants" as defined by the General Liability policy, the policy must include an endorsement removing the absolute pollution exclusion and adding broadened pollution coverage for bodily injury and property damage resulting from the discharge, dispersal, seepage, migration, release or escape of "pollutants", and providing coverage on behalf of the "additional insured" including ongoing and completed operations.

Commercial Automobile Liability – in the amount of $1,000,000 combined single limit for bodily injury and property damage, covering all owned, non-owned, or hired automobiles used in the course of the Contractor's business.

Workers' Compensation – in compliance with any and all statues requiring such coverage in the State of Missouri.

Employer's Liability – in a minimum amount of $1,000,000 each accident, $1,000,000 each employee, $1,000,000 policy aggregate.

Such other insurance as may be required from time to time by Owner.

END OF SECTION 00090

SECTION 00410 - BID FORM

Date:_____

Proposal of _____ (herein called "Bidder")
*a corporation organized and existing under the laws of the State

of _____, *a partnership consisting

of _____, or *an individual trading

as _____.

*(*insert name of corporation, partnership, or individual as applicable.)*

To: Ozarks Technical Community College
1001 E. Chestnut Expressway
Springfield Missouri, 65802
Phone 417-447-4806
Fax 417-447-4804

The undersigned bidder, in compliance with your Invitation to Bid for the following project:

Springfield Campus
HVAC Replacements- Information Commons West (ICW) #1, #2, #3E, #3W, #4 and #8
1001 E. Chestnut Expressway
Springfield, Missouri 65802

Dated: _____

and in accordance with the Contract Documents and having visited the site of the proposed work and being familiar with all conditions that may affect the proposed work, including availability of labor and materials, hereby proposes to furnish all labor materials, tools, equipment, machinery, equipment rental, transportation, superintendence, perform all work, provide all services, and to construct all work in accordance with the Contract Documents set forth herein, and at the prices stated below. These prices are to cover all expenses incurred in performance of the work required for the Contract stated below.

The Bidder acknowledges that Addenda Nos. _____ have been received and considered in the preparation of this proposal.

BASE BID PROPOSAL: Bidder agrees to perform all related Work of the Plans, Specifications, and Addenda for the sum of:

_____
_
_____ Dollars ($_____).

Bid shall have: NO MINIMUM CHARGES, NO FUEL SURCHARGES, NO MISCELLANEOUS CHARGES ON BILLING THAT HAVE NOT BEEN PRE AUTHORIZED BY SIGNATURE OF THE DEPARTMENTAL SUPERVISOR.

The Bidder agrees that this Bid cannot be withdrawn during the period of 60 calendar days after the date of opening of Bids.

If notified of the acceptance of the Proposal within 60 calendar days, the Undersigned agrees to execute a Contract for the work on the form of "Contractor's Service Agreement Standard", within 7 calendar days after receipt of notification. Contract shall be based upon all Contract Documents, including all Addenda.

The Undersigned agrees that the Bid Security shall become the property of the Owner in the event the Bidder fails to execute the Contract and the Bonds within the time set forth above, as liquidated damages for the delay and additional expense to Owner caused thereby.

The Undersigned understands that his competence and responsibility, and that of his proposed subcontractors, as well as any other factors of interest to Owner, may be a consideration in making the award.

Documents to Accompany Bids: The bidder shall be aware that the following fully executed documents are required in order for his bid to be considered.

1. Bid Proposal (Section 00410)
2. E-Verify Affidavit (Section 00440)
3. Non-collusion Affidavit (Section 00450)

Owner reserves the right to reject any or all Proposals, to accept or reject Alternate Proposals and waiver technicalities concerning the Proposals received as it may be in his best interest to do.

Respectfully submitted,

Firm Name: _____

Address: _____

_____

_____

E-mail Address: _____

Phone Number: _____

By: _____

Title: _____

Date: _____

SEAL (If by Corporation)

END OF SECTION 00410

Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 26

Section 039
GREENE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by
Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: **March 8, 2019**

Last Date Objections May Be Filed: **April 8, 2019**

Prepared by Missouri Department of Labor and Industrial Relations

Building Construction Rates for
GREENE County

Section 039

OCCUPATIONAL TITLE	** Date of Increase	Basic Hourly Rates
Asbestos Worker		$28.59
Boilermaker		$24.94*
Bricklayer		$47.71
Carpenter		$42.40
Lather		
Linoleum Layer		
Millwright		
Pile Driver		
Cement Mason		$29.59
Plasterer		
Communications Technician		$38.42
Electrician (Inside Wireman)		$41.94
Electrician Outside Lineman		$38.51
Lineman Operator		
Lineman - Tree Trimmer		
Groundman		
Groundman - Tree Trimmer		
Elevator Constructor		$24.94*
Glazier		$58.89
Ironworker		$56.55
Laborer		$34.86
General Laborer		
First Semi-Skilled		
Second Semi-Skilled		
Mason		$48.10
Marble Mason		
Marble Finisher		
Terrazzo Worker		
Terrazzo Finisher		
Tile Setter		
Tile Finisher		
Operating Engineer		$40.57
Group I		
Group II		
Group III		
Group III-A		
Group IV		
Group V		
Painter		$33.84
Plumber		$46.13
Pipe Fitter		
Roofer		$38.11
Sheet Metal Worker		$46.31
Sprinkler Fitter		$55.76
Truck Driver		$24.94*
Truck Control Service Driver		
Group I		
Group II		
Group III		
Group IV		

*The Division of Labor Standards received less than 1,000 reportable hours as required by RSMo 290.257.4(b). Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.

Heavy Construction Rates for
GREENE County

Section 039

OCCUPATIONAL TITLE	** Date of Increase	Basic Hourly Rates
Carpenter		$55.02
Millwright		
Pile Driver		
Electrician (Outside Lineman)		$38.51
Lineman Operator		
Lineman - Tree Trimmer		
Groundman		
Groundman - Tree Trimmer		
Laborer		$40.05
General Laborer		
Skilled Laborer		
Operating Engineer		$47.45
Group I		
Group II		
Group III		
Group IV		
Truck Driver		$43.54
Truck Control Service Driver		
Group I		
Group II		
Group III		
Group IV		

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received less than 1,000 reportable hours as required by RSMo 290.257.4(b). Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, **"overtime work"** shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 00440 - E-VERIFY AFFIDAVIT

Project Name: Springfield Campus HVAC Replacements-
Information Commons West (ICW) #1, #2, #3E, #3W, #4 and #8
Ozarks Technical Community College
Springfield, Missouri

Contractor_____,
being first duly sworn, deposes and says that he/she is_____ of
_____ (sole owner, a partner, president, secretary, etc.) the party making the foregoing Bid is a participating Employer in the Department of Homeland Security (DHS) E-Verify program for Employment Verification. The Bidder has full understanding of the requirements set forth in the E-Verify Memorandum of Understanding (MOU), and the Bidder does not knowingly employ illegal aliens. Upon award of Bid and at the Contract Execution, the successful Bidder shall provide Ozarks Technical Community College with the following documentation:

1. E-Verify Memorandum of Understanding (MOU)
2. E-Verify Company Profile Page

Signed:

_____
Contractor

_____
Title

_____
Address

_____
Company ID Number

State of _____
County of _____
On this _____day of _____ in the year_____ , before me, the undersigned notary public, personally appeared_____ , known to me to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged that he/she/they executed the same for the purposes therein contained. In witness whereof, I hereunto set my hand and official seal.
Seal of Notary:

_____
Notary Public

END OF SECTION 00440

SECTION 00450-NON-COLLUSION AFFIDAVIT

Project Name: Springfield Campus HVAC Replacements-
Information Commons West (ICW) #1, #2, #3E, #3W, #4 and #8
Ozarks Technical Community College
Springfield, Missouri

Contractor_____
_____ being first duly sworn, deposes and says that he/she is_____of_____
(sole owner, a partner, president, secretary, etc.) the party making the foregoing Bid that such Bid is not made in the interest of behalf of any undisclosed person, partnership, company, association, organization, or corporation; that such Bid is genuine and not collusive or sham that said Bidder has not directly or indirectly induced or solicited any other Bidder to put in a false or sham Bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put in a sham Bid, or that any one shall refrain from bidding, that said Bidder has not in any manner, directly or indirectly, sought by agreement, communication or conference with anyone to fix the Bid price of said Bidder or any of other Bidder, or to fix any overhead, profit, or cost element of such Bid price, or of that of any other Bidder, or to secure any advantage against the Owner awarding the contract to anyone interested in the proposed contract, that all statements contained in such Bid are true, and further, that said Bidder has not, directly or indirectly, submitted his Bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid and will not pay any fee in connection therewith, to any corporation, partnership, company, association, organization, Bid depository, or to any member or agent thereof, or to any other individual except to such person or persons as have a partnership or the financial interest with said Bidder in his general business.

Signed:

_____
Contractor

_____
Title

State of _____
County of _____
On this _____day of _____ in the year_____ , before me, the undersigned notary public, personally appeared_____ , known to me to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged that he/she/they executed the same for the purposes therein contained. In witness whereof, I hereunto set my hand and official seal.
Seal of Notary:

_____
Notary Public

END OF SECTION 00450

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections shall apply to this Section.

1.2 SPECIFICATION FORM AND DEFINITIONS:

A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as noted on the Drawings", "according to the drawings", "a", "an", "the", and "all" are intentional. Omitted words and phrases shall be supplied by inference.

When a word such as "proper", "satisfactory", "equivalent", and "as directed" is used, it requires Engineer's review.

"Provide" means furnish and install.

"Working Day" wherever used in these specifications shall mean the normal working days, Monday through Friday, exclusive of Saturday, Sunday and f federally observed holidays.

Architect - Engineer hereinafter abbreviated A/E shall mean both the Design Architects and the Design Engineers.

Design Engineer hereinafter abbreviated D/E shall mean the engineering firm.

Electrical Contractor hereinafter abbreviated E/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the electrical division work.

Mechanical Contractor hereinafter abbreviated M/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the mechanical division work.

General Contractor hereinafter abbreviated G/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the general division work.

Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred too.

1.3 GENERAL EXTENT OF WORK:

Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which M/C could have informed himself before bids were taken.

M/C shall familiarize himself with equipment provided by other Contractors, which require mechanical connections and controls.

1.4 LOCAL CONDITIONS:

Visit site and determine existing local conditions affecting work in contract.

Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.5 CODES, ORDINANCES, RULES AND REGULATIONS:

Provide work in accordance with applicable codes, rules, ordinances, and regulations of Local, State and Federal Governments and other authorities having lawful jurisdiction.

Conform to latest editions and supplements of following codes, standards or recommended practices as adopted by the authority having jurisdiction.

1. CITY CODES:

2012 International Building Code.
2012 International Plumbing Code.
2012 International Fuel Gas Code.
2012 International Mechanical Code.
2012 International Fire Protection Code.

2. SAFETY CODES:

National Electric Safety Code Handbook H30- National Bureau of Standards.
Occupational Safety and Health Standards - Department of Labor.
Specifications for Making Buildings and Facilities Accessible To, and Usable By, the Physically Handicapped - American National Standards Institute ANSI Al 17.1

3. NATIONAL FIRE CODES:

NFPA No. 54 Gas Appliance and Gas Piping Code.
NFPA No. 70 National Electric Code - 2005 Edition.
NFPA No. 89M Clearances, Heat Producing Appliances.
NFPA No. 90A Air Conditioning and Ventilation Systems.
NFPA No. 91 Blower and Exhaust Systems.
NFPA No. 101 Life Safety Code - Current Edition.

Where following standards are applicable to equipment specified, equipment shall conform to requirements of standard and shall display the appropriate seal or seals:

AGA - The American Gas Association Laboratories.
ASME - American Society of Mechanical Engineers.
NSF National Sanitation Foundation.
UL Underwriters Laboratories Inc.

Drawings and specifications indicate minimum construction standards, but should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall execute work in accordance with such ordinances, laws, codes rules or regulations without increased cost to Owner, but not until he has referred such variances to A/E for approval.

M/C shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submits two copies to A/E with request for final inspection.

CONTRACT CHANGE:

Changes or deviations from contract; including those for extra or additional work must be submitted in writing for review of A/E. No verbal orders will be recognized.

Changes in the work shall be submitted in accordance with AIA Document A201. General Conditions of the Contract for Construction.

All change proposals shall be itemized indicating separately the costs for materials, labor, restocking changes, freight, bonds, insurance, overhead and profit. All materials shall be listed separately with quantities and individual unit prices. Labor factors shall be from a nationally recognized source with appropriate adjustment factors.

LOCATIONS AND INTERFERENCES:

Locations of equipment, piping and other mechanical work is indicated diagrammatically by mechanical drawings. Determine exact locations on job, subject to structural conditions, work of other Contractors, access requirements for installation and maintenance and to approval of A/E.

Study and become familiar with contract drawings of other trades and in particular the general construction plans and details to obtain necessary information for figuring installation. Cooperate with other workmen and install work to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitations may be permitted if reviewed by A/E prior to installation.

Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, his subcontractor, or his workmen shall be restored as specified for new work.

Do not scale mechanical and electrical drawings for dimensions. Accurately lay out work from dimensions indicated on architectural drawings unless such be found in error.

SYSTEM PERFORMANCE:

Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended, work shall include required adjustment of systems and control equipment installed under this specification.

1.9 WARRANTY:

M/C warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after date of substantial completion of building and acceptance of mechanical systems by Owner.

Where manufacturers' warranties expire during the one-year warranty period, M/C shall include provisions for extending warranty for the full one-year period and shall include cost for warranty extension in his base bid. Where warranty extensions are not available from manufacturer, supplier or installer, M/C shall provide labor, parts and material warranty services equal to the requirements of these specifications and the terms of the manufacturer, supplier and installer warranties.

M/C warrants to Owner and Architect that on receipt of written notice from either of them within one-year warranty period following date of acceptance all defects that have appeared in materials and /or workmanship, shall be promptly corrected to condition required by contract documents at M/C's expense.

The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10 MATERIALS, EQUIPMENT AND SUBSTITUTIONS:

The intent of these specifications is to allow ample opportunity for M/C to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

In general, these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturers' product, series, model, catalog and/or identification numbers shall set quality and capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer's names are listed they are considered an approved manufacturer for the product specified, however, the listing of

their names implies no prior approval of any product they may propose to furnish as equivalent to the first named product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for M/C's base bid proposal it shall be his responsibility to determine prior to bid time that his proposed materials and equipment selections are products of approved manufacturers, that will meet or exceed the specifications and are acceptable to the D/E.

Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to A/E for review prior to procurement.

Prior to receipt of bids, if M/C wishes to incorporate products other than those named in Specifications in his bid, he shall submit a written request for review of substitutions to D/E not less than five working days prior to bid date. D/E will review requests and acceptable items will be listed in an addendum issued to principal bidders.

Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by A/E whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including E/M's name, model, and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

In proposing a substitution prior to or subsequent to receipt of bids, include in such proposal cost of altering other elements of Project, including adjustments in mechanical-electrical service requirements necessary to accommodate such substitution; whether such affected elements be under this contract or under separate contracts.

Within seven working days after bids are received, apparent low bidder shall submit to A/E for approval three copies of a list of all major items of equipment he intends to provide. As soon as practicable and within 30 working days after award of Contract, M/C shall submit shop drawings for equipment and materials to be incorporated in work, for A/E review. Where 30 day limit is insufficient for preparation of detailed shop drawings

on major equipment or assemblies, M/C shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

After execution of contract, substitution of product brands for those named in Specifications will be considered, only if:

Request is received within thirty days after Contract date and request includes statement showing credit due Owner, if any, if substitution products are used.

or

Owner requests consideration be given to substitute brands.

1.11 SHOP DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTION:

M/C shall furnish digital shop drawings of all materials and equipment for review by A/E. Engineer will review shop drawings a maximum of two times for compliance with construction documents. If M/C does not provide adequate documentation to complete the reviewed equipment after a second time, the cost for additional reviews will be $500 per review.

Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fittings, sizes, etc. that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, OR PLAN SHEET NUMBER when item does not appear in specifications. Where equipment submitted does not appear in base specifications of specified equivalent, mark submittals with applicable alternate numbers, change order numbers, change order number or letters of authorization. Each submittal shall contain at least two sets of original catalog cuts. Each catalog sheet shall bear E/M's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

M/C shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the A/E for their review. All shop drawings submitted to A/E shall bear M/C approval stamp, which shall indicate that M/C has reviewed submittals and that they meet specification and/or drawing requirements. M/C's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting M/C's approval shall be returned to his supplier for resubmittal.

No shop drawings submittals will be considered for review by the A/E without M/C's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review.

A/E will not be responsible for the cost of returning shop drawing submittals that are submitted to them without M/C's review and approval stamp. A letter will be sent to M/C by either the Architect or Engineer indicating receipt of an improper submittal. M/C shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. A/E will hold improper submittals for pick-up by M/C or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals will be disposed of by A/E.

A/E's review of shop drawings will not relieve M/C of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner of his representative, nor shall it relieve M/C of responsibility for errors in shop drawings. No work shall be fabricated until A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be M/C's responsibility.

Operating and Maintenance Instructions:

Submit with shop drawings of equipment three copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Instructions shall be prepared by E/M.

Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain a receipt for same upon completion of project.

Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to A/E for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:

Certified equipment drawings and/or catalog data with equipment provided clearly marked as outlined under this specification.

Complete installation, operating, maintenance instructions and parts lists for each item of equipment.

Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical systems.

Provide brochures bound in appropriately sized vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

Project name and address.

Section of work covered by brochure, i.e., "Heating Ventilating and Air Conditioning", and "Plumbing" etc.

RECORD DOCUMENTS:

Record Drawings: Maintain a reproducible set of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations, which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding location on working drawings. Mark with red erasable red pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Markup new information, which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings of shop drawings. Give particular attention to concealed work, which would be difficult to measure and record at a later date. Note related change-order numbers where applicable. Organize record drawing sheers into manageable sets, bind with durable paper cover sheets, and prints suitable titles, dates and other identification on cover of each sheet.

Record Specifications: Maintain one copy of specifications, including addenda, change orders, and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of option, and similar information on work where it is concealed or cannot otherwise by readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable. Upon completion of mark-up, submit to Architect/Engineer for Owner's records.

As-built documents shall be submitted for approval prior to final payment. Copies of “In-Progress” asbuilt drawings shall be submitted at each pay request.

ELECTRICAL REQUIREMENTS:

Consult Division 16 electrical specifications for work to be provided by E/C in conjunction with installation of mechanical equipment.

Electrical work required to install and control mechanical equipment, which is not shown on plans or specified, shall be included in M/C's base bid proposal.

The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment, which was not used for basis of design as outlined in specifications, shall be paid by M/C at no cost to Owner or A/E.

M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

Furnish electrical wiring diagrams to A/E and three complete sets to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.

M/C shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approval form which shall be presented monthly, or on request, to E/C. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow E/C to order electrical equipment required in his contract.

Safety disconnect switches and manual and magnetic motor starters shall be provided by E/C. Exceptions will be allowed where mechanical equipment is provided with these devices installed as part of factory built control systems.

END OF SECTION 15010

SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and section 15010 - General Mechanical Requirements shall apply to this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXCECUTION

3.1 CUTTING AND PATCHING:

M/C shall do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Architect's approval and in a manner approved by him.

Patching shall be by mechanics of particular trade involved and shall meet approval of Architect.

Drilling and cutting of openings through building materials requires Architect's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Do not use star drill or air hammer for this work.

3.2 PIPE SLEEVES:

Provide proper type and size pipe sleeves and install in walls or floors and where otherwise noted. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab on grade except where penetrating a membrane waterproof floor.

Each sleeve shall be continuous through wall, floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved. Sleeves shall be required through floors subject to flooding such as toilet rooms, equipment rooms and kitchens. The contractor shall have the option of:

Providing a cast iron sleeve with integral flanges extending 1 inch above finished floor. Sleeve shall be cast in concrete when floor is poured. Annular space between sleeve and pipe shall be filled with Kaowool.

or

Provide core-drilled opening in concrete with Thunderline Link-Seal or Calpico Sealing Linx between piping and opening.

Sleeves passing through floors with waterproof membranes shall be core-drilled and sealed with Thunderline Link-Seal or Calpico Sealing Linx.

Sleeves passing through walls with waterproof membranes shall be sealed with Thunderline Link-Seal or Calpico Sealing Linx.

Pipe insulation shall run continuous thru pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing thru firewalls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Provide Kaowool fire master bulk packing between sleeve and metal jacket. Packing thickness shall be sized per manufacturer's recommendation for maintaining the integrity, of the fire wall/floor or smoke partition. Fire protection system shall be rated per ASTM E 119. Equivalents to Kaowool are 3M, Flame Stop or Flame Safe.

Where piping passes through walls serving as air plenums or chases, seal annular space between pipe and sleeve air tight with Kaowool Firemaster Bulk Packing.

3.3 OPENINGS:

This Contractor shall include the installation of all boxes and sleeves for openings required to install this work, excepting only structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. He shall set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown.

Penetrations in walls for sheet metal ducts shall be sealed by the M/C by stuffing glass fiber into the cracks between the walls, and floors and the ducts. The exposed joints shall then be caulked on each side with non-hardening caulking such as "Tremco Acoustical Sealant". This work applies to all walls in buildings.

3.4 MUTILATION:

Mutilation of building finishes, caused by installation of mechanical equipment, fixtures, piping and other mechanical devices shall be repaired at M/C's expense to approval of Architect.

3.5 WELDING:

Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standards B31.1.

Welding shall be done only by welders who have successfully passed welder qualification tests in previous 12 months for type of welding required. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of

a list of welders who will work on project listing welders' code, date and types of latest qualifications test passed by each welder.

Welded joints shall be fusion-welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

3.6 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS:

Work shall include mounting, alignment and adjustment of systems and equipment.

Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown specified or required by E/M's installation instructions.

PAINTING OF MATERIALS AND EQUIPMENT:

Equipment and materials exposed to interior dry environment shall have a minimum of one primer and one finish coat. Equipment and materials mounted in exterior location shall have a minimum if one primer and two finish coats with total thickness of at least 5 mils. Finish coat colors in finish areas shall be as selected by A/E.

After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.

Where extensive refinishing of factory-applied finishes are required, equipment shall be completely repainted. A/E will make final determination on extent of refinishing required.

Paint all exterior natural gas piping with one primer coat and two finish coats.

MAINTENANCE OF SYSTEMS:

M/C shall be responsible for operation, maintenance and lubrication of equipment installed under his contract.

3.9 FILTERS:

Provide temporary MERV 8 throw-away filters in all permanent heating and air conditioning equipment systems and the return ductwork being utilized during construction. Prior to testing

and balancing systems, remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment for final acceptance inspection by A/E.

Final filters shall have a MERV 8 rating.

3.10 ACCESS PANELS:

Duct Access Doors: Doors shall be equivalent to CESCO Model 14AD-5. Frame shall not be less than 22 gauge galvanized steel, with 24 gauge door panels. Doors shall have minimum 1" thick insulation, PVC foam tape gaskets; zinc plated steel continuous type hinge and latches. Equivalent by Nailor.

Mechanical Wall Access Doors: Doors shall be equivalent to CESCO Model FW-SS, all purpose access panel. Frame shall be 16-gauge stainless steel #304, with 14-gauge stainless steel #304 frame. The hinge shall be continuous stainless steel – concealed. The latch shall be flush mounted screwdriver operated cam latch. The finish shall be #304 stainless steel with a #4 satin finish.

3.11 CLEANING OF SYSTEM AND EQUIPMENT:

After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment.

Clean equipment as recommended by manufacturers. Where specific instructions are not provided by equipment manufacturer clean equipment systems as follows:

Air Handling System: Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blowers, etc., with throwaway filters specified under this specification. After cleaning air system install temporary filters and run continuously for 8 hours at full volume.

START-UP, CHANGE-OVER, TRAINING AND OPERATIONAL CHECK:

M/C shall perform initial start-up of systems and equipment and shall provide necessary supervision and labor to make first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including E/M's technicians when specified, and Owner's operating personnel shall be present during these operations.

3.13 PRE-FINAL AND FINAL CONSTRUCTION REVIEW:

At M/C's request, A/E will make pre-final construction review to determine if to the best of their knowledge project is completed in accordance with plans and specifications. Items found by A/E as not complete or not in accordance with requirements of contract will be outlined in report to

M/C. After completion and/or correction of these items M/C shall notify Architect, he is ready for final review.

All necessary system adjustments including air and water systems balancing shall be completed and all specified records and reports submitted in sufficient time to be received by A/E at least ten working days prior to date of final construction review.

At final construction review, M/C and his major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by A/E, that his work complies with purpose and intent of plans and specifications. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 15050

SECTION 15060 – HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

Provide and be responsible for location of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturer's Standardization Society Specification (MSS) SP-58.

PART 2 - PRODUCTS

PIPE HANGERS AND SUPPORTS:

Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1 ¼”	3/8”	8 ft.
1 ½” to 2”	3/8”	10 ft.
2 ½” to 3 ½”	½”	12 ft. 4” to 5”
	5/8”	15 ft.
6”	¾”	17 ft.

Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIUM SPACING
Up to 1”	3/8”	6 ft.
1 ¼” and 1 ½”	3/8”	8 ft. 2”
	3/8”	9 ft. 2 ½”
	½”	9 ft.
3” and 4”	½”	10 ft.

Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used. Hanger rods shall be subjected to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support details to Architect-Engineer for review prior to fabrication.

Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	½" thru 4"	CT-121
Steel	¾" thru 20"	261

Provide Grinnell Fig. 194, 195, 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.

Provide Grinnell Fig. 167 protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation. Omit copper plating on hangers mounted outside insulation on copper tubing.

Structural Attachments for pipe hangers shall be as follows:

Concrete Structure: Provide Grinnell Fig. 285 concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge type concrete insert for loads up to 1200 lbs.

Steel Beam Structure: Provide Grinnell Fig. No. 86 malleable iron C-clamp for pipe size 2" and smaller and Grinnell Fig. 229 malleable iron beam clamp for pipe size 2-1/2" and larger.

PIPE MATERIAL	PIPE SIZE	HANGER FIG NO.
Copper	½" thru 4"	CT-65*
Steel	3/8" thru 4"	65
Steel	5" thru 30"	260

Provide Anvil Fig. 45 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIAL	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	PS1100*	PS1901
Steel	3/8" thru 6"	PS1100	PS1902

*Copper Plated

Provide necessary structural steel and attachment accessories for installation of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with A/E prior to installation.

Provide Control Devices HGR series vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

Provide necessary structural steel and attachment accessories for installation of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with A/E prior to installation.

All piping installed on roofs shall be supported by Cooper B-line C-Series or equivalent roof pipe supports. The bas of the support shall be manufactured from UV resistant rubber.

EQUIPMENT ANCHORS:

Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

2.3 CONCRETE INSERTS AND ANCHORS:

Provide concrete inserts for attaching piping and equipment as follows:

In new construction where attachment points can be predetermined, provide PHD Fig. 950 continuous concrete insert of Fig. 950N Universal Steel Concrete insert.

In existing construction or new construction where attachment points cannot be located before setting concrete forms provide McCullock Kwik-Bolt or Phillips red head concrete anchors of proper type for attachments.

PART 3 - EXCECUTION

3.1 PIPE HANGERS AND SUPPORTS

Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments so that rod is vertical in hot position. Hangers shall not become disengaged by movements of supported pipe.

Provide sufficient hangers to adequately support piping system at specified spacing at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustments to maintain pitch required for proper drainage and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.

Hangers in direct contact with copper pipe or tubing shall be copper plated.

Support plastic piping as recommended by piping manufacturer.

Mount hangers for insulated piping on outside of pipe, hangers sized to allow for full thickness of pipe insulation.

END OF SECTION 15060

SECTION 15080 – PIPING INSULATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 PIPING INSULATION:

Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in insulation schedule.

Provide insulation materials manufactured by Certain Teed, Knauf, Dow Chemical, Johns Manville or Owen/Corning Fiberglas.

Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Provided insulation accessories such as adhesives, mastics, cements, tape and glass fabric with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke ratings. Treatment of jackets or facings for impart flame and smoke safety shall be permanent. Use of water-soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.

Where glass is specified in the following insulation methods provide resin impregnated with open weave glass fabric with 10/20 thread count.

Abbreviations for manufacturers of adhesives, mastics and coating specified shall be C.M. for Chicago Mastic Company and B.F. for Benjamin Foster Company.

Pipe insulation materials and application methods by type shall be as follows:

Elastomeric: Insulation for cold surface piping system with -40 degrees F to +220 degrees F operating temperature range shall be Armstrong AP Armaflex Elastomeric Pipe insulation average thermal conductivity shall not exceed 0.27 BTU/Hr. at 75 degrees F mean temperature. To greatest extent possible, apply insulation without longitudinal joint by slipping insulation over piping. Seal all seams and butt joints with Armstrong 520 adhesive. Insulate fittings as follows:

Insulate fittings with Miter-Cut pieces of AP Armaflex pipe insulation equal to thickness of adjoining pipe insulation. Insulate fittings too large to cover with pipe insulation with insulation from fabricated Armaflex sheet insulation using Armstrong templates. Join and seal all fittings joints with Armstrong 520 adhesive. Finish insulation as soon as possible with two coats of Armstrong Armaflex vinyl- lacquer finish in color selected by Architect. All insulation used outdoors shall be painted to prevent ultra violet deterioration of insulation.

Fiberglass: Insulation for hot and cold surface piping systems with -60 degrees F to +850 degrees F operating range shall be Owens-Corning Fiberglas 25 pipe insulation with white fire retardant ASJ jacket. Average 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows:

Insulate exposed and concealed valves and fittings with PVC premolded fitting covers. Provide "Zeston" Series 300 fitting covers as manufactured by Johns Manville.

Insulation materials and application methods for piping hangers supports, anchors, guides, expansion joints, etc., shall be as follows:

Insulate hangers and supports from direct contact with cold surfaces with Styrofoam HD- 300 plastic foam inserts of half or full sections of premolded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2" over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degrees of pipe insulation sized so that pipe compressive load does not exceed one third of insulation insert compressive strength. Seal joints with vapor barrier sealer specified for insulation type used.

Insulate pipe anchors in direct contact with cold piping for a distance of 12" or as detailed on drawings from contact point with piping. Anchor insulation shall be one-half the thickness of adjoining pipe insulation with vapor barrier. Seal and finish joints with vapor barrier sealer specified for insulation type used.

Insulate pipe guides from direct contact with cold surfaces piping with Styrofoam HD-300 plastic foam full section inserts of premolded pipe insulation equal in thickness to adjoining pipe insulation. Provide inserts with vapor barrier jacket for overlapping 2" over adjoining pipe insulation. Insert jacket shall be equal in performance and appearance to adjacent insulation jacket. Seal and finish joints with vapor barrier sealer specified for insulation type used.

Insulate pipe expansion joints on cold surface piping with over-sized section of premolded pipe insulation equal in thickness to adjoining pipe insulation. Cover shall float free one end with expansion and contraction of piping system. Seal free end with 4-mil thick PVC vinyl sheet attached to adjoining insulation. Provide sufficient slack in vinyl material to allow for maximum pipe movement.

Where piping hanger cannot be isolated from cold pipe surfaces, insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point 12" above pipe with

minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer specified for insulation type used.

Insulate floor supports in direct contact with cold surface piping with Armstrong 1/2" thick Armstrong FR/Armaflex pipe or sheet insulation as required by surface. Insulate supports from pipe to floor plate and seal insulation joints with Armstrong No. 520. Finish insulation with Armstrong Armaflex vinyl-lacquer finish.

PIPING INSULATION SCHEDULE

Service	Size	Type	Thickness
Heating Hot Water	0.5”-2”	Fiberglass	1”
Heating Hot Water	2”-Larger	Fiberglass	1.5”
Air Conditioning Condensate Drain (interior)	All	Fiberglass	1/2”
Refrigerant Suction Lines (Interior)	All	Elastomeric	1/2”
Refrigerant Suction Lines (Exterior)*	All	Elastomeric	1/2”

*All exterior piping insulation shall be painted with ultraviolet-resistant paint, Color as selected by architect.

**Install hard PVC covering over insulation where piping insulation is exposed (not concealed above ceiling).

PART 3 - EXCECUTION

Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc., shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degrees angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers. Seal butt joints at maximum intervals of 45 feet to prevent vapor barrier failures from being transmitted to adjoining insulation sections.

Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

All pipe insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.

Insulation of removable heads and valves, manholes access covers, HVAC and plumbing pumps, etc., shall be fabricated to allow removal without damage to insulation. Provide removable units with vapor-proof cover fabricated to be sealed to equipment vapor barrier.

Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at M/C's expense at not cost to Own

END OF SECTION 15080

SECTION 15085 – DUCTWORK INSULATION

PART 1 – GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 – PRODUCTS

DUCTWORK INSULATION:

Provide necessary materials and accessories for installation of interior and exterior ductwork insulation as specified and/or details on drawings. Insulation type and thickness for specific ductwork systems shall be as listed in Insulation Schedule of this specification.

Provide insulation materials manufactured by Armstrong Cork Co., CertainTeed/Saint Gobain.

Insulation and application adhesives, except where specified otherwise, shall have fire and smoke hazard rating as tested by ASTM E-84 procedure not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Abbreviations for manufacturers of adhesives, insulating cements and coating specified shall be C.M. for Chicago Mastic Company, B.F. for Benjamin Foster Company and 3M for 3M Company. Average thermal conductivity is expressed in BTU/Hr./Sq.Ft./degrees F/In.

Install interior duct liner insulation cut to insure tight fitting corner, and longitudinal joints. Apply liner to sheet metal with 100% coverage of C.M. No. 17-477, B.F. No. 81-18 or 3M manufacturers recommended applications rate. Coat all edges of liner with adhesive. Provide mechanical fasteners on surfaces 18" or wider in addition to liner adhesive with fastener clips set flush with duct liner surface. Provide fasteners as follows:

Low Velocity Ductwork (Velocities less than 2000 FPM): Provide fasteners within 3" of leading edge of each section 12" O.C. around joint perimeter and 3" from longitudinal joints 12" O.C. Elsewhere space fasteners 18" O.C. except not more than 6" from longitudinal joints nor 12" from corner break.

High Velocity Ductwork (Velocities 2000 or 6000 FPM): Provide fasteners within 3" of leading edge of each section 6" O.C. around joint perimeter and 3" from longitudinal joints 6" O.C. Elsewhere space fasteners 16" O.C. except not more than 6" from longitudinal joints nor 12"

from corner break. Provide liner upstream leading edges on ducts with velocities 4000 FPM and greater with metal nosing or channels. The above fastener spacing and nosing are minimum requirements. Where liner manufacturer recommends nosing at lower velocities close fastener spacing or fasteners on smaller ducts, provide fasteners in accordance with their recommendations.

Provide concealed rectangular or round ductwork with exterior thermal insulation of type and thickness listed in schedule. Apply insulation to duct with C.M. No. 17477 or B.F. No. 85-20 adhesive. Provide mechanical fasteners 18" O.C. on duct width 30" and greater. Butt insulation joints tightly together and lap facing 2" over adjacent insulation and seal with vapor barrier adhesive. Seal all breaks with vapor barrier adhesive and vapor barrier tape matching insulation facing.

Provide exposed rectangular ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply with mechanical fasteners spaced 12" O.C. with minimum of two rows per duct side. Seal fasteners, joints, breaks, and punctures with vapor barrier adhesive reinforced with 3" wide vapor barrier tape matching insulation facing.

Provide exposed round sheet metal ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply insulation with joints tightly butted together with vapor barrier adhesive. Insulate fittings with insulation thickness equal to adjoining insulation with cover overlapping 2" onto adjacent covering.

Duct insulation materials by type shall be as follows:

TYPE 1-DIL: Internal acoustical and thermal duct insulation for low velocity ductwork shall be Certain Teed 2.0 lb. density duct liner with .021 average air friction and .23 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.

TYPE 2-DIH: Internal acoustical and thermal duct insulation for high velocity ductwork shall be Certain Teed 3.0 lb. density duct liner with .022 average friction co-efficient and .22 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.

TYPE 3-DEW: External thermal insulation for rectangular or round duct shall be Certain Teed 1.0 lb. density standard duct insulation type IV with foilscrim-kraft facing and .27 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.

TYPE 4-DEW: External thermal insulation for rectangular or round duct shall be 2” rigid Styrofoam aquare edge per ASTM C578, with applied vapor retarder jacket wrapped with a 16mil thick aluminum stucco embossed jacket and sealed watertight. Equals by prior approval only.

DUCTWORK INSULATION SCHEDULE

System	Type	Thickness
Supply Air – Rectangular – Low Velocity	1-DIL	½”
Supply Air – Rectangular – High Velocity	2-DIH	½”
Supply Air – Round	3-DEW	1 ½”
Return Air – Rectangular	1-DIL	½”
Return Air – Round	3-DEW	1 ½”
Exterior Supply Air – Rectangular	4-DEW	2”

PART 3 – EXCECUTION

Ductwork scheduled for internal lining is NOT sized on the drawings to include the lining. Size shown on the drawings is the inside duct measurement.

END OF SECTION 15085

SECTION 15110 – GENERAL-DUTY VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 VALVES AND INSTALLATION:

Valves 2-1/2" and smaller shall have solder, socket weld, flanged or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections or butt weld ends as scheduled. Optional grooved valves may be used where scheduled.

Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Architect-Engineer, non-rising stem valves may be installed at particular points where space is restricted.

Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe-joining method, and fluid or gas conveyed in system.

Valves shall be the same size as piping. Do not reduce valve size.

Valves shall be designed for repacking under pressure when fully opened and back seated.

Equivalent gate and plug valves listed on current comparison charts of specified valve manufacturers by Anvil, Crane, Centerline, Nibco, Fairbanks, Hale, Stockham, Jenkins, Kennedy, Keystone, Powell, Walworth or Victaulic will be acceptable.

Equivalent silent check valves listed on current comparison charts of specified valve manufacturers by Anvil, Combination Pump Valve Co., Pagent, Nibco, Stockham, Williams Hager, Mission or Victaulic will be acceptable.

2.2 VALVES:

Ball valves shall be scheduled as Type "BLV" valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
BLV-1	3" valves and smaller, Crane bronze full port ball valve 600 PSI-WOG, Teflon seats, stainless steel ball, stem with insulated handle

(Model no. 9303-S), with screwed ends.

Balancing valves shall be scheduled as Type "BAV" valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
BAV-1	4" valves and smaller, Bell and Gossett Model CB circuit setter balance valve, bronze body, 125 PSI-WP at 250 degrees F precision machined orifice calibrated position indicator, meter connections with built-in check valves flanged ends. Provide complete with Polyurethane insulation cover.

Silent check valves shall be scheduled as type "SCV" valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
SCV-1	2" valves and smaller Anvil Fig. 3600 bronze check valve, 250 PSI-WOG, stainless steel spring, stainless steel stem, Teflon disc and seat ring, screwed or solder ends.
SCV-2	2-1/2" and larger Metra flex Style 900 ANSI Class 125 iron body, stainless steel trim check valve 125 PSI-ASA with flanged ends.

Plug valves shall be scheduled as type PLV valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
PLV-1	1 " valves and smaller Hays 7400 series iron body gas cock, 175 PSI-WOG bronze plug washer and nut, screwed ends.
PLV-2	1-1/4" thru 2-1/2" valves, Homestead Fig. 651, semi-steel lubricated plug valve, 200 PSI-WOG, coated plug, short pattern screwed ends. Provide complete with standard pattern cast handle.

PART 3 - EXCECUTION

VALVES AND INSTALLATION:

Install necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.

Install each valve so that it is easily accessible for operation, visual inspection, and maintenance.

Install globe valves with pressure on top of disc except where prevented by code. Globe valves installed in lines that must be completely drained for inspection, maintenance or to prevent freezing shall be installed with stem in horizontal position to insure complete drainage of pipelines.

Gate valves shall not be installed in pipelines where intended service is throttling service or where piping is subject to vibration as part of normal operation conditions.

END OF SECTION 15110

SECTION 15140 – PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 PIPING IDENTIFICATION:

Lettering on marker shall be at least 1-inch high block type in contrasting color. An arrow indicating flow direction shall be painted next to each marker. Where markers occur on parallel groups of piping they shall be neatly lined up. Match existing piping identification colors and designations.

2.2 PIPING MATERIALS AND FITTINGS:

Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. Not all materials listed may be required on this project. See piping material schedule.

1. Carbon Steel Pipe (1/8" through 2-1/2"):

Provide continuous weld or electric resistance welded carbon steel pipe conforming to ASTM Specification A-120 or A-53 as scheduled.

Pipe joints shall be threaded conforming to ANSI Standard B2.1.

Pipe by Armco, Youngstown, United States Steel or equal.

2. Polyvinyl Chloride (PVC) Pipe:

Provide Type 1, Grade 1, Polyvinyl Chloride Pipe conforming to requirements of current ASTM Specification D-1785 for pressure piping as scheduled. Pipe shall be approved by National Sanitation Foundation (NSF) for potable water.

Provide Type 1, Grade 1, Polyvinyl Chloride Pipe conforming to requirements of current ASTM Specification D-2665 for DWV piping as scheduled. Cellular core PVC piping will not be approved.

Pipe for pressure piping shall have plain ends for socket type fittings.

Pipe by Chemtrol, Charlotte, Tyler or equal.

3. Copper Tube:

Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L or M as listed in schedule.

Tubing joints shall be soldered or brazed, See schedule for joining method to be used.

Pipe by Cerro, Chase, Mueller, Revere Copper or equal.

2.3 PIPING FITTINGS:

Piping fittings used throughout project shall be proper type for installation method used and shall be compatible with piping system materials. Fittings listed in piping material schedule shall conform to the following specifications:

1. Carbon Steel Welding Fittings:

Provide Carbon Low Alloy Seamless Steel Welding Fittings conforming to current ANSI Standard B16.9 and ASTM Specification A234.

Fittings by Anvil, Midwest or equal.

2. Branch Connection Welding Fittings:

Provide carbon steel Weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM Specification Al 05 grade 11.

Fittings by Bonney Forge or equal.

3. Branch Connection, Welding to Screwed Fitting:

Provide carbon steel Threadolet fitting conforming to ANSI Standards B16.9, B16.1 1, B31.1 and ASTM Specification A105 Grade 11.

Fittings by Bonney Forge or equal.

4. Carbon Steel Flanges:

Provide carbon steel flanges conforming to ASTM Specification A181 Grade 1 and ANSI Standard B16.5.

Flanges by Anvil, Midwest or equal.

5. Malleable Iron Screwed Fittings:

Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, B2.1 and ASTM Specification A-47 grade 32510.

Fittings by Crane, Anvil, Stockham or equal.

6. Cast Iron Screwed Fittings:

Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.

Fittings by Crane, Anvil, Stockham or equal.

7. Wrought Copper Fittings:

Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22.

Fittings by Chase, Nibco or equal.

8. Cast Bronze Fittings:

Provide cast bronze solder joint fittings conforming to ANSI Standard B16.18.

Fittings by Chase, Nibco or equal.

9. PVC, DWV Fittings:

Provide PVC, DWV socket fittings conforming to ASTM D-3311 and D-2661.

Solvent cement of socket fittings shall conform to ASTM D-2235.

Fittings by Chemtrol, Charlotte, Tyler or equal.

2.4 INSULATING UNIONS AND FLANGES:

Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturer's name and pressure class rating. Unions and flanges shall be as follows:

1. Iron or steel pipe to copper pipe:

Provide Epco dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.

STRAINERS:

General: Provide Zurn "Y" type self-cleaning strainers with FIPT blow-off outlet, flanges or screwed end with pressure rating as required by piping system. Provide strainers with removable stainless steel or monel screens with perforations.

Equivalent strainers by Armstrong, Metraflex, Trane, Nibco, Victaulic or Spirax Sarco.

2.6 UNIONS:

Provide Stockham brass seat unions of material and pressure rating required by piping system.

Equivalent union by Metraflex, Grinnell or equal.

PART 3 - EXCECUTION

3.1 PIPING IDENTIFICATION:

Identify piping in mechanical rooms, open pipe chases, tunnels, and other places where piping is accessible for operation and maintenance by painting with identification colors and with pressure sensitive pipe markers.

Place piping markers so they can be easily read from operating position and floor.

Mark piping with marker and a 3-inch wide bank of identification color around circumference of pipe in lieu of painting complete pipe or pipe covering.

STRAINERS:

Install strainers upstream from automatic control valves, steam traps and pumps. Where strainers are an integral part of these items or incorporated in accessory equipment directly upstream, individual line strainers will not be required. Strainers shall be same size as piping. Provide strainers with proper isolation and blow down valves to allow basket removal for cleaning.

UNIONS:

Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.

Where piping systems of dissimilar materials are jointed together, provide proper insulating union as specified under this specification.

3.4 PIPING INSTALLATION:

Pipe sizes indicated on plans and as specified refer to nominal size in inches for steel pipe, cast iron pipe and copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.

Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturers' recommendations for fixed hanger and supports. Provide copper plated hangers and supports for suspension of uninsulated copper tubing lines.

Install all piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. All piping shall be concealed unless noted otherwise. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.

Provided piping materials and wall thickness for specific piping systems as listed in piping schedules on drawings. Steel piping systems 2-1/2" under shall be threaded pipe and fittings. Steel pipe systems 3" and above shall be weld end pipe and fittings unless required otherwise by Code.
Provide unions or flanged joints in each pipeline preceding connections to equipment to allow removal for repair or replacement. Provide all screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line. Provide unions on identical sizes of equipment for which one replacement item to be installed between unions without making any piping changes.

Piping fitting materials for specific piping systems shall be as listed in piping schedule. Fittings shall be approved factory made type with threaded or weld ends as required. Fitting pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipefittings will be permitted.

All pipe threads shall meet ANSI Standard B2.1 for taper threads. Lubricate pipe threads with Astroseal teflon thread sealant and lubricating compound applied full strength. Powdered or made up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.

Welded pipe joints shall be made by qualified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe fitting ends shall be beveled a minimum of 30 degrees prior to welding.

Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.

Soft soldered socket type joints shall be made in with 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket joints shall be limited to systems containing nonflammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock or vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.

Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings 2-1/2" and smaller shall be threaded type, pipe and fittings 3" and larger shall be weld type. Provide fittings suitable for at least 125-PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

TESTING PROCEDURES:

Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests. Where entire system cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as an entire system.

Repair or replace defects, leaks and materials failures revealed by tests and then retested until satisfactory. Make repairs with new materials.

Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings remove or isolate components from system during tests.

Test methods and pressures shall be as follows:

1. Hydrostatic Test (Closed Systems):

Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.

2. Hydrostatic Test (Open System):

Test entire system with 10-foot head of water. Where system is tested in sections, each joint in building except uppermost 10 feet of system shall be submitted to at least 10 feet head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.

3. Pneumatic Test:

Test entire system with compressed air. Systems operating above 2 PSI shall be tested at 75 PSI or 150% of operating pressure or whichever is greater.

Allow at least 1 hour after test pressure has been applied before making initial test.

During test, completely isolate entire system from compressor or other sources of air pressure.

All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.

Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.

For test pressures, see Piping Material Schedule on drawings.

3.6 PIPING PROTECTIVE COATING:

Prepare and coat field made pipe joints and make coating repairs according to manufacturer's recommendation. Cover joints with shrinkable polyethylene sleeve. Coated piping passing through pipe sleeve shall have double thickness coating through sleeve.

END OF SECTION 15140

SECTION 15730 - PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

REFERENCES

NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
ARI 340 - Commercial and Industrial Unitary Heat pump Equipment.
ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
California Energy Commission Administrative Code - Title 20/24 - Establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California.
ARI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment.
ARI 270 - Sound Rating of Outdoor Unitary Equipment.
ARI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
ANSI/NFPA 70-1995 - National Electric Code.

DELIVERY, STORAGE and HANDLING

Contractor shall be responsible for receiving equipment from shipping company. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

Protect units from physical damage. Leave factory-shipping covers in place until installation.

PART 2 - PRODUCTS

2.1 SUMMARY

Packaged rooftop unit(s) are to be supplied by Trane as shown and scheduled on the contract documents. The contractor shall be responsible for installation of units. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

UNIT DESCRIPTION

Refer to complete Trane equipment submittal included in these specifications for reference.

OPERATING CONTROLS

All temperature control systems and components are to be furnished and installed by Trane.

PART 3 - EXECUTION

3.1 EXAMINATION

Contractor shall verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

Contractor shall verify that proper power supply is available.

3.2 INSTALLATION

Contractor shall install in accordance with manufacturer's instructions.

Mount units on existing roof curbs providing watertight enclosure to protect ductwork and utility services. Install units square and level.

END OF SECTION 15730

SECTION 15815 – METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

SUMMARY

This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:

Rectangular ducts and fittings.
Single-wall, round spiral-seam ducts and formed fittings.
Double-wall, round spiral-seam ducts and formed fittings.
Duct liner.

1.3 SYSTEM DESCRIPTION

Duct system design, as indicated, has been used to select size and type of air moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

Provide commercial quality prime, bright spangled galvanized sheet steel, on all ductwork. Sheet metal shall be manufactured in the United States of America.

Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

2.2 SEALANT MATERIALS

Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

2.3 HANGERS AND SUPPORTS

Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

Hanger Materials: Galvanized sheet steel or threaded steel rod.

Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.4 RECTANGULAR DUCT FABRICATION

Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

Provide turning vanes in all elbows over 20 degrees unless otherwise noted.

Make ductwork transitions with sides sloped not to exceed a maximum of 20 degrees, 40 degrees included angle for diverging airflow and 30 degrees, 60 degrees included angle for converging air flow. Factory fabricated reducing fittings of ASME short flow nozzle design will be acceptable for round ductwork.

VAV primary supply air ductwork shall be joined with prefabricated galvanized "Ductmate” sections. The joint packing material and joint construction details using this method shall be submitted to the engineer for review.

2.5 APPLICATION OF LINER IN RECTANGULAR DUCTS

All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1 " or 2" in height and width of ductwork to accommodate insulation thickness. Mount duct specialties such as turning vanes, damper, etc., to ductwork with the section insulated "Build Outs" to maintain continuity of thermal barrier.

Adhere a single layer of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

Butt transverse joints without gaps and coat joint with adhesive.

Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

Fan discharges.

Intervals of lined duct preceding unlined duct.

ROUND DUCT AND FITTING FABRICATION (Concealed Areas)

Round, Longitudinal- and Spiral Lock-Seam Ducts (Concealed Low Pressure only): Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

Duct Joints:

Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.

Round Concealed VAV primary shall be single wall spiral lock seam. Fittings shall be “Ductmate”

2.7 DOUBLE-WALL DUCT AND FITTING FABRICATION (Exposed Structure Areas)

Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers: Lewis & Lambert or McGill Airflow.

Ducts: Fabricate double-wall insulated ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.

Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.

Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.

Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch- diameter perforations, with overall open area of 23 percent.

Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

Static-Pressure Classes: Each duct system shall be constructed throughout for the specific pressure classifications shown on the contract documents in equipment or fan schedules listed as external or total static pressure.

3.2 DUCT INSTALLATION

Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

Construct and install ductwork to be completely free from vibration under all conditions of operation. Support and securely anchor ductwork and equipment from structural framing of building. Provide suitable intermediate metal framing where required between building structural framing.

Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

Install ducts with fewest possible joints.

Install fabricated fittings for changes in directions, size, and shape and for connections.

Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and fire stopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories."

Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

Seal ducts before external insulation is applied.

HANGING AND SUPPORTING

Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

Support vertical ducts at maximum intervals of 16 feet and at each floor.

Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

Install concrete inserts before placing concrete.

Install powder-actuated concrete fasteners after concrete is placed and completely cured.

Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

CONNECTIONS

Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories & HVAC Specialties."

Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 15815

SECTION 15820 – DUCT ACCESSORIES AND HVAC SPECIALTIES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 15010 - General Mechanical Requirements, section 15050 – Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

Specialties shall be factory-fabricated items designed for low, medium or high velocity systems as indicated on contract documents. Submit shop drawings on all specialties required with shop drawings of ductwork layout. Specialties shall be as follows:

Turning Vanes: Turning vanes shall be a true airfoil design; smoothly rounded entry nose with extended trailing edge. Generated sound power level shall not exceed 54 decibels in band 4 at 2,000 FPM—duct size 24 x 24. Turning vanes shall be H•E•P–High Efficiency Profile—as manufactured by Aero/Dyne Co. or equivalent. Assemblies shall be fabricated with Aero/Dyne Co. side rails; vanes installed on design centers across the full diagonal dimension of the elbow.

Volume Dampers: (Rectangular - Velocities 1500 FPM and less) Provide Ruskin model MD35. Equivalent by Carnes, CESCO, Greenheck, Nailor, Pottorff, Prefco, Titus, United McGill, and Louvers & Dampers Co.

Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4 inch wide heat and fire resistant neoprene coated glass fabric with two 3-inch wide 24 gauge metal strips attached to each edge. Duro-Dyne Corp. or equal.

Access Doors: Provide access doors in ductwork for access to fire dampers, smoke dampers etc., installed under this contract. Doors and frames shall be furnished in prime coat of gray rust inhibitive paint. Frames shall be seamless one-piece galvanized mild steel. The doors shall be outer and inner panels one-piece galvanized mild steel. The door insulation shall be a minimum of 1 " thick. Gasket shall be positive seal and fasteners progressive action cam locks type (zinc plated). Access doors shall be Nailor, Higgins, Milcor, CESCO or equal.

PART 3 - EXCECUTION

SHEET METAL SPECIALTIES:
Install sheet metal specialties in accordance with the manufacturer’s requirements.

END OF SECTION 15820

SECTION 16010 – Description of Work

This project requires the removal and installation of RTU #1, #2, #3E, #3W, #4, and #8 from the roof of Information Commons West. The units are scheduled to be replaced with updated 2020 like units from Trane. The cut sheets are included with the spec book.

Contractor will coordinate with the crane company to remove and install all of the units and off-loading of the trucks for the delivery of the units. The contractor will be responsible for temporary storage of the RTUs at their site from the time the units arrive until the units have been installed. The units are scheduled to be delivered the week of May 11th.

The contractor will be responsible for a complete installation including all trades necessary for a complete and functional installation. The contractor is responsible for all mobilization costs necessary to complete the installation including but not limited to: Utility line protection, site disturbance or damage replacement, etc.

City permits, inspections, public utility connection fees, etc. are to be included in the contract and paid by the Contractor

Contractor will coordinate with OTC as to the disposal of the old RTUs.

END OF SECTION 16010

SECTION 16050 – Trane Submittal

Submittal

Prepared For:

Date: *February 7, 2020*

Customer P.O. Number:
Customer Project Number:

Sold To:

Job Number:
Job Name:
OTC Information Center West

Trane U.S. Inc. is pleased to provide the enclosed submittal for your review and approval.

Product Summary

Qty	Product
1	3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
3	12.5 thru 25 ton Voyager Packaged Gas/Electric Rooftop Units
2	Commercial Rooftop Air Conditioning Units (Large)

Stewart W. Rogers
Trane U.S. Inc.
540 N. Cedarbrook
Springfield, MO 65802-6324
Phone: (417) 520-3322

The attached information describes the equipment we propose to furnish for this project, and is submitted for your approval.

Product performance and submittal data is valid for a period of 6 months from the date of submittal generation. If six months or more has elapsed between submittal generation and equipment release, the product performance and submittal data will need to be verified. It is the customer's responsibility to obtain such verification.

DESIGN ASSIST SUBMITTAL

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Tag Data - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop (Qty: 1)

Item	Tag(s)	Qty	Description	Model Number
A1	RTU-4	1	8.5 Ton R-410A PKGD Unitary Gas/Electric	YHC102F4RHA--C0B1000700A7000000000000000

Product Data - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop

Item: A1 Qty: 1 Tag(s): RTU-4

DX cooling, gas heat
High efficiency
Convertible configuration
8.5 Ton
460/60/3
Microprocessor controls
High gas heat
Economizer Dry Bulb 0-100%
Standard panel/2 in pleated filters MERV 8
Standard condenser coil w/hail guard
Air-Fi wireles communication interface
Return air smoke detector
Clogged filter switch, Fan failure and Discharge air sensing tube
Power exhaust (Fld)
Curb adapter
Spring replacement on existing spring isolation curb by others (Fld)
5 Year parts, labor & refrigeration warranty
10 year heat exchanger warranty
5 year semi-annual inspection service
Start up

Performance Data - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop

Tags	RTU-4
Design Airflow (cfm)	3400
Airflow Application	Downflow
Cooling Entering DB (F)	80.00
Cooling Entering WB (F)	67.00
Ent Air Relative Humidity (%)	51.08
Ambient Temp (F)	95.00
Evap Coil Leaving Air Temp (DB) (F)	58.80
Evap Coil Leaving Air Temp (WB) (F)	57.73
Cooling Leaving Unit DB (F)	60.19
Cooling Leaving Unit WB (F)	58.26
Gross Total Capacity (MBh)	98.14
Gross Sensible Capacity (MBh)	77.86
Gross Latent Capacity (MBh)	20.28
Net Total Capacity (MBh)	94.17
Net Sensible Capacity (MBh)	73.89
Net Sensible Heat Ratio (Number)	0.78
Heating EAT (F)	60.00
Heating LAT (F)	103.80
Heating Delta T (F)	43.80
Input Heating Capacity (MBh)	200.00
Output Heating Capacity (MBh)	160.00
Output Heating Cap. w/Fan (MBh)	163.97

Tags	RTU-4
Design ESP (in H2O)	0.500
Component SP (in H2O)	0.300
Field supplied drive kit required	None
Indoor mtr operating power (bhp)	1.37
Indoor RPM (rpm)	1254
Indoor Motor Power (kW)	1.02
Outdoor Motor Power (kW)	0.70
Compressor Power (kW)	6.58
System Power (kW)	8.30
IPLV @ AHRI (IPLV)	14.7
MCA (A)	22.00
MOP (A)	25.00
Compressor 1 RLA (A)	7.80
Compressor 2 RLA (A)	4.70
Evaporator fan FLA (A)	3.60
Condenser fan FLA (A)	2.90
Evaporator face area (sq ft)	12.36
Evaporator rows (Each)	5.00
Evaporator fin spacing (Per Foot)	192
Evaporator face velocity (ft/min)	275
Min. unit operating weight (lb)	1035.0
Max. unit operating weight (lb)	1300.0
Fan motor heat (MBh)	3.97
Dew Point (F)	57.07
Ducted Discharge - 63 Hz (dB)	79
Ducted Discharge - 125 Hz (dB)	88
Ducted Discharge - 250 Hz (dB)	82
Ducted Discharge - 500 Hz (dB)	79
Ducted Discharge - 1 kHz (dB)	74
Ducted Discharge - 2 kHz (dB)	70
Ducted Discharge - 4 kHz (dB)	69
Ducted Discharge - 8 kHz (dB)	60
Ducted Inlet - 63 Hz (dB)	79
Ducted Inlet - 125 Hz (dB)	80
Ducted Inlet - 250 Hz (dB)	77
Ducted Inlet - 500 Hz (dB)	68
Ducted Inlet - 1 kHz (dB)	57
Ducted Inlet - 2 kHz (dB)	58
Ducted Inlet - 4 kHz (dB)	59
Ducted Inlet - 8 kHz (dB)	49
Outdoor Noise - 63 Hz (dB)	83
Outdoor Noise - 125 Hz (dB)	85
Outdoor Noise - 250 Hz (dB)	85
Outdoor Noise - 500 Hz (dB)	86
Outdoor Noise - 1 kHz (dB)	84
Outdoor Noise - 2 kHz (dB)	78
Outdoor Noise - 4 kHz (dB)	74
Outdoor Noise - 8 kHz (dB)	70
Rated capacity (AHRI) (MBh)	99.00
Refrig charge (HFC-410A) - ckt 1 (lb)	6.3

Tags	**RTU-4**
Refrig charge (HFC-410A) - ckt 2 (lb)	4.9
ASHRAE 90.1	Yes
Saturated Suction Temp Circuit 1 (F)	46.86
Saturated Discharge Temp Circuit 1 (F)	119.55
Saturated Suction Temp Circuit 2 (F)	57.02
Saturated Discharge Temp Circuit 2 (F)	114.82
IEER ( )	14.70
EER @ AHRI Conditions (EER)	12.5
Total Static Pressure (in H2O)	0.813
Length (ft)	7.39
Width (ft)	4.44
Height (ft)	3.91
Indoor Fan Drive Type	Variable Direct
Outdoor Fan Type	Propeller
Outdoor Fan Drive Type	Direct
Outdoor Fan Quantity ( )	1
Heating Type	Gas Heat
Heating Stages	2

Mechanical Specifications - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4

General
The units shall be convertible airflow. The operating range shall be between 115°F and 0°F in cooling as standard from the factory for units with microprocessor controls. Operating range for units with electromechanical controls shall be between 115°F and 40°F. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners.

Casing
Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing two fasteners while providing a water and air tight seal. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with 1/8", foil-faced, closed-cell insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8" high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit.

Unit Top
The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.

Two-Inch Pleated Filters
2" pleated media filters shall be available on all models.

Compressors
All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors.

Dual compressors are outstanding for humidity control, light load cooling conditions and system back-up applications. Dual compressors are available on 7½-10 ton models and allow for efficient cooling utilizing 3-stages of compressor operation for all high efficiency models.

Indoor Fan
The following units shall be equipped with a direct drive plenum fan design (T/YSC120F,T/YHC074F, T/YHC092F,T/YHC102F, 120F). Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.

3 to 5 ton units (high efficiency 3-phase with optional motor) are belt driven, FC centrifugal fans with adjustable motor sheaves. 3 to 5 ton units (standard and high efficiency 3-phase) have multispeed, direct drive motors. All 6 to 8½ ton units (standard efficiency) shall have belt drive motors with an adjustable idler-arm assembly for quick-adjustment to fan belts and motor sheaves. All motors shall be thermally protected. All 10 tons, 6 ton (074), 7½ to 8½ (high efficiency) units have variable speed direct drive motors. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).

Outdoor Fans
The outdoor fan shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.

Evaporator and Condenser Coils
Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Evaporator coils are standard for all 3 to 10 ton standard efficiency models. Microchannel condenser coils are standard for all 3 to 10 ton standard efficiency models and 4, 5, 6, 7.5, 8.5 ton high efficiency models. The microchannel type condenser coil is not offered on the 4 and 5 ton dehumidification model. Due to flat streamlined tubes with small ports, and metallurgical tube-to-fin bond, microchannel coil has better heat transfer performance. Microchannel condenser coil can reduce system refrigerant charge by up to 50% because of smaller internal volume, which leads to better compressor reliability. Compact all-aluminum microchannel coils also help to reduce the unit weight. These all aluminum coils are recyclable. Galvanic corrosion is also minimized due to all aluminum construction. Strong aluminum brazed structure provides better fin protection. In addition, flat streamlined tubes also make microchannel coils more dust resistant and easier to clean. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig. The condenser coil shall have a patent pending 1+1+1 hybrid coil designed with slight gaps for ease of cleaning. A plastic, dual-sloped, removable and reversible condensate drain pan with through-the-base condensate drain is standard.

Tool-less Hail Guards
Tool-less, hail protection quality coil guards are available for condenser coil protection.

Controls
Unit shall be completely factory-wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. A choice of microprocessor or electromechanical controls shall be available. Microprocessor controls provide for all 24V control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection. 24-volt electromechanical control circuit shall include control transformer and contactor

High Pressure Control
All units include High Pressure Cutout as standard.

Phase monitor
Phase monitor shall provide 100% protection for motors and compressors against problems caused by phase loss, phase imbalance, and phase reversal. Phase monitor is equipped with an LED that provides an ON or FAULT indicator. There are no field adjustments. The module will automatically reset from a fault condition.

Refrigerant Circuits
Each refrigerant circuit offer thermal expansion valve as standard. Service pressure ports, and refrigerant line filter driers are factory-installed as standard. An area shall be provided for replacement suction line driers.

Gas Heating Section
The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and corrosion resistant steel throughout. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The 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, the 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) and also comply with the California requirement for low NOx emissions (Gas/Electric Only).

Plenum Fan
The following unit shall be equipped with a direct drive plenum fan design (all 10 tons and 7.5-8.5 ton high efficiency units). Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.

Economizer
This accessory shall be available with or without barometric relief. The assembly includes fully modulating 0-100 percent motor and dampers, minimum position setting, preset linkage, wiring harness with plug, spring return actuator and fixed dry bulb control. The barometric relief shall provide a pressure operated damper that shall be gravity closing and shall prohibit entrance of outside air during the equipment off cycle. Optional solid state or differential enthalpy control shall be available for either factory or field installation. The economizer arrives in the shipping position and shall be moved to the operating position by the installing contractor.

Discharge Air Sensing
This option provides true discharge air sensing in heating models. This sensor is a status indicator readable through Tracer or Tracker. This option is available for microprocessor controlled units.

Supply and/or Return Air Smoke Detector
Smoke detector shall be factory installed photoelectric smoke detector mounted in the return air section (with or without the economizer or motorized damper option), AND/OR in the supply air fan compartment. The detector will be wired for continuous power whenever the unit is energized. Upon detection of smoke, the detector will shut down all unit operations. Local codes may dictate the location of detectors. Note: Due to the shipping position of the economizer or motorized damper, the return air smoke detector will not be completely factory installed. The wiring harness for the detector will be routed and tied off in the fan compartment for shipping. The smoke detector and barometric damper hood will also be installed in a shipping position in the fan compartment.

Accessory - Powered Exhaust
The powered exhaust shall provide exhaust of return air, when using an economizer, to maintain better building pressurization.

Installation of this power exhaust kit will affect unit level MCA and could affect MOP sizing having a direct impact on existing field wiring and unit protection devices. The change in MCA/MOP is the sole responsibility of the field installing party. Trane will not issue new nameplates as a result of this power exhaust accessory installation.FLA of the power exhaust kit option must be added to the MCA of the unit for building supply conductor sizing determination.

Supply, Return, and Plenum Air Smoke Detector
With this option installed, if smoke is detected, all unit operation will be shut down. Reset will be manual at the unit. In order for the supply air smoke detector or return air smoke detector to properly sense smoke in the supply air stream or the return air stream, the air velocity entering the smoke detector unit must be between 500 - 4000 feet per minute. Equipment covered in this manual will develop an airflow velocity that falls within these limits over the entire airflow range specified in the evaporator fan performance table. Supply and/or Return Smoke Detectors may not be used with the Plenum Smoke Detector.

Control Specification (if applied in a system with a system-level controller)

A. CONTROL SYSTEM OVERVIEW:

Control System shall include a System Controller, all controllers for HVAC equipment and ancillary devices (such as lights and exhaust fans), wireless communication between the System Controller, equipment controllers, and space sensors, and all wiring and end devices required. Control System to be fully programmed and commissioned by the installing contractor.

B. TOUCH SCREEN DISPLAY:
Control System shall include a 10" color Touch Screen Display for use by building occupants to adjust zone temperature setpoints, override lighting and HVAC equipment for after-hours use, modify schedules, and view service notifications. This display shall have PIN access for users and provide setpoint adjustment limits.

C. MOBILE APP:
Control System manufacturer shall provide a Mobile App for iOS and Android devices to allow occupants to perform the same functions (listed above) as the Touch Screen Display.

D. WEB BROWSER INTERFACE:
System Controller shall have an embedded Web Browser Interface to allow the installer and service providers to make adjustments to system control parameters and view trend logs and other service information.

E .SYSTEM CONTROLLER:
System Controller shall provide scheduling and coordination of all HVAC equipment, exhaust fans, and controlled lighting devices. The System Controller shall include a software application that coordinates the operation of rooftop units and VAV terminals. The System Controller shall support multiple system types, including Single-Zone Constant Volume, Single-Zone VAV, Changeover Bypass, Changeover VAV, and Multiple-Zone VAV with Terminal Heat (electric or hot water). The System Controller shall provide energy optimization strategies including Night Setback, Optimal Start, Fan Pressure Optimization, Discharge Air Temperature Reset, and Demand-Controlled Ventilation.

F. REMOTE ACCESS/NETWORK SECURITY:
Installer shall provide secure remote access to the Control System to enable the owner or service provider to access the system remotely using the Mobile App or Web Browser Interface. The Control System must be secured behind a firewall and not allow any inbound ports to be open or exposed to the internet. Control System manufacturer shall provide a remote access portal accessible by the owner and/or a service provider (as authorized by the owner).

G. WIRELESS COMMUNICATION: *(Air-Fi Wireless Communication interface)*
Control System shall provide wireless communication between the System Controller, HVAC equipment controllers, and space sensors. This wireless communication shall be based on ANSI/ASHRAE Standard 135-2016 (BACnet/ZigBee). Space sensors shall measure temperature, relative humidity, occupancy, and CO2 per the equipment schedule, and shall have a 15-year battery life with low-battery indication and alarm. Multiple space sensors in larger spaces shall be averaged for control and individually monitored.

Sequence of Operation (if applied in a SINGLE-ZONE CONSTANT-VOLUME SYSTEM or a CHANGEOVER BYPASS SYSTEM)

A. SYSTEM OPERATING MODES:
The System Controller shall send the equipment controllers Occupied/Unoccupied, Morning Warm-up/Pre-cool, and Heat/Cool modes. If communication is lost, the equipment controllers shall operate using default modes and setpoints.

1. NIGHT SETBACK:
During unoccupied mode, the system shall shut off. If the zone temperature drifts to the unoccupied heating or cooling setpoint, the system shall start up to heat or cool the zone, while the OA damper remains closed (unless economizing).

2. OPTIMAL START:
The System Controller shall automatically determine the optimal start time, such that each zone reaches its occupied setpoint just in time for scheduled occupancy.

3. DEMAND-CONTROLLED VENTILATION:
For those zones equipped with an occupancy sensor or CO2 sensor, outdoor airflow shall be reset based on occupancy status and/or measured CO2 concentration.

B. SINGLE-ZONE CONSTANT-VOLUME SYSTEM

1. OCCUPIED HEAT/COOL:
The RTU shall operate the supply fan continuously and modulate (or cycle) compressors, modulate (or stage) heat, and/or enable airside economizing to maintain zone temperature at setpoint. The OA damper shall open to bring in the required amount of ventilation.

2. MORNING WARM-UP/PRE-COOL:
The RTU shall operate the supply fan and modulate (or cycle) compressors or modulate (or stage) heat to raise/lower zone temperature to its occupied setpoint. The OA damper shall remain closed, unless economizing.

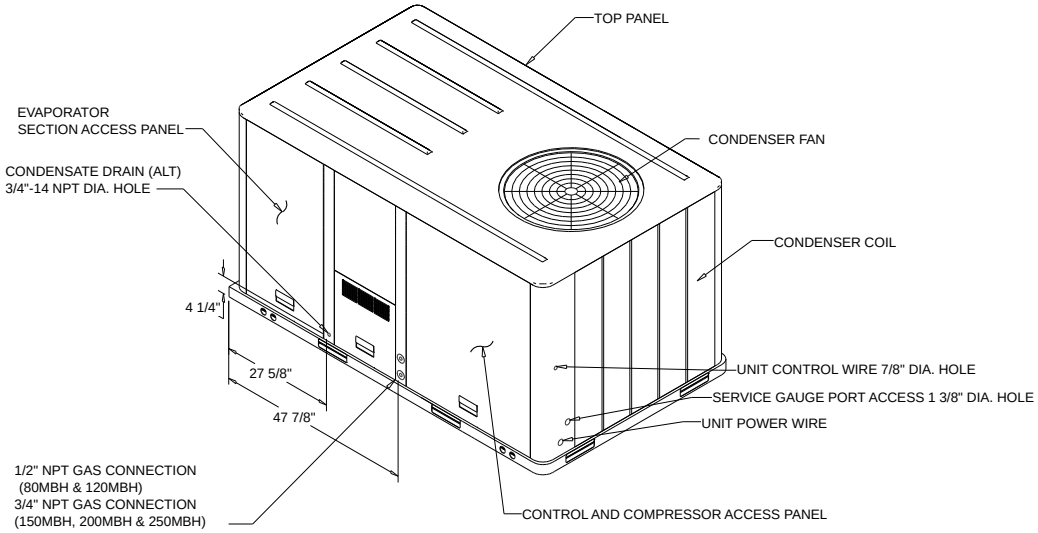
D. CHANGEOVER BYPASS SYSTEM

1. OCCUPIED HEAT/COOL:
Each VAV terminal shall use pressure-independent control, with airflow measurement, to vary primary airflow to maintain zone temperature at its occupied setpoint. The RTU shall modulate the bypass damper to maintain duct static pressure at setpoint and modulate (or cycle) compressors, modulate (or stage) heat, and/or enable airside economizing based on current zone cooling/heating demands. The OA damper shall open to bring in the required amount of ventilation.

2. MORNING WARM-UP/PRE-COOL:
Each VAV terminal unit shall vary primary airflow to raise/lower zone temperature to its occupied setpoint. The RTU shall modulate the bypass damper to maintain duct static pressure at setpoint and modulate (or cycle) compressors or modulate (or stage) heat based on current zone cooling/heating demands. The OA damper shall remain closed, unless economizing.

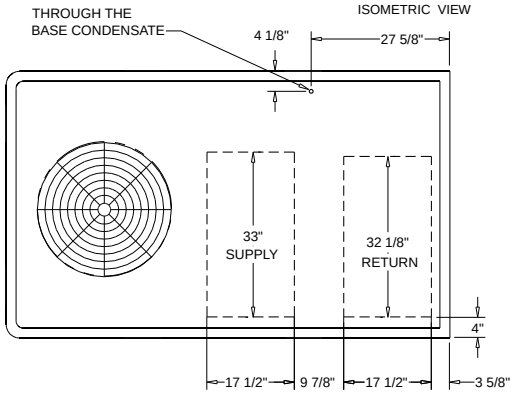
3. COOLING/HEATING CHANGEOVER LOGIC:
The System Controller shall determine the overall system cooling/heating mode based on "voting" from each zone. When the majority of zones require cooling, the RTU shall operate in cooling mode and any zone that requires heating shall reduce primary airflow to minimum. When the majority of zones require heating, the RTU shall operate in heating mode and any zone that requires cooling shall reduce primary airflow to minimum.

Unit Dimensions - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4



PACKAGED GAS / ELECTRICAL

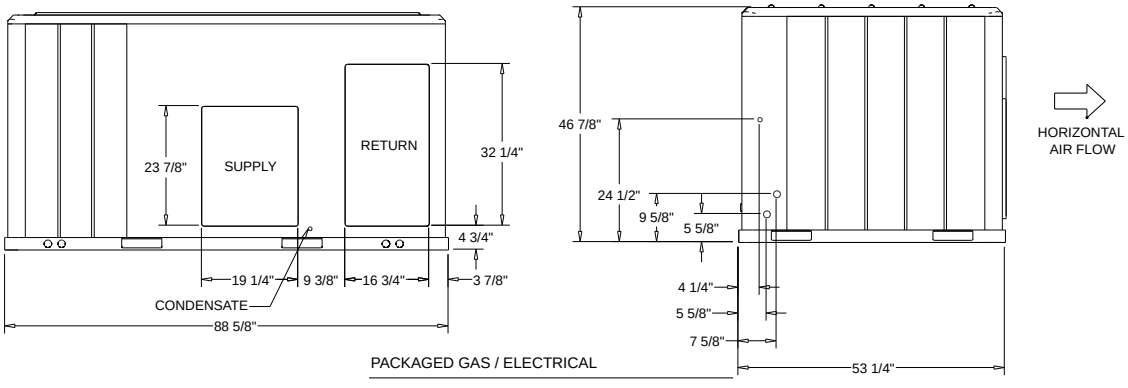
ISOMETRIC VIEW



NOTES:
1. THRU -THE -BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.

PLAN VIEW UNIT

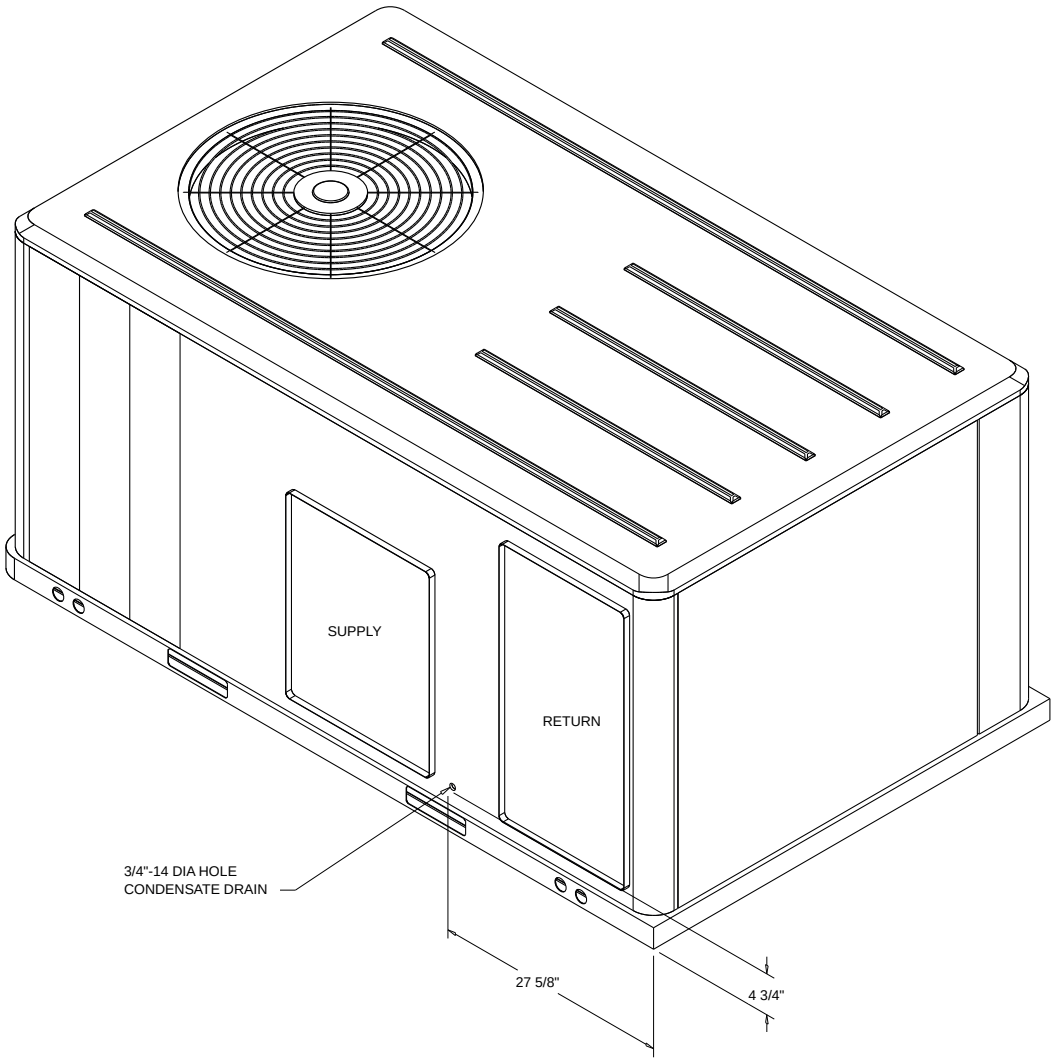
DIMENSION DRAWING



PACKAGED GAS / ELECTRICAL

DIMENSION DRAWING

Unit Dimensions - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4



ISOMETRIC-PACKAGED COOLING

Unit Dimensions - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4

ELECTRICAL / GENERAL DATA

GENERAL (2)(4)(6)

Model:	YHC102F
Unit Operating Voltage:	414-506
Unit Primary Voltage:	460
Unit Secondary Voltage	--
Unit Hertz:	60
Unit Phase:	3
EER	12.5

Oversized Motor: MCA: N/A; MFS: N/A; MCB: N/A

Standard Motor

MCA:	22.0
MFS:	25.0
MCB:	25.0

Field Installed Oversized Motor: MCA: N/A; MFS: N/A; MCB: N/A

HEATING PERFORMANCE

HEATING - GENERAL DATA

Heating Model:	High
Heating Input (BTU):	200,000/140,000
Heating Output (BTU):	160,000/112,000
No. Burners:	4
No. Stages	2

Gas Inlet Pressure

Natural Gas (Min/Max):	4 1/2"/14"
LP (Min/Max)	11"/14"
Gas Pipe Connection Size:	3/4"

INDOOR MOTOR

Standard Motor		Oversized Motor		Field Installed Oversized Motor	
Number:	1	Number:	N/A	Number:	N/A
Horsepower:	2.75	Horsepower:	N/A	Horsepower:	N/A
Motor Speed (RPM):	--	Motor Speed (RPM):	N/A	Motor Speed (RPM):	N/A
Phase	3	Phase	N/A	Phase	N/A
Full Load Amps:	3.6	Full Load Amps:	N/A	Full Load Amps:	N/A
	--		N/A		N/A

COMPRESSOR Circuit 1/2

Number:	2
Horsepower:	4.5/2.4
Phase:	3
Rated Load Amps:	7.8/4.7
	--

OUTDOOR MOTOR

Number:	1
Horsepower:	0.75
Motor Speed (RPM):	1100
Phase:	1
Full Load Amps:	2.9
	--

POWER EXHAUST ACCESSORY (3,7)

(Field Installed Power Exhaust)

Phase:	1
Horsepower:	0.87
Motor Speed (RPM):	1075
Full Load Amps:	3.3
Locked Rotor Amps:	6.8

FILTERS

Type:	Throwaway
Furnished:	Yes
Number	4
Recommended	20"x25"x2"

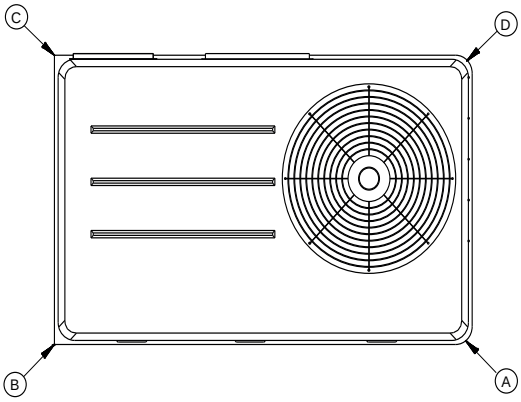
REFRIGERANT (2)

Type	R-410
Factory Charge	
Circuit #1	6.3 lb
Circuit #2	4.9 lb

NOTES:

1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value does not include Power Exhaust Accessory.
4. Value includes oversized motor.
5. Value does not include Power Exhaust Accessory.
6. EER is rated at AHRI conditions and in accordance with DOE test procedures.
7. Installation of this power exhaust kit will affect unit level MCA and could affect MOP sizing having a direct impact on existing field wiring and unit protection devices. The change in MCA/MOP is the sole responsibility of the field installing party. Trane will not issue new nameplates as a result of this power exhaust accessory installation. FLA of the power exhaust kit option must be added to the MCA of the unit for building supply conductor sizing determination.

Weight, Clearance & Rigging Diagram - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4



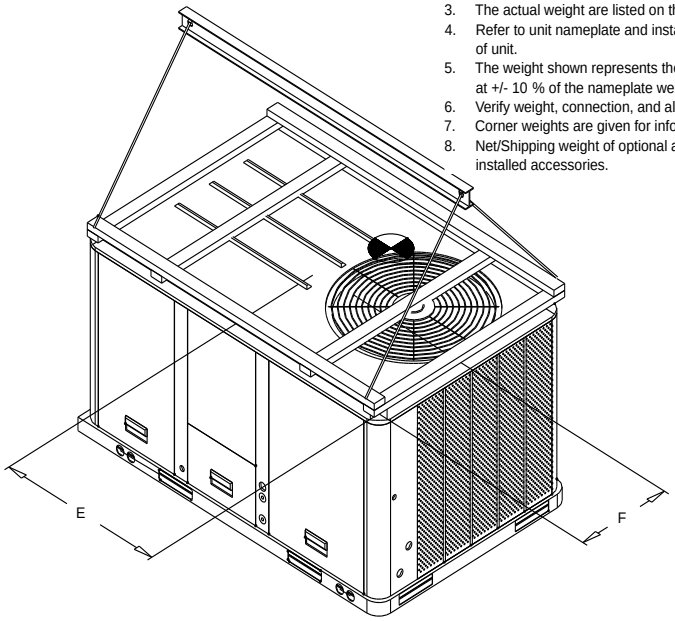
PACKAGED GAS / ELECTRICAL
CORNER WEIGHT

INSTALLED ACCESSORIES NET WEIGHT DATA

ACCESSORY	WEIGHTS
ECONOMIZER	36.0 lb
MOTORIZED OUTSIDE AIR DAMPER	
MANUAL OUTSIDE AIR DAMPER	
BAROMETRIC RELIEF	
OVERSIZED MOTOR	
BELT DRIVE MOTOR	
POWER EXHAUST	80.0 lb
THROUGHT THE BASE ELECTRICAL/GAS (FIOPS)	
UNIT MOUNTED CIRCUIT BREAKER (FIOPS)	
UNIT MOUNTED DISCONNECT (FIOPS)	
POWERED CONVENIENCE OUTLET (FIOPS)	
HINGED DOORS (FIOPS)	
HAIL GUARD	30.0 lb
SMOKE DETECTOR, SUPPLY / RETURN	7.0 lb
NOVAR CONTROL	
STAINLESS STEEL HEAT EXCHANGER	
REHEAT	
ROOF CURB	

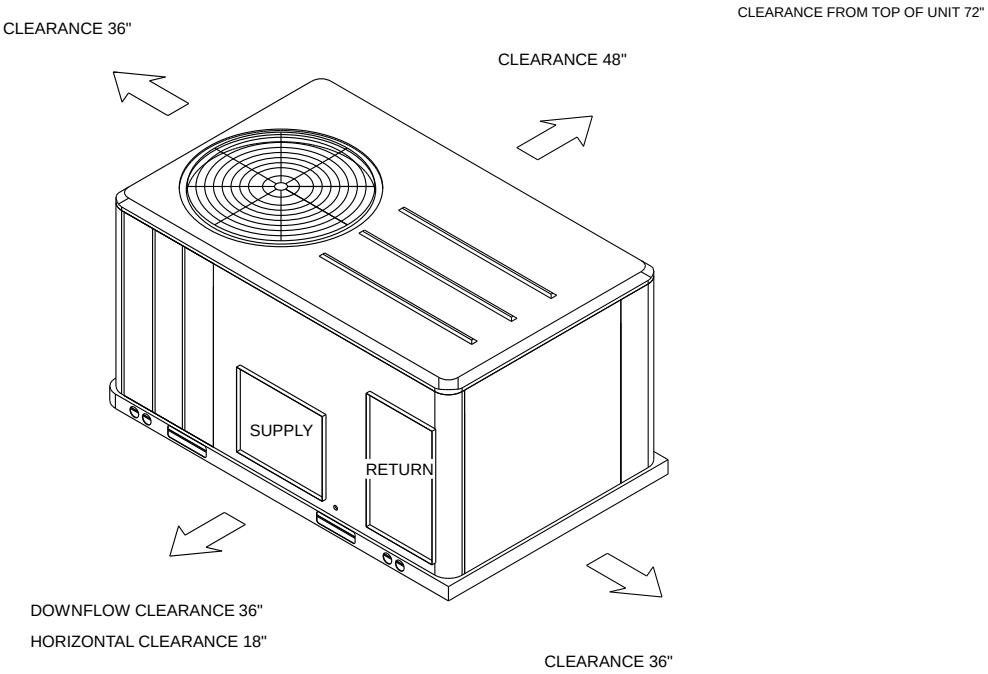
BASIC UNIT WEIGHTS		CORNER WEIGHTS				CENTER OF GRAVITIY	
SHIPPING	NET	A	341.0 lb	C	253.0 lb	(E) LENGHT	(F) WIDTH
1133.0 lb	1035.0 lb	B	236.0 lb	D	205.0 lb	49"	23"

NOTE:
1. All weights are approximate.
2. Weights for options that are not list refer to Installation guide.
3. The actual weight are listed on the unit nameplate.
4. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
5. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
6. Verify weight, connection, and all dimension with installer documents before installation.
7. Corner weights are given for information only.
8. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.

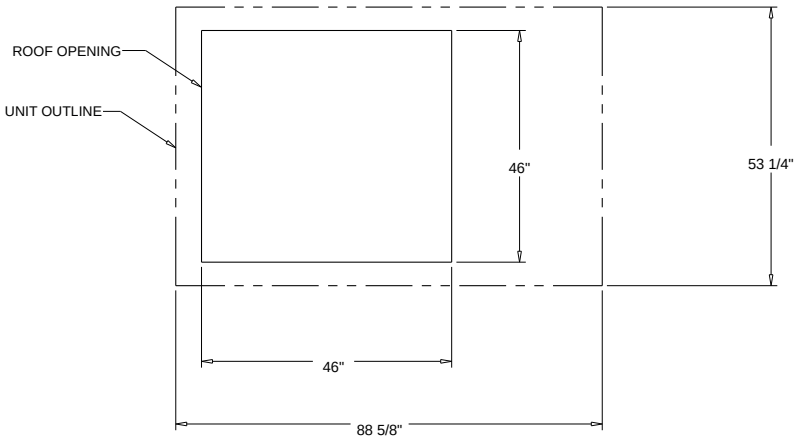


PACKAGED GAS / ELECTRICAL
RIGGING AND CENTER OF GRAVITY

Weight, Clearance & Rigging Diagram - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4

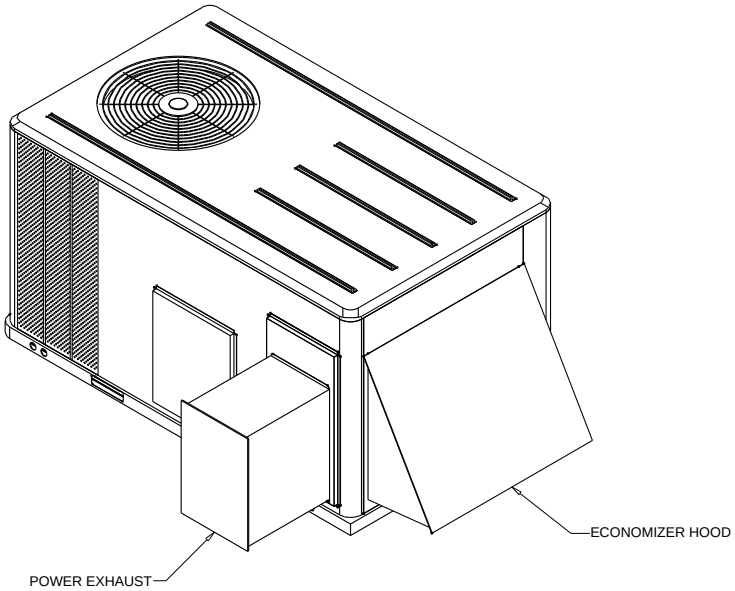


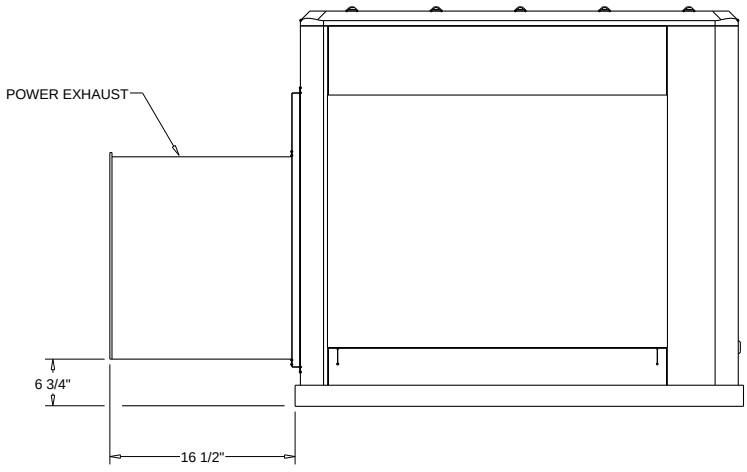
PACKAGED GAS / ELECTRIC
CLEARANCE



PACKAGED GAS / ELECTRIC
DOWNFLOW TYPICAL ROOF OPENING

Accessory - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop
Item: A1 Qty: 1 Tag(s): RTU-4





POWER EXHAUST AND HOOD
ACCESSORY

Tag Data - Packaged Gas/Electric Rooftop Units (Qty: 3)

Item	Tag(s)	Qty	Description	Model Number
B1	RTU-8	1	15 Ton Packaged Unitary Gas/Electric	YSD180G4RLA--D0B1000700A7000000000000000
B2	RTU-3W, RTU-3E	2	25 Ton Packaged Unitary Gas/Electric	YHH300G4RHB--00B1000700070000000000000000

Product Data - Packaged Gas/Electric Rooftop Units

All Units

Gas/Electric
460/60/3
Reliatel
Standard panels/Pleated Filters MERV 8
Standard condenser coil with hail guard
Air-Fi wireless communication interface
Clogged filter switch, Fan failure switch and Discharge air sensing tube
Spring replacement on existing spring isolation curb by others (Fld)
5 Year parts, labor & refrigeration warranty
10 year heat exchanger warranty
5 year semi-annual inspection service
Start up

Item: B1 Qty: 1 Tag(s): RTU-8

Standard efficiency
Downflow
15 Ton
Gas Heat - Low
Economizer Dry Bulb 0-100% with barometric relief
Return air smoke detector
Power exhaust (Fld)

Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E

High efficiency
Horizontal
25 Ton
Gas Heat - High
Low Leak Econ, Dry Bulb (Fld)
Power exhaust mounted by others in horizontal return duct (Fld)

Performance Data - Packaged Gas/Electric Rooftop Units

Tags	RTU-8	RTU-3W, RTU-3E
Design Airflow (cfm)	6000	10000
Cooling Entering Dry Bulb (F)	80.00	80.00
Cooling Entering Wet Bulb (F)	67.00	67.00
Ent Air Rel Humidity (%)	51.08	51.08
Ambient Temp (F)	95.00	95.00
Cooling Leaving Unit DB (F)	59.01	60.90
Cooling Leaving Unit WB (F)	57.76	58.50
Gross Total Capacity (MBh)	184.07	292.29
Gross Sensible Capacity (MBh)	149.21	231.85
Gross Latent Capacity (MBh)	34.85	60.44
Net Total Capacity (MBh)	173.41	270.14
Net Sensible Capacity (MBh)	138.56	209.70

Tags	RTU-8	RTU-3W, RTU-3E
Net Sensible Heat Ratio (Number)	0.80	0.78
Heating EAT (F)	70.00	70.00
Heating LAT (F)	100.72	99.49
Heating Temp Rise (F)	30.72	29.49
Output Htg Capacity (MBh)	200.00	320.00
Output Htg Capacity w/Fan (MBh)	210.66	342.15
Design ESP (in H2O)	0.750	0.750
Component SP Add (in H2O)	0.240	0.025
Field Supplied Drive Kit Required	None	High Static Drive Kit
Indoor Mtr. Operating Power (bhp)	3.38	7.03
Indoor RPM (rpm)	697	818
Indoor Motor Power (kW)	2.52	5.24
Outdoor Motor Power (kW)	0.89	1.97
Compressor Power (kW)	13.55	21.21
System Power (kW)	16.96	28.42
IPLV @ AHRI (IPLV)	12.2	12.4
MCA (A)	36.00	54.00
MOP (A)	50.00	70.00
Compressor 1 RLA (A)	15.97	8.20
Compressor 2 RLA (A)	7.74	8.20
Condenser Fan FLA (A)	1.35	1.80
Evaporator Fan FLA (A)	4.80	11.00
Evaporator Face Area (sq ft)	23.00	31.42
Evaporator Face Velocity (ft/min)	261	318
Evaporator Fin Spacing (Per Foot)	192	180
Evaporator Rows ( )	2	4
Min. Unit Operating Weight (lb)	1858.0	2310.0
Max Unit Operating Weight (lb)	2280.0	2940.0
Fan Motor Heat (MBh)	10.66	22.15
Evap Coil Leav Air Temp (DB) (F)	56.97	58.53
Evap Coil Leav Air Temp (WB) (F)	56.97	57.61
Dew Point Temp (F)	57.16	57.02
Run Acoustics	Yes	Yes
Ducted Discharge - 63 Hz (dB)	86	94
Ducted Discharge - 125 Hz (dB)	81	89
Ducted Discharge - 250 Hz (dB)	75	81
Ducted Discharge - 500 Hz (dB)	78	79
Ducted Discharge - 1k Hz (dB)	71	77
Ducted Discharge - 2k Hz (dB)	68	77
Ducted Discharge - 4k Hz (dB)	68	77
Ducted Discharge - 8k Hz (dB)	61	72
Ducted Inlet - 63 Hz (dB)	91	94
Ducted Inlet - 125Hz (dB)	80	85
Ducted Inlet - 250 Hz (dB)	72	80
Ducted Inlet - 500 Hz (dB)	69	75
Ducted Inlet - 1k Hz (dB)	64	70
Ducted Inlet - 2k Hz (dB)	59	72
Ducted Inlet - 4k Hz (dB)	58	72

Tags	RTU-8	RTU-3W, RTU-3E
Ducted Inlet - 8k Hz (dB)	51	67
Outdoor Noise - 63 Hz (dB)	89	102
Outdoor Noise - 125 Hz (dB)	97	90
Outdoor Noise - 250 Hz (dB)	94	93
Outdoor Noise - 500 Hz (dB)	92	94
Outdoor Noise - 1k Hz (dB)	89	92
Outdoor Noise - 2k Hz (dB)	83	87
Outdoor Noise - 4k Hz (dB)	79	83
Outdoor Noise - 8k Hz (dB)	75	75
Rated capacity (AHRI) (MBh)	176.00	274.00
Exhaust fan power (kW)	0.56	-
Refrig charge (HFC-410A) - ckt 1 (lb)	9.0	11.8
Refrig charge (HFC-410A) - ckt 2 (lb)	5.0	11.3
ASHRAE 90.1	Yes	Yes
Saturated Suction Temp Circuit 1 (F)	46.61	53.59
Saturated Discharge Temp Circuit 1 (F)	119.90	121.50
Saturated Suction Temp Circuit 2 (F)	48.77	49.98
Saturated Discharge Temp Circuit 2 (F)	119.89	126.46
IEER Rating ( )	12.20	12.40
EER @ AHRI Conditions (EER)	11.0	10.6
Total Static Pressure (in H2O)	1.009	0.788
Length (ft)	10.14	10.14
Width (ft)	7.02	7.02
Height (ft)	4.68	5.52
T24_SZVZV	NA	NA
Indoor Fan Type	FC Centrifugal	FC Centrifugal
Indoor Fan Drive Type	Belt	Belt
Outdoor Fan Type	Propeller	Propeller
Outdoor Fan Drive Type	Direct	Direct
Outdoor Fan Quantity ( )	2	2
Exhaust Fan Type	FC Centrifugal	-
Exhaust Drive Type	Direct	-
Heating Type	Gas	Gas
Heating Stages	2	2

Mechanical Specifications - Packaged Gas/Electric Rooftop Units
Item: B1, B2 Qty: 3 Tag(s): RTU-8, RTU-3W, RTU-3E

General - Downflow
The units shall be dedicated downflow airflow. The operating range shall be between 115°F and 0°F in cooling as standard from the factory for all units. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation and control sequence, before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance to UL 1995/C 22.2, 236-05 3rd Edition.

Packaged Rooftop units cooling, heating capacities, and efficiencies are AHRI certified within scope of AHRI Standard 340/360 (I-P) and ANSIZ21.47 and 10 CFR Part 431 pertaining to Commercial Warm Air Furnaces (gas heating units).

General - Horizontal
The units shall be dedicated horizontal airflow. The operating range shall be between 115°F and 0°F in cooling as standard from the factory for all units. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation and control sequence, before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance to UL 1995/C 22.2, 236-05 3rd Edition.

Packaged Rooftop units cooling, heating capacities, and efficiencies are AHRI certified within scope of AHRI Standard 340/360 (I-P) and ANSIZ21.47 and 10 CFR Part 431 pertaining to Commercial Warm Air Furnaces (gas heating units).

Casing - Downflow
Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. In order to ensure a water and air tight seal, service panels shall have lifting handles and no more than three screws to remove. All exposed vertical panels and top covers in the indoor air section shall be insulated with a 1/2 inch, 1 pound density foil-faced, fire-resistant, permanent, odorless, glass fiber material. The base of the downflow unit shall be insulated with 1/2 inch, 1 pound density foil-faced, closed-cell material. The downflow unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 11/8 inch high supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting.

Casing - Horizontal
Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. In order to ensure a water and air tight seal, service panels shall have lifting handles and no more than three screws to remove. All exposed vertical panels and top covers in the indoor air section shall be insulated with a 1/2 inch, 1 pound density foil-faced, fire-resistant, permanent, odorless, glass fiber material. The base of the unit shall have provisions for forklift and crane lifting.

Unit Top
The top cover shall be one piece, or where seams exist, double hemmed and gasket sealed to prevent water leakage.

Filters
Two inch standard filters shall be factory supplied on all units

Compressors
All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of nameplate voltage. Internal overloads shall be provided with the scroll compressors. All models shall have crankcase heaters, phase monitors and low and high pressure control as standard. Dual compressors are available on all standard efficiency models and 12.5 to 20 tons high efficiency models and allow for efficient cooling utilizing 3 stages of compressor operation (high efficiency models only). 25 tons high efficiency units have 3 compressors for up to 4 stages of compressor operation.

Crankcase Heaters
These band heaters provide improved compressor reliability by warming the oil to prevent migration during off-cycles or low ambient conditions.

Refrigerant Circuits
Each refrigerant circuit shall have service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.

Evaporator and Condenser Coils
Evaporator Coils (only on T/YS*150, 180, 210, 240, 300G models)-
Microchannel evaporator coils will be burst tested by the manufacturer. Internally finned, 5/16"copper tubes mechanically bonded to a configured aluminum plate fin shall be standard for evaporator coils. Coils shall be leak tested to ensure the pressure integrity. The evaporator coil shall be leak tested to 225 psig and pressure tested to 450 psig.

Condenser Coils (available on T/Y**150, 180, 210, 240, 300G models) - Microchannel condenser coils shall be standard on all units. Coils shall be leak tested to ensure the pressure integrity. The condenser coil shall be leak tested to 225 psig and pressure tested to 450 psig.

Gas Heating Section
The heating section shall have a drum and tube heat exchanger design using corrosion resistant steel components. A forced combustion blower shall supply premixed fuel to a single burner ignited by a pilotless hot surface ignition system.

In order to provide reliable operation, a negative pressure gas valve shall be used on standard furnaces and a pressure switch on furnaces with modulating heat that requires blower operation to initiate gas flow. On an initial call for heat, the combustion blower shall purge the heat exchanger 45 seconds before ignition.

After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat. Units shall be suitable for use with natural gas shall also comply with California requirements for low NOx emissions.

Condenser Coil
The microchannel type condenser coil is standard for the standard efficiency models.
Due to flat streamlined tubes with small ports, and metallurgical tube-tofin bond, microchannel coil has better heat transfer performance. Microchannel condenser coil can reduce system refrigerant charge by up to 50% because of smaller internal volume, which leads to better compressor reliability. Compact all-

aluminum microchannel coils also help to reduce the unit weight. All-aluminum construction improves re-cyclability. Galvanic corrosion is also minimized due to all aluminum construction. Strong aluminum brazed structure provides better fin protection. In addition, flat streamlined tubes also make microchannel coils more dust resistant and easier to clean. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig.

Outdoor Fans
The outdoor fan shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor(s) shall be permanently lubricated and shall have built-in thermal overload protection.

Indoor Fan
Units above shall have belt driven, FC centrifugal fans with adjustable motor sheaves. Units with standard motors shall have an adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves. All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).

Controls
Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. ReliaTel controls shall be provided for all 24 volt control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized control shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.

High Pressure Cutout
This option is offered for units that do not have High Pressure cutout as standard.

Discharge Line Thermostat
A bi-metal element discharge line thermostat is installed as a standard option on the discharge line of each system. This standard option provides extra protection to the compressors against high discharge temperatures in case of loss of charge, extremely high ambient and other conditions which could drive the discharge temperature higher. Discharge line thermostat is wired in series with high pressure control. When the discharge temperature rises above the protection limit, the bi-metal disc in the thermostat switches to the off position, opening the 24 VAC circuit. When the temperature on the discharge line cools down, the bi-metal disc closes the contactor circuit, providing power to the compressor. When the thermostat opens the fourth time, the ReliaTel control must be manually reset to resume operation on that stage.

Tool-less Hail Guards
Tool-less, hail protection quality coil guards are available for condenser coil protection.

Two-Inch Pleated Filters (MERV 8 & 13)
Two inch pleated media filters shall be available on all models.

Supply and/or Return Air Smoke Detector
With this option installed, if smoke is detected, all unit operation will be shut down. Reset will be manual at the unit. Return Air Smoke Detectors require minimum allowable airflow when used with certain models. See the Installation, Operation, and Maintenance (IOM) manual for the models affected and the minimum allowable airflow required.

Supply and/or Return Air Smoke Detector
With this option installed, if smoke is detected, all unit operation will be shut down. Reset will be manual at the unit. Return Air Smoke Detectors require minimum allowable airflow when used with certain models. See the Installation, Operation, and Maintenance (IOM) manual for the models affected and the minimum allowable airflow required.

Differential Pressure Switches
These options allow for individual fan failure and dirty filter indication. The fan failure switch will disable all unit functions and "flash" the Service LED on the zone sensor. The dirty filter switch will light the Service LED on the zone sensor and will allow continued unit operation.

Clogged Filter/Fan Failure Switch
A dedicated differential pressure switch is available to achieve active fan failure indication and/or clogged filter indication. These indications will be registered with either a zone sensor with status indication lights or an Integrated Comfort System.

Accessory - Low Leak Economizer

This accessory meets low leak requirements for ASHRAE90.1, IECC, and Title 24 standards; Allows 100 percent outdoor air supply from 0-100 percent modulating dampers; Comes standard with Barometric Relief; can be paired with Powered exhaust for additional building evacuation; Can be paired with Fault Detection (FDD) to meet current mandatory Title 24 requirements; Dry Bulb; And, available for down flow applications.

Accessory - Powered Exhaust
The powered exhaust shall provide exhaust of return air, when using an economizer, to maintain better building pressurization.

Installation of this power exhaust kit will affect unit level MCA and could affect MOP sizing having a direct impact on existing field wiring and unit protection devices. The change in MCA/MOP is the sole responsibility of the field installing party. Trane will not issue new nameplates as a result of this power exhaust accessory installation.FLA of the power exhaust kit option must be added to the MCA of the unit for building supply conductor sizing determination.

Control Specification (if applied in a system with a system-level controller)

A. CONTROL SYSTEM OVERVIEW:
Control System shall include a System Controller, all controllers for HVAC equipment and ancillary devices (such as lights and exhaust fans), wireless communication between the System Controller, equipment controllers, and space sensors, and all wiring and end devices required. Control System to be fully programmed and commissioned by the installing contractor.

B. TOUCH SCREEN DISPLAY:
Control System shall include a 10" color Touch Screen Display for use by building occupants to adjust zone temperature setpoints, override lighting and HVAC equipment for after-hours use, modify schedules, and view service notifications. This display shall have PIN access for users and provide setpoint adjustment limits.

C. MOBILE APP:
Control System manufacturer shall provide a Mobile App for iOS and Android devices to allow occupants to perform the same functions (listed above) as the Touch Screen Display.

D. WEB BROWSER INTERFACE:
System Controller shall have an embedded Web Browser Interface to allow the installer and service providers to make adjustments to system control parameters and view trend logs and other service information.

F. SYSTEM CONTROLLER:
System Controller shall provide scheduling and coordination of all HVAC equipment, exhaust fans, and controlled lighting devices. The System Controller shall include a software application that coordinates the operation of rooftop units and VAV terminals. The System Controller shall support multiple system types, including Single-Zone Constant Volume, Single-Zone VAV, Changeover Bypass, Changeover VAV, and Multiple-Zone VAV with Terminal Heat (electric or hot water). The System Controller shall provide energy optimization strategies including Night Setback, Optimal Start, Fan Pressure Optimization, Discharge Air Temperature Reset, and Demand-Controlled Ventilation.

E. REMOTE ACCESS/NETWORK SECURITY:
Installer shall provide secure remote access to the Control System to enable the owner or service provider to access the system remotely using the Mobile App or Web Browser Interface. The Control System must be secured behind a firewall and not allow any inbound ports to be open or exposed to the internet. Control System manufacturer shall provide a remote access portal accessible by the owner and/or a service provider (as authorized by the owner).

G. WIRELESS COMMUNICATION: (Air-Fi Wireless) Communication Interface
Control System shall provide wireless communication between the System Controller, HVAC equipment controllers, and space sensors. This wireless communication shall be based on ANSI/ASHRAE Standard 135-2016 (BACnet/ZigBee). Space sensors shall measure temperature, relative humidity, occupancy, and CO2 per the equipment schedule, and shall have a 15-year battery life with low-battery indication and alarm. Multiple space sensors in larger spaces shall be averaged for control and individually monitored.

Sequence of Operation (if applied in a SINGLE-ZONE CONSTANT-VOLUME SYSTEM or a CHANGEOVER BYPASS SYSTEM)

A. SYSTEM OPERATING MODES:
The System Controller shall send the equipment controllers Occupied/Unoccupied, Morning Warm-up/Pre-cool, and Heat/Cool modes. If communication is lost, the equipment controllers shall operate using default modes and setpoints.

1. NIGHT SETBACK:
During unoccupied mode, the system shall shut off. If the zone temperature drifts to the unoccupied heating or cooling setpoint, the system shall start up to heat or cool the zone, while the OA damper remains closed (unless economizing).

2. OPTIMAL START:
The System Controller shall automatically determine the optimal start time, such that each zone reaches its occupied setpoint just in time for scheduled occupancy.

3. DEMAND-CONTROLLED VENTILATION:
For those zones equipped with an occupancy sensor or CO2 sensor, outdoor airflow shall be reset based on occupancy status and/or measured CO2 concentration.

B. SINGLE-ZONE CONSTANT-VOLUME SYSTEM

1. OCCUPIED HEAT/COOL:
The RTU shall operate the supply fan continuously and modulate (or cycle) compressors, modulate (or stage) heat, and/or enable airside economizing to maintain zone temperature at setpoint. The OA damper shall open to bring in the required amount of ventilation.

2. MORNING WARM-UP/PRE-COOL:
The RTU shall operate the supply fan and modulate (or cycle) compressors or modulate (or stage) heat to raise/lower zone temperature to its occupied setpoint. The OA damper shall remain closed, unless economizing.

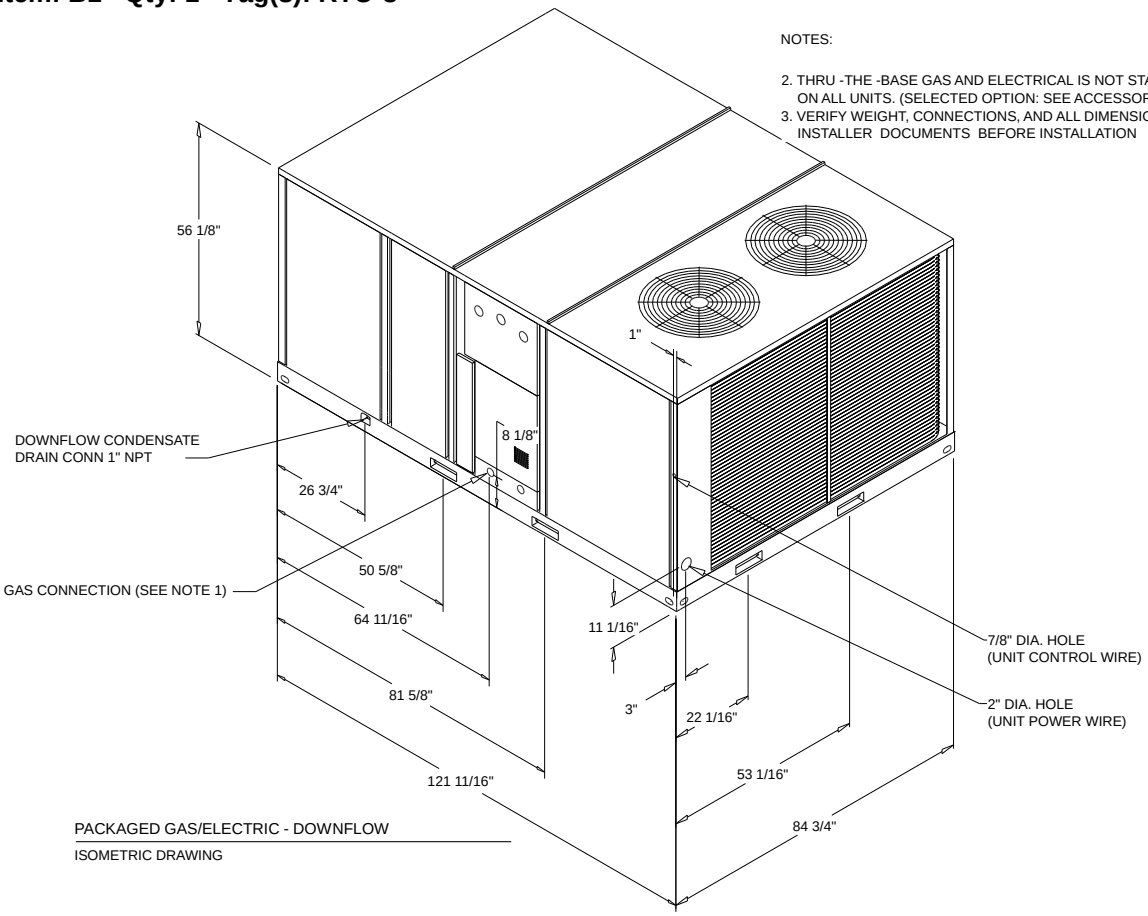
D. CHANGEOVER BYPASS SYSTEM

1. OCCUPIED HEAT/COOL:
Each VAV terminal shall use pressure-independent control, with airflow measurement, to vary primary airflow to maintain zone temperature at its occupied setpoint. The RTU shall modulate the bypass damper to maintain duct static pressure at setpoint and modulate (or cycle) compressors, modulate (or stage) heat, and/or enable airside economizing based on current zone cooling/heating demands. The OA damper shall open to bring in the required amount of ventilation.

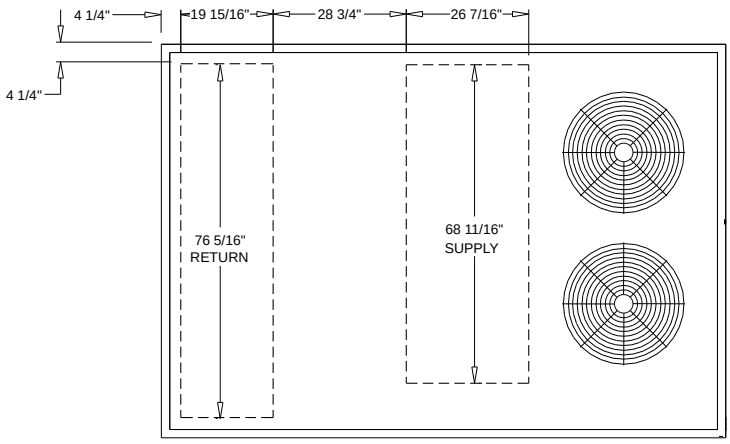
2. MORNING WARM-UP/PRE-COOL:
Each VAV terminal unit shall vary primary airflow to raise/lower zone temperature to its occupied setpoint. The RTU shall modulate the bypass damper to maintain duct static pressure at setpoint and modulate (or cycle) compressors or modulate (or stage) heat based on current zone cooling/heating demands. The OA damper shall remain closed, unless economizing.

3. COOLING/HEATING CHANGEOVER LOGIC:
The System Controller shall determine the overall system cooling/heating mode based on "voting" from each zone. When the majority of zones require cooling, the RTU shall operate in cooling mode and any zone that requires heating shall reduce primary airflow to minimum. When the majority of zones require heating, the RTU shall operate in heating mode and any zone that requires cooling shall reduce primary airflow to minimum.

Unit Dimensions - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8



PACKAGED GAS/ELECTRIC - DOWNFLOW
ISOMETRIC DRAWING



PACKAGED GAS/ELECTRIC - DOWNFLOW
PLAN VIEW DRAWING

Unit Dimensions - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8

ELECTRICAL / GENERAL DATA

GENERAL PERFORMANCE

Model (Ton):	YSD180G (15.0)
Unit Operating Voltage Range:	414-506
Unit Primary Voltage:	460
Unit Secondary Voltage:	-
Unit Hertz:	60
Unit Phase:	3
EER: (5)	11.0

Standard Motor (1) (3)

Minimum Circuit Ampacity:	36.0
Maximum Fuse Size:	50.0
Maximum (HACR) Circuit Breaker:	50.0

Oversized Motor (1) (4)

MCA:	N/A
MFS:	N/A
MCB (HACR):	N/A

Field Installed Oversized Motor (1) (4)

MCA:	N/A
MFS:	N/A
MCB (HACR):	N/A

GAS HEATING

Heating Models:	Low
Heating and 1 Stage Input (Btu/h)	250000 / 175000
Heating and 1 Stage Output (Btu/h):	200000 / 140000
Min./Max. Gas Input -	
Pressure Natural or LP:	2.5 / 14.0
Gas Connection Pipe Size:	1/2"

COMPRESSOR

	Circuit(s)
Number:	2
Horsepower:	9.2/4.5
Phase:	3
Rated Load Amps:	14.7/7.7
Locked Rotor Amps:	142.0/52.0

INDOOR MOTOR

Number: (3)	1
Horsepower:	3.00
Motor Speed (RPM):	1,740
Phase:	3
Full Load Amps:	4.8
Locked Rotor Amps:	40.5

Oversized Motor (4)

Number:	N/A
Horsepower:	N/A
Motor Speed (RPM):	N/A
Phase:	N/A
Full Load Amps:	N/A
Locked Rotor Amps:	N/A

Field Installed Oversized Motor (4)

Number:	N/A
Hp:	N/A
Motor Speed (RPM):	N/A
Phase:	N/A
FLA:	N/A
LRA:	N/A

OUTDOOR MOTOR

Number:	2
Horsepower:	0.50
Motor speed (RPM):	1,100
Phase:	3
Full Load Amps:	1.35
Locked Rotor Amps:	4.82

POWER EXHAUST
(Field Installed Power Exhaust)

Horsepower:	0.75
Motor Speed (RPM):	1,040
Phase:	1
Full Load Amps:	3.3
Locked Rotor Amps:	8.4

COMBUSTION BLOWER MOTOR
(Gas-Fired Heating only)

Horsepower:	0.1
Motor Speed (RPM):	3,500/2,800
Phase:	1
Full Load Amps:	0.8
Locked Rotor Amps:	2.00

FILTER

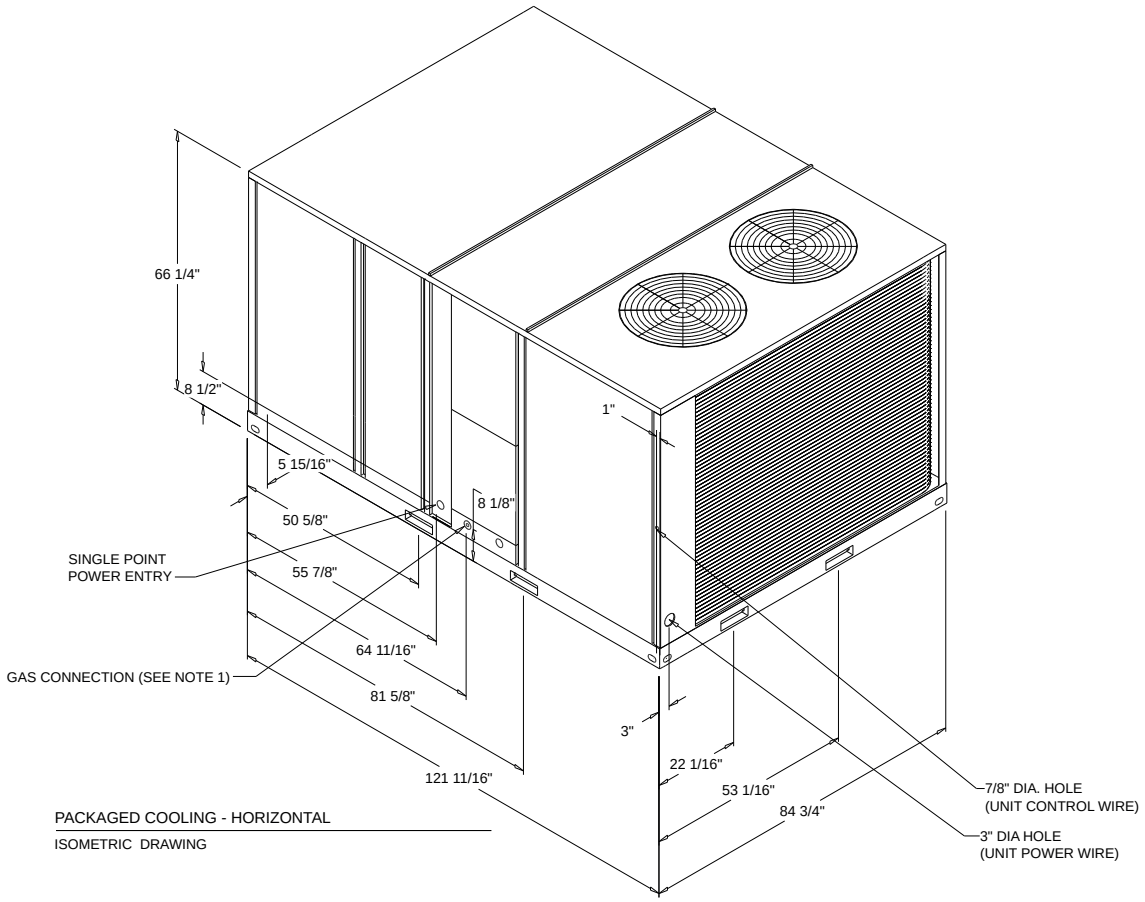
Type:	Throwaway
Furnished:	Yes
Number:	4 / 4
Recommended Size:	20"x20"x2" / 20"x25"x2"

REFRIGERANT (2)

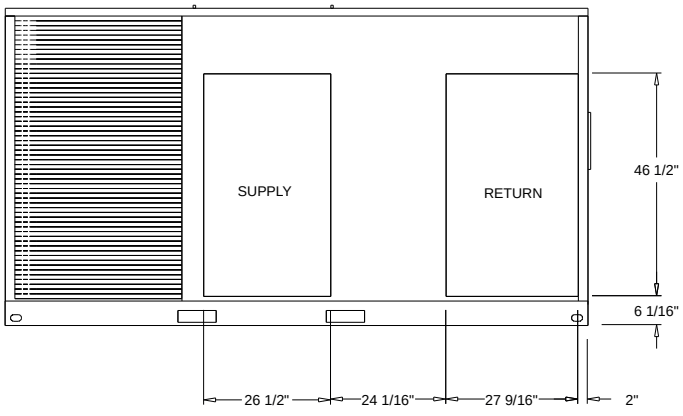
	Circuit #1 / 2
Type:	R410
Factory Charge	
Circuit #1 / 2:	9.0 lb / 5.0 lb

NOTES:
1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value includes oversized motor.
4. Value does not include Power Exhaust Accessory.
5. EER is rated at AHRI conditions and in accordance with DOE test procedures.

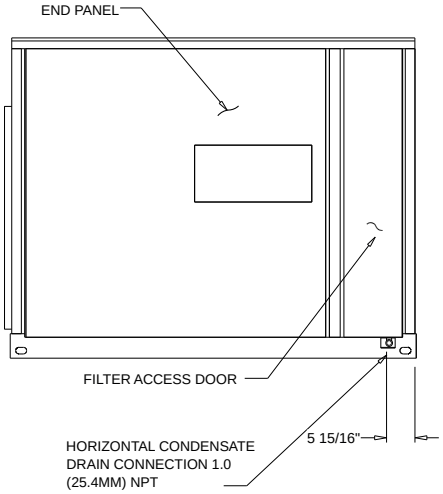
Unit Dimensions - Packaged Gas/Electric Rooftop Units
Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E



PACKAGED COOLING - HORIZONTAL
ISOMETRIC DRAWING



PACKAGED GAS/ELECTRIC -HORIZONTAL
AIR FLOW SIDE



HORIZONTAL CONDENSATE DRAIN AND FILTER ACCESS
SIDE VIEW

Unit Dimensions - Packaged Gas/Electric Rooftop Units
Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E

ELECTRICAL / GENERAL DATA

GENERAL PERFORMANCE

Model (Ton):	YHH300G (25.0)
Unit Operating Voltage Range:	414-506
Unit Primary Voltage:	460
Unit Secondary Voltage:	-
Unit Hertz:	60
Unit Phase:	3
EER: (5)	10.6

Standard Motor (1) (3)

Minimum Circuit Ampacity:	54.0
Maximum Fuse Size:	70.0
Maximum (HACR) Circuit Breaker:	70.0

Standard Oversized Motor (1) (4)

Minimum Circuit Ampacity:	"
Maximum Fuse Size:	
Maximum (HACR) Circuit Breaker:	

Accessory Oversized Motor (1) (4)

Minimum Circuit Ampacity:	
Maximum Fuse Size:	
Maximum (HACR) Circuit Breaker:	

GAS HEATING

Heating Models:	High
Heating and 1 Stage Input (Btu/h)	400,000 / 300,000
Heating and 1 Stage Output (Btu/h):	320000 / 240000
Min./Max. Gas Input - Pressure Natural or LP (in w.c):	2.5/14.0
Gas Connection Pipe Size:	3/4"

COMPRESSOR

	Circuit(s)
Number:	3
Horsepower:	12.8/6.9
Phase:	3
Rated Load Amps:	8.2/8.2/18.26
Locked Rotor Amps:	66.1/66.1/140.0

INDOOR MOTOR

Standard Motor

Number: (3)	1
Horsepower:	7.5
Motor Speed (RPM):	3,450
Phase:	3
Full Load Amps:	11.0
Locked Rotor Amps:	74.0

Standard Oversized Motor (4)

Number:	"
Horsepower:	
Motor Speed (RPM):	
Phase:	
Full Load Amps:	
Locked Rotor Amps:	

Accessory Oversized Motor (4)

Number:	"
Horsepower:	
Motor Speed (RPM):	
Phase:	
Full Load Amps:	
Locked Rotor Amps:	

OUTDOOR MOTOR

Number:	2
Horsepower:	1.0
Motor speed (RPM):	1,125
Phase:	3
Full Load Amps:	1.8
Locked Rotor Amps:	7.7

POWER EXHAUST
(Field Installed Power Exhaust)

Horsepower:	N/A
Motor Speed (RPM):	N/A
Phase:	N/A
Full Load Amps:	N/A
Locked Rotor Amps:	N/A

COMBUSTION BLOWER MOTOR
(Gas-Fired Heating only)

Horsepower:	0.1
Motor Speed (RPM):	3500/2800
Phase:	1
Full Load Amps:	0.8
Locked Rotor Amps:	2.00

FILTER

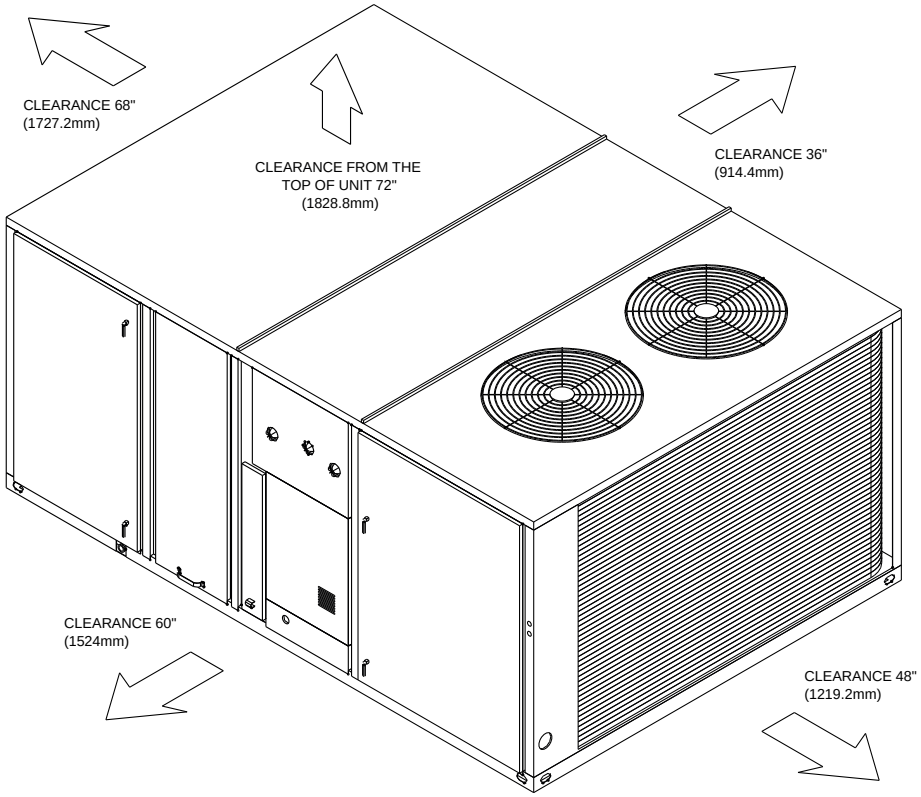
Type:	Throwaway
Furnished:	Yes
Number:	12
Recommended Size:	20"x20"x2"

REFRIGERANT (2)

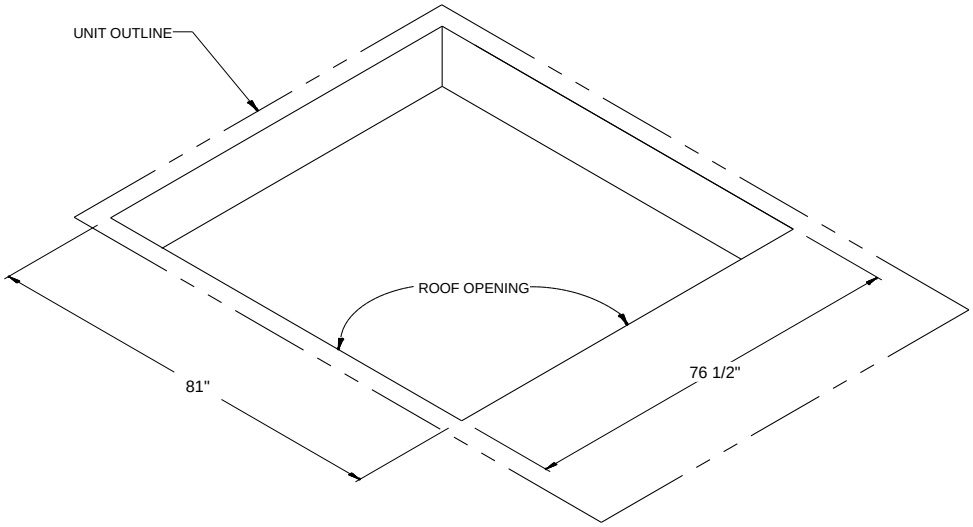
	Circuit #1 / 2
Type:	R-410
Factory Charge Circuit #1 / 2:	11.8 lb / 10.6 lb

NOTES:
1. Maximum (HACR) Circuit Breaker sizing is for installations in the United States only.
2. Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.
3. Value include Standard Motor.
4. Value include Oversized Motor
5. EER is rated at AHRI conditions and in accordance with DOE test procedures.

Weight, Clearance & Rigging Diagram - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8

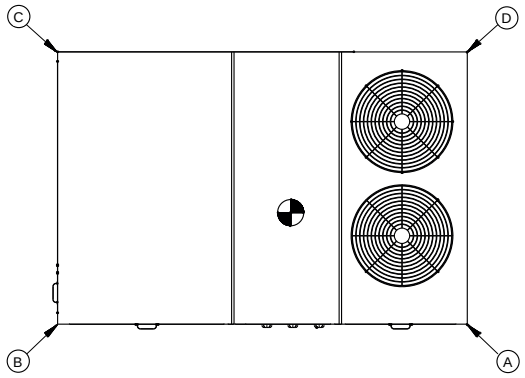


DOWNFLOW-PACKAGED GAS/ELECTRIC CLEARANCE



DOWNFLOW-PACKAGED GAS/ELECTRIC ROOF OPENING CLEARANCE

Weight, Clearance & Rigging Diagram - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8



CORNER WEIGHT

Base Unit and Corner Weights only

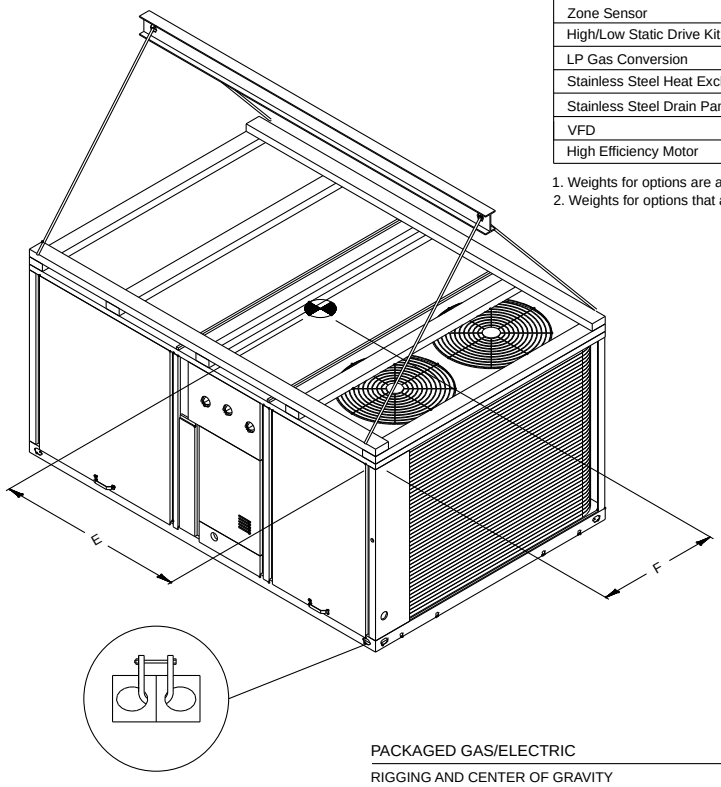
Base unit weights		Corner Weights				Center of Gravity	
SHIPPING	NET	Ⓐ	Ⓑ	Ⓒ	Ⓓ	E	F
2269.0 lb	1838"	595.0 lb	497.0 lb	355.0 lb	390.0 lb	45"	34"

1. All weights are approximate.
2. The actual weight are listed on the unit nameplate.
3. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
4. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
5. Verify weight, connection, and all dimension with installer documents before installation.
6. Corner weights are given for information only.
7. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.

Installed Options Net Weight Data

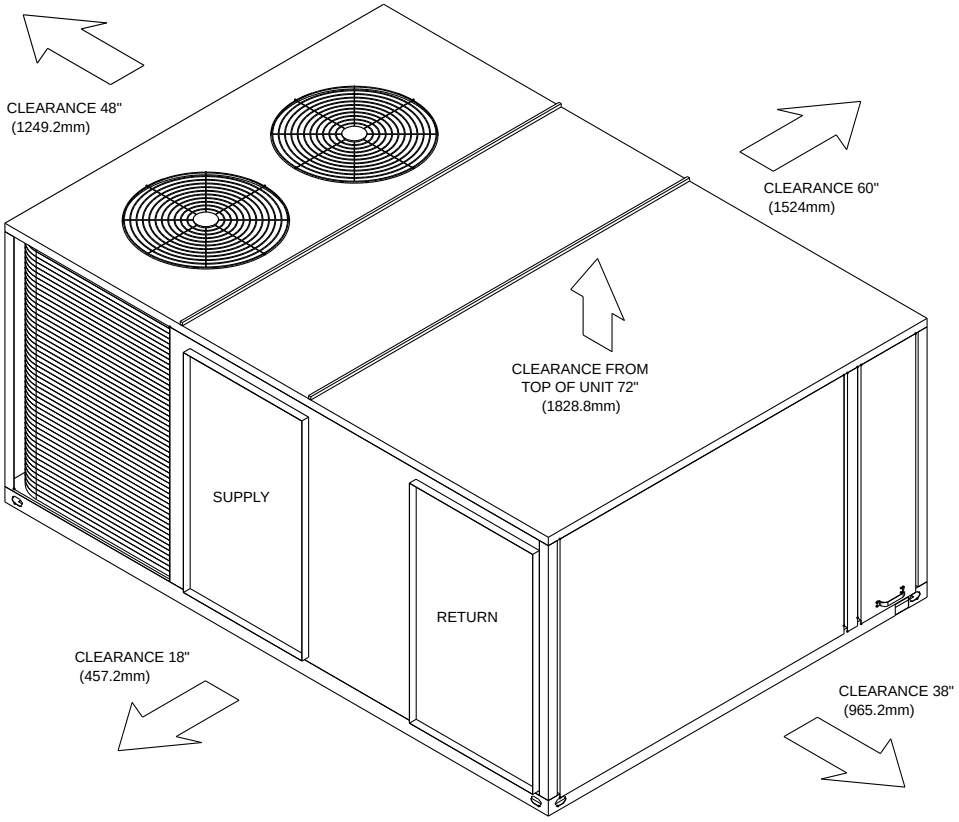
Accessory	Weight
Economizer, Manual and Motorized Outside Air Damper	80.0 lb
Power Exhaust	95.0 lb
Roof Curb	
Oversized Motor	
Hail Guard	43.0 lb
Hinged Access Doors	
Power Conv. Outlet	
Through the Base Electrical	
Circuit Breaker	
Disconnect	
Smoke Detector	5.0 lb
Novar	
Zone Sensor	
High/Low Static Drive Kit	
LP Gas Conversion	
Stainless Steel Heat Exchanger	
Stainless Steel Drain Pan	
VFD	
High Efficiency Motor	

1. Weights for options are approximate.
2. Weights for options that are not list refer to Installation guide.



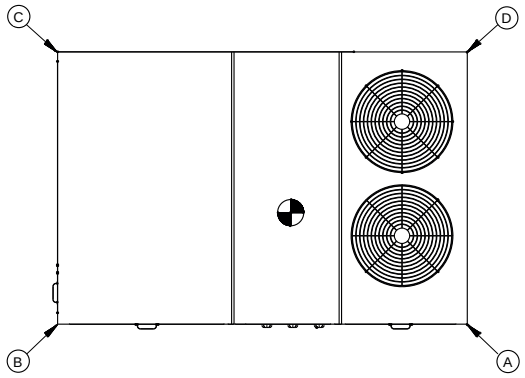
PACKAGED GAS/ELECTRIC
RIGGING AND CENTER OF GRAVITY

Weight, Clearance & Rigging Diagram - Packaged Gas/Electric Rooftop Units
Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E



HORIZONTAL ISOMETRIC-PACKAGED GAS/ELECTRIC CLEARANCE

Weight, Clearance & Rigging Diagram - Packaged Gas/Electric Rooftop Units
Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E



CORNER WEIGHT

Base Unit and Corner Weights only

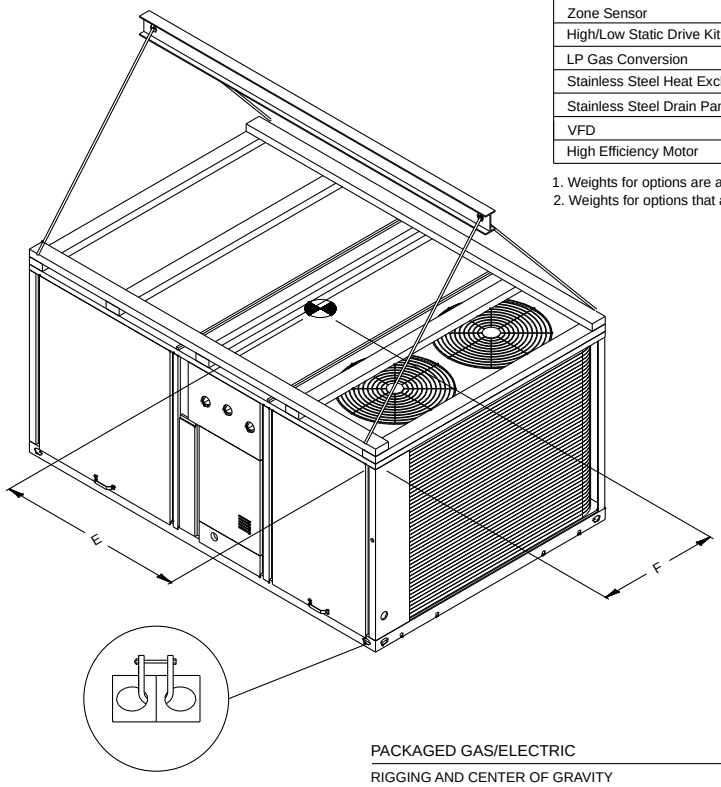
Base unit weights		Corner Weights				Center of Gravity	
SHIPPING	NET	Ⓐ	Ⓑ	Ⓒ	Ⓓ	E	F
2734.0 lb	2291.0 lb	734.0 lb	603.0 lb	432.0 lb	523.0 lb	55"	35"

1. All weights are approximate.
2. The actual weight are listed on the unit nameplate.
3. Refer to unit nameplate and installation guide for weights before scheduling transportation and installation of unit.
4. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10 % of the nameplate weight. .
5. Verify weight, connection, and all dimension with installer documents before installation.
6. Corner weights are given for information only.
7. Net/Shipping weight of optional accessories should be added to unit weight when ordering factory or field installed accessories.

Installed Options Net Weight Data

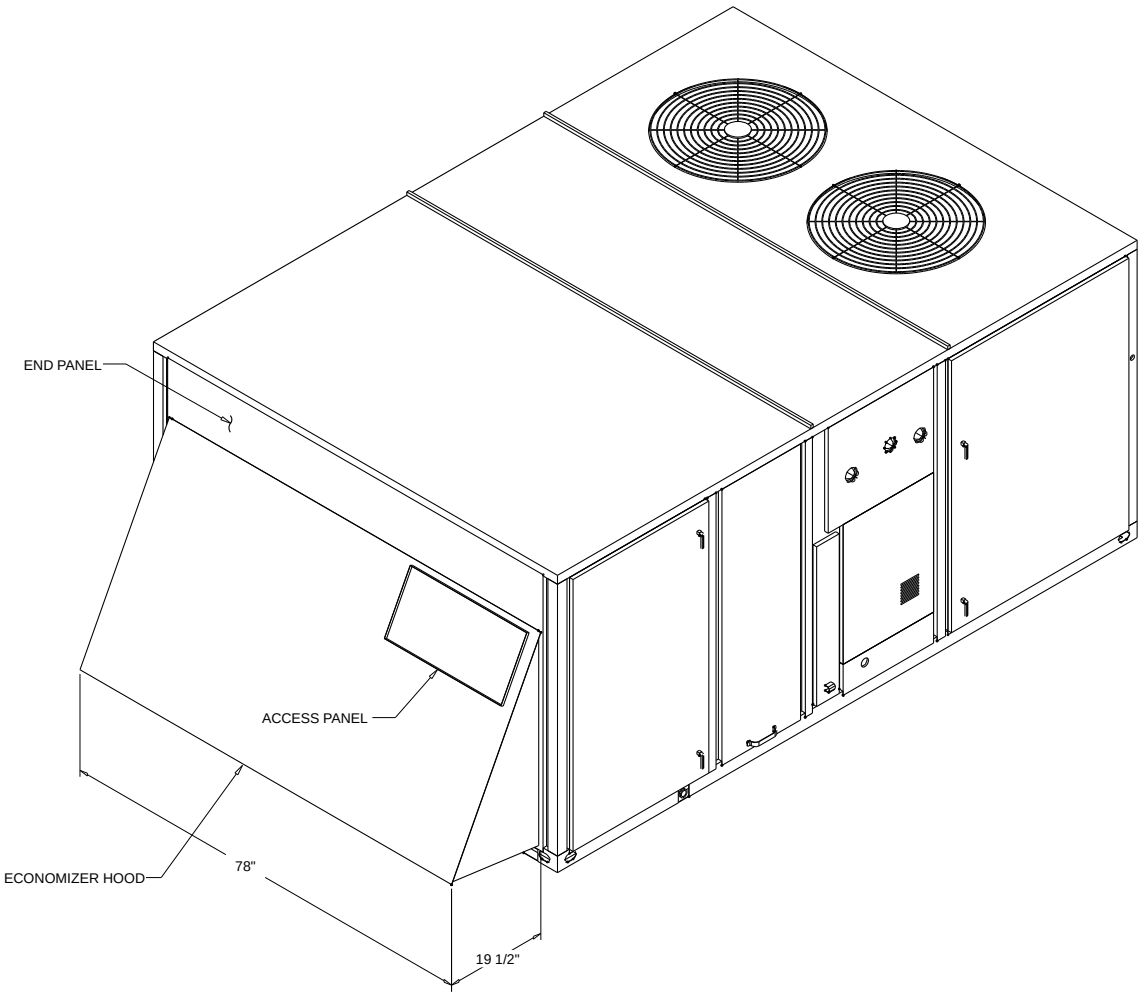
Accessory	Weight
Economizer, Manual and Motorized Outside Air Damper	250.0 lb
Power Exhaust	
Roof Curb	
Oversized Motor	
Hail Guard	51.0 lb
Hinged Access Doors	
Power Conv. Outlet	
Through the Base Electrical	
Circuit Breaker	
Disconnect	
Smoke Detector	
Novar	
Zone Sensor	
High/Low Static Drive Kit	
LP Gas Conversion	
Stainless Steel Heat Exchanger	
Stainless Steel Drain Pan	
VFD	
High Efficiency Motor	

1. Weights for options are approximate.
2. Weights for options that are not list refer to Installation guide.



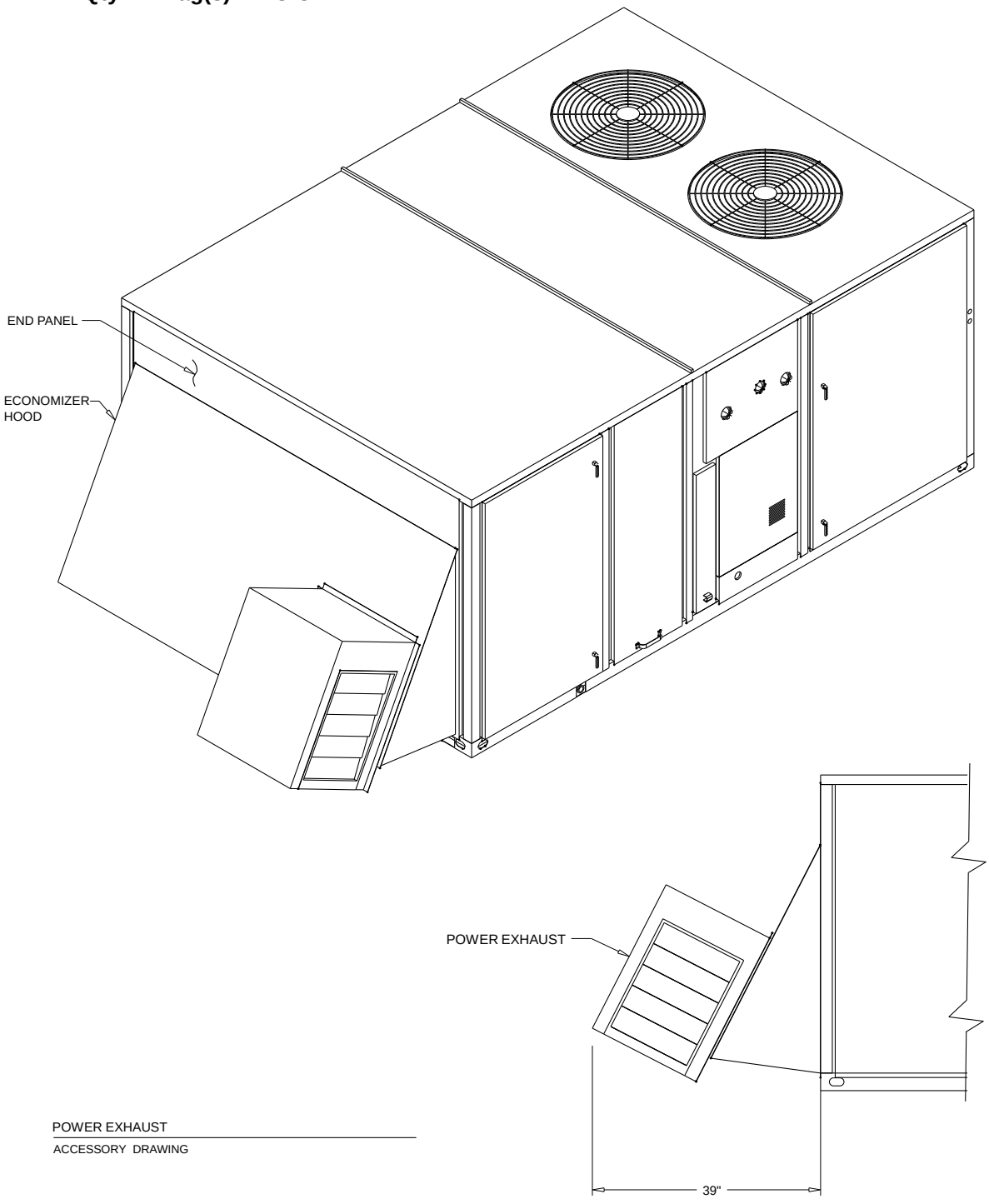
PACKAGED GAS/ELECTRIC
RIGGING AND CENTER OF GRAVITY

Accessory - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8



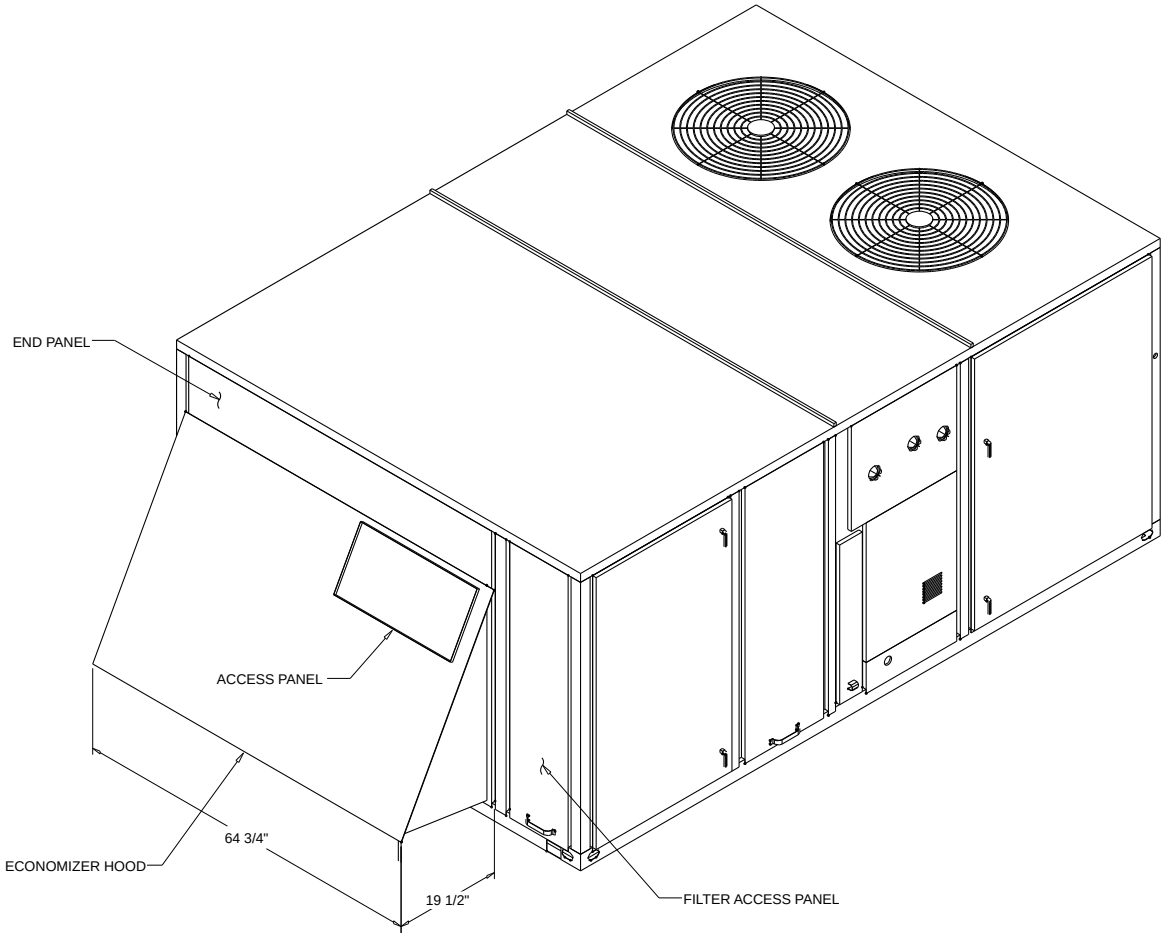
ECONOMIZER HOOD
PLAN VIEW DRAWING

Accessory - Packaged Gas/Electric Rooftop Units
Item: B1 Qty: 1 Tag(s): RTU-8



POWER EXHAUST
ACCESSORY DRAWING

Accessory - Packaged Gas/Electric Rooftop Units
Item: B2 Qty: 2 Tag(s): RTU-3W, RTU-3E



ECONOMIZER HOOD
PLAN VIEW DRAWING

Tag Data - Commercial Rooftop Air Conditioning Units (Large) (Qty: 2)

Item	Tag(s)	Qty	Description	Model Number
C1	RTU-1	1	90 ton Packaged Industrial Rooftop	SXHKC904
C2	RTU-2	1	105 ton Packaged Industrial Rooftop	SXHKD114

Product Data - Commercial Rooftop Air Conditioning Units (Large)

All Units

DX Cooling, no heat, extended casing
R-410A refrigerant
IntelliPak replacement unit order
460 Volt-60 Hertz-3 Phase
100% Exhaust - 15 hp with Statitrac building pressure control
600 rpm
MERV 8 High efficiency throwaway filters
40 hp (2-20 hp Motors) Supply motors
1300 rpm
0-100% Economizer
Economizer control w/ dry bulb
VAV (DTC) with supply & exhaust VFD
Room sensor with timed override and cancel buttons- Local setpoint adjustment (Fld)
UL Approval
Low leak outside air dampers
High Duct Temperature Thermostats
Extended grease lines
IntelliPak replacement unit with hinged access doors
BACnet communication interface module 7
WCI, wireless control interface
Startup Included - Trane Service must start equipment for warranty to be honored
Spring replacement on existing spring isolation curb by others (Fld)
5 Year parts, labor & refrigeration warranty

5 year semi-annual inspection service

Item: C1 Qty: 1 Tag(s): RTU-1

90 Ton unit
High capacity evaporator coil & high efficiency condenser coil

Item: C2 Qty: 1 Tag(s): RTU-2

105 Ton unit
High capacity evaporator coil

Performance Data - Commercial Rooftop Air Conditioning Units (Large)

Tags	RTU-1	RTU-2
Supply airflow (cfm)	32000	36750
Exhaust airflow (cfm)	30000	30000
Elevation (ft)	0.00	0.00
Cooling entering DB (F)	80.00	80.00
Cooling entering WB (F)	67.00	67.00
Ent air relative humidity (%)	51.08	51.08
Ambient DB (F)	95.00	95.00
Cooling leaving coil DB (F)	56.07	56.97
Cooling leaving coil WB (F)	55.19	55.80
Cooling leaving unit DB (F)	58.68	59.69
Cooling leaving unit WB (F)	56.27	56.92
Gross total capacity (MBh)	1163.35	1273.23

Tags	RTU-1	RTU-2
Gross sensible capacity (MBh)	857.01	947.42
Gross latent capacity (MBh)	306.34	325.81
Net total capacity (MBh)	1081.43	1172.48
Net sensible capacity (MBh)	775.09	846.67
Net sensible heat ratio (%)	71.67	72.21
Fan motor heat (MBh)	81.92	100.75
Supply duct static pressure (in H2O)	2.100	2.100
Return duct static pressure (in H2O)	0.300	0.300
Component S.P. drop (in H2O)	1.520	1.637
Total static pressure (in H2O)	3.920	4.037
Supply motor brake horsepower (bhp)	29.30	36.04
Supply fan rpm (rpm)	1176	1255
Exhaust static pressure (in H2O)	0.300	0.300
Exhaust motor brake horsepower (bhp)	13.28	13.28
Exhaust fan rpm (rpm)	550	550
System power (kW)	113.59	133.07
EER @ AHRI (EER)	11.0	10.3
IEER @ AHRI (EER)	15.4	14.4
Minimum circuit ampacity (A)	241.90	263.05
Maximum overcurrent protection (A)	250.00	300.00
Minimum disconnect switch size (A)	267.00	289.00
Recommended dual element (A)	250.00	300.00
Compressor 1 count (Each)	4.00	2.00
Compressor 1 RLA (A)	37.20	37.20
Compressor 2 count (Each)	0.00	2.00
Compressor 2 RLA (A)	0.00	45.00
Supply fan motor FLA (A)	24.70	24.70
Supply fan count (Each)	2.00	2.00
Condenser fan FLA (A)	14.40	18.00
Exhaust fan motor FLA (A)	18.00	18.00
Other FLA (A)	2.00	2.00
Evaporator face area (sq ft)	59.30	59.30
Evaporator rows (Each)	6.00	5.00
Evaporator fin spacing (Per Foot)	148	148
Condenser rows (Each)	0.00	0.00
Condenser fin spacing (Per Foot)	0	0
Discharge duct - 63 Hz (dB)	90	91
Discharge duct - 125 Hz (dB)	86	87
Discharge duct - 250 Hz (dB)	90	91
Discharge duct - 500 Hz (dB)	86	88
Discharge duct - 1 kHz (dB)	82	84
Discharge duct - 2 kHz (dB)	75	77
Discharge duct - 4 kHz (dB)	71	73
Discharge duct - 8 kHz (dB)	64	67
Return duct - 63 Hz (dB)	81	81
Return duct - 125 Hz (dB)	81	82
Return duct - 250 Hz (dB)	83	85
Return duct - 500 Hz (dB)	74	76
Return duct - 1 kHz (dB)	69	70
Return duct - 2 kHz (dB)	67	68

Tags	RTU-1	RTU-2
Return duct - 4 kHz (dB)	65	66
Return duct - 8 kHz (dB)	55	56
Exhaust fan - 63 Hz (dB)	85	85
Exhaust fan - 125 Hz (dB)	82	82
Exhaust fan - 250 Hz (dB)	79	79
Exhaust fan - 500 Hz (dB)	78	78
Exhaust fan - 1 kHz (dB)	76	76
Exhaust fan - 2 kHz (dB)	77	77
Exhaust fan - 4 kHz (dB)	74	74
Exhaust fan - 8 kHz (dB)	66	67
Installed point load 1 (lb)	1547.4	1478.1
Installed point load 2 (lb)	1562.3	1501.5
Installed point load 3 (lb)	1529.5	1518.4
Installed point load 4 (lb)	1544.5	1541.7
Installed point load 5 (lb)	1515.0	1551.3
Installed point load 6 (lb)	1529.9	1574.7
Installed point load 7 (lb)	1500.5	1583.9
Installed point load 8 (lb)	1515.5	1607.3
Installed point load 9 (lb)	1487.2	1614.0
Installed point load 10 (lb)	1502.1	1637.4
Total weight (lb)	15234.0	15608.3
First X dimension (ft)	17.24	17.75
First Y dimension (ft)	5.86	5.87
Installed point load 1 - X (in)	4.000	4.000
Installed point load 1 - Y (in)	4.000	4.000
Installed point load 2 - X (in)	120.000	120.000
Installed point load 2 - Y (in)	136.000	136.000
Installed point load 3 - X (in)	215.000	215.000
Installed point load 4 - X (in)	309.000	309.000
Installed point load 5 - X (in)	396.000	396.000
R-410A refrigerant charge - circuit 1 (lb)	64.8	73.2
R-410A refrigerant charge - circuit 2 (lb)	64.8	73.2

Mechanical Specifications - Commercial Rooftop Air Conditioning Units (Large)
Item: C1, C2 Qty: 2 Tag(s): RTU-1, RTU-2

General
Units shall be specifically designed for outdoor rooftop installation on a roof curb and be completely factory assembled and tested, piped, internally wired, fully charged with R-410A compressor oil and shipped in one piece. Units shall be available for direct expansion cooling only, or direct expansion cooling with natural gas, electric, hot water or steam heating. Filters, outside air system, exhaust air system, optional non-fused disconnect switches and all operating and safety controls shall be furnished factory installed. All units shall be cULus approved and factory run tested. Cooling capacity shall be rated in accordance with AHRI Standard 360. All units shall have decals and tags to aid in service and indicate caution areas. Electrical diagrams shall be printed on long life water resistant material and shall ship attached to control panel doors.

Unit Casing
Exterior panels shall be zinc coated galvanized steel, phosphatized and painted with a slate gray air-dry finish durable enough to withstand a minimum of 672 hours consecutive salt spray application in accordance with standard ASTM B117. Screws shall be coated with zinc-plus-zinc chromate. Heavy gauge steel hinged access panels with tiebacks to secure door in open position shall provide access to filters and heating sectionsInterior surfaces or exterior casing members will have 1/2"" [12.7 mm] Tuf-Skin fiberglass insulation. Unit base will be watertight with 14 gauge formed load bearing members, formed recess and curb overhang. Unit lifting lugs will accept chains or cables for rigging. Lifting lugs will also serve as unit tie down points."

IntelliPak Replacement Unit (IRU)
The IntelliPak replacement solution shall include a
condenser base pan, strengthening of the condenser section with welded reinforcement of condenser base rail, as well as welded integral supports to the condenser base. This additional strength shall allow the reuse of the existing pedestal as well as any Trane full perimeter curb and reduce installation risk and labor. Also optional with stainless steel.

Hinged Access Doors
Hinged access doors shall provide easy access to supply fan, filters, exhaust fan, and heating section.These access doors shall feature double wall construction with dual density insulation sandwiched between heavy gauge galvanized steel panels for strength and durability

Scroll Compressors
The Trane Scroll compressor shall be industrial grade, direct drive 3600 RPM maximum speed scroll type. The motor shall be suction gas-cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve.
Compressor shall also be provided with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge, high and low pressure cutouts, and reset relay.

Evaporator Coil
Internally enhanced seamless copper tubing of 1/2 "" [12.7 mm] O.D. shall be mechanically bonded to heavy-duty aluminum fins of configured design. The coils shall be be equipped with thermal expansion valves and factory pressure and leak tested.

Air-Cooled Condenser Coil
Condenser coils shall have all Aluminum Microchannel coils. All coils shall be leak tested at the factory to ensure pressure integrity. The condenser coil is pressure tested to 650 psig. Subcooling circuit(s) shall be provided as standard.

High Efficiency Condenser Coil
Additional rows of coil shall provide increased efficiency compared to standard coils.

High Capacity Evaporator Coil
Additional rows of coil and enhanced evaporator tube surfaces shall provide increased capacity as compared to standard coils.

Supply Fan (90-130T)
All supply fans shall have two independent fan assemblies with double inlet, air foil fan, motor and fixed pitch sheave drive. All fans shall be statically and dynamically balanced and tested in factory. Supply fans shall be test run in unit as part of unit test. Unit shall reach rated rpm before fan shaft passes through first critical speed. Fan shafts shall be mounted on two grease lubricated ball bearings designed for 200,000 hours average life. Optional extended grease lines shall allow greasing of bearings from unit filter section. Fan motor and fan assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. Entire assemblies shall be completely isolated from unit and fan board by two-inch deflection spring isolators. All 60 Hz supply fan motors meet the Energy Independence Security Act of 2007 (EISA)

Variable Air Volume Supply Air Temperature Control
The unit shall be provided with all the necessary controls to operate a variable air volume rooftop from the discharge air temperature, including discharge air microprocessor controller and discharge air sensor. The microprocessor controller shall coordinate the economizer control and the stages of cooling with zone or outdoor air reset capabilities and an adjustable control band to fine-tune the control to specific applications.

Variable Frequency Drive
Unit shall include factory-installed and tested variable frequency drive[s] (VFD) to provide motor speed modulation. The VFD shall receive a 0-10VDC speed signal from the unit controller. The drive will respond to the signal by accelerating or decelerating to maintain the controlling set point (duct static, space pressure, etc). VFD shall also include the following features:

1. Designed, constructed, and tested in accordance with NEMA ICS, NFPA, and IEC standards and housed in a plastic IP20 enclosure.

2. DC link reactors on both the positive and negative rails of the DC bus equal to 3% impedance to minimize power line harmonics.

3. Full rated output current continuously - 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

4. Isolation between the Drive's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by
voltage spikes, current surges, and ground loop currents.

5. Audible noise reduction through automatic adjustment of the carrier frequency and frequency avoidance.

6. Rated at 40C with a standard operating range of -10 to 50C (14 to 124F) ambient temperatures and 0 to 95% relative humidity

7. Self-diagnostics and motor protections such as: cULus listed overload, phase loss, and internal thermal overload.

8. Off/Stop and Auto/Start selector switches to start and stop the AC Drive and determine the speed reference.
   a. On units with bypass, an AC Drive/Off/Bypass hand selector switch shall be provided in the unit control box
   b. In DRIVE mode speed reference shall be provided by a 0-10 VDC analog input

9. A keypad interface which shall be programmable by language and feature multiple lines for easy reading.

10. Controlled and/or accessible points such as AC Drive Start/Stop, speed reference, and fault diagnostics.

11. Meter points such as motor power in HP, motor power in kW, motor kW-hr, motor current, motor voltage, hours run, DC link voltage, thermal load on motor,
    Thermal load on AC
    Drive and Heatsink temperature.
12. Troubleshooting features such as:
    a. AC Drive memory storage of the last 10 faults and related operational data

    b. Four simultaneous displays: frequency or speed, run time, output amps and output power

    c. Keypad which shall display: Reference Signal Value, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kW

13. Coated circuit boards for protection against corrosive environments

14. Field readable BACnet points to allow for communication of stauts, setpoints and diagnostics to the BAS.

Extended Grease Lines
Lines shall be provided to allow greasing of supply and exhaust fan bearings through the filter access door.

100 Percent Exhaust with Statitrac
Two, double-inlet, forward-curved fans shall be mounted on a common shaft with fixed sheave drive. All fans shall be dynamically balanced and tested in factory before being installed in unit. Exhaust fan shall be test run as part of unit final run test. Unit shall reach rated rpm before fan shaft passes through first critical speed. Fan shaft shall be mounted on two grease lubricated ball bearings designed for 200,000-hour average life. Optional extended grease lines shall be provided to allow greasing of bearings from unit filter section. Fan motor and assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. Entire assembly shall be completely isolated from unit and fan board by double deflection, rubber in shear isolators or spring isolation on motor sizes larger than five hp. For both CV and VAV rooftops, the 100 percent modulating exhaust discharge dampers (or VFD) shall be modulated in response to building pressure. A differential pressure control system, (Statitrac), shall use a differential pressure transducer to compare indoor building pressure to outdoor ambient atmospheric pressure. The FC exhaust fan shall be turned on when required to lower building static pressure setpoint. The (Statitrac) control system shall then modulate the discharge dampers (or VFD) to control the building pressure to within the adjustable, specified dead band that shall be adjustable at the Human Interface Panel. All 60 Hz exhaust fan motors meet the Energy Independence Security Act of 2007 (EISA).

0-100 Percent Economizer
Automatically modulating return and outside air dampers assist in the maintaining of the control temperature setpoint to allow "free" cooling. The economizer is equipped with an automatic lockout when the outdoor enthalpy/temperature is not suitable for space temperature control. Minimum position is

standard and adjustable with either the Human Interface Control, remote potentiometer, or through the building management system. A spring return actuator insures closure of the outside air dampers during shutdown or power interruption. Mechanical cooling is available to assist the economizing mode. Low leak dampers are standard with a leakage rate of 2.5 percent of nominal airflow of 400 Cfm/ton [189 L/s] per ton at a static pressure of 1" [25.8 mm] w.c.

0-100 percent modulating economizer
Operated through the primary temperature controls to automatically utilize OA for "free" cooling. Automatically modulated return and OA dampers shall maintain proper temperature in the conditioned space. Economizer shall be equipped with an automatic lockout when the outdoor high ambient temperature is too high for proper cooling. Minimum position control shall be standard and adjustable at the Human Interface Panel or with a remote potentiometer or through the building management system. A spring return motor shall ensure closure of OA dampers during unit shutdown or power interruption. Mechanical cooling shall be available to aid the economizer mode at any ambient. Low leak economizer dampers shall be standard with a leakage rate of 2.5 percent of nominal airflow (400 CFM/ton) at 1" wg. static pressure.

Economizer Dry Bulb Control
An outdoor temperature sensor shall be included for comparing the outdoor dry bulb temperature to a locally adjustable temperature setpoint. The setpoint shall be programmed at the human interface, or remote human interface, to determine if outdoor air temperature is suitable for economizer operation.

Low Leak Dampers
Standard low leak dampers shall be provided with chlorinated polyvinyl chloride gasketing added to the damper blades and rolled stainless steel jamb seals to the sides of the damper assembly. Dampers shall have a leakage rate of 1% at 1.0 in WC pressure differential.

High efficiency throwaway, MERV 8
Filters are 2"" [50.8 mm] thick, MERV 8, UL class 2 high efficiency pleated media type. Filters have an average efficiency of 25 to 30 percent, and are rated in excess of 90 percent average synthetic dust weight arrestance, when tested in accordance with ASHRAE 52.76 and 52.1 test methods. Filters mounted in galvanized steel rack.

Controls
The rooftop unit shall utilize a DDC microprocessor control system which is suitable for CV and VAV applications. The control system shall be factory installed in the main control panel with the necessary internal controls and run tested. Terminal blocks for field power wiring connections shall be standard. Units shall provide a location for a non-fused disconnect switch with an external handle for safety. Unit mounted microprocessor controls shall provide compressor anti-short cycle protection. The unit shall be equipped with a Human Interface Panel with a 16 key keypad, a 2 line by 40 character English display to provide the operator with full adjustment and display of control data function. The unit controls can be used as a stand-alone controller or as part of a building management system.

BACnet Communication Interface Module (BCI)
Shall provide control and monitoring of the rooftop by Tracer SC or a 3rd party building management system utilizing BACnet protocol.

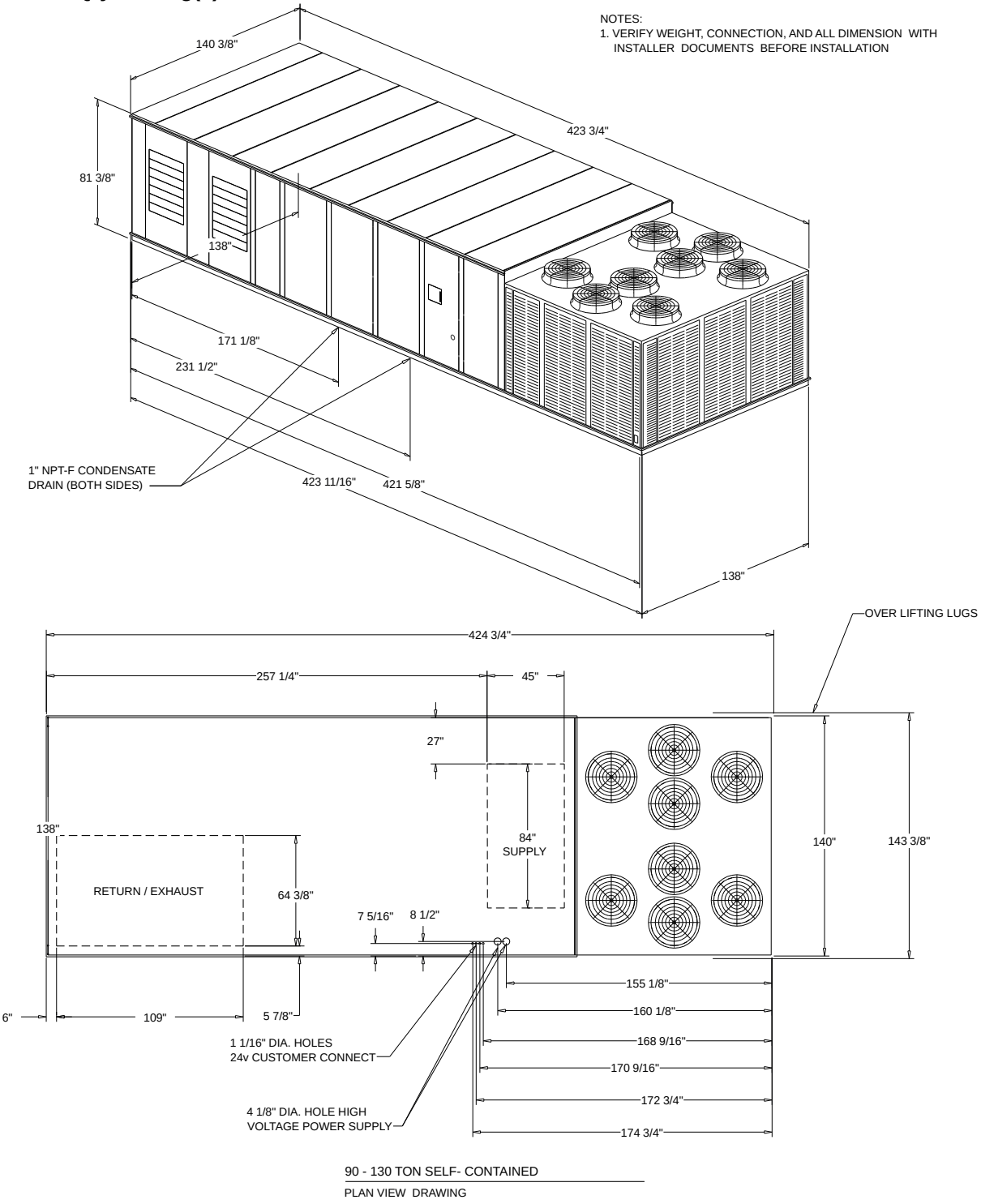
Unit Interrupt Rating (Standard Short Circuit Current Rating-SCCR)
A 5,000 Amp rating shall be applied to the unit enclosure using a non-fused circuit breaker for disconnect switch purposes. Fan motors, compressors, and electric heat circuits shall be provided with protective devices that will provide the unit rated level of fault protection. The unit shall be marked with approved cULus markings and will adhere to cULus regulations.

High Duct Temperature Thermostats
Shall consist of two manual reset thermostats, one located in the discharge section of the unit set at 240 F [115.6 C] and the other in the return section set at 135 F [57.2 C]. The rooftop shall shut down if the thermostats are tripped.

Room Sensor w/Timed Override and Local Setpoint Adjustment
Electronic sensor with zone temperature set point capability used in conjunction with a Trane Integrated Comfort System. The Timed Override Button allows the system to operate at the occupied set points while in an unoccupied status.

Equipment manufactured by Trane that includes required start-up and sold in North America will not be warranted by Trane unless Trane or its authorized independent Trane commercial sales office performs the startup on the equipment.

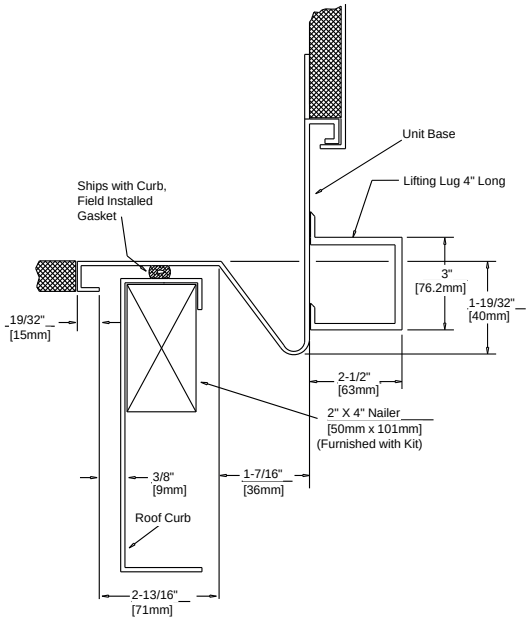
Unit Dimensions - Commercial Rooftop Air Conditioning Units (Large)
Item: C1 Qty: 1 Tag(s): RTU-1



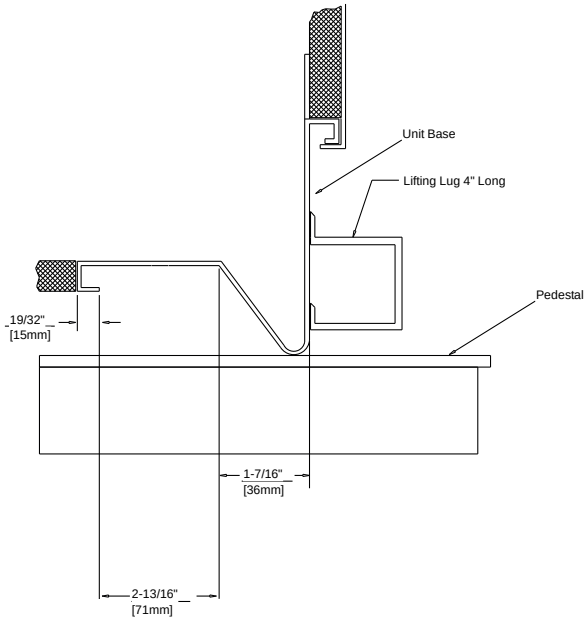
90 - 130 TON SELF- CONTAINED
PLAN VIEW DRAWING

Unit Dimensions - Commercial Rooftop Air Conditioning Units (Large)
Item: C1, C2 Qty: 2 Tag(s): RTU-1, RTU-2

TYPICAL ROOF CURB AND BASE PAN DETAIL



TYPICAL PEDESTAL AND BASE PAN DETAIL



Unit Dimensions - Commercial Rooftop Air Conditioning Units (Large)
Item: C1 Qty: 1 Tag(s): RTU-1

ELECTRICAL / GENERAL DATA

GENERAL DATA	
Tonnage:	90
Unit Operating Voltage Range:	414 -506
Unit Primary Voltage:	460
Unit Hertz:	60
Unit Phase:	3
EER	11.0 EER

ELECTRIC HEATER	
Electric Heater kw	
Electric Heater Full Load Amps	

HEATING - PERFORMANCE	
Heat Input:	
Heat Output:	
Capacity Steps:	

HEATING - GENERAL DATA	
Gas Inlet Pressure (in w.c.):	
Gas Pipe Connection Size:	

COMPRESSOR	Circuit #1	Circuit #2
Number:	2	2
Tons (Each) (5):	20/20	20/20
Compressor Rated Load Amps (Each):	37.20 A	0.00 A
Locked Rotor Amps (Each):	215.0 / 215.0	215.0 / 215.0

SUPPLY FAN MOTOR	
Number:	2
Horsepower (Each):	20.0
Supply Fan Motor Full Load Amps (Each):	24.70 A

EXHAUST FAN MOTOR	
Number:	1
Horsepower (Each):	15.0
Exhaust Fan Motor Full Load Amps (Each):	18.00 A

CONDENSOR FAN MOTOR	
Number:	8
Horsepower (Each):	1.0
Condensor Fan Motor Full Load Amps (Each):	14.40 A

REFRIGERANT	
Refrigeran Type:	R-410A
Factory Charge (Circuit #1) (6):	64.8 lb
Factory Charge (Circuit #2) (6):	64.8 lb

FILTERS - TYPE	
Type:	High Efficiency Rack-less Filter Yes
Furnished:	No
Number:	25
Recommended Size:	24" x 24" x 2"

FINAL FILTERS - TYPE	
Type:	
Furnished:	
Number:	
Recommended Size:	

Cooling MCA = (1.25 x LOAD 1) + LOAD 2 + LOAD 4

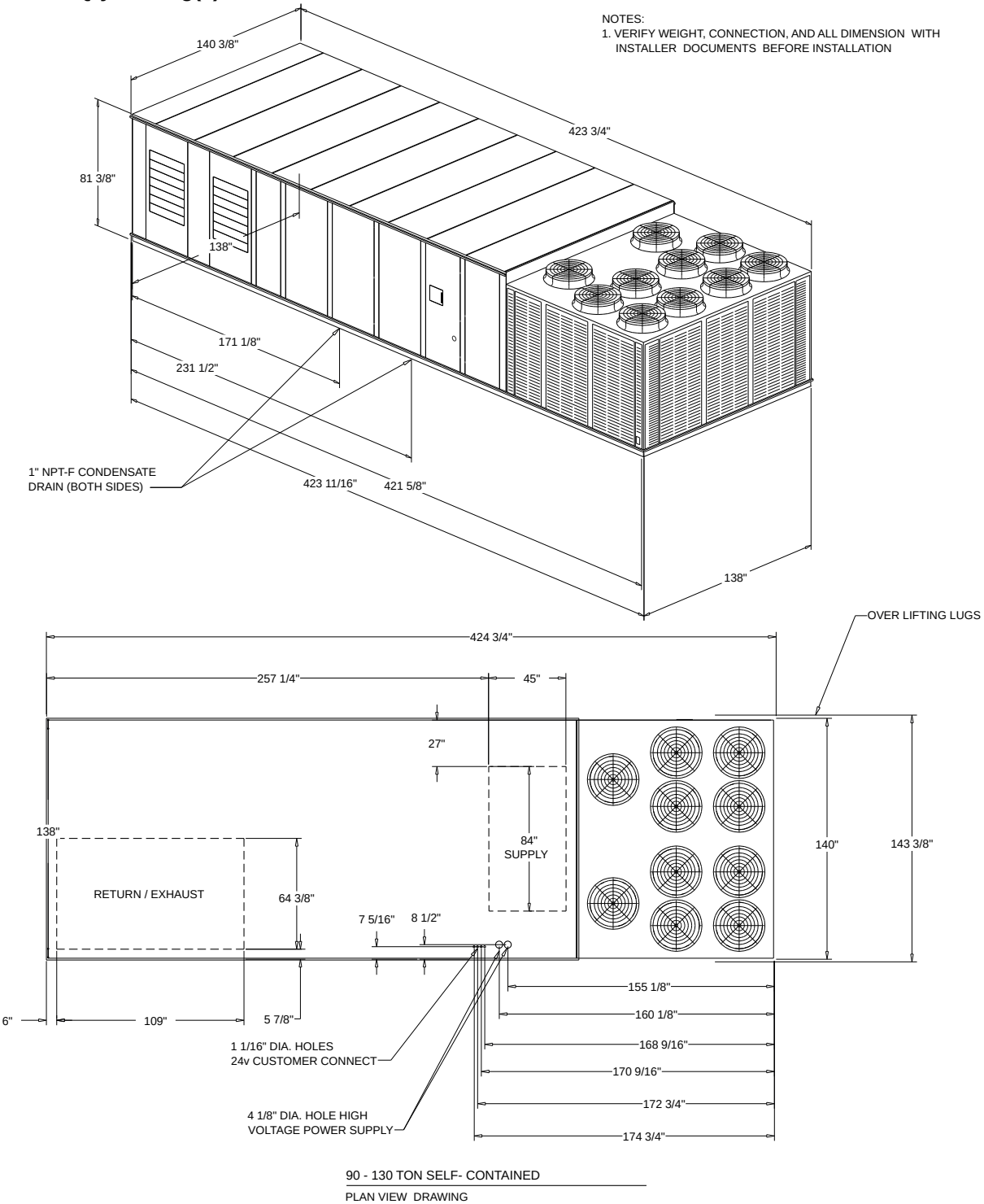
Cooling MOP= (2.25 x LOAD 1) + LOAD 2 + LOAD 4

Cooling RDE= (1.5 x LOAD 1) + LOAD 2 + LOAD 4

Notes:

1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors
LOAD 3= FLA(Full Load Amps) of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Min Cir Amp, then select the lowest maximum fuse size which is equal to or larger than the Min Cir Amp, provided the selected fuse size does not exceed 800 amps.
4. If the selected Recommended Dual Element fuse size is greater than the selected Max Over Cur Protection value, then select the Recommended Dual Element fuse size value to equal the Max Over Protection value.
5.. Compressor KW at AHRI rating conditions of 80/67 -95
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.

Unit Dimensions - Commercial Rooftop Air Conditioning Units (Large)
Item: C2 Qty: 1 Tag(s): RTU-2



90 - 130 TON SELF- CONTAINED
PLAN VIEW DRAWING

Unit Dimensions - Commercial Rooftop Air Conditioning Units (Large)
Item: C2 Qty: 1 Tag(s): RTU-2

ELECTRICAL / GENERAL DATA

GENERAL DATA	
Tonnage:	105
Unit Operating Voltage Range:	414 -506
Unit Primary Voltage:	460
Unit Hertz:	60
Unit Phase:	3
EER	10.3 EER

ELECTRIC HEATER	
Electric Heater kw	
Electric Heater Full Load Amps	

HEATING - PERFORMANCE	
Heat Input:	
Heat Output:	
Capacity Steps:	

HEATING - GENERAL DATA	
Gas Inlet Pressure (in w.c.):	
Gas Pipe Connection Size:	

COMPRESSOR	Circuit #1	Circuit #2
Number:	2	2
Tons (Each) (5):	20/25	20/25
Compressor Rated Load Amps (Each):	37.20 A	45.00 A
Locked Rotor Amps (Each):	215.0 / 260.0	215.0 / 260.0

SUPPLY FAN MOTOR	
Number:	2
Horsepower (Each):	20.0
Supply Fan Motor Full Load Amps (Each):	24.70 A

EXHAUST FAN MOTOR	
Number:	1
Horsepower (Each):	15.0
Exhaust Fan Motor Full Load Amps (Each):	18.00 A

CONDENSOR FAN MOTOR	
Number:	10
Horsepower (Each):	1.0
Condensor Fan Motor Full Load Amps (Each):	18.00 A

REFRIGERANT	
Refrigeran Type:	R-410A
Factory Charge (Circuit #1) (6):	73.2 lb
Factory Charge (Circuit #2) (6):	73.2 lb

FILTERS - TYPE	
Type:	High Efficiency Rack-less Filter Yes
Furnished:	No
Number:	25
Recommended Size:	24" x 24" x 2"

FINAL FILTERS - TYPE	
Type:	
Furnished:	
Number:	
Recommended Size:	

Cooling MCA = (1.25 x LOAD 1) + LOAD 2 + LOAD 4

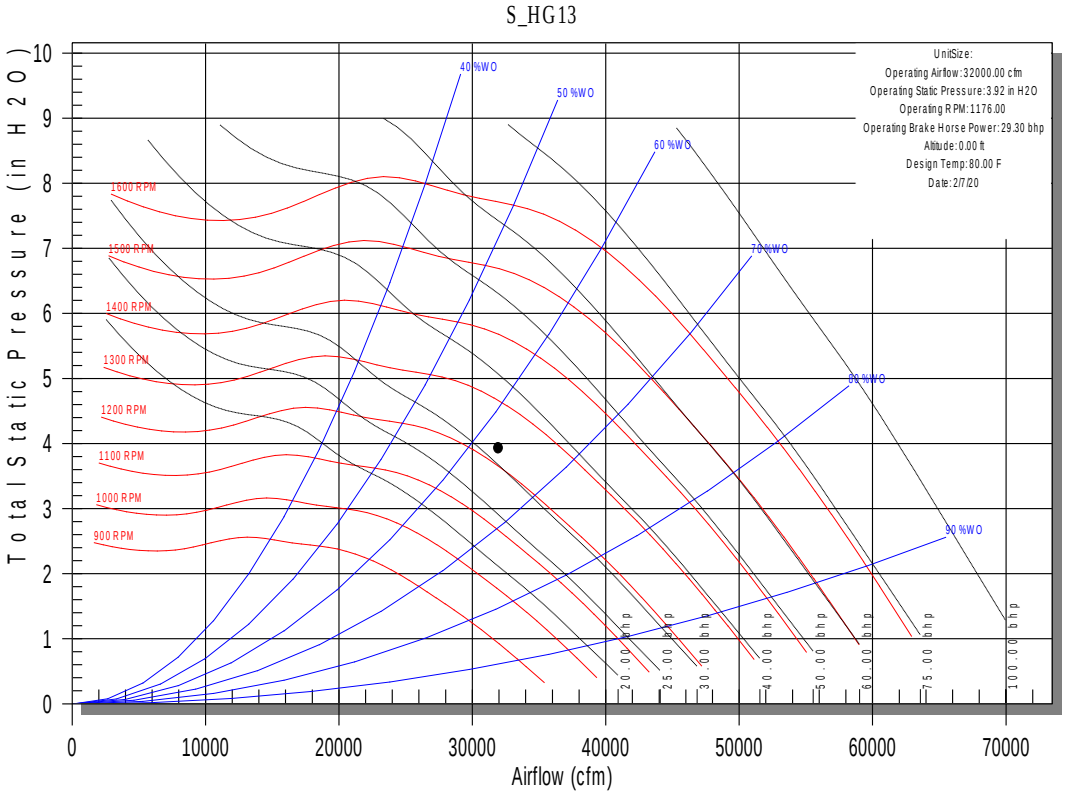
Cooling MOP= (2.25 x LOAD 1) + LOAD 2 + LOAD 4

Cooling RDE= (1.5 x LOAD 1) + LOAD 2 + LOAD 4

Notes:

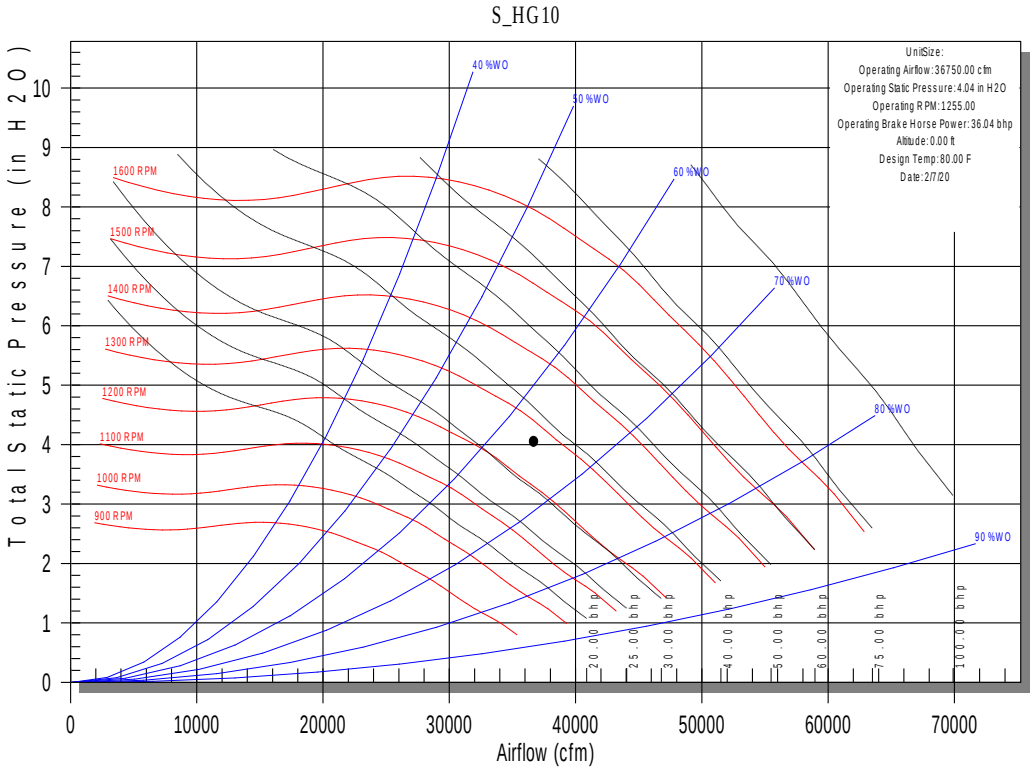
1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors
LOAD 3= FLA(Full Load Amps) of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Min Cir Amp, then select the lowest maximum fuse size which is equal to or larger than the Min Cir Amp, provided the selected fuse size does not exceed 800 amps.
4. If the selected Recommended Dual Element fuse size is greater than the selected Max Over Cur Protection value, then select the Recommended Dual Element fuse size value to equal the Max Over Protection value.
5.. Compressor KW at AHRI rating conditions of 80/67 -95
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.

Fan Curve - Commercial Rooftop Air Conditioning Units (Large)
Item: C1 Qty: 1 Tag(s): RTU-1



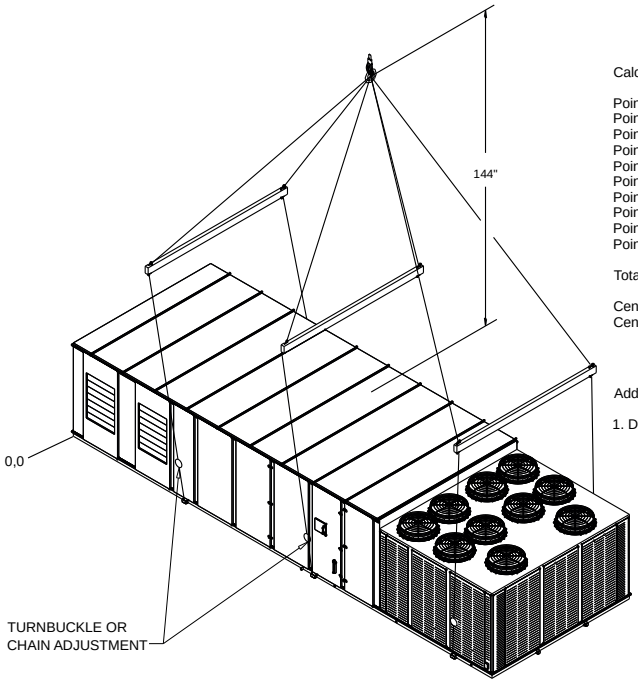
	63Hz	125Hz	250Hz	500Hz	1 kHz	2 kHz	4 kHz	8 kHz
Discharge duct:	90	86	90	86	82	75	71	64
Return duct:	81	81	83	74	69	67	65	55
Exhaust fan:	85	82	79	78	76	77	74	66

Fan Curve - Commercial Rooftop Air Conditioning Units (Large)
Item: C2 Qty: 1 Tag(s): RTU-2



	63Hz	125Hz	250Hz	500Hz	1 kHz	2 kHz	4 kHz	8 kHz
Discharge duct:	91	87	91	88	84	77	73	67
Return duct:	81	82	85	76	70	68	66	56
Exhaust fan:	85	82	79	78	76	77	74	67

Weight, Clearance & Rigging Diagram - Commercial Rooftop Air Conditioning Units (Large)
Item: C1 Qty: 1 Tag(s): RTU-1



Calculated weight:	N/A
Point Load 1:	1547.4 lb
Point Load 2:	1562.3 lb
Point Load 3:	1529.5 lb
Point Load 4:	1544.5 lb
Point Load 5:	1515.0 lb
Point Load 6:	1529.9 lb
Point Load 7:	1500.5 lb
Point Load 8:	1515.5 lb
Point Load 9:	1487.2 lb
Point Load 10:	1502.1 lb
Total Weight:	15234.0 lb
Center f Grivity x:	17.24 ft
Center of Grivity y:	5.86 ft

Point Load Location
Installed point load 1 - X: 4.000 in
Installed point load 1 - Y: 4.000 in
Installed point load 2 - X: 120.000 in
Installed point load 2 - Y: 136.000 in
Installed point load 3 - X: 215.000 in
Installed point load 4 - X: 309.000 in
Installed point load 5 - X: 396.000 in

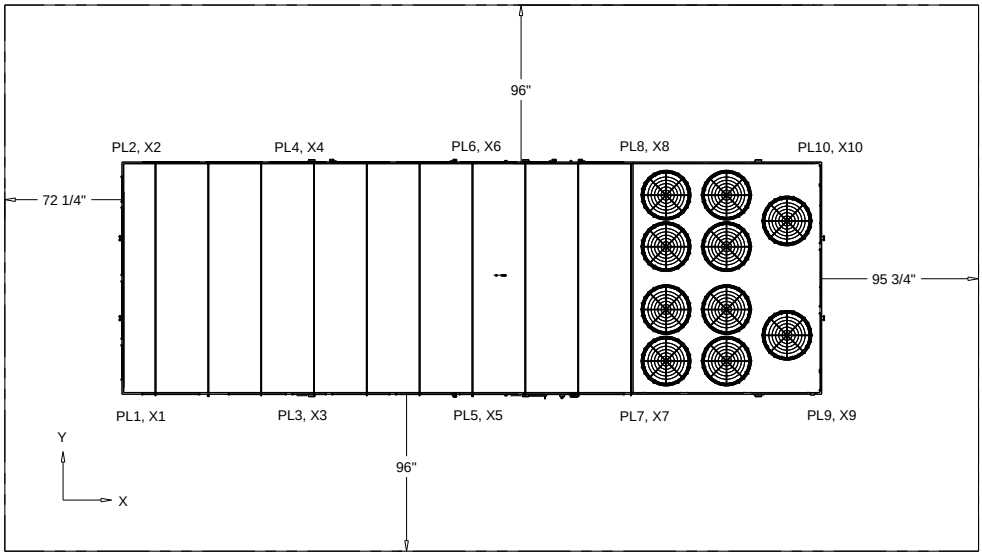
Add Weight

1. Double Wall Wieght : [3]

Notes:
1.The actual weight is stamped on the unit nameplate.
2. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10% of the nameplate weight.
3. Add weight to the total unit weight.
4. Design special weights are not displayed. Any weight added through COD (Custom Order Design) will not be accounted in the +/- 10% estimate
5. When 2 or more units are to be placed side by side, the distance between the units should be increased to 150% of the recommended single unit clearance. The units should also be staggered to reduce span deflection & assure proper diffusion of exhaust air.

RIGGING
ISOMETRIC VIEW OF UNIT

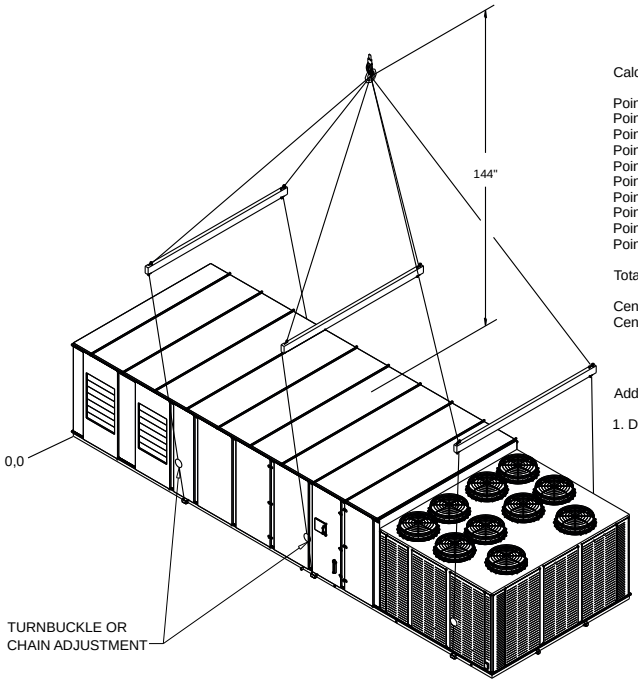
SERVICE CLEARANCE



SERVICE CLEARANCE

CENTER OF GRAVITY AND CLEARANCES
PLAN VIEW OF UNIT

Weight, Clearance & Rigging Diagram - Commercial Rooftop Air Conditioning Units (Large)
Item: C2 Qty: 1 Tag(s): RTU-2



Calculated weight:	N/A
Point Load 1:	1478.1 lb
Point Load 2:	1501.5 lb
Point Load 3:	1518.4 lb
Point Load 4:	1541.7 lb
Point Load 5:	1551.3 lb
Point Load 6:	1574.7 lb
Point Load 7:	1583.9 lb
Point Load 8:	1607.3 lb
Point Load 9:	1614.0 lb
Point Load 10:	1637.4 lb
Total Weight:	15608.3 lb
Center f Grivity x:	17.75 ft
Center of Grivity y:	5.87 ft

Point Load Location
Installed point load 1 - X: 4.000 in
Installed point load 1 - Y: 4.000 in
Installed point load 2 - X: 120.000 in
Installed point load 2 - Y: 136.000 in
Installed point load 3 - X: 215.000 in
Installed point load 4 - X: 309.000 in
Installed point load 5 - X: 396.000 in

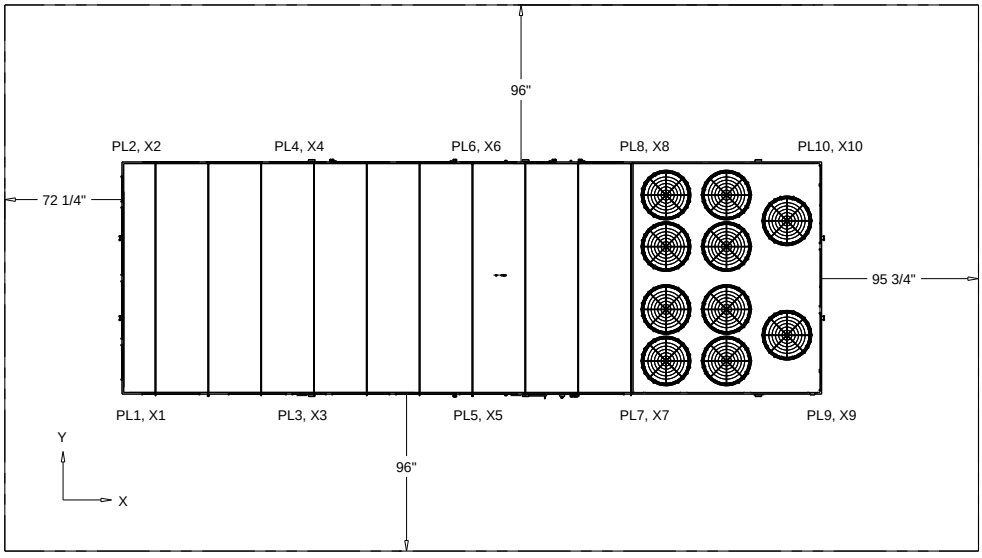
Add Weight

1. Double Wall Wieght : [3]

Notes:
1.The actual weight is stamped on the unit nameplate.
2. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10% of the nameplate weight.
3. Add weight to the total unit weight.
4. Design special weights are not displayed. Any weight added through COD (Custom Order Design) will not be accounted in the +/- 10% estimate
5. When 2 or more units are to be placed side by side, the distance between the units should be increased to 150% of the recommended single unit clearance. The units should also be staggered to reduce span deflection & assure proper diffusion of exhaust air.

RIGGING
ISOMETRIC VIEW OF UNIT

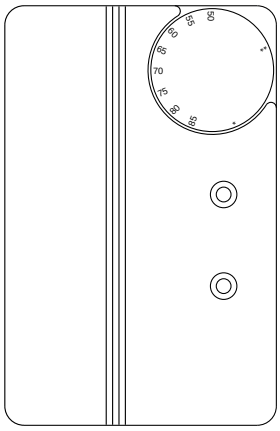
SERVICE CLEARANCE

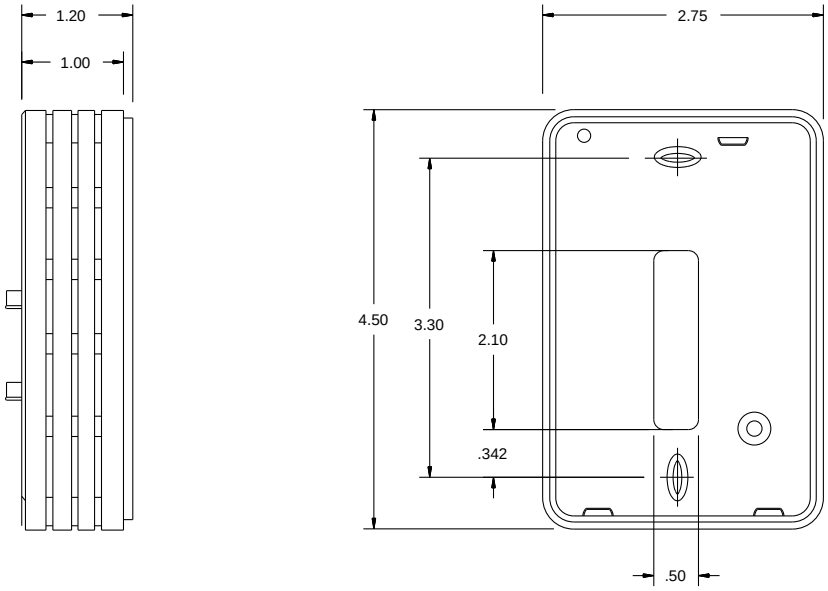


SERVICE CLEARANCE

CENTER OF GRAVITY AND CLEARANCES
PLAN VIEW OF UNIT

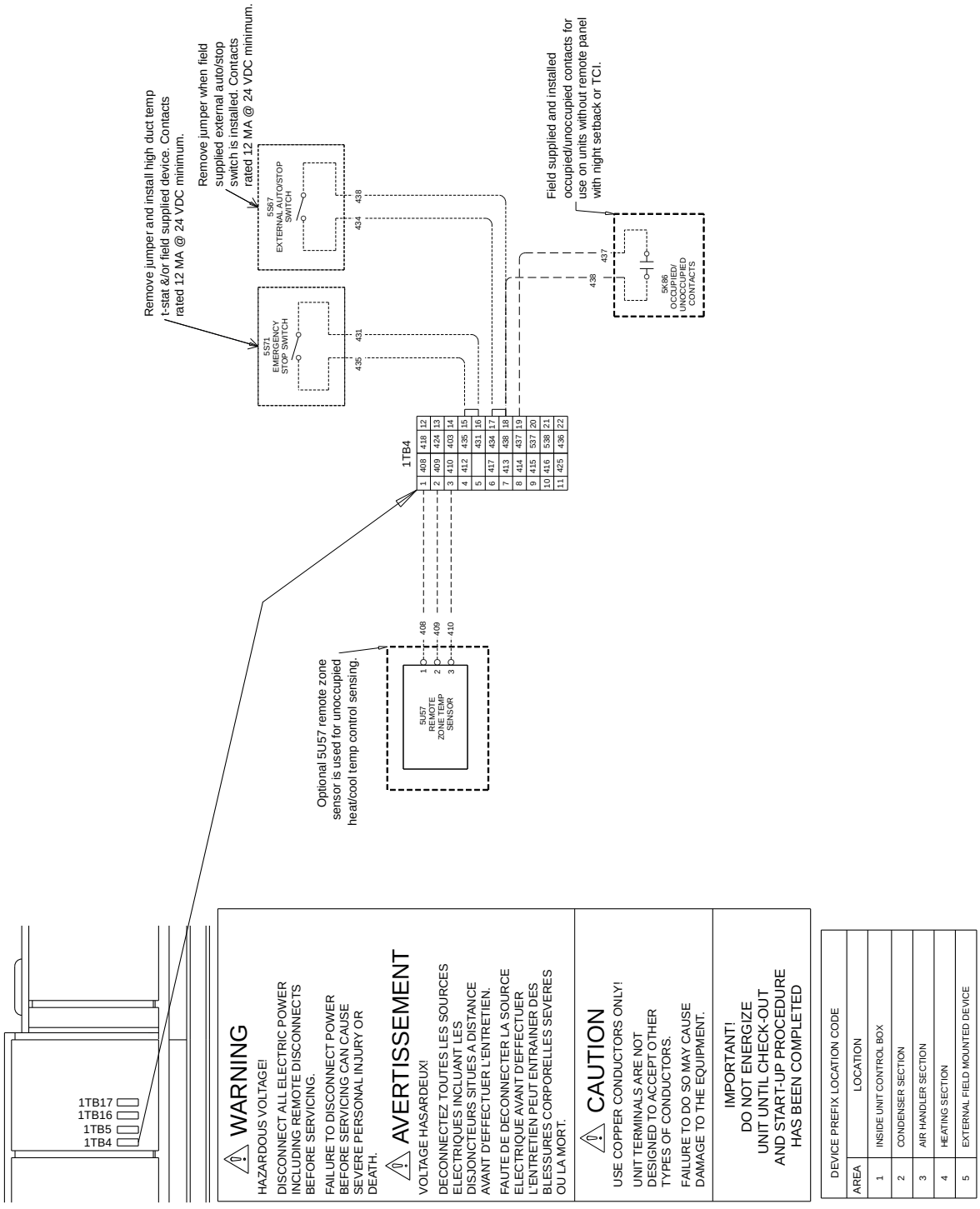
Accessory - Commercial Rooftop Air Conditioning Units (Large)
Item: C1, C2 Qty: 2 Tag(s): RTU-1, RTU-2





BAYSEN014 - ROOM SENSOR W/TO AND CANCEL AND LOCAL STPT ADJ

Field Wiring - Commercial Rooftop Air Conditioning Units (Large)
Item: C1, C2 Qty: 2 Tag(s): RTU-1, RTU-2



Note: All wiring and components shown dashed to be supplied and installed by the customer in accordance with local electrical codes.

Field Installed Options - Part/Order Number Summary
This is a report to help you locate field installed options that arrive at the jobsite. This report provides part or order numbers for each field installed option, and references it to a specific product tag. It is NOT intended as a bill of material for the job.

Product Family - 3-10 Ton R-410A PKGD Unitary Gas/Electric Rooftop

Item	Tag(s)	Qty	Description	Model Number
A1	RTU-4	1	8.5 Ton R-410A PKGD Unitary Gas/Electri	YHC102F4RHA--C0B1000700A7000000000000000

Field Installed Option Description	Part/Ordering Number
Power exhaust	BAYPWRX027A

Product Family - Packaged Gas/Electric Rooftop Units

Item	Tag(s)	Qty	Description	Model Number
B1	RTU-8	1	15 Ton Packaged Unitary Gas/Ele	YSD180G4RLA--D0B1000700A7000000000000000

Field Installed Option Description	Part/Ordering Number
Power exhaust	BAYPWRX030B

Item	Tag(s)	Qty	Description	Model Number
B2	RTU-3W, RTU-3E	2	25 Ton Packaged Unitary Gas/Ele	YHH300G4RHB--00B100070007000000000000000

Field Installed Option Description	Part/Ordering Number
Low Leak Econ, Dry Bulb	BAYECON703A

Product Family - Commercial Rooftop Air Conditioning Units (Large)

Item	Tag(s)	Qty	Description	Model Number
C1	RTU-1	1	90 ton Packaged Industrial Rooftop	SXHKC904
C2	RTU-2	1	105 ton Packaged Industrial Rooftop	SXHKD114

Field Installed Option Description	Part/Ordering Number
Room sensor with timed override and cancel buttons- Local setpoint adjustment	

END OF SECTION--16050