# Installation, Operation, and Maintenance

## IntelliPak™ II

Commercial Single-Zone Rooftop Air Conditioners with CV, VAV, SZVAV, or RR Controls

**"F0" and later design sequence**

SEHJ090-162
SFHJ090-162
SLHJ090-162
SSHJ090-162
SXHJ090-162

**⚠SAFETY WARNING**

**Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.**

August 2013

**RT-SVX24J-EN**

# Warnings, Cautions and Notices

**Warnings, Cautions and Notices.** Note that warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provide to alert installing contractors to potential hazards that could result in death or personal injury. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

Read this manual thoroughly before operating or servicing this unit.

**ATTENTION**: Warnings, Cautions and Notices appear at appropriate sections throughout this literature. Read these carefully:

| | |
|---|---|
| **⚠WARNING** | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| **⚠CAUTION** | Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices. |
| ***NOTICE:*** | Indicates a situation that could result in equipment or property-damage only |

### Important Environmental Concerns!

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment.Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs such as HCFCs and HFCs.

### Responsible Refrigerant Practices!

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

**⚠WARNING**

**Proper Field Wiring and Grounding Required!**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.**

**⚠WARNING**

**Personal Protective Equipment (PPE) Required!**

**Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.**

- **Before installing/servicing this unit, technicians MUST put on all Personal Protective Equipment (PPE) recommended for the work being undertaken. ALWAYS refer to appropriate MSDS sheets and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS sheets and OSHA guidelines for information on allowable personal exposure levels, proper respiratory protection and handling recommendations.**
- **If there is a risk of arc or flash, technicians MUST put on all Personal Protective Equipment (PPE) in accordance with NFPA 70E or other country-specific requirements for arc flash protection, PRIOR to servicing the unit.**

**Failure to follow recommendations could result in death or serious injury.**

# About the Manual

***Note:*** *This document is customer property and must be retained by the unit owner for use by maintenance personnel.*

These units are equipped with electronic Unit Control Modules (UCM). Refer to the “Startup” and “Test Mode” procedures within this Installation, Operation, and Maintenance manual and the latest edition of the appropriate programming manual for Constant Volume (CV), Rapid Restart (RR), Variable Air Volume (VAV), or Single Zone Variable Air Volume (SZ VAV) applications before attempting to operate or service this equipment.

***Note:*** *The procedures discussed in this manual should only be performed by qualified and experienced HVAC technicians.*

## Overview of Manual

This booklet describes proper installation, startup, operation, and maintenance procedures for 90 to 162 ton rooftop air conditioners designed for CV, RR, VAV, or SZ VAV applications. By carefully reviewing the information within this manual and following the instructions, the risk of improper operation and/or component damage will be minimized.

***Note:*** *One copy of the appropriate service literature ships inside the control panel of each unit.*

It is important that periodic maintenance be performed to help assure trouble free operation. Should equipment failure occur, contact a qualified service organization with qualified, experienced HVAC technicians to properly diagnose and repair this equipment.

***Note:*** *Do Not release refrigerant to the atmosphere!*

If adding or removing refrigerant is required, the service technician must comply with all federal, state, and local laws.

## Revision Summary

RT-SVX24J-EN (Aug 2013)

This version includes minor updates to the compressor nameplate summary (see p. 10), electrical service sizing (Table 22, p. 79) and installation checklist (see float and thermostatic step ("Steam Heat," p. 94).

# Table of Contents

# Model Number Descriptions

| S | X | H | J | 105 | 4 | 0 | A | A | 7 | 1 | 5 | M | F | D | E | 8 | 1 | D | 1 | 1 | 0 | 0 | A | 1 | B | A | 1 | 0 | 0 | 0 | A | A | 1 | A | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 567 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |

### DIGIT 1 — UNIT TYPE

S Self-Contained (Packaged Rooftop)

### DIGIT 2 — UNIT FUNCTION

E DX Cooling, Electric Heat
F DX Cooling, Natural Gas Heat
L DX Cooling, Hot Water Heat
S DX Cooling, Steam Heat
X DX Cooling, No Heat, Extended Casing

### DIGIT 3 — SYSTEM TYPE

H Single Zone

### DIGIT 4 — DEVELOPMENT SEQUENCE

J Ninth

### DIGIT 5, 6, 7 — NOMINAL CAPACITY

090 90 Ton Air-Cooled
105 105 Ton Air-Cooled
120 120 Ton Air-Cooled
130 130 Ton Air-Cooled
150 150 Ton Air-Cooled
100 100 Ton Evap Condenser
118 118 Ton Evap Condenser
128 128 Ton Evap Condenser
140 140 Ton Evap Condenser
162 162 Ton Evap Condenser

### DIGIT 8 — VOLTAGE SELECTION

4 460/60/3 XL
5 575/60/3 XL
C 380/50/3 XL

### DIGIT 9 — HEATING CAPACITY SELECTION

0 No Heat
1 Electric heat 90/56 kW 60/50 Hz
2 Electric heat 140/88 kW 60/50 Hz
3 Electric heat 265/166 kW 60/50 Hz
4 Electric Heat 300/188 kW 60/50 Hz
A Low Gas Heat — 2-stage
B Medium Gas Heat — 2-stage
C High Gas Heat — 2-stage
D Low Gas Heat — Modulating
E Medium Gas Heat — Modulating
F High Gas Heat — Modulating

**Steam or Hot Water Heat:**

G Low Heat - 1.0" (25mm) Valve
H Low Heat - 1.25" (32mm) Valve
J Low Heat - 1.5" (38mm) Valve
K Low Heat - 2.0" (50mm) Valve
L Low Heat - 2.50" (64mm) Valve
M Low Heat - 3.0" (76mm) Valve
N High Heat - 1.0" (25mm) Valve
P High Heat - 1.25" (32mm) Valve
Q High Heat - 1.5" (38mm) Valve
R High Heat - 2.0" (50mm) Valve
T High Heat - 2.50" (64mm) Valve
U High Heat - 3.0" (76mm) Valve

### DIGIT 10, 11 — DESIGN SEQUENCE

A-ZZ (Factory Assigned) Sequence may be any letter A to Z, or any digit 1 to 9.

### DIGIT 12 — UNIT CONFIGURATION SELECTION

1 One-Piece Unit w/o Blank Section
2 One-Piece Unit w/4' Blank Section
3 One-Piece Unit w/8' Blank Section
4 Two-Piece Unit w/o Blank Section
5 Two-Piece Unit w/4' Blank Section
6 Two-Piece Unit w/8' Blank Section
7 Three-Piece unit w/o Blank Section
8 Three-Piece Unit w/4' Blank Section
9 Three-Piece Unit w/8' Blank Section

### DIGIT 13 — AIRFLOW DIRECTION

1 Downflow Supply /Upflow Return
2 Downflow Supply / Horiz End Return
3 Downflow Supply / Horiz Right Return
4 Right Side Horiz Supply/Upflow Return
5 Right Side Horiz Supply / Horiz End Return
6 Right Side Horiz Supply / Horz Right Return

### DIGIT 14 — SUPPLY FAN OPTIONS

1 Standard CFM
3 Standard CFM - TEFC Motor(s)
4 Low CFM
6 Low CFM - TEFC Motor(s)
7 = Standard CFM w/ Motor Shaft Grounding
9 = TEFC Motor(s) w/ Shaft Grounding
A = Low CFM w/ Motor Shaft Grounding
B = Low CFM - TEFC Motor(s) w/ Shaft Grounding

### DIGIT 15 — SUPPLY FAN MOTOR SELECTION

F 15 hp
G 20 Hp
H 25 Hp
J 30 Hp
K 40 Hp
L 50 Hp
M 60 Hp
N 75 Hp
P 100 Hp

### DIGIT 16 — SUPPLY FAN RPM SELECTION

7 700
8 800
9 900
A 1000
B 1100
C 1200
D 1300
E 1400
F 1500
G 1600
H 1700
J 1800
K 1900
L 2000

### DIGIT 17 — EXHAUST/RETURN FAN OPTIONS

0 None
1 Std CFM Exhaust Fan w/o Statitrac CV Only
2 Low CFM Exhaust Fan w/o Statitrac CV Only
4 Low CFM Exhaust w/o VFD w/ Statitrac
5 Std CFM Exhaust w/ VFD w/ Bypass w/ Statitrac
6 Low CFM Exhaust w/ VFD w/ Bypass w/ Statitrac
7 Std CFM Exhaust w/ VFD w/o Bypass w/ Statitrac
8 Low CFM Exhaust w/ VFD w/o Bypass w/ Statitrac
A Std CFM Return w/o Statitrac CV Only
B Low CFM Return w/o Statitrac CV Only
C Std CFM Return w/ VFD w/ Bypass w/ Statitrac
D Low CFM Return w/ VFD w/ Bypass w/ Statitrac
E Std CFM Return w/ VFD w/o Bypass w/ Statitrac
F Low CFM Return w/ VFD w/o Bypass w/ Statitrac

**DIGIT 18 — EXHAUST/RETURN FAN MOTOR SELECTION**

0 None
D 7.5 Hp
E 10 Hp
F 15 Hp
G 20 Hp
H 25 Hp
J 30 Hp
K 40 Hp
L 50 Hp
M 60 Hp

**DIGIT 19 — EXHAUST/RETURN RPM SELECTION**

0 None
3 300
4 400
5 500
6 600
7 700
8 800
9 900
A 1000
B 1100
C 1200
D 1300
E 1400

**DIGIT 20 — SYSTEM CONTROL SELECTION**

1 Constant Volume (CV) (Zone Temperature Control)
2 CV w/ Discharge Temp Control
4 VAV w/ VFD Supply w/o Bypass (Discharge Temp Control)
5 VAV w/ VFD Supply w/ Bypass (Discharge Temp Control)
6 VAV – Single Zone VAV w/VFD w/o Bypass (Zone Temperature Control)
7 VAV – Single Zone VAV w/VFD w/ Bypass (Zone Temperature Control)

**DIGIT 21 — OUTSIDE AIR and ECONOMIZER OPTION/ CONTROLS**

A 0-25% Motorized Damper
B Economizer w/Dry Bulb
C Economizer w/Reference Enthalpy
D Economizer w/Comparative Enthalpy
E Econ w/TRAQ/DCV/Dry Bulb[1]
F Econ w/TRAQ/DCV/Ref Enthalpy[1]
G Econ w/TRAQ/DCV/Comp Enthalpy[1]
H Econ w/DCV/Dry Bulb[1]
J Econ w/DCV/Ref Enthalpy[1]
K Econ w/DCV/Comp Enthalpy[1]

**DIGIT 22 — DAMPER OPTION**

0 Standard
1 Low Leak
2 Ultra Low Leak

**DIGIT 23— PRE-EVAPORATOR COIL FILTER SELECTION**

0 Two Inch High Efficiency Throwaway
1 Two Inch Throwaway Rack/Less Filters
2 90-95% Bag Filters w/Prefilters
3 Bag Filter Rack/Less Filters
4 90-95% Cartridge Filters w/ Prefilters
5 Cartridge Rack/Less Filters
6 90-95% Low Pressure Drop Cartridge Filters w/ Prefilters
7 Low Pressure Drop Cartridge Rack/Less Filters

**DIGIT 24 — BLANK SECTION APPLICATION OPTIONS**

0 None
A 90-95% Bag w/Prefilters
B 90-95% Low Pressure Drop Cartridge w/ Prefilters
C 90-95%, Cartridge Filters w/ Prefilters
D 90-95% High Temp Cartridge w/ Prefilters
E HEPA w/Prefilters
F High Temp HEPA w/Prefilters

**DIGIT 25 — ENERGY RECOVERY WHEEL**

0 None
1 Low CFM ERW w/ Bypass Defrost
2 Standard CFM ERW w/ Bypass Defrost

**DIGIT 26 — UNIT MOUNTED POWER CONNECTION SELECTION**

A Terminal Block
B Non-Fused Disconnect
C Non-Fused Disconnect w/ Powered Convenience Outlet
D Circuit Breaker w/ High Fault SCCR
E Circuit Breaker w/ High Fault SCCR w/ Powered Convenience Outlet

**DIGIT 27 — CONDENSER COIL SELECTION**

0 Air-Cooled Aluminum
A Evap Condenser
B Evap Condenser w/ Sump Heater
C Evap Condenser w/ Dolphin WaterCare™ System
D Evap Condenser w/ Dolphin WaterCare™ System & Sump Heater
E Evap Condenser w/ Conductivity Controller
F Evap Condenser w/ Conductivity Controller and Sump Heater
J Corrosion Protected Condenser Coil[2]

**DIGIT 28 — EVAPORATOR COIL AND DRAIN PAN**

0 Standard Evap Coil w/Galvanized Drain Pan
A Standard Evap Coil w/ Stainless Steel Drain Pan
B High Cap Evap Coil w/Galvanized Drain Pan
C High Cap Evap Coil w/Stainless Steel Drain Pan

**DIGIT 29 — REFRIGERATION SYSTEM SELECTION A**

0 Standard
A Suction Service Valves
B Replaceable Core Liquid Filter Driers
C Suction Service Valves & Replaceable Core Liquid Filter Driers

**DIGIT 30 — REFRIGERATION SYSTEM SELECTION B**

0 Standard
1 Hot Gas Reheat[3]
2 Hot Gas By-Pass
3 Hot Gas Reheat[3]/Hot Gas By-Pass

**DIGIT 31 — AMBIENT CONTROL OPTION**

0 Standard Ambient
1 Low Ambient

**DIGIT 32 — HIGH DUCT TEMP THERMOSTAT**

0 None
1 High Duct Temp Thermostat

**DIGIT 33 — CONTROLS OPTION**

0 None
1 Remote Human Interface (RHI) & Inter-Processor Communication Bridge (IPCB)
2 IPCB
3 Rapid Restart

[1] Requires $CO_2$ Zone Sensor(s) for DCV to function

[2] Offered on Air-Cooled units
[3] Humidity sensor required

**DIGIT 34 — MODULE OPTIONS**

0 None
A 0-5 volt Generic Building Automation System (GBAS)
B 0-10 volt GBAS
C 0-5 volt GBAS and 0-10 volt GBAS
F LonTalk® Communication Interface (LCI)
D Ventilation Override
G 0-5 volt GBAS volt & Ventilation Override
H 0-10 volt GBAS & Ventilation Override
J 0-5 volt GBAS and 0-10 volt GBAS & Ventilation Override
L LCI & Ventilation Override
M BACnet® Communication Interface (BCI)
N BCI & Ventilation Override

**DIGIT 35 — ZONE SENSOR OPTION**

0 None
A Dual Setpoint w/Man/Auto Changeover — BAYSENS108
B Dual Setpoint w/Man/Auto Chgovr & Sys Lights — BAYSENS110
C Room Sensor w/timed Override & Cancel — BAYSENS073
D Room Sensor w/TO (Timed Override) & Cancel & Local Stpt Adj — BAYSENS074
G VAV w/System Lights — BAYSENS021
L Programmable Night Setback — BAYSENS119

**DIGIT 36 — AGENCY APPROVAL OPTION**

0 None
1 cULus

**DIGIT 37 — SERVICE ENHANCEMENTS**

0 Single Side Access Door
A Dual Side Access Door
B Single Side Access Doors/ Marine Lights
C Dual Side Access Doors/ Marine Lights

**DIGIT 38 — MISCELLANEOUS OPTIONS**

0 None
1 Belt Guards
2 Burglar Bars
3 Belt Guards/Burglar Bars

***Tip:*** ***EXAMPLE***
*Model number*
SXHJ10540AA715MFDE81
D1100A1BA1000AA1A1
*describes a unit with the following characteristics:*

*DX Cooling, No Heat, Extended Casing, 105 Ton nominal capacity, with 460/3/60 power supply, 3 piece construction with downflow supply and upflow return, low CFM fans, a 60 hp supply fan w/ a 1500 rpm drive, a 10 Hp return fan with VFD, bypass and statitrac, with CV control, and economizer w/ comparative enthalpy, low leak dampers, 2” throwaway rack less filters, terminal block connection, Air Cooled Copper Condenser coil, high cap evap with galvanized drain pan, suction service valves, hot gas reheat, 0-5V GBAS, dual setpoint with Manual/Auto Changeover, cULus approval, Dual side access, and belt guards.*

*The service digit for each model number contains 38 digits; all 38 digits must be referenced.*

# Unit Inspection

## As soon as the unit arrives at the job site

[ ] Verify that the nameplate data matches the data on the sales order and bill of lading (including electrical data).

[ ] Verify that the power supply complies with the unit nameplate specifications.

[ ] Verify that the power supply complies with the electric heater specifications on the unit nameplate.

[ ] Visually inspect the exterior of the unit, including the roof, for signs of shipping damage.

[ ] Check for material shortages. Refer to the Component Layout and Ship with Location illustration.

***Important:*** *If the job site inspection of the unit reveals damage or material shortages, file a claim with the carrier immediately. Specify the type and extent of the damage on the "bill of lading" before signing.*

[ ] Visually inspect the internal components for shipping damage as soon as possible after delivery and before it is stored. Do **not** walk on the sheet metal base pans.

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

[ ] If concealed damage is discovered, notify the carrier's terminal of damage immediately by phone and by mail. Concealed damage must be reported within 15 days.
Request an immediate joint inspection of the damage by the carrier and the consignee. Do not remove damaged material from the receiving location. Take photos of the damage, if possible. The owner must provide reasonable evidence that the damage did not occur after delivery.

[ ] Remove the protective plastic coverings that shipped over the compressors.

## Storage

Take precautions to prevent condensate from forming inside the unit electrical compartments and motors if:

a. The unit is stored before it is installed; or,

b. The unit is set on the roof curb, and temporary heat is provided in the building. Isolate all side panel service entrances and base pan openings (e.g., conduit holes, S/A and R/A openings, and flue openings) from the ambient air until the unit is ready for startup.

***Note:*** *Do not use the unit heater for temporary heat without first completing the startup procedure detailed under "Unit Startup," p. 96.*

Trane will not assume any responsibility for equipment damage resulting from condensate accumulation on the unit electrical and/or mechanical components.

## Unit Clearances

Figure 10, p. 21 Table 4, p. 21 illustrates the minimum operating and service clearances for either a single or multiple unit installation. These clearances are the minimum distances necessary for adequate service, cataloged unit capacity, and peak operating efficiency.

Providing less than the recommended clearances may result in condenser coil starvation, "short-circulating" of exhaust and economizer airflows, or recirculation of hot condenser air.

## Unit Dimensions and Weight Information

| Description | Reference |
|---|---|
| **Air-Cooled Condenser** | |
| One-piece unit dimensions | Figure 12, p. 23, Table 5, p. 24 |
| Two-piece unit dimensions | Figure 12, p. 23, Table 6, p. 25 |
| Three-piece unit dimensions | Figure 12, p. 23, Table 8, p. 31 |
| Typical unit and operation weights | Table 12, p. 42 |
| **Evaporative Condenser** | |
| Two-piece unit dimensions | Figure 12, p. 23, Table 7, p. 28 |
| Three-piece unit dimensions | Figure 12, p. 23, Table 9, p. 34 |
| Typical unit and operation weights[a] | Table 12, p. 42 |

(a) Weights shown represent approximate operating weights. Actual weights are stamped on the unit nameplate.

# General Information

## Unit Nameplate

One Mylar unit nameplate is located on the outside upper left corner of the control panel door. It includes the unit model number, serial number, electrical characteristics, weight, refrigerant charge, as well as other pertinent unit data. A small metal nameplate with the Model Number, Serial Number, and Unit Weight is located just above the Mylar nameplate, and a third nameplate is located on the inside of the control panel door.

### Compressor Nameplate

The Nameplate for the Scroll Compressor is located on the compressor lower housing. Max amps is listed on the nameplate and is the absolute highest amp load on the compressor at any operating condition (does not include locked rotor amps or inrush). This value should never be exceeded.

## Commonly Used Acronyms

For convenience, a number of acronyms and abbreviations are used throughout this manual. These acronyms are alphabetically listed and defined below.

- AC = Air Cooled Condenser
- BAS = Building automation systems
- BCI = BACnet® Communication Interface module
- CFM = Cubic-feet-per-minute
- CKT. = Circuit
- CLV = Cooling valve (reheat only)
- CV = Constant volume
- CW = Clockwise
- CCW = Counterclockwise
- E/A = Exhaust air
- EC = Evaporative Condenser
- ECEM = Exhaust/comparative enthalpy module
- RT = Rooftop unit
- O/A = Outside air
- GBAS = Generic building automation system
- HGBP = Hot gas bypass
- MCHE = Microchannel Condenser Coil
- HGRH = Hot gas reheat
- HI = Human Interface
- HVAC = Heating, ventilation and air conditioning
- I/O = Inputs/outputs
- IOM = Installation/operation/ maintenance manual
- IPC = Interprocessor communications
- IPCB = Interprocessor communications bridge
- LCI-I = LonTalk® Communication Interface for IntelliPak
- LH = Left-hand
- MCM = Multiple compressor module
- MDM = Modulating Dehumidification Module
- MPM = Multipurpose module
- MWU = Morning warm-up
- NSB = Night setback
- O/A = Outside air
- psig = Pounds-per-square-inch, gauge pressure
- PTFE = Polytetrafluoroethylene (Teflon®)
- R/A = Return air
- RAH = Return air humidity
- RH = Right-hand
- RHV = Reheat valve
- RPM = Revolutions-per-minute
- RTM = Rooftop module
- S/A = Supply air
- SCCR = Short circuit current rating
- SCM = Single circuit module
- SZ = Single-zone (unit airflow)
- SZVAV = Single zone variable air volume
- TCI = Tracer communications module
- UCM = Unit control modules
- VAV = Variable air volume
- VCM = Ventilation control module
- VOM = Ventilation override module
- w.c. = Water column
- WCI = Wireless Communication Interface

## Unit Description

### Available tonnages

| Air-Cooled Tonnages | Evaporative Condenser Tonnages |
|---|---|
| 90 | 100 |
| 105 | 118 |
| 120 | 128 |
| 130 | 140 |
| 150 | 162 |

Each Trane commercial, single-zone rooftop air conditioner ships fully assembled from the factory. An optional roof curb, specifically designed for the S_HJ units is available from Trane. The roof curb kit must be field assembled and installed according to the latest edition of the roof curb installation manual.

Trane Commercial Rooftop Units are controlled by a microelectronic control system that consists of a network of modules and are referred to as Unit Control Modules (UCM). The acronym UCM is used extensively throughout this document when referring to the control system network. These modules through Proportional/Integral control algorithms perform specific unit functions which provide the best possible comfort level for the customer.

They are mounted in the control panel and are factory wired to their respective internal components. They receive and interpret information from other unit modules, sensors, remote panels, and customer binary contacts to satisfy the applicable request for economizing, mechanical cooling, heating, and ventilation. Refer to the following discussion for an explanation of each module function.

Table 1. Resistance input vs. setpoint temperature

| RTM cooling or heating setpoint input used as the source for a ZONE temp setpoint (°F) | RTM cooling setpoint input used as the source for SUPPLY AIR temp setpoint cooling (°F) | Resistance (Ohms) Max. Tolerance 5% |
|---|---|---|
| 40 | 40 | 1084 |
| 45 | 45 | 992 |
| 50 | 50 | 899 |
| 55 | 55 | 796 |
| 60 | 60 | 695 |
| 65 | 65 | 597 |
| 70 | 70 | 500 |
| 75 | 75 | 403 |
| 80 | 80 | 305 |
| n/a | 85 | 208 |
| n/a | 90 | 111 |

Table 2. RTM resistance value vs. system operating mode

| Resistance applied to RTM MODE input Terminals (Ohms) Max. Tolerance 5% | Constant Volume Units | |
|---|---|---|
| | Fan Mode | System Mode |
| 2320 | Auto | Off |
| 4870 | Auto | Cool |
| 7680 | Auto | Auto |
| 10770 | On | Off |
| 13320 | On | Cool |
| 16130 | On | Auto |
| 19480 | Auto | Heat |
| 27930 | On | Heat |

## Rooftop Module (RTM - Standard on all units)

The rooftop Module (RTM) responds to cooling, heating, and ventilation requests by energizing the proper unit components based on information received from other unit modules, sensors,
remote panels, and customer supplied binary inputs. It initiates supply fan, exhaust fan, exhaust damper positioning or variable frequency drive output, and economizer operation based on
that information.

## Compressor Module (MCM - standard on all units)

The Compressor module, upon receiving a request for mechanical cooling, energizes the appropriate compressors and condenser fans. It monitors the compressor operation through feedback information it receives from various protection devices.

## Human Interface Module (HI - standard on all units)

The Human Interface module enables the operator to adjust the operating parameters for the unit using a 16 key keypad. The 2 line, 40 character LCD screen provides status information for the various unit functions as well as menus for the operator to set or modify the operating parameters.

## Heat Module (used on heating units)

The Heat module, upon receiving a request for Heating, energizes the appropriate heating stages or strokes the Modulating Heating valve as required.

## Ventilation Override Module (VOM - Optional)

The Ventilation Override module initiates specified functions such as; space pressurization, exhaust, purge, purge with duct pressure control, and unit off when any one of the five (5) binary inputs to the module are activated. The compressors and condenser fans are disabled during the ventilation operation. If more than one ventilation sequence is activated, the one with the highest priority is initiated.

## Interprocessor Communications Board (IPCB - Optional used with the Optional Remote Human Interface)

The Interprocessor Communication Board expands communications from the rooftop unit UCM network to a Remote Human Interface Panel. DIP switch settings on the IPCB module for this application should be; Switches 1 and 2 “Off”, Switch 3 “On”.

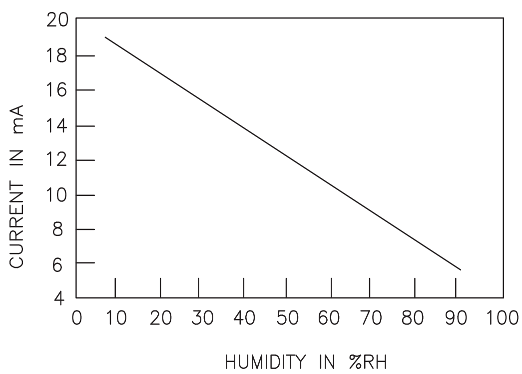
## Lontalk®/BACnet® Communication Interface Module (LCI/BCI - Optional - used on units with Trane ICS™ or 3rd party Building Automation Systems)

The LonTalk/BACnet Communication Interface modules expand communications from the unit UCM network to a Trane Tracer Summit™ or a 3rd party building automation system and allow external setpoint and configuration adjustment and monitoring of status and diagnostics.

## Exhaust/Comparative Enthalpy Module (ECEM - Optional used on units with Statitrac and/or comparative enthalpy options)

The Exhaust/Comparative Enthalpy module receives information from the return air humidity sensor, the outside air humidity sensor, and the return air temperature sensor to utilize the lowest possible humidity level when considering economizer operation. In addition, it receives space pressure information which is used to maintain the space pressure to within the setpoint control band. Refer to Figure 1 for the Humidity vs. Voltage input values.

**Figure 1. Humidity vs. current**




## Multi Purpose Module MPM (Optional - used with Return Fan Control, Energy Recovery, and Evaporative Condensers)

The MPM supports three optional features. The first of which is return plenum pressure control by receiving analog voltage information for measuring return plenum pressure, calibrating that reading, and providing an output to control the return fan speed (if variable speed configured) in response to control algorithm requests.

This module also provides inputs and outputs for control of all Energy Recovery feature devices including the energy wheel, exhaust and outdoor air bypass dampers, and recovery preheat. The liquid line pressure sensor inputs for both refrigeration circuits are received through the MPM in support of head pressure control on water-cooled condenser units.

## Modulating Dehumidification Module MDM (Optional - used with Dehumidification Control)

The MDM supports specific control inputs and outputs for Modulating Dehumidification control including modulating Reheat and Cooling valve control as well as the Reheat Pumpout Coil Relay output. The Modulating Dehumidification control algorithm provides control requests to the MDM to accomplish proper Dehumidification control.

## Ventilation Control Module (VCM)

The Ventilation Control Module (VCM) is located in the filter section of the unit and is linked to the unit UCM network. Using a "velocity pressure" sensing ring located in the outside air section allows the VCM to monitor and control the quantity of outside air entering the unit to a minimum airflow setpoint.

An optional temperature sensor can be connected to the VCM which enables it to control a field installed outside air preheater. An optional $CO_2$ sensor can be connected to the VCM to control $CO_2$ reset. The reset function adjusts the minimum CFM upward as the $CO_2$ concentrations increase.

The maximum effective (reset) setpoint value for outside air entering the unit is limited to the systems operating CFM. The following table lists the velocity pressure vs. Input Voltage (see also Figure 6, p. 17.).

**Table 3. Minimum outside air setpoint w/VCM and TRAQ™ sensing**

| Unit | Input Volts | CFM |
|---|---|---|
| 90-162 Tons | 0.5 - 4.5 VDC | 0 - 46000 |

The velocity pressure transducer/solenoid assembly is illustrated below. Refer to the "Units with TRAQ™ Sensor," p. 101 for VCM operation.

**Figure 2. Velocity pressure transducer/solenoid assembly**

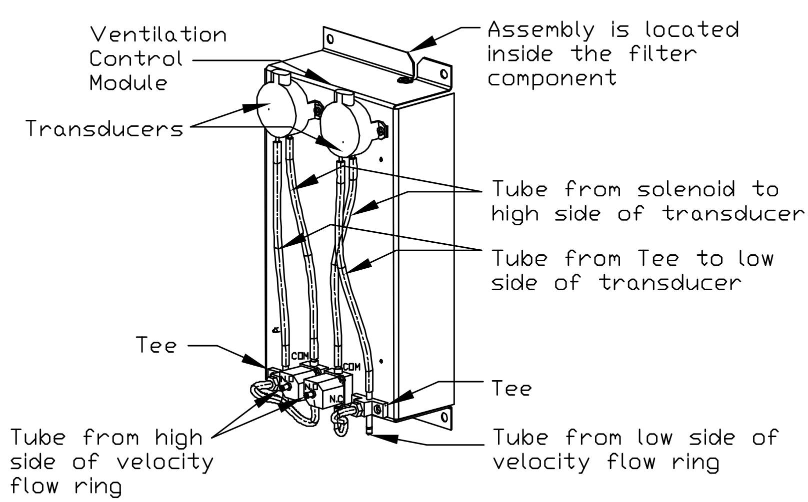


Figure 3. Outside air tubing schematic

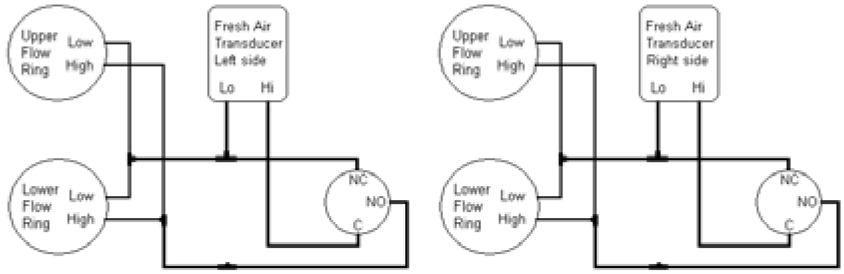
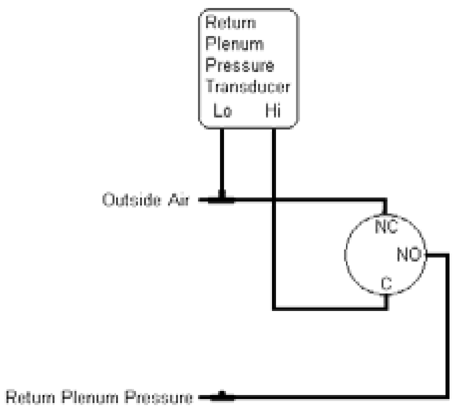



Figure 4. Return air pressure tubing schematic




### Generic Building Automation System Module (GBAS - Optional used with non-Trane building control systems)

The Generic Building Automation System (GBAS) module allows a non-Trane building control system to communicate with the rooftop unit and accepts external setpoints in the form of analog inputs for cooling, heating, supply air pressure, and a binary Input for demand limit. Refer to the "Field Installed Control Wiring" section for the input wiring to the GBAS module and the various desired setpoints with the corresponding DC voltage inputs for both VAV, SZVAV, RR and CV applications.

### Input Devices and System Functions

The descriptions of the following basic Input Devices used within the UCM network are to acquaint the operator with their function as they interface with the various modules. Refer to the unit electrical schematic for the specific module connections.

## Constant Volume (CV) and Variable Air Volume (VAV) Units

### Supply Air Temperature Sensor

An analog input device used with CV and VAV applications that monitors the supply air temperature for: supply air temperature control (VAV), supply air temperature reset (VAV), supply air temperature low limiting (CV), supply air tempering (CV/VAV). It is mounted in the supply air discharge section of the unit and is connected to the RTM.

### Return Air Temperature Sensor

An analog input device used with a return humidity sensor on CV and VAV applications when the comparative enthalpy option is ordered. It monitors the return air temperature and compares it to the outdoor temperature to establish which temperature is best suited to maintain the cooling requirements. It is mounted in the return air section and is connected to the ECEM.

### Leaving Evaporator Temperature Sensor

An analog input device used with CV and VAV applications that monitors the refrigerant temperature inside the evaporator coil to prevent coil freezing. It is attached to the suction line near the evaporator coil and is connected to the MCM. It is factory set for 30°F and has an adjustable range of 25°F to 35°F. The compressors are staged "Off" as necessary to prevent icing. After the last compressor stage has been turned "Off", the compressors will be allowed to restart once the evaporator temperature rises 10°F above the "coil frost cutout temperature" and the minimum three minute "Off" time has elapsed.

### Entering Evaporator Temperature Sensors

Analog input devices used with CV and VAV applications. This device is used in conjunction with the Leaving Evaporator Temperature Sensor to prevent the unit from running compressors with insufficient charge.

### Filter Switch

A binary input device used on CV and VAV applications that measures the pressure differential across the unit filters. It is mounted in the filter section and is connected to the RTM. A diagnostic SERVICE signal is sent to the remote panel if the pressure differential across the filters is at least 0.5" w.c. The contacts will automatically open when the pressure differential across the filters decrease to 0.4" w.c. The switch differential can be field adjusted between 0.17" w.c. to 5.0" w.c. ± 0.05" w.c.

## Leaving Recovery Exhaust Temp Sensor

Analog input device used on CV and VAV applications with Energy Recovery option installed. It is used to monitor the temperature of the leaving air on the Exhaust Fan side of the energy recovery wheel. This temperature is used to determine if the temperature of the wheel is too cold as compared to the Recovery Frost Avoidance Setpoint. The result is used to determine when to enable energy wheel frost avoidance functions.

## Supply, Exhaust and Return Fan Airflow Proving Switches

Supply Airflow Proving Switch is a binary input device used on CV and VAV applications to signal the RTM when the supply fan is operating. It is located in the supply fan section of the unit and is connected to the RTM. During a request for fan operation, if the differential switch is detected to be open for 40 consecutive seconds; compressor operation is turned "Off", heat operation is turned "Off", the request for supply fan operation is turned "Off" and locked out, exhaust dampers (if equipped) are "closed", economizer dampers (if equipped) are "closed", and a manual reset diagnostic is initiated.

Exhaust/return Airflow Proving Switch is a binary input device used on all rooftop units equipped with an exhaust fan. It is located in the exhaust/return fan section of the unit and is connected to the RTM. During a request for fan operation, if the differential switch is detected to be open for 40 consecutive seconds, the economizer is closed to the minimum position setpoint, the request for exhaust fan operation is turned "Off" and locked out, and a manual reset diagnostic is initiated. The fan failure lockout can be reset at the Human Interface located in the unit control panel, by Tracer, or by cycling the control power to the RTM Off/On.

## Lead-Lag

A selectable mode of operation through the Human Interface. It alternates the starting between the first compressor of each refrigeration circuit. Only the compressor banks will switch, not the order of the compressors within a bank, providing the first compressor in each circuit had been activated during the same request for cooling.

## Charge Isolation

During the OFF cycle, most of the charge is isolated between the compressor (internal) discharge check valves and liquid line solenoid valve. This reduces the OFF cycle charge migration, and liquid feedback during subsequent startup. The liquid line solenoid is energized (opened) with the start of the circuit compressor.

## Supply, Exhaust and Return Fan Circuit Breakers

The supply fan and exhaust fan motors are protected by circuit breakers or fuses. They will trip and interrupt the power supply to the motors if the current exceeds the breaker's "must trip" value. The rooftop module (RTM) will shut all system functions "Off" when an open fan proving switch is detected.

## Low Pressure Control

Low Pressure Control is accomplished using a binary input device on CV and VAV applications. LP cutouts are located on the suction lines near the scroll compressors. The LPC contacts are designed to close when the suction pressure exceeds 41 ± 4 psig. If the LP control is open when a compressor is requested to start, none of the compressors on that circuit will be allowed to operate. They are locked out and a manual reset diagnostic is initiated.

The LP cutouts are designed to open if the suction pressure approaches 22 ± 4 psig. If the LP cutout opens after a compressor has started, all compressors operating on that circuit will be turned off immediately and will remain off for a minimum of three minutes. If the LP cutout trips four consecutive times during the first three minutes of operation, the compressors on that circuit will be locked out and a manual reset diagnostic is initiated.

## Saturated Condenser Temperature Sensors

Analog input devices used on CV and VAV applications mounted inside a temperature well located on a condenser tube bend. They monitor the saturated refrigerant temperature inside the condenser coil and are connected to the MCM. As the saturated refrigerant temperature varies due to operating conditions, the condenser fans are cycled "On" or "Off" as required to maintain acceptable operating pressures.

## Head Pressure Control

Accomplished using two saturated refrigerant temperature sensors on CV and VAV applications. During a request for compressor operation, when the condensing temperature rises above the "lower limit" of the controlband, the Compressor Module (MCM) starts sequencing condenser fans "On". If the operating fans can not bring the condensing temperature to within the controlband, more fans are turned on. As the saturated condensing temperature approaches the lower limit of the controlband, fans are sequenced "Off".

The minimum "On/Off" time for condenser fan staging is 5.2 seconds. If the system is operating at a given fan stage below 100% for 30 minutes and the saturated condensing temperature is above the "efficiency check point" setting, a fan stage will be added. If the saturated condensing temperature falls below the "efficiency check point" setting, the fan control will remain at the present operating stage. If a fan stage cycles four times within a 10 minute period, the control switches from controlling to the "lower limit" to a temperature equal to the "lower limit" minus the "temporary low limit suppression" setting. It will utilize this new "low limit" temperature for one hour to reduce condenser fan short cycling.

For evaporative condensing units, head pressure is monitored with pressure transducers attached to the saturated condensing line and converted to a temperature by the MPM. This temperature is used to control the variable speed fan and sump pump. When the temperature rises above the upper limit (120°F) the sump pump is energized. If the condensing temperature drops below the lower limit (70°F) the sump pump is de-energized.

## High Pressure Limit Controls

High Pressure controls are located on the discharge lines near the scroll compressors. They are designed to open when the discharge pressure approaches 650 ± 10 psig. The controls reset automatically when the discharge pressure decreases to approximately 550 ± 10 psig. However, the compressors on that circuit are locked out and a manual reset diagnostic is initiated after the fourth occurrence of a high pressure condition.

## Outdoor Air Humidity Sensor

An analog input device used on CV and VAV applications with 100% economizer. It monitors the outdoor humidity levels for economizer operation. It is mounted in the outside air intake section and is connected to the RTM.

## Return Air Humidity Sensor

An analog input device used on CV and VAV applications with the comparative enthalpy option. It monitors the return air humidity level and compares it to the outdoor humidity level to establish which conditions are best suited to maintain the cooling requirements. It is mounted in the return air section and is connected to the ECEM.

## Space Humidity Sensor

Analog input device used on CV and VAV applications with modulating dehumidification option and/or humidification field installed option. It is used to monitor the humidity level in the space and compared to dehumidification and humidification setpoints to maintain space humidity requirements. It is field mounted in the space and connected to the RTM.

## Status/Annunciator Output

An internal function within the RTM module on CV and VAV applications that provides:

c. diagnostic and mode status signals to the remote panel (LEDs) and to the Human Interface

d. control of the binary Alarm output on the RTM

e. control of the binary outputs on the GBAS module to inform the customer of the operational status and/or diagnostic conditions

## Low Ambient Compressor Lockout

Utilizes an analog input device for CV and VAV applications. When the system is configured for low ambient compressor lockout, the compressors are not allowed to operate if the temperature of the outside air falls below the lockout setpoint. When the temperature rises 5°F above the lockout setpoint, the compressors are allowed to operate. The factory preset is 50°F.

These compressors come equipped with a protection module that monitors phase loss, phase sequencing and motor temperature.

## Space Pressure Transducer

An analog input device used on CV and VAV applications with the Statitrac option. It modulates the exhaust dampers to keep the space pressure within the building to a customer designated controlband. It is mounted on the bottom support below the return damper blade assembly and is connected to the ECEM. Field supplied pneumatic tubing must be connected between the space being controlled and the transducer assembly.

## Morning Warm-Up—Zone Heat

When a system changes from an unoccupied to an occupied mode, or switches from STOPPED to AUTO, or power is applied to a unit with the MWU option, the heater in the unit or external heat will be brought on if the space temperature is below the MWU setpoint. The heat will remain on until the temperature reaches the MWU setpoint.

If the unit is VAV, then the VAV box/unocc relay will continue to stay in the unoccupied position and the VFD output will stay at 100% during the MWU mode. When the MWU setpoint is reached and the heat mode is terminated, then the VAV box/unocc relay will switch to the occupied mode and the VFD output will be controlled by the duct static pressure. During Full Capacity MWU the economizer damper is held closed for as long as it takes to reach setpoint. During Cycling Capacity MWU the economizer damper is allowed to go to minimum position after one hour of operation if setpoint has not been reached.

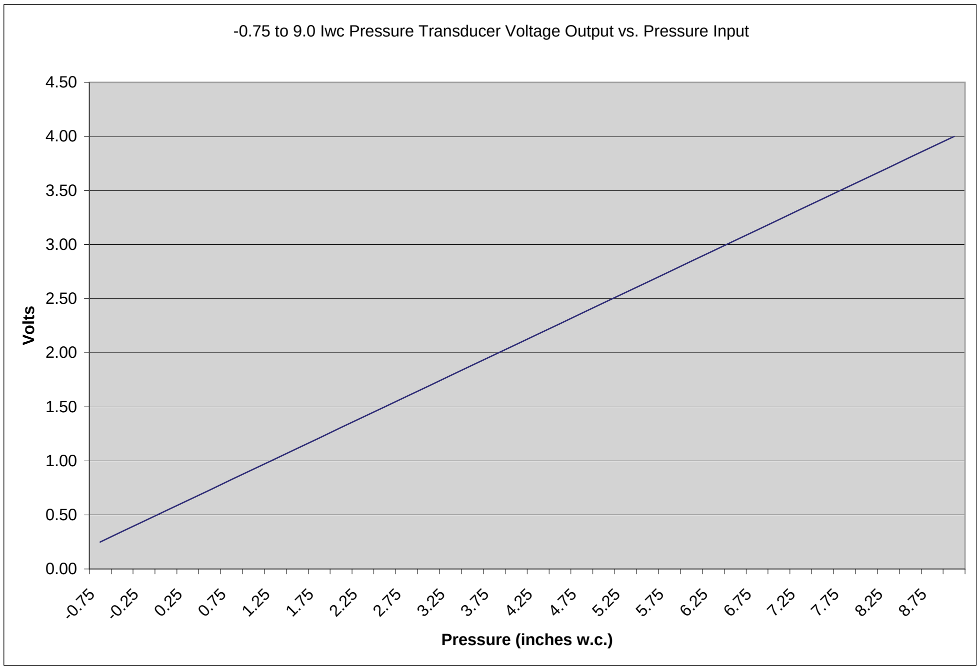
## Compressor Motor Winding Thermostats

A thermostat is embedded in the motor windings of each Scroll compressor. Each thermostat is designed to open if the motor windings exceed approximately 221°F. The thermostat will reset automatically when the winding temperature decreases to approximately 181°F.

Rapid cycling, loss of charge, abnormally high suction temperatures, or the compressor running backwards could cause the thermostat to open. During a request for compressor operation, if the Compressor Module detects a problem outside of normal parameters, it turns any operating compressor(s) on that circuit "Off", locks out all compressor operation for that circuit, and initiates a manual reset diagnostic (compressor trip).

These compressors come equipped with a protection module that monitors phase loss, phase sequencing and motor temperature.

**Figure 5. Transducer voltage output vs. pressure input for supply, return and building pressure**




## Supply Air Temperature Low Limit

Uses the supply air temperature sensor input to modulate the economizer damper to minimum position in the event the supply air temperature falls below the occupied heating setpoint temperature.

## Discharge Line Thermostat for Evaporative Condensers

The first compressor on each circuit is equipped with a Discharge Line Thermostat. If the temperature of the line exceeds 210°F the thermostat interrupts the 115V circuit for the compressors and both of the compressors on that circuit will be de-energized. Once the temperature drops below 170°F the thermostat will close and allow the compressor to be energized.

## Freezestat

A binary input device used on CV and VAV units with Hydronic Heat. It is mounted in the heat section and connected to the Heat Module. If the temperature of the air leaving the heating coil falls to 40°F, the normally open contacts on the freezestat closes signalling the Heat Module and the Rooftop Module (RTM) to:

f. drive the Hydronic Heat Actuator to the full open position
g. turn the supply fan “Off”
h. closes the outside air damper
i. turns “On” the SERVICE light at the Remote Panel
j. initiates a “Low Temp Limit” diagnostic to the Human Interface

## Compressor Circuit Breakers

The Scroll Compressors are protected by circuit breakers which interrupt the power supply to the compressors if the current exceeds the breakers “must trip” value. During a request for compressor operation, if the Compressor Module detects a problem outside normal parameters, it turns any operating compressor(s) on that circuit “Off”, locks out all compressor operation for that circuit, and initiates a manual reset diagnostic (compressor trip).

# Constant Volume (CV) Units

## Zone Temperature—Cooling

Relies on input from a sensor located directly in the space, while a system is in the occupied “Cooling” mode. It modulates the economizer (if equipped) and/or stages the mechanical cooling “On and Off” as required to maintain the zone temperature to within the cooling setpoint deadband.

## Zone Temperature—Heating

Relies on input from a sensor located directly in the space, while a system is in the occupied “Heating” mode or an unoccupied period, to stage the heat “on and off” or to modulate the heating valve (hydronic heat only) as required to maintain the zone temperature to within the heating setpoint deadband. The supply fan will be requested to operate any time there is a request for heat. On gas heat units, the fan will continue to run for 60 seconds after the furnace is turned off.

## Supply Air Tempering

On CV units equipped with staged gas heat, if the supply air temperature falls 10°F below the occupied heating setpoint temperature while the heater is "Off", the first stage of heat will be turned "On". The heater is turned "Off" when the supply air temperature reaches 10°F above the occupied heating setpoint temperature.

# Variable Air Volume (VAV) Units

## Occupied Heating—Supply Air Temperature

When a VAV unit is equipped with "Modulating Heat", and the system is in an occupied mode, and the field supplied changeover relay contacts have closed or per a BAS command, the supply air temperature will be controlled to the customer specified supply air heating setpoint. It will remain in the heating status until the changeover relay contacts are opened or BAS has released the heat command.

## Occupied Cooling—Supply Air Temperature

When a VAV unit is in the occupied mode, the supply air temperature will be controlled to the customer specified supply air cooling setpoint by modulating the economizer and/or staging the mechanical cooling "On and Off" as required. The changeover relay contacts must be open, or BAS command set to auto or cool, for the cooling to operate.

## Daytime Warm-up

On VAV units equipped with heat, if the zone temperature falls below the daytime warm-up initiate temperature during the occupied mode, the system will switch to full airflow. During this mode, the VAV box/unocc relay will be energized (this is to signal the VAV boxes to go to 100%). After the VAV box max stroke time has elapsed (factory set at 6 minutes), the VFD output will be set to 100%. The airflow will be at 100% and the heat will be turned on to control to the occupied heating setpoint.

When the zone temperature reaches the daytime warm-up termination setpoint, the heat will be turned off, the relay will be de-energized, releasing the VAV boxes, the VFD output will go back to duct static pressure control and the unit will return to discharge air control. If the occ zone heating setpoint is less than the DWU terminate setpoint, the heat will turn off when the occ zone heat setpoint is reached, but it will stay in DWU mode and cycle the heat to maintain setpoint.

## Unoccupied Heating—Zone Temperature

When a VAV unit is equipped with gas, electric, or hydronic heat and is in the unoccupied mode, the zone temperature will be controlled to within the customer specified setpoint deadband. During an unoccupied mode for a VAV unit, the VAV box/unocc relay will be in the unoccupied position and the VFD output will be at 100%. This means that if there is a call for heat (or cool) and the supply fan comes on, it will be at full airflow and the VAV boxes in the space will need to be 100% open as signaled by the VAV box/unocc relay.

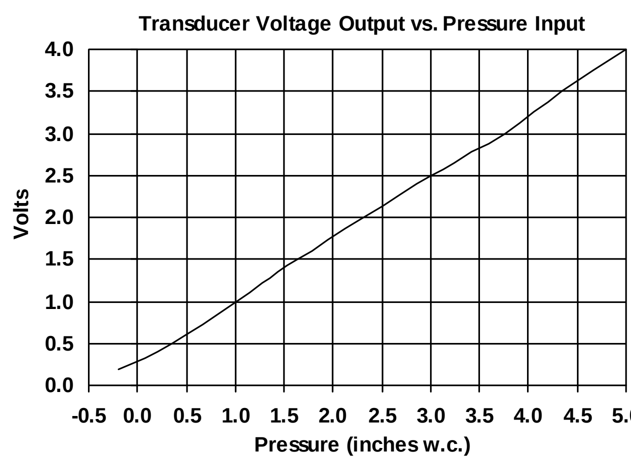
## Supply Air Tempering

On VAV units equipped with "Modulating Heat", if the supply air temperature falls 10°F below the supply air temperature setpoint, the heat will modulate to maintain the supply air temperature to within the low end of the setpoint deadband.

## Supply Duct Static Pressure Control (Occupied)

The RTM relies on input from the duct pressure transducer when a unit is equipped with a Variable Frequency Drive to set the supply fan speed to maintain the supply duct static pressure to within the static pressure setpoint deadband. The transducer compares supply duct pressure to ambient pressure. Refer to Figure 43, p. 65.

**Figure 6. Transducer voltage output vs. pressure input with VCM and TRAQ™ sensing**




## Space Temperature Averaging

Space temperature averaging for Constant Volume applications is accomplished by wiring a number of remote sensors in a series/parallel circuit.

The fewest number of sensors required to accomplish space temperature averaging is four. The Space Temperature Averaging with Multiple Sensors figure illustrates a single sensor circuit (Single Zone), four sensors wired in a series/parallel circuit (Four Zone), nine sensors wired in a series/parallel circuit (Nine Zone). Any number squared, is the number of remote sensors required.

Wiring termination will depend on the type of remote panel or control configuration for the system. Refer to the wiring diagrams that shipped with the unit.

**Figure 7. Unit component layout and "ship with" locations**

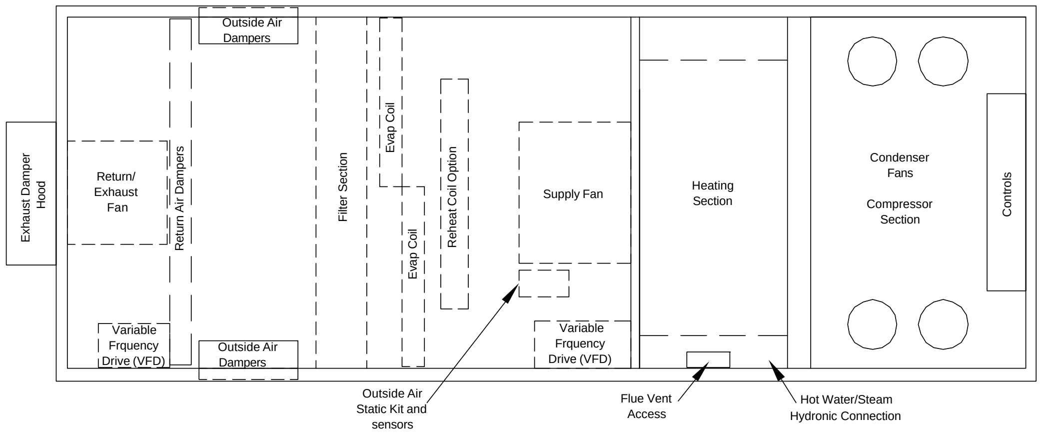
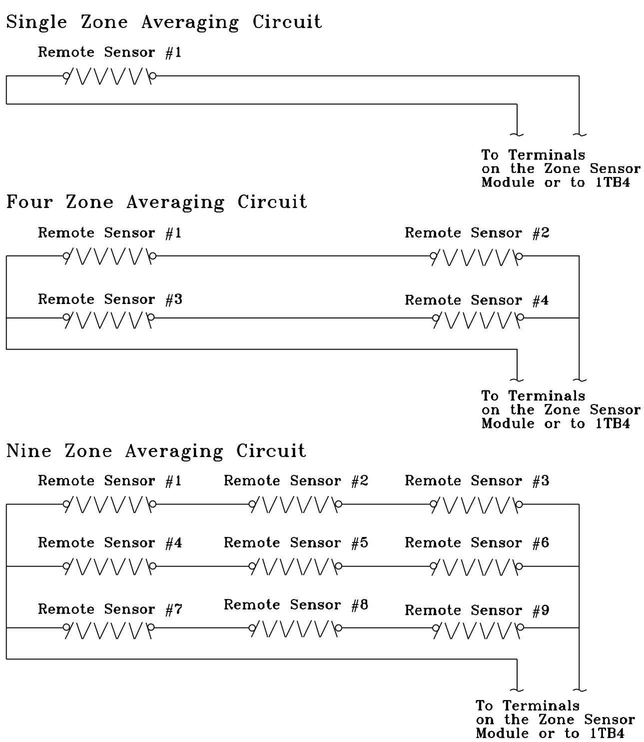



**Figure 8. Space temperature averaging with multiple sensors**

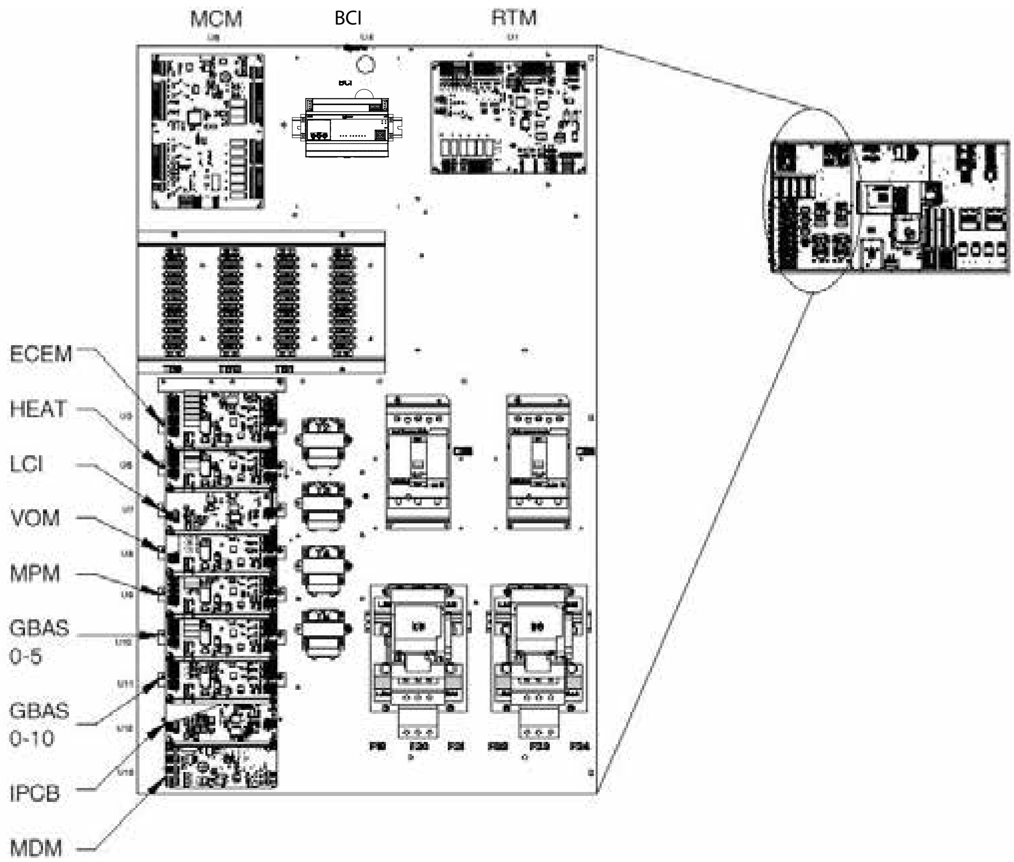



## Unit Control Modules

Unit control modules are microelectronic circuit boards designed to perform specific unit functions. The control modules, through proportional/integral control algorithms, provide the best possible comfort level for the customer. They are mounted in the control panel and are factory wired to their respective internal components.

The control modules receive and interpret information from other unit modules, sensors, remote panels, and customer binary contacts to satisfy the applicable request for economizing, mechanical cooling, heating, and ventilation. Figure 9 illustrates the typical location of each designated module.

**Figure 9. Control module locations**




## Single Zone Variable Air Volume (SZVAV) Only

The IntelliPak controls platform will support Single Zone VAV as an optional unit control type in order to meet ASHRAE 90.1. The basic control will be a hybrid VAV/CV configured unit that provides discharge temperature control to a varying discharge air temperature target setpoint based on the space temperature and/or humidity conditions. Concurrently, the unit will control and optimize the supply fan speed to maintain the zone temperature to a zone temperature setpoint.

### Supply Fan Output Control

Units configured for Single Zone VAV control will utilize the same supply fan output control scheme as on traditional VAV units except the VFD signal will be based on zone heating and cooling demand instead of the supply air pressure.

### VFD Control

Single Zone VAV units will be equipped with a VFD-controlled supply fan which will be controlled via a 0-10VDC signal from the Rooftop Module (RTM). With the RTM supply fan output energized and the RTM VFD output at 0VDC, the fan speed output is 37% (22Hz) from the VFD by default; and at 10VDC the fan speed output is 100% (60Hz). The control scales the 0-10VDC VFD output from the RTM linearly to control between the 37-100% range. The VFD will modulate the supply fan motor speed, accelerating or decelerating as required to maintain the zone temperature to the zone temperature setpoint. When subjected to high ambient return conditions the VFD will reduce its output frequency to maintain operation. Bypass control is offered to provide full nominal airflow in the event of drive failure.

### Ventilation Control

Units configured for Single Zone VAV control will require special handling of the OA Damper Minimum Position control in order to compensate for the non-linearity of airflow associated with the variable supply fan speed and damper combinations. Units configured for TRAQ with or without DCV will operate identically to traditional units with no control changes.

### Space Pressure Control

For units configured with Space Pressure Control with or without Statitrac, the new schemes implemented for economizer minimum position handling require changes to the existing Space Pressure Control scheme in order to prevent over/under pressurization. The overall scheme will remain very similar to VAV units with Space Pressure Control with the exception of the dynamic Exhaust Enable Setpoint.

For SZVAV an Exhaust Enable Setpoint must be selected during the 100% Fan Speed Command. Once selected, the difference between the Exhaust Enable Setpoint and Design OA Damper Minimum Position at 100% Fan Speed Command will be calculated. The difference calculated will be used as an offset and added to the Active Building Design OA Minimum Position Target in order to calculate the dynamic Exhaust Enable Target, which will be used throughout the Supply Fan Speed/OA Damper Position range.

The Exhaust Enable Target could be above or below the Active Building Design OA Minimum Position Target Setpoint, based on the Active Exhaust Enable Setpoint being set above or below the Building Design Minimum Position at 100% Fan Speed Command. Note that an Exhaust Enable Setpoint of 0% will result in the same effect on Exhaust Fan control as on VAV applications with and without Statitrac.

## Occupied Cooling Operation

For normal cooling operation, cooling capacity will be staged or modulated in order to meet the calculated discharge air target setpoint. If the current active cooling capacity is controlling the discharge air within the deadband, no additional cooling capacity change will be requested. As the Discharge Air Temperature rises above the deadband, the algorithm will request additional capacity as required (additional compressors or economizer). As the Discharge Air Temperature falls below the deadband, the algorithm will request a reduction in active capacity.

## Default Economizer Operation

By default, the unit will be setup to optimize the minimum supply fan speed capability during Economizer Only operation. If the economizer is able to meet the demand alone, due to desirable ambient conditions, the supply fan speed will be allowed to increase above the minimum prior to utilizing mechanical cooling if discharge air setpoint falls below the discharge air Lower Limit (Cooling) setpoint.

## Unoccupied Mode

In Unoccupied mode the unit will utilize setback setpoints, 0% Minimum OA Damper position, and Auto Fan Mode operation as on normal CV units. The Supply Fan speed, and cooling and modulating types of heat, will be controlled to the discharge air target setpoint as is done during occupied periods. The Supply fan speed during staged heat control will be forced to 100% as on normal CV units.

## Occupied Heating Operation

Occupied heating operation has two separate control sequences; staged and modulated. All staged heating types will drive the supply fan to maximum flow and stage heating to control to the Zone Heating Setpoint. For units with Hydronic and Gas heat, modulated SZVAV Heating. On an initial call for heating, the supply fan will drive to the minimum heating airflow.

On an additional call for heating, the heat will control in order to meet the calculated discharge air target setpoint. As the load in the zone continues to request heat operation, the supply fan will ramp-up while the control maintains the heating discharge air temperature. Heating can be configured for either the energy saving SZVAV Heating solution as described above, or the traditional, less efficient CV Heating solution.

## Compressor (DX) Cooling

Compressor control and protection schemes will function identical to that of a traditional unit. Normal compressor proving and disable input monitoring will remain in effect as well as normal 3-minute minimum on, off, and inter-stage timers. Also, all existing head pressure control schemes will be in effect.

## Cooling Sequence

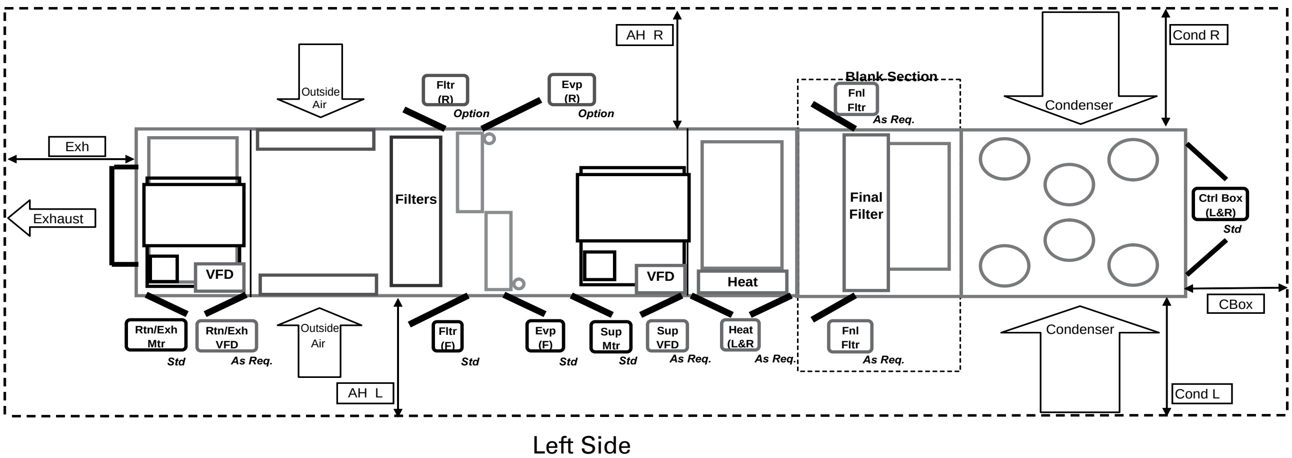
If the control determines that there is a need for active cooling capacity in order to meet the calculated discharge air target setpoint, once supply fan proving has been made, the unit will begin to stage compressors accordingly. Note that the compressor staging order will be based on unit configuration and compressor lead/lag status.

Once the discharge air target setpoint calculation has reached the Minimum Setpoint and compressors are being utilized to meet the demand, as the discharge air target setpoint value continues to calculate lower the algorithm will begin to ramp the supply fan speed up toward 100%. Note that the supply fan speed will remain at the compressor stage's associated minimum value (as described below) until the discharge air target setpoint value is calculated below the discharge air temperature Minimum Setpoint (limited discharge air target setpoint).

As the cooling load in the zone decreases the zone cooling algorithm will reduce the speed of the fan down to minimum per compressor stage and control the compressors accordingly. As the compressors begin to de-energize, the supply fan speed will fall back to the Cooling Stage's associated minimum fan speed, but not below. As the load in the zone continues to drop, cooling capacity will be reduced in order to maintain the discharge air within the ± ½ discharge air target deadband.

# Unit Clearances

**Figure 10. Minimum required clearance [(a)]**




(a) Unit drawing is representative only and may not accurately depict all models.

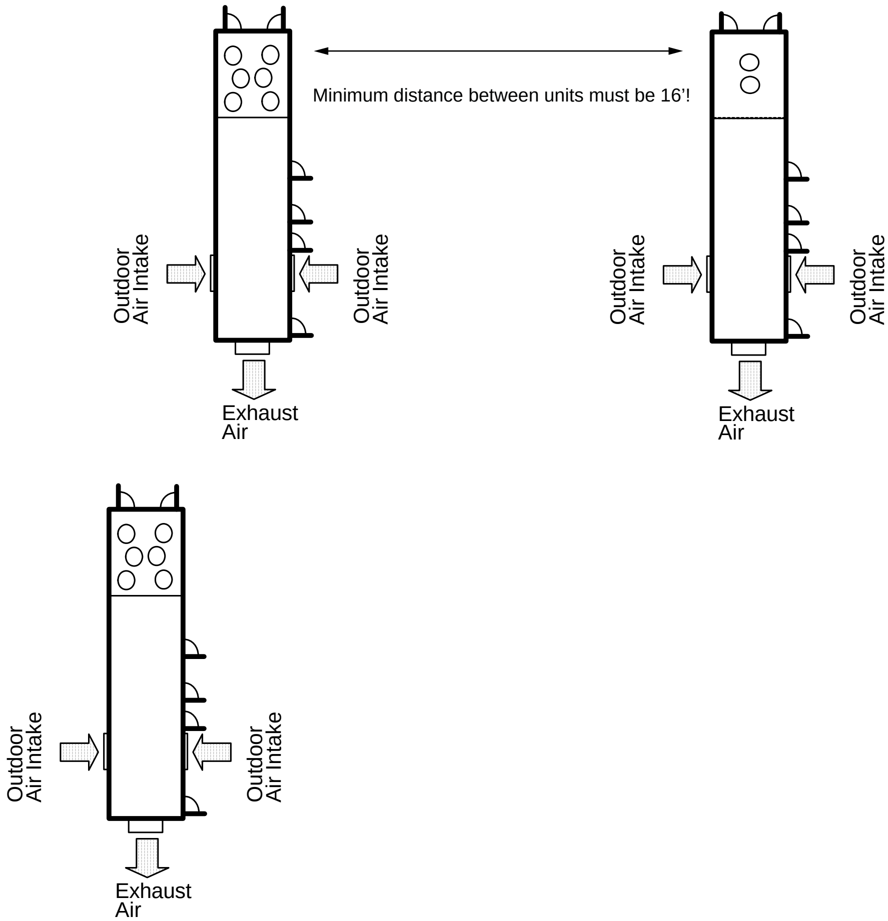
**Table 4. Minimum required clearance**

| | | Unit Option Selection (Door Swing Ft. and In.) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Standard | | VFD | | | | Two-side Access | | | |
| Door Location | Availability | 90-118 | 120-162 | Return/ Exhaust | Supply | Heat | Reheat | 90-118 | 120-162 | Final Filter | Energy Recovery |
| Exhaust/Ret Motor | Std | 2' 2" | 2' 2" | * | * | * | * | * | * | * | |
| Exhaust/Ret VFD | As Req. | * | * | 2' 2" | * | * | * | * | * | * | |
| ERW Fltr[(a)] (L & R) (F) | Option | * | * | * | * | * | * | * | * | * | 2' 2" |
| ERW Fltr(a) (L & R) (R) | Option | * | * | * | * | * | * | * | * | * | 2' 2" |
| Filter (Front) | Std | 2' 8" | 2' 8" | * | * | * | * | * | * | * | |
| Filter (Rear) | Option | * | * | * | * | * | * | 2' 2" | 2' 8" | * | |
| Evap (Front) | Std | 2' 2" | 2' 2" | * | * | * | * | * | * | * | |
| Evap (Rear) | Std | 2' 8" | * | * | * | * | * | * | * | * | |
| or Evap (Rear) | Option | * | * | * | * | * | 2' 2 | * | 2' 2" | * | |
| Supply Motor | Std | 2' 8" | 2' 8" | * | * | * | * | * | * | * | |
| Supply VFD | As Req. | * | * | * | 2' 2" | * | * | * | * | * | |
| Heat (Left & Right) | As Req. | * | * | * | * | 2' 2" | * | * | * | * | |
| Final Filter (Front) | As Req. | * | * | * | * | * | * | * | * | 2' 2" | |
| Final Filter (Rear) | As Req. | * | * | * | * | * | * | * | * | 2' 2" | |
| Control Box (L & R) | Std | 3' 2" | 3' 2" | * | * | * | * | * | * | * | |

| Minimum Required Clearance (Ft.) | | | | | |
|---|---|---|---|---|---|
| AH_L | AH_R | Exh | Cond_L | Cond_R | Control Box |
| 8' | 8' | 8' | 8' | 8' | 6' |

(a) See Unit Dimensions for Energy Recovery Wheel location.

**Figure 11. Multiple unit placement**

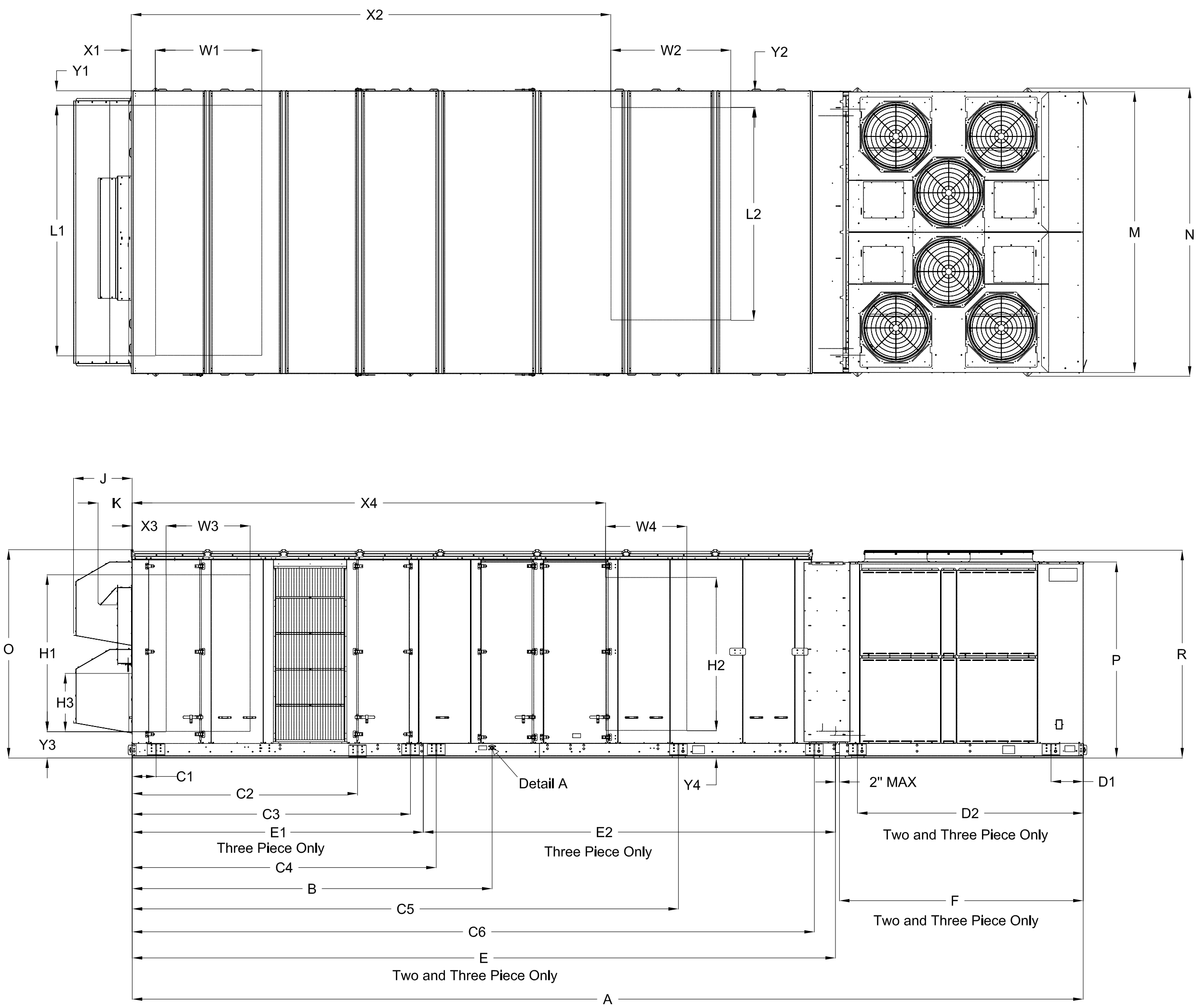


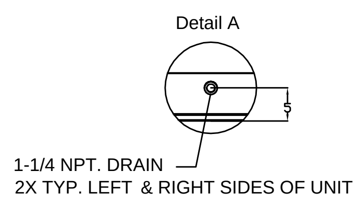

**Notes:**

1. Stagger units to minimize span deflection which deters sound transmission and to maximize proper diffusion of the exhaust air before it reaches the adjacent unit outside air intake.
2. Cooling tower should be 5 feet above or 20 feet away from the outside air intake. For additional information, see 2007 ASHRAE Handbook: HVAC Applications, page 44.4.

# Dimensional Data

**Figure 12. Unit Top/Front View**



# Dimensional Data

## Table 5. Unit dimensions (in.)—one-piece unit air-cooled

**ONE-PIECE Dimensions without Energy Recovery Wheel (ERW)**

| | | | | Lifting Lug Locations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unit Dimensions | | Air Handler Side | | | Condenser Side | Unit Width | |
| Tonnage | Blank Section | A | B | C1 | C2 | C3 | D1 | M | N |
| 90 | None | 437 3/16 | 159 15/16 | 66 | 252 14/16 | N/A | 27 11/16 | 139 13/16 | 143 8/16 |
| 90 | 4 ft | 485 6/16 | 159 15/16 | 66 | 252 14/16 | N/A | 54 2/16 | 139 13/16 | 143 8/16 |
| 90 | 8 ft | 533 9/16 | 159 15/16 | 66 | 252 14/16 | N/A | 54 2/16 | 139 13/16 | 143 8/16 |
| 105 | None | 455 3/16 | 159 15/16 | 66 | 252 14/16 | N/A | 27 11/16 | 139 13/16 | 143 8/16 |
| 105 | 4 ft | 503 6/16 | 159 15/16 | 66 | 252 14/16 | N/A | 54 2/16 | 139 13/16 | 143 8/16 |
| 105 | 8 ft | 551 9/16 | 159 15/16 | 66 | 252 14/16 | N/A | 54 2/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 528 15/16 | 197 1/16 | 66 | 269 6/16 | N/A | 63 2/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 577 2/16 | 197 1/16 | 66 | 269 6/16 | N/A | 63 2/16 | 139 13/16 | 143 8/16 |
| 120-150 (High Heat Gas Models Only) | None | 540 15/16 | 197 1/16 | 66 | 269 6/16 | N/A | 63 2/16 | 139 13/16 | 143 8/16 |

| | | Unit Height | | | Return Fan | Exhaust Fan |
|---|---|---|---|---|---|---|
| Tonnage | Blank Section | O | P | R | J | K |
| 90-150 | None | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 90-150 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 90-150 | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |

**ONE-PIECE Dimensions with Energy Recovery Wheel**

| | | | | Lifting Lug Locations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unit Dimensions | | Air Handler Side | | | Condenser Side | Unit Width | |
| Tonnage | Blank Section | A | B | C1 | C2 | C3 | D1 | M | N |
| 90 | None | 533 9/16 | 256 5/16 | 66 | 201 1/16 | 349 4/16 | 27 11/16 | 139 13/16 | 143 8/16 |
| 90 | 4 ft | 581 13/16 | 256 5/16 | 66 | 201 1/16 | 349 4/16 | 54 2/16 | 139 13/16 | 143 8/16 |
| 105 | None | 551 9/16 | 256 5/16 | 66 | 201 1/16 | 349 4/16 | 27 11/16 | 139 13/16 | 143 8/16 |
| 105 | 4 ft | 599 13/16 | 256 5/16 | 66 | 201 1/16 | 349 4/16 | 54 2/16 | 139 13/16 | 143 8/16 |

| | | Unit Height | | | Return Fan | Exhaust Fan |
|---|---|---|---|---|---|---|
| Tonnage | Blank Section | O | P | R | J | K |
| 90 | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 90 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 105 | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 105 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |

Table 6. Unit dimensions (In.)—two-piece unit air-cooled

| TWO-PIECE Dimensions without Energy Recovery Wheel (ERW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unit Dimensions | | | | Lifting Lug Locations | | | |
| | | | | | | Air Handler Side | | | |
| Tonnage | Blank Section | A | B | E | F | C1 | C2 | C3 | C4 |
| 90 | None | 454 4/16 | 159 15/16 | 330 14/16 | 121 6/16 | 66 | 252 14/16 | N/A | N/A |
| 90 | 4 ft | 502 7/16 | 159 15/16 | 379 1/16 | 121 6/16 | 66 | 252 14/16 | 368 6/16 | N/A |
| 90 | 8 ft | 550 11/16 | 159 15/16 | 427 4/16 | 121 6/16 | 66 | 252 14/16 | 416 10/16 | N/A |
| 105 | None | 472 4/16 | 159 15/16 | 330 14/16 | 139 6/16 | 66 | 252 14/16 | N/A | N/A |
| 105 | 4 ft | 520 7/16 | 159 15/16 | 379 1/16 | 139 6/16 | 66 | 252 14/16 | 368 6/16 | N/A |
| 105 | 8 ft | 568 11/16 | 159 15/16 | 427 4/16 | 139 6/16 | 66 | 252 14/16 | 416 10/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | None | 546 | 197 1/16 | 395 10/16 | 148 6/16 | 66 | 269 6/16 | 384 15/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 594 4/16 | 197 1/16 | 443 13/16 | 148 6/16 | 66 | 269 6/16 | 433 2/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 642 7/16 | 197 1/16 | 492 1/16 | 148 6/16 | 66 | 269 6/16 | 481 6/16 | N/A |
| 120-150 (High Heat Gas Models Only) | None | 558 | 197 1/16 | 407 10/16 | 148 6/16 | 66 | 269 6/16 | 396 15/16 | N/A |

| | | Lug Locations | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Condenser Side | | Unit Width | | Unit Height | | |
| Tonnage | Blank Section | D1 | D2 | M | N | O | P | R |
| 90 | None | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 90 | 4 ft | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 90 | 8 ft | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | None | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | 4 ft | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | 8 ft | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (High Heat Gas Models Only) | None | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |

Continued on next page

**Table 6. Unit dimensions (In.)—two-piece unit air-cooled (continued)**

| Tonnage | Blank Section | Return Fan | Exhaust Fan |
|---|---|---|---|
| | | J | K |
| 90 | None | 29 3/16 | 17 |
| 90 | 4 ft | 29 3/16 | 17 |
| 90 | 8 ft | 29 3/16 | 17 |
| 105 | None | 29 3/16 | 17 |
| 105 | 4 ft | 29 3/16 | 17 |
| 105 | 8 ft | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | None | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 29 3/16 | 17 |
| 120-150 (High Heat Gas Models Only) | None | 29 3/16 | 17 |

**TWO-PIECE Dimensions with Energy Recovery Wheel (ERW)**

| Tonnage | Blank Section | Unit Dimensions | | | | Lifting Lug Locations Air Handler Side | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | E | F | C1 | C2 | C3 | C4 |
| 90 | None | 550 11/16 | 256 5/16 | 427 5/16 | 121 6/16 | 66 | 201 1/16 | 349 4/16 | N/A |
| 90 | 4 ft | 598 14/16 | 256 5/16 | 475 8/16 | 121 6/16 | 66 | 201 1/16 | 349 4/16 | 464 13/16 |
| 90 | 8 ft | 647 2/16 | 256 5/16 | 523 12/16 | 121 6/16 | 66 | 201 1/16 | 349 4/16 | 513 |
| 105 | None | 568 11/16 | 256 5/16 | 427 5/16 | 139 6/16 | 66 | 201 1/16 | 349 4/16 | N/A |
| 105 | 4 ft | 616 14/16 | 256 5/16 | 475 8/16 | 139 6/16 | 66 | 201 1/16 | 349 4/16 | 464 13/16 |
| 105 | 8 ft | 665 2/16 | 256 5/16 | 523 12/16 | 139 6/16 | 66 | 201 1/16 | 349 4/16 | 513 |
| 120-150 (All Units Except High Heat Gas Models) | None | 642 7/16 | 293 8/16 | 492 1/16 | 148 6/16 | 66 | 238 5/16 | 365 5/16 | 480 14/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 690 10/16 | 293 8/16 | 540 4/16 | 148 6/16 | 66 | 238 5/16 | 365 5/16 | 529 2/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 738 14/16 | 293 8/16 | 588 8/16 | 148 6/16 | 66 | 238 5/16 | 365 5/16 | 577 5/16 |
| 120-150 (High Heat Gas Models Only) | None | 654 7/16 | 293 8/16 | 504 1/16 | 148 6/16 | 66 | 238 5/16 | 365 5/16 | 492 14/16 |

Continued on next page

**Table 6. Unit dimensions (In.)—two-piece unit air-cooled (continued)**

| Tonnage | Blank Section | Lug Locations Condenser Side | | Unit Width | | Unit Height | | |
|---|---|---|---|---|---|---|---|---|
| | | D1 | D2 | M | N | O | P | R |
| 90 | None | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 90 | 4 ft | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 90 | 8 ft | 16 | 112 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | None | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | 4 ft | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 105 | 8 ft | 16 | 130 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |
| 120-150 (High Heat Gas Models Only) | None | 16 | 139 7/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 103 7/16 |

| Tonnage | Blank Section | Return Fan | Exhaust Fan |
|---|---|---|---|
| | | J | K |
| 90 | None | N/A | 17 |
| 90 | 4 ft | N/A | 17 |
| 90 | 8 ft | N/A | 17 |
| 105 | None | N/A | 17 |
| 105 | 4 ft | N/A | 17 |
| 105 | 8 ft | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | None | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | N/A | 17 |
| 120-150 (High Heat Gas Models Only) | None | N/A | 17 |

Table 7. Unit dimensions (in.)—two-piece unit evaporative condenser

| TWO-PIECE Dimensions without Energy Recovery Wheel (ERW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lifting Lug Locations | | | |
| | Blank | Unit Dimensions | | | | Air Handler Side | | | |
| Tonnage | Section | A | B | E | F | C1 | C2 | C3 | C4 |
| 100-118 | None | 475 8/16 | 159 15/16 | 330 14/16 | 142 10/16 | 66 | 252 14/16 | N/A | N/A |
| 100-118 | 4 ft | 523 12/16 | 159 15/16 | 379 1/16 | 142 10/16 | 66 | 252 14/16 | 368 6/16 | N/A |
| 100-118 | 8 ft | 571 15/16 | 159 15/16 | 427 5/16 | 142 10/16 | 66 | 252 14/16 | 416 10/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | None | 540 5/16 | 197 1/16 | 395 10/16 | 142 10/16 | 66 | 269 6/16 | 384 15/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 588 8/16 | 197 1/16 | 443 14/16 | 142 10/16 | 66 | 269 6/16 | 433 2/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 636 11/16 | 197 1/16 | 492 1/16 | 142 10/16 | 66 | 269 6/16 | 481 6/16 | N/A |
| 128-162 (High Heat Gas Models Only) | None | 552 5/16 | 197 1/16 | 407 10/16 | 142 10/16 | 66 | 269 6/16 | 396 15/16 | N/A |

| | | Lug Locations | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Blank | Condenser Side | | Unit Width | | Unit Height | | |
| Tonnage | Section | D1 | D2 | M | N | O | P | R |
| 100-118 | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 100-118 | 4 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 100-118 | 8 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (High Heat Gas Models Only) | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |

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**Table 7. Unit dimensions (in.)—two-piece unit evaporative condenser (continued)**

| Tonnage | Blank Section | Return Fan J | Exhaust Fan K |
|---|---|---|---|
| 100-118 | None | 29 3/16 | 17 |
| 100-118 | 4 ft | 29 3/16 | 17 |
| 100-118 | 8 ft | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | None | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 29 3/16 | 17 |
| 128-162 (High Heat Gas Models Only) | None | 29 3/16 | 17 |

**TWO-PIECE Dimensions with Energy Recovery Wheel (ERW)**

| Tonnage | Blank Section | Unit Dimensions | | | | Lifting Lug Locations Air Handler Side | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | E | F | C1 | C2 | C3 | C4 |
| 100-118 | None | 571 15/16 | 256 5/16 | 427 5/16 | 142 10/16 | 66 | 201 1/16 | 349 4/16 | N/A |
| 100-118 | 4 ft | 620 3/16 | 256 5/16 | 475 8/16 | 142 10/16 | 66 | 201 1/16 | 349 4/16 | 464 13/16 |
| 100-118 | 8 ft | 668 6/16 | 256 5/16 | 523 12/16 | 142 10/16 | 66 | 201 1/16 | 349 4/16 | 513 |
| 128-162 (All Units Except High Heat Gas Models) | None | 636 11/16 | 293 8/16 | 492 1/16 | 142 10/16 | 66 | 238 5/16 | 365 5/16 | 480 14/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 684 15/16 | 293 8/16 | 540 4/16 | 142 10/16 | 66 | 238 5/16 | 365 5/16 | 529 2/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 733 2/16 | 293 8/16 | 588 8/16 | 142 10/16 | 66 | 238 5/16 | 365 5/16 | 577 5/16 |
| 128-162 (High Heat Gas Models Only) | None | 648 11/16 | 293 8/16 | 504 1/16 | 142 10/16 | 66 | 238 5/16 | 365 5/16 | 492 14/16 |

Continued on next page

**Table 7. Unit dimensions (in.)—two-piece unit evaporative condenser (continued)**

| Tonnage | Blank Section | Lug Locations Condenser Side | | Unit Width | | Unit Height | | |
|---|---|---|---|---|---|---|---|---|
| | | D1 | D2 | M | N | O | P | R |
| 100-118 | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 100-118 | 4 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 100-118 | 8 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |
| 128-162 (High Heat Gas Models Only) | None | 16 | 133 11/16 | 139 13/16 | 143 8/16 | 103 12/16 | 97 9/16 | 102 12/16 |

| Tonnage | Blank Section | Return Fan | Exhaust Fan |
|---|---|---|---|
| | | J | K |
| 100-118 | None | N/A | 17 |
| 100-118 | 4 ft | N/A | 17 |
| 100-118 | 8 ft | N/A | 17 |
| 128-162 (All Units Except High Heat Gas Models) | None | N/A | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | N/A | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | N/A | 17 |
| 128-162 (High Heat Gas Models Only) | None | N/A | 17 |

**Table 8. Unit dimensions (in.)—three-piece unit air-cooled**

| THREE-PIECE Dimensions without Energy Recovery Wheel (ERW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unit Dimensions | | | | | | Lifting Lug Locations Air Handler Side | |
| Tonnage | Blank Section | A | B | E | E1 | E2 | F | C1 | C2 |
| 90 | None | 473 9/16 | 179 3/16 | 350 3/16 | 144 15/16 | 205 3/16 | 121 6/16 | 11 14/16 | N/A |
| 90 | 4 ft | 521 12/16 | 179 3/16 | 398 6/16 | 144 15/16 | 253 7/16 | 121 6/16 | 11 14/16 | N/A |
| 90 | 8 ft | 569 15/16 | 179 3/16 | 446 9/16 | 144 15/16 | 301 10/16 | 121 6/16 | 11 14/16 | N/A |
| 105 | None | 491 9/16 | 179 3/16 | 350 3/16 | 144 15/16 | 205 3/16 | 139 6/16 | 11 14/16 | N/A |
| 105 | 4 ft | 539 12/16 | 179 3/16 | 398 6/16 | 144 15/16 | 253 7/16 | 139 6/16 | 11 14/16 | N/A |
| 105 | 8 ft | 587 15/16 | 179 3/16 | 446 9/16 | 144 15/16 | 301 10/16 | 139 6/16 | 11 14/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | None | 571 8/16 | 222 9/16 | 421 2/16 | 161 2/16 | 260 | 148 6/16 | 11 14/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 619 11/16 | 222 9/16 | 469 5/16 | 161 2/16 | 308 4/16 | 148 6/16 | 11 14/16 | N/A |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 667 15/16 | 222 9/16 | 517 9/16 | 161 2/16 | 356 7/16 | 148 6/16 | 11 14/16 | N/A |
| 120-150 (High Heat Gas Models Only) | None | 583 8/16 | 222 9/16 | 433 2/16 | 161 2/16 | 272 | 148 6/16 | 11 14/16 | N/A |
| | | Lug Locations | | | | | | Unit Width | |
| | | Air Handler Side | | | | Condenser Side | | | |
| Tonnage | Blank Section | C3 | C4 | C5 | C6 | D1 | D2 | M | N |
| 90 | None | 138 9/16 | 151 6/16 | 272 | 339 11/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 90 | 4 ft | 138 9/16 | 151 6/16 | 272 | 387 14/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 90 | 8 ft | 138 9/16 | 151 6/16 | 272 | 436 1/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 105 | None | 138 9/16 | 151 6/16 | 272 | 339 11/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 105 | 4 ft | 138 9/16 | 151 6/16 | 272 | 387 14/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 105 | 8 ft | 138 9/16 | 151 6/16 | 272 | 436 1/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 155 2/16 | 167 5/16 | 294 14/16 | 410 10/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 155 2/16 | 167 5/16 | 294 14/16 | 458 13/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 155 2/16 | 167 5/16 | 294 14/16 | 507 1/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (High Heat Gas Models Only) | None | 155 2/16 | 167 5/16 | 294 14/16 | 422 10/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |

continued on next page

**Table 8. Unit dimensions (in.)—three-piece unit air-cooled (continued)**

| Tonnage | Blank Section | Unit Height | | | Return Fan | Exhaust Fan |
|---|---|---|---|---|---|---|
| | | O | P | R | J | K |
| 90 | None | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 90 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 90 | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 105 | None | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 105 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 105 | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | None | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |
| 120-150 (High Heat Gas Models Only) | None | 103 12/16 | 97 9/16 | 103 7/16 | 29 3/16 | 17 |

**THREE-PIECE Dimensions with Energy Recovery Wheel (ERW)**

| Tonnage | Blank Section | Unit Dimensions | | | | | | Lifting Lug Locations Air Handler Side | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | E | E1 | E2 | F | C1 | C2 |
| 90 | None | 569 15/16 | 275 10/16 | 446 9/16 | 241 6/16 | 205 3/16 | 121 6/16 | 17 12/16 | 201 1/16 |
| 90 | 4 ft | 618 3/16 | 275 10/16 | 494 13/16 | 241 6/16 | 253 7/16 | 121 6/16 | 17 12/16 | 201 1/16 |
| 90 | 8 ft | 666 6/16 | 275 10/16 | 543 | 241 6/16 | 301 10/16 | 121 6/16 | 17 12/16 | 201 1/16 |
| 105 | None | 587 15/16 | 275 10/16 | 446 9/16 | 241 6/16 | 205 3/16 | 139 6/16 | 17 12/16 | 201 1/16 |
| 105 | 4 ft | 636 3/16 | 275 10/16 | 494 13/16 | 241 6/16 | 253 7/16 | 139 6/16 | 17 12/16 | 201 1/16 |
| 105 | 8 ft | 684 6/16 | 275 10/16 | 543 | 241 6/16 | 301 10/16 | 139 6/16 | 17 12/16 | 201 1/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 667 15/16 | 318 15/16 | 517 9/16 | 257 8/16 | 260 | 148 6/16 | 17 12/16 | 204 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 716 2/16 | 318 15/16 | 565 12/16 | 257 8/16 | 308 4/16 | 148 6/16 | 17 12/16 | 204 7/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 764 5/16 | 318 15/16 | 613 15/16 | 257 8/16 | 356 7/16 | 148 6/16 | 17 12/16 | 204 7/16 |
| 120-150 (High Heat Gas Models Only) | None | 679 15/16 | 318 15/16 | 529 9/16 | 257 8/16 | 272 | 148 6/16 | 17 12/16 | 204 7/16 |

continued on next page

**Table 8. Unit dimensions (in.)—three-piece unit air-cooled (continued)**

| Tonnage | Blank Section | Lug Locations | | | | | | Unit Width | |
|---|---|---|---|---|---|---|---|---|---|
| | | Air Handler Side | | | | Condenser Side | | | |
| | | C3 | C4 | C5 | C6 | D1 | D2 | M | N |
| 90 | None | 234 13/16 | 247 13/16 | 368 7/16 | 436 2/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 90 | 4 ft | 234 13/16 | 247 13/16 | 368 7/16 | 484 5/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 90 | 8 ft | 234 13/16 | 247 13/16 | 368 7/16 | 532 8/16 | 16 | 112 7/16 | 139 13/16 | 143 8/16 |
| 105 | None | 234 13/16 | 247 13/16 | 368 7/16 | 436 2/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 105 | 4 ft | 234 13/16 | 247 13/16 | 368 7/16 | 484 5/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 105 | 8 ft | 234 13/16 | 247 13/16 | 368 7/16 | 532 8/16 | 16 | 130 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | None | 252 12/16 | 263 12/16 | 391 5/16 | 507 1/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 252 12/16 | 263 12/16 | 391 5/16 | 555 4/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 252 12/16 | 263 12/16 | 391 5/16 | 603 7/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |
| 120-150 (High Heat Gas Models Only) | None | 252 12/16 | 263 12/16 | 391 5/16 | 519 1/16 | 16 | 139 7/16 | 139 13/16 | 143 8/16 |

| Tonnage | Blank Section | Unit Height | | | Return Fan | Exhaust Fan |
|---|---|---|---|---|---|---|
| | | O | P | R | J | K |
| 90 | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 90 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 90 | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 105 | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 105 | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 105 | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 4 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 120-150 (All Units Except High Heat Gas Models) | 8 ft | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |
| 120-150 (High Heat Gas Models Only) | None | 103 12/16 | 97 9/16 | 103 7/16 | N/A | 17 |

**Table 9. Unit dimensions (in.)—three-piece unit evaporative condenser**

| THREE-PIECE Dimensions without Energy Recovery Wheel (ERW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unit Dimensions | | | | | | Lifting Lug Location Air Handler Side | |
| Tonnage | Blank Section | A | B | E | E1 | E2 | F | C1 | C2 |
| 100/118 | None | 494 13/16 | 179 3/16 | 350 3/16 | 144 15/16 | 205 3/16 | 142 10/16 | 11 14/16 | N/A |
| 100/118 | 4 ft | 543 | 179 3/16 | 398 6/16 | 144 15/16 | 253 7/16 | 142 10/16 | 11 14/16 | N/A |
| 100/118 | 8 ft | 591 4/16 | 179 3/16 | 446 9/16 | 144 15/16 | 301 10/16 | 142 10/16 | 11 14/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | None | 565 12/16 | 222 9/16 | 421 2/16 | 161 2/16 | 260 | 142 10/16 | 11 14/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 613 15/16 | 222 9/16 | 469 5/16 | 161 2/16 | 308 4/16 | 142 10/16 | 11 14/16 | N/A |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 662 3/16 | 222 9/16 | 517 9/16 | 161 2/16 | 356 7/16 | 142 10/16 | 11 14/16 | N/A |
| 128-162 (High Heat Gas Models Only) | None | 577 12/16 | 222 9/16 | 433 2/16 | 161 2/16 | 272 | 142 10/16 | 11 14/16 | N/A |
| | | Lifting Lug Locations | | | | | | | |
| | | Air Handler Side | | | | Condenser Side | | Unit Width | |
| Tonnage | Blank Section | C3 | C4 | C5 | C6 | D1 | D2 | M | N |
| 100/118 | None | 138 9/16 | 151 6/16 | 272 | 339 11/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 100/118 | 4 ft | 138 9/16 | 151 6/16 | 272 | 387 14/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 100/118 | 8 ft | 138 9/16 | 151 6/16 | 272 | 436 1/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | None | 155 2/16 | 167 5/16 | 294 14/16 | 410 10/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 155 2/16 | 167 5/16 | 294 14/16 | 458 13/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 155 2/16 | 167 5/16 | 294 14/16 | 507 1/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (High Heat Gas Models Only) | None | 155 2/16 | 167 5/16 | 294 14/16 | 422 10/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |

continued on next page

**Table 9. Unit dimensions (in.)—three-piece unit evaporative condenser (continued)**

| Tonnage | Blank Section | Unit Height | | | Return Fan | Exhaust Fan |
|---|---|---|---|---|---|---|
| | | O | P | R | J | K |
| 100/118 | None | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 100/118 | 4 ft | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 100/118 | 8 ft | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | None | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |
| 128-162 (High Heat Gas Models Only) | None | 103 12/16 | 97 9/16 | 102 12/16 | 29 3/16 | 17 |

**THREE-PIECE Dimensions with Energy Recovery Wheel (ERW)**

| Tonnage | Blank Section | Unit Dimensions | | | | | | Lifting Lug Locations | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Air Handler Side | |
| | | A | B | E | E1 | E2 | F | C1 | C2 |
| 100/118 | None | 591 4/16 | 275 10/16 | 446 9/16 | 241 6/16 | 205 3/16 | 142 10/16 | 17 12/16 | 201 1/16 |
| 100/118 | 4 ft | 639 7/16 | 275 10/16 | 494 13/16 | 241 6/16 | 253 7/16 | 142 10/16 | 17 12/16 | 201 1/16 |
| 100/118 | 8 ft | 687 10/16 | 275 10/16 | 543 | 241 6/16 | 301 10/16 | 142 10/16 | 17 12/16 | 201 1/16 |
| 128-162 (All Units Except High Heat Gas Models) | None | 662 3/16 | 318 15/16 | 517 9/16 | 257 8/16 | 260 | 142 10/16 | 17 12/16 | 204 7/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 710 6/16 | 318 15/16 | 565 12/16 | 257 8/16 | 308 4/16 | 142 10/16 | 17 12/16 | 204 7/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 758 10/16 | 318 15/16 | 613 15/16 | 257 8/16 | 356 7/16 | 142 10/16 | 17 12/16 | 204 7/16 |
| 128-162 (High Heat Gas Models Only) | None | 674 3/16 | 318 15/16 | 529 9/16 | 257 8/16 | 272 | 142 10/16 | 17 12/16 | 204 7/16 |

continued on next page

Table 9. Unit dimensions (in.)—three-piece unit evaporative condenser (continued)

| Tonnage | Blank Section | Lifting Lug Locations: Air Handler Side C3 | C4 | C5 | C6 | Condenser Side D1 | D2 | Unit Width M | N |
|---|---|---|---|---|---|---|---|---|---|
| 100/118 | None | 234 13/16 | 247 13/16 | 368 7/16 | 436 2/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 100/118 | 4 ft | 234 13/16 | 247 13/16 | 368 7/16 | 484 5/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 100/118 | 8 ft | 234 13/16 | 247 13/16 | 368 7/16 | 532 8/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | None | 252 12/16 | 263 12/16 | 391 5/16 | 519 1/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 252 12/16 | 263 12/16 | 391 5/16 | 507 1/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | 4 ft | 252 12/16 | 263 12/16 | 391 5/16 | 507 1/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (All Units Except High Heat Gas Models) | 8 ft | 252 12/16 | 263 12/16 | 391 5/16 | 555 4/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |
| 128-162 (High Heat Gas Models Only) | None | 252 12/16 | 263 12/16 | 391 5/16 | 603 7/16 | 16 | 133 11/16 | 139 13/16 | 143 8/16 |

| Tonnage | Blank Section | Unit Height O | P | R | Return Fan J | Exhaust Fan K |
|---|---|---|---|---|---|---|
| 100-162 | None | 103 12/16 | 97 9/16 | 102 12/16 | N/A | 17 |
| 100-162 | 4 ft | 103 12/16 | 97 9/16 | 102 12/16 | N/A | 17 |
| 100-162 | 8 ft | 103 12/16 | 97 9/16 | 102 12/16 | N/A | 17 |

Table 10. Downflow/horizontal airflow configuration dimensions (in.) air cooled (AC) and evap condenser (EC) without energy recovery wheel (ERW)

| Tonnage | Blank Section | Gas Heat | DOWNFLOW Opening Dimensions: Return Opening—with or without Exhaust Fan X1 | Y1 | W1 | L1 | Return Opening—with Return Fan X1 | Y1 | W1 | L1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 90-105/100-118 | None | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 90-105/100-118 | 4 ft | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 90-105/100-118 | 8 ft | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | None | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | 4 ft | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | 8 ft | None | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 90-105/100-118 | None | Low/Med | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 90-105/100-118 | 8 ft | Low/Med | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | None | Low/Med | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | 8 ft | Low/Med | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |
| 120-150/128-162 | None | High | 14 13/16 | 8 14/16 | 48 3/16 | 121 15/16 | 14 13/16 | 42 14/16 | 48 3/16 | 53 14/16 |

continued on next page

**Table 10. Downflow/horizontal airflow configuration dimensions (in.) air cooled (AC) and evap condenser (EC) without energy recovery wheel (ERW) (continued)**

| | | | DOWNFLOW Opening Dimensions | | | | |
|---|---|---|---|---|---|---|---|
| | | | Supply Opening | | | | |
| Tonnage | Blank Section | Gas Heat | X2 (One or Two-Piece Models) | X2 (Three-Piece Models) | Y2 | W2 | L2 |
| 90-105/100-118 | None | None | 256 1/16 | 275 6/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 4 ft | None | 304 4/16 | 323 9/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 8 ft | None | 352 8/16 | 371 12/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | None | 320 13/16 | 346 4/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 4 ft | None | 369 | 394 8/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 8 ft | None | 417 3/16 | 442 11/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | None | Low/Med/ High | 256 1/16 | 275 6/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 8 ft | Low/Med/ High | 352 8/16 | 371 12/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | Low/Med | 320 13/16 | 346 4/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 8 ft | Low/Med | 417 3/16 | 442 11/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | High | 320 13/16 | 346 4/16 | 13 | 59 14/16 | 102 8/16 |

| | | | HORIZONTAL Opening Dimensions | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Return Side Opening | | | | Return End Opening | | | |
| Tonnage | Blank Section | Gas Heat | X3 | Y3 | W3 | H1 | Y1 | Y3 | H3 | L1 |
| 90-105/100-118 | None | None | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 90-105/100-118 | 4 ft | None | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 90-105/100-118 | 8 ft | None | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 120-150/128-162 | 8 ft | None | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 90-105/100-118 | None | Low/Med | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 90-105/100-118 | 8 ft | Low/Med | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 120-150/128-162 | None | Low/Med | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 120-150/128-162 | 8 ft | Low/Med | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| 120-150/128-162 | None | High | 9 5/16 | 10 10/16 | 54 12/16 | 84 15/16 | 6 5/16 | 8 3/16 | 35 3/16 | 127 2/16 |
| | | | | | | | | | | |

| | | | Supply Opening | | | | |
|---|---|---|---|---|---|---|---|
| Tonnage | Blank Section | Gas Heat | X4 (One or Two-Piece Models) | X4 (Three-Piece Models) | Y4 | W4 | H2 |
| 90-105/100-118 | None | None | 254 12/16 | 274 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | 4 ft | None | 302 15/16 | 322 4/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | 8 ft | None | 351 2/16 | 370 7/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | None | 319 8/16 | 345 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | 4 ft | None | 367 11/16 | 393 3/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | 8 ft | None | 415 15/16 | 441 6/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | None | Low/Med | 254 12/16 | 274 | 10 10/16 | 54 12/16 | 66 11/16 |
| 90-105/100-118 | 8 ft | Low/Med | 351 2/16 | 370 7/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | Low/Med | 319 8/16 | 345 | 10 10/16 | 54 12/16 | 66 11/16 |
| 120-150/128-162 | 8 ft | Low/Med | 415 15/16 | 441 6/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | High | 319 8/16 | 345 | 10 10/16 | 66 12/16 | 66 11/16 |

Table 11. Downflow/horizontal airflow configuration dimensions (in.) air-cooled (AC) and evap condenser (EC) with energy recovery wheel

| Tonnage | Blank Section | Gas Heat | DOWNFLOW Opening Dimensions: Return Opening—with or without Exhaust Fan X1 | Y1 | W1 | L1 | Return Opening—with Return Fan X1 | Y1 | W1 | L1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 90-105/100-118 | None | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 90-105/100-118 | 4 ft | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 90-105/100-118 | 8 ft | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | None | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | 4 ft | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | 8 ft | None | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 90-105/100-118 | None | Low/Med | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 90-105/100-118 | 8 ft | Low/Med | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | None | Low/Med | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | 8 ft | Low/Med | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |
| 120-150/128-162 | None | High | 82 3/16 | 8 14/16 | 49 10/16 | 121 15/16 | N/A | N/A | N/A | N/A |

| Tonnage | Blank Section | Gas Heat | DOWNFLOW Opening Dimensions: Supply Opening X2 (One or Two-Piece Models) | X2 (Three-Piece Models) | Y2 | W2 | L2 |
|---|---|---|---|---|---|---|---|
| 90-105/100-118 | None | None | 352 8/16 | 371 12/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 4 ft | None | 400 11/16 | 420 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 8 ft | None | 448 15/16 | 468 3/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | None | 417 4/16 | 442 11/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 4 ft | None | 465 7/16 | 490 14/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 8 ft | None | 513 10/16 | 539 2/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | None | Low/Med | 352 8/16 | 371 12/16 | 13 | 47 14/16 | 102 8/16 |
| 90-105/100-118 | 8 ft | Low/Med | 448 15/16 | 468 3/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | Low/Med | 417 4/16 | 442 11/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | 8 ft | Low/Med | 513 10/16 | 539 2/16 | 13 | 47 14/16 | 102 8/16 |
| 120-150/128-162 | None | High | 417 4/16 | 442 11/16 | 13 | 59 14/16 | 102 8/16 |

| Tonnage | Blank Section | Gas Heat | HORIZONTAL Opening Dimensions[a]: Return Side Opening X3 | Y3 | W3 | H1 |
|---|---|---|---|---|---|---|
| 90-105/100-118 | None | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 90-105/100-118 | 4 ft | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 90-105/100-118 | 8 ft | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | None | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | 4 ft | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | 8 ft | None | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 90-105/100-118 | None | Low/Med | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 90-105/100-118 | 8 ft | Low/Med | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | None | Low/Med | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | 8 ft | Low/Med | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |
| 120-150/128-162 | None | High | 71 8/16 | 10 10/16 | 54 12/16 | 43 6/16 |

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**Table 11. Downflow/horizontal airflow configuration dimensions (in.) air-cooled (AC) and evap condenser (EC) with energy recovery wheel (continued)**

| Tonnage | Blank Section | Gas Heat | Supply Opening X4 (One or Two-Piece Models) | X4 (Three-Piece Models) | Y4 | W4 | H2 |
|---|---|---|---|---|---|---|---|
| 90-105/100-118 | None | None | 351 3/16 | 370 7/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | 4 ft | None | 399 6/16 | 418 11/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | 8 ft | None | 447 10/16 | 466 14/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | None | 415 15/16 | 441 6/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | 4 ft | None | 464 2/16 | 489 10/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | 8 ft | None | 512 6/16 | 537 13/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 90-105/100-118 | None | Low/Med | 351 3/16 | 370 7/16 | 10 10/16 | 54 12/16 | 66 11/16 |
| 90-105/100-118 | 8 ft | Low/Med | 447 10/16 | 466 14/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | Low/Med | 415 15/16 | 441 6/16 | 10 10/16 | 54 12/16 | 66 11/16 |
| 120-150/128-162 | 8 ft | Low/Med | 512 6/16 | 537 13/16 | 10 10/16 | 54 12/16 | 84 15/16 |
| 120-150/128-162 | None | High | 415 15/16 | 441 6/16 | 10 10/16 | 66 12/16 | 66 11/16 |

(a) On horizontal return with ERW units, the return end opening can be on the front, rear, or both sides of the unit and must be specified.

**Figure 13. Evaporative condenser water connection locations**

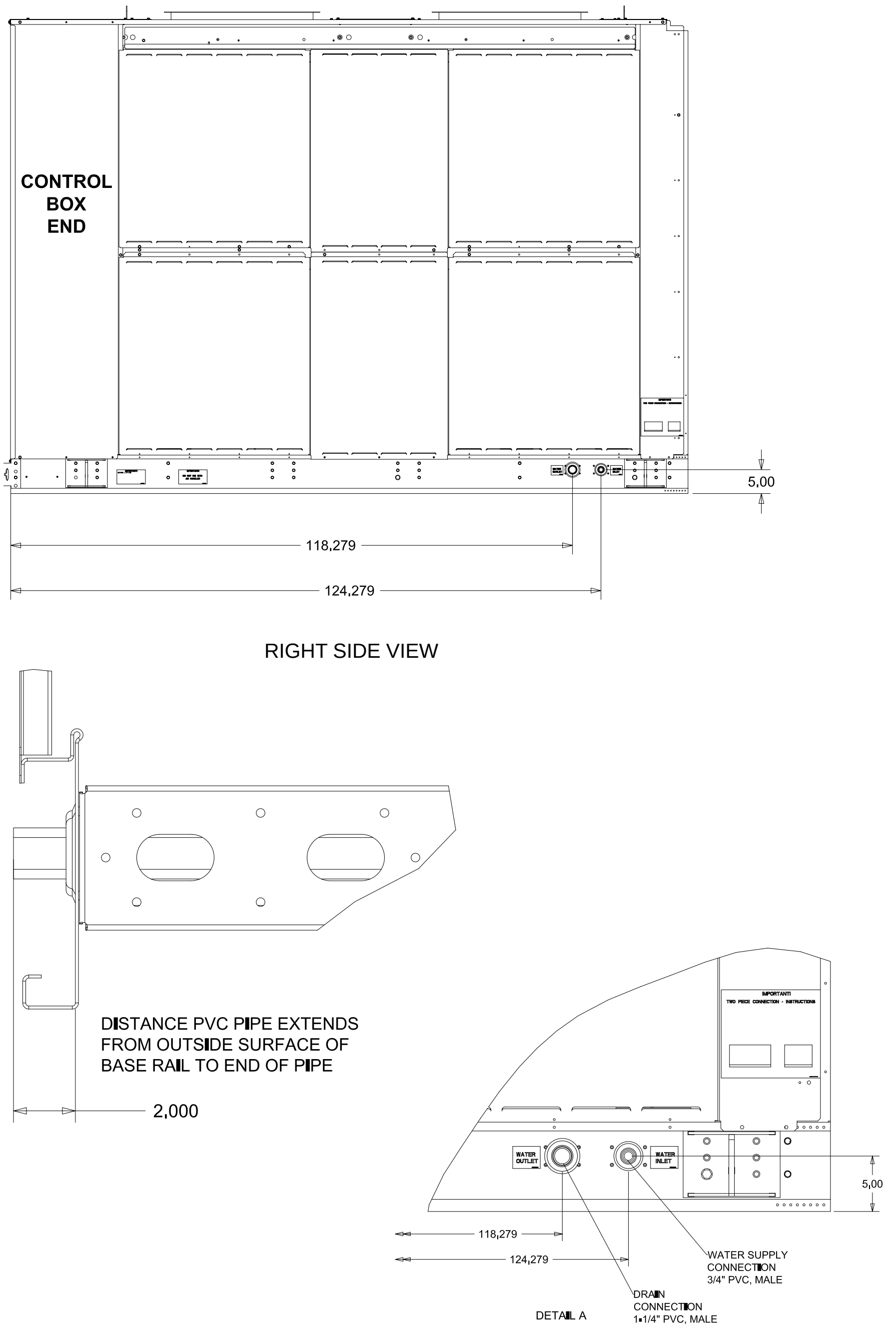
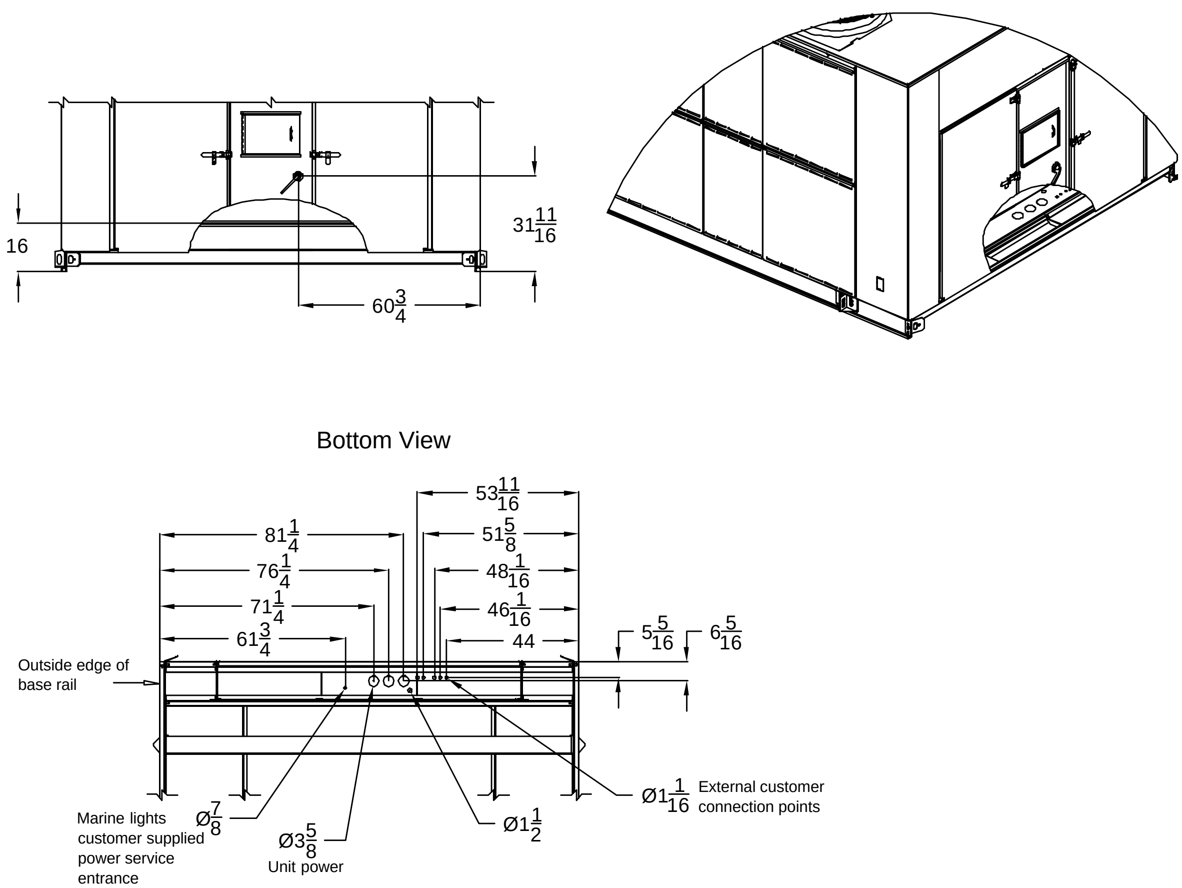


**Figure 14. Electrical entry details (in.)**



# Weights

**Table 12. Approximate operating weights (lbs.)**

| Air-Cooled Condensers | | | Evaporative Condensers | | |
|---|---|---|---|---|---|
| Nominal Tons | Unit (Minimum) | Roof Curb (Minimum) | Nominal Tons | Unit (Minimum) | Roof Curb (Minimum) |
| 90 | 14197 | 907 | 100 | 18430 | 1055 |
| 105 | 14792 | 907 | 118 | 18941 | 1055 |
| 120 | 16939 | 1040 | 128 | 21362 | 1194 |
| 130 | 17690 | 1040 | 140 | 21348 | 1194 |
| 150 | 17923 | 1040 | 162 | 21470 | 1194 |

**Notes:**

1. Weights shown for air-cooled units include the following features: standard coils, 0-25% outside air, throwaway filters, low CFM supply fan, minimum motor sizes, constant volume, 460 XL, No heat. Weights shown for Evaporative condensing units include high-capacity evaporator coil and the weight of the extra structure associated with a two piece unit.
2. Weights shown represent approximate operating weights and have a + 5% accuracy. To calculate weight for a specific unit configuration, utilize TOPSS or contact the local Trane sales representative. ACTUAL WEIGHTS ARE STAMPED ON THE UNIT NAMEPLATE.

**Table 13. Component weights (lbs)**

| | 90/100 | | 105/118 | | 120/128 | | 130/140 | | 150/162 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Size | Weight | Size | Weight | Size | Weight | Size | Weight | Size | Weight |
| **Refrigeration** | | | | | | | | | | |
| Compressor Assembly | - | 1126 | - | 1344 | - | 1562 | - | 1616 | - | 1670 |
| Air-Cooled Condensing Coil (Al) | - | 623 | - | 722 | - | 1049 | - | 1224 | - | 924 |
| Evaporative Condensing Coil[(a)] | | 4566 | | 4329 | | 4129 | | 4109 | | 4029 |
| Evap Coil - Std. Cap | - | 1034 | - | 1300 | - | 1664 | - | 1892 | - | 2564 |
| Evap Coil - Hi. Cap. | - | 1382 | - | 1462 | - | 2564 | - | 2496 | - | N/A |
| Reheat Coil & Tubing | - | 292 | - | 294 | - | 367 | - | 367 | - | 367 |
| Replaceable Core Filter Driers | - | 26 | - | 25 | - | 35 | - | 35 | - | 35 |
| HGBP | - | 46 | - | 49 | - | 53 | - | 53 | - | 53 |
| **Supply Fan Assembly** | | | | | | | | | | |
| Supply Fan & Fan Board Assembly - Low CFM | 25" | 1159 | 32" | 1361 | 32" | 1361 | 32" | 1361 | 32" | 1361 |
| Supply Fan & Fan Board Assembly - Std. CFM | 36" | 1490 | 36" | 1490 | 40" | 1653 | 40" | 1653 | 40" | 1653 |
| Belt Guard | - | 116 | - | 116 | - | 116 | - | 116 | - | 116 |
| Supply VFD (50 hp and below) | - | 233 | - | 233 | - | 233 | - | 233 | - | 233 |
| Supply VFD (60-100 hp) | - | 284 | - | 284 | - | 284 | - | 284 | - | 284 |
| Supply-Exhaust Fan Motor - 15 hp | - | 181 | - | 181 | - | 181 | - | 181 | - | 181 |
| Supply-Exhaust Fan Motor - 20 hp | - | 206 | - | 206 | - | 206 | - | 206 | - | 206 |
| Supply-Exhaust Fan Motor - 25 hp | - | 358 | - | 358 | - | 358 | - | 358 | - | 358 |
| Supply-Exhaust Fan Motor - 30 hp | - | 413 | - | 413 | - | 413 | - | 413 | - | 413 |
| Supply-Exhaust Fan Motor - 40 hp | - | 495 | - | 495 | - | 495 | - | 495 | - | 495 |
| Supply-Exhaust Fan Motor - 50 hp | - | 604 | - | 604 | - | 604 | - | 604 | - | 604 |
| Supply-Exhaust Fan Motor - 60 hp | - | 776 | - | 776 | - | 776 | - | 776 | - | 776 |
| Supply-Exhaust Fan Motor - 75 hp | - | 879 | - | 879 | - | 879 | - | 879 | - | 879 |
| Supply-Exhaust Fan Motor - 100 hp | - | 1102 | - | 1102 | - | 1102 | - | 1102 | - | 1102 |
| **Return/Exhaust Fan Assembly** | | | | | | | | | | |
| Return Fan & Dampers - Low CFM | 36" | 2294 | 36" | 2294 | 36" | 2294 | 36" | 2294 | 36" | 2294 |
| Return Fan & Dampers - Std. CFM | 40" | 2343 | 40" | 2343 | 44" | 2445 | 44" | 2445 | 44" | 2445 |
| Exhaust Fan & Dampers - Low CFM | 25" | 889 | 28" | 979 | 28" | 979 | 28" | 979 | 28" | 979 |
| Exhaust Fan & Dampers - Std. CFM | 28" | 979 | 32" | 1429 | 32" | 1429 | 32" | 1429 | 32" | 1429 |
| Belt Guard | - | 119 | - | 119 | - | 119 | - | 119 | - | 119 |
| Exhaust VFD (50 hp and below) | - | 244 | - | 244 | - | 244 | - | 244 | - | 244 |

**Table 13. Component weights (lbs) (continued)**

| | 90/100 | | 105/118 | | 120/128 | | 130/140 | | 150/162 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Size | Weight | Size | Weight | Size | Weight | Size | Weight | Size | Weight |
| Exhaust VFD (60-100 hp) | - | 295 | - | 295 | - | 295 | - | 295 | - | 295 |
| Exhaust Fan Motor - 7.5 hp | - | 160 | | 160 | - | 160 | - | 160 | - | 160 |
| Exhaust Fan Motor - 10 hp | - | 181 | - | 181 | - | 181 | - | 181 | - | 181 |
| Exhaust Fan Motor - 15 hp | - | 206 | - | 206 | - | 206 | - | 206 | - | 206 |
| Exhaust Fan Motor - 20 hp | - | 206 | - | 206 | - | 206 | - | 206 | - | 206 |
| Exhaust Fan Motor - 25 hp | - | 358 | - | 358 | - | 358 | - | 358 | - | 358 |
| Exhaust Fan Motor - 30 hp | - | 413 | - | 413 | - | 413 | - | 413 | - | 413 |
| Exhaust Fan Motor - 40 hp | - | 495 | - | 495 | - | 495 | - | 495 | - | 495 |
| Exhaust Fan Motor - 50 hp | - | 604 | - | 604 | - | 604 | - | 604 | - | 604 |
| Exhaust Fan Motor - 60 hp | - | 776 | - | 776 | - | 776 | - | 776 | - | 776 |
| **Heat** | | | | | | | | | | |
| Gas Heat Low | 0.85 M | 690 | 0.85M | 690 | 1.1M | 840 | 1.1M | 840 | 1.1M | 840 |
| Gas Heat Medium | 1.1 M | 840 | 1.1M | 840 | 1.8M | 1150 | 1.8M | 1150 | 1.8M | 1150 |
| Gas Heat High | 1.8 M | 1150 | 1.8M | 1150 | 2.5M | 1398[b] | 2.5M | 1398 [2] | 2.5M | 1398 [2] |
| Electric Heat | - | 485 | - | 485 | - | 485 | - | 485 | - | 485 |
| Steam Heat Low | - | 753 | - | 753 | - | 802 | - | 802 | - | 802 |
| Steam Heat High | - | 821 | - | 821 | - | 886 | - | 886 | - | 886 |
| Hot Water Heat Low | - | 773 | - | 773 | - | 841 | - | 841 | - | 841 |
| Hot Water Heat High | - | 818 | - | 818 | - | 897 | - | 897 | - | 897 |
| **Filters** | | | | | | | | | | |
| Filter Rack - Throwaway Filters | - | 181 | - | 181 | - | 191 | - | 191 | - | 191 |
| Filter Rack - Bag Filters | - | 395 | - | 395 | - | 395 | - | 395 | - | 395 |
| Filter Rack - Cartridge Filters | - | 662 | - | 662 | - | 662 | - | 662 | - | 662 |
| Final Filters - Bag Filters | - | 392 | - | 392 | - | 392 | - | 392 | - | 392 |
| Final Filters - Cartridge Filters w/ 2" pre-filter | - | 607 | - | 607 | - | 607 | - | 607 | - | 607 |
| Final Filters - Cartridge Filters w/ 4" pre-filter | - | 638 | - | 638 | - | 638 | - | 638 | - | 638 |
| Final Filters - High Temp. Cartridge | - | 669 | - | 669 | - | 669 | - | 669 | - | 669 |
| Final Filters - HEPA | - | 1777 | - | 1777 | - | 1777 | - | 1777 | - | 1777 |
| Final Filters - HEPA High Temp. | - | 1839 | - | 1839 | - | 1839 | - | 1839 | - | 1839 |
| **Outside Air** | | | | | | | | | | |
| 0-25% Damper | - | 637 | - | 637 | - | 699 | - | 699 | - | 699 |
| Economizer | - | 760 | - | 760 | - | 865 | - | 865 | - | 865 |
| Economizer w/ TRAQ | - | 724 | - | 724 | - | 807 | - | 807 | - | 807 |
| ERW, Low CFM w/ Economizer[c] | - | 3307 | - | 3307 | - | 3518 | - | 3681 | - | 3681 |
| ERW, High CFM w/ Economizer[3] | - | 3545 | - | 3514 | - | 3756 | - | 3756 | - | 3756 |
| ERW, Low CFM w/ Economizer & TRAQ[3] | - | 3487 | - | 3487 | - | 3727 | - | 3890 | - | 3890 |
| ERW, High CFM w/ Economizer & TRAQ[3] | - | 3725 | - | 3694 | - | 3965 | - | 3965 | - | 3965 |

Table 13. Component weights (lbs) (continued)

| | 90/100 | | 105/118 | | 120/128 | | 130/140 | | 150/162 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Size | Weight | Size | Weight | Size | Weight | Size | Weight | Size | Weight |
| **Cabinet** | | | | | | | | | | |
| Cabinet | - | 8097 | - | 8315 | - | 9473 | - | 9473 | - | 9473 |
| Cabinet - 4' Blank Section | - | 935 | - | 935 | - | 901 | - | 901 | - | 901 |
| Cabinet - 8' Blank Section | - | 1709 | - | 1709 | - | 1682 | - | 1682 | - | 1682 |
| **Control Box - Main** | | | | | | | | | | |
| Control Box - Main | - | 519 | - | 519 | - | 519 | - | 519 | - | 519 |
| Convenience Outlet | - | 36 | - | 36 | - | 36 | - | 36 | - | 36 |
| Low Ambient VFD | - | 57 | - | 57 | - | 57 | - | 57 | - | 57 |
| **2/3 Piece Unit Adder** | | | | | | | | | | |
| 2 Piece Adder | - | 406 | - | 406 | - | 406 | - | 406 | - | 406 |
| 3 Piece Adder | - | 1157 | - | 1157 | - | 1236 | - | 1236 | - | 1236 |
| **Air-Cooled Condenser** | | | | | | | | | | |
| Total Weight of Condenser Section | - | 4637 | - | 5201 | - | 6015 | - | 6075 | - | 6092 |

(a) Evaporative Condenser weight includes the additional weight in the cabinet structure. coil weight and additional refrigerant charge. Add 1300 lbs for operating sump base water weight.
(b) 2.5M includes weight associated with 12" of cabinet length.
(c) Energy Recovery includes weight associated w/ 96" of cabinet length.

Table 14. Roof curb weights — air-cooled (AC) and evaporative condensing (EC)

| Tonnage AC/EC | Energy Recovery Wheel | Blank Section | One-Piece Unit[(a)] | Two/Three Piece Unit |
|---|---|---|---|---|
| 90-105/100-118 | No | None | 907 | 1055 |
| 90-105/100-118 | No | 4 ft | 988 | 1136 |
| 90-105/100-118 | No | 8 ft | 1069 | 1217 |
| 90-105/100-118 | Yes | None | 1093 | 1240 |
| 90-105/100-118 | Yes | 4 ft | 1174 | 1321 |
| 90-105/100-118 | Yes | 8 ft | N/A | 1401 |
| 120-150/128-162 (All Units Except High Heat Gas models) | No | None | 1040 | 1194 |
| 120-150/128-162 (All Units Except High Heat Gas models) | No | 4 ft | 1122 | 1275 |
| 120-150/128-162 (All Units Except High Heat Gas models) | No | 8 ft | N/A | 1357 |
| 120-150/128-162 (High Heat Gas Models Only) | No | None | 1055 | 1209 |
| 120-150/128-162 (All Units Except High Heat Gas models) | Yes | None | N/A | 1378 |
| 120-150/128-162 (All Units Except High Heat Gas models) | Yes | 4 ft | N/A | 1459 |
| 120-150/128-162 (All Units Except High Heat Gas models) | Yes | 8 ft | N/A | 1540 |
| 120-150/128-162 (High Heat Gas Models Only) | Yes | None | N/A | 1393 |

(a) One-piece available with air-cooled condenser only.

# Installation

## Roof Curb and Ductwork

The roof curbs for units consist of two main components; a pedestal to support the unit condenser section and a "full perimeter" enclosure to support the unit air handler section.

Before installing any roof curb, verify;

1. That it is the correct curb for the unit,
2. That it includes the necessary gaskets and hardware
3. That the purposed installation location provides the required clearance for proper operation.
4. ensure that the curb is level and square. The top surface of the curb must be true to assure an adequate curb-to-unit seal.

Step-by-step curb assembly and installation instructions ship with each Trane accessory roof curb kit. Follow the instructions carefully to assure proper fit-up when the unit is set into place.

***Note:*** *To assure proper condensate flow during operation, the unit (and curb) must be as level as possible. The maximum slope allowable for rooftop unit applications,* ***excluding Steam Heat Units****, is 4" end-to-end and 2" side-to-side. Units with steam coils must be set level!*

If the unit is elevated, a field constructed catwalk around the unit is strongly recommended to provide easy access for unit maintenance and service. Recommendations for installing the Supply Air and Return Air ductwork joining the roof curb are included in the curb instruction booklet. Curb ductwork must be fabricated and installed by the installing contractor before the unit is set into place.

***Note:*** *For sound consideration, cut only the holes in the roof deck for the ductwork penetrations. Do not cut out the entire roof deck within the curb perimeter.*

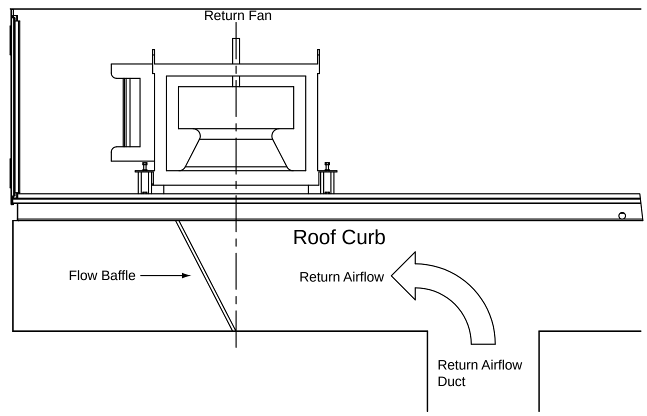
## Pitch Pocket Location

The location of the main supply power entry is located at the bottom right-hand corner of the control panel. Figure 16, p. 46 illustrates the location for the electrical entrance through the base in order to enter the control panel. If the power supply conduit penetrates the building roof beneath this opening, it is recommended that a pitch pocket be installed before the unit is placed onto the roof curb.

The center line dimensions shown in the illustration below indicates the center line of the electrical access hole in the unit base when it is positioned on the curb, ±3/8 inch. The actual diameter of the hole in the roof should be at least 1/2 inch larger than the diameter of the conduit penetrating the roof. This will allow for the clearance variable between the roof curb rail and the unit base rail illustrated in Figure 17, p. 46.

The pitch pocket dimensions listed are recommended to enhance the application of roofing pitch after the unit is set into place. The pitch pocket may need to be shifted as illustrated to prevent interference with the curb pedestal.

**Figure 15. Solid flow baffle wall installation for non-Trane roof curbs**




If a Trane Curb Accessory Kit is not used:

a. The ductwork can be attached directly to the unit bottom, around the unit supply and return air openings. Be sure to use flexible duct connections at the unit.

b. For "built-up" curbs supplied by others, gaskets must be installed around the curb and the supply and return air opening perimeters.

***Notes:***

- *If a "built-up" curb is provided by others, it should NOT be made of wood.*
- *If a "built-up" curb is provided by others, keep in mind that these commercial rooftop units do not have base pans in the condenser section.*
- *If this is a REPLACEMENT UNIT keep in mind that the CURRENT DESIGN commercial rooftop units do not have base pans in the condenser section.*

**Figure 16. Pitch pocket location**

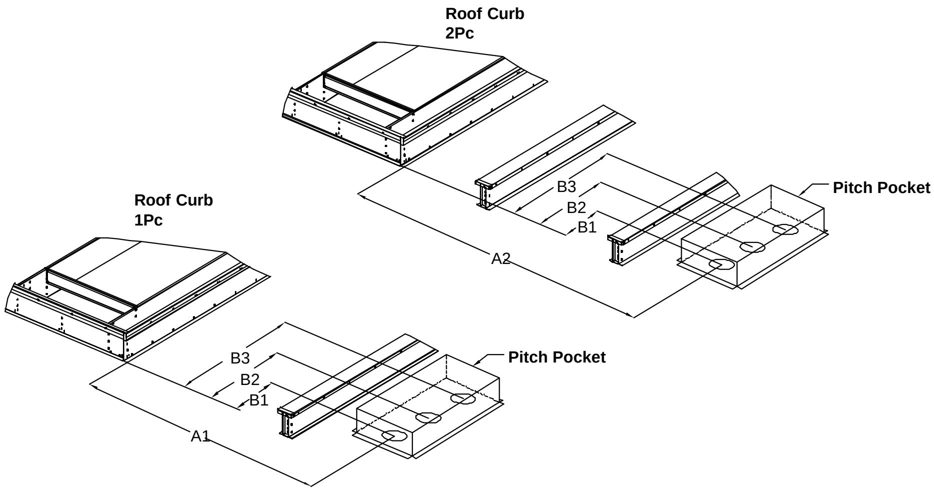
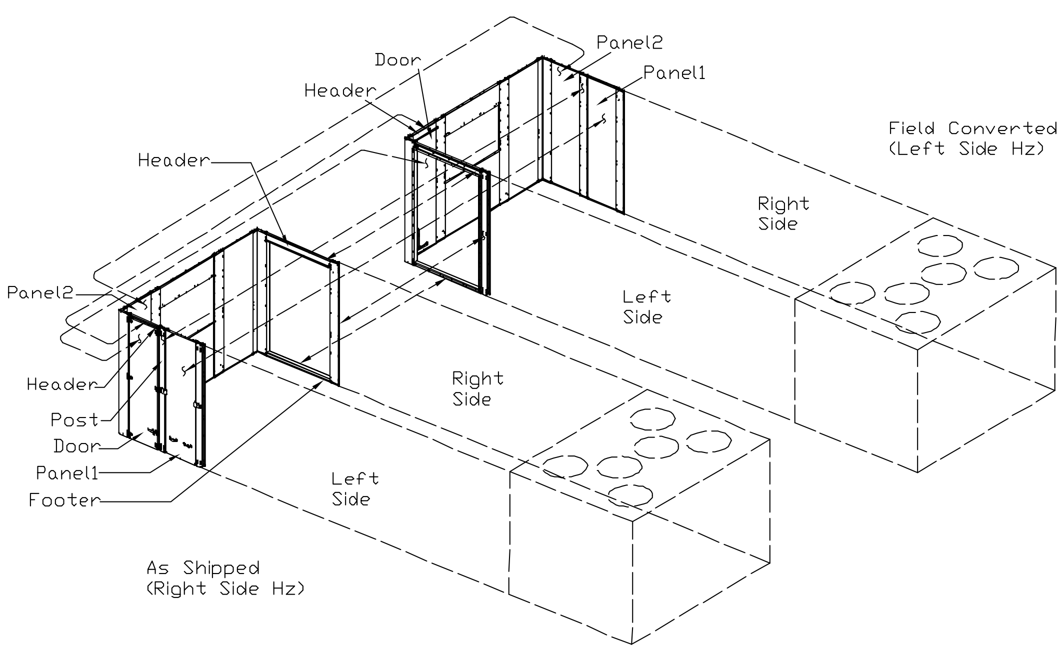



**Table 15. Pitch pocket dimensions (in.)**

| | One-Piece | Two/Three-Piece | One, Two, or Three-Piece | | |
|---|---|---|---|---|---|
| Tonnages | A1 | A2 | B1 | B2 | B3 |
| 90 | 113.8 | 129.9±1 | 68.875 | 73.875 | 78.875 |
| 105 | 131.8 | 147.9±1 | 68.875 | 73.875 | 78.875 |
| 120,130,150 | 140.8 | 156.9±1 | 68.875 | 73.875 | 78.875 |
| 100,118,128,140,162 | N/A | 135.0±1 | 68.875 | 73.875 | 78.875 |

**Figure 17. Ductwork conversion**

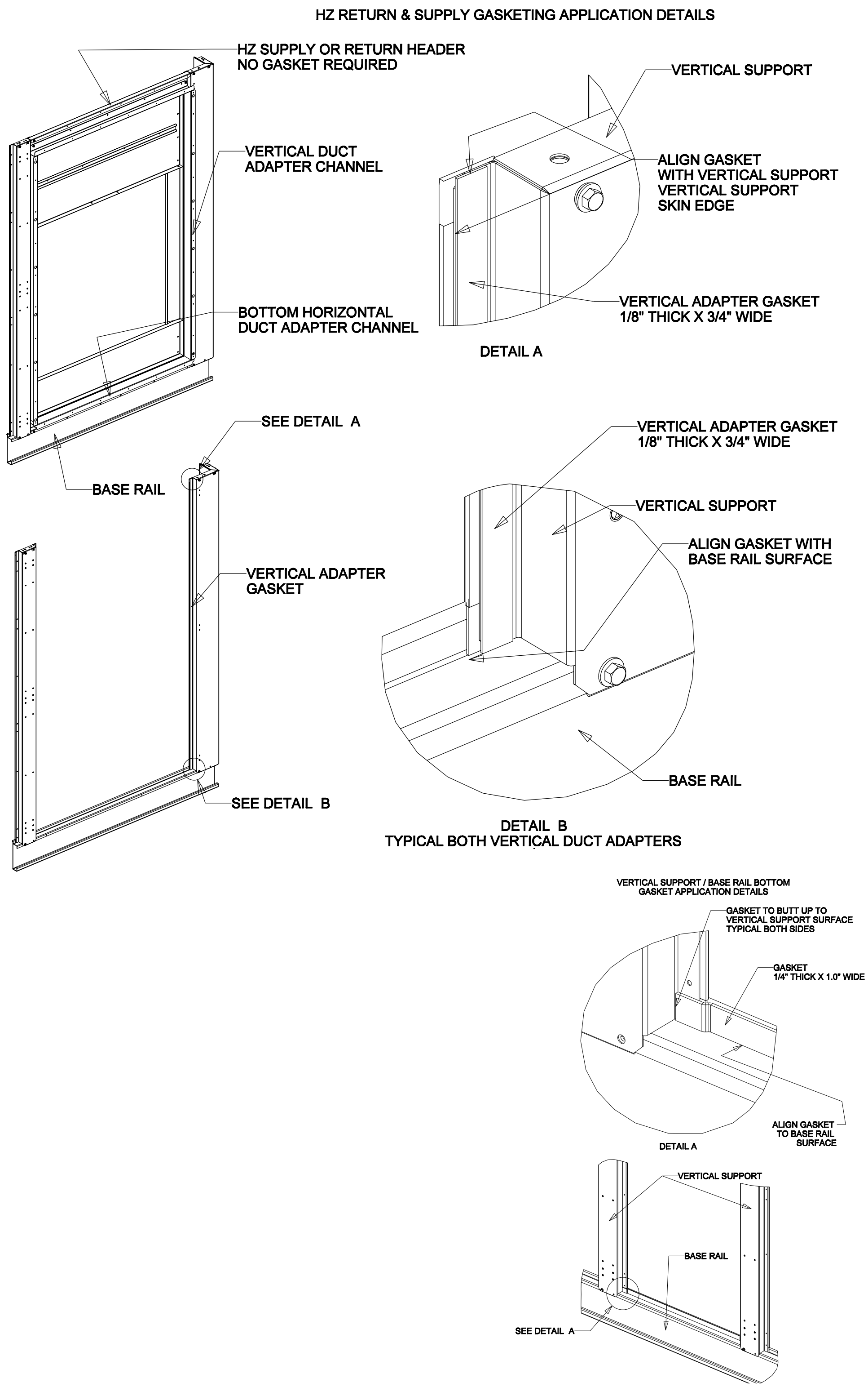


## Field Converting Horizontal Ductwork (Supply or Return) from Right to the Left Side

To field convert horizontal ductwork from right side to the left, follow this procedure:

1. Remove Panel 2 from end of unit
2. Remove the Door and Door header from the left side.
3. Assemble Door header and Door removed from the left side in the empty location on the end wall.
4. Remove Panel 1 and Post from the left side. Remove gaskets from the base rail flange at the bottom.
5. Remove the top duct adapter, side duct adapters, header, and footer in this order from the right side. Remove gaskets from post side flanges and the base rail flange at the bottom.
6. Assemble gaskets, header, footer, side duct adapters, and top duct adapter in this order to the left side. See Figure 17, p. 46 for gasket application details.
7. Finally assemble Post, gaskets, Panel 1, and Panel 2 in this order to the right side to complete the field conversion. See figure 14 for gasket application details.

**Figure 18. Ductwork conversion**



## Unit Rigging and Placement

**⚠WARNING**

**Heavy Objects!**

**Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements could cause equipment or property damage. Failure to follow instructions above or properly lift unit could result in unit dropping and possibly crushing operator/ technician which could result in death or serious injury.**

1. To configure the unit Center-of-Gravity, utilize TOPSS or contact the local Trane sales office.
2. Attach adequate strength lifting slings to all lifting lugs. The figures beginning with Figure 20, p. 49 show the minimum distance between the lifting hook and the top of the unit and illustrate the installation of spreader bars to protect the unit and to facilitate a uniform lift. Table 12, p. 42 lists typical approximate minimal unit operating weights. To determine additional component weight, see Table 13, p. 42
3. Test lift the unit to ensure it is properly rigged and balanced, make any necessary rigging adjustments.
4. Lift the unit and position it over the curb and pedestal. (These units have a continuous base rail around the air handler section which matches the curb.
5. Align the base rail of the unit air handler section with the curb rail while lowering the unit onto the curb. Make sure that the gasket on the curb is not damaged while positioning the unit. (The pedestal simply supports the unit condenser section)

A cross section of the juncture between the unit and the roof curb is shown in Figure 19.

**Figure 19. Curb cross section**

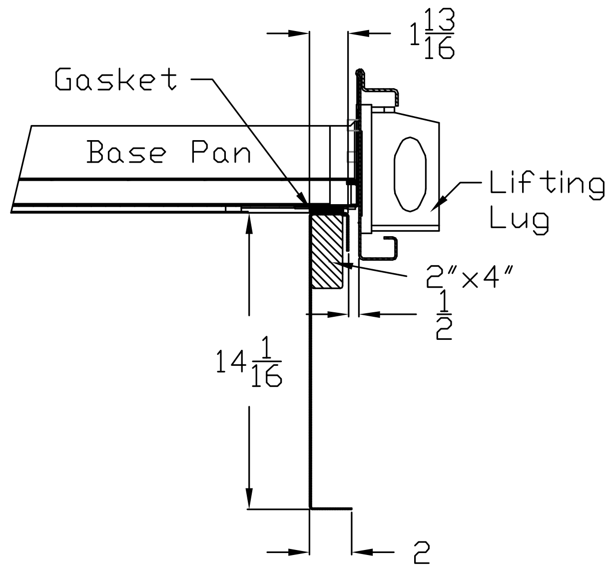



**Figure 20. Typical unit rigging—one-piece unit with three lifting lugs per side[a]**

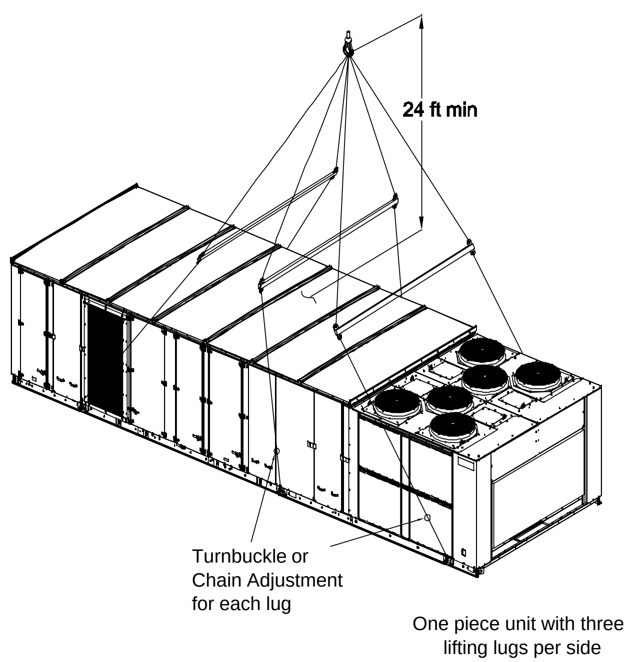


**Figure 21. Typical unit rigging—one piece unit with four lifting lugs per side [(a)]**

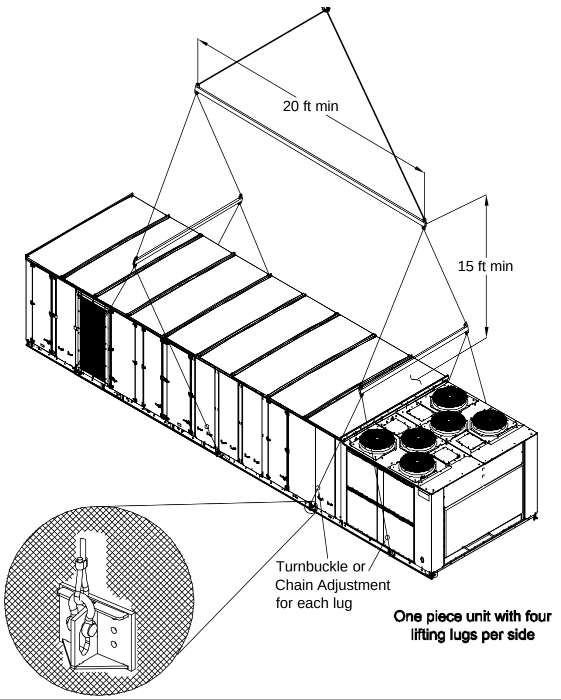



**Figure 22. Typical unit rigging—two-piece unit with two lifting lugs per side[(a)]**

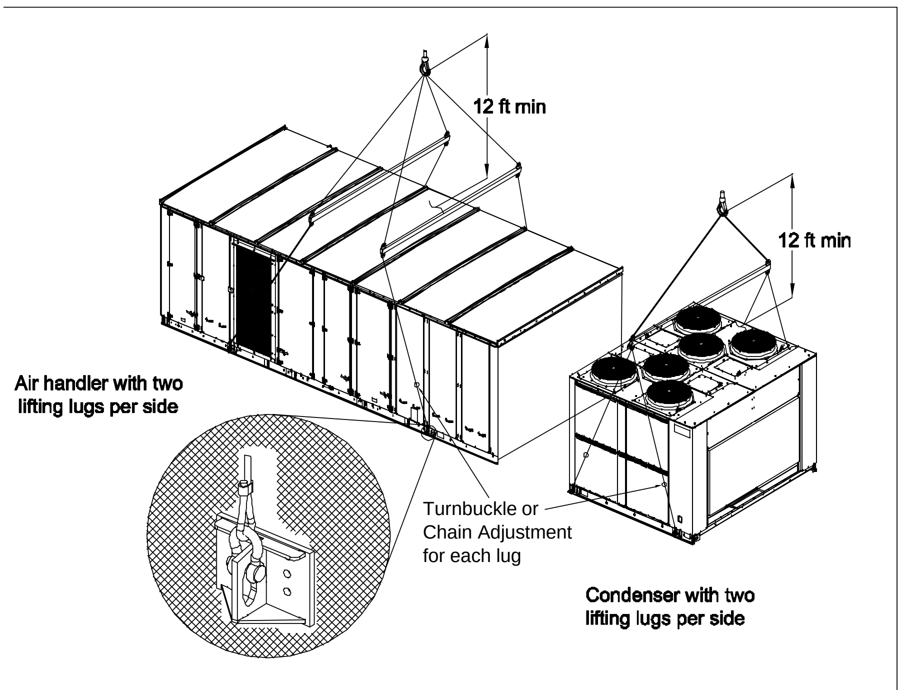
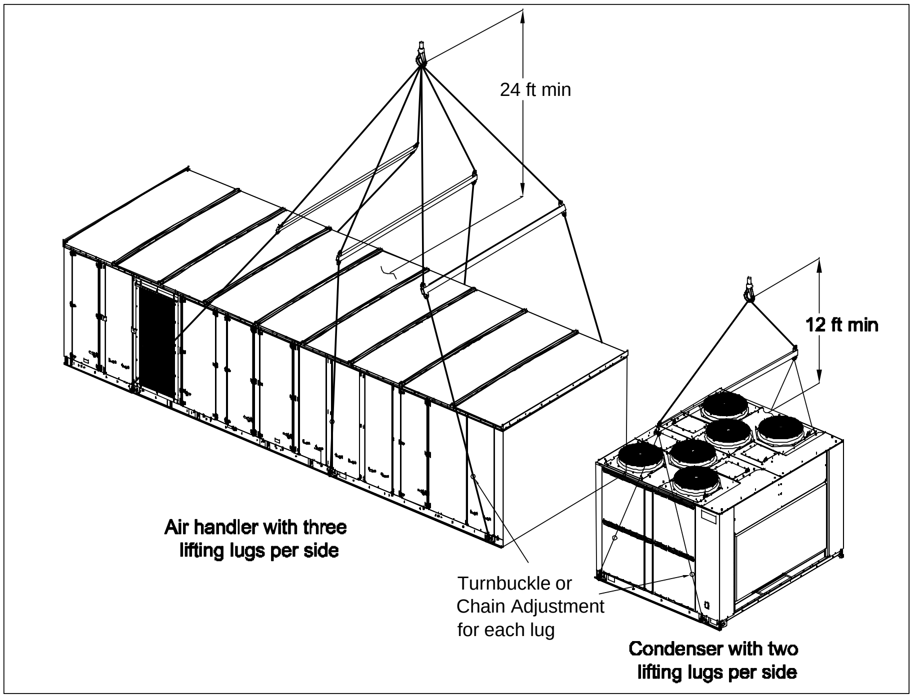
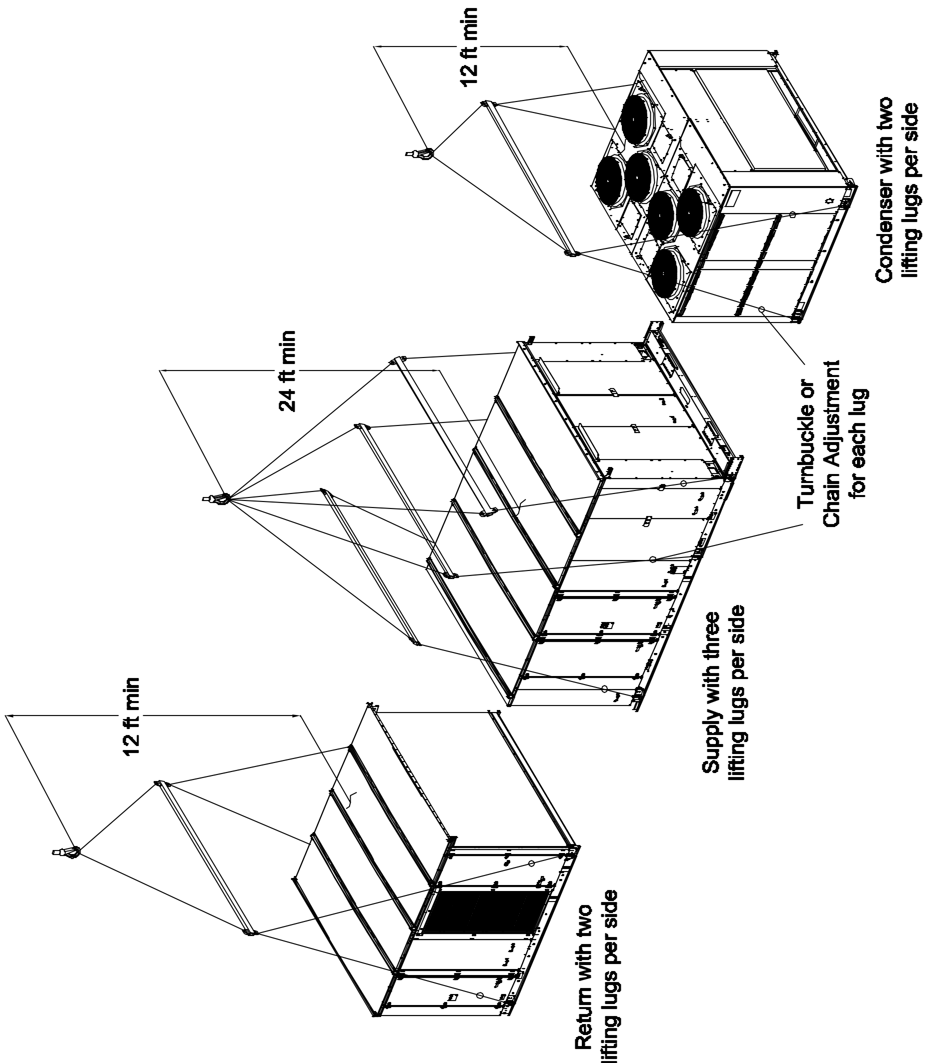


**Figure 23. Typical unit rigging—two-piece unit with three lifting lugs per air handler side(a)**




(a) Turnbuckle or Chain Adjustment required for each lifting point

Figure 24. Typical unit rigging—three-piece unit




## Air-Cooled and Evaporative Condensers—Three-Piece Unit Fit Up

1. Rig and lift outside air section and evaporator section separately.
2. Do not assemble unit on ground and attempt to lift to roof. Unit must be assembled on roof curb.
3. Attach rail guide provided to bottom of the evaporator base rails as shown with screws.
4. Rig and set the evaporator section onto the roof curb (aligned with supply end).
5. Remove and discard shipping protection panels and top block-offs from evaporator section.
6. Remove side panels and roof cap from evaporator section and set aside to be assembled later.
7. Apply gasket to the base channel and butyl tape to the base rail edge of the evaporator section.
8. Remove and discard shipping protection panels and top block off from outside air section.
9. Rig and set outside air section onto roof curb using the rail guides as an alignment aid. Outside air section must be within 2.0" from the evaporator section.
10. Use 0.75" x 24" threaded rod, nuts, washers and backing plate provided to pull and secure sections together. This must be done using the lifting lugs at the unit split as shown.
11. Use 0.375" bolts, nuts and washers provided to pull and secure the roof rails together. This must be done using the brackets on the roof rails as shown.
12. Attach roof splice plate to bottom side of roof panels at the unit split with ¼" sheet metal screws.
13. Add bullwrap to electrical wiring.
14. Connect power and control wiring at the unit split. Place power wiring connectors inside junction box.

15. Apply gasket to side panels removed earlier. Attach side panel to unit split.
16. Apply 1.25" butyl tape on top of unit split along the roof seam.
17. Attach roof cap over roof seam and butyl tape with screws

**Figure 25. Rail guide locations**

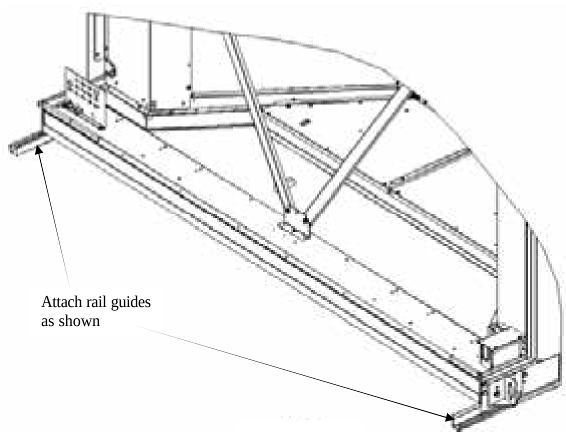



**Figure 26. Evaporator section shipping protection removal**

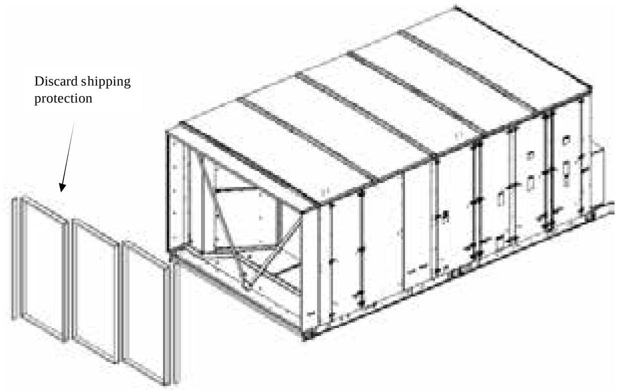



**Figure 27. Evaporator section side panel and roof cap removal**

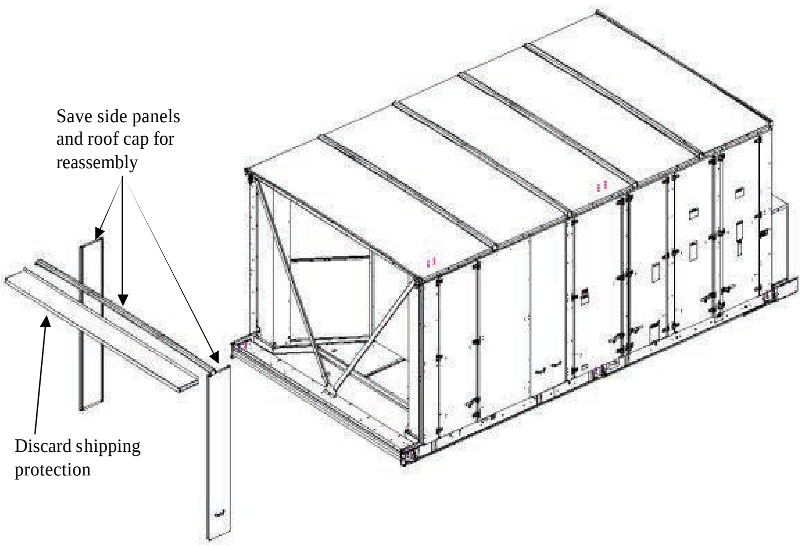


**Figure 28. Evaporator section gasket locations**

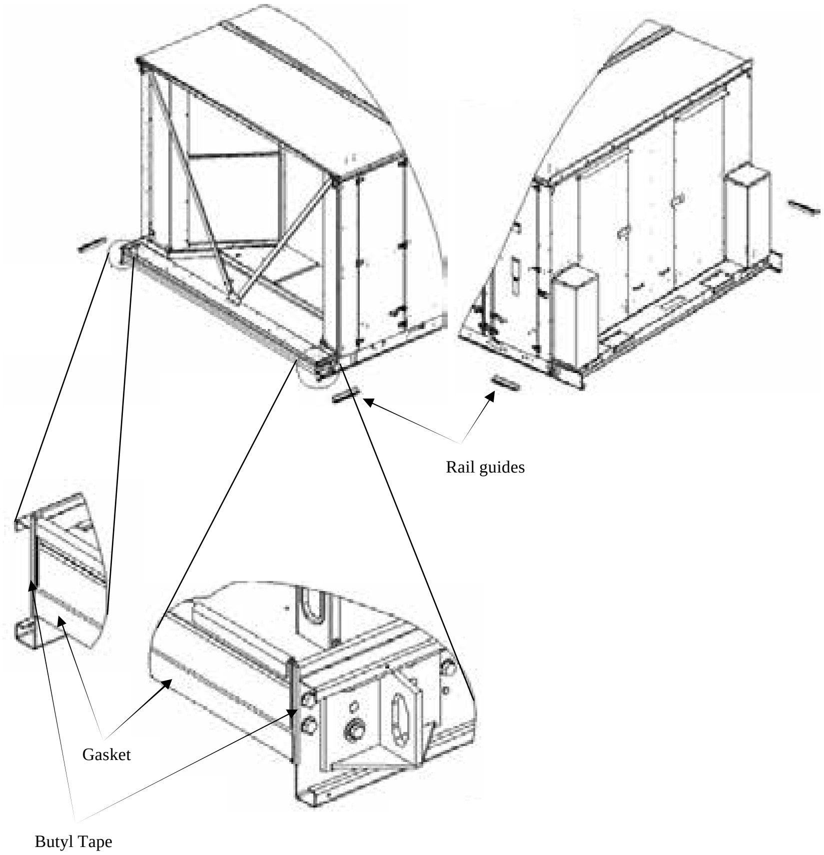



**Figure 29. Outside air section shipping protection removal**

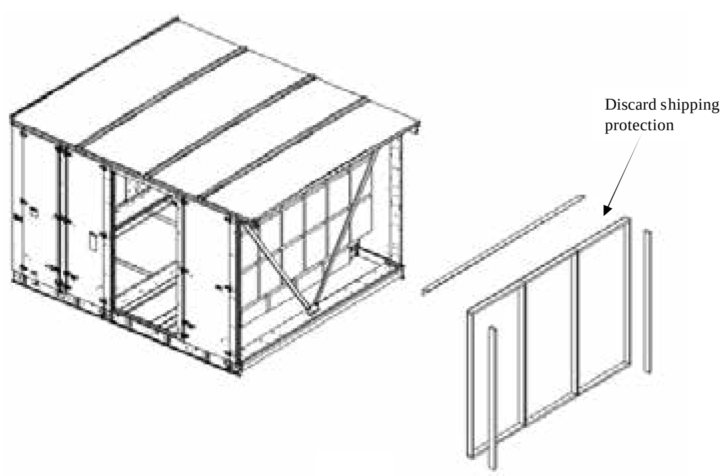


**Figure 30. Base rail connection**

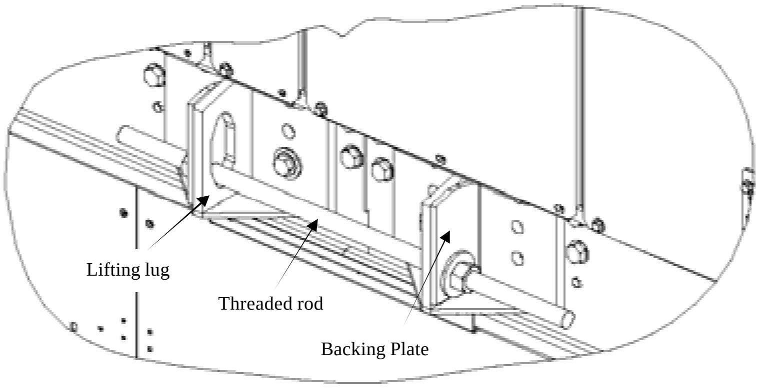



**Figure 31. Roof rail connection**

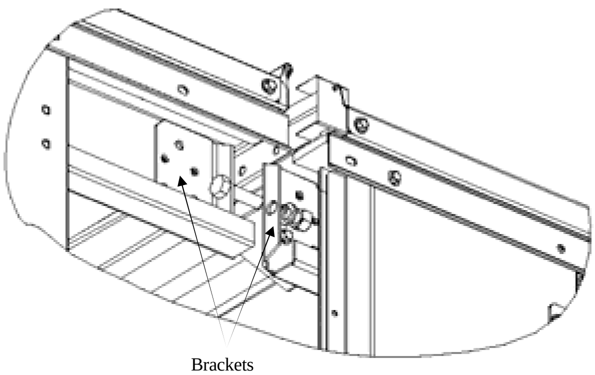


Figure 32. Roof panel splice plate connection

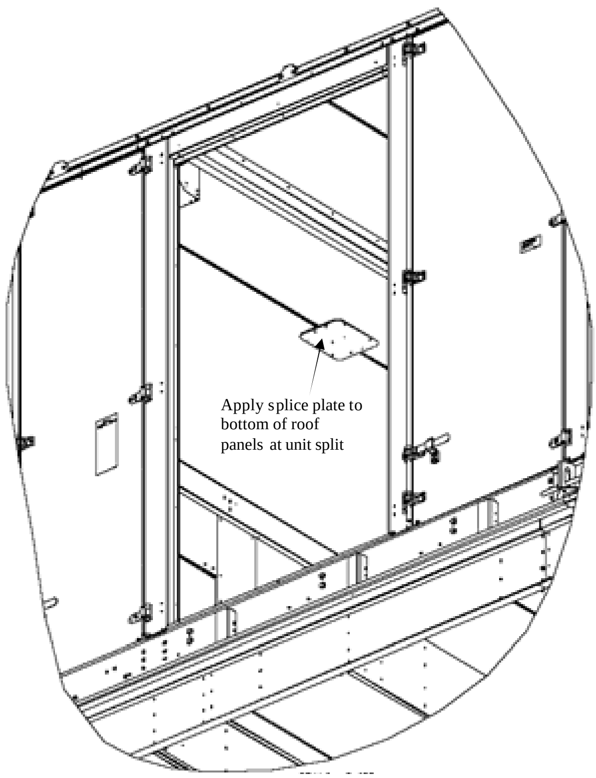
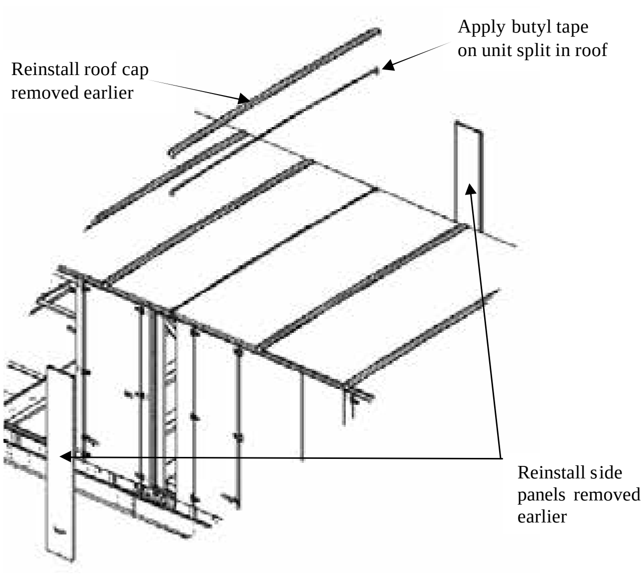



Figure 33. Side panel and roofcap reinstallation




## Air-Cooled and Evaporative Condensers—Two-Piece Unit Fit Up

1. Rig the low side unit (Air handler) and the high side unit (Condenser) separately.
2. First, rig and set the low side unit on the roof curb (aligned with return end).
3. Take off and discard the protection boxes. (Do not remove wire shields).
4. Remove the rail connector splice brackets and install the brackets on the low side unit base rails.
5. Take off the side panels (these are labeled) and the top cover of the high side unit and set aside to be assembled later.
6. Rig and set the high side unit on roof curb pedestal, using the rail splice bracket as an alignment aid to connect the Low and high side units.The Low and high side unit rails should be butted together with a maximum 2" separation.
7. Remove the left upper and lower louvered panels and the corner panels on each side to aid in tubing and wiring connections.

Figure 34. (1) Protection box removal/(2) rail connector installation position

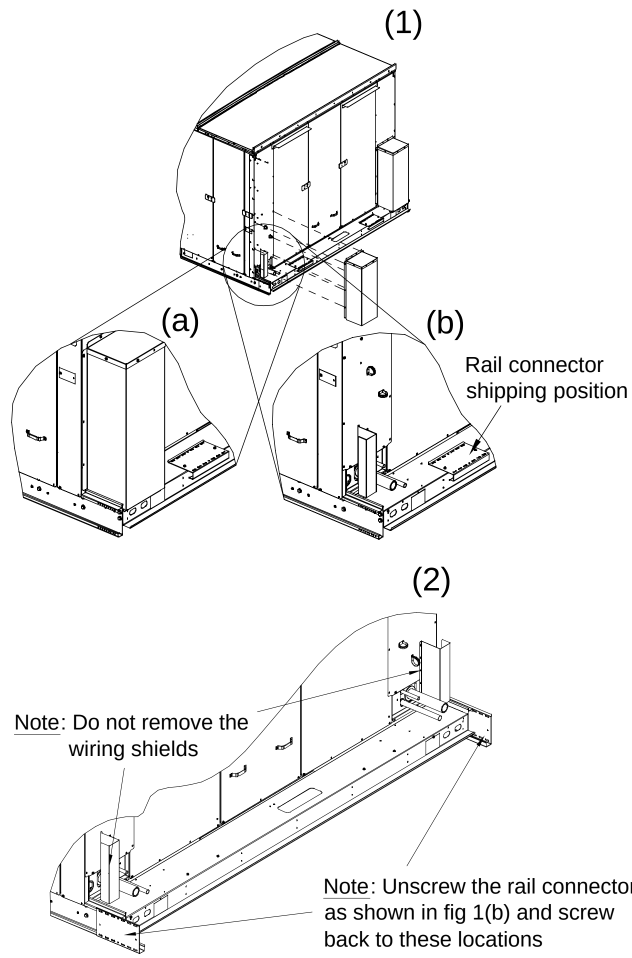
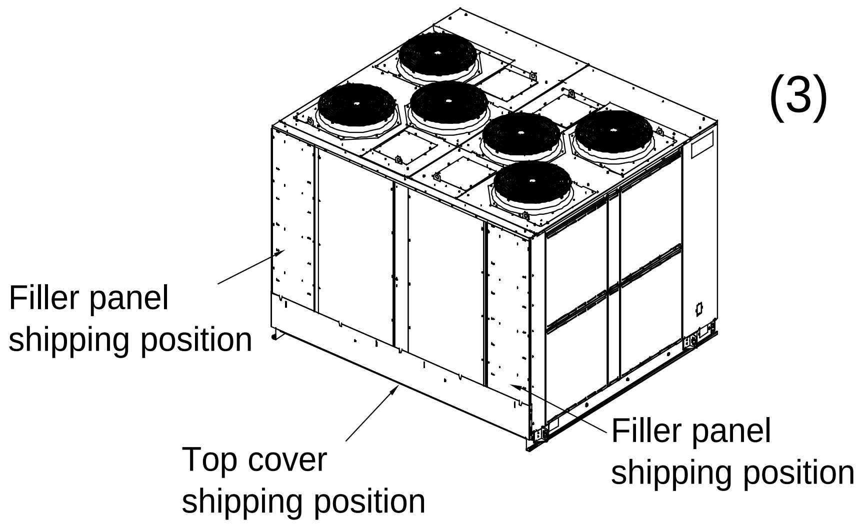


**Figure 35. (3) Side and top filler panel removal/(4) high side installation preparation**




Note: Remove the filler panels and top cover before putting the Indoor and Outdoor sections together and screw to both Indoor and Outdoor panels on each side as shown in fig (6). Finally the top cover is assembled in space.

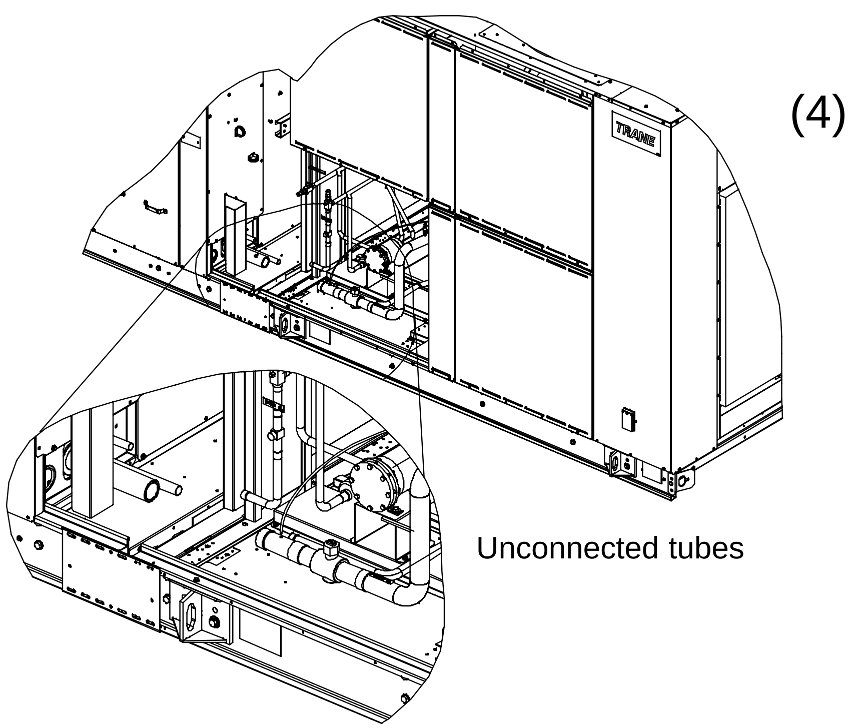


**Figure 36. (5) Connected tubes/(6) install panels**

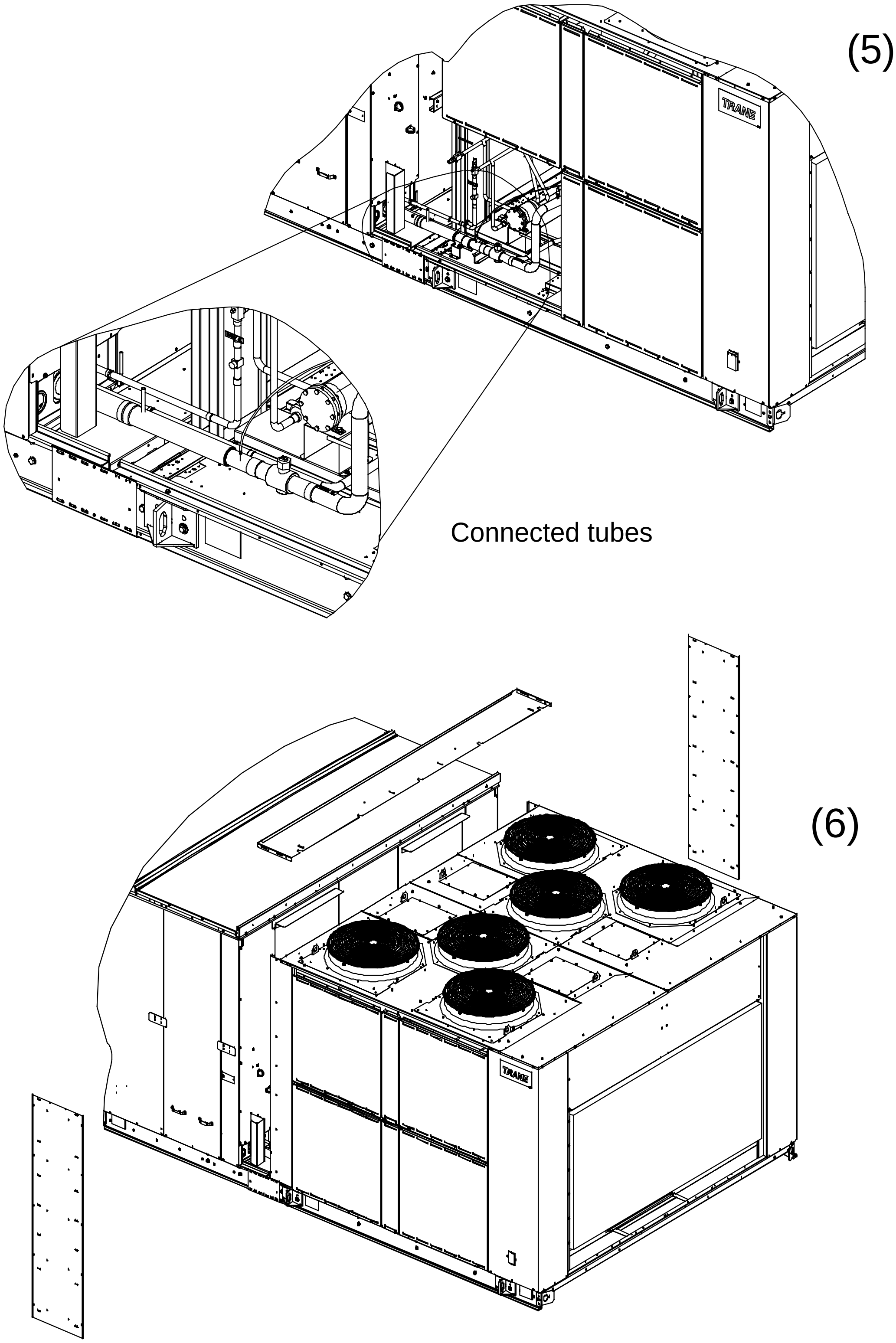
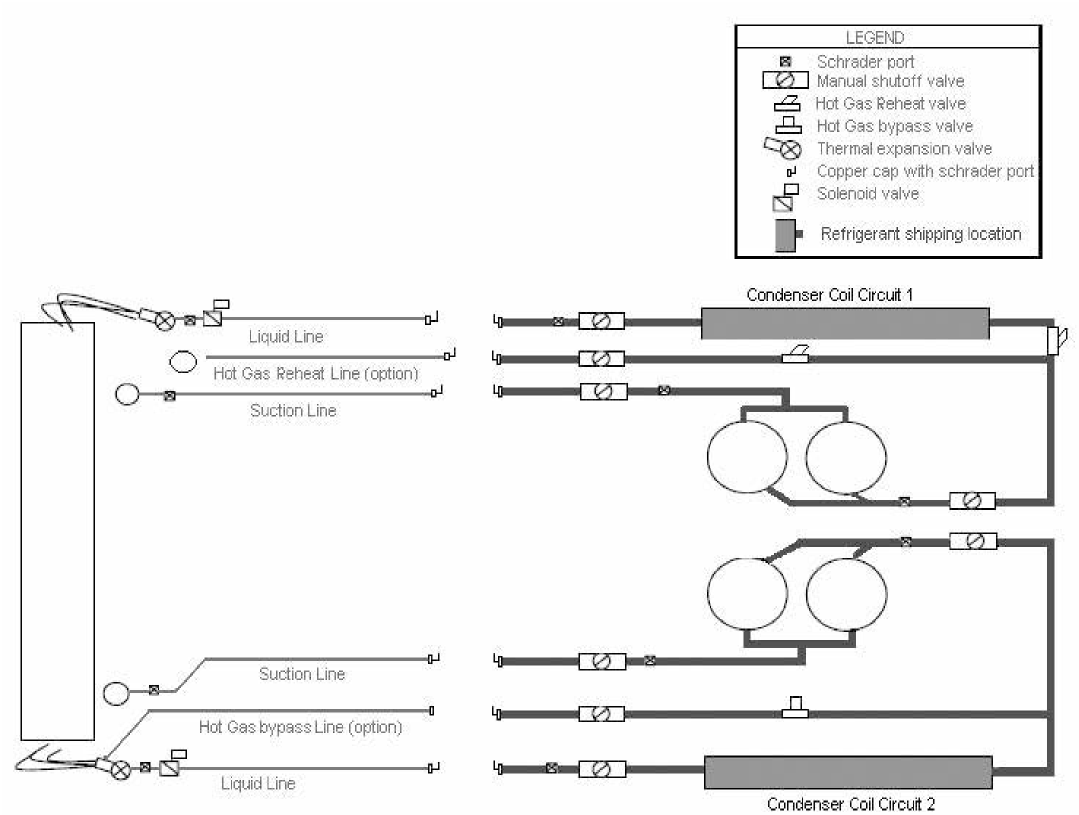


**Figure 37. Charge evacuation diagram - evaporative condensers**




## Complete Tubing and Wiring Connections as follows:

## Air-Cooled Tubing Connection

One piece Air Cooled units are shipped with refrigerant throughout the entire tubing assemblies.

Two and three piece Air-Cooled low side and condenser sections are shipped with a Nitrogen holding charge. All service valves are shipped in an open position. Additional interconnecting tubes (approx. 15-20" in length) will be supplied with the unit.

***Note:*** *Field charging of 2 and 3 piece air-cooled units is REQUIRED.*

To prepare the two or three piece sections for joining install pressure gauges to the appropriate access valve(s) to verify nitrogen charge is present.

1. Relieve the pressure before attempting to unsweat the "seal" caps.
2. Remove the brackets which support the suction tubes (retain for possible use later for unit reassembly) after the tubing connections are complete.
3. Place wet rags on the flow/ ball valve on the high side when suction tubes are being brazed.

***Note:*** *Additional care should be taken when brazing near the wire bundle.*

4. Sweat the copper caps off both the high and low side of the suction and liquid lines of both circuits. If present also sweat off the copper caps from hot gas bypass or hot gas reheat lines.
5. Clean the joints of weld puddles to avoid insertion problems.
6. Cut the appropriate interconnecting tube to a length approximately 0.75"- 1" more than the distance between the two tubes.
7. Insert the appropriate tube to the complete depth of the bell on one side of the joint and align the other side(prying the high side may be needed). Make sure the insertion depth is met.
8. Complete the connections by brazing the tubes in place.

***Note:*** *Refrigeration ball valves are intended for general service and are not a positive shutoff device.*

9. Once all connections have been brazed, evacuate the entire system. The recommended method for evacuation and dehydration is to evacuate the system to 500 microns or less. To establish that the unit is leak-free, use a standing vacuum test. The maximum allowable rise over a 15 minute period is 200 microns.

If the rise exceeds this, there is either still moisture in the system or a leak is present.

10. Charge the system per the unit nameplate field charge.Do not add refrigerant in the suction line at this time to prevent excessive refrigerant in the low side prior to compressor startup.
11. At the liquid line angle valve add as much R-410A LIQUID as possible. Depending on conditions, it could not be possible to add more than 60% of the field charge. This will be adequate for compressor startup.More charge will be added after compressors are started. Use an accurate scale to measure and record the preliminary amount of R-410A added to each circuit.
12. With all the circuit compressors operating, SLOWLY meter R410-A into the suction line from the LIQUID charging connection.

## Evaporative Condenser Tubing Connection

***Important:*** *For units with electric heat, complete tubing connections AFTER completing wiring connections. See “Electric Heat Wiring Connection” on page 61 section.*

***Important:*** *Complete tubing connections BEFORE Power and Control wiring connections. See “Power and Control Wiring Connections” on page 61 section.*

There will be a $N_2$ nitrogen charge in the air handler section. This holding charge should be relieved prior to removing the caps.

The condenser section will ship with R-410A throughout the entire tubing assemblies. The service valves will be shipped in an open position. Additional interconnecting tubes (approx. 15-20" in length) will be supplied with the unit.

1. To prepare the condensing section for the joining of the two sections, the discharge and liquid line service valves should be shut and the refrigerant remaining between the valves and the end caps should be transferred/recovered.
2. If the unit has been purchased with hot gas bypass or hot gas reheat options, those valves should be shut as well and the refrigerant transferred/recovered from the sections between the valves and the end caps.
3. Remove the brackets which support the suction tubes (retain for possible use later for unit reassembly) after the tubing connections are complete.
4. Relieve the pressure (charge) for the section of the tubing being worked on.
5. Place wet rags on the flow/ ball valve on the high side when suction tubes are being brazed.

***Note:*** *Additional care should be taken when brazing near the wire bundle.*

**⚠WARNING**

### Hazard of Explosion and Deadly Gases!

**Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids. Failure to follow all proper safe refrigerant handling practices could result in death or serious injury.**

6. Sweat the copper caps off both the high and low side of the suction and liquid lines of both circuits.
7. Clean the joints of weld puddles to avoid insertion problems.
8. Cut the appropriate interconnecting tube to a length approximately 0.75"- 1" more than the distance between the two tubes.
9. Insert the appropriate tube to the complete depth of the bell on one side of the joint and align the other side (prying the high side may be needed). Make sure the insertion depth is met.
10. Complete the connections by brazing the tubes in place.

***Note:*** *Refrigeration ball valves are intended for general service and are not a positive shutoff device.*

11. Once all connections have been brazed, evacuate the low side. The low side may be evacuated by the schrader ports on the discharge line just past the compressor and the liquid line below the sight glass. See Figure 37, p. 59.

    The recommended method for evacuation and dehydration is to evacuate the low side to 500 microns or less. To establish that the unit is leak-free, use a standing vacuum test. The maximum allowable rise over a 15 minute period is 200 microns. If the rise exceeds this, there is either still moisture in the system or a leak is present.

***Note:*** *Only after evacuation should the tagged valves be opened.*

**⚠WARNING**

**Proper Field Wiring and Grounding Required!**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.**

## Electric Heat Wiring Connection

***Important:*** *For units with electric heat, complete tubing connections AFTER completing wiring connections. See "Tubing Connections" section.*

1. Cut and remove wire ties which hold the electric control wires together, remove the shield bracket. Leave the armaflex on the hole with the control wires.
2. Cut the lowest wire tie which holds the electric heat power wires to the vertical post on the high side.
3. Route the power wires one by one in to the hole on the low side end panel and connect them to the terminal block inside the electric Junction Box or inside the extended casing section.

***Note:*** *For 8' extended casing units, remove the panel (this panel weighs approximately 60 pounds) next to the corner post in the low side to locate the terminal block.*

4. Bundle the electric heat power and control wires with armaflex wrap on the low side end of the unit. Screw the shield bracket to compress the wire bundle and create a good seal. Figure 39, p. 62
5. Route the electric heat control wires to the Junction box located on the high side. Figure 39, p. 62

## Power and Control Wiring Connections

***Note:*** *Complete Power and Control Wiring Connections after the tubing connections are complete.*

1. Discard the clamps and the wire shield which hold the power and control wires.
2. Make the power and the control wire connections and route the wires such that they route straight from the hole at the bottom of the air handler, turn at right angles and straight up through the bottom of the high voltage junction box on the condenser side. Figure 39, p. 62
3. Assemble the louvered panels and the corner panels in the condenser side back in place.
4. Screw the side panels to both the air handler and condenser side panels to act as filler panels.
5. Finally, assemble the top cover back in place.

**Figure 38. Wire routing at low side end wall**

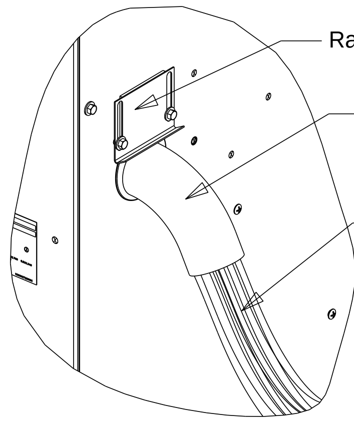
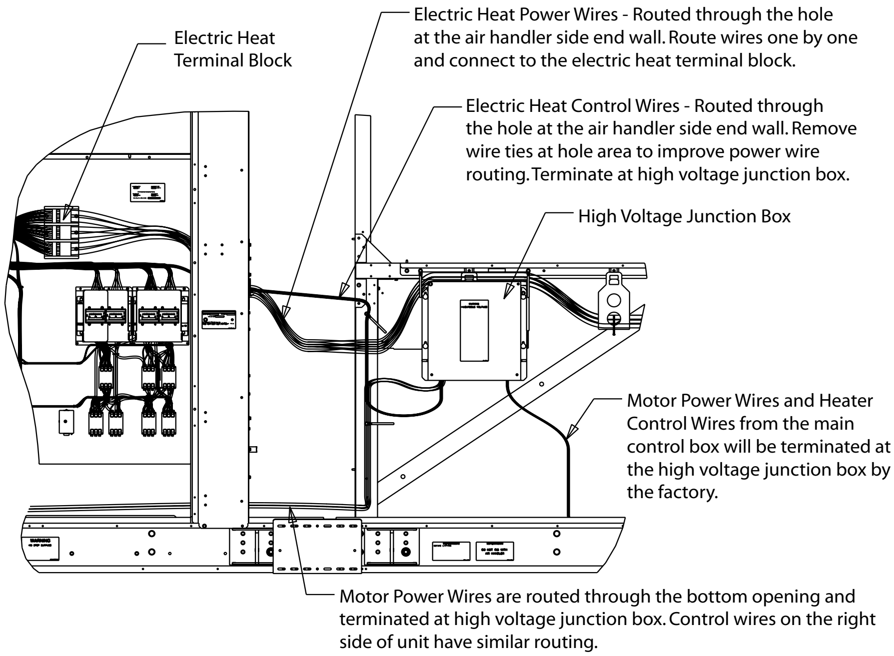


**Figure 39. Wire routing and connections**




## General Unit Requirements

The checklist below is a summary of the steps required to successfully install a Commercial rooftop unit. This checklist is intended to acquaint the installing personnel with what is required in the installation process. It does not replace the detailed instructions called out in the applicable sections of this manual.

[ ] Check the unit for shipping damage and material shortage; file a freight claim and notify Trane office.

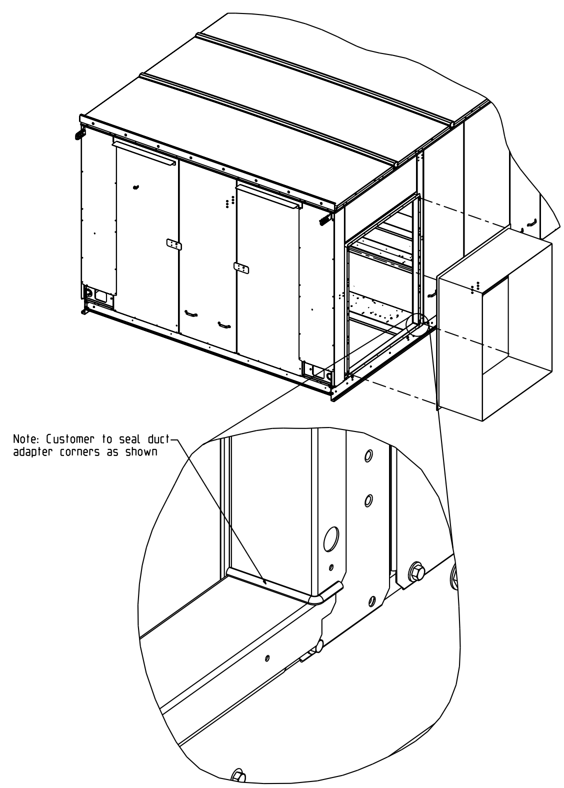
[ ] Verify that the installation location of the unit will provide the required clearance for proper operation.

[ ] Assemble and install the roof curb. Refer to the current edition of the roof curb installer's guide.

[ ] Fabricate and install ductwork; secure ductwork to curb. Seal the corners of duct adapters as shown in Figure 41, p. 64. Ducting attached to the unit should be self supporting. Do not use the unit to support the weight of the ducting

[ ] Install pitch pocket for power supply through building roof. (If applicable)

**Figure 40. Sealed ductwork**



## Rigging the Unit

[ ] Set the unit onto the curb; check for levelness.

[ ] Ensure unit-to-curb seal is tight and without buckles or cracks.

[ ] Install and connect condensate drain lines to each evaporator drain connection.

[ ] Remove the shipping hardware from each compressor assembly.

[ ] Remove the shipping hold-down bolts and shipping channels from the supply and exhaust fans with spring isolators.

[ ] Check all supply and exhaust fan spring isolators for proper adjustment.

[ ] Verify that all plastic coverings are removed from the compressors.

[ ] Verify all discharge and liquid line service valves (one per circuit) are back seated.

## Main Electrical Power Requirements

[ ] Verify that the power supply complies with the unit nameplate specifications.

[ ] Inspect all control panel components; tighten any loose connections.

[ ] Connect properly sized and protected power supply wiring to a field-supplied/installed disconnect and unit

[ ] Properly ground the unit.

All field-installed wiring must comply with NEC and applicable local codes.

## Field Installed Control Wiring

[ ] Complete the field wiring connections for the constant volume controls as applicable. Refer to "Field Installed Control Wiring" for guidelines.

[ ] Complete the field wiring connections for the variable air volume controls as applicable. Refer to "Field Installed Control Wiring" for guidelines.

**Note:** *All field-installed wiring must comply with NEC and applicable local codes.*

## Requirements for Electric Heat Units

[ ] Verify that the power supply complies with the electric heater specifications on the unit and heater nameplate.

[ ] Inspect the heater junction box and control panel; tighten any loose connections.

[ ] Check electric heat circuits for continuity.

## Requirement for Gas Heat

[ ] Gas supply line properly sized and connected to the unit gas train.

[ ] All gas piping joints properly sealed.

[ ] Drip leg Installed in the gas piping near the unit.

[ ] Gas piping leak checked with a soap solution. If piping connections to the unit are complete, do not pressurize piping in excess of 0.50 psig or 14 inches w.c. to prevent component failure.

[ ] Main supply gas pressure adequate.

[ ] Flue Tubes clear of any obstructions.

[ ] Factory-supplied flue assembly installed on the unit.

[ ] Connect the 3/4" CPVC furnace drain stubout to a proper condensate drain. Provide heat tape or insulation for condensate drain as needed.

## Requirements for Hot Water Heat

[ ] Route properly sized water piping through the base of the unit into the heating section.

[ ] Install the factory-supplied, 3-way modulating valve.

[ ] Complete the valve actuator wiring.

## Requirements for Steam Heat

[ ] Route properly sized steam piping through the base of the unit into the heating section.

[ ] Install the factory-supplied, 2-way modulating valve

[ ] Complete the valve actuator wiring.

[ ] Install 1/2", 15-degree swing-check vacuum breaker(s) at the top of each coil section. Vent breaker(s) to the atmosphere or merge with return main at discharge side of steam trap.

[ ] Position the steam trap discharge at least 12" below the outlet connection on the coil.

[ ] Use float and thermostatic traps in the system, as required by the application.

## O/A Pressure Sensor and Tubing Installation

### (All VAV units and all units with Statitrac) Figure 44, p. 66

- O/A pressure sensor mounted to the roof bracket.
- Factory supplied pneumatic tubing installed between the O/A pressure sensor and the connector on the vertical support.
- Field supplied pneumatic tubing connected to the proper fitting on the space pressure transducer located in the filter section, and the other end routed to a suitable sensing location within the controlled space.

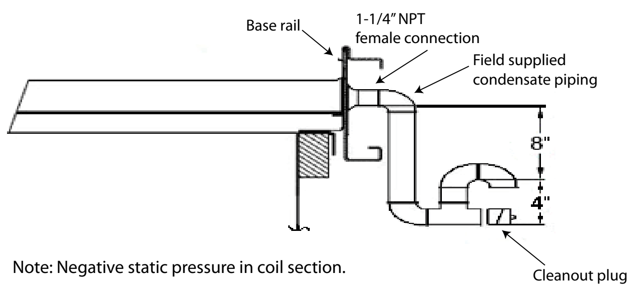
## Condensate Drain Connections

Each unit provides two 1-1/4" evaporator drain connections on each side of the unit.

Due to the size of these units, all condensate drain connections must be connected to the evaporator drain connections. Refer to Detail A in Figure 12, p. 23 for the location of these drain connections.

A condensate trap must be installed due to the drain connection being on the "negative pressure" side of the fan. Install the P-Traps at the unit using the guidelines in Figure 41.

**Figure 41. Condensate trap installation**




Pitch the drain lines at least 1/2 inch for every 10 feet of horizontal run to assure proper condensate flow. Do not allow the horizontal run to sag causing a possible double-trap condition which could result in condensate backup due to "air lock".

## Units with Gas Furnace

Units equipped with a gas furnace have a 3/4" CPVC drain connection stubbed out through the vertical support in the gas heat section. It is extremely important that the condensate be piped to a proper drain. Refer to the appropriate illustration in Figure 49, p. 71 for the location of the drain connection.

***Note:*** *Units equipped with an optional modulating gas furnace will likely operate in a condensing mode part of the time.*

Ensure that all condensate drain line installations comply with applicable building and waste disposal codes.

***Note:*** *Installation on gas heat units will require addition of heat tape to the condensate drain.*

## Removing Compressor Assembly Shipping Hardware

Each manifolded compressor assembly is rigidly bolted to a mounting rail assembly. The rail assembly is set on six (6) rubber isolators. The assembly is held in place by six (6) shipping "Tiedown" bolts. To remove the shipping hardware, follow the procedures below:

1. Remove the bolt in each rubber isolator and the slotted shipping spacer located between the compressor rails and the unit base rail illustrated in Figure 43, p. 65. Reinstall the bolts at the same location by screwing them into the base rail two to three turns only.
2. Ensure that the compressor rail assembly is free to move on the rubber isolator.

## Removing Supply and Exhaust Fan Shipping Channels

Each supply fan assembly and exhaust fan assembly is equipped with spring isolators. Shipping channels are installed beneath each fan assembly and must be removed. To locate and remove these channels, refer to Figure 42, p. 65 and use the following procedures.

## Spring Isolators

Spring isolators for the supply and/or exhaust fan are shipped with the isolator adjusting bolt backed out. Field adjustment is required for proper operation. Figure 42, p. 65 shows isolator locations. To adjust the spring isolators use the following procedure.

1. Remove and discard the shipping tie down bolts but leave the shipping channels in place during the adjustment procedure. See Figure 42, p. 65.
2. Tighten the leveling bolt on each isolator until the fan assembly is approximately 1/4" above each shipping channel.
3. Secure the lock nut on each isolator.
4. Remove the shipping channels and discard.

## Remove Evaporative Condenser Fan Shipping Brackets

### *To remove shipping brackets*

***Important:*** *Remove fan shipping brackets before startup. Failure to remove brackets could result in fan damage.*

Evaporative condensers are shipped with fan shipping brackets to reduce damage caused by vibration during shipment. The fan shipping brackets must be removed prior to unit startup.

To remove the shipping brackets start from the side opposite to the drain actuator
(see Figure 113, p. 162):

1. Loosen the screw for the bracket that holds the inlet louvers below the door side.
2. Remove inlet louvers and set to the side.

***Note:*** *Service technician may need to step on the horizontal surface of FRP coated base. Step with care.*

3. Unscrew the bolt in the middle of the door. Keep the bolt in a safe place.
4. Lift one door with handle until it touches the top. Swivel bottom of door to remove it from the door opening and set it to the side.
5. Slide and remove the middle mist eliminator section so that the shipping bracket is visible.

6. Use screw gun to unscrew the two screws that hold the fan shipping bracket. The bracket should drop down but still remain engaged with a hook on the bracket.
7. Go to the other side of the unit and follow the procedure for inlet louver and door removal (see steps 1 - 6).
8. Hold the bracket with one hand and remove remaining two screws.

**Figure 42. Removing fan assembly shipping hardware**

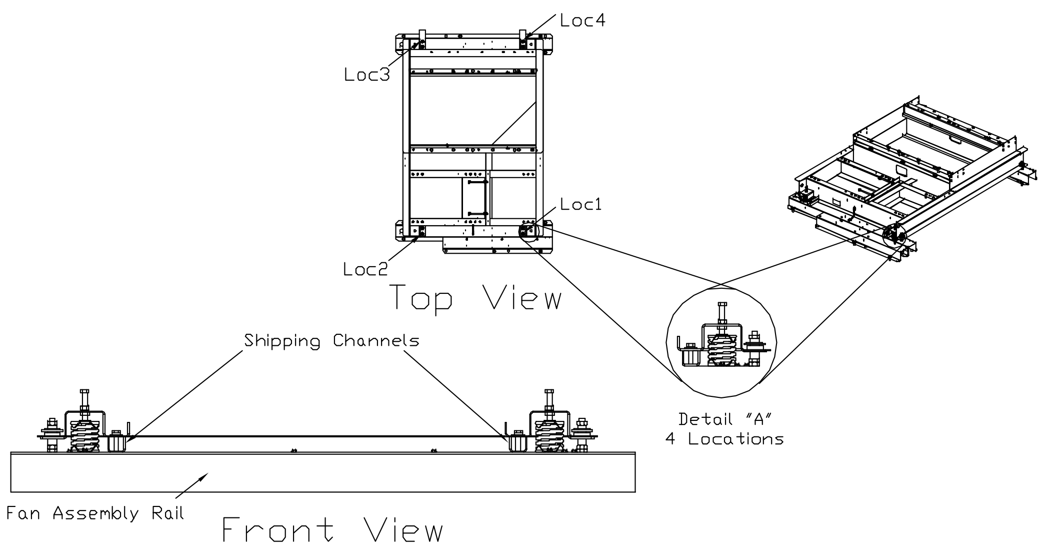
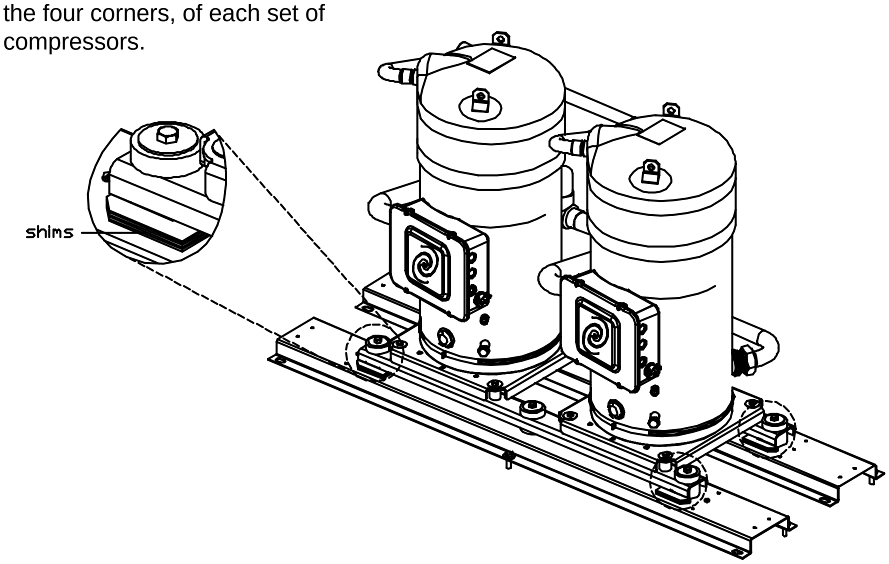



**Figure 43. Removing compressor shipping hardware**

Note:
Shims are located in the center, and on the four corners, of each set of compressors.




9. Remove the bracket and all the removed screws from the unit.

***Important:*** *Make sure there are no screws remaining in the coil area.*

10. Reinstall inlet louvers, mist eliminators and louvers.
11. Check that the direction of arrow on the inlet louver is correct.

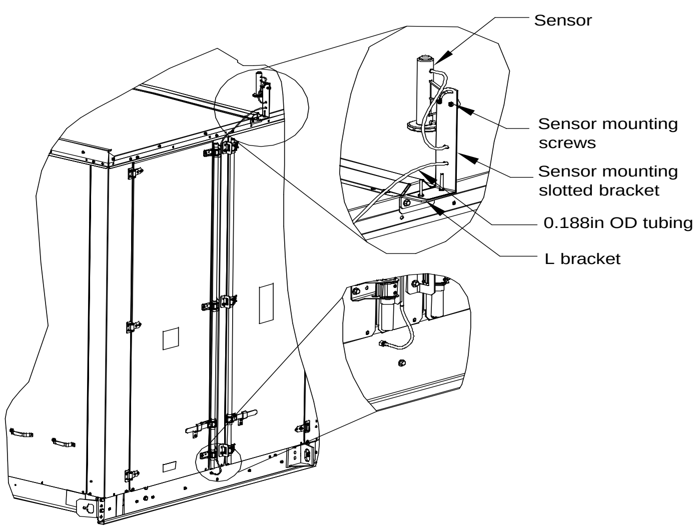
## O/A Sensor and Tubing Installation

An Outside Air Pressure Sensor is shipped with all units designed to operate on variable air volume applications or constant volume units with 100% modulating exhaust w/ Statitrac.

On VAV systems, a duct pressure transducer and the outside air sensor is used to control the discharge duct static pressure to within a customer-specified parameter. On CV & VAV units equipped with 100% modulating exhaust w/Statitrac, a space pressure transducer and the outside air sensor is used to control the exhaust fan and dampers to relieve static pressure, to within a customer-specified parameter, within the controlled space. Refer to Figure 44, p. 66 and the following steps to install the sensor and the pneumatic tubing.

1. Remove the O/A pressure sensor kit located inside the “ship with” item container. The kit contains the following items:
   a. O/A static pressure sensor with slotted mounting bracket
   b. 50 ft. 0.188 in tubing
   c. Mounting hardware
2. Remove the two roof cap screws and install the provided L mounting bracket as shown in the figure.

**Figure 44. Outside air sensing kit**

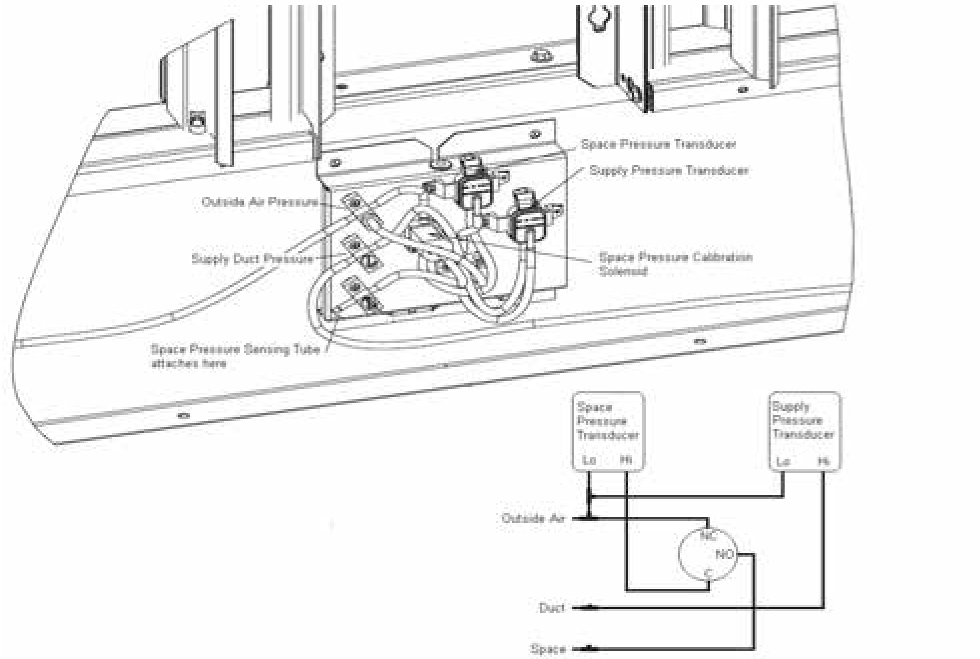



3. Place the sensor mounting slotted bracket to the L mounting bracket with the slot located to the top.
4. Install the sensor vertically to the slotted bracket and secure it with provided bolt and nut.
5. Connect one end of factory provided tubing to the top port of sensor and pass it through the two slots in the mount and the other end to the port in the base.
6. Secure the tubing with the mounting hardware located in the ship with item container.

## Units with Statitrac:

1. Open the filter access door, and locate the Space Pressure and Duct Supply Pressure control devices illustrated in Figure 45, p. 67. There are three tube connectors mounted on the left of the solenoid and transducers. Connect one end of the field provided1/4" (length 50-100 ft.) or 3/8" (length greater than 100 ft.) O.D. pneumatic tubing for the space pressurization control to the bottom fitting.
2. Route the opposite end of the tubing to a suitable location inside the building. This location should be the largest open area that will not be affected by sudden static pressure changes.

**Figure 45. Space pressure and duct supply pressure tubing schematic**




## Evaporative-Cooled Condenser Make-up Water and Drain Line Installation

### Make-up Water and Drain Lines

#### *Water Supply Source*

The supply line should be designed to provide a minimum supply of water within customary domestic supply pressures, 35 to 60 psig; dynamic pressure (measured with the valve open) which will allow approximately 30 GPM to enter the sump through the makeup water valve, when the sump is empty. The unit uses about 2-4 GPM. Attach a hand valve at the inlet for use during inspection and maintenance; an inlet strainer is recommended as well. Make-up water inlet connection is a ¾" PVC slip connector. Care must be taken to ensure the water line upstream of the water solenoid valve will not freeze. Insulating the line and utilizing heat tape is recommended if ambient temperatures below 32° F are expected.

#### *Water Quality*

Overall performance of any water-cooled device can be affected by suspended particulates, mineral concentration, trash and debris resulting in clogging and heat transfer loss. The evaporative-cooled condenser is designed to greatly minimize problems with these impurities.

However, float valves and solenoid valves are used to control the incoming water. If the incoming water contains contaminants, sand or other objects, an incoming line strainer with a 80 to 100 mesh screen is required. The inlet line should be flushed prior to connection to the unit, whether or not there is a strainer.

***Note:*** *Backflow preventer is field installed and should only be installed by qualified personnel .*

Water Drain Schedule 80 PVC pipe of 1¼" is normally adequate for sump water drain. Periodically, the sump is emptied and flushed to eliminate accumulated dirt, debris, and minerals. Concentration of these foreign substances will increase as the system operates.

The evaporative process releases essentially pure water vapor into the atmosphere, leaving the impurities behind that accumulate in the sump. Although these impurities are present in the original make-up water, their concentration will be higher in the sump discharge. Care and judgment should be exercised when selecting a discharge site.

#### *Local Site Discharge*

Rooftop or simple storm sewer discharge is generally acceptable. Do not routinely direct the sump discharge onto an area where these higher concentrations will adversely affect that area, i.e. continued sump discharge into a flower bed for example, where the input water contains $CaCO_3$ (lime) will eventually decrease the pH of the soil.

#### *Sewer Discharge*

The quantities of mineral and debris flushed are actually very small, and do not cause problems when diluted in normal sewer flow. However, local, state or federal standards and restrictions must be followed in any given locality.

### *Make Up Water Solenoid Valve*

This valve is controlled by the UCM based on water level in the sump, as well as whether a call for mechanical cooling exists. During low ambient temperatures, the solenoid valve will be de-energized preventing water from further filling sump. The sump drain valve opens to empty sump of water. Operation can be extended to 10 deg by providing an optional sump heater.

### *Drain Valve*

The drain valve is shipped to "drain during power loss conditions". If "hold during power loss conditions" is desired, refer to "Evaporative Condenser Drain Valve Setup" on page 98

## Gas Heat Units

All internal gas piping is factory-installed and pressure leak-tested before shipment. Once the unit is set into place, the gas supply line must be field-connected to the elbow located inside the gas heat control compartments.

**⚠WARNING**

**Hazardous Gases and Flammable Vapors!**

**Exposure to hazardous gases from fuel substances have been shown to cause cancer, birth defects or other reproductive harm. Improper installation, adjustment, alteration, service or use of this product could cause flammable mixtures and result in a fire. To avoid hazardous gases and flammable vapors follow proper installation and set up of this product and all warnings as provided in this manual. Failure to follow all instructions could result in death or serious injury.**

**When using dry nitrogen cylinders for pressurizing units for leak testing, always provide a pressure regulator on the cylinder to prevent excessively high unit pressures. Never pressurize unit above the maximum recommended unit test pressure as specified in applicable unit literature. Failure to properly regulate pressure could result in a violent explosion, which could result in death or serious injury or equipment or property-only-damage.**

Access holes are provided on the unit as illustrated in Figure 49, p. 71 to accommodate a side or bottom pipe entry. Following the guidelines listed below will enhance both the installation and operation of the furnace.

**Note:** *In the absence of local codes, the installation must conform with the American National Standard Z223-1a of the National Fuel Gas Code, (latest edition).*

3. To assure sufficient gas pressure at the unit, use Table 16, p. 69 as a guide to determine the appropriate gas pipe size for the unit heating capacity listed on the unit nameplate.
4. If a gas line already exists, verify that it is sized large enough to handle the additional furnace capacity before connecting to it.
5. Take all branch piping from any main gas line from the top at 90 degrees or at 45 degrees to prevent moisture from being drawn in with the gas.
6. Ensure that all piping connections are adequately coated with joint sealant and properly tightened. Use a piping compound that is resistant to liquid petroleum gases.
7. Provide a drip leg near the unit.
8. Install a pressure regulator at the unit that is adequate to maintain 7" w.c. for natural gas while the furnace is operating at full capacity.

**Note:** *Gas pressure in excess of 14" w.c. or 0.5 psig will damage the gas train.*

Failure to use a pressure regulating device will result in incorrect gas pressure. This can cause erratic operation due to gas pressure fluctuations as well as damage the gas valve. Over sizing the regulator will cause irregular pulsating flame patterns, burner rumble, potential flame outages, and possible gas valve damage.

If a single pressure regulator serves more than one rooftop unit, it must be sized to ensure that the inlet gas pressure does not fall below 7" w.c. with all the furnaces operating at full capacity. The gas pressure must not exceed 14" w.c. when the furnaces are off.

9. Provide adequate support for all field installed gas piping to avoid stressing the gas train and controls.
10. Leak test the gas supply line using a soap-and-water solution or equivalent before connecting it to the gas train.
11. Check the supply pressure before connecting it to the unit to prevent possible gas valve damage and the unsafe operating conditions that will result.

**Note:** *Do not rely on the gas train shutoff valves to isolate the unit while conducting gas pressure/leak test. These valves are not designed to withstand pressures in excess of 14" w.c. or 0.5 psig.*

### Connecting the Gas Supply Line to the Furnace Gas Train

Follow the steps below to complete the installation between the supply gas line and the furnace. Refer to Figure 46, p. 69, Figure 47, p. 70 for the appropriate gas train configuration.

1. Connect the supply gas piping using a "ground-joint" type union to the furnace gas train and check for leaks.
2. Adjust the inlet supply pressure to the recommended 7" to 14" w.c. parameter for natural gas
3. Ensure that the piping is adequately supported to avoid gas train stress.
4. If the through the base gas opening is used, seal off around the pipe and the 3" water dam. If the through the base gas opening is not used, the 3" opening should be sealed shut to prevent indoor air leakage.

**Table 16. Sizing natural gas pipe mains and branches**

| Gas Supply Pipe Run (ft) | Gas Input (Cubic Feet/Hour)* | | | | | |
|---|---|---|---|---|---|---|
| | 1¼" Pipe | 1½" Pipe | 2" Pipe | 2½" Pipe | 3" Pipe | 4" Pipe |
| 10 | 1050 | 1600 | 3050 | 4800 | 8500 | 17500 |
| 20 | 730 | 1100 | 2100 | 3300 | 5900 | 12000 |
| 30 | 590 | 890 | 1650 | 2700 | 4700 | 9700 |
| 40 | 500 | 760 | 1450 | 2300 | 4100 | 8300 |
| 50 | 440 | 670 | 1270 | 2000 | 3600 | 7400 |
| 60 | 400 | 610 | 1150 | 1850 | 3250 | 6800 |
| 70 | 370 | 560 | 1050 | 1700 | 3000 | 6200 |
| 80 | 350 | 530 | 990 | 1600 | 2800 | 5800 |
| 90 | 320 | 490 | 930 | 1500 | 2600 | 5400 |
| 100 | 305 | 460 | 870 | 1400 | 2500 | 5100 |
| 125 | 275 | 410 | 780 | 1250 | 2200 | 4500 |
| 150 | 250 | 380 | 710 | 1130 | 2000 | 4100 |
| 175 | 225 | 350 | 650 | 1050 | 1850 | 3800 |
| 200 | 210 | 320 | 610 | 980 | 1700 | 3500 |

**Notes:**

1. *Table is based on a specific gravity of 0.60. Use Table 17, p. 69 for the specific gravity of the local gas supply.
2. If more than one unit is served by the same main gas supply, consider the total gas input (cubic feet/hr.) and the total length when determining the appropriate gas pipe size.
3. Obtain the Specific Gravity and BTU/Cu.Ft. from the gas company.
4. The following example demonstrates the considerations necessary when determining the actual pipe size:
   Example: A 40' pipe run is needed to connect a unit with a 850 MBH furnace to a natural gas supply having a rating of 1,000 BTU/Cu.Ft. and a specific gravity of 0.60
   Cu.Ft/Hour = Furnace MBH Input / Gas BTU/Cu.Ft. X Multiplier Table 17, p. 69
   Cu.Ft/Hour = 850

Table 16, p. 69 indicates that a 2" pipe is required.

**Table 17. Specific gravity multipliers**

| Specific Gravity | Multiplier |
|---|---|
| 0.50 | 1.10 |
| 0.55 | 1.04 |
| 0.60 | 1.00 |
| 0.65 | 0.96 |

**Table 18. Gas heating capacity altitude correction factors**

| | Altitude (Ft.) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sea Level To 2000 | 2001 to 2500 | 2501 to 3500 | 3501 to 4500 | 4501 to 5500 | 5501 to 6500 | 6501 to 7500 |
| **Capacity Multiplier** | 1.00 | .92 | .88 | .84 | .80 | .76 | .72 |

**Note:** Correction factors are per AGA Std. 221.30 - 1964, Part VI, 6.12. Local codes may supersede.

**Figure 46. Two-stage natural gas train for 850, 1100 Mbh heaters**

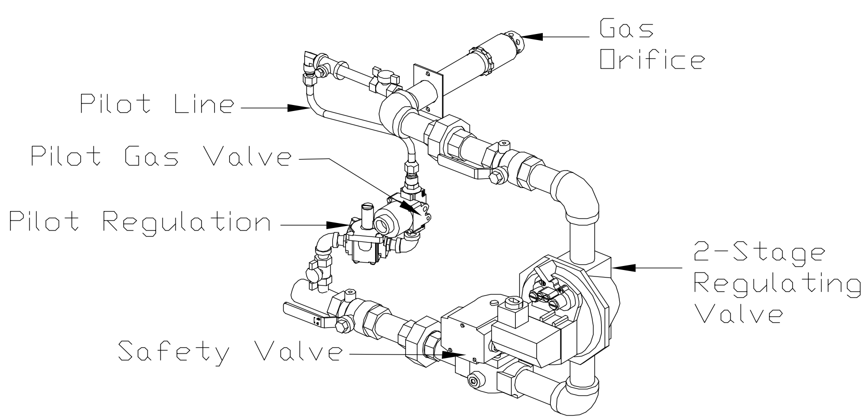
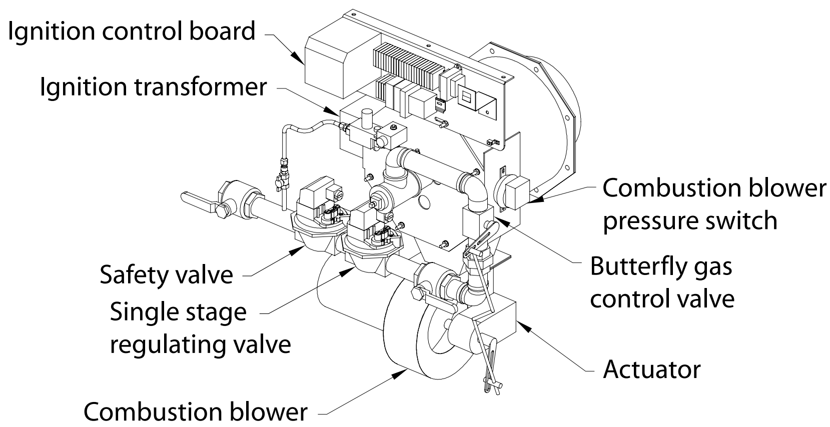


**Figure 47. Modulating (850-2500 Mbh heaters) and two-stage (1800-2500 Mbh heaters) natural gas train**




**Gas heat inlet sizes**

| Standard Gas Heat Input (MBh) | Gas Heat Inlet Sizes (in.) |
|---|---|
| 850 | 1 |
| 1100 | 1 1/4 |
| 1800 | 1 1/2 |
| 2500 | 1 1/2 |

## Flue Assembly Installation

1. Locate the collapsed flue assembly in the compartment above the gas heat controls by removing the panel screws. The assembly is secured by screws up through the roof of the gas controls compartment roof.
2. Separate the pieces of the collapsed assembly.
3. Then assemble the stack as shown in Figure 48.
4. Insert the tube on the flue assembly into the hole located in the vertical support for the heat section.
5. Butt both tube sections together and center the pipe clamp over joint.
6. Using the pre-punch hole in the flue assembly, extension, and the vertical support, install the appropriate number of mounting brackets (Refer to the installation instructions that ship with the flue assembly.)

**Figure 48. Flue assembly**

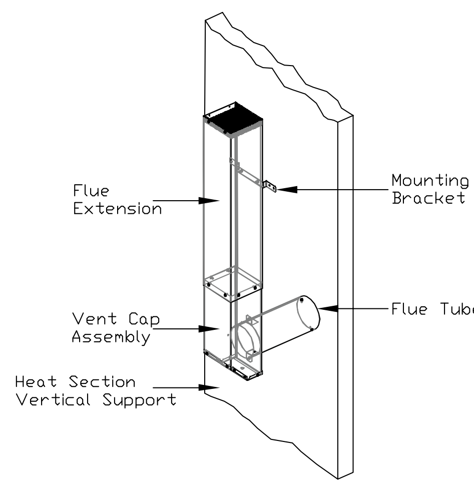


**Figure 49. Gas heat piping penetration locations**

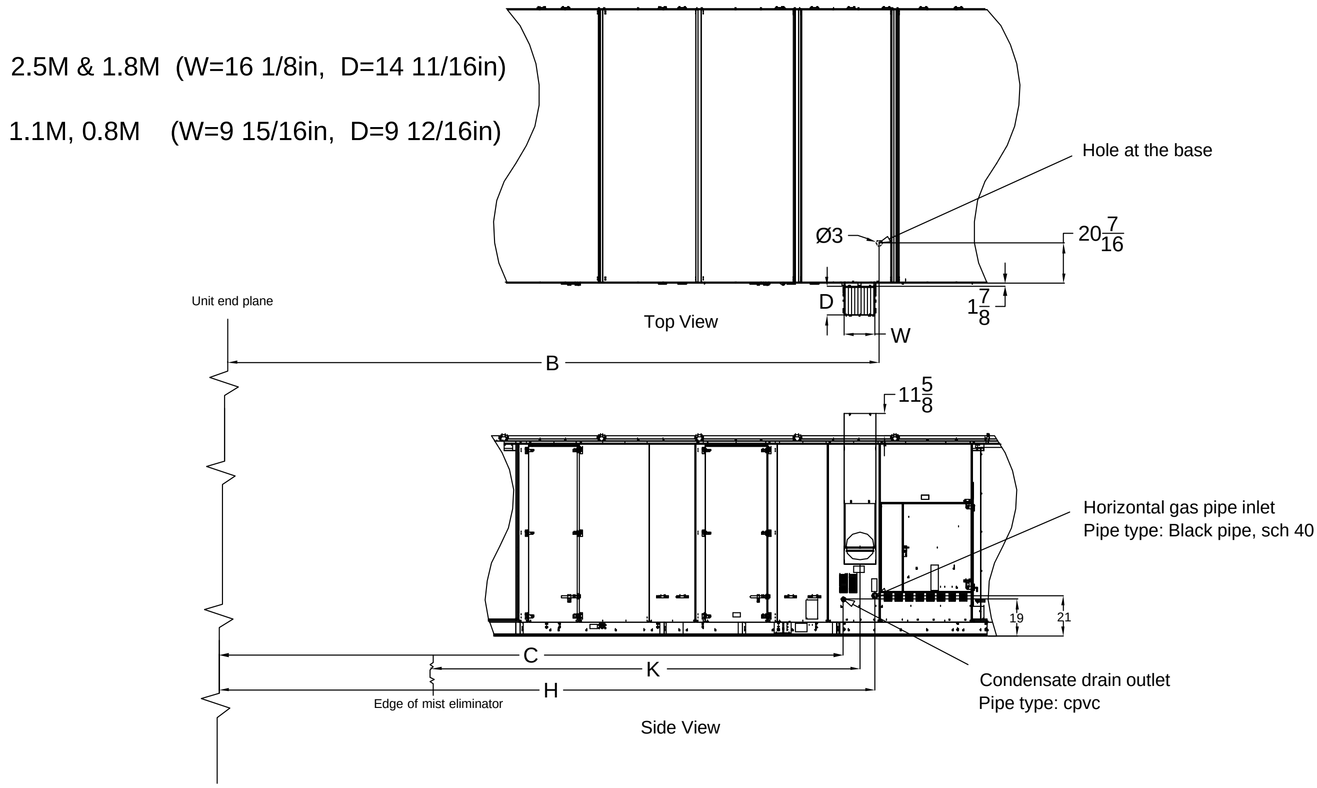


**Table 19. Gas heat piping penetration measurements**

| Tons | Energy Recovery Wheel (ERW) | Pieces | Heat (MBH) | Gas Flue | Condensate Drain Outlet | Gas Connection, Horizontal | Gas Connection, Base |
|---|---|---|---|---|---|---|---|
| | | | | Horizontal Distance | | | |
| | | | | Mist Elim to Flue C/L | Unit End to Hole C/L | Unit End to Hole C/L | |
| | | | | K | C | H | B |
| 90-118 | No ERW | 1 & 2 Pc | 1800 | 160 1/16 | 254 14/16 | 266 4/16 | 274 11/16 |
| 90-118 | No ERW | 1 & 2 Pc | 1100 | 159 15/16 | 263 15/16 | 265 5/16 | 274 11/16 |
| 90-118 | No ERW | 1 & 2 Pc | 850 | 159 15/16 | 263 15/16 | 265 5/16 | 274 11/16 |
| 120-162 | No ERW | 1 & 2 Pc | 2500 | 214 11/16 | 321 | 337 7/16 | 339 7/16 |
| 120-162 | No ERW | 1 & 2 Pc | 1800 | 214 13/16 | 319 11/16 | 331 | 339 7/16 |
| 120-162 | No ERW | 1 & 2 Pc | 1100 | 214 11/16 | 327 14/16 | 330 1/16 | 339 7/16 |
| 90-118 | ERW | 1 & 2 Pc | 1800 | 164 11/16 | 351 5/16 | 362 10/16 | 371 1/16 |
| 90-118 | ERW | 1 & 2 Pc | 1100 | 164 8/16 | 360 6/16 | 361 12/16 | 371 1/16 |
| 90-118 | ERW | 1 & 2 Pc | 850 | 164 8/16 | 360 6/16 | 361 12/16 | 371 1/16 |
| 120-162 | ERW | 1 & 2 Pc | 2500 | 219 13/16 | 417 7/16 | 433 14/16 | 435 14/16 |
| 120-162 | ERW | 1 & 2 Pc | 1800 | 220 | 416 2/16 | 427 7/16 | 435 14/16 |
| 120-162 | ERW | 1 & 2 Pc | 1100 | 219 13/16 | 424 5/16 | 426 8/16 | 435 14/16 |
| 90-118 | No ERW | 3 Pc | 1800 | 179 6/16 | 274 3/16 | 285 8/16 | 293 15/16 |
| 90-118 | No ERW | 3 Pc | 1100 | 179 3/16 | 283 3/16 | 284 9/16 | 293 15/16 |
| 90-118 | No ERW | 3 Pc | 850 | 179 3/16 | 283 3/16 | 284 9/16 | 293 15/16 |
| 120-162 | No ERW | 3 Pc | 2500 | 240 2/16 | 346 8/16 | 362 15/16 | 364 15/16 |
| 120-162 | No ERW | 3 Pc | 1800 | 240 5/16 | 345 3/16 | 356 8/16 | 364 15/16 |
| 120-162 | No ERW | 3 Pc | 1100 | 240 2/16 | 353 6/16 | 355 9/16 | 364 15/16 |
| 90-118 | ERW | 3 Pc | 1800 | 183 15/16 | 376 13/16 | 388 2/16 | 390 6/16 |
| 90-118 | ERW | 3 Pc | 1100 | 183 13/16 | 385 13/16 | 387 3/16 | 390 6/16 |
| 90-118 | ERW | 3 Pc | 850 | 183 13/16 | 385 13/16 | 387 3/16 | 390 6/16 |
| 120-162 | ERW | 3 Pc | 2500 | 245 5/16 | 442 15/16 | 459 6/16 | 461 6/16 |
| 120-162 | ERW | 3 Pc | 1800 | 245 8/16 | 441 9/16 | 452 15/16 | 461 6/16 |
| 120-162 | ERW | 3 Pc | 1100 | 245 5/16 | 449 12/16 | 452 | 461 6/16 |

## General Coil Piping and Connection Recommendations

Proper installation, piping, and trapping is necessary to ensure satisfactory coil operation and to prevent operational damage:

- Support all piping independently of the coils.
- Provide swing joints or flexible fittings on all connections that are adjacent to heating coils to absorb thermal expansion and contraction strains.
- Install factory supplied control valves (valves ship separately).

***Note:*** *The contractor is responsible for supplying the installation hardware.*

**⚠CAUTION**

**Connection Leaks!**

**Use a backup wrench when attaching piping to coils with copper headers to prevent damage to the coil header. Do not use brass connectors because they distort easily and could cause connection leaks.**

- When attaching the piping to the coil header, make the connection only tight enough to prevent leaks. Maximum recommended torque is 200 foot-pounds.

**⚠CAUTION**

**Over Tightening!**

**Do not use teflon-based products for any field connections because their high lubricity could allow connections to be over-tightened, resulting in damage to the coil header.**

- Use pipe sealer on all thread connections.

**⚠CAUTION**

**Leakage!**

**Properly seal all penetrations in unit casing. Failure to seal penetrations from inner panel to outer panel could result in unconditioned air entering the module, and water infiltrating the insulation, resulting in equipment damage.**

- After completing the piping connections, seal around pipe from inner panel to outer panel.

### Hot Water Heat Units

Hot water heating coils are factory installed inside the heater section of the unit. Once the unit is set into place, the hot water piping and the factory provided three way modulating valve must be installed. The valve can be installed inside the heat section or near the unit. If the valve is installed in a remote location, use field supplied wiring to extend the control wires from the heater section to the valve. Two access holes are provided in the unit base as illustrated in Figure 50, p. 74.

Following the guidelines listed below will enhance both the installation and operation of the "wet heat" system.

Figure 51, p. 75 illustrates the recommended piping configuration for the hot water coil. Table 20 on page 74 lists the coil connection sizes.

***Note:*** *The valve actuators are not waterproof. Failure to protect the valve from moisture may result in the loss of heating control.*

1. Support all field-installed piping independently from the heating coil.
2. Use swing joints or flexible connectors adjacent to the heating coil. (These devices will absorb the strains of expansion and contraction).
3. All return lines and fittings must be equal to the diameter of the "outlet" connection on the hot water coil.
4. Install a "Gate" type valve in the supply branch line as close as possible to the hot water main and upstream of any other device or takeoff.
5. Install a "Gate" type valve in the return branch line as close as possible to the return main and down stream of any other device.
6. Install a strainer in the hot water supply branch as shown in Figure 51, p. 75.
7. Install the 3-way valve in an upright position, piped for valve seating against the flow. Ensure that the valve location lends itself to serviceability.
8. The Type "W" hot water coil is self-venting only when the tube water velocity exceeds 1.5 feet per second (fps). If the tube velocity is less than 1.5 feet per second, either:
   a. install an automatic air vent at the top of the return header, using the tapped pipe connection

   or,

   b. vent the coil from the top of the return header down to the return piping. At the vent connection, size the return piping to provide sufficient water velocity.
9. Install a "Globe" type valve in the Bypass line as shown in Figure 51 on page 75.

### Steam Heat Units

Steam heating coils are factory installed inside the heater section of the unit. The coils are pitched, within the units, to provide the proper condensate flow from the coil. To maintain the designed degree of pitch for the coil, the unit must be level.

Once the unit is set into place, the steam piping and the factory provided two way modulating valve must be installed. The valve can be installed inside the heater section or near the unit. If the valve is installed in a remote location, use field supplied wiring to extend the control wires from the heater section to the valve. Two access holes are provided in the unit base as illustrated in Figure 50, p. 74.

Following the guidelines listed below will enhance both the installation and operation of the "wet heat" system. Figure 52, p. 75 illustrates the recommended piping configurations for the steam coil. Table 20, p. 74 lists the coil connection sizes.

***Note:*** *The valve actuators are not waterproof. Failure to protect the valve from moisture may result in the loss of heating control.*

1. Support all field-installed piping independently from the heating coil.
2. Use swing joints or flexible connectors adjacent to the heating coil. (These devices will absorb the strains of expansion and contraction.)
3. Install the 2-way valve in an upright position. Ensure that the valve's location lends itself to serviceability.
4. Pitch the supply and return steam piping downward 1" per 10' of run in the direction of flow.
5. All return lines and fittings must be equal to the diameter of the "outlet" connection on the steam coil(s). If the steam trap connection is smaller that the coil "outlet" diameter, reduce the pipe size between the strainer and the steam trap connections only.
6. Install a 1/2" 15 degree swing-check vacuum breaker at the top of the return coil header using the tapped pipe connection. Position the vacuum breaker as close to the coil as possible.

***Note:*** *Vacuum breakers should have extended lines from the vent ports to the atmosphere or connect each vent line to the return pipe on the discharge side of the steam traps.*

7. Install a "Gate" type valve in the supply branch line as close as possible to the steam main and upstream of any other device.
8. Install a "Gate" type valve in the return branch line as close as possible to the condensate return main and downstream of any other device.
9. Install a strainer as close as possible to the inlet of the control valve and steam trap(s).
10. Steam trap selection should be based on the maximum possible condensate flow and the recommended load factors.
11. Install a Float-and-Thermostatic (FT) type trap to maintain proper flow. They provide gravity drains and continuous discharge operation. FT type traps are required if the system includes either;
    a. an atmospheric pressure/gravity condensate return;

    or,

    b. a potentially low pressure steam supply.
12. Position the outlet or discharge port of the steam trap at least 12" below the outlet connection on the coil(s). This will provide adequate hydrostatic head pressure to overcome the trap losses and assure complete condensate removal.

    The two steam coils are stacked together and must be piped in a parallel arrangement. The steps listed below should be used in addition to the previous steps. Figure 52, p. 75 illustrates the recommended piping configuration for the steam coils.
13. Install a strainer in each return line before the steam trap.
14. Trap each steam coil separately as described in steps 10 and 11 to prevent condensate backup in one or both coils.
15. In order to prevent condensate backup in the piping header supplying both coil sections, a drain must be installed utilizing a strainer and a steam trap as illustrated in Figure 52, p. 75.

**Figure 50. Hot water and steam heat connection location**

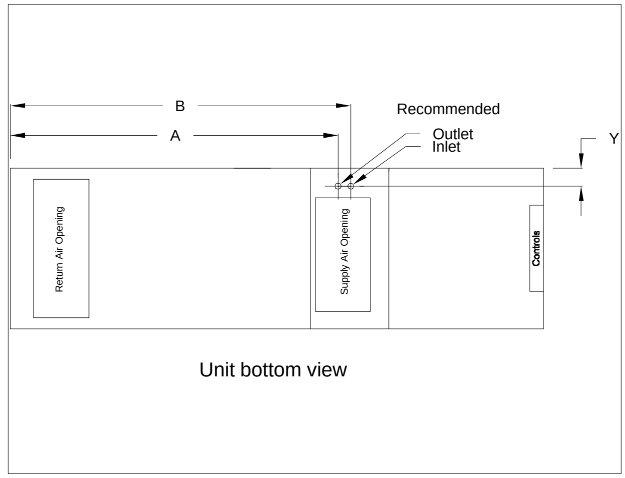



**Table 20. Hot water and steam coil connection sizes**

| | Hot Water Coil | | | Steam Coil | | |
|---|---|---|---|---|---|---|
| Unit Size | Supply | Return | Drain / Vent | Supply | Return | Vent |
| 90-162 Ton | 2 ½ | 2 ½ | ½ | 3.0 | 1 ¼ | 1 ¼ |

**Notes:**
1. Type W coils, with center offset headers, are used in Hot Water units; Type NS coils are used in Steam units.
2. Hot water and Steam units have multiple headers.
3. All sizes are in inches.
4. All connection threads are internal.

**Table 21. Hot water and steam heat connection dimensions**

| Tons | A | B | Y | Diameter |
|---|---|---|---|---|
| 90-118 | 276 9/16 | 290 5/16 | 18 | 5 |
| 120-162 | 341 5/16 | 355 1/16 | 18 | 5 |

Figure 51. Hot water coil piping

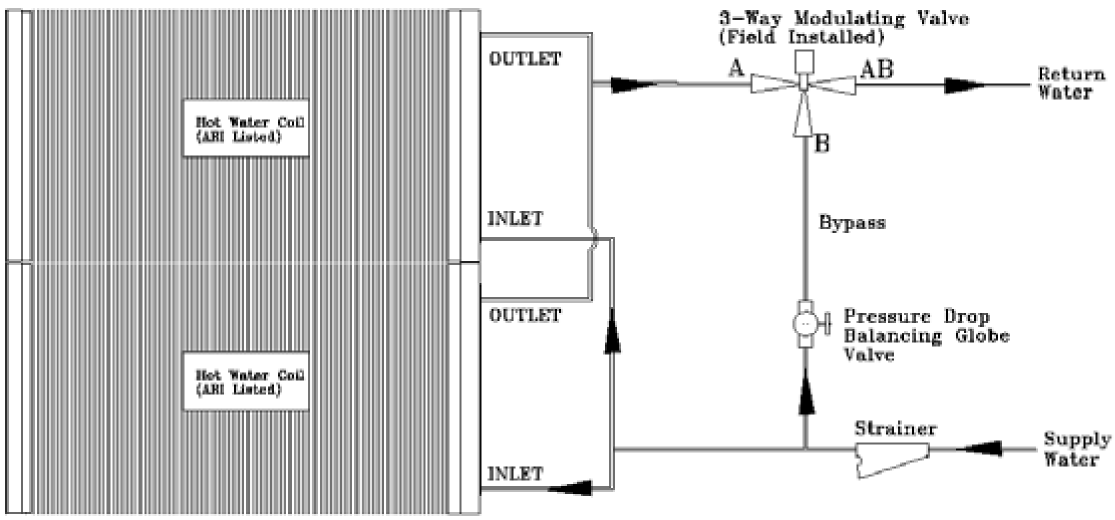
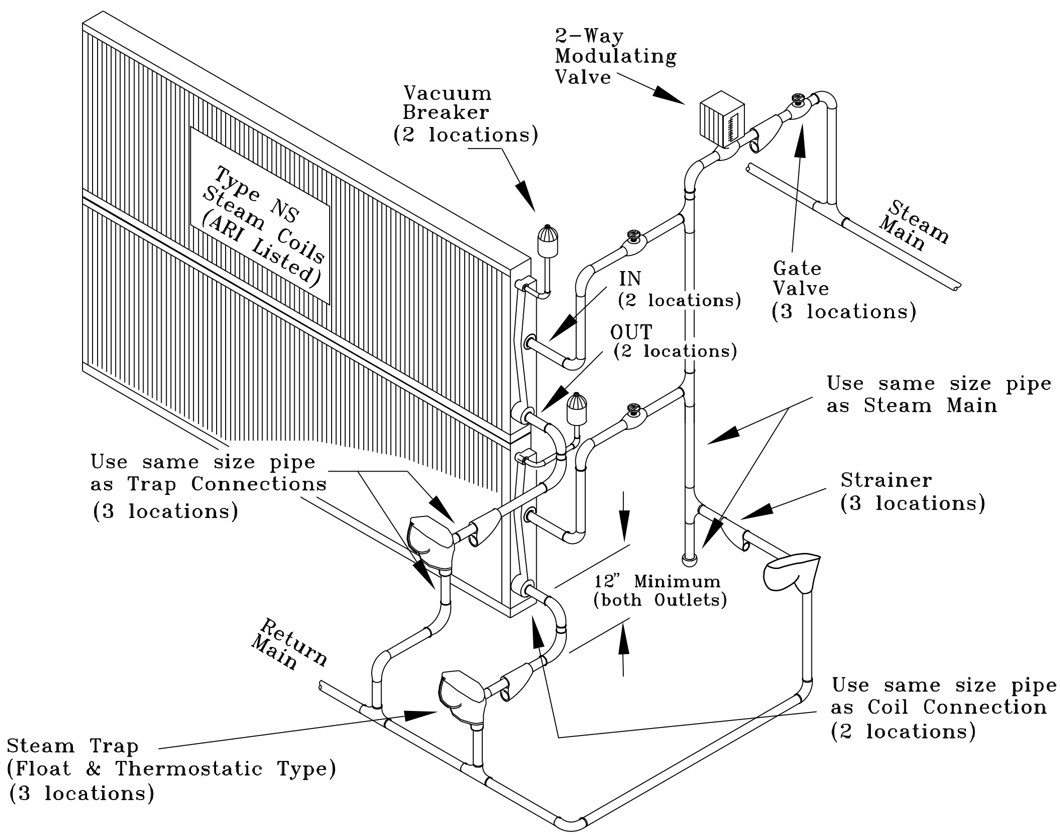



Figure 52. Steam coil piping



## Disconnect Switch w/External Handle

Units come equipped with a factory mounted disconnect switch with an externally mounted handle. This allows the operator to disconnect power from the unit without having to open the control panel door. The handle locations and its three positions are shown below;

"ON" - Indicates that the disconnect switch is closed, allowing the main power supply to be applied at the unit.

"OFF" - Indicates that the disconnect switch is open, interrupting the main power supply to the unit controls.

"RESET" - Turning the handle to this position resets the circuit breaker (if so equipped).

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

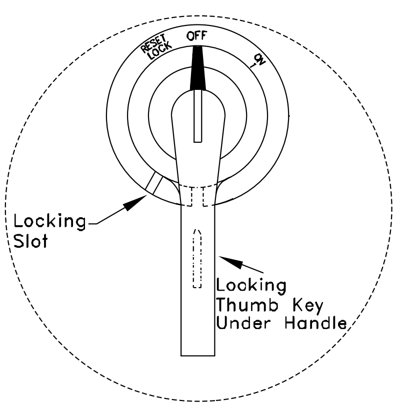
**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

The handle can be locked in the "OFF" position. While holding the handle in the "OFF" position, push the spring loaded thumb key, attached to the handle, into the base slot. Place the lock shackle between the handle and the thumb key. This will prevent it from springing out of position.

An overall layout of the field required power wiring is illustrated beginning with Figure 54, p. 77. To ensure that the unit supply power wiring is properly sized and installed, follow these guidelines.

**Figure 53. Disconnect switch external handle**




***Note:*** *All field installed wiring must conform to NEC guidelines as well as State and Local codes.*

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

Verify that the power supply available is compatible with the unit nameplate rating for all components. The available power supply must be within 10% of the rated voltage stamped on the nameplate. Use only copper conductors to connect the
3-phase power supply to the unit.

**⚠CAUTION**

**Use Copper Conductors Only!**

**Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors may result in equipment damage.**

## Electric Heat Units

Electric Heat Units require one power entry as illustrated in Figure 54, p. 77. Use the information provided in Table 24, p. 80 and the "Power Wire Sizing & Protection Device Equations", to determine the appropriate wire size and Maximum Over current Protection for the heaters/ unit.

***Note:*** *Each power supply must be protected from short circuit and ground fault conditions. To comply with NEC, protection devices must be sized according to the "Maximum Over current Protection" (MOP) or "Recommended Dual Element" (RDE) fuse size data on the unit nameplate.*

Provide grounding for the supply power circuit in the electric heat control box.

## Main Unit Power Wiring

Figure 56, p. 78 lists the field connection wire ranges for both the main power terminal block and the optional main power disconnect switch. The electrical tables beginning with Table 22, p. 79 list the component electrical data. The electrical service must be protected from over current and short circuit conditions in accordance with NEC requirements. Protection devices must be sized according to the electrical data on the nameplate. Refer to the "Power Wire Sizing and Protection Device Equations", for determining;

- the appropriate electrical service wire size based on "Minimum Circuit Ampacity" (MCA),
- the "Maximum Over current Protection" (MOP) device,
- the "Recommended Dual Element fuse size" (RDE).

1. Location for the electrical service entrance is illustrated in Figure 54, p. 77. Complete the unit power wiring connections onto either the main terminal block, or the factory mounted non-fused disconnect switch, inside the unit control panel. Refer to the customer connection diagram that shipped with the unit for specific termination points.
2. Provide proper grounding for the unit in accordance with local and national codes

**Figure 54. Typical field power wiring**

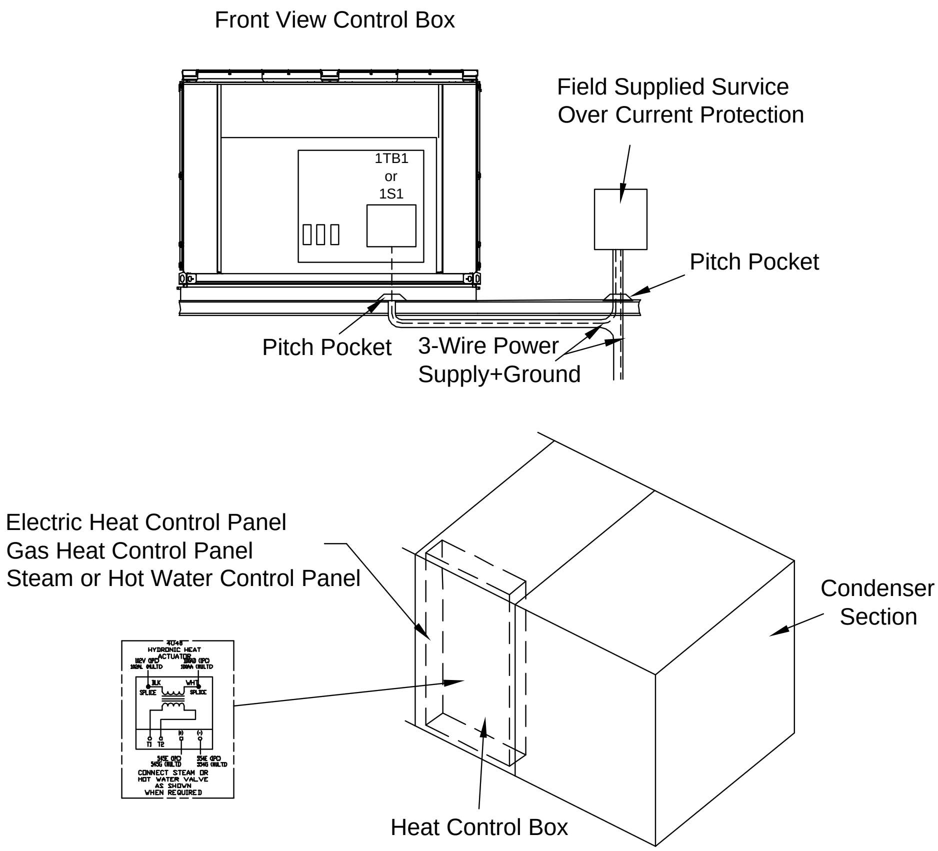


**Figure 55. Typical field power wiring**

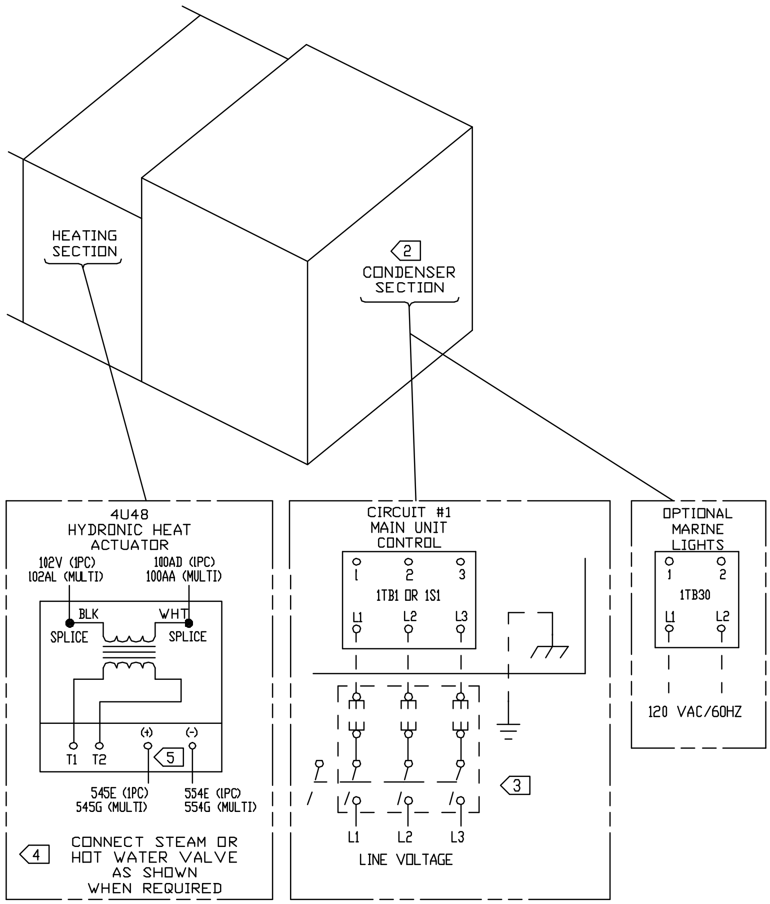



**Figure 56.Customer connection wire range**

UNITS WITH MAIN POWER TERMINAL BLOCK (ALL VOLTAGES)

| BLOCK SIZE | WIRE QTY | CONNECTOR WIRE RANGE |
|---|---|---|
| 760 AMP | (2) | #4 - 500 MCM |

UNITS WITH MAIN POWER DISCONNECT SWITCH (ALL VOLTAGES)

| SWITCH SIZE | WIRE QTY | CONNECTOR WIRE RANGE |
|---|---|---|
| 250 AMP | (1) | #4 - 500 MCM |
| 400 AMP | (1) | #1 - 600 MCM |
| OR | (2) | #1 - 250 MCM |
| 600 AMP | (2) | 250 - 500 MCM |
| OR | (3) | 3/0 - 500 MCM |
| 800 AMP | (2) | 250 - 500 MCM |
| OR | (3) | 3/0 - 500 MCM |

**Note:** *Non-fused disconnect switch size is calculated by selecting the size greater than or equal to 1.15 X (sum of unit loads). See unit literature for unit load values. (See following page for circuit breaker sizing)*

NOTES:

1. ALL WIRING AND COMPONENTS SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. CUSTOMER CONNECTIONS - MAIN UNIT CONTROLS ARE LOCATED IN THE CONDENSER SECTION FOR 90 THRU 150 TON UNITS.
3. SEE CUSTOMER CONNECTION WIRE RANGE TABLE FOR ACCEPTABLE WIRE SIZES FOR CONNECTION TO MAIN UNIT TERMINAL BLOCK (1TB1) OR DISCONNECT SWITCH (1S1).
4. WIRES TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT VALVE ARE SUPPLIED WITH THE UNIT. WIRE CONNECTIONS TO THE VALVE TO BE MADE BY THE CUSTOMER.
5. WIRES CONNECTING TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT ACTUATOR AT NODES 100, 102, 545 AND 554 WILL BE NUMBERED 100AD, 102V, 545E AND 554E ON 1-PIECE UNITS AND WILL BE NUMBERED 100AA, 102AL, 545G AND 554G ON MULTI-PIECE UNITS.

## Power Wire Sizing and Protection Devices

To correctly size electrical service wiring for a unit, find the appropriate calculations listed below. Each type of unit has its own set of calculations for MCA (Minimum Circuit Ampacity), MOP (Maximum Overcurrent Protection), and RDE (Recommended Dual Element fuse size). Read the load definitions that follow and then find the appropriate set of calculations based on unit type.

**Note:** *Set 1 is for cooling only and cooling with gas heat units, and set 2 is for cooling with electric heat units.*

Load Definitions: (To determine load values, see the Electrical Service Sizing Data Tables on the following page.)

LOAD1 = CURRENT OF THE LARGEST MOTOR (COMPRESSOR OR FAN MOTOR)

LOAD2 = SUM OF THE CURRENTS OF ALL REMAINING MOTORS

LOAD3 = CURRENT OF ELECTRIC HEATERS

LOAD4 = ANY OTHER LOAD RATED AT 1 AMP OR MORE

## Set 1. Cooling Only Rooftop Units and Cooling with Gas Heat Rooftop Units

MCA = (1.25 x LOAD1) + LOAD2 + LOAD4

MOP = (2.25 x LOAD1) + LOAD2 + LOAD4

Select a fuse rating equal to the MOP value. If the MOP value does not equal a standard fuse size as listed in NEC 240-6, select the next lower standard fuse rating.

**Note:** *If selected MOP is less than the MCA, then select the lowest standard maximum fuse size which is equal to or larger than the MCA, provided the selected fuse size does not exceed 800 amps.*

RDE = (1.5 x LOAD1) + LOAD2 + LOAD4

Select a fuse rating equal to the RDE value. If the RDE value does not equal a standard fuse size as listed in NEC 240-6, select the next higher standard fuse rating.

**Note:** *If the selected RDE is greater than the selected MOP value, then select the RDE value to equal the MOP value.*

## Set 2. Rooftop units with Electric Heat

To arrive at the correct MCA, MOP, and RDE values for these units, two sets of calculations must be performed. First calculate the MCA, MOP, and RDE values as if the unit was in cooling mode (use the equations given in Set 1). Then calculate the MCA, MOP, and RDE values as if the unit were in the heating mode as follows.

(Keep in mind when determining LOADS that the compressors don't run while the unit is in the heating mode).

MCA = 1.25 x (LOAD1 + LOAD2 + LOAD4) + LOAD3

The nameplate MCA value will be the larger of the cooling mode MCA value or the heating mode MCA value calculated above.

MOP = (2.25 x LOAD1) + LOAD2 + LOAD3 + LOAD4

The selection MOP value will be the larger of the cooling mode MOP value or the heating mode MOP value calculated above.

Select a fuse rating equal to the MOP value. If the MOP value does not equal a standard fuse size as listed in NEC 240-6, select the next lower standard fuse rating.

**Note:** *If selected MOP is less than the MCA, then select the lowest standard maximum fuse size which is equal to or larger than the MCA, provided the selected fuse size does not exceed 800 amps.*

RDE = (1.5 x LOAD1) + LOAD2 + LOAD3 + LOAD4

The selection RDE value will be the larger of the cooling mode RDE value or the heating mode RDE value calculated above.

Select a fuse rating equal to the RDE value. If the RDE value does not equal a standard fuse size as listed in NEC 240-6, select the next higher standard fuse rating.

***Notes:***

- *If the selected RDE is greater than the selected MOP value, then select the RDE value to equal the MOP value.*
- *On 90 to 162 ton rooftops, the selected MOP value is stamped in the MOP field on the nameplate.*

**Table 22. Electrical service sizing data**

| | Compressor | | | | | | Nominal Voltage | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Capacity kW (ea.) | | | | 460 V | | 575 V | | 380 V | |
| | | | 60 Hz | | 50 Hz | | | | | | | |
| Nom Tons | Size | Number per Unit | Std. Coil | High Cap | Std. Coil | High Cap | RLA (ea.) | LRA (ea.) | RLA (ea.) | LRA (ea.) | RLA (ea.) | LRA (ea.) |
| 90/100 | 240 | 4 | 21.3 | 21.6 | 17.6 | 17.9 | 34.1 | 215 | 27.3 | 175 | 34.0 | 215 |
| 105/118 | 240 | 2 | 24.2 | 24.5 | 20.2 | 20.3 | 34.1 | 215 | 27.3 | 175 | 34.0 | 215 |
| | 300 | 2 | 25.0 | 25.3 | 20.9 | 21.0 | 44.7 | 260 | 35.8 | 210 | 44.6 | 260 |
| 120/128 | 300 | 4 | 26.9 | 27.8 | 22.4 | 23.0 | 44.7 | 260 | 35.8 | 210 | 44.6 | 260 |
| 130/140 | 300 | 2 | 28.5 | 28.8 | 23.8 | 23.8 | 44.7 | 260 | 35.8 | 210 | 44.6 | 260 |
| | 380 | 2 | 33.7 | 34.2 | 28.2 | 28.2 | 52.1 | 320 | 41.1 | 235 | 52.0 | 320 |
| 150/162 | 380 | 4 | 34.7 | -- | 28.7 | -- | 52.1 | 320 | 41.1 | 235 | 52.0 | 320 |

**Table 23. Electrical service sizing data—motors**

| Condenser Fan Motors | | | | |
|---|---|---|---|---|
| Nominal Tons | No. of Fans | 460 V | 575 V | 380 V |
| | | FLA | FLA | FLA |
| 90, 105 | 6 | 16.2 | 13.2 | 15 |
| 120, 130, 150 | 8 | 21.6 | 17.6 | 20 |
| 100 | 2 | 11.8 | N/A | N/A |
| 118, 128, 140, 162 | 2 | 11.8 | N/A | N/A |

| Supply Fan Motors | | | |
|---|---|---|---|
| Motor Horsepower | 460 V | 575 V | 380 V |
| | FLA | FLA | FLA |
| 15 | 18.5 | 15.1 | 24 |
| 20 | 24.7 | 19.6 | 29 |
| 25 | 31 | 24.5 | 38 |
| 30 | 36.6 | 29.2 | 47 |
| 40 | 49.0 | 39 | 54 |
| 50 | 60.5 | 48 | 68 |
| 60 | 71.5 | 57.2 | 81 |
| 75 | 90 | 72 | 103 |
| 100 | 115 | 92 | N/A |

| Exhaust/Return Fan Motors | | | |
|---|---|---|---|
| Motor Horsepower | 460 V | 575 V | 380 V |
| | FLA | FLA | FLA |
| 7.5 | 9.4 | 7.8 | 13.6 |
| 10 | 12.6 | 10.1 | 16 |
| 15 | 18.5 | 15.1 | 24 |
| 20 | 24.7 | 19.6 | 29 |
| 25 | 31 | 24.5 | 38 |
| 30 | 36.6 | 29.2 | 47 |
| 40 | 49.0 | 39 | 54 |
| 50 | 60.5 | 48 | 68 |
| 60 | 71.5 | 57.2 | 81 |

**Table 24. Electrical service sizing data—electric heat module (electric heat units only)**

| | Voltage | | |
|---|---|---|---|
| | 460 | 575 | 380 |
| Module kW | FLA | FLA | FLA |
| 90 / 56 | 108.3 | 86.6 | 85.1 |
| 140 / 88 | 168.4 | 134.7 | 133.7 |
| 265 / 166 | 318.8 | 255 | 252.2 |
| 300 / 188 | 360.8 | 288.7 | 285.6 |

**Table 25. Electrical service sizing data—control power transformer (heating mode only)**

| Nominal Tons | Digit 2 Unit Function | Voltages | | |
|---|---|---|---|---|
| | | 460 | 575 | 380 |
| | | FLA | FLA | FLA |
| 90-150/100-162 | E, L, S, X | 3 | 3 | 4 |
| 90, 105/100, 118 | F (850 MBH) | 4 | 4 | 5 |
| 90, 105/100, 118 | F (1100 MBH) | 4 | 4 | 5 |
| 90, 105/100, 118 | F (1800 MBH) | 4 | 4 | 5 |
| 120-150/128-162 | F (1100 MBH) | 4 | 4 | 5 |
| 120-150/128-162 | F (1800 MBH) | 4 | 4 | 5 |
| 120-150/128-162 | F (2500 MBH) | 4 | 4 | 5 |

**Table 26. Electrical service sizing data—crankcase heater**

| Nominal Tons | Voltage | | |
|---|---|---|---|
| | 460 | 575 | 380 |
| | FLA (add) | FLA (add) | FLA (add) |
| 90-162 | 1 | 1 | 1 |

**Table 27. Voltage utilization range**

| Unit Voltage | |
|---|---|
| 460/60/3 | 414-506 |
| 575/60/3[(a)] | 517-633 |
| 380/50/3[(i)] | 342-418 |

(a) Units with air-cooled condensers only.

**Table 28. Electrical service sizing data—evaporative condenser**

| Unit Part | kw | HP | Voltage |
|---|---|---|---|
| | | | 460 |
| | | | FLA |
| **Pump** | | 1.5 | 2.7 |
| **Sump Heater** | 3 | | 3.8 |

**Table 29. Electrical service sizing data—energy recovery wheel motor**

| Nominal Tons | Unit Function | Voltages | |
|---|---|---|---|
| | | 460 | 575 |
| | | FLA | FLA |
| 90-128 | 1 (Low CFM ERW) | 1.2 | 0.95 |
| 130-162 | 1 (Low CFM ERW) | 1.7 | 1.4 |
| 90-162 | 2 (Std. CFM ERW) | 1.7 | 1.4 |

Table 30. Electrical service sizing data—convenience outlet transformer

| | Voltage | |
|---|---|---|
| | 460 | 575 |
| Nominal Tons | FLA (add) | FLA (add) |
| 90-162 | 3.3 | 2.6 |

Table 31. Compressor data

| Unit Size | Number of Compressors | Compressor Size | Compressor Designator | Compressor Type |
|---|---|---|---|---|
| 90/100 Ton Std & Hi-Capacity | 2 | CSHN250 | 1A, 2A | Scroll |
| | 2 | CSHN250 | 1B, 2B | Scroll |
| 105/118 Ton Std & Hi-Capacity | 2 | CSHN250 | 1A, 2A | Scroll |
| | 2 | CSHN315 | 1B, 2B | Scroll |
| 120/128 Ton Std & Hi-Capacity | 2 | CSHN315 | 1A, 2A | Scroll |
| | 2 | CSHN315 | 1B, 2B | Scroll |
| 130/140 Ton Std & Hi-Capacity | 2 | CSHN315 | 1A, 2A | Scroll |
| | 2 | CSHN374 | 1B, 2B | Scroll |
| 150/162 Ton Std | 2 | CSHN374 | 1A, 2A | Scroll |
| | 2 | CSHN374 | 1B, 2B | Scroll |

## Field Installed Control Wiring

The Rooftop Module (RTM) must have a mode input in order to operate the rooftop unit. The flexibility of having several system modes depends upon the type of sensor and/or remote panel selected to interface with the RTM. An overall layout of the various control options available, with the required number of conductors for each device, is illustrated beginning with Figure 57, p. 87.

***Note:*** *All field wiring must conform to NEC guidelines as well as state and local codes.*

The various field installed control panels, sensors, switches, and contacts discussed in this section require both AC and DC consideration. These diagrams are representative of standard applications and are provided for general reference only. Always refer to the wiring diagram that shipped with the unit for specific electrical schematic and connection information.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

## Controls using 24 VAC

Before installing any connecting wiring, refer to Figure 10, p. 21 for the electrical access locations provided on the unit and Table 32, p. 81 for AC conductor sizing guidelines, and;

a. Use copper conductors unless otherwise specified.

b. Ensure that the AC control wiring between the controls and the unit's termination point does not exceed three (3) ohms/conductor for the length of the run.

***Note:*** *Resistance in excess of 3 ohms per conductor may cause component failure due to insufficient AC voltage supply.*

c. Be sure to check all loads and conductors for grounds, shorts, and miswiring.

Table 32. AC conductors

| Distance from Unit to Control | Recommended Wire Size |
|---|---|
| 000-460 feet | 18 gauge |
| 461-732 feet | 16 gauge |
| 733-1000 feet | 14 gauge |

d. Do not run the AC low voltage wiring in the same conduit with the high voltage power wiring.

## Controls using DC Analog Input/Outputs

Before installing any connecting wiring between the unit and components utilizing a DC analog input\output signal, refer to the appropriate illustration in Figure 10, p. 21 for the electrical access locations provided on the unit and Table 33, p. 81 for conductor sizing guidelines and;

e. Use standard copper conductor thermostat wire unless otherwise specified.

f. Ensure that the wiring between the controls and the unit termination point does not exceed two and a half (2.5) ohms/conductor for the length of the run.

***Note:*** *Resistance in excess of 2.5 ohms per conductor can cause deviations in the accuracy of the controls.*

Table 33. DC conductors

| Distance from Unit to Control | Recommended Wire Size |
|---|---|
| 000-150 feet | 22 gauge |
| 151- 240 feet | 20 gauge |
| 241- 385 feet | 18 gauge |
| 386- 610 feet | 16 gauge |
| 611- 970 feet | 14 gauge |

g. Do not run the electrical wires transporting DC signals in or around conduit housing high voltage wires.

Units equipped with a Trane BACnet® Communication Interface (BCI) or LonTalk® communication Interface (LCI) option which utilizes a serial communication link;

a. Must be 18 AWG shielded twisted pair cable (Belden 8760 or equivalent).

b. Must not exceed 5,000 feet maximum for each link.

c. Must not pass between buildings.

## Constant Volume System Controls

### Remote Panel w/o NSB—BAYSENS110*

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto) with four system status LED's. It is a manual or automatic changeover control with dual setpoint capability. It can be used with a remote zone sensor BAYSENS077*. Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient.

### Constant Volume Zone Panel -BAYSENS108*

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto). It is a manual or automatic changeover control with dual setpoint capability.

## Variable Air Volume System Controls

### VAV Changeover Contacts

The changeover input is used with modulating gas heat, electric heat, or hydronic heat. When the contacts are closed, the unit will control to the discharge heating setpoint. Refer to the unit wiring diagram for the field connection terminals in the unit control panel. The switch must be rated at 12 ma @ 24 VDC minimum.

## Constant Volume or Variable Air Volume System Controls

### Remote Human Interface Module

The remote Human Interface module enables the operator to set or modify the operating parameters of the unit using a 16 key keypad and to view the operating status of the unit on the 2 line, 40 character LCD screen without leaving the building. However, the Remote Human Interface module can not be used to perform any service functions.

One remote panel is designed to monitor and control up to four units providing each of the units are equipped with an IPCB module. Use the installation instructions that shipped with the module to install it, and the appropriate illustrations beginning with Figure 57, p. 87 to connect it to the unit.

### Remote Panel w/ NSB -BAYSENS119*

This 7 day programmable sensor features four periods for Occupied\Unoccupied programming per day. Either one or all four periods can be programmed. If the power is interrupted, the program is retained in permanent memory. If power is off longer than 2 hours, only the clock and day may have to be reset.

The front panel allows selection of Occupied/Unoccupied periods with two temperature inputs (Cooling Supply Air Temperature and Heating Warm-up temperature) per occupied period.

The occupied cooling setpoint ranges between 40 and 80°F. The warm-up setpoint ranges between 50 and 90°F with a 2 degree deadband. The Unoccupied cooling setpoint ranges between 45 and 98°F. The heating setpoint ranges between 43 and 96°F.

The liquid crystal display (LCD) displays zone temperature, temperature setpoints, week day, time, and operational mode symbols. The DIP switches on the subbase are used to enable or disable applicable functions, i.e.; Morning warm-up, economizer minimum position override during unoccupied status, heat installed, remote zone temperature sensor, 12/24 hour time display, and daytime warm-up. Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient. During an occupied period, an auxiliary relay rated for 1.25 amps @ 30 volts AC with one set of single pole double throw contacts is activated.

### Remote Zone Sensor (BAYSENS073*)

This electronic analog sensor features remote zone sensing and timed override with override cancellation. It is used when the RTM has been programmed as the source for zone temperature control. Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient.

### Remote Zone Sensor (BAYSENS074*)

This electronic analog sensor features single setpoint capability and timed override with override cancellation. It is used with a Trane Integrated Comfort™ system. Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient.

### Remote Zone Sensor (BAYSENS016*)

This bullet type analog Temperature sensor can be used for; outside air (ambient) sensing, return air temperature sensing, supply air temperature sensing, remote temperature sensing (uncovered), morning warm-up temperature sensing, and for VAV zone reset. Wiring procedures vary according to the particular application and equipment involved. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient.

### Remote Zone Sensor (BAYSENS077*)

This electronic analog sensor can be used with BAYSENS119* or 021* Remote Panels. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to the specific Remote Panel for wiring details.

### $CO_2$ Sensing—Space or Duct

The $CO_2$ sensor shall have the ability to monitor space occupancy levels within the building by measuring the parts per million of $CO_2$ in the air. As the $CO_2$ levels increase, the outside air damper modulates to meet the $CO_2$ space ventilation requirements.

### Remote Minimum Position Potentiometer (BAYSTAT023*)

The remote minimum position potentiometer is used on units with an economizer. It allows the operator to remotely set the economizer minimum position (which controls the amount of outside air entering the unit). Use the installation instructions that shipped with the potentiometer to install it, and the appropriate illustrations beginning with Figure 57, p. 87 to connect it to the unit.

## Single Zone Variable Air Volume & Rapid Restart System Control

### Remote Zone Sensor (BAYSENS016*)

This bullet-type, analog temperature sensor can be used for supply air and return air temperature sensing. Wiring procedures vary according to application and equipment. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to Table 34, p. 85 for the Temperature vs. Resistance coefficient.

### External Auto/Stop Switch

A field supplied single pole single throw switch may be used to shut down the unit operation. This switch is a binary input wired to the RTM. When opened, the unit shuts down immediately and can be cancelled by closing the switch. Refer to the appropriate illustrations beginning with Figure 57, p. 87 for the proper connection terminals in the unit control panel. The switch must be rated for 12 ma @ 24 VDC minimum.

## Emergency Override

When a Lontalk®/BACnet® communication module is installed, the user can initiate from the Trane Tracer Summit or 3rd party BAS one of five (5) predefined, not available to configure, Emergency Override sequences. All compressors, condenser fans and the Humidification output are deenergized for any Emergency Override sequence. Each Emergency Override sequence commands the unit operation as follows:

1. PRESSURIZE_EMERG:
   - Supply Fan - On
   - Supply Fan VFD   Open/Max (if so equipped)
   - Exhaust Fan - Off; Exhaust Dampers   Closed (if so equipped)
   - OA Dampers - Open; Return Damper - Closed
   - Heat - All heat stages off; Mod Heat output at 0 VDC
   - Occupied/Unoccupied/VAV box output - Energized
   - VOM Relay - Energized (if so equipped)
   - Preheat Output - Off
   - Return Fan - Off; Exhaust Dampers - Closed (if so equipped)
   - Return VFD - Min (if so equipped)
2. EMERG_DEPRESSURIZE:
   - Supply Fan - Off
   - Supply Fan VFD - Closed/Min (if so equipped)
   - Exhaust Fan - On; Exhaust Dampers   Open/Max (if so equipped)
   - OA Dampers - Closed; Return Damper - Open
   - Heat - All heat stages off; Mod Heat output at 0 VDC
   - Occupied/Unoccupied/VAV box output - Energized
   - VOM Relay - Energized (if so equipped)
   - Preheat Output - Off
   - Return Fan - On; Exhaust Dampers - Open (if so equipped)
   - Return VFD - Max (if so equipped)
3. EMERG_PURGE:
   - Supply Fan - On
   - Supply Fan VFD - Open/Max (if so equipped)
   - Exhaust Fan - On; Exhaust Dampers   Open (if so equipped)
   - OA Dampers - Open; Return Damper - Closed
   - Heat - All heat stages off; Mod Heat output at 0 VDC
   - Occupied/Unoccupied/VAV box output - Energized
   - VOM Relay - Energized (if so equipped)
   - Preheat Output - Off
   - Return Fan - On; Exhaust Dampers - Open (if so equipped)
   - Return VFD - Max (if so equipped)
4. EMERG_SHUTDOWN:
   - Supply Fan - Off
   - Supply Fan VFD - Closed/Min (if so equipped)
   - Exhaust Fan - Off; Exhaust Dampers   Closed (if so equipped)
   - OA Dampers - Closed; Return Damper - Open
   - Heat - All heat stages off; Mod Heat output at 0 VDC
   - Occupied/Unoccupied/VAV box output - Energized
   - VOM Relay - Energized (if so equipped)
   - Preheat Output - Off
   - Return Fan - Off; Exhaust Dampers - Closed (if so equipped)
   - Return VFD - Min (if so equipped)
5. EMERG_FIRE - Input from fire pull box/system:
   - Supply Fan - Off
   - Supply Fan VFD - Closed/Min (if so equipped)
   - Exhaust Fan - Off; Exhaust Dampers   Closed (if so equipped)

- OA Dampers - Closed; Return Damper - Open
- Heat - All heat stages off; Mod Heat output at 0 VDC
- Occupied/Unoccupied/VAV box output - Energized
- VOM Relay - Energized (if so equipped)
- Preheat Output - Off
- Return Fan - Off; Exhaust Dampers - Closed (if so equipped)
- Return VFD - Min (if so equipped)

## Ventilation Override Module (VOM)

***Important:*** *The ventilation override system should not be used to signal the presence of smoke caused by a fire, as it is not intended nor designed to do so.*

The user can customize up to five (5) different override sequences for purposes of ventilation override control. If more than one VOM sequence is being requested, the sequence with the highest priority is initiated first. Sequence hierarchy is the sequence "A" (UNIT OFF) is first, with sequence "E" (PURGE with Duct Pressure Control) last. A ventilation override mode can be initiated by closing any of the five (5) corresponding binary inputs on the VOM module. A binary output is provided on the VOM module to provide remote indication of an active VOM mode. All compressors, condenser fans and the Humidification output are deenergized for any VOM sequence. The factory default definitions for each mode are as follows:

1. UNIT OFF sequence "A"

When complete system shutdown is required the following sequence can be used.

- Supply Fan - Off
- Supply Fan VFD - Closed/Min (if so equipped)
- Exhaust Fan - Off; Exhaust Dampers Closed (if so equipped)
- OA Dampers - Closed; Return Damper - Open
- Heat - All heat stages off; Mod Heat output at 0 VDC
- Occupied/Unoccupied/VAV box output - Deenergized
- VOM Relay - Energized
- Preheat Output - Off
- Return Fan - Off; Exhaust Dampers - Closed (if so equipped)
- Return VFD - Min (if so equipped)
- OA Bypass Dampers - Open (if so equipped)
- Exhaust Bypass Dampers - Open (if so equipped)

2. PRESSURIZE sequence "B"

Perhaps a positively pressurized space is desired instead of a negatively pressurized space. In this case, the supply fan should be turned on with VFD at 100% speed and exhaust fan should be turned off.

- Supply Fan - On
- Supply Fan VFD - Max (if so equipped)
- Exhaust Fan - Off; Exhaust Dampers Closed (if so equipped)
- OA Dampers - Open; Return Damper - Closed
- Heat - All heat stages off; Mod Heat output at 0 VDC
- Occupied/Unoccupied/VAV box output - Energized
- VOM Relay - Energized
- Preheat Output - Off
- Return Fan - Off; Exhaust Dampers - Closed (if so equipped)
- Return VFD - Min (if so equipped)
- OA Bypass Dampers - Open (if so equipped)
- Exhaust Bypass Dampers - Open (if so equipped)

3. EXHAUST sequence "C"

With only the exhaust fans running (supply fan off), the space that is conditioned by the rooftop would become negatively pressurized. This is desirable for clearing the area of smoke from the now-extinguished fire, possibly keeping smoke out of areas that were not damaged.

- Supply Fan - Off
- Supply Fan VFD - Closed/Min (if so equipped)
- Exhaust Fan - On; Exhaust Dampers - Open (if so equipped)
- OA Dampers - Closed; Return Damper - Open
- Heat - All heat stages off; Mod Heat output at 0 VDC
- Occupied/Unoccupied/VAV box output - Deenergized
- VOM Relay - Energized
- Preheat Output - Off
- Return Fan - On; Exhaust Dampers - Open (if so equipped)
- Return VFD - Max (if so equipped)
- OA Bypass Dampers - Open (if so equipped)
- Exhaust Bypass Dampers - Open (if so equipped)

4. PURGE sequence "D"

Possibly this sequence could be used for purging the air out of a building before coming out of Unoccupied mode of operation on VAV units or for the purging of smoke or stale air if required after a fire.

- Supply Fan - On
- Supply Fan VFD - Max (if so equipped)
- Exhaust Fan - On; Exhaust Dampers - Open (if so equipped)
- OA Dampers - Open; Return Damper - Closed

– Heat - All heat stages off; Mod Heat output at 0 VDC
– Occupied/Unoccupied/VAV box output - Energized
– VOM Relay - Energized
– Preheat Output - Off
– Return Fan - On; Exhaust Dampers - Open (if so equipped)
– Return VFD - Max (if so equipped)
– OA Bypass Dampers - Open (if so equipped)
– Exhaust Bypass Dampers - Open (if so equipped)

5. PURGE with duct pressure control sequence "E"

This sequence can be used when supply air control is required for smoke control.

– Supply Fan - On
– Supply Fan VFD - (If so equipped) Controlled by Supply Air Pressure Control function; Supply Air Pressure High Limit disabled
– Exhaust Fan - On; Exhaust Dampers Open (if so equipped)
– OA Dampers - Open; Return Damper - Closed
– Heat - All heat stages off; Mod Heat output at 0 VDC
– Occupied/Unoccupied/VAV box output - Energized
– VOM Relay - Energized
– Preheat Output - Off
– Return Fan - On; Exhaust Dampers - Open (if so equipped)
– Return VFD - Max (if so equipped)
– OA Bypass Dampers - Open (if so equipped)

Exhaust Bypass Dampers - Open (if so equipped)

## Temperature vs. Resistance Coefficient

The UCM network relies on various sensors located throughout the system to provide temperature information in the form of an analog input. All of the sensors used have the same temperature vs. resistance co-efficient and are made from Keystone Carbon D97 material with a 1 degree Centigrade tolerance.

**Table 34. Temp vs. resistance**

| Temp (F) | Resistance (in. 1000 Ohms) | Temp (F) | Resistance (in. 1000 Ohms) |
|---|---|---|---|
| -40 | 346.10 | 71 | 11.60 |
| -30 | 241.70 | 72 | 11.31 |
| -20 | 170.10 | 73 | 11.03 |
| -10 | 121.40 | 74 | 10.76 |
| -5 | 103.00 | 75 | 10.50 |
| 0 | 87.56 | 76 | 10.25 |
| 5 | 74.65 | 77 | 10.00 |
| 10 | 63.80 | 78 | 9.76 |
| 15 | 54.66 | 79 | 9.53 |

**Table 34. Temp vs. resistance (continued)**

| Temp (F) | Resistance (in. 1000 Ohms) | Temp (F) | Resistance (in. 1000 Ohms) |
|---|---|---|---|
| 20 | 46.94 | 80 | 9.30 |
| 25 | 40.40 | 85 | 8.25 |
| 30 | 34.85 | 90 | 7.33 |
| 35 | 30.18 | 100 | 5.82 |
| 40 | 26.22 | 105 | 5.21 |
| 45 | 22.85 | 110 | 4.66 |
| 50 | 19.96 | 120 | 3.76 |
| 55 | 17.47 | 130 | 3.05 |
| 60 | 15.33 | 140 | 2.50 |
| 65 | 13.49 | 150 | 2.05 |
| 66 | 13.15 | 160 | 1.69 |
| 67 | 12.82 | 170 | 1.40 |
| 68 | 12.5 | 180 | 1.17 |
| 69 | 12.19 | 190 | 0.98 |
| 70 | 11.89 | 200 | 0.83 |

## Emergency Stop Input

A normally closed (N.C.) switch wired to the RTM may be used during emergency situations to shut down all unit operations. When opened, an immediate shutdown occurs. An emergency stop diagnostic is entered into the Human Interface and the unit must be manually reset. Refer to the appropriate illustrations in Figure 57, p. 87 Figure 59, p. 89 for the proper connection terminals in the unit control panel. The switch must be rated for 12 ma @ 24 VDC minimum.

## External Stop Input

A normally closed (N.C.) switch wired to the RTM may be used during emergency situations to shut down all unit operations. When opened, an immediate shutdown occurs. When the contacts are closed, the unit will resume normal operation after minimum delays have occurred. Refer to the appropriate illustrations in Figure 57, p. 87 for the proper connection terminals in the unit control panel.

## Occupied/Unoccupied Contacts

To provide Night Setback control if a remote panel **with NSB** was not ordered, a field supplied contact must be installed. This binary input provides the Occupied/ Unoccupied status information of the building to the RTM. It can be initiated by a time clock, or a Building Automation System control output. The relay's contacts must be rated for 12 ma @ 24 VDC minimum. Refer to the appropriate illustrations in Figure 58, p. 88 Figure 59, p. 89 for the proper connection terminals in the unit control panel.

## Demand Limit Relay

If the unit is equipped with a Generic BAS Module, a normally open (N.O.) switch may be used to limit the electrical power usage during peak periods. When demand limit is initiated, the mechanical cooling and heating operation is limited to either 50% or 100%. Demand limit can be initiated by a toggle switch closure, a time clock, or an ICS™ control output. These contacts must be rated for 12 ma @ 24 VDC minimum.

## Outside Air Sensor—BAYSENS016*

This device senses the outdoor air temperature and sends this information in the form of an analog input to the RTM. It's factory installed on units with an economizer, but can be field provided/installed and used for informational purposes on units without an economizer. Refer to the appropriate illustrations in Figure 58, p. 88 Figure 59, p. 89 for the proper connection terminals in the unit control panel. Refer to Table 34, p. 85 for Temperature vs. Resistance coefficient.

## Generic Building Automation System

The Generic Building Automation System (GBAS) module allows a non-Trane building control system to communicate with the rooftop unit and accepts external setpoints in form of analog inputs for cooling, heating, demand limiting, and supply air pressure parameters. Refer to Figure 61, p. 91 & Table 35, p. 92 for the input wiring to the GBAS module and the various desired setpoints with the corresponding DC voltage inputs for VAV, SZVAV and CV applications.

**Figure 57. Typical field wiring diagram for 90 to 162 ton CV control options**

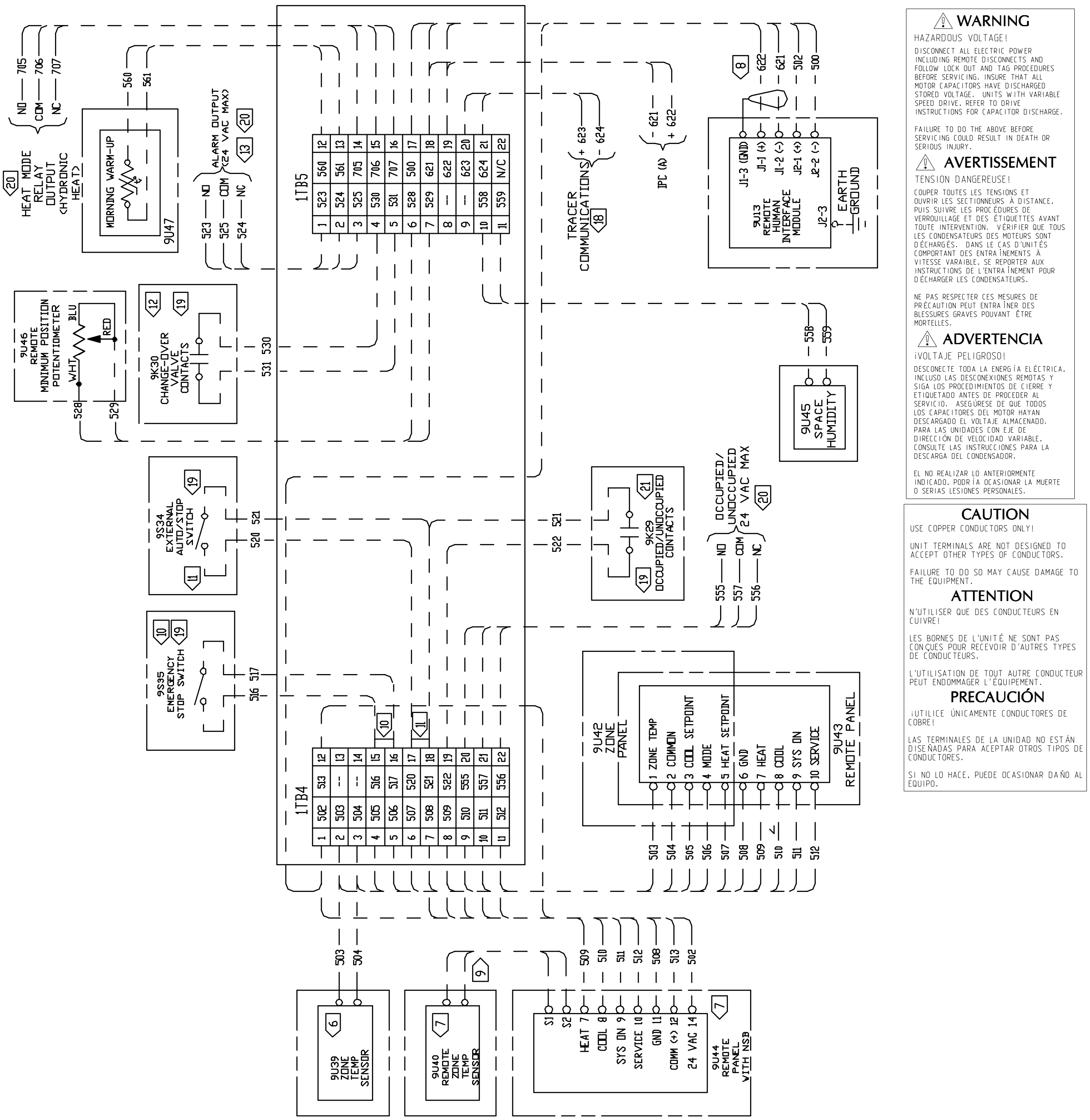


**Figure 58. Typical ventilation override binary output for 90 to 162 ton CV control options**

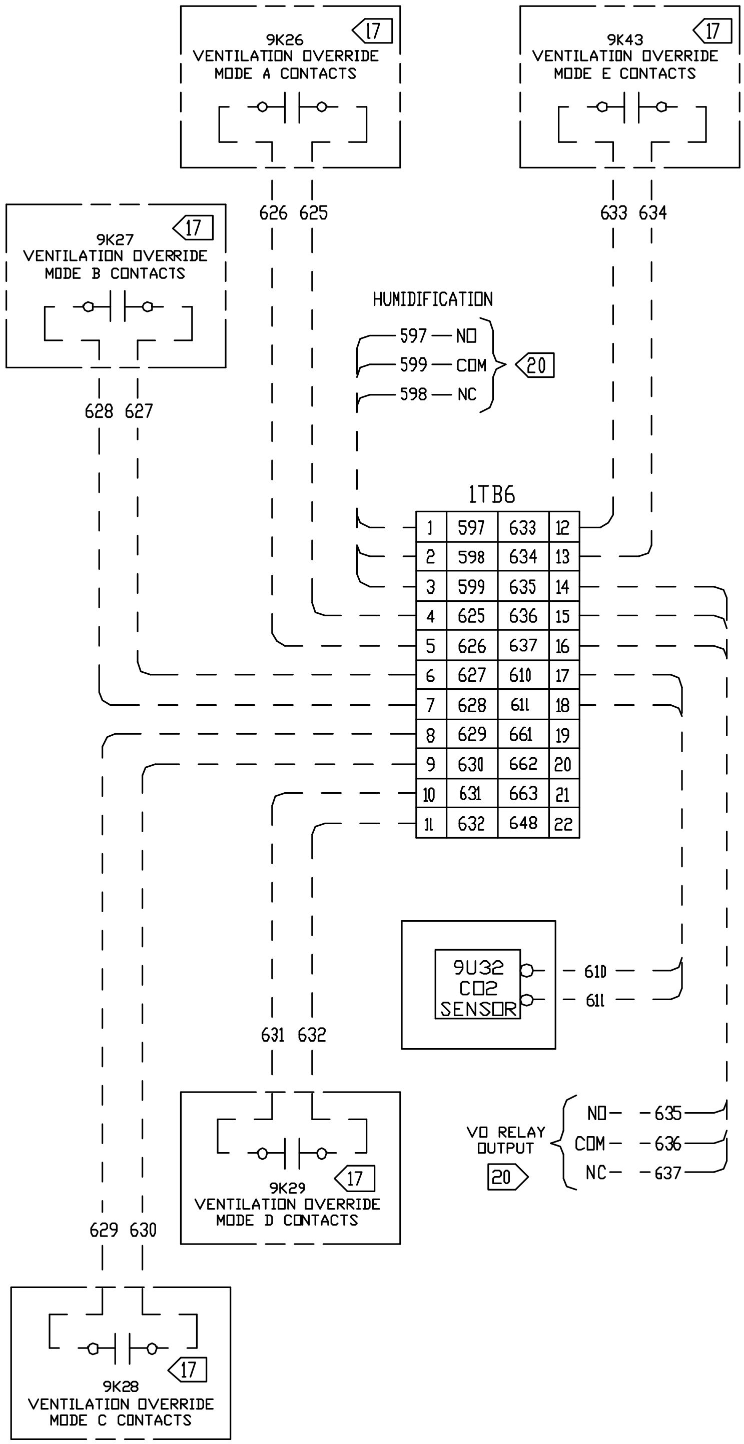
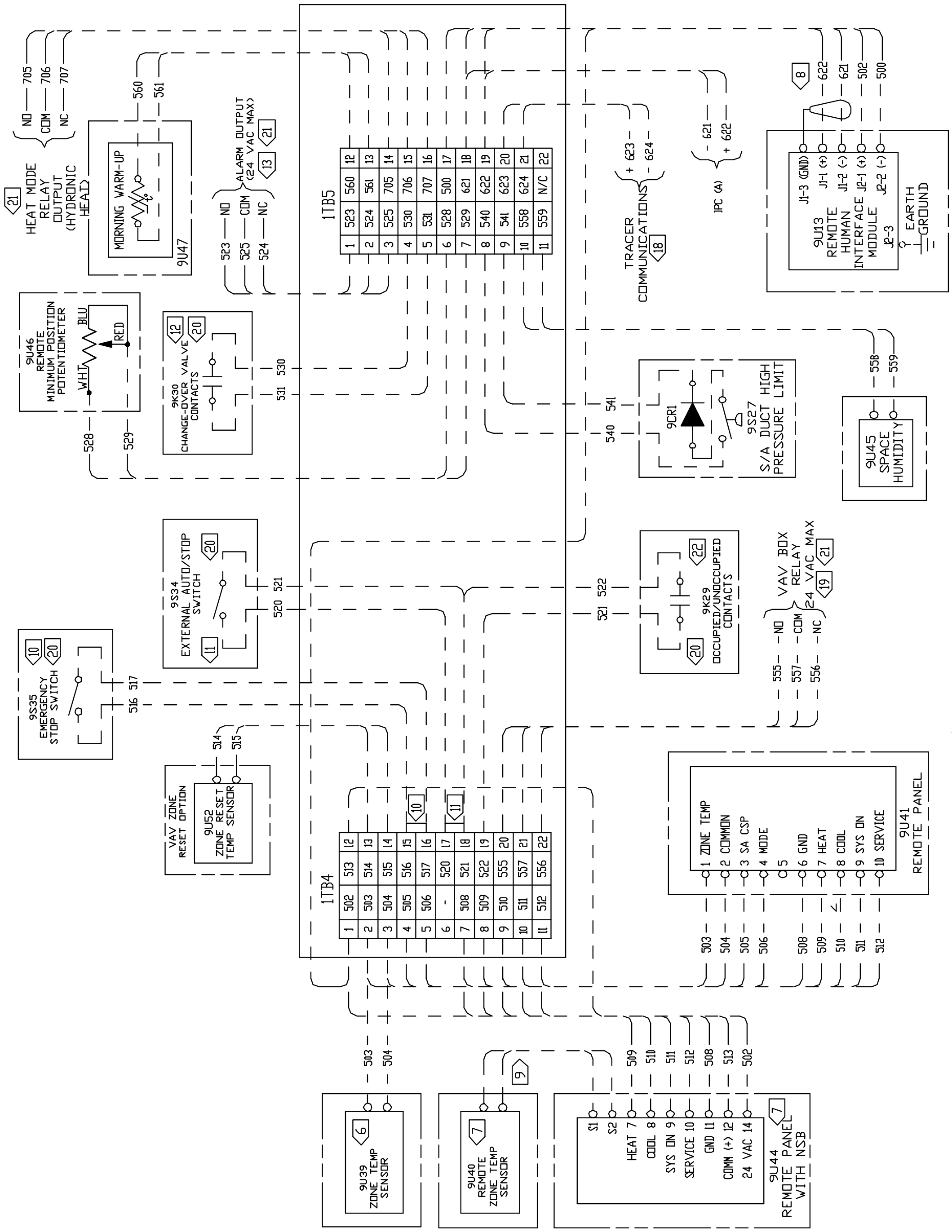


**Figure 59. Typical field wiring diagram for 90 to 162 ton VAV control options**




## ⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE.

FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

## ⚠ AVERTISSEMENT

TENSION DANGEREUSE!

COUPER TOUTES LES TENSIONS ET OUVRIR LES SECTIONNEURS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET DES ÉTIQUETTES AVANT TOUTE INTERVENTION. VÉRIFIER QUE TOUS LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. DANS LE CAS D'UNITÉS COMPORTANT DES ENTRAÎNEMENTS À VITESSE VARAIBLE, SE REPORTER AUX INSTRUCTIONS DE L'ENTRAÎNEMENT POUR DÉCHARGER LES CONDENSATEURS.

NE PAS RESPECTER CES MESURES DE PRÉCAUTION PEUT ENTRAÎNER DES BLESSURES GRAVES POUVANT ÊTRE MORTELLES.

## ⚠ ADVERTENCIA

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EL NO REALIZAR LO ANTERIORMENTE INDICADO, PODRÍA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.

## CAUTION

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

## ATTENTION

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**Figure 60. Typical field wiring diagram notes for 90 to 162 ton VAV and CV control options**

NOTES:

1. ALL WIRING AND COMPONENTS SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.

2. CUSTOMER CONNECTIONS - MAIN UNIT CONTROLS ARE LOCATED IN THE CONDENSER SECTION FOR 90 THRU 150 TON UNITS.

3. SEE CUSTOMER CONNECTION WIRE RANGE TABLE FOR ACCEPTABLE WIRE SIZES FOR CONNECTION TO MAIN UNIT TERMINAL BLOCK (1TB1) OR DISCONNECT SWITCH (1S1).

4. WIRES TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT VALVE ARE SUPPLIED WITH THE UNIT. WIRE CONNECTIONS TO THE VALVE TO BE MADE BY THE CUSTOMER.

5. WIRES CONNECTING TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT ACTUATOR AT NODES 100, 102, 545 AND 554 WILL BE NUMBERED 100AD, 102V, 545E AND 554E ON 1-PIECE UNITS AND WILL BE NUMBERED 100AA, 102AL, 545G AND 554G ON MULTI-PIECE UNITS.

6. OPTIONAL 9U39 REMOTE ZONE TEMP SENSOR IS USED FOR UNOCCUPIED HEAT/COOL TEMP CONTROL SENSING.

7. WHEN 9U40 REMOTE ZONE TEMP SENSOR IS USED, REMOVE INTERGRAL ZONE TEMP SENSOR ATTACHED TO TERMINALS S1 AND S2 ON 9U44 REMOTE PANEL.

8. WIRE USING SHIELDED TWISTED PAIR CABLE.

9. WIRE USING SHIELDED TWISTED PAIR CABLE. WRAP SHIELDS WITH TAPE TO PREVENT CONTACT WITH GROUND.

10. REMOVE JUMPER (1TB4-15 & 1TB4-16) AND INSTALL HIGH DUCT TEMP T-STAT OR FIELD SUPPLIED DEVICE.

11. REMOVE JUMPER (1TB4-17 & 1TB4-18) WHEN FIELD SUPPLIED EXTERNAL AUTO/STOP SWITCH (9S34) IS INSTALLED.

12. CHANGEOVER (9K30) AVAILABLE ONLY ON HYDRONIC HEAT UNITS OR MODULATING GAS HEAT UNITS.

13. ALARM OUTPUT ACTIVATES ON ANY MAPPED DIAGNOSTIC.

14. OPTIONAL HEAT MODULE AUX. TEMP (9RT17) IS USED FOR MORNING WARM-UP CONTROL ON UNITS WITH HEATING OPTION.

15. TERMINAL BLOCK 1TB7 AND ASSOCIATED WIRING REQUIRED WITH GBAS 0-5V (1U10) OPTION. DEMAND LIMIT RELAY (9K31) TO BE PROVIDED BY CUSTOMER.

16. TERMINAL BLOCK 1TB8 AND ASSOCIATED WIRING REQUIRED WITH GBAS 0-10V (1U11) OPTION.

17. VENTILATION OVERRIDE MODE CONTACTS (5K90 - 5K94) RATED 12 MA TO BE PROVIDED BY CUSTOMER.

18. WIRE NODES 623 & 624 REQUIRED WITH BAS/NETWORK COMM MODULE (1U7) OPTION.

19. FIELD CONNECTIONS TO DRIVE VAV BOXES FULL OPEN DURING NIGHT SETBACK MODE.

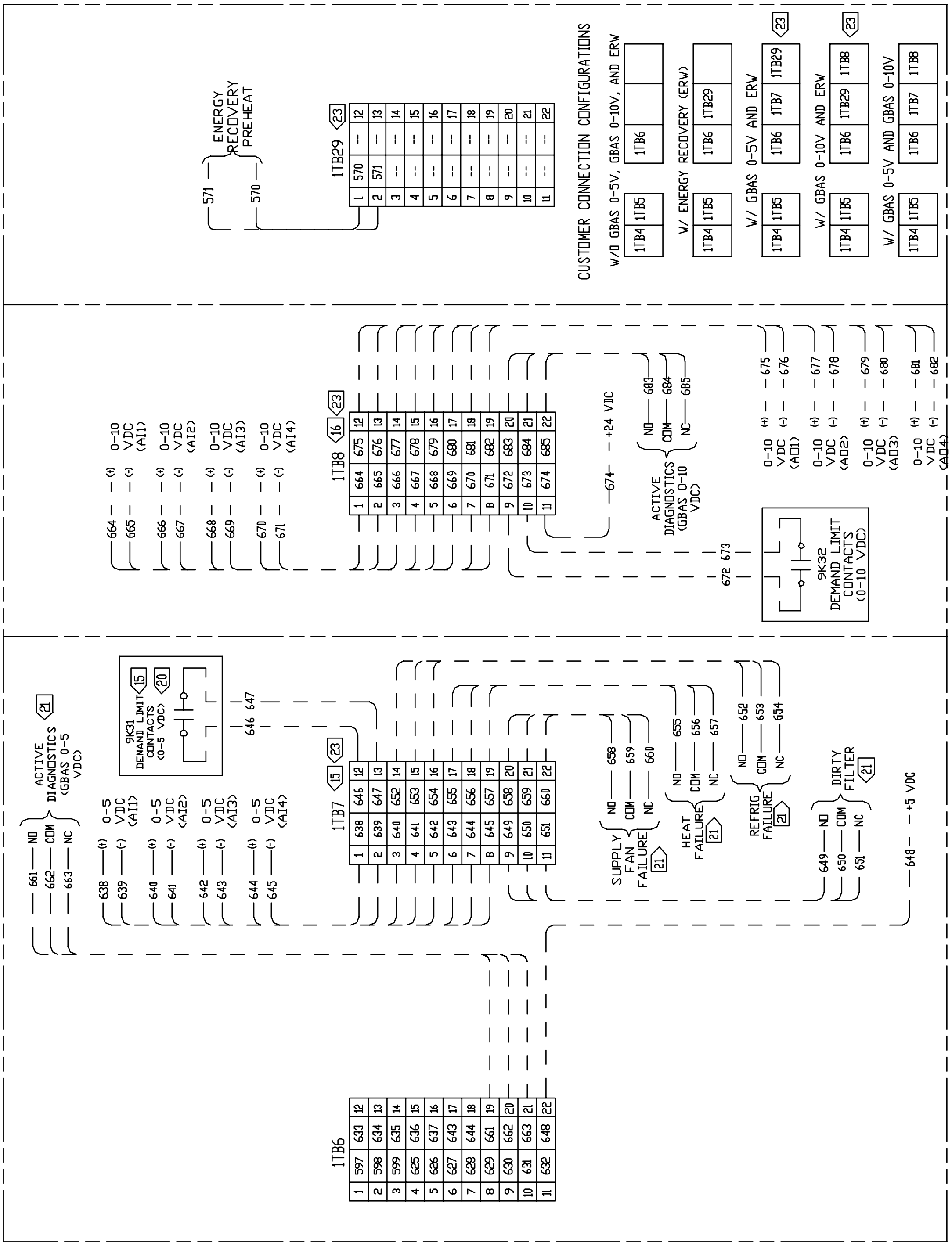
20. CONTACTS RATED 12 MA @ 24 VDC MINIMUM.

21. CONNECT TO 24VAC CLASS 2 CIRCUITS ONLY.

22. FIELD SUPPLIED AND INSTALLED OCCUPIED/UNOCCUPIED CONTACTS (9K29) FOR USE ON UNITS WITHOUT REMOTE PANEL WITH NIGHT SETBACK (9U44).

23. 1TB29 NOT AVAILABLE WHEN BOTH 0-5V GBAS AND 0-10V GBAS ARE INSTALLED. IF A SINGLE GBAS IS INSTALLED, 1TB29 WILL OCCUPY THE POSITION WHERE THE TERMINAL BLOCK SUPPORTING THE SECOND GBAS WOULD BE PLACED.

**Figure 61. Typical GBAS analog input wiring diagram for 90 to 162 ton CV and VAV control options**

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**Note:** See Figure 64, p. 99

### Table 35. GBAS voltage vs. setpoint

| Setpoint | GBAS 0-5 VDC | GBAS 0-10 VDC | Valid Range |
|---|---|---|---|
| Occ Zone Cooling Setpoint(CV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 90°F |
| Unocc Zone Cooling Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 90°F |
| Occ Zone Heating Setpoint(CV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 90°F |
| Unocc Zone Heating Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 90°F |
| SA Cooling Setpoint (VAV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 40 to 90°F |
| SA Cooling Setpoint (SZVAV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 40 to 70°F |
| Zone Cooling Setpoint (SZVAV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 80°F |
| Zone/Return Critical Temperature Setpoint (RR only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 75 to 95°F |
| SA Heating Setpoint (VAV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 40 to 180°F |
| SA Heating Setpoint (SZVAV only) | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 65 to 95°F |
| Space Static Pressure Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | -0.20 to 0.30 IWC |
| SA Static Pressure Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 0.7 to 5.1 IWC |
| Min OA Flow Setpoint 1 | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 0 to Unit Max Flow |
| MWU Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 90°F |
| Econ Dry Bulb Enable Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 50 to 140°F |
| SA_Reheat_Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 60 to 90°F |
| Minimum Position Setpoint 3 | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 0 to 100% |
| Occ Dehumidification Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 40 to 65% |
| Unocc Dehumidification Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 40 to 65% |
| Occ Humidification Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 20 to 50% |
| Unocc Humidification Setpoint | 0.5 to 4.5 VDC | 0.5 to 9.5 VDC | 20 to 50% |

**Notes:**
1. If DCV is enabled this is used for Design Minimum OA Flow Setpoint
2. If DCV is enabled, this is used for Design Minimum OA Damper Position Setpoint

### Table 36. GBAS 0-10 VDC output range

| Setpoint | GBAS 0-10 VDC | Valid Range |
|---|---|---|
| Outdoor Air Temperature | 0.5 to 9.5 VDC | -40 to 200°F |
| Zone Temperature | 0.5 to 9.5 VDC | -40 to 200°F |
| Supply Air Temperature (VAV only) | 0.5 to 9.5 VDC | -40 to 200°F |
| Supply Air Pressure (VAV only) | 0.5 to 9.5 VDC | 0.0 to 7.91 wc |
| Space Pressure | 0.5 to 9.5 VDC | -0.67-0.67 wc |
| Space RH | 0.5 to 9.5 VDC | 0-100% |
| OA RH | 0.5 to 9.5 VDC | 0-100% |
| Space CO2 Level | 0.5 to 9.5 VDC | 50-2000 PPM |
| Cooling Capacity % | 0.5 to 9.5 VDC | 0-100% |
| Heating Capacity % | 0.5 to 9.5 VDC | 0-100% |
| Outdoor Air Damper Position | 0.5 to 9.5 VDC | 0-100% |
| Outdoor Airflow | 0.5 to 9.5 VDC | 0 to 65,000 CFM |

# Installation Checklist

## General Checklist (applies to all units)

☐ Unit checked for shipping damage and material shortage

☐ Verify that the installation location of the unit will provide the required clearance for proper operation

☐ Roof curb assembled and installed

☐ Roof curb level and square

☐ Ductwork secured to curb, or unit

☐ Corners of duct adapters sealed on units with horizontal supply or return

☐ Horizontal supply or return ductwork is self supporting

☐ Pitch pocket installed for units with power supply through building roof

☐ Unit set on curb and checked level

☐ Unit-to-curb seal checked to ensure it is tight and without buckles or cracks

☐ Condensate drain lines installed to each evaporator drain connection

☐ Verify that all access doors open 100% and are not obstructed by drain lines etc.

☐ Shipping hardware removed from each compressor assembly

☐ Shipping hold-down bolts and shipping channels removed from the supply and exhaust/return fans with spring isolators

☐ Supply and exhaust/return fans spring isolators checked for proper adjustment

☐ Plastic coverings (paint shields) removed from all compressors (if present)

☐ Verify all discharge, suction, and liquid line service valves are back seated

☐ Compressor crankcase heaters energized for a minimum of 12 hours prior to unit refrigeration system startup

☐ Verify that unit literature (IOM, PTG) are left inside control box for startup

## Unit Rigging and Placement (Two-Piece—addition to General Checklist)

☐ First, rig and set the low side unit on the roof curb (aligned with return end)

☐ Remove the rail connector splice brackets and install the brackets on the low side unit base rails

☐ Take off the side panels (these are labeled) and the top cover of the high side unit and set aside to be assembled later

☐ Rig and set the high side unit on roof curb pedestal

☐ Lift the unit and position it over the pedestal

☐ Use the rail splice bracket as an alignment aid to connect the Low and high side units. The Low and high side unit rails should be butted together with a maximum 2" (preferably 1") separation

☐ Remove the left upper and lower louvered panels of the high side unit as well as the corner panels on each side to aid in tubing and wiring connections

☐ Close refrigeration shut off valves as indicated in this manual—Liquid, discharge, hot gas bypass (if present), and hot gas reheat (if present).

☐ For Evaporative Condensers

  ☐ Recover/transfer charge from tubing between shut valves and stub point.

☐ For 2 and 3 piece Air-Cooled condensers add field charge per nameplate.

☐ Braze refrigerant piping connections and leak test

☐ Low side and high side evacuated to 500 microns

☐ Standing vacuum does not rise over 200 microns in 15 minutes

☐ Open service valves to allow refrigerant flow

☐ Refrigerant released from discharge to suction until suction pressure is approximately 60 PSIG

☐ Power wires connected in connection box

☐ Control wires connected in connection box

☐ Seal air gaps around wiring and refrigerant tubing through bulkhead

☐ Side panels and top cover assembled between high and low side

☐ Verify line dampening weights are installed on each discharge line.

## Unit Rigging and Placement (Three-piece unit) (in addition to Two-piece unit rigging and placement)

☐ Rail guide attached to evaporator section base rails

☐ Evaporator section rigged and set onto roof curb, aligned with supply end

☐ Removed and discarded shipping protection panels and top blockoffs from evaporator section

☐ Removed side panels and roof cap from evaporator section

☐ Applied gasket and butyl tape as indicated in the IOM

☐ Removed and discarded shipping protection panels and top block off from outside air section

☐ Rigged and set outside air section onto roof curb to within 2" of evaporator section

☐ Using 0.75" x 24" threaded rod pull and secure evaporator section and outside air section together

☐ Using .375" bolts, nuts and washers pull and secure the roof rails together

☐ Installed roof splice plate

☐ Added bullwrap to electrical wiring between evaporator and outside air section

☐ Connected power and control wiring between evaporator and outside air section

☐ Gasket applied and side panels installed on unit split

☐ Butyl tape applied on top of unit split along roof seam and roof cap installed

☐ Field Installed Control Wiring—Complete the field wiring connections for constant volume or variable air volume controls as applicable. Refer to "Field Installed Control Wiring" for guidelines

## Electric Heat Units

☐ Inspect the heater junction box and control panel; tighten any loose connections

☐ Check electric heat circuits for continuity

☐Two and Three piece units only) Route power wiring to high side junction box

## Gas Heat Units

☐ Gas supply line properly sized and connected to the unit gas train

☐ All gas piping joints properly sealed

☐ Drip leg Installed in the gas piping near the unit

☐ Gas piping leak checked with a soap solution. If piping connections to the unit are complete, do not pressurize piping in excess of 0.50 psig or 14" W.C. to prevent component failure

☐ Main supply gas pressure between 7" and 14" W.C.

☐ Flue Tubes clear of any obstructions

☐ Factory-supplied flue assembly installed on the unit

☐ Connect the 3/4" CPVC furnace drain stub-out to a proper condensate drain

☐ Install field provided heat tape to furnace drain line

## Hot Water Heat

☐ Route properly sized water piping through the base of the unit into the heating section

☐ Install the factory-supplied, 3-way modulating valve

☐ Complete the valve actuator wiring

## Steam Heat

☐ Route properly sized steam piping through the base of the unit into the heating section

☐ Install the factory-supplied, 2-way modulating valve

☐ Complete the valve actuator wiring

☐ Install 1/2", 15-degree swing check vacuum breaker(s) at the top of each coil section. Vent breaker(s) to the atmosphere or merge with return main at discharge side of steam trap

☐ Position the steam trap discharge at least 12" below the outlet connection on the coil

☐ Use float and thermostatic traps in the system, as required by the application.

☐ O/A Pressure Sensor and Tubing Installation (All VAV units and CV units with return fan or StatiTrac)

☐ O/A pressure sensor mounted to the roof bracket

☐ Factory supplied pneumatic tubing installed between the O/A pressure sensor and the connector on the vertical support

☐ (Units with StatiTrac) Field supplied pneumatic tubing connected to the proper fitting on the space pressure transducer located in the filter section, and the other end routed to a suitable sensing location within the controlled space

## Electrical

☐ Verify that the power supply to the unit complies with the unit nameplate specification

☐ Properly ground the unit

☐ Inspect all control panel components and tighten any loose connections

☐ Connect properly sized and protected power supply wiring to a field supplied/installed disconnect and the unit (copper wiring only to the unit)

☐ Verify that phasing to the unit is correct (ABC)

☐Turn the 1S2 toggle switch off to prevent accidental unit operation

☐Turn on power to the unit

☐ Press the STOP button on the Human Interface (1U2)

☐ Verify that all compressor crankcase heaters are energized for at least 12 hours prior to unit startup

## Evaporative Condenser

☐ Remove fan bracket

☐ Hookup inlet and drain piping

☐ Install Heat tape if needed

☐ Setup drain hold or drain on power loss

☐ Setup Mechanical Float

☐ Setup drain time

☐ Setup water quality management (3rd party or Trane factory-installed Dolphin Water Care System)

☐ Options setup

- ☐ Calibrate Conductivity Controller
- ☐ Setup blowdown set points on the conductivity sensor

## Energy Recovery Wheel

☐ Verify that the wheel turns freely though a full rotation

☐ Confirm that all wheel segments are fully engaged in the wheel frame and that the segment retainers are completely fastened

☐ Confirm the seal adjustment and proper belt tracking on the wheel rim

# Unit Startup

## Sequence of Operation

**NOTICE:**

**Compressors Failure!**

**Unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started. This will protect the compressors from premature failure.**

### Cooling Sequence of Operation

Time delays are built into the controls to increase reliability and performance by protecting the compressors and maximizing unit efficiency.

#### SZVAV Cooling Sequence of Operation

Single Zone VAV units will be equipped with a VFD controlled supply fan which will be controlled via the 0-10VDC RTM VFD output and the RTM Supply Fan output. With the RTM Supply Fan output energized and the RTM VFD output at 0Vdc the fan speed output is 37% (22Hz) from the VFD motor, by default, and at 10VDC the Fan Speed output is 100% (60Hz). The control scales the 0-10Vdc VFD output from the RTM linearly to control between the 37%-100% controllable range.

If the RTM determines that there is a need for active cooling capacity in order to meet the calculated Temperature Setpoint (Tset), the unit will begin to stage compressors accordingly once supply fan proving has been made. Note that the compressor staging order will be based on unit configuration and compressor lead/lag status.

Once the Tset calculation has reached its bottom limit (Tset Lower Limit Setpoint) and compressors are being utilized to meet the demand, the Tset value continues to calculate below the Tset Lower Limit Setpoint and the algorithm will begin to ramp the Supply Fan Speed up toward 100%. Note that the supply fan speed will remain at the compressor stage's associated minimum value (as described below) until the Tset value is calculated below the Tset Lower Limit Setpoint.

As the cooling load in the zone decreases the zone cooling algorithm will reduce the speed of the fan down to minimum per compressor stage and control the compressor outputs accordingly. As the compressors begin to de-energize, the Supply Fan speed will fall back to the Cooling Stage's associated minimum fan speed, but not below. As the load in the zone continues to drop cooling capacity will be reduced in order to maintain the discharge air within the ± ½ Tset deadband.

***Cooling Stages Minimum Fan Speed***

As the unit begins to stage compressors to meet the cooling demand, the following minimum Supply Fan Speeds will be utilized for each corresponding Cooling Stage. Note that the Supply Fan Speed will be allowed to ramp up beyond 37% as determined by the active Tset calculation; the speeds below are only the minimum speeds per cooling stage. Note that when transitioning between active cooling stages, compressors may energize prior to the supply fan reaching the minimum speed for the associated step.

1. 2-Stage DX Cooling -The minimum fan speed for units with 2 stages of DX Cooling will be 37% of the unit's full airflow capacity. At Stage 1 of DX Cooling the minimum Fan Speed will be 37% and at Stage 2 of DX Cooling the Fan Speed will be at a minimum of 67%.
2. 3-Stage DX Cooling -There are no IntelliPak applications with 3 stages of DX Cooling.
3. 4-Stage DX Cooling -The minimum fan speed for units with 4 stages of DX Cooling will be 37% of the unit's total airflow. At Stage 1 the minimum Supply Fan Speed will be 37%, at Stage 2 the minimum Supply Fan Speed will be 58%, and at Stages 3 & 4 the minimum Supply Fan Speed will be 67%.

#### Rapid Restart

This feature will occur after every power cycle. Once power is restored (e.g., via a backup generator), the RTM will maximize cooling capacity within 3-5 minutes. Once the space has returned to its Zone Temperature Setpoint, the RTM controls the load using normal capacity control algorithms. The supply fan will be turned on immediately after a power cycle, module initialization, or after the Unit Start Delay has timed out. The supply fan proving switch input must be closed prior to continuing with Rapid Restart.

Once the supply fan proving switch input has closed, the unit will consider the outside air temperature to determine whether economizing or DX mechanical cooling will be utilized to provide the necessary cooling. If the outside air temperature is less than 50°F and economizing is enabled, the outside air damper will be utilized. If the outside air temperature is above 50°F, the outside air damper will remain closed and DX mechanical cooling will occur for the duration of Rapid Restart.

### Compressor Sequence of Operation

Each compressor is equipped with a crankcase heater and is controlled by a 600 volt auxiliary switch on the compressor contactor. The proper operation of the crankcase heater is important to maintain an elevated compressor oil temperature during the “Off” cycle to reduce oil foaming during compressor starts.

When the compressor starts, the sudden reduction in crankcase pressure causes the liquid refrigerant to boil rapidly causing the oil to foam. This condition could damage compressor bearings due to reduced lubrication and could cause compressor mechanical failures.

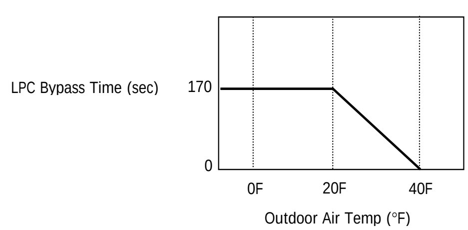
## Low Ambient Compressor Operation

Certain applications require compressor operation at lower ambient conditions than standard units. Low ambient compressor operation is a factory configured option that allows units to operate down to -10°F by extending the low ambient compressor lockout setpoint range.

Standard configuration units are limited to a minimum low ambient compressor lockout setpoint of 40° F. In conditions below 40°F the low-pressure cutout (LPC) switch can open in the first few minutes of initial compressor operation due to refrigerant circulation characteristics. To prevent nuisance LPC events at startup in these conditions the unit controller will bypass LPC processing for a varying period of time as defined below:

– For ambient temps below 20°F LPC events will be bypassed for the first 170 seconds of compressor operation.

For ambient temps between 20° and 40°F the bypass time reduces linearly from 170 seconds at 20°F to 0 seconds at 40°F. LPC events are not bypassed at initial compressor start in ambient conditions above 40°F.




– An open LPC switch detected at compressor start will result in a manual-reset compressor lockout condition.

– 4 consecutive LPC trip occurrences after the bypass time expires without a minimum of 3 minutes of compressor operation between trips will result in a manual-reset compressor lockout.

In addition to alternate LPC event processing, the second compressor to start on each refrigerant circuit will be disabled for 40 minutes each time a circuit starts in ambient conditions less than 40°F. To properly maintain head pressure control in low ambient conditions one condenser fan on each refrigerant circuit will be controlled by a Variable-frequency motor drive (VFD).

This fan will always be the first fan active. The VFD will control fan speed at all times compressors are active to the HI-adjustable Low Ambient Control Point. If head pressure control requires additional condenser fan stages to maintain proper Saturated Condenser Temperature within limits they will be activated as necessary according to the standard head pressure control fan-staging algorithm.

## Units with Evaporative Condenser Sequence of Operation

Upon a power up without water in the sump, the condenser sump drain will be controlled to allow the sump to hold water. The fill relay will be energized if there is a call for mechanical cooling and if the outdoor air temperature is greater than 10°F on units with a sump heater installed or greater than 40°F on units without sump heat. Once the fill solenoid is energized, the sump will begin to fill. The minimum water level switch will close and the fill relay will be de-energized. The sump water temperature sensor is invalid unless the minimum water level switch is closed.

If the sump water temperature is less than the setpoint (default is 38°F), the sump heater will be energized until the water temperature reaches the setpoint plus 5 degrees (43°F for default). The fill solenoid will remain closed for 20 minutes or until the water temperature is greater than 35°F. Once a water temperature of 35°F or greater is achieved, the fill solenoid is energized, the sump will continue to fill, and a five minute timer is started.

When the timer expires, the compressor lockout will be released and mechanical cooling will be allowed. Head pressure control will be regulated by a variable speed fan until the liquid line pressure from either circuit reaches the upper limit, which is set on the Human Interface under the setup menu 120°F default. The liquid line pressure is converted to a temperature for display at the Human Interface. When the temperature exceeds the upper limit, the condenser sump pump will be energized. When the sump pump is energized, water is pumped from the sump and sprayed over the condenser coil. If the liquid line pressure from either circuit falls below the lower limit the sump pump will be de-energized.

When the sump pump is energized or de-energized a change in state is observed from an auxiliary contactor to ensure proper sump pump operation. A change in states must be observed by the auxiliary contactor within 6 seconds of the command to change states or mechanical cooling will be locked out on a sump pump failure causing a manual reset diagnostic to be set.

The fill solenoid will remain energized and the water level will be controlled by the mechanical float valve. If the maximum level float ever closes, an information-only diagnostic is set and the fill solenoid is de-energized. This is an indication that the mechanical float is not adjusted properly or a failure of the mechanical float valve has occurred. If the maximum level input is open for two continuous minutes, the diagnostic will be cleared and the fill solenoid will be energized.

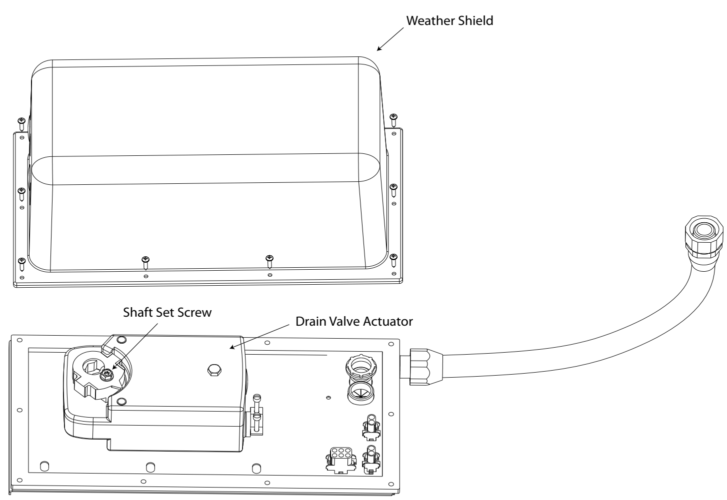
If the sump water temperature ever drops below 35°F, the drain actuator will be controlled in order to drain the water from the sump. If there is a call for mechanical cooling and the outdoor air temp is greater than 10°F on units with sump heat installed or greater than 40°F on units without sump heat, the unit will be allowed to refill the sump.

The drain control can be configured via the Human Interface, and by the drain actuator installation, to hold or drain water on power loss; the default is set to drain. Periodic purge is a cyclic opening of the drain to remove debris and buildup from the sump and add additional fresh water to the sump. Periodic purge has an adjustable interval from the setup menu on the Human Interface with a range of 1-12 hours or can be set to disabled - the default position if periodic purge is not required. The duration of the blowdown, or the time that the drain valve is opened, is adjustable to a range of 5 - 255 seconds, with 120 seconds being the default.

The optional conductivity controller also uses this timer to open the drain, when required, based on water quality. During this purge, the fill solenoid will remain energized to provide fresh water to the sump to replace water being released during the blowdown. Water treatment blowdown is provided by shorting the designated input on the customer-supplied terminal strip. This gives the customer more flexibility in determining water conditions via external controls. Once the input is detected closed, the drain valve will be opened for a time equal to the Human Interface adjustable periodic purge duration.

Once the duration timer expires, or if the minimum level switch opens, the drain valve will be closed and the water treatment blowdown input will be ignored for 15 minutes. During this blowdown the fill relay will remain open to provide fresh water to the sump. The adjustable duration time period should be set so that during drain operation 1 inch of water is drained from the sump with the fill solenoid valve closed. If the minimum water level switch opens during a blowdown cycle, the unit will de-energize the sump pump in order to protect the compressors and sump heater from insufficient water levels. Once the water level reaches the minimum level input and this input closes for 10 seconds, the compressors and sump heater operations will be allowed to restart.

**Figure 62. Drain valve actuator with weather shield**




## Evaporative Condenser Drain Valve Setup

The drain valve is shipped to “Drain During Unit Power Loss Conditions.” This means that when the unit disconnect is turned off, the 1S2 toggle switch is turned off, or the unit loses power, the drain will open. The valve is spring loaded and will travel from fully closed to fully open in approximately 25 seconds.

This is desirable in cold climates where a risk of freezing exists. In milder climates it may be desirable to keep the water in the sump when unit power is off to avoid unnecessarily wasting water whenever the unit disconnect is turned off.

To convert the unit to “Hold During Unit Power Loss Conditions”:

1. Remove power from the unit.
2. Remove the weather shield cover (Figure 62, p. 98).
3. Loosen the shaft set screw (Figure 62, p. 98), remove the locking clip, remove the shaft adapter (Figure 63, p. 99).
4. Lift the drain valve actuator and rotate it to the “hold during power loss” position. (Figure 64, p. 99)
5. Reinstall the shaft adapter and locking clip and reinstall the actuator onto the base. Make sure the arrow on the shaft adapter is set to 0°.
6. Make sure the valve is in the fully closed position, then tighten the shaft set screw.
7. Reinstall the weather shield cover.
8. Restore power to the unit.
9. At the Human Interface, press SETUP, NEXT until 'Head Pressure Control Setup Submenu” is seen. Press ENTER.
10. Change the “Sump Drain Valve Relay Control” from Drain to Hold.

Figure 63. Actuator shaft adapter removal/assembly

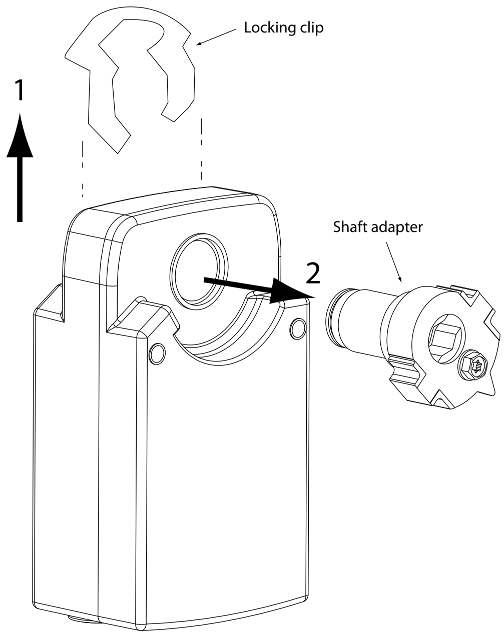
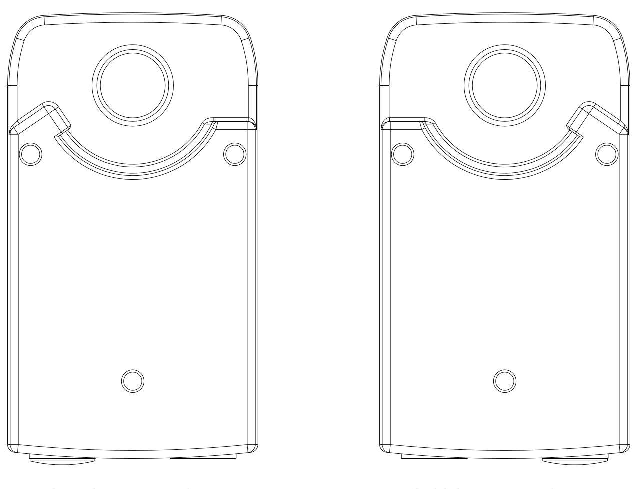



Figure 64. Actuator is shipped in “Drain during power loss” configuration




## Set Drain Duration Timer

Enter service test mode from unit Human Interface. Navigate to the compressor condenser fan submenu. Under head pressure control, use manual control.

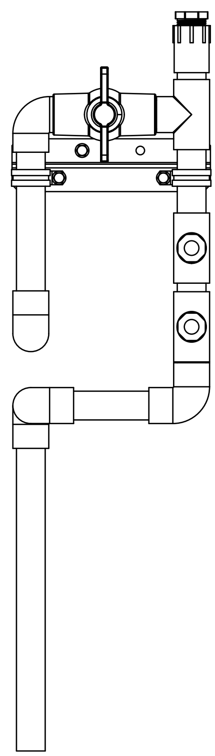
Close drain valve and energize water inlet solenoid valve until water reaches nominal level. Once level is achieved, de-energize fill solenoid. Open drain valve and time how long it takes for the water level to drop one inch, make sure to take into account the closing time of the valve.

## Chemical Water Treatment Tree

The Trane evaporative condenser comes with a PVC tree to allow easier inputs for third party water treatment. The tee labeled A is a ¾ inch NPT threaded input, see Figure 65. Tees B and C are 1/2 inch NPT threaded inputs. The ball valve can be used to stop the water flow through the tree to allow the customer to add hookup of water treatment, or to change and update water treatment with the unit running.

Units with Dolphin WaterCare™ or conductivity sensor will have the conductivity sensor installed into the ¾ inch tee with the other tees plugged. For all other units, A, B and C will be plugged, see Figure 65. Ensure the ball valve is in the open position when water treatment is being operated in the system to make sure water flows through the tree and transports treatment to the unit sump.

Figure 65. Chemical water treatment tree



## Conductivity Controller

Upon startup, the conductivity controller must be calibrated and setup for operation. Below are the necessary steps to accomplish those tasks. The controller has two setpoints that control two relays. Both of these setpoints will need to be set by Dolphin or a local water treatment expert.

1. The first setpoint is the standard point blowdown point.
   – When the setpoint is exceeded the relay (K1) will be energized and a blowdown request will close the Water treatment request binary input on the MCM.

2. The second setpoint will be the emergency point
   – The second setpoint will open the normally closed K2 relay which will interrupt the sump proving circuit which will generate a manual lockout. This second setpoint will be used to protect the unit from extremely high conductivity that would indicate a failure in the system.
3. Inside the enclosure for the controller, there will be a thermostat and strip heater that will protect LCD from cracking at low ambient conditions. The thermostat closes at 15°F and opens at 25°F.

### *Procedure to calibrate conductivity*

***Note:*** *Visit this webpage for additional documentation: <http://www.gfsignettools.com/products/pdf/8860eng.pdf>*

Use a calibrated thermometer and a known conductivity rating. There are two different options for having a liquid with known conductivity. Purchase a liquid with known conductivity rating and purchase a handheld conductivity reader.

1. Close the ball valve on the chemical treatment tree and remove the conductivity sensor from the tree.
2. Enter service test mode on the unit and turn the pump on, ensuring the compressors are set to Off.
3. With the conductivity controller connected to the sensor and power, enter the CALIBRATE menu by holding down the enter key for 2 seconds.
4. When asked for the calibration key code, hit the UP-UP-UP-DOWN arrow keys in sequence.
5. Using the UP and DOWN arrows go to Chan 1 Cell: Standard. Ensure this channel is set to standard.
6. If not press the RIGHT arrow key and set to standard then press the ENTER key to return to the CALIBRATION menu.
7. Using the UP and DOWN arrows go to Chan 1 Cell. Ensure that the cell constant is set to 1.0.
8. If not press the RIGHT arrow key and set the cell constant to 1.0 then press the ENTER key to return to the CALIBRATION menu.
9. Using the UP and DOWN arrows go to Chan 1 Set: Temperature and press the RIGHT arrow key to enter the edit mode.
10. Adjust the temperature on the controller to match the actual temperature.
11. Press the ENTER key to save the input and return to the CALIBRATE menu.
12. Using the UP and DOWN arrows, go to the Chan 1 Set: Conductivity and press the RIGHT arrow key to enter the edit mode.
13. Adjust the conductivity on the controller to match the actual conductivity rating of the liquid.
14. Press the ENTER key to save the conductivity rating and return to the CALIBRATE menu.
15. When finished calibrating the controller, press the UP and DOWN key simultaneously to return to normal operating mode.

### *Procedure to set purge setpoints on the conductivity controller*

***Note:*** *Visit this webpage for additional documentation: <http://www.gfsignettools.com/products/pdf/8860eng.pdf>*

Work with local water treatment expert to identify nominal purge and emergency purge conductivity value.

1. Close the ball valve on the chemical treatment tree and remove the conductivity sensor from the tree.
2. Enter Service test mode on the unit HI and energize the sump pump, ensuring the compressors are set to "OFF".
3. With the conductivity controller connected to the sensor and power, enter the CALIBRATE menu by holding down the enter key for 2 seconds.
4. When asked for the calibration key code, hit the UP-UP-UP-DOWN arrow keys in sequence.
5. Using the UP and DOWN arrows, go to Relay 1 Setpoint: and press the RIGHT arrow key to enter edit mode (K1).
6. Adjust the set point to the nominal blowdown conductivity value.
7. Press the ENTER key to return to the CALIBRATE menu.
8. Using the UP and DOWN arrows, go to Relay 2 Setpoint: and press the RIGHT arrow key to enter edit mode (K2).
9. Adjust the set point to the emergency conductivity value.
10. Press the ENTER key to return to the CALIBRATE menu.
11. When finished setting the values, press the UP and DOWN key simultaneously to return to normal operating mode.

## Units Without an Economizer

Upon entering an "occupied" mode of operation, the RTM receives input from the remote panel to start the supply fan. For constant volume applications, the RTM supply fan contacts close which energizes the supply fan contactor. When the supply fan starts, the fan proving switch closes, signaling the RTM that airflow has been established and the VFD will begin to ramp the fan (if equipped).

When a cooling request is sent to the RTM from a zone temperature sensor, the RTM evaluates the operating condition of the system using the supply air temperature input and the outdoor temperature input before sending the request to the MCM. Once the request is sent to the MCM, the compressor module checks the compressor protection circuit before closing "Stage 1". After the first functional stage has started, the compressor module monitors the saturated refrigerant temperature and closes the condenser fan output contact, when the saturated refrigerant temperature rises above the "lower limit" setpoint.

### Units with an Economizer

Upon entering an "occupied" mode of operation, the RTM receives input from the remote panel to start the supply fan. For constant volume applications, the RTM supply fan contacts close which energizes the supply fan contactor. When the supply fan starts, the fan proving switch closes, signaling the RTM that airflow has been established. The RTM opens the economizer dampers to the specified "minimum position".

When a cooling request is sent to the RTM from the zone temperature sensor, the RTM evaluates the operating condition of the system using the supply air temperature input and the outdoor temperature input before sending the request to the MCM for mechanical cooling. If the outdoor conditions are suitable for cooling (temperature and humidity are within specified setpoints), the RTM will attempt to maintain the zone temperature without using any compressors. If the zone temperature can not be maintained within the setpoint deadband, the RTM sends a cooling request to the MCM. The compressor module checks the compressor protection circuit before closing "Stage 1". After the first functional stage has started, the compressor module monitors the saturated refrigerant temperature and closes the condenser fan output contact, when the saturated refrigerant temperature rises above the "lower limit" setpoint.

### Units with TRAQ™ Sensor

The outside air enters the unit through the TRAQ Sensor assemblies and is measured by velocity pressure flow rings. The velocity pressure flow rings are connected to a pressure transducer/solenoid assemblies. The solenoid is used for calibration purposes to compensate for temperature swings that could affect the transducer. The Ventilation Control Module (VCM) utilizes the velocity pressure inputs, the RTM outdoor air temperature input, and the minimum outside air CFM setpoint to modify the volume (CFM) of outside air entering the unit as the measured airflow deviates from setpoint.

When the optional temperature sensor is installed and the Preheat function is enabled, the sensor will monitor the combined (averaged) outside air and return air temperatures. As this mixed air temperature falls below the Preheat Actuate Temperature Setpoint, the VCM will activate the preheat binary output used to control a field installed heater. The output will be deactivated when the temperature rises 5 above the Preheat Actuate Temperature Setpoint.

When the optional $CO_2$ sensor is installed and DCV is enabled, the OA damper will be modulated to control $CO_2$ concentrations. If the $CO_2$ concentration is greater than the Design Minimum $CO_2$ Setpoint the OA damper will be opened to the Design Minimum OA Damper Setpoint (w/o TRAQ) or until the Design Minimum OA Flow Setpoint is met (w/TRAQ).

If the $CO_2$ concentration is less than the DCV Minimum $CO_2$ Setpoint the OA damper will be closed to the DCV Minimum OA Damper Setpoint (w/o TRAQ) or until the DCV Minimum OA Flow Setpoint is met (w/TRAQ).

If the $CO_2$ concentration is between the Design Minimum $CO_2$ Setpoint and the DCV Minimum $CO_2$ Setpoint the OA damper will be modulated proportionally between the Design Minimum OA Damper Setpoint and the DCV Minimum OA Damper Setpoint (w/TRAQ) and between the Design Minimum OA Flow Setpoint and the DCV Minimum OA Flow Setpoint (w/o TRAQ).

### Frostat™ Control

The compressor module utilizes an evaporator temperature sensor, mounted on the suction line of each circuit, to protect the evaporator from freezing. If the evaporator temperature approaches the specified setpoint, adjustable between 25°F and 35°F, the compressor(s) will be cycled "off". The compressors will not be allowed to restart until the evaporator temperature has risen 10 F above the specified cutout temperature and the compressor(s) have been off for a minimum of three minutes.

### Lead/Lag Operation

When Lead/Lag is enabled, each time the system cycles after having stages 1 and 2 "On", "Stage 2" and the corresponding condenser fan output will start first. The compressor module cycles the compressors "On" and "Off" to keep the zone temperature within the cooling setpoint deadband. The condenser fans are cycled "On" and "Off" to maintain the saturated refrigerant temperature within the specified controlband.

### Units equipped with 100% modulating exhaust

The exhaust dampers are controlled through an Exhaust/Comparative Enthalpy Module (ECEM). The ECEM module receives input from a space transducer and modulates the exhaust dampers to maintain the space pressure to within the specified setpoint controlband.

## Modulating Dehumidification (Hot Gas Reheat) Sequence of Operation

When the relative humidity in the controlled space (as measured by the sensor assigned to space humidity sensing) rises above the space humidity setpoint, compressors and the supply fan will energize to reduce the humidity in the space.

All compressors on both refrigerant circuits will be staged up during active dehumidification. Circuit #1 is designated the reheat circuit and will feature additional refrigerant control devices as well as a split condenser coil with one placed section in the indoor air stream and the other in the outdoor coil compartment.

During active dehumidification the discharge unit discharge air will be controlled to the Supply Air Reheat Setpoint by modulating the amount of reheat produced by the reheat coil. The Supply Air Reheat Setpoint, Occupied and Unoccupied Dehumidification Setpoints are adjustable via the human interface, BAS/Network control, or GBAS.

Active dehumidification will be terminated when the humidity in the space is reduced to the active space humidity setpoint - 5% or when an overriding condition such as heating or cooling demand or a failure occurs in a component required for dehumidification.

On VAV units, at startup, satisfying the VAV Occupied Cooling setpoint, MWU setpoint, and DWU setpoint will have priority over dehumidification mode. Once heating modes are satisfied, and the unit is satisfying the SA Cooling Setpoint, dehumidification mode will be entered if no more than half the unit mechanical cooling capacity is requested.

On SZVAV units, dehumidification will be similar to VAV modulating dehumidification with the exception of a dynamic Supply Air Reheat Setpoint. Rather than utilizing a static Supply Air Reheat Setpoint, once the unit enters dehumidification, the Discharge Air Setpoint will be calculated based on the Zone temperature vs. Zone Cooling Setpoint error and will be capped at the user selected Supply Air Reheat setpoint.

Dehumidification is not allowed during VAV Heating Modes (Changeover input closed). Once active, dehumidification control will remain active for a minimum of three minutes unless a priority unit shutdown request is received or the High Pressure Control input opens on either circuit.

On VAV units dehumidification is best performed in full airflow mode therefore the “VAV Box Open” relay will be energized during active dehumidification control and the supply air pressure control algorithm will indirectly open the VFD output within a few minutes after entering dehumidification.

Dehumidification control can be enabled separately for occupied and unoccupied modes of operation via the Human Interface and is overridden/disabled whether active or inactive by the following methods:

- Priority unit shutdown conditions (Emergency stop, Ventilation Override, Network Stop, etc.)
- Compressor circuit manual reset lockouts on either circuit. Low Refrigerant Charge monitoring is active during dehumidification mode and will lockout compressor circuits based on the same criteria used for cooling mode.
- Outdoor Air Temp is less then 40°F or greater the 100°F.
- Humidity Sensor Failure
- For VAV units, (in occupied) dehumidification will be disabled if space temp is less than the Dehumid Override Low Zone Setpoint or higher than the Dehumid Override High Zone Setpoint. If dehumidification is inactive it will not be allowed until it space temp rises higher than the Dehumid Override Low Zone Setpoint + 1.0°F or lower than the Dehumid Override High Zone Setpoint - 2.0°F.
- For SZVAV units, dehumidification will be disabled if space humidity levels have fallen below the Active Occ/Unocc Dehumidification Setpoint -5% Dehumidification Hysteresis Offset, the zone temperature has dropped too close to the Zone Heating Setpoint in any unit mode (Zone Temp. is less than ZHSP + 0.5°F), the zone temperature rises above the Zone Cooling Setpoint +2°F in any unit mode, Entering Evaporator Temperature falls too low, Froststat input becomes active, or Dehumidification/Reheat becomes disabled.
- For CV and all units in unoccupied, if space temp is less than the Zone Heating Setpoint (ZHSP) + 0.5° F if dehumidification is active, or less than ZHSP + 1.0° F if not dehumidification mode will be disabled. If zone conditions result in a cooling request for more than one-half the available cooling capacity of the unit dehumidification will be disabled and will transition to cooling control. If dehumidification is inactive, dehumidification will not be allowed until the active unit cooling capacity request drops to half the available cooling capacity or less, unless the space temp is less than the Zone Cooling Setpoint.
- In CV units in occupied mode, if the unit is not in “AUTO” system mode and is set to “HEAT” system mode via the HI, BAS, or Zone Sensor device, dehumidification control will be disabled at space temps above Occupied ZCSP + 1.0° F. If dehumidification is inactive it will not be allowed to activate if space temp is greater than the OZCSP.

All units configured for modulating dehumidification will have a reheat condenser coil purge function to ensure proper refrigerant distribution in the reheat circuit. This feature is always enabled and will monitor the amount of cumulative compressor run time while the reheat condenser coil pumpout relay is in a certain state. If compressors accrue an amount of run time equal to the HI-adjustable purge interval time without the pumpout relay changing states a purge cycle will be initiated lasting for three minutes.

During this cycle all compressors but the 2nd compressor on circuit #1 will be energized if not already, the reheat valve and cooling valves to will be set to 50%, and the reheat coil pumpout relay will be toggled to its opposite state. After the three-minute purge cycle completes the purge interval timer will be reset and all system components will return to the state they were in prior to entering purge.

During dehumidification control an evaporator frost control function designed specifically for reheat modes will be active. This function will reduce refrigeration circuit capacity to 50% (1st compressor on each circuit remaining on) when the Entering Evaporator Temp drops below a non-adjustable limit of 35° F for 10 continuous minutes. Once capacity is reduced, it will remain reduced until the current cycle of dehumidification is terminated or a purge cycle occurs.

If the Entering Evaporator Temp remains below 35° F for an additional 10 minutes both circuits will be de-activated and remain off until the Entering Evaporator Temp rises above 45°F. Even though all compressors have been de-activated the unit will remain in dehumidification mode and re-enable compressors up to 50% capacity when the Entering Evaporator Temp rises to 45°F or greater.

## Energy Recovery Sequence of Operation

**⚠WARNING**

**Toxic Hazards!**

**Do not use an energy wheel in an application where the exhaust air is contaminated with harmful toxins or biohazards. Failure to follow this instruction could result in death or serious injury.**

The primary components of the energy recovery system are the energy recovery wheel, exhaust air bypass damper, outdoor air bypass damper, and the energy recovery preheat output. See Figure 67, p. 104 Figure 68, p. 105 A filter is also placed between the wheel and the outdoor air damper and an indicator scheme similar to that for final filters is provided to notify the user when that filter needs to be changed.

The energy recovery wheel will only be energized when both the Supply Fan and Exhaust Fan are requested on by the various functions that control them. Energy recovery is a passive function and can not request fan operation.

Once the required airflow is present the wheel will be commanded on if the indoor vs. outdoor conditions are such that energy can be recovered. This is assessed differently in cooling and heating modes.

In cooling mode, wheel activation conditions are assessed based on indoor (return air) vs. outdoor enthalpy. Indoor and outdoor enthalpy values are calculated using the same sensors as used for comparative enthalpy. If the outdoor enthalpy is 3 BTU/lb. greater than indoor enthalpy the wheel is activated to remove energy from the incoming outdoor air. In heating mode the wheel is activated based on indoor vs. outdoor dry bulb temperature. If the outdoor temperature is 5° F less than the indoor temperature. the wheel is activated to recover heat energy from the exhaust air.

In cooling mode the exhaust air bypass damper is held closed, providing 100% energy recovery capacity during cooling modes of operation. In heating modes, including CV heating, VAV Heating, CV Supply Air Tempering, VAV Supply Air Tempering, Morning Warm-up, and Daytime Warm-up the exhaust air bypass damper is controlled to discharge air temperature. The damper is modulated to keep the supply air temp at the Supply Air Heating setpoint for VAV control, or for CV control, supply air temp will be controlled to a calculated Supply Air Heat Setpoint based on conditions in the space.

If the wheel is active, supplemental heat (electric, hydronic, gas) control algorithms will be disabled until the exhaust air bypass damper is fully closed (maximum heating capacity from the wheel). At this point, supplemental heat algorithms are released to calculate supplemental heat capacity requests using standard setpoints until the setpoints are satisfied. In VAV occupied modes the energy recovery wheel will remain active after termination of supplemental heat above heating setpoint until the exhaust air bypass damper is opened fully for 3 minutes (indicating minimal capacity requested from the wheel). In CV occupied heating mode the wheel will remain active after termination of a heating cycle until the zone temp rises above the Occupied Zone Heating Setpoint + 1.0°F and the exhaust air bypass damper is fully open. The wheel will remain active if these conditions persist continuously until the expiration of a HI-adjustable time-out period or until the zone temp rises above the Occupied Zone Cooling Setpoint - 0.5°F.

During active Economizing control the energy wheel will be disabled but the outdoor air bypass damper will open an amount that tracks the opening of the OA damper proportionally from minimum position to fully open.

To protect the wheel from frost build-up in heating modes a frost avoidance function is included. This feature will energize the energy recovery preheat output (if configured) and modulate the outdoor air bypass damper open (to reduce incident cold outdoor air on the wheel) as necessary when the Leaving Recovery Temp Sensor value is less than the Recovery Frost Avoidance Setpoint. The Leaving Recovery Temp Sensor is installed in the leaving air stream on the exhaust-fan side of the energy wheel.

Figure 66 provides the exhaust air temperature setpoint for 70°F return air at various percents of relative humidity.

Where variable effectiveness / outside air bypass is not enough to prevent frosting conditions, the energy recovery wheel shuts off. Turning the wheel off during frost conditions is a reliable method of preventing the wheel from frosting, however, energy is not being recovered and the extreme heating load must be handled otherwise. Extreme winter design condition for energy recovery units may require return air preheat.

An energy recovery wheel proving function is also provided to indicate when the wheel is not turning after it has been commanded on.

**Figure 66. Energy recovery wheel exhaust air setpoint temperatures**

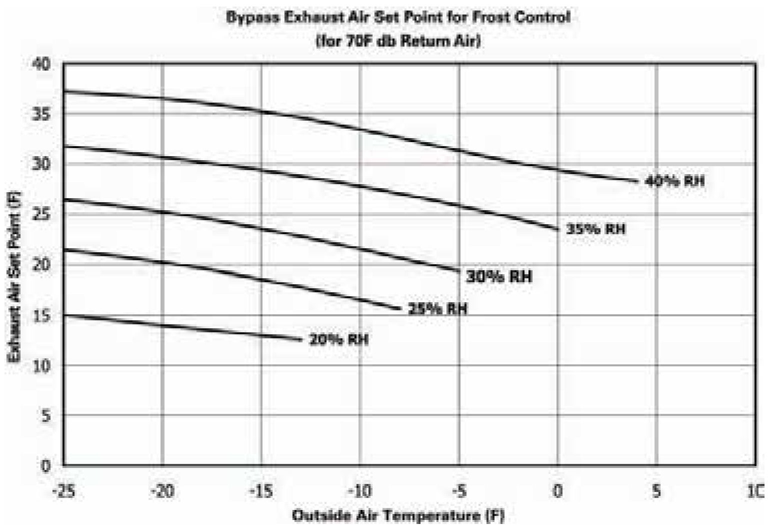



**Figure 67. Energy recovery wheel operation**

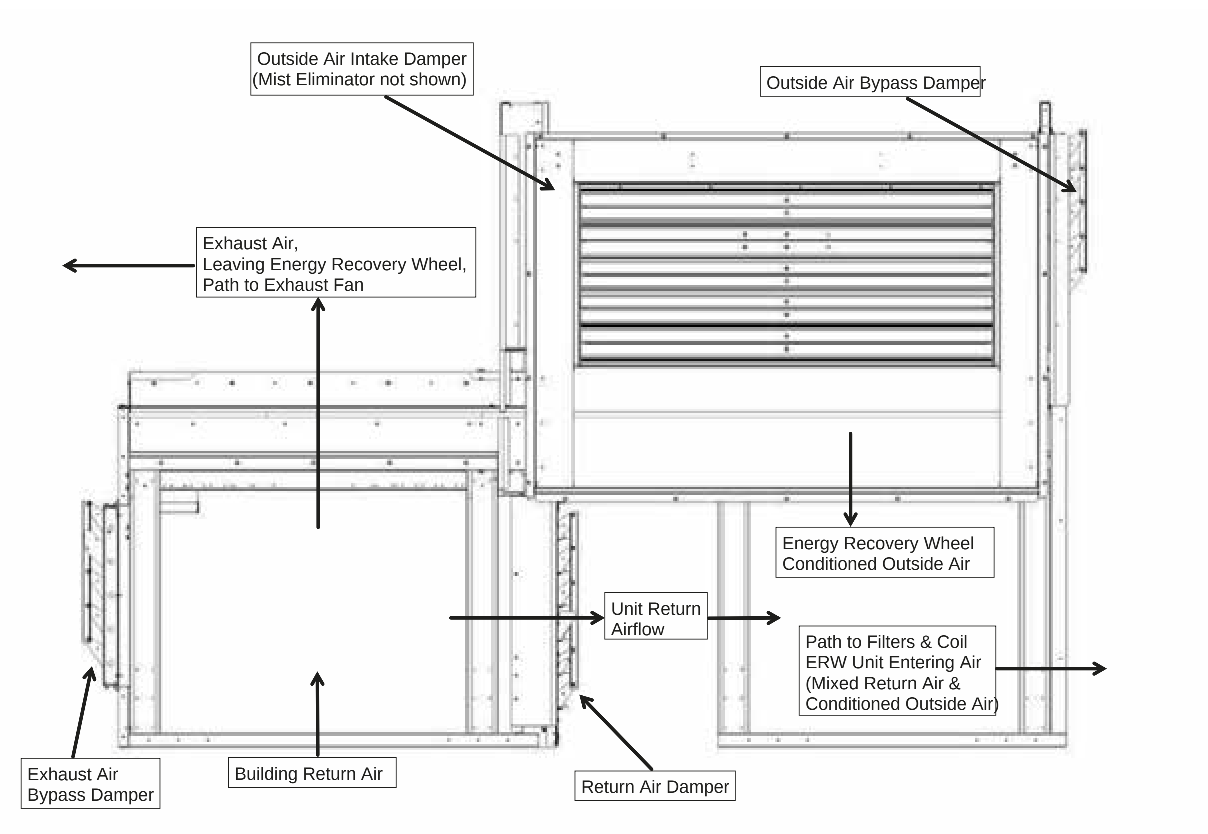
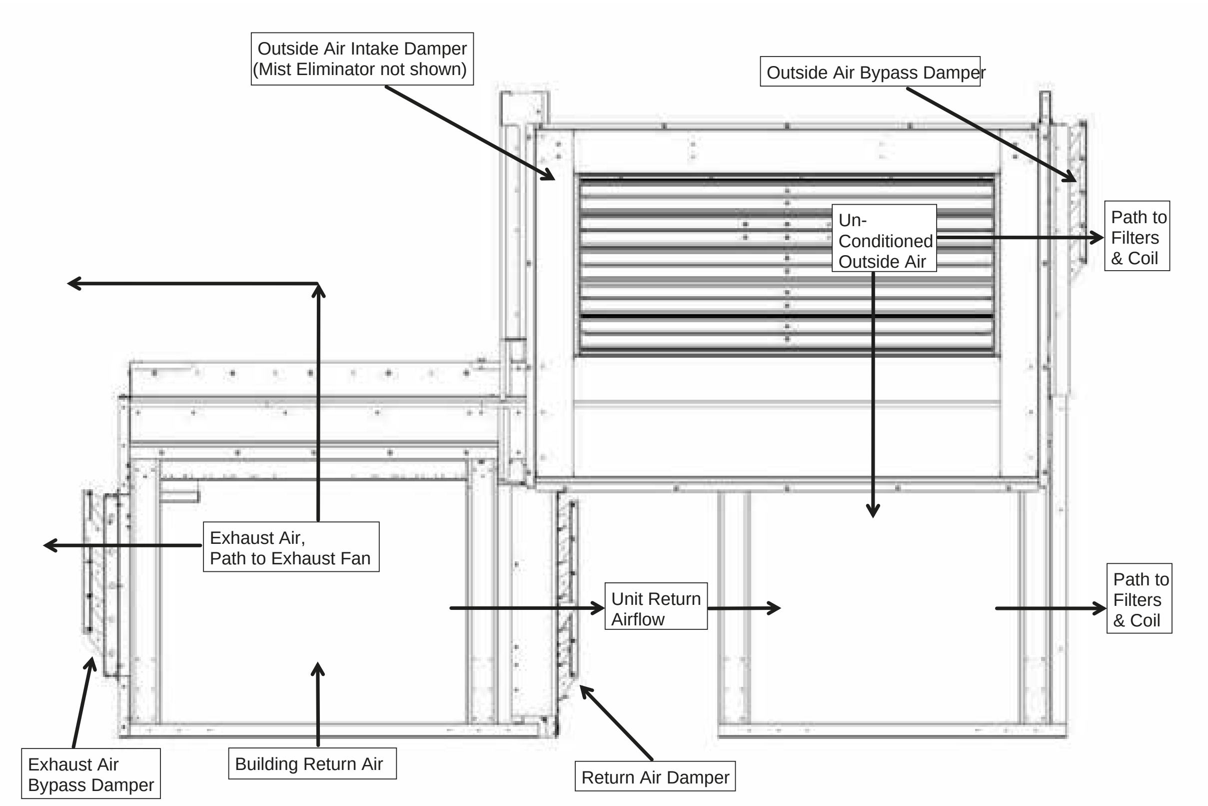


**Figure 68. Energy recovery wheel economizer operation**




## Gas Heating Sequence of Operation Standard

### Two Stage Gas Furnace

The control system for the rooftop units are wired to ensure that the heating and cooling do not occur simultaneously. Refer to the wiring diagram that shipped with the unit while reviewing the following sequence of operation.

## Honeywell Ignition System

### (850 & 1100 MBH Two Stage Natural Gas)

When a heating requirement exists, the Rooftop Module (RTM) starts the supply fan and sends a request for heat to the Heat Module. The Heat Module closes contacts and starts the combustion blower motor. The combustion blower motor starts on low speed through the normally closed combustion blower relay contacts.

The supply airflow switch and the combustion air switch closes. Power is applied through the high limit cutout to the Honeywell ignition control board. The ignition control board starts a pre-purge timing cycle. At the end of the pre-purge cycle, the ignition transformer and the pilot solenoid valve are energized. This starts a 10 second trial for pilot ignition. When the pilot flame is established and sensed by the flame sensing rod, stage 1 of the main gas valve and the 60 seconds sequencing time delay relay is energized.

The system will operate in the low heat mode until an additional call for heat is established by closing the contacts on the Heat Module. The sequencing time delay relay will energize the combustion blower motor relay which switches the combustion blower motor to high speed and energizes the 2nd stage solenoid on the gas valve after approximately 60 seconds.

If the flame rod does not detect a pilot flame within the 10 second trial for ignition period, the control will lockout. If a flame failure occurs during operation, the gas valve, the sequencing time delay relay, and the combustion blower relay is de-energized. The system will purge and attempt to relight the pilot. If a flame is not detected after this attempt, the Honeywell ignition control will lock out. The combustion blower motor will continue to operate as long as a heating demand exists and the system switch is “On”.

Once the heating demand has been satisfied, the combustion blower and the Honeywell ignition control board is de-energized.

***Note:*** *The above sequence is the same for Propane. The orifices are smaller and the manifolds are adjusted to different values*

### (1800 & 2500 MBH Two Stage Natural Gas)

When a heating requirement exists, the Rooftop Module (RTM) starts the supply fan and sends a request for heat to the Heat Module. The Heat Module closes contacts and starts the combustion blower motor through the combustion blower relay.

The supply airflow switch and the combustion air switch closes. Power is applied through the high limit cutout to the Honeywell ignition control board. The ignition control board begins the pre-purge timing cycle with the damper in the light off position and the low fire start interlock is closed

At the end of the pre-purge cycle, the ignition transformer and the pilot solenoid valve are energized. This starts a 10-second trial for pilot ignition.

When the pilot flame is established and sensed by the flame sensing rod, the stage 1 of the main gas valve will begin. The gas butterfly control valve is in the low fire setting by the linkage arm connection between the combustion air actuator and the butterfly valve.

The system will operate in the low heat mode until there is an additional call for heat established by closing the contacts on the Heat Module.

If the flame rod does not detect a pilot flame within the 10 second trial for ignition period, the ignition control board will lockout. The combustion blower motor will continue to operate as long as a heating demand exists and the system switch is "On".

Once locked out on flame failure, the IC board will not reactivate the ignition/combustion control circuit until it is reset manually. To do this, press the reset button on the front of the IC board case.

A set of relay contacts is available for external use for heat fail (Information Only).

Once the heating demand has been satisfied, the combustion blower and the Honeywell ignition control board is de-energized.

## Modulating Gas Sequence of Operation

The control system for the rooftop units is wired to ensure that the heating and cooling do not occur simultaneously. Refer to the modulating heat wiring diagram that shipped with the unit while reviewing the following sequence of operation. As you review the sequence of operation, keep the following in mind:

1. The furnace will not light unless the manual gas valves are open and the control circuit switch is closed.
2. The control systems are wired to ensure that heating and cooling cannot occur simultaneously.
3. The unit supply fans must run continuously so airflow switch will stay closed.
4. Modulating Gas heat is available during both occupied and unoccupied operation.

When there is a call for heat, the heat module energizes the combustion blower which causes the combustion air flow switch to close. The ignition control board will energize providing that the indoor air flow switch, high limit, and low and high pressure gas switches are closed.

The ignition control board then causes the combustion air actuator to drive the inlet air damper to the fully open position for a 30 second pre-purge. The pre-purge time does not begin until the purge interlock switches are made.

After the pre-purge, the combustion air actuator drives the inlet air damper and the gas butterfly control valve to a nearly closed position for light off. When the Low fire interlock switch is closed the ignition transformer is energized, the igniter begins to spark and the pilot valve opens.

This begins a 10-second trial for ignition period during which the flame rod must detect the flame. If does not detect a flame at the end of the period, it will shut down and lock out the ignition/ combustion circuit.

Once the pilot flame has been established, the heat module will open the main gas valve and auxiliary gas valve. After the main flame is established, the pilot valve closes. The ignition sequence is completed and the heat module will drive the combustion air actuator to a firing rate based on a 2-10 VDC signal. The gas butterfly control valve will respond through the connecting linkage.

The heater will continue to run until the call for heat is removed or a limit opens.

Following the completion of the call for heat, there is a 15-second post-purge.

### Flame Failure

In the event that (IC) board loses the "proof-of-flame" input signal during furnace operation, it will lock out and the must be manually reset (Combustion blower motor continues to run as long as a heating requirement exists and control circuit switch is ON.)

Once locked out on flame failure, the (IC) board will not reactivate the ignition/combustion control circuit until it is reset manually. To do this, press the reset button on the front of the (IC) board case.

A set of relay contacts is available for external use for heat fail (Information Only).

***Note:*** *The modulating gas heaters are factory adjusted for safe operation and to reach the nameplate rated firing MBH for most areas of the country. The proper air/gas ratio must be reached by the service tech during startup..*

## Electric Heat Sequence of Operation

The control system for the rooftop units are wired to ensure that heating and cooling do not occur simultaneously. Refer to electric heat wiring diagrams that shipped with the unit while reviewing the following sequence of operation. As you review the sequence of operations, remember these points:

1. The high limit switch will trip if exposed to a temperature greater than the trip point, and will reset automatically once the temperature falls below the reset point.
2. The linear high limit switch is encased in a capillary that extends across the unit supply air opening. The limit will trip if any 6" span of the capillary exceeds the trip point. Refer to Table 42, p. 133.
3. Electric heat will only energize if both of the high limit safety controls are closed.

## Electric Heat—CV, VAV Daytime Warm-up

CV electric heat operation is done with discrete stages of electric heat. Stages 2 and 3 will not energize unless Stage 1 is already operating and unable to satisfy the heating load. The heat will be staged to control to the Heating Setpoint.

## VAV Active Occupied Discharge Heating

When the changeover input is closed (or when commanded by BAS) the unit will control discrete stages of electric heat to the active supply air heating setpoint. VAV occupied electric heating operation is done with discrete stages (steps) of electric heat. The heat staging is dependent on unit tonnage and heater selection. The heat will be staged to control to the Supply Air Heating Setpoint.

## SZVAV Occupied Heating

Single Zone VAV heating will only be available with modulating types of heat - IPak II units can use hydronic and modulating gas and will include electric heat. During SZVAV heating, the unit will calculate a discharge heating setpoint based on zone heating demands, and the unit will modulate heat to maintain the discharge temperature to this setpoint.

## Demand Control Ventilation Sequence of Operation

***Note:*** *$CO_2$ sensor used with Demand Control Ventilation must be powered from an external power source or separate 24 VAC transformer.*

### Sequence of Operation without TRAQ

If the space $CO_2$ level is greater than or equal to the Design Minimum $CO_2$ Setpoint, the outdoor air damper will open to the Design Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space $CO_2$ level is less than or equal to the DCV Minimum $CO_2$ Setpoint, the outdoor air damper will close to the DCV Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space $CO_2$ level is greater than the DCV Minimum $CO_2$ Setpoint and less than the Design Minimum $CO_2$ Setpoint, the outdoor air damper position is modulated proportionally to the space $CO_2$ level relative to a target position between the DCV Minimum $CO_2$ Setpoint and the Design Minimum $CO_2$ Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

### Sequence of Operation with TRAQ

If the space $CO_2$ level is greater than or equal to the Design Minimum $CO_2$ Setpoint, the outdoor air damper will open to the Design Minimum Outdoor Air Flow Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space $CO_2$ level is less than or equal to the DCV Minimum $CO_2$ Setpoint, the outdoor air damper will close to the DCV Minimum Outdoor Air Flow Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space $CO_2$ level is greater than the DCV Minimum $CO_2$ Setpoint and less than the Design Minimum $CO_2$ Setpoint, the outdoor air damper position is modulated proportionally to the space $CO_2$ level relative to a target position between the DCV Minimum $CO_2$ Setpoint and the Design Minimum $CO_2$ Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

## Return Fan Sequence of Operation

Whenever the Supply Fan is turned ON, the return fan will be turned ON. The speed of the return fan will control to the Return Air Plenum Pressure Target. The target is calculated internal to the control and will be between the Minimum Return Air Plenum Pressure Setpoint and the Maximum Return Air Plenum Pressure Setpoint depending on unit operation conditions. A Return Air Pressure High Limit will be set at 3.5 IWC. If the pressure inside the return plenum exceeds the limit the unit will shut down.

### Unit Clustering

A cluster is a master unit and one or more similarly configured slave units operative cooperatively, as a group, to provide higher capacity and/or redundancy at partial capacity. Clustering is accomplished by binding variables between unit LCI-I modules, communicating common setpoints and allowing each unit to run independent algorithms. A cluster will share a common supply and return duct network.

### Low Charge Protection

For each refrigeration circuit, the entering and leaving evaporator temperatures are used to calculate superheat. When the calculated superheat exceeds the Evaporator

Temperature Differential Setpoint minus 5°F but not the Evaporator Temperature Differential Setpoint, an information only, auto-reset, High Superheat diagnostic is initiated. If the calculated superheat exceeds the Evaporator Temperature Differential Setpoint, a manual reset, low refrigerant charge diagnostic is initiated and all compressors on the circuit are locked out.

## Wet Heat Sequence of Operation

Electrical circuitry for units with steam or hot water heat is limited to the connections associated with the modulating valve actuator and the freezestat.

Like the furnaces described earlier, steam and hot water heat control systems are wired to ensure that simultaneous heating and cooling do not occur. The supply fan will cycle "On" and "Off" with each call for heat during both an occupied and unoccupied period.

Whenever there is a call for heat, **the relay on the heat module** energizes. This allows a modulated voltage signal to be sent to the "Wet" heat actuator. The value of this signal regulates the flow of steam or hot water through the coil by positioning the valve stem at some point between fully closed (6 VDC) and fully open (8.5 VDC).

### Freeze Protection

A freezestat is mounted inside the heat section of hot water and steam heat units to prevent the "wet" heat coil from freezing during the "Off" cycle.

If the temperature of the air leaving the heating coils falls to 40 F, the freezestat normally open contacts close, completing the heat fail circuit on the UCM. When this occurs:

a. The supply fan is turned "Off".

b. "Wet" heat actuator fully opens to allow hot water or steam to pass through the heating coil and prevent freeze-up.

c. A "Low Air Temperature Unit Trip" diagnostic is displayed on the Human Interface LCD screen.

For heating control settings and time delay specifications, refer to Table 45, p. 156.

# Unit Startup Check List

Use the following checklist, in conjunction with the "General Unit Requirement" checklist", to ensure that the unit is properly installed and ready for operation. Be sure to complete all of the procedures described in this section before starting the unit for the first time.

[ ]Turn the field supplied disconnect switch, located upstream of the rooftop unit, to the "Off" position.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

- [ ] Turn the 115 volt control circuit switch 1S2 to the "Off" position. It is located in the secondary of the 1T1 transformer.
- [ ]Turn the 24 volt control circuit switch 1S3 to the "Off" position. It is located in the secondary of the 1T2 - 1T5 transformers.
- [ ] Turn the "System" selection switch (at the Remote Panel) to the "Off" position and the "Fan" selection switch (if Applicable) to the "Auto" or "Off" position.
- [ ] Check all electrical connections for tightness and "point of termination" accuracy.
- [ ] Verify that the condenser airflow will be unobstructed.
- [ ] Check the compressor crankcase oil level. Oil should be visible in the compressor oil sight glass. The oil level should be 1/2 to 3/4 high in the sight glass with the compressor "Off".
- [ ] Verify that all refrigerant service valves are back seated on each circuit.

**⚠CAUTION**

**Compressor Damage!**

**Do not allow liquid refrigerant to enter the suction line. Excessive liquid accumulation in the liquid lines could result in compressor damage.Compressor service valves must be fully opened before startup (suction, discharge, liquid line, and oil line).**

Do not start the unit in the cooling mode if the ambient temperature is below the following minimum recommended operating temperature:

Standard unit with or without HGBP-+45°F

- [ ] Check the supply fan belts for proper tension and the fan bearings for sufficient lubrication. If the belts require adjustment, or if the bearings need lubricating, refer to the Service/Maintenance section of this manual for instructions.
- [ ] Inspect the interior of the unit for tools and debris. Install all panels in preparation for starting the unit.

### Electrical Phasing

Scroll compressors are phase sensitive. Proper phasing of the electrical supply to the unit is critical for proper operation and reliability. The compressor motor is internally connected for clockwise rotation with the incoming power supply phased as A, B, C.

Proper electrical supply phasing can be quickly determined and corrected before starting the unit by using an instrument such as an Associated Research Model 45 Phase Sequence Indicator and following the steps below:

- [ ] Turn the field supplied disconnect switch that provides power to terminal block or to the unit mounted disconnect switch to the "Off" position.
- [ ] Connect the phase sequence indicator leads to the terminal block or unit mounted disconnect switch as follows:

| Phase Sequence Leads | Unit Power Terminal |
|---|---|
| Black (phase A) | L1 |
| Red (phase B) | L2 |
| Yellow (phase C) | L3 |

- [ ] Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

- [ ] Observe the ABC and CBA phase indicator lights on the face of the sequencer. The ABC indicator light will glow if the phase is ABC. If the CBA indicator light glows, open the disconnect switch or circuit protection switch and reverse any two power wires.
- [ ] Restore the main electrical power and recheck the phasing. If the phasing is correct, open the disconnect switch or circuit protection switch and remove the phase sequence indicator.

## Voltage Supply and Voltage Imbalance

### Voltage Supply

Electrical power to the unit must meet stringent requirements for the unit to operate properly. Measure each leg (phase-to-phase) of the power supply. Each reading must fall within the utilization range stamped on the unit nameplate. If any of the readings do not fall within the proper tolerances, notify the power company to correct this situation before operating the unit.

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

### Voltage Imbalance

Excessive three phase voltage imbalance between phases will cause motors to overheat and eventually fail. The maximum allowable voltage imbalance is 2%. Measure and record the voltage between phases 1, 2, and 3 and calculate the amount of imbalance as follows:

% Voltage Imbalance = $100 \times \frac{AV - VD}{AV}$ where;

AV (Average Voltage) = $\frac{Volt1 + Volt2 + Volt3}{3}$

V1, V2, V3 = Line Voltage Readings

VD = Line Voltage reading that deviates the farthest from the average voltage.

**Example:** If the voltage readings of the supply power measured 221, 230, and 227, the average volts would be:

$$\frac{211 + 230 + 227}{3} = 226\ Avg$$

VD (reading farthest from average) = 221

The percentage of Imbalance equals:

$$100 \times \frac{226 - 221}{226} = 2.2\ percent$$

The 2.2% imbalance in this example exceeds the maximum allowable imbalance of 2.0%. This much imbalance between phases can equal as much as a 20% current imbalance with a resulting increase in motor winding temperatures that will decrease motor life. If the voltage imbalance is over 2%, notify the proper agencies to correct the voltage problem before operating this equipment.

## Table 37. Service test guide for component operation — part I of II

| Component Being Tested | COMPONENT CONFIGURATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Supply Fan | Return Fan | Exhaust Fan | Condenser Fans | Heat Stages | | | Compressor Stage | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | 4 |
| **COMPRESSOR** | | | | | | | | | | | |
| **90 - 105 Ton** | | | | | | | | | | | |
| 1A | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| 1B | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | ON | ON | OFF | OFF |
| 2A | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF |
| 2B | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | OFF | OFF | ON | ON |
| **120 - 162 Ton** | | | | | | | | | | | |
| 1A | OFF | OFF | OFF | 1A-On /1B-Off/1C-Off/1D-Off 2A-Off/2B-Off/2C-Off/2D-Off | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| 1B | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | ON | ON | OFF | OFF |
| 2A | OFF | OFF | OFF | 1A-Off/1B-Off/1C-Off/1D-Off 2A-On/2B-Off/2C-Off/2D-Off | OFF | OFF | OFF | OFF | OFF | ON | OFF |
| 2B | OFF | OFF | OFF | ALL OFF | OFF | OFF | OFF | OFF | OFF | ON | ON |
| **CONDENSER FANS** | | | | | | | | | | | |
| **90 - 105 Ton — Air Cooled** | | | | | | | | | | | |
| 1A | OFF | OFF | OFF | 1A-On/1B-Off/1C-Off 2A-Off/2B-Off/2C-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 1B & 1C | OFF | OFF | OFF | 1A-Off/1B-On/1C-On 2A-Off/2B-Off/2C-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2A | OFF | OFF | OFF | 1A-Off/1B-Off/1C-Off 2A-On /2B-Off/2C-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2B & 2C | OFF | OFF | OFF | 1A-On/1B-Off/1C-Off 2A-Off /2B-On /2C-On | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| **120 - 150 Ton — Air Cooled** | | | | | | | | | | | |
| 1A | OFF | OFF | OFF | 1A-On/1B-Off/1C-Off/1D-Off 2A-Off/2B-Off/2C-Off/2D-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 1B | OFF | OFF | OFF | 1A-Off/1B-On/1C-Off/1D-Off 2A-Off/2B-Off/2C-Off/ 2D-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 1C & 1D | OFF | OFF | OFF | 1A-Off/1B-On/1C-On/1D-On 2A-Off/2B-Off/2C-Off/ 2D-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2A | OFF | OFF | OFF | 1A-Off/1B-Off/1C-Off/1D-Off 2A-On /2B-Off/2C-Off & 2D-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2B & 2C | OFF | OFF | OFF | 1A-Off/1B-On/1C-Off/1D-Off 2A-Off/2B-On/2C-On/ 2D-Off | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2D | OFF | OFF | OFF | 1A-Off/1B-On/1C-Off1D-Off 2A-Off/2B-Off/2C-Off/ 2D-On | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| **100, 118, 128, 140, 162 Ton — Evaporative Condensing** | | | | | | | | | | | |
| 1A | OFF | OFF | OFF | 1A0-100% 2A OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2A | OFF | OFF | OFF | 1A OFF 2A 0 - 100% | OFF | OFF | OFF | OFF | OFF | OFF | OFF |

**Table 37. Service test guide for component operation — part I of II (continued)**

| Component Being Tested | COMPONENT CONFIGURATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Supply Fan | Return Fan | Exhaust Fan | Condenser Fans | Heat Stages | | | Compressor Stage | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | 4 |
| **SUPPLY FAN** | ON | ON | OFF | ALL OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| **RETURN FAN** | ON | ON | N/A | ALL OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| **EXHAUST FAN** | OFF | N/A | ON | ALL OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| **GAS HEAT (Full Capacity)** | ON | ON | OFF | ALL OFF | ON | ON | ON | OFF | OFF | OFF | OFF |
| STAGE 1 | ON | ON | OFF | ALL OFF | ON | OFF | ON | OFF | OFF | OFF | OFF |
| STAGE 2 | ON | ON | OFF | ALL OFF | OFF | ON | N/A | OFF | OFF | OFF | OFF |
| Full Modulating | ON | ON | OFF | ALL OFF | 10% - 90% | | | OFF | OFF | OFF | OFF |
| **ELECTRIC HEAT** | ON | ON | OFF | ALL OFF | ON | ON | ON | OFF | OFF | OFF | OFF |
| Stage 1 | ON | ON | OFF | ALL OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF |
| Stage 2 | ON | ON | OFF | ALL OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF |
| Stage 3 | ON | ON | OFF | ALL OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF |
| **HYDRONIC HEAT** | OFF | OFF | OFF | ALL OFF | 100% Select | | | OFF | OFF | OFF | OFF |
| **OUTSIDE AIR DAMPERS** | OFF | OFF | OFF | ALL OFF | 100% Select | | | OFF | OFF | OFF | OFF |
| **EXHAUST DAMPERS** | OFF | OFF | OFF | ALL OFF | 100% Select | | | OFF | OFF | OFF | OFF |
| **EVAP COND** | | | | | | | | | | | |
| Sump Pump | OFF | OFF | OFF | ALL OFF | 100% Select | | | OFF | OFF | OFF | OFF |
| Sump Heater | OFF | OFF | OFF | ALL OFF | 100% Select | | | OFF | OFF | OFF | OFF |

**Table 38. Service test guide for component operation — part II of II**

| Component Being Tested | Component Configuration: Econo Damper | Exhaust Damper | VFD Output | Occ Unocc Relay | Sump Pump | Sump Heater |
|---|---|---|---|---|---|---|
| **COMPRESSOR** | | | | | | |
| **90 - 105 Ton** | | | | | | |
| 1A | Closed | Closed | 0% | Default | OFF | OFF |
| 1B | Closed | Closed | 0% | Default | OFF | OFF |
| 2A | Closed | Closed | 0% | Default | OFF | OFF |
| 2B | Closed | Closed | 0% | Default | OFF | OFF |
| **120 - 162 Ton** | | | | | | |
| 1A | Closed | Closed | 0% | Default | OFF | OFF |
| 1B | Closed | Closed | 0% | Default | OFF | OFF |
| 2A | Closed | Closed | 0% | Default | OFF | OFF |
| 2B | Closed | Closed | 0% | Default | OFF | OFF |
| **CONDENSER FANS** | | | | | | |
| **90 - 105 Ton — Air Cooled** | | | | | | |
| 1A | Closed | Closed | 0% | Default | OFF | OFF |
| 1B & 1C | Closed | Closed | 0% | Default | OFF | OFF |
| 2A | Closed | Closed | 0% | Default | OFF | OFF |
| 2B & 2C | Closed | Closed | 0% | Default | OFF | OFF |
| **120 - 150 Ton — Air Cooled** | | | | | | |
| 1A | Closed | Closed | 0% | Default | OFF | OFF |
| 1B | Closed | Closed | 0% | Default | OFF | OFF |
| 1C & 1D | Closed | Closed | 0% | Default | OFF | OFF |
| 2A | Closed | Closed | 0% | Default | OFF | OFF |
| 2B & 2C | Closed | Closed | 0% | Default | OFF | OFF |
| 2D | Closed | Closed | 0% | Default | OFF | OFF |
| **100, 118, 128, 140, 162 Ton — Evaporative Cooled** | | | | | | |
| 1A | Closed | Closed | 0% | Default | OFF | OFF |
| 2A | Closed | Closed | 0% | Default | OFF | OFF |
| | | | | | | |
| **SUPPLY FAN** | Closed | Closed | 100% | Unocc | OFF | OFF |
| **RETURN FAN** | Closed | Closed | 100% | Default | OFF | OFF |
| **EXHAUST FAN** | Closed | Closed | 100% | Default | OFF | OFF |
| **GAS HEAT (Full Capacity)** | Closed | Closed | 100% | Unocc | OFF | OFF |
| Stage 1 | Closed | Closed | 100% | Unocc | OFF | OFF |
| Stage 2 | Closed | Closed | 100% | Unocc | OFF | OFF |
| Full Modulating | Closed | Closed | 100% | Unocc | OFF | OFF |
| **ELECTRIC HEAT** | Closed | Closed | 100% | Unocc | OFF | OFF |
| Stage 1 | Closed | Closed | 100% | Unocc | OFF | OFF |
| Stage 2 | Closed | Closed | 100% | Unocc | OFF | OFF |
| Stage 3 | Closed | Closed | 100% | Unocc | OFF | OFF |
| **HYDRONIC HEAT** | Closed | Closed | 100% | Default | OFF | OFF |
| **OUTSIDE AIR DAMPERS** | Closed | Closed | 100% | Default | OFF | OFF |
| **EXHAUST DAMPERS** | Closed | Closed | 100% | Default | OFF | OFF |
| **EVAP COND** | | | | | | |
| Sump Pump | Closed | Closed | 100% | Default | ON | OFF |
| Sump Heater | Closed | Closed | 100% | Default | OFF | ON |

## Service Testing—Evaporative Condenser Components

From the Compressor and Condenser Service Menu screens—Head Pressure Control: AUTO or Head Pressure Control: MANUAL

1. Select:

   Head Pressure Control: MANUAL

***Note:*** *All outputs, Sump Control, Fan Stage Control and Fan speed Control (per circuit where specified), will be available for ON/OFF, OPEN/CLOSED, 0-100% manual settings considering the stipulations in Table 39:*

**Table 39. Service test guide component operation—evaporative condenser**

| COMPONENT BEING TESTED | Requirements (ON) | Requirements (OFF) |
|---|---|---|
| Compressors | Sump minimum level switch must be closed for a minimum of five minutes | No Requirements |
| Sump Pump | Sump minimum level switch must be closed for a minimum of five minutes | No Requirements |
| Condenser Fans | No Requirements | No Requirements |
| Fill Valve Solenoid | No Requirements | No Requirements |
| Drain Valve Actuator | No Requirements | No Requirements |
| Sump Heater | No Requirements | No Requirements |

**Notes:**
1. Sump Freeze Protection is active during AUTO but is inactive in service test modes (Head Pressure Control set to MANUAL).
2. Water Treatment Drain Request will be ignored in Service Test.

## Verifying Proper Fan Rotation

***Note:*** *Fans controlled by VFD will run in the correct direction even if phasing is incorrect.*

1. Ensure that the “System” selection switch at the remote panel is in the “Off” position and the “Fan” selection switch for constant volume units is in the “Auto” position. (VAV and SZVAV units do not utilize a “Fan” selection input.)
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block 1TB1 or the unit mounted disconnect switch 1S14.
3. Turn the 115 volt control circuit switch 1S2 and the 24 volt control circuit switch 1S3 to the “On” position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for applications for the SERVICE TEST screens and programming instructions.
5. Use Table 37, p. 110 to program the unit Fans for operation by scrolling through the displays. All of the Fans (Supply, Exhaust, and Condenser fans) can be programmed to be “On”, if desired.

   Refer to Figure 69, p. 114 for the condenser fan locations and the Human Interface designator.
6. Once the configuration for the Fans is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. **This service test will begin after the TEST START key is pressed** and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fans will begin to operate.
8. Check the supply fan and the exhaust fans (if equipped) for proper rotation. The direction of rotation is indicated by an arrow on the fan housings. Check the condenser fans for clockwise rotation when viewed from the top.

## If all of the fans are rotating backwards;

a. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

b. Open the field supplied disconnect switch upstream of the rooftop unit. Lock the disconnect switch in the open position while working at the unit.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

c. Interchange any two of the field connected main power wires at the unit terminal block or the factory mounted disconnect switch.

***Note:*** *Interchanging "Load" side power wires at the fan contactors will only affect the individual fan rotation. Ensure that the voltage phase sequence at the main terminal block or the factory mounted disconnect switch is ABC as outlined in the "Electrical Phasing" section.*

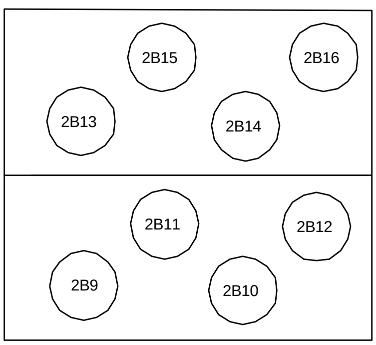
## If some of the fans are rotating backwards;

a. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

b. Open the field supplied disconnect switch upstream of the rooftop unit. Lock the disconnect switch in the open position while working at the unit.

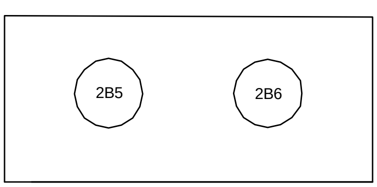
c. Interchange any two of the fan motor leads at the contactor for each fan that is rotating backwards.

**Figure 69. Air-cooled (90-150 tons)/evaporative (100-162 tons) condenser fan locations with human interface designator**




120 TON
130 TON
150 TON

| Condenser Fan Motor Designator | Condenser Fan contactor Designator |
|---|---|
| 2B9 | 1K9 |
| 2B10 | 1K10 |
| 2B11 | 1K10 |
| 2B12 | 1K4 |
| 2B13 | 1K11 |
| 2B14 | 1K12 |
| 2B15 | 1K12 |
| 2B16 | 1K1 |




100 TON
118 TON
128 TON
140 TON
162 TON

| Condenser Fan Motor Designator | Condenser Fan contactor Designator |
|---|---|
| 2B5 | 1K4* |
| 2B6 | 1K1* |

*Note: 2B5 and 2B6 are initiated with operation of 1K4 and 1K1 compressor contactors.

## System Airflow Measurements

### Constant Volume Systems

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position and the "Fan" selection switch for constant volume units is in the "Auto" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 37, p. 110 to program the Supply Fan for operation by scrolling through the displays.
6. Once the configuration for the Fan is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the **+** key to designate the delay before the test is to start. **This service test will begin after the TEST START key is pressed** and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fans will begin to operate.
8. With the system in the SERVICE MODE and the supply fan rotating in the proper direction, measure the amperage at the supply fan contactors. If the amperage exceeds the motor nameplate value, the static pressure is less than design and the airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);
   a. Measure the actual fan RPM
   b. Calculate the Theoretical BHP

   Actual Motor Amps X Motor HP

   Motor Nameplate Amps

   c. Plot this data onto the appropriate Fan Performance Curve beginning with Figure 62, p. 98. Where the two points intersect, read straight down to the CFM line.

Use this data to assist in calculating a new fan drive if the CFM is not at design specifications.

An alternate method with less accuracy is to measure the static pressure drop across the evaporator coil. This can be accomplished by;

   a. drilling a small hole through the unit casing on each side of the coil.

***Note:*** *Coil damage can occur if care is not taken when drilling holes in this area.*

   b. Measure the difference between the pressures at both locations.
   c. Plot this value onto the appropriate pressure drop curve beginning with Figure 71, p. 118. Use the data in Table 40, p. 125 (Component Static Pressure Drops) to assist in calculating a new fan drive if the CFM is not at design specifications.
   d. Plug the holes after the proper CFM has been established.

9. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

### Variable Air Volume Systems

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate Programming Manual for VAV applications for the SERVICE TEST screens and programming instructions.

   Use Table 37, p. 110 to program the following system components for operation by scrolling through the displays:

   Supply Fan,

   Variable Frequency Drive (100% Output, if applicable),

   RTM Occ/Unocc Output (Unoccupied)
5. Once the configuration for the components is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the **+** key to designate the delay before the test is to start. **This service test will begin after the TEST START key is pressed** and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

6. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
7. With the VFD at 100% and the supply fan operating at full airflow capability, measure the amperage at the supply fan contactors. If the amperage exceeds the motor nameplate value, the static pressure is less than design and the airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);
   a. Measure the actual fan RPM
   b. Calculate the Theoretical BHP

   Actual Motor Amps X Motor HP

   Motor Nameplate Amps

   c. Plot this data onto the appropriate Fan Performance Curve beginning with Figure 62, p. 98. Where the two points intersect, read straight down to the CFM line.

Use this data to assist in calculating a new fan drive if the CFM is not at design specifications.

An alternate method with less accuracy is to measure the static pressure drop across the evaporator coil. This can be accomplished by:

   a. drilling a small hole through the unit casing on each side of the coil.

***Note:*** *Coil damage can occur if care is not taken when drilling holes in this area.*

   b. Measure the difference between the pressures at both locations.
   c. Plot this value onto the appropriate pressure drop curve beginning with Figure 71, p. 118. Use the data in Table 40, p. 125 (Component Static Pressure Drops) to assist in calculating a new fan drive if the CFM is not at design specifications.
   d. Plug the holes after the proper CFM has been established. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

8. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

## Exhaust Airflow Measurement (Optional)

1. Close the disconnect switch or circuit protector switch that provides the supply power to the unit's terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

2. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
3. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE

key to display the first service screen. Refer to the latest edition of the appropriate programming manual for applications for the SERVICE TEST screens and programming instructions.

4. Use Table 37, p. 110 to program the following system components for operation by scrolling through the displays:

   Exhaust Fan,

   Exhaust Dampers (100% Open, if applicable),

   Outside air dampers (100% Open),

   Variable Frequency Drive (100%, if applicable),

   RTM Occ/Unocc Output (Default)

5. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the **+** key to designate the delay before the test is to start. **This service test will begin after the TEST START key is pressed** and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

6. Press the TEST START key to start the test. Remember that the delay designated in step 5 must elapse before the fans will begin to operate.

7. With the exhaust dampers open and the exhaust fan operating at full airflow capability, measure the amperage at the exhaust fan contactor. If the amperage exceeds the motor nameplate value, the static pressure is less than design and airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);

   a. Measure the actual fan RPM

   b. Calculate the Theoretical BHP

   Actual Motor Amps X Motor HP

   Motor Nameplate Amps

Use appropriate figures beginning with Figure 71, p. 118 to calculate a new fan drive if the CFM is not at design specifications.

8. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

## TRAQ™ Sensor Airflow Measurement

### (Optional with all units equipped with an economizer)

1. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for applications for the SERVICE TEST screens and programming instructions.

2. Use Table 37, p. 110 to program the following system components for Economizer operation by scrolling through the displays;

   Supply Fan (On)

   Outside air dampers (Selected % Open)

   Variable Frequency Drive (100% Output, if applicable)

   RTM Occ/Unocc Output (Unoccupied)

   Outside Air CFM Setpoint

   Outside Air Pre-Heater Operation (if applicable)

3. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the **+** key to designate the delay before the test is to start. **This service test will begin after the TEST START key is pressed** and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

4. Press the TEST START key to start the test. Remember that the delay designated in step 3 must elapse before the fans will begin to operate.

5. With the unit operating in the “TEST MODE”, the amount of outside air flowing through the TRAQ sensor can be viewed by switching to the “STATUS MENU” screen “OA CFM.

6. Scroll to the “ECONOMIZER ENABLE/ECONOMIZER POSITION” screen by pressing the “NEXT” key and read the corresponding damper opening percentage (%).

7. Press the STOP key at the Human Interface Module in the unit control panel to stop the unit operation.

# Performance Data

## Supply Fan with or without Variable Frequency Drive

**Figure 70. Supply fan performance LOW CFM — 90/100 tons, 25” supply fan**

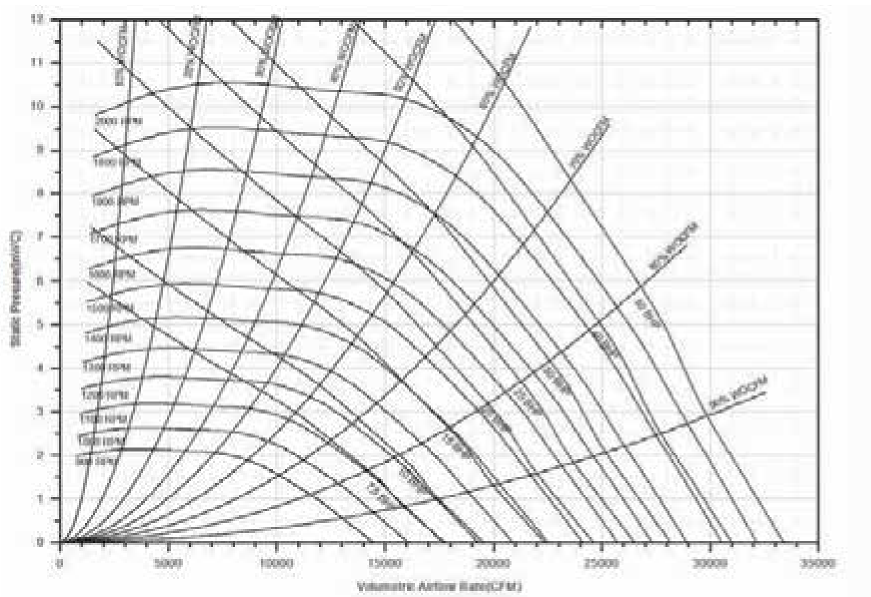



**Figure 71. Supply fan performance STANDARD CFM — 90/100 and 105/118 tons, 36” supply fan**

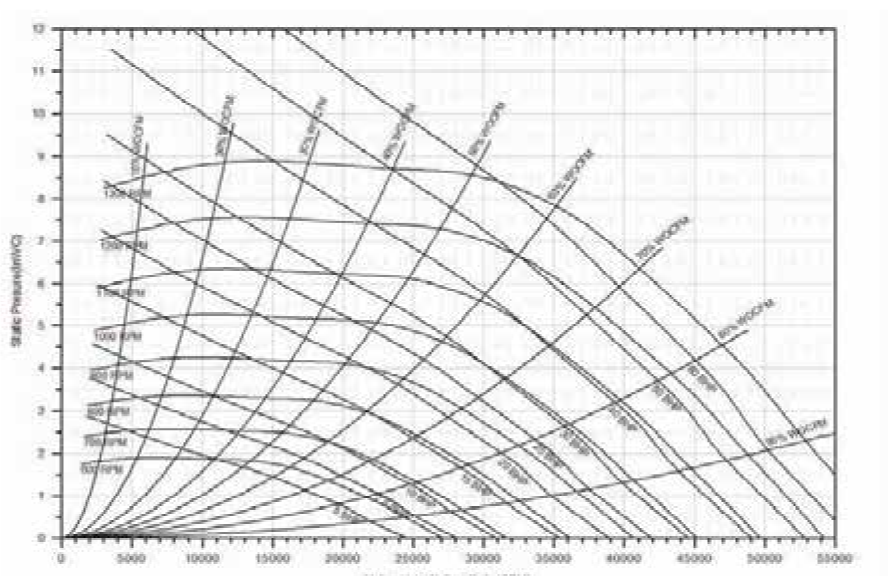


**Figure 72. Supply fan performance LOW CFM — 105-162 ton, 32” supply fan**

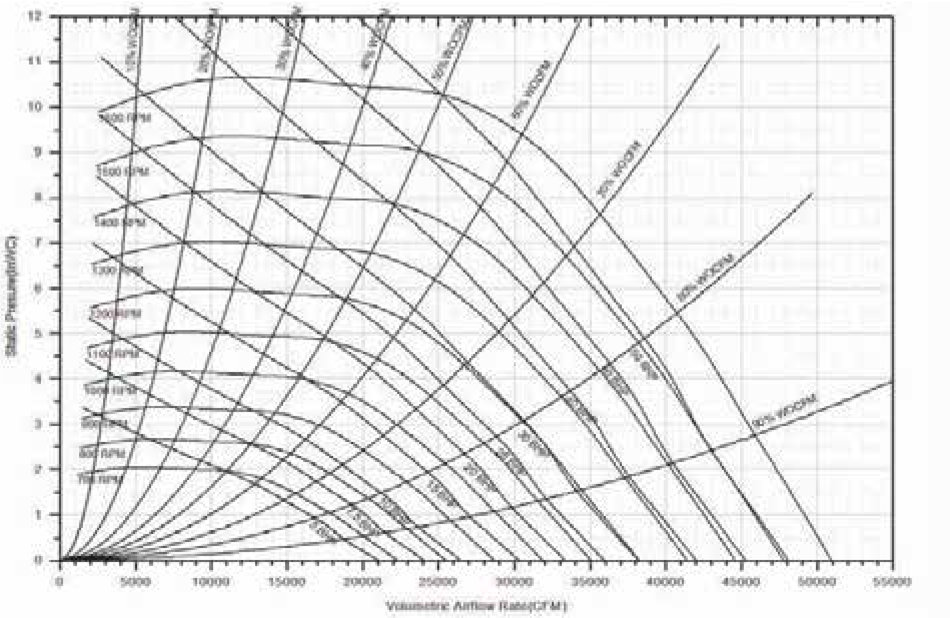
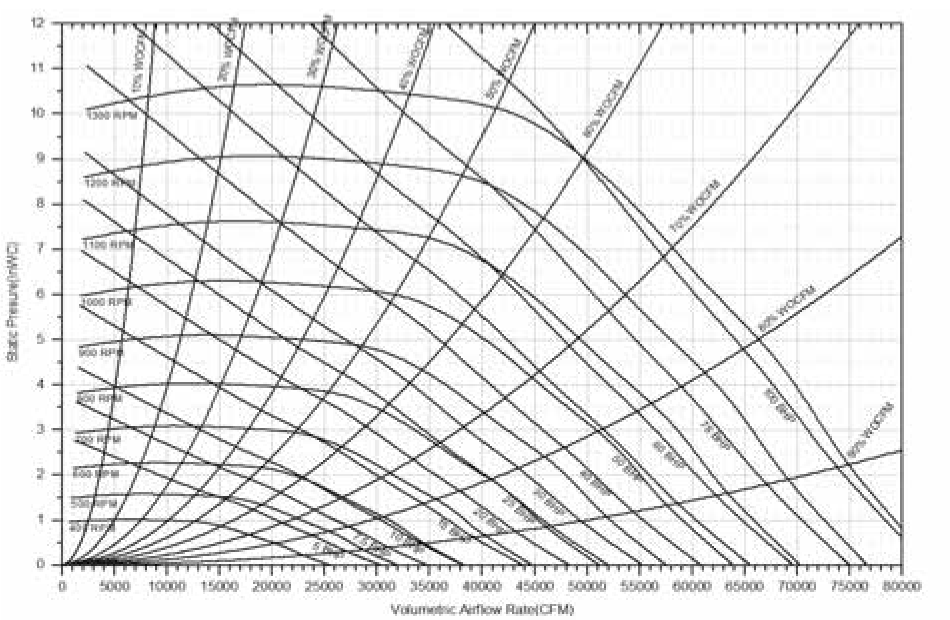



**Figure 73. Supply fan performance STANDARD CFM — 120-162 tons, 40” supply fan**



## Airside Pressure Drop Standard Evaporator Coil

**Figure 74. Wet airside pressure drop at 0.075 lb./cu. ft.—90-162 tons standard evaporator coil**

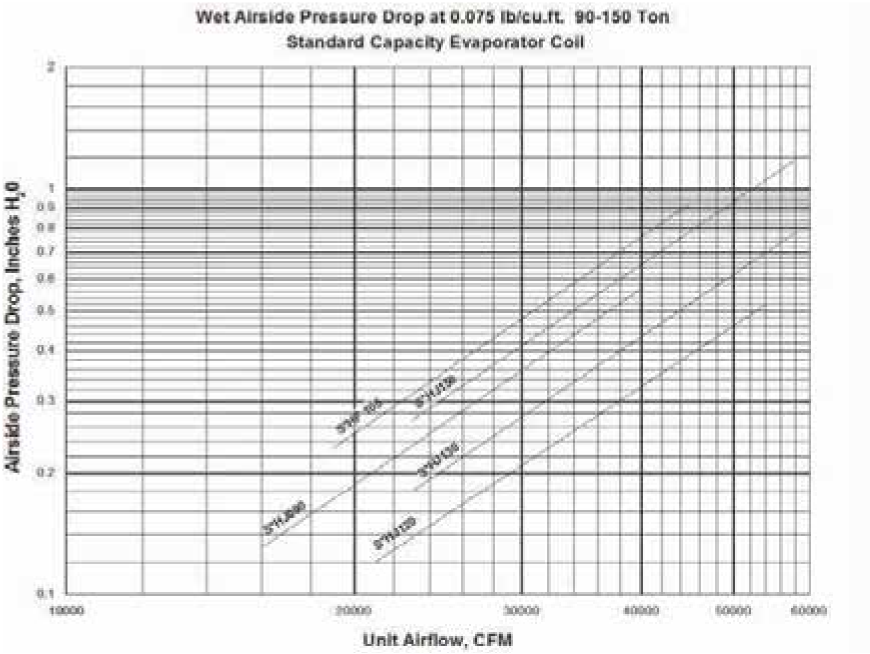



**Figure 75. Dry airside pressure drop at 0.075 lb./cu. ft.—90-162 tons standard capacity evaporator coil**

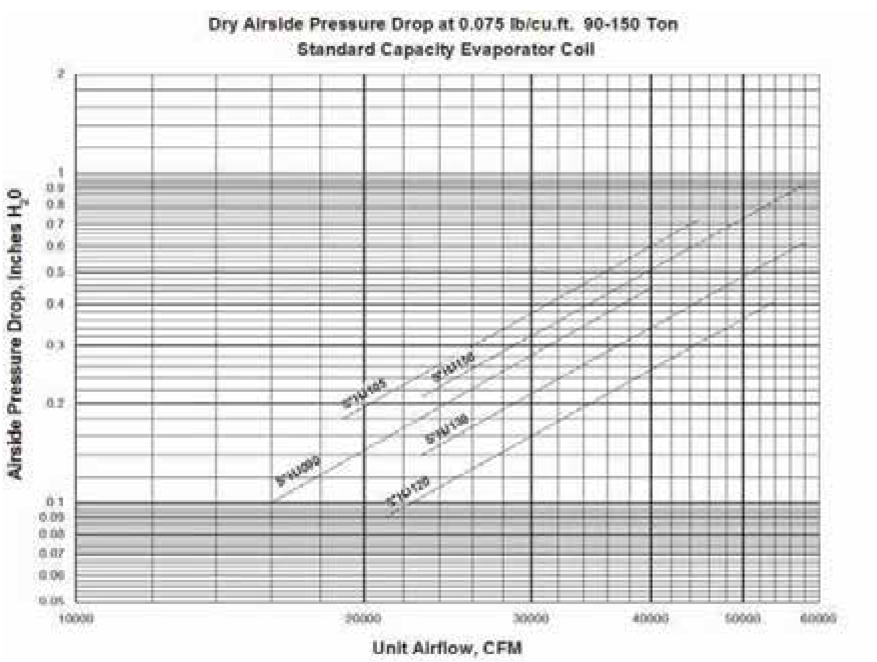


**Figure 76. Wet airside pressure drop at 0.075 lb./cu. ft.—90-140 tons high capacity evaporator coil**

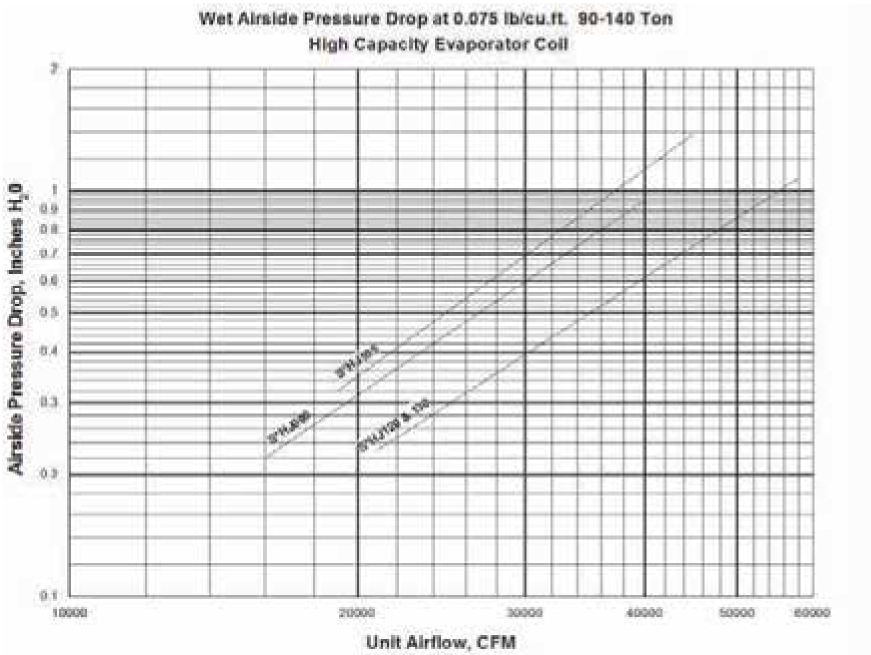
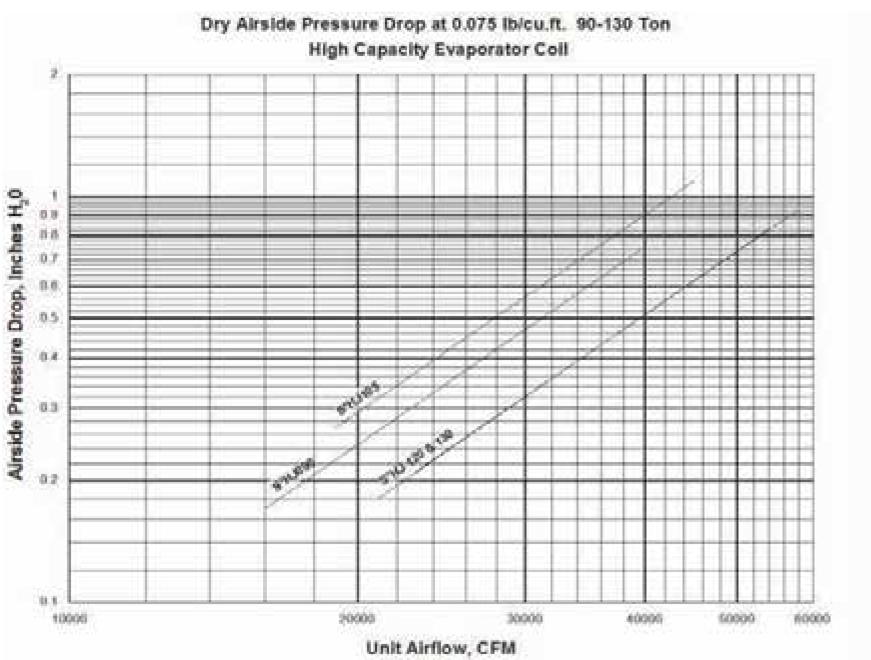



**Figure 77. Dry airside pressure drop at 0.075 lb./cu. ft.—90-140 tons high capacity evaporator coil**



## Exhaust Fan Performance

**Figure 78. Exhaust fan performance LOW CFM — 90/100 tons**

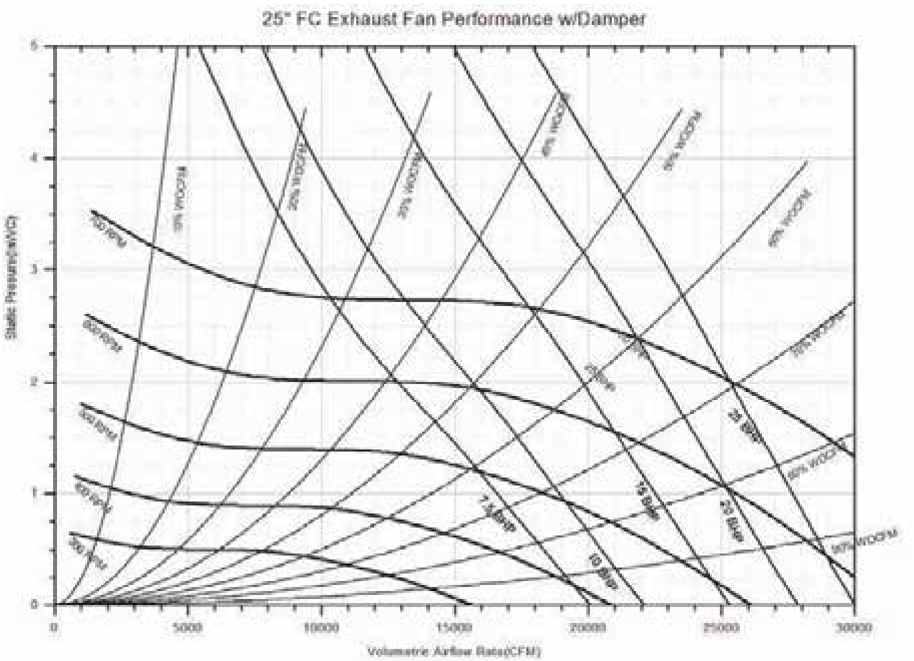



**Figure 79. Exhaust fan performance STANDARD CFM — 90/100 tons; LOW CFM — 105-162 tons**

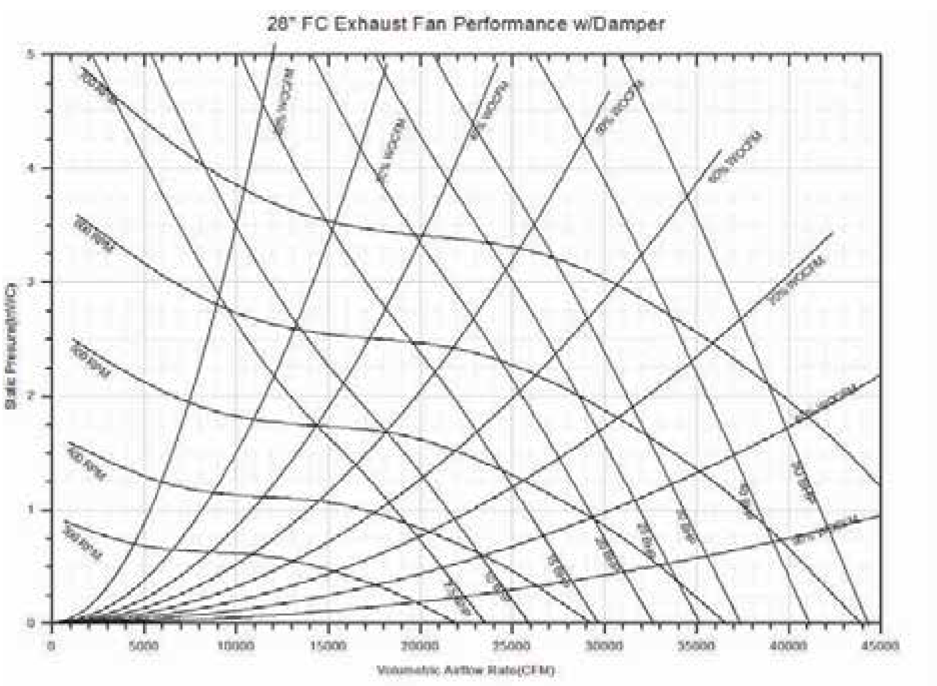
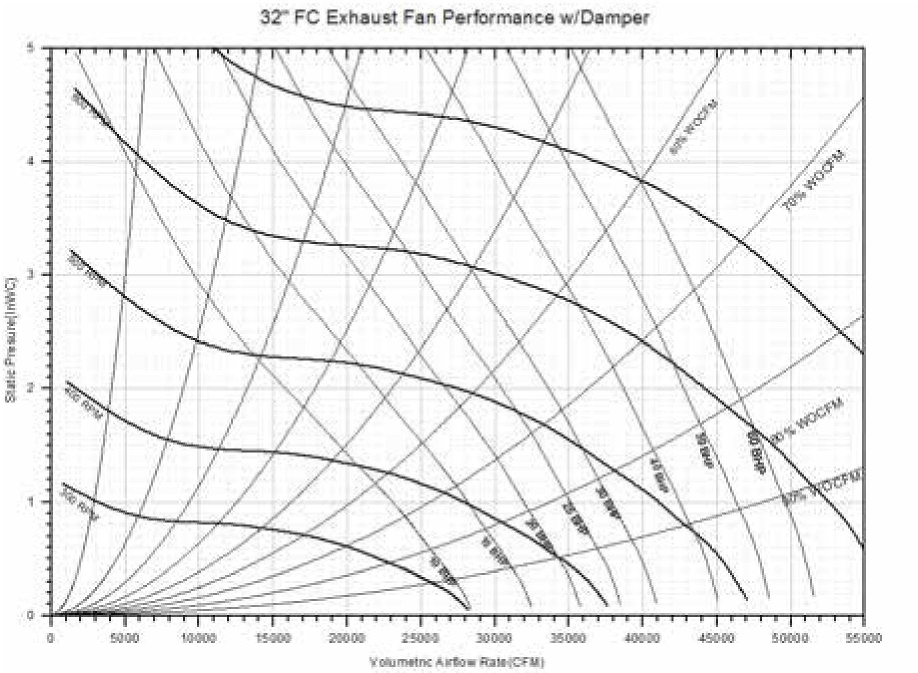


**Figure 80. Exhaust fan performance STANDARD CFM — 105-162 tons**




## Return Fan Performance

**Figure 81. Return fan performance LOW CFM — 90-162 tons**

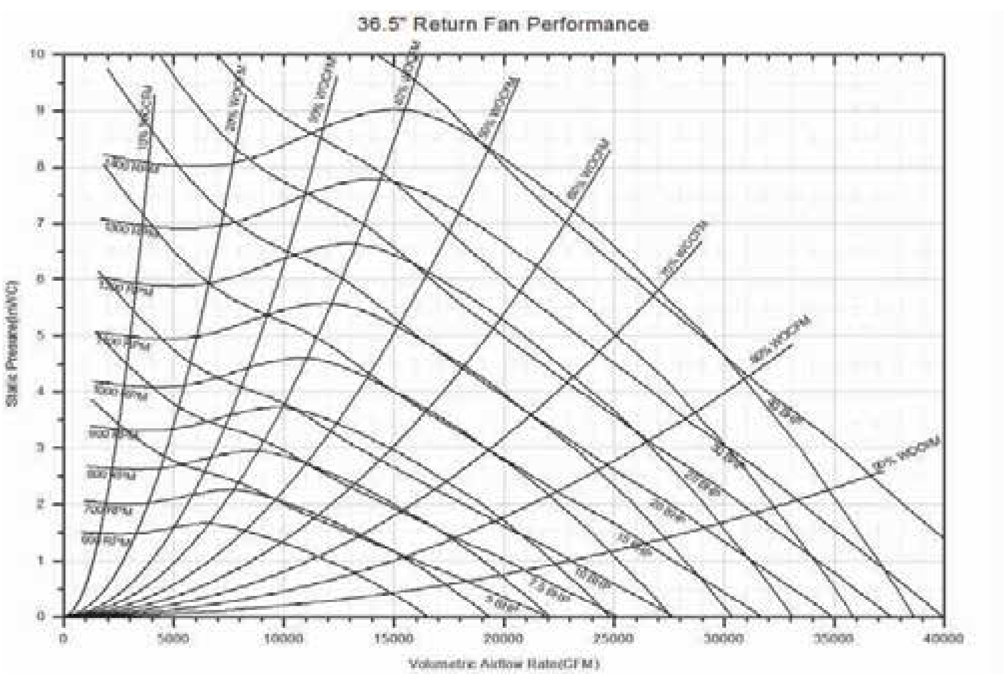


**Figure 82. Return fan performance STANDARD CFM — 90-118 tons**

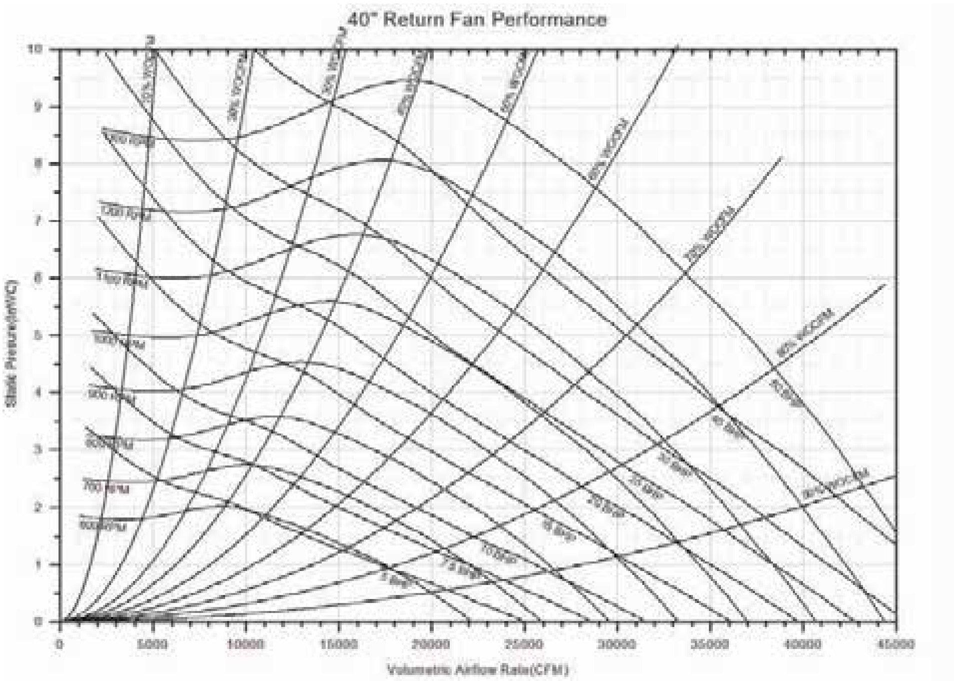
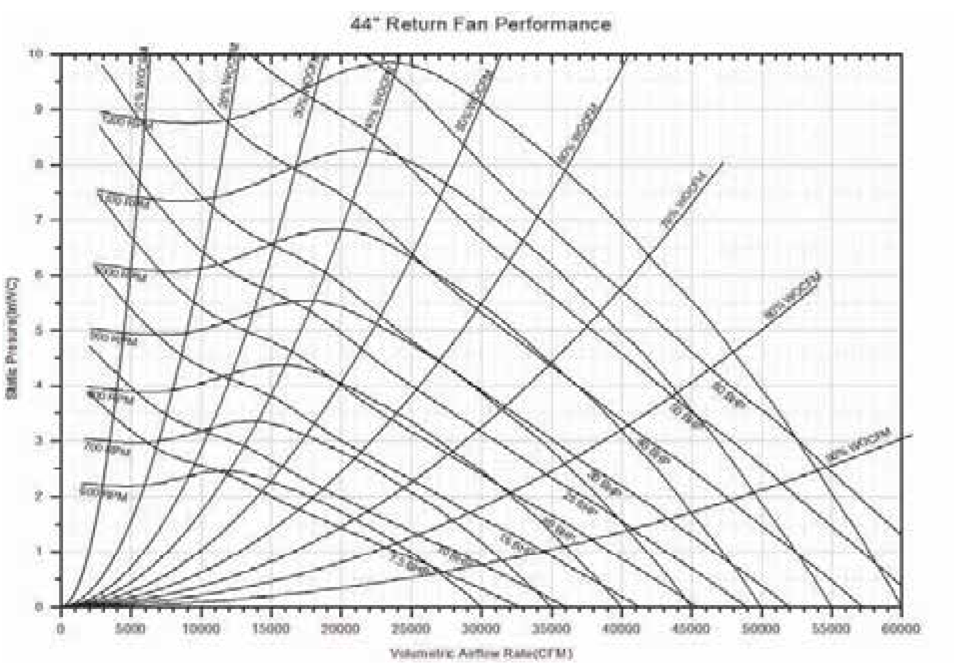



**Figure 83. Return fan performance STANDARD CFM — 120-162 tons**



## Component Static Pressure Drops

**Table 40. Component static pressure drops (in. $H_2O$)**

| Nom Tons | CFM (a) | Evaporator Coil | | | | Reheat Coil | (Dampers wide open) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Standard | | High Capacity | | | | | |
| | | Dry | Wet | Dry | Wet | Dry | Return Damper | Econo Damper | TRAQ Damper |
| 90/100 | 16000 | 0.10 | 0.13 | 0.17 | 0.22 | 0.04 | 0.06 | 0.11 | 0.19 |
| | 20000 | 0.15 | 0.19 | 0.24 | 0.31 | 0.06 | 0.10 | 0.17 | 0.29 |
| | 25000 | 0.21 | 0.27 | 0.35 | 0.45 | 0.08 | 0.16 | 0.27 | 0.45 |
| | 30000 | 0.28 | 0.36 | 0.47 | 0.60 | 0.11 | 0.23 | 0.39 | 0.65 |
| | 33000 | 0.33 | 0.42 | 0.55 | 0.70 | 0.13 | 0.28 | 0.47 | 0.79 |
| | 36000 | 0.38 | 0.48 | 0.63 | 0.80 | 0.15 | 0.34 | 0.57 | 0.94 |
| | 40000 | 0.45 | 0.57 | 0.75 | 0.95 | 0.18 | 0.42 | 0.70 | 1.16 |
| 105/118 | 19000 | 0.18 | 0.23 | 0.27 | 0.32 | 0.05 | 0.09 | 0.15 | 0.26 |
| | 23000 | 0.20 | 0.31 | 0.37 | 0.47 | 0.07 | 0.13 | 0.23 | 0.38 |
| | 28000 | 0.34 | 0.43 | 0.51 | 0.64 | 0.10 | 0.20 | 0.34 | 0.57 |
| | 33000 | 0.44 | 0.56 | 0.66 | 0.84 | 0.13 | 0.28 | 0.47 | 0.79 |
| | 38000 | 0.55 | 0.70 | 0.83 | 1.05 | 0.16 | 0.38 | 0.63 | 1.05 |
| | 43000 | 0.67 | 0.85 | 1.01 | 1.28 | 0.20 | 0.49 | 0.81 | 1.34 |
| | 45000 | 0.73 | 0.92 | 1.09 | 1.38 | 0.21 | 0.53 | 0.89 | 1.47 |
| 120/128 | 21000 | 0.09 | 0.12 | 0.18 | 0.23 | 0.04 | 0.05 | 0.10 | 0.17 |
| | 26000 | 0.13 | 0.16 | 0.25 | 0.32 | 0.06 | 0.09 | 0.15 | 0.26 |
| | 31000 | 0.17 | 0.21 | 0.34 | 0.43 | 0.08 | 0.12 | 0.22 | 0.36 |
| | 36000 | 0.21 | 0.27 | 0.43 | 0.55 | 0.10 | 0.17 | 0.30 | 0.49 |
| | 41000 | 0.26 | 0.34 | 0.53 | 0.67 | 0.12 | 0.22 | 0.39 | 0.64 |
| | 46000 | 0.32 | 0.40 | 0.64 | 0.81 | 0.15 | 0.28 | 0.49 | 0.80 |
| | 51000 | 0.38 | 0.48 | 0.75 | 0.95 | 0.18 | 0.35 | 0.61 | 0.99 |
| | 54000 | 0.41 | 0.52 | 0.83 | 1.05 | 0.20 | 0.39 | 0.68 | 1.11 |
| 130/140 | 23000 | 0.14 | 0.18 | 0.21 | 0.27 | 0.05 | 0.07 | 0.12 | 0.20 |
| | 26000 | 0.17 | 0.22 | 0.25 | 0.32 | 0.06 | 0.09 | 0.15 | 0.26 |
| | 30000 | 0.21 | 0.27 | 0.32 | 0.41 | 0.07 | 0.12 | 0.21 | 0.34 |
| | 35000 | 0.27 | 0.35 | 0.41 | 0.52 | 0.10 | 0.16 | 0.28 | 0.46 |
| | 40000 | 0.34 | 0.43 | 0.51 | 0.65 | 0.12 | 0.21 | 0.37 | 0.61 |
| | 45000 | 0.41 | 0.52 | 0.61 | 0.78 | 0.15 | 0.27 | 0.47 | 0.77 |
| | 50000 | 0.49 | 0.62 | 0.73 | 0.93 | 0.17 | 0.33 | 0.59 | 0.95 |
| | 55000 | 0.57 | 0.72 | 0.85 | 1.08 | 0.20 | 0.40 | 0.71 | 1.15 |
| | 58000 | 0.62 | 0.78 | 0.93 | 1.18 | 0.22 | 0.45 | 0.79 | 1.28 |
| 150/162 | 23000 | 0.21 | 0.27 | - | - | 0.05 | 0.07 | 0.12 | 0.20 |
| | 26000 | 0.25 | 0.32 | - | - | 0.06 | 0.09 | 0.15 | 0.26 |
| | 30000 | 0.32 | 0.41 | - | - | 0.07 | 0.12 | 0.21 | 0.34 |
| | 35000 | 0.41 | 0.52 | - | - | 0.10 | 0.16 | 0.28 | 0.46 |
| | 40000 | 0.51 | 0.65 | - | - | 0.12 | 0.21 | 0.37 | 0.61 |
| | 45000 | 0.61 | 0.78 | - | - | 0.15 | 0.27 | 0.47 | 0.77 |
| | 50000 | 0.73 | 0.93 | - | - | 0.17 | 0.33 | 0.59 | 0.95 |
| | 55000 | 0.85 | 1.08 | - | - | 0.20 | 0.40 | 0.71 | 1.15 |
| | 58000 | 0.93 | 1.18 | - | - | 0.22 | 0.45 | 0.79 | 1.28 |

**Table 40. Component static pressure drops (in. $H_2O$) (continued)**

| Nom Tons | CFM | Electric Heating (Horizontal) All kW's (b) | Gas Heating Low Heat DF | Gas Heating Low Heat Hz | Gas Heating Medium Heat DF | Gas Heating Medium Heat Hz | Gas Heating High Heat DF | Gas Heating High Heat Hz | Hydronic Hot Water Coil High | Hydronic Hot Water Coil Low | Hydronic Steam Coil High | Hydronic Steam Coil Low |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90/100 | 16000 | 0.01 | 0.01 | 0.10 | 0.01 | 0.12 | 0.01 | 0.14 | 0.13 | 0.08 | 0.12 | 0.08 |
| | 20000 | 0.02 | 0.01 | 0.16 | 0.01 | 0.19 | 0.01 | 0.22 | 0.19 | 0.12 | 0.17 | 0.12 |
| | 25000 | 0.03 | 0.01 | 0.24 | 0.01 | 0.30 | 0.01 | 0.35 | 0.27 | 0.17 | 0.26 | 0.18 |
| | 30000 | 0.05 | 0.02 | 0.35 | 0.02 | 0.44 | 0.02 | 0.50 | 0.36 | 0.24 | 0.35 | 0.25 |
| | 33000 | 0.06 | 0.02 | 0.42 | 0.02 | 0.53 | 0.02 | 0.61 | 0.42 | 0.28 | 0.41 | 0.30 |
| | 36000 | 0.07 | 0.03 | 0.51 | 0.03 | 0.63 | 0.03 | 0.72 | 0.49 | 0.33 | 0.48 | 0.35 |
| | 40000 | 0.08 | 0.03 | 0.62 | 0.03 | 0.77 | 0.03 | 0.89 | 0.58 | 0.39 | 0.57 | 0.43 |
| 105/118 | 19000 | 0.02 | 0.01 | 0.14 | 0.01 | 0.17 | 0.01 | 0.20 | 0.17 | 0.11 | 0.16 | 0.11 |
| | 23000 | 0.03 | 0.01 | 0.21 | 0.01 | 0.26 | 0.01 | 0.30 | 0.23 | 0.15 | 0.22 | 0.16 |
| | 28000 | 0.04 | 0.02 | 0.31 | 0.02 | 0.38 | 0.02 | 0.44 | 0.32 | 0.21 | 0.31 | 0.22 |
| | 33000 | 0.06 | 0.02 | 0.42 | 0.02 | 0.53 | 0.02 | 0.61 | 0.42 | 0.28 | 0.41 | 0.30 |
| | 38000 | 0.07 | 0.03 | 0.56 | 0.03 | 0.70 | 0.03 | 0.81 | 0.53 | 0.36 | 0.52 | 0.39 |
| | 43000 | 0.10 | 0.04 | 0.72 | 0.04 | 0.89 | 0.04 | 1.03 | 0.65 | 0.45 | 0.65 | 0.49 |
| | 45000 | 0.10 | 0.04 | 0.79 | 0.04 | 0.98 | 0.04 | 1.13 | 0.71 | 0.49 | 0.70 | 0.53 |
| 120/128 | 21000 | 0.02 | 0.00 | 0.16 | 0.00 | 0.19 | 0.00 | 0.23 | 0.14 | 0.09 | 0.13 | 0.09 |
| | 26000 | 0.03 | 0.00 | 0.25 | 0.00 | 0.30 | 0.00 | 0.35 | 0.20 | 0.13 | 0.19 | 0.13 |
| | 31000 | 0.05 | 0.00 | 0.35 | 0.00 | 0.42 | 0.00 | 0.49 | 0.26 | 0.17 | 0.25 | 0.18 |
| | 36000 | 0.07 | 0.00 | 0.48 | 0.00 | 0.57 | 0.00 | 0.67 | 0.33 | 0.22 | 0.33 | 0.24 |
| | 41000 | 0.09 | 0.00 | 0.62 | 0.00 | 0.74 | 0.00 | 0.86 | 0.42 | 0.28 | 0.41 | 0.30 |
| | 46000 | 0.11 | 0.00 | 0.78 | 0.00 | 0.93 | 0.00 | 1.09 | 0.50 | 0.34 | 0.50 | 0.37 |
| | 51000 | 0.13 | 0.00 | 0.96 | 0.00 | 1.15 | 0.00 | 1.34 | 0.60 | 0.41 | 0.59 | 0.44 |
| | 54000 | 0.15 | 0.00 | 1.07 | 0.00 | 1.28 | 0.01 | 1.50 | 0.66 | 0.45 | 0.65 | 0.49 |
| 130/140 | 23000 | 0.03 | 0.00 | 0.20 | 0.00 | 0.23 | 0.01 | 0.27 | 0.16 | 0.10 | 0.15 | 0.10 |
| | 26000 | 0.03 | 0.00 | 0.25 | 0.00 | 0.30 | 0.00 | 0.35 | 0.20 | 0.13 | 0.19 | 0.13 |
| | 30000 | 0.05 | 0.00 | 0.33 | 0.00 | 0.40 | 0.00 | 0.46 | 0.25 | 0.16 | 0.24 | 0.17 |
| | 35000 | 0.06 | 0.00 | 0.45 | 0.00 | 0.54 | 0.00 | 0.63 | 0.32 | 0.21 | 0.31 | 0.22 |
| | 40000 | 0.08 | 0.00 | 0.59 | 0.00 | 0.70 | 0.00 | 0.82 | 0.40 | 0.27 | 0.39 | 0.28 |
| | 45000 | 0.10 | 0.00 | 0.75 | 0.00 | 0.89 | 0.00 | 1.04 | 0.49 | 0.33 | 0.48 | 0.35 |
| | 50000 | 0.13 | 0.00 | 0.92 | 0.00 | 1.10 | 0.00 | 1.29 | 0.58 | 0.39 | 0.57 | 0.43 |
| | 55000 | 0.16 | 0.00 | 1.12 | 0.01 | 1.33 | 0.01 | 1.56 | 0.68 | 0.47 | 0.67 | 0.51 |
| | 58000 | 0.17 | 0.01 | 1.24 | 0.01 | 1.48 | 0.01 | 1.74 | 0.75 | 0.51 | 0.74 | 0.56 |
| 150/162 | 23000 | 0.03 | 0.00 | 0.20 | 0.00 | 0.23 | 0.01 | 0.27 | 0.16 | 0.10 | 0.15 | 0.10 |
| | 26000 | 0.03 | 0.00 | 0.25 | 0.00 | 0.30 | 0.00 | 0.35 | 0.20 | 0.13 | 0.19 | 0.13 |
| | 30000 | 0.05 | 0.00 | 0.33 | 0.00 | 0.40 | 0.00 | 0.46 | 0.25 | 0.16 | 0.24 | 0.17 |
| | 35000 | 0.06 | 0.00 | 0.45 | 0.00 | 0.54 | 0.00 | 0.63 | 0.32 | 0.21 | 0.31 | 0.22 |
| | 40000 | 0.08 | 0.00 | 0.59 | 0.00 | 0.70 | 0.00 | 0.82 | 0.40 | 0.27 | 0.39 | 0.28 |
| | 45000 | 0.10 | 0.00 | 0.75 | 0.00 | 0.89 | 0.00 | 1.04 | 0.49 | 0.33 | 0.48 | 0.35 |
| | 50000 | 0.13 | 0.00 | 0.92 | 0.00 | 1.10 | 0.00 | 1.29 | 0.58 | 0.39 | 0.57 | 0.43 |
| | 55000 | 0.16 | 0.00 | 1.12 | 0.01 | 1.33 | 0.01 | 1.56 | 0.68 | 0.47 | 0.67 | 0.51 |
| | 58000 | 0.17 | 0.01 | 1.24 | 0.01 | 1.48 | 0.01 | 1.74 | 0.75 | 0.51 | 0.74 | 0.56 |

**Table 40. Component static pressure drops (in. $H_2O$) (continued)**

| Nom Tons | CFM | Standard Filter Section (Pre Evap): Std 2" High Eff Throw Away Filters | 90-95% Low PD Cartridge Filters w/ 2" Prefilter | 90-95% Low PD Cartridge Filters w/ 4" Prefilter | 90-95% Cartridge Filters w/ 2" Prefilter (c) | 90-95% Bag Filters w/ 2" Prefilter (c) | Final Filter Section (Post Evap): 90-95% Std Temp Low PD Cartridge Filters w/4" Prefilter (d) | 90-95% Std Temp Bag Filters w/ 2" Prefilter (e) | 90-95% Std Temp Cartridge Filters w/ 2" Prefilter (e) | 90-95% Hi Temp Cartridge Filters w/ 2" Hi Temp Prefilter (e) | 90-95% Hi Temp HEPA w/ 2" Hi Temp Prefilter (f) | 90-95% Std Temp HEPA Filters w/ 2" Hi Temp Prefilter (f) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90/105 | 16000 | 0.08 | 0.24 | - | 0.27 | 0.34 | 0.23 | 0.36 | 0.29 | 0.35 | 0.54 | 0.48 |
| | 20000 | 0.11 | 0.31 | - | 0.33 | 0.41 | 0.31 | 0.43 | 0.36 | 0.44 | 0.69 | 0.61 |
| | 25000 | 0.15 | 0.42 | - | 0.42 | 0.50 | 0.43 | 0.54 | 0.47 | 0.58 | 0.89 | 0.78 |
| | 30000 | 0.20 | 0.53 | - | 0.54 | 0.60 | 0.56 | 0.65 | 0.60 | 0.74 | 1.10 | 0.95 |
| | 33000 | 0.23 | 0.61 | - | 0.61 | 0.67 | 0.65 | 0.73 | 0.69 | 0.86 | 1.22 | 1.06 |
| | 36000 | 0.26 | 0.69 | - | 0.70 | 0.73 | 0.74 | 0.80 | 0.79 | 0.98 | 1.36 | 1.16 |
| | 40000 | 0.30 | 0.80 | - | 0.82 | 0.83 | 0.88 | 0.91 | 0.93 | 1.15 | - | - |
| 105/118 | 19000 | 0.10 | 0.27 | - | 0.30 | 0.37 | 0.27 | 0.40 | 0.32 | 0.40 | 0.62 | 0.55 |
| | 23000 | 0.11 | 0.29 | - | 0.32 | 0.39 | 0.29 | 0.42 | 0.34 | 0.42 | 0.66 | 0.58 |
| | 28000 | 0.18 | 0.49 | - | 0.49 | 0.56 | 0.51 | 0.61 | 0.54 | 0.68 | 1.01 | 0.88 |
| | 33000 | 0.23 | 0.61 | - | 0.61 | 0.67 | 0.65 | 0.73 | 0.69 | 0.86 | 1.22 | 1.06 |
| | 38000 | 0.28 | 0.74 | - | 0.76 | 0.78 | 0.81 | 0.86 | 0.86 | 1.06 | - | - |
| | 43000 | 0.33 | 0.89 | - | 0.92 | 0.91 | 0.98 | 1.00 | 1.05 | 1.30 | - | - |
| | 45000 | 0.36 | 0.95 | - | 0.99 | 0.96 | 1.05 | 1.06 | 1.13 | 1.40 | - | - |
| 120/128 | 21000 | 0.10 | - | 0.30 | 0.35 | 0.42 | 0.34 | 0.45 | 0.38 | 0.47 | 0.73 | 0.64 |
| | 26000 | 0.13 | - | 0.41 | 0.44 | 0.52 | 0.46 | 0.56 | 0.49 | 0.61 | 0.93 | 0.81 |
| | 31000 | 0.17 | - | 0.53 | 0.56 | 0.62 | 0.59 | 0.68 | 0.63 | 0.78 | 1.14 | 0.99 |
| | 36000 | 0.20 | - | 0.66 | 0.70 | 0.73 | 0.74 | 0.80 | 0.79 | 0.98 | 1.36 | 1.16 |
| | 41000 | 0.25 | - | 0.81 | 0.85 | 0.86 | 0.91 | 0.94 | 0.97 | 1.20 | - | - |
| | 46000 | 0.29 | - | 0.96 | 1.03 | 0.99 | 1.09 | 1.09 | 1.17 | 1.45 | - | - |
| | 51000 | 0.34 | - | 1.14 | - | - | 1.29 | - | - | - | - | - |
| | 54000 | 0.37 | - | 1.25 | - | - | 1.42 | - | - | - | - | - |
| 130/140 | 23000 | 0.10 | - | 0.32 | 0.37 | 0.44 | 0.36 | 0.47 | 0.40 | 0.49 | 0.77 | 0.68 |
| | 26000 | 0.14 | - | 0.43 | 0.47 | 0.54 | 0.48 | 0.58 | 0.52 | 0.64 | 0.97 | 0.85 |
| | 30000 | 0.17 | - | 0.55 | 0.59 | 0.64 | 0.62 | 0.70 | 0.66 | 0.82 | 1.18 | 1.02 |
| | 35000 | 0.21 | - | 0.69 | 0.73 | 0.76 | 0.78 | 0.83 | 0.82 | 1.02 | 1.40 | 1.20 |
| | 40000 | 0.26 | - | 0.84 | 0.89 | 0.88 | 0.94 | 0.97 | 1.01 | 1.25 | - | - |
| | 45000 | 0.30 | - | 1.00 | 1.07 | 1.02 | 1.13 | 1.12 | 1.22 | 1.51 | - | - |
| | 50000 | 0.35 | - | 1.17 | 1.27 | 1.16 | 1.33 | - | - | - | - | - |
| | 55000 | 0.41 | - | 1.36 | - | - | 1.55 | - | - | - | - | - |
| | 58000 | 0.44 | - | 1.48 | - | - | - | - | - | - | - | - |

### Table 40. Component static pressure drops (in. $H_2O$) (continued)

| Nom Tons | CFM | Standard Filter Section (Pre Evap): Std 2" High Eff Throw Away Filters | 90-95% Low PD Cartridge Filters w/ 2" Prefilter | 90-95% Low PD Cartridge Filters w/ 4" Prefilter | 90-95% Cartridge Filters w/ 2" Prefilter (c) | 90-95% Bag Filters w/ 2" Prefilter (c) | Final Filter Section (Post Evap): 90-95% Std Temp Low PD Cartridge Filters w/4" Prefilter (d) | 90-95% Std Temp Bag Filters w/ 2" Prefilter (e) | 90-95% Std Temp Cartridge Filters w/ 2" Prefilter (e) | 90-95% Hi Temp Cartridge Filters w/ 2" Hi Temp Prefilter (e) | 90-95% Hi Temp HEPA w/ 2" Hi Temp Prefilter (f) | 90-95% Std Temp HEPA Filters w/ 2" Hi Temp Prefilter (f) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 150/162 | 23000 | 0.10 | - | 0.32 | 0.37 | 0.44 | 0.36 | 0.47 | 0.40 | 0.49 | 0.77 | 0.68 |
| | 26000 | 0.14 | - | 0.43 | 0.47 | 0.54 | 0.48 | 0.58 | 0.52 | 0.64 | 0.97 | 0.85 |
| | 30000 | 0.17 | - | 0.55 | 0.59 | 0.64 | 0.62 | 0.70 | 0.66 | 0.82 | 1.18 | 1.02 |
| | 35000 | 0.21 | - | 0.69 | 0.73 | 0.76 | 0.78 | 0.83 | 0.82 | 1.02 | 1.40 | 1.20 |
| | 40000 | 0.26 | - | 0.84 | 0.89 | 0.88 | 0.94 | 0.97 | 1.01 | 1.25 | - | - |
| | 45000 | 0.30 | - | 1.00 | 1.07 | 1.02 | 1.13 | 1.12 | 1.22 | 1.51 | - | - |
| | 50000 | 0.35 | - | 1.17 | 1.27 | 1.16 | 1.33 | - | - | - | - | - |
| | 55000 | 0.41 | - | 1.36 | - | - | 1.55 | - | - | - | - | - |
| | 58000 | 0.44 | - | 1.48 | - | - | - | - | - | - | - | - |

(a) Actual Supply Fan CFM Range: 90/100 Ton 16,000-40,000; 105/118 Ton 19,000-45,000; 120/128 Ton 21,000-54,000; 130-162 Ton 23,000-58,000
(b) There is no pressure drop with Electric Heat DF configuration
(c) 120-162 Ton Max CFM 50,000
(d) 130-162 Ton Max CFM 55,500
(e) 120-162 Ton Max CFM 46,250
(f) 90-162 Ton Max CFM 37,000

**Table 41. Energy recovery wheel component static pressure drops**

| Nom Tons | CFM | Outside Air Bypass Damper Open | Outside Air Bypass Damper Closed | Exhaust Air Bypass Damper Open | Exhaust Air Bypass Damper Closed |
|---|---|---|---|---|---|
| **Low CFM Energy Recovery Wheel** | | | | | |
| 90/100 | 8000 | 0.07 | 0.78 | 0.09 | 0.66 |
| | 9000 | 0.09 | 0.88 | 0.11 | 0.79 |
| | 10000 | 0.12 | 0.99 | 0.14 | 0.92 |
| | 12000 | 0.16 | 1.20 | 0.19 | 1.16 |
| | 14000 | 0.21 | 1.42 | 0.24 | 1.41 |
| | 16000 | 0.27 | - | 0.29 | - |
| | 20000 | 0.40 | - | 0.42 | - |
| | 25000 | 0.59 | - | 0.60 | - |
| | 30000 | 0.80 | - | 0.80 | - |
| | 33000 | 0.94 | - | 0.94 | - |
| | 36000 | 1.08 | - | 1.07 | - |
| | 40000 | 1.30 | - | 1.27 | - |
| 105/118 | 9000 | 0.09 | 0.88 | 0.11 | 0.79 |
| | 12000 | 0.16 | 1.20 | 0.19 | 1.16 |
| | 14000 | 0.21 | 1.42 | 0.24 | 1.41 |
| | 16000 | 0.27 | - | 0.29 | - |
| | 19000 | 0.36 | - | 0.39 | |
| | 23000 | 0.51 | - | 0.52 | - |
| | 28000 | 0.71 | - | 0.72 | - |
| | 33000 | 0.94 | - | 0.94 | - |
| | 38000 | 1.19 | - | 1.18 | - |
| | 43000 | 1.46 | - | 1.41 | - |
| | 45000 | 1.58 | - | 1.52 | - |
| 120/128 | 9000 | 0.09 | 0.78 | 0.11 | 0.69 |
| | 12000 | 0.16 | 1.06 | 0.18 | 1.02 |
| | 15000 | 0.23 | 1.36 | 0.26 | 1.36 |
| | 18000 | 0.31 | - | 0.34 | - |
| | 21000 | 0.41 | - | 0.44 | - |
| | 26000 | 0.59 | - | 0.62 | - |
| | 31000 | 0.79 | - | 0.82 | - |
| | 36000 | 1.01 | - | 1.04 | - |
| | 41000 | 1.25 | - | 1.28 | - |
| | 46000 | 1.51 | - | 1.52 | - |
| | 51000 | 1.79 | - | 1.79 | - |
| | 54000 | 1.96 | - | 1.95 | - |

**Continued on next page**

**Table 41. Energy recovery wheel component static pressure drops (continued)**

| Nom Tons | CFM | Outside Air Bypass Damper Open | Outside Air Bypass Damper Closed | Exhaust Air Bypass Damper Open | Exhaust Air Bypass Damper Closed |
|---|---|---|---|---|---|
| 130/140 | 9000 | 0.09 | 0.71 | 0.10 | 0.62 |
| | 12000 | 0.15 | 0.97 | 0.18 | 0.92 |
| | 16000 | 0.25 | 1.34 | 0.28 | 1.33 |
| | 20000 | 0.36 | - | 0.40 | - |
| | 23000 | 0.46 | - | 0.49 | - |
| | 26000 | 0.57 | - | 0.60 | - |
| | 30000 | 0.72 | - | 0.75 | - |
| | 35000 | 0.93 | - | 0.97 | - |
| | 40000 | 1.16 | - | 1.20 | - |
| | 45000 | 1.40 | - | 1.43 | - |
| | 50000 | 1.67 | - | 1.69 | - |
| | 55000 | 1.95 | - | 1.96 | - |
| | 58000 | 2.12 | - | 2.12 | - |
| 150/162 | 9000 | 0.09 | 0.71 | 0.10 | 0.62 |
| | 12000 | 0.15 | 0.97 | 0.18 | 0.92 |
| | 16000 | 0.25 | 1.34 | 0.28 | 1.33 |
| | 20000 | 0.36 | - | 0.40 | - |
| | 23000 | 0.46 | - | 0.49 | - |
| | 26000 | 0.57 | - | 0.60 | - |
| | 30000 | 0.72 | - | 0.75 | - |
| | 35000 | 0.93 | - | 0.97 | - |
| | 40000 | 1.16 | - | 1.20 | - |
| | 45000 | 1.40 | - | 1.43 | - |
| | 50000 | 1.67 | - | 1.69 | - |
| | 55000 | 1.95 | - | 1.96 | - |
| | 58000 | 2.12 | - | 2.12 | - |
| **Nom Tons** | **CFM** | **Outside Air Bypass Damper Open** | **Outside Air Bypass Damper Closed** | **Exhaust Air Bypass Damper Open** | **Exhaust Air Bypass Damper Closed** |
| **Standard CFM Energy Recovery Wheel** | | | | | |
| 90/100 | 8000 | 0.06 | 0.54 | 0.07 | 0.44 |
| | 9000 | 0.08 | 0.61 | 0.10 | 0.53 |
| | 10000 | 0.10 | 0.68 | 0.12 | 0.62 |
| | 12000 | 0.15 | 0.83 | 0.17 | 0.77 |
| | 14000 | 0.19 | 0.99 | 0.22 | 0.94 |
| | 16000 | 0.24 | 1.16 | 0.26 | 1.12 |
| | 18000 | 0.30 | 1.32 | 0.31 | 1.29 |
| | 20000 | 0.35 | - | 0.37 | - |
| | 25000 | 0.52 | - | 0.54 | - |
| | 30000 | 0.70 | - | 0.73 | - |
| | 33000 | 0.82 | - | 0.84 | - |
| | 36000 | 0.95 | - | 0.97 | - |
| | 40000 | 1.12 | - | 1.14 | - |

**Continued on next page**

**Table 41. Energy recovery wheel component static pressure drops (continued)**

| Nom Tons | CFM | Outside Air Bypass Damper Open | Outside Air Bypass Damper Closed | Exhaust Air Bypass Damper Open | Exhaust Air Bypass Damper Closed |
|---|---|---|---|---|---|
| 105/118 | 9000 | 0.08 | 0.57 | 0.09 | 0.47 |
| | 12000 | 0.14 | 0.77 | 0.16 | 0.65 |
| | 14000 | 0.19 | 0.93 | 0.21 | 0.78 |
| | 16000 | 0.24 | 1.08 | 0.26 | 0.91 |
| | 19000 | 0.32 | 1.33 | 0.34 | 1.11 |
| | 21000 | 0.37 | 1.49 | 0.40 | 1.25 |
| | 23000 | 0.44 | - | 0.46 | - |
| | 28000 | 0.61 | - | 0.64 | - |
| | 33000 | 0.80 | - | 0.82 | - |
| | 38000 | 1.00 | - | 1.03 | - |
| | 43000 | 1.23 | - | 1.25 | - |
| | 45000 | 1.33 | - | 1.34 | - |
| 120/128 | 10000 | 0.10 | 0.56 | 0.11 | 0.50 |
| | 12000 | 0.14 | 0.69 | 0.16 | 0.63 |
| | 15000 | 0.20 | 0.89 | 0.23 | 0.85 |
| | 18000 | 0.27 | 1.10 | 0.29 | 1.05 |
| | 21000 | 0.35 | 1.33 | 0.38 | 1.28 |
| | 24000 | 0.43 | 1.57 | 0.47 | 1.51 |
| | 26000 | 0.50 | - | 0.54 | - |
| | 31000 | 0.66 | - | 0.72 | - |
| | 36000 | 0.84 | - | 0.91 | - |
| | 41000 | 1.04 | - | 1.11 | - |
| | 46000 | 1.26 | - | 1.34 | - |
| | 51000 | 1.49 | - | 1.56 | - |
| | 54000 | 1.63 | - | 1.71 | - |
| 130-162 | 13000 | 0.16 | 0.59 | 0.17 | 0.53 |
| | 15000 | 0.20 | 0.69 | 0.22 | 0.63 |
| | 18000 | 0.26 | 0.86 | 0.28 | 0.79 |
| | 21000 | 0.33 | 1.04 | 0.36 | 0.96 |
| | 23000 | 0.38 | 1.16 | 0.42 | 1.06 |
| | 26000 | 0.45 | 1.36 | 0.50 | 1.24 |
| | 29000 | 0.54 | 1.57 | 0.60 | 1.42 |
| | 30000 | 0.57 | - | 0.63 | - |
| | 35000 | 0.72 | - | 0.80 | - |
| | 40000 | 0.89 | - | 0.98 | - |
| | 45000 | 1.08 | - | 1.17 | - |
| | 50000 | 1.28 | - | 1.38 | - |
| | 55000 | 1.50 | - | 1.60 | - |
| | 58000 | 1.63 | - | 1.74 | - |

**Continued on next page**

**Table 41. Energy recovery wheel component static pressure drops (continued)**

| Tons | CFM | Return Damper, ERW only | Econo Damper, ERW only |
|---|---|---|---|
| 90/100 | 16000 | 0.14 | 0.15 |
| | 20000 | 0.20 | 0.24 |
| | 25000 | 0.29 | 0.39 |
| | 30000 | 0.42 | 0.56 |
| | 33000 | 0.51 | 0.69 |
| | 36000 | 0.61 | 0.82 |
| | 40000 | 0.75 | 1.01 |
| 105/118 | 19000 | 0.19 | 0.22 |
| | 23000 | 0.25 | 0.33 |
| | 28000 | 0.37 | 0.49 |
| | 33000 | 0.51 | 0.69 |
| | 38000 | 0.68 | 0.91 |
| | 43000 | 0.87 | 1.17 |
| | 45000 | 0.96 | 1.29 |
| 120/128 | 21000 | 0.22 | 0.18 |
| | 26000 | 0.32 | 0.27 |
| | 31000 | 0.45 | 0.39 |
| | 36000 | 0.61 | 0.53 |
| | 41000 | 0.79 | 0.69 |
| | 46000 | 1.00 | 0.87 |
| | 51000 | 1.24 | 1.07 |
| | 54000 | 1.40 | 1.20 |
| 130-162 | 23000 | 0.25 | 0.21 |
| | 26000 | 0.32 | 0.27 |
| | 30000 | 0.42 | 0.36 |
| | 35000 | 0.57 | 0.50 |
| | 40000 | 0.75 | 0.65 |
| | 45000 | 0.96 | 0.83 |
| | 50000 | 1.19 | 1.02 |
| | 55000 | 1.45 | 1.24 |
| | 58000 | 1.63 | 1.38 |

**Table 42. Energy recovery wheel pLoss ΔP (in. wg), and total effectiveness**

| Actual Air Flow CFM | 90-118 Tons Low | | 120/128 Tons Low | | 130-162 Tons Low | | 90/100 Tons Standard | | 105/118 Tons Standard | | 120/128 Tons Standard | | 130-162 Tons Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ΔP | Eff | ΔP | Eff | ΔP | Eff | ΔP | Eff | ΔP | Eff | ΔP | Eff | ΔP | Eff |
| 8000 | 0.73 | 77.5 | 0.64 | 79.0 | 0.58 | 80.0 | 0.49 | 81.6 | | | | | | |
| 9000 | 0.82 | 75.9 | 0.72 | 77.6 | 0.65 | 78.7 | 0.55 | 80.6 | 0.51 | 81.3 | | | | |
| 10000 | 0.91 | 74.3 | 0.80 | 76.2 | 0.73 | 77.5 | 0.61 | 79.5 | 0.56 | 80.3 | 0.49 | 81.6 | | |
| 11000 | 1.00 | 72.7 | 0.88 | 74.8 | 0.80 | 76.2 | 0.67 | 78.5 | 0.62 | 79.4 | 0.54 | 80.7 | | |
| 12000 | 1.09 | 71.1 | 0.96 | 73.4 | 0.87 | 75.0 | 0.73 | 77.4 | 0.67 | 78.4 | 0.59 | 79.8 | | |
| 13000 | 1.18 | 69.5 | 1.04 | 72.0 | 0.94 | 73.7 | 0.79 | 76.4 | 0.73 | 77.4 | 0.64 | 79.0 | 0.48 | 74.7 |
| 14000 | | | 1.12 | 70.6 | 1.02 | 72.4 | 0.85 | 75.3 | 0.79 | 76.5 | 0.69 | 78.1 | 0.51 | 72.9 |
| 15000 | | | 1.20 | 69.2 | 1.09 | 71.1 | 0.91 | 74.3 | 0.84 | 75.5 | 0.74 | 77.3 | 0.55 | 71.9 |
| 16000 | | | | | 1.16 | 69.8 | 0.97 | 73.2 | 0.90 | 74.5 | 0.79 | 76.4 | 0.58 | 71.0 |
| 17000 | | | | | 1.24 | 68.5 | 1.03 | 72.1 | 0.95 | 73.5 | 0.83 | 75.6 | 0.61 | 70.0 |
| 18000 | | | | | | | 1.09 | 71.1 | 1.01 | 72.5 | 0.88 | 74.7 | 0.64 | 69.0 |
| 19000 | | | | | | | 1.15 | 70.0 | 1.07 | 71.5 | 0.93 | 73.9 | 0.67 | 68.1 |
| 20000 | | | | | | | 1.22 | 68.9 | 1.12 | 70.5 | 0.98 | 73.0 | 0.71 | 67.1 |
| 21000 | | | | | | | | | 1.18 | 69.5 | 1.03 | 72.1 | 0.74 | 66.1 |
| 22000 | | | | | | | | | 1.23 | 68.5 | 1.08 | 71.3 | 0.77 | 65.1 |
| 23000 | | | | | | | | | | | 1.13 | 70.4 | 0.80 | 64.2 |
| 24000 | | | | | | | | | | | 1.18 | 69.5 | 0.84 | 63.2 |
| 25000 | | | | | | | | | | | 1.23 | 68.7 | 0.87 | 62.2 |
| 26000 | | | | | | | | | | | | | 0.90 | 61.2 |
| 27000 | | | | | | | | | | | | | 0.93 | 60.3 |
| 28000 | | | | | | | | | | | | | 0.97 | 59.3 |
| 29000 | | | | | | | | | | | | | 1.00 | 58.3 |

# Pressure Curves

## (60 Hz) Air-Cooled Condensers

**Figure 84. Operating pressure curve (all comp. and cond. fans per ckt. on)—90 tons std. capacity**

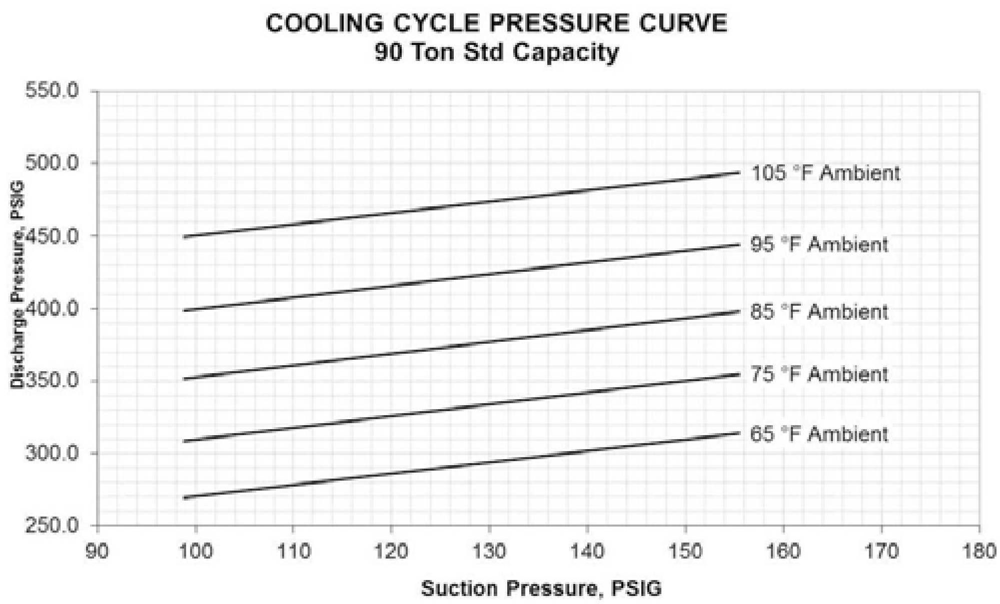



**Figure 85. Operating pressure curve (all comp. and cond. fans per ckt. on)—90 tons high capacity**

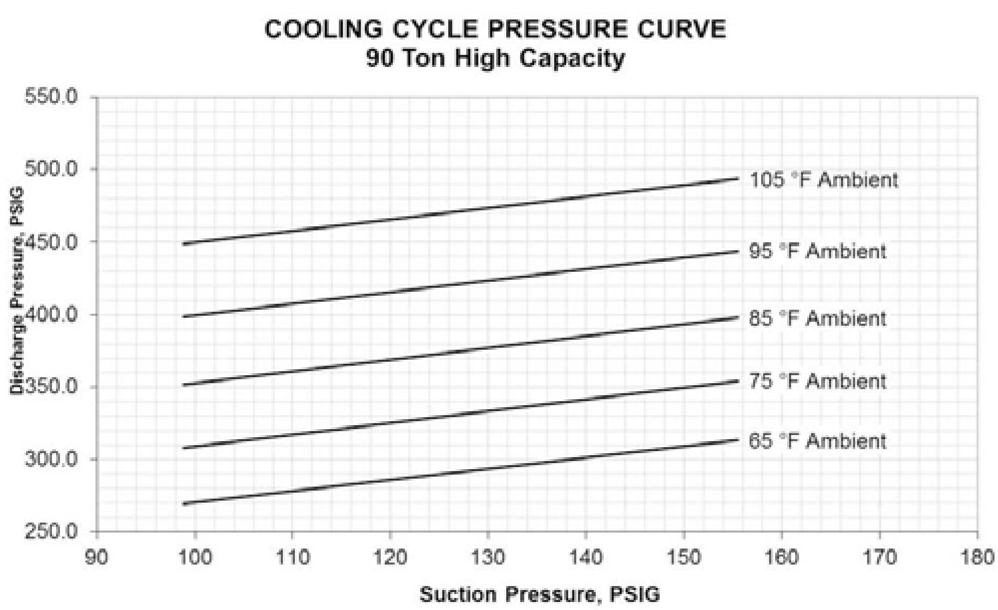


Figure 86. Operating pressure curve (all comp. and cond. fans per ckt. on)—105 tons std. capacity

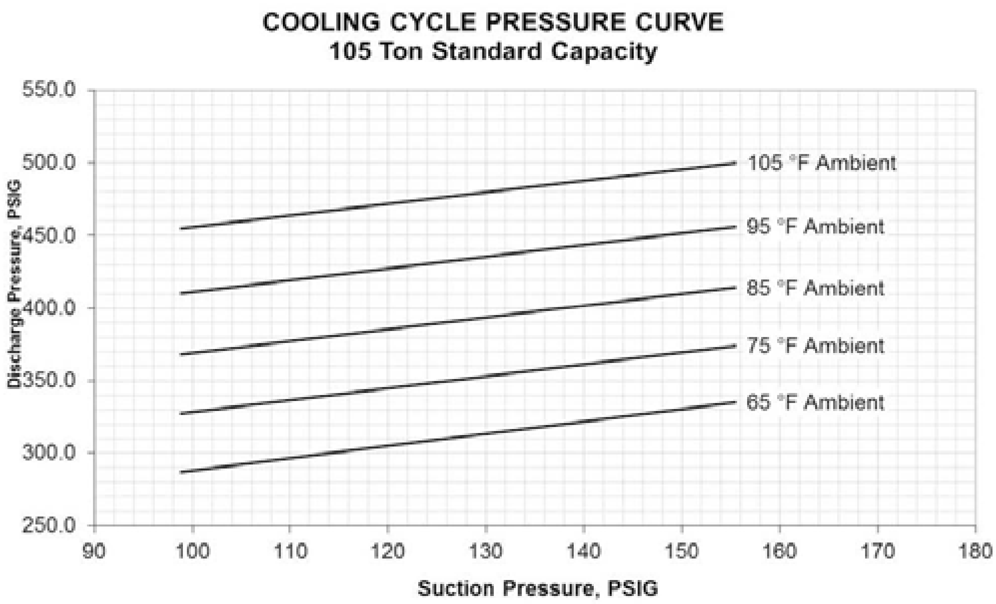



Figure 87. Operating pressure curve (all comp. and cond. fans per ckt. on)—105 tons high capacity

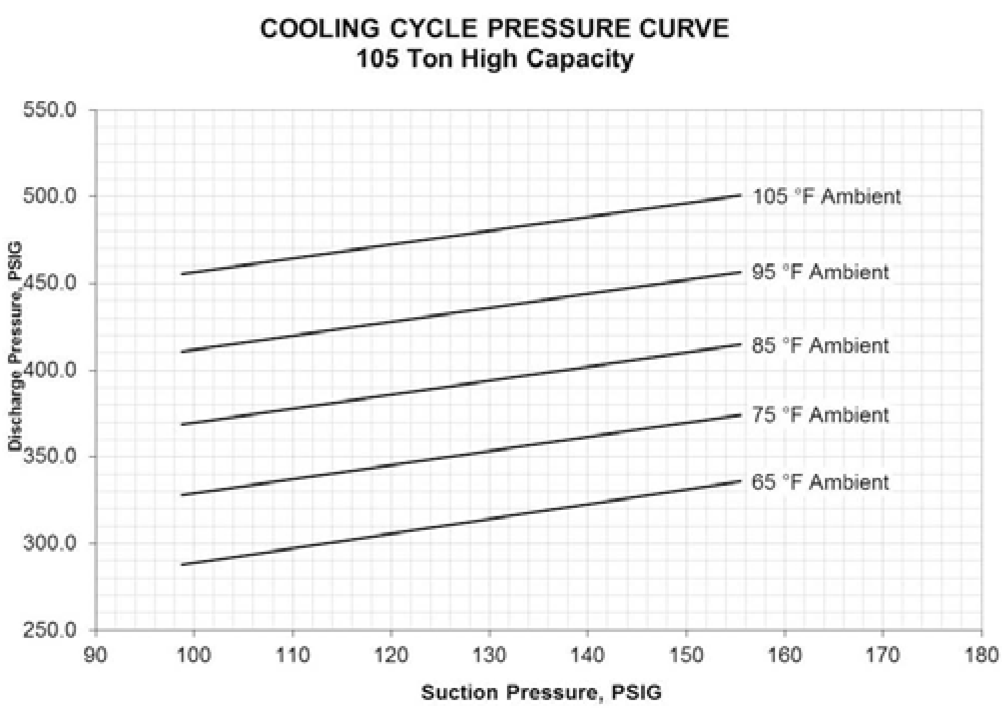


**Figure 88. Operating pressure curve (all comp. and cond. fans per ckt. on)—120 tons std. capacity**

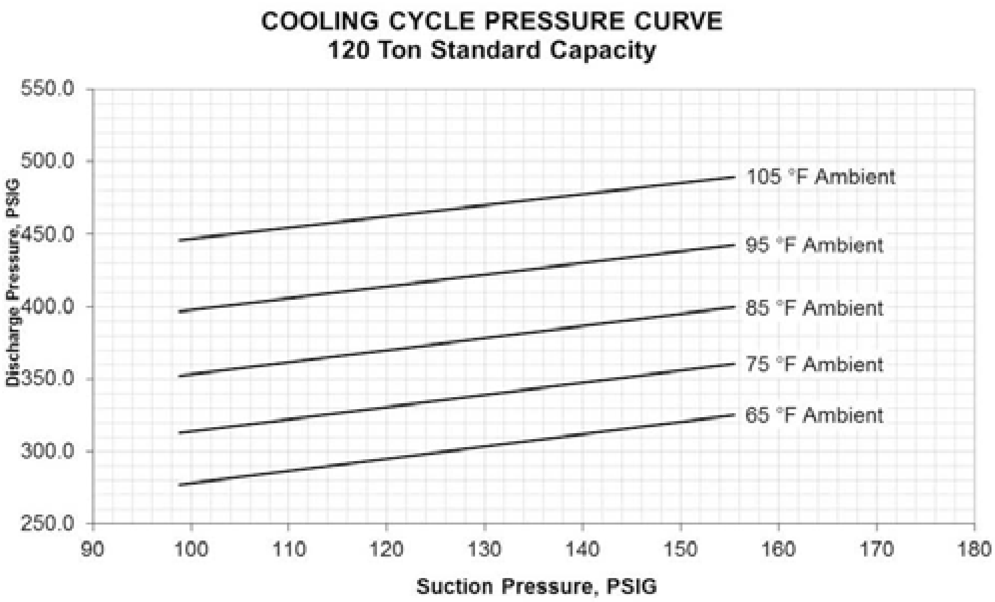



**Figure 89. Operating pressure curve (all comp. and cond. fans per ckt. on)—120 tons high capacity**

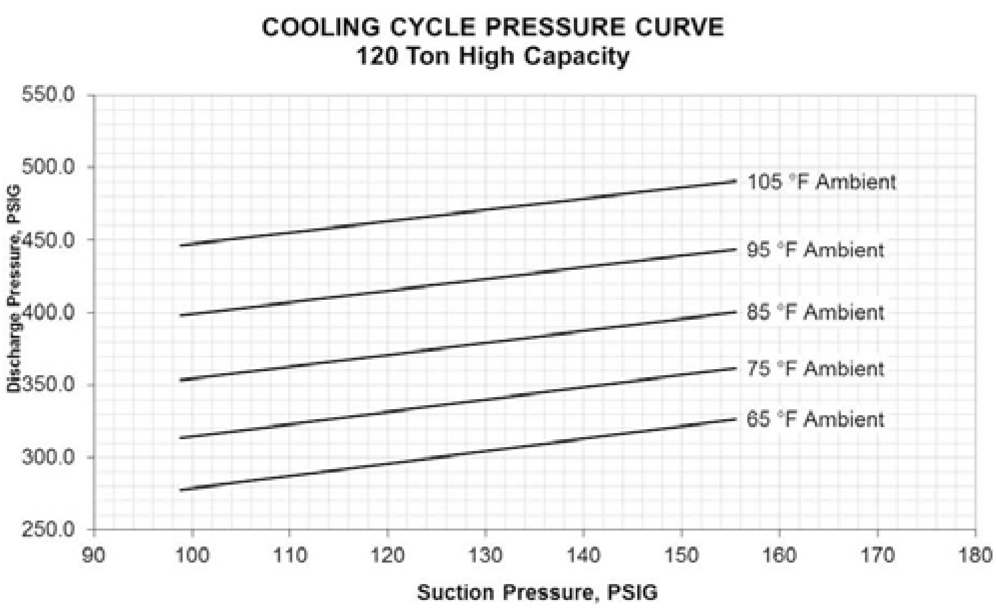


Figure 90. Operating Pressure Curve (All Comp. and Cond. Fans per ckt. on)—130 Tons Std. Capacity

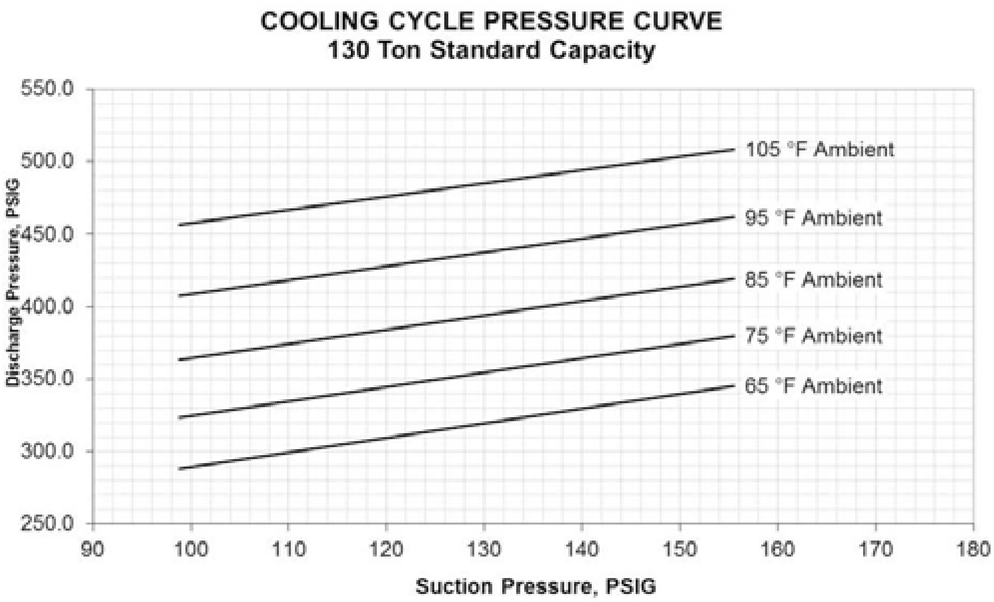



Figure 91. Operating Pressure Curve (All Comp. and Cond. Fans per ckt. on)—130 Tons High Capacity

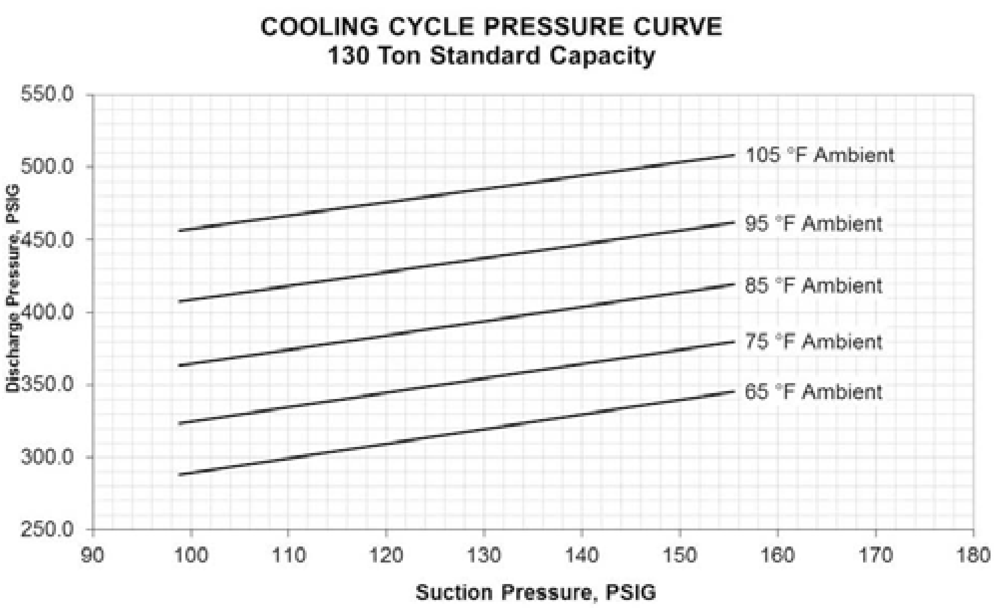
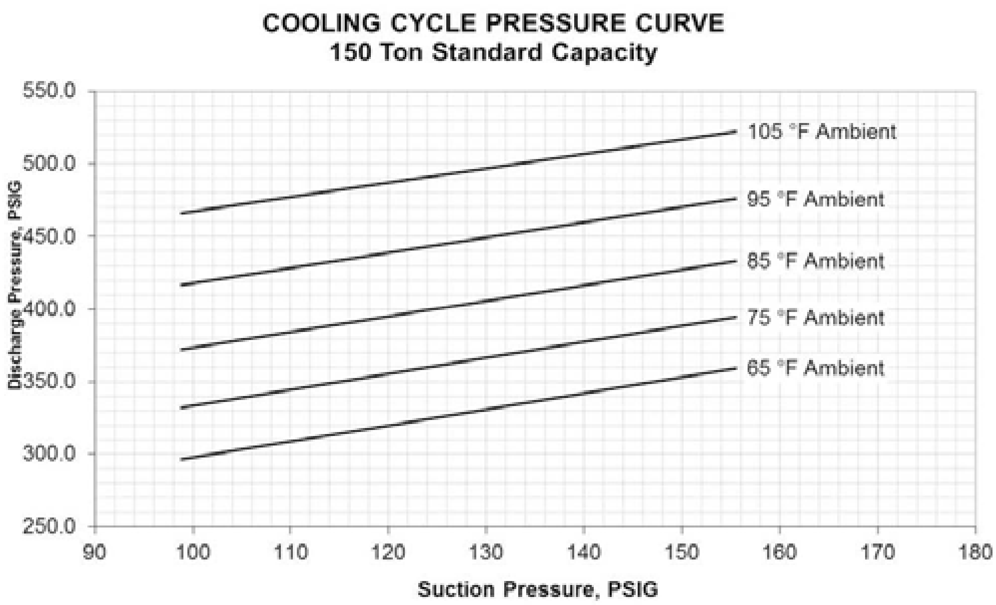


Figure 92. Operating pressure curve (all comp. and cond. fans per ckt. on)—150 ton std. capacity




***Note:*** *Due to the variable speed fans on Evaporative Condenser units, typical operating pressure curves are not relevant. If operating pressures at certain conditions are needed, contact a local Trane sales representative.*

Figure 93. Operating pressure curve (all comp. and cond. fans per ckt. on)—90 tons standard capacity

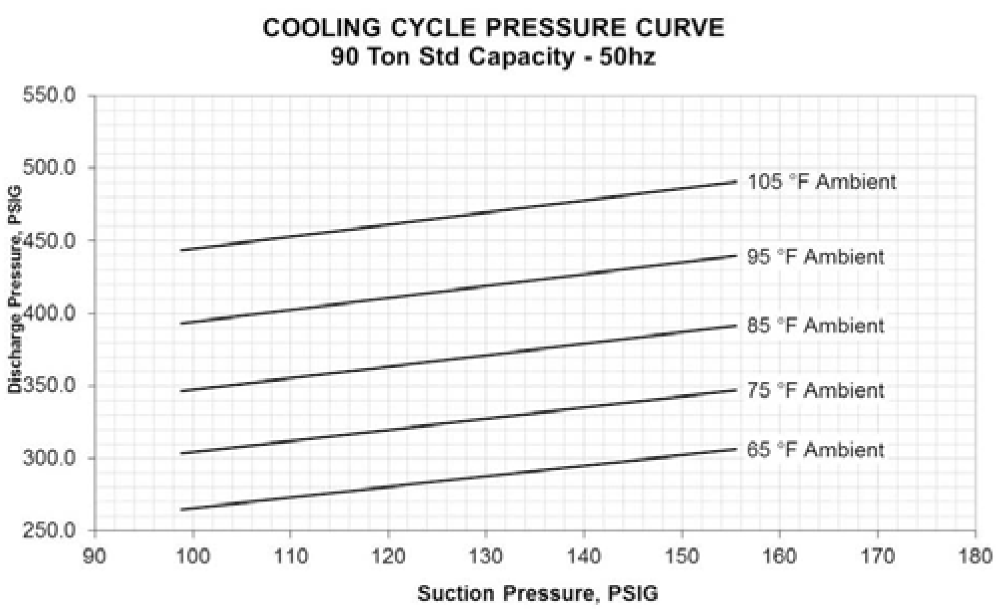


Figure 94. Operating pressure curve (all comp. and cond. fans per ckt. on)—90 tons high capacity

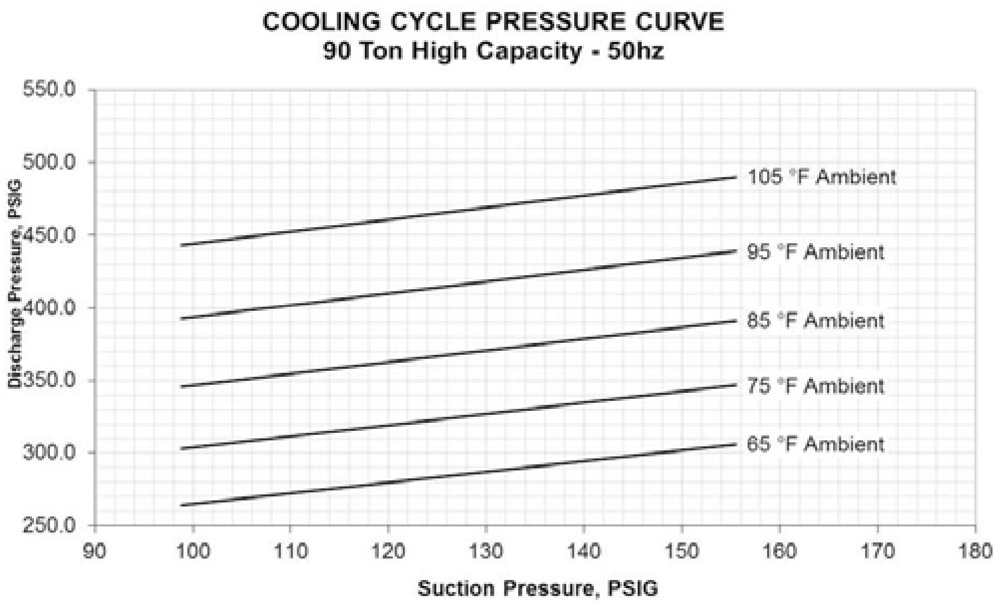



Figure 95. Operating pressure curve (all comp. and cond. fans per ckt. on)—105 tons standard capacity

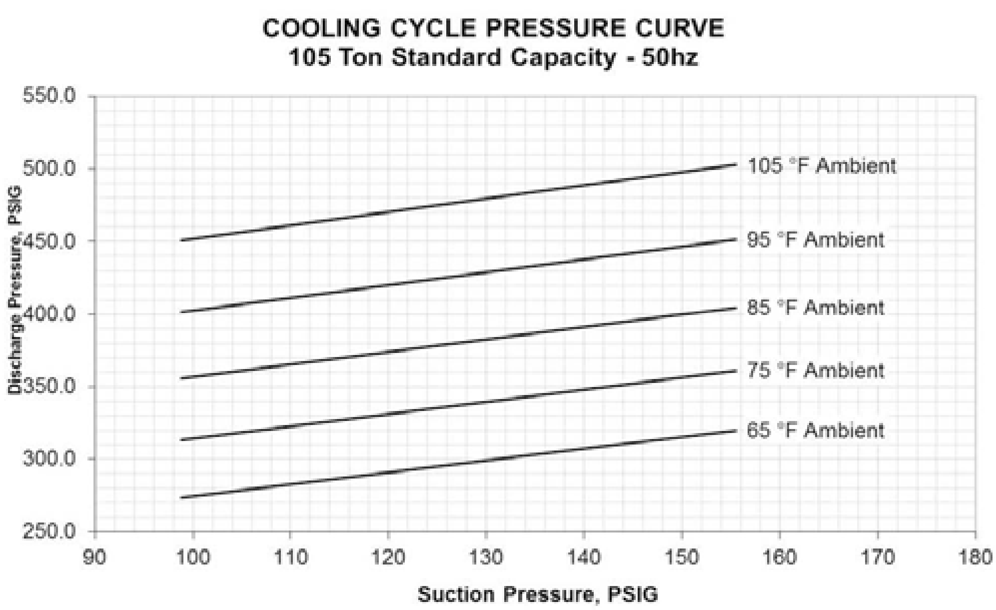


Figure 96. Operating pressure curve (all comp. and cond. fans per ckt. on)—105 tons high capacity

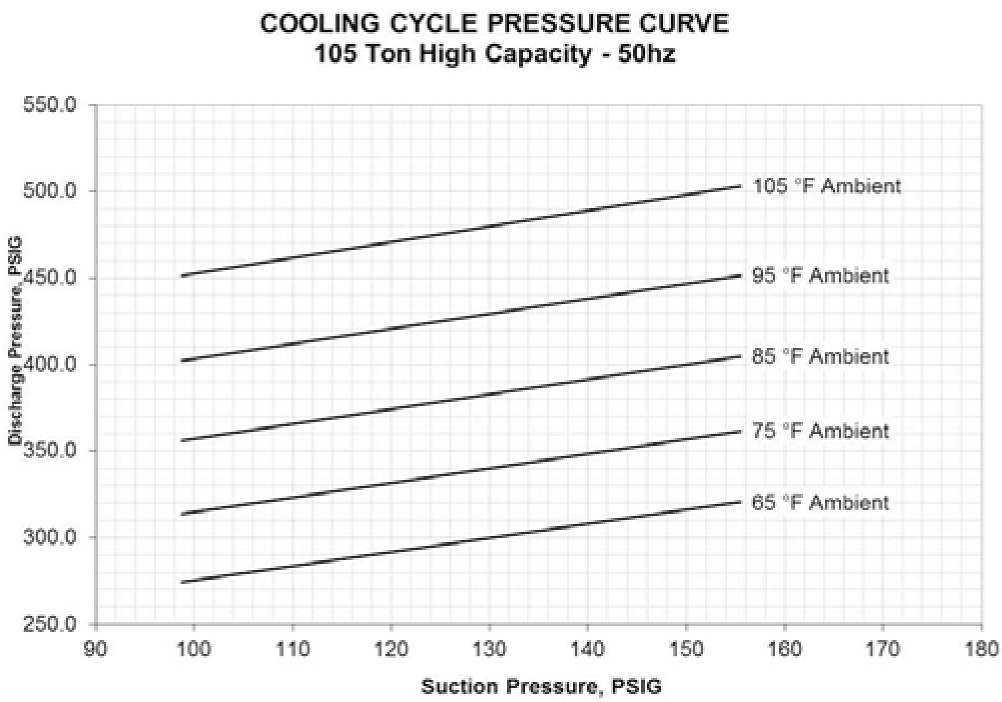



Figure 97. Operating pressure curve (all comp. and cond. fans per ckt. on)—120 tons standard capacity

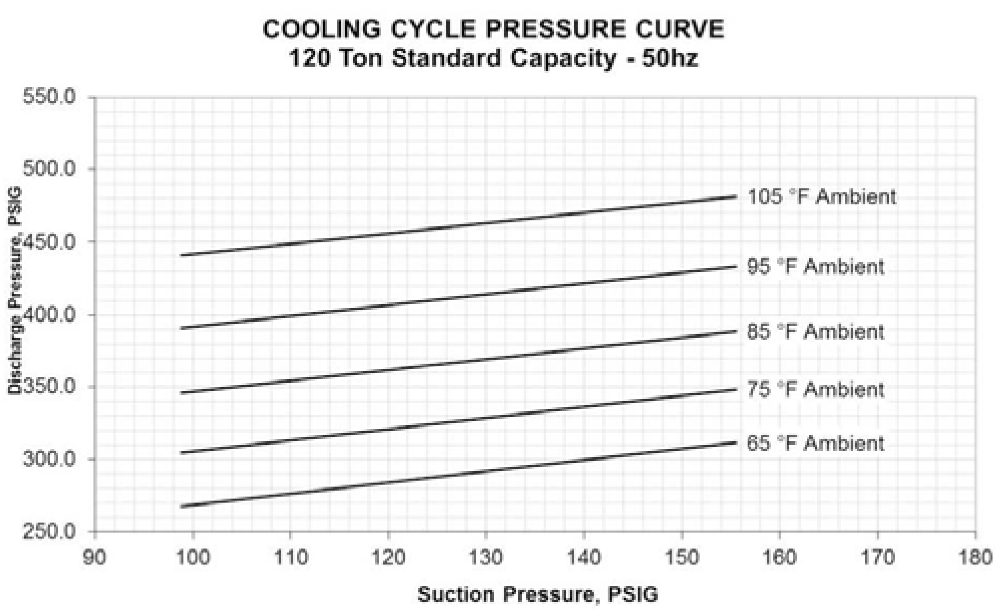


Figure 98. Operating pressure curve (all comp. and cond. fans per ckt. on)—120 tons high capacity

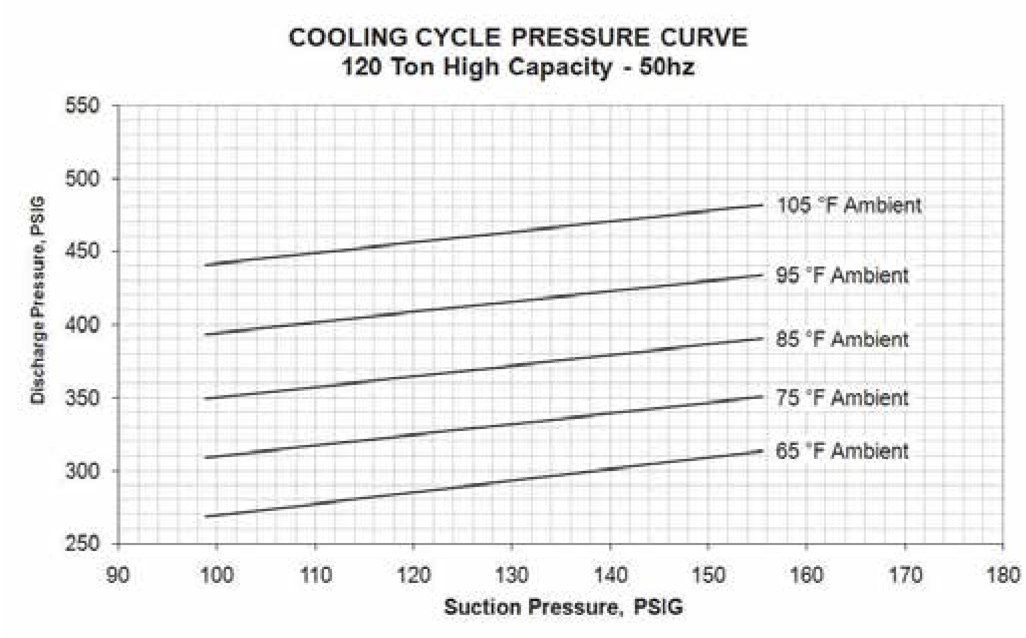



Figure 99. Operating pressure curve (all comp. and cond. fans per ckt. on)—130 tons standard capacity

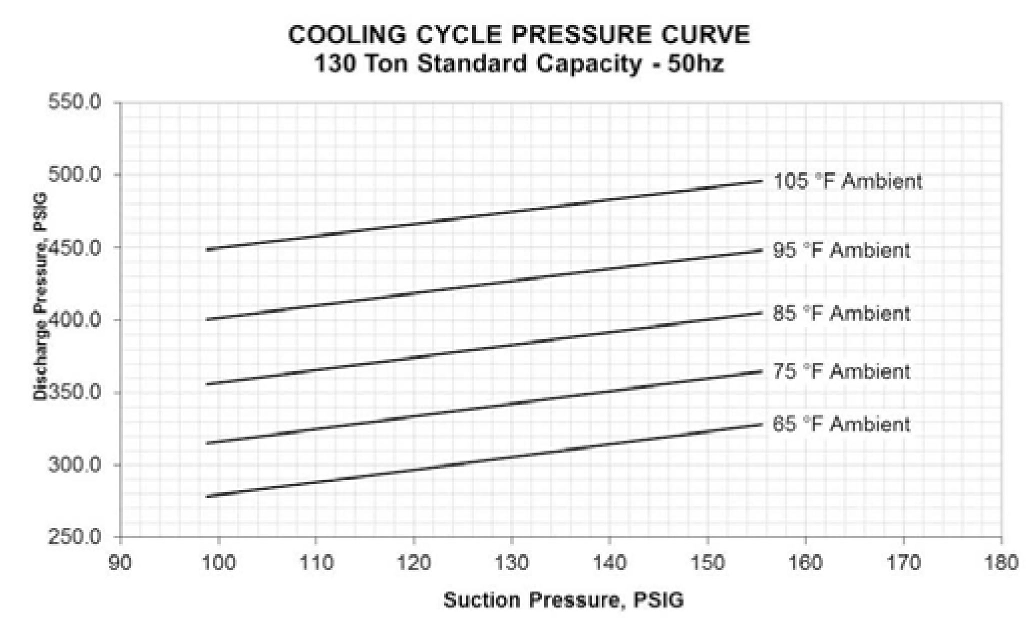


**Figure 100. Operating pressure curve (all comp. and cond. fans per ckt. on)—130 tons high capacity**

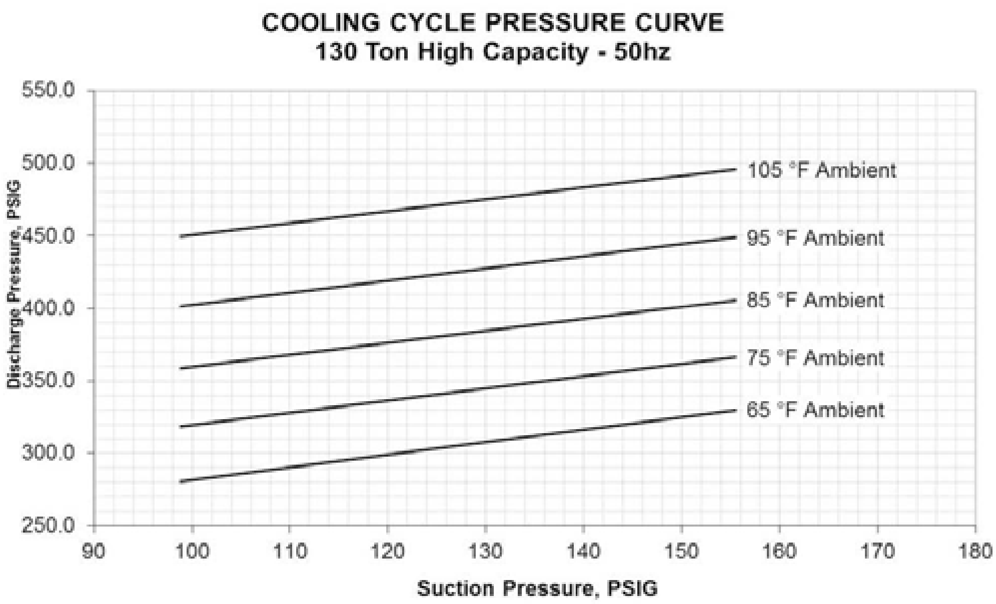
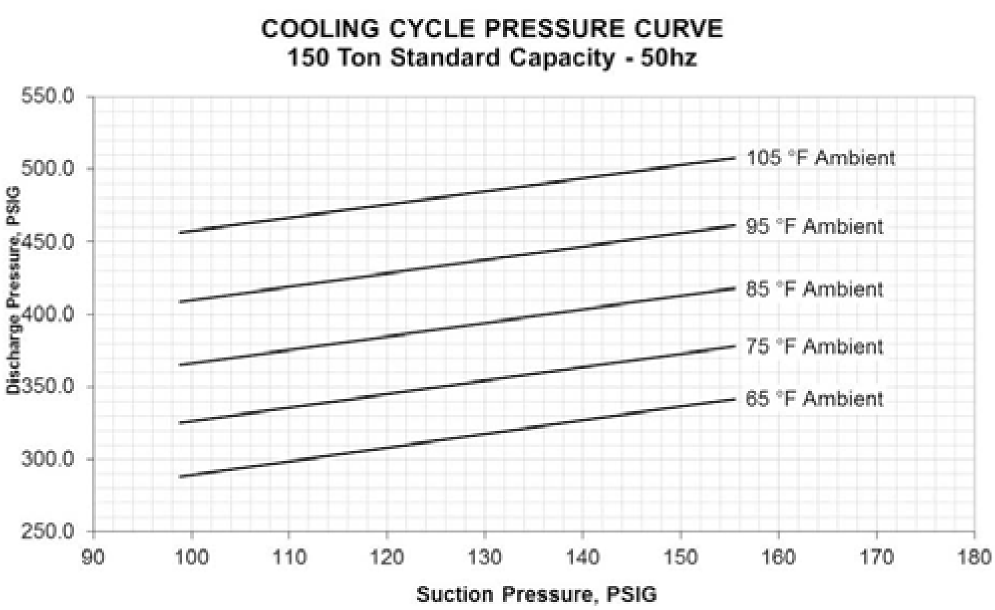



**Figure 101. Operating pressure curve (all comp. and cond. fans per ckt. on)—150 tons standard capacity**




***Note:*** *Due to the variable speed fans on evaporative condenser units, typical operating pressure curves are not relevant. If operating pressures at certain conditions are needed, contact a local Trane sales representative.*

# Components

## Standard Unit without Energy Recovery Wheel

### Economizer Damper Adjustment

### Exhaust Air Dampers

Verify that the exhaust dampers (if equipped) close tightly when the unit is off. Adjust the damper linkage as necessary to ensure proper closure. An access panel is provided under each damper assembly.

### Outside Air & Return Air Damper Operation

The outside air and return air damper linkage is accessible from the filter section of the unit. The damper linkage connecting the outside air dampers to the return air dampers is preset from the factory in the number 1 position. Refer to Figure 102, p. 144 for the appropriate linkage position for the unit and operating airflow (CFM).

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

***Note:*** *Bridging between the unit main supports may consist of multiple 2 by 12 boards or sheet metal grating.*

Arbitrarily adjusting the outside air dampers to open fully when the return air dampers are closed or; failing to maintain the return air pressure drop with the outside air dampers when the return air dampers are closed, can overload the supply fan motor and cause building pressurization control problems due to improper CFM being delivered to the space.

The outside air/return air damper linkage is connected to a crank arm with a series of holes that allows the installer or operator to modify the amount of outside air damper travel in order to match the return static pressure. Refer to Table 43, p. 146 for the equivalent return air duct losses that correspond to each of the holes illustrated in Figure 102, p. 144.

### To Adjust the Outside Air Damper Travel:

1. Drill a 1/4" hole through the unit casing up stream of the return air dampers. Use a location that will produce an accurate reading with the least amount of turbulence. Several locations may be necessary, and average the reading.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the “On” position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the applicable programming manual for applications for the SERVICE TEST screens and programming instructions.
5. Use Table 37, p. 110 to program the following system components for operation by scrolling through the displays;

   Supply Fan (On)

   Variable Frequency Drive (100% Output, if applicable)

   RTM Occ/Unocc Output (Unoccupied)

   Outside Air Dampers (Closed)
6. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
8. With the outside air dampers fully closed and the supply fan operating at 100% airflow requirements,

measure the return static pressure at the location determined in step 1.

9. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.
10. Open the field supplied main power disconnect switch upstream of the rooftop unit. Lock the disconnect switch in the “Open” position while working on the dampers.

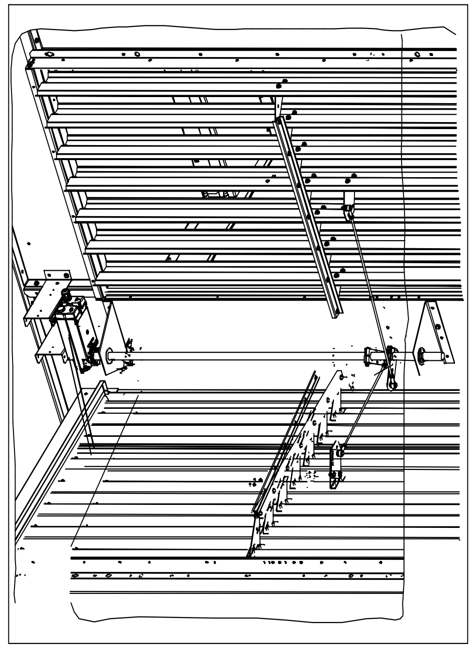
***Note:*** *Gravity will cause the damper to close. Support or secure the damper blades while removing the actuator to prevent unexpected damper rotation.*

11. Compare the static pressure reading to the static pressure ranges and linkage positions in Table 43, p. 146 for the unit size and operating CFM.

To relocate the outside air/return air connecting rod to balance the outside air damper pressure drop against the return static pressure, use the following steps. If no adjustment is necessary, proceed to step 17.

12. Remove the drive rod and swivel from the crank arm(s). If only one hole requires changing, loosen only that end.
13. Manually open the return air dampers to the full open position.
14. Manually close the outside air dampers.
15. Reattach the drive rod and swivel to the appropriate hole(s). The length of the drive rod may need to be adjusted to align with the new hole(s) location. If so, loosen the lock nut on the drive rod against the swivel. Turn the swivel “in” or “out” to shorten or lengthen the rod as necessary. For some holes, both ends of the rod may need to be adjusted.
16. Tighten the lock nut against the swivel(s).
17. Plug the holes after the proper CFM has been established.

**Figure 102. Outside air and return air damper assembly**



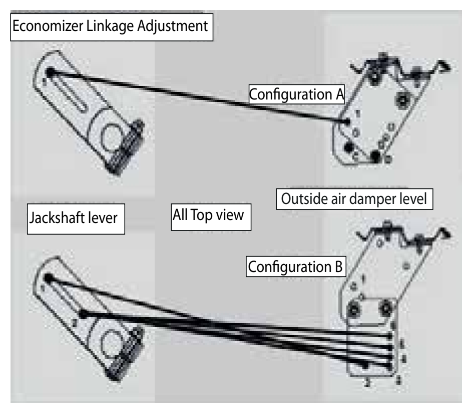


**Figure 103. Outside air and return air economizer assembly (w/TRAQ™ dampers)**

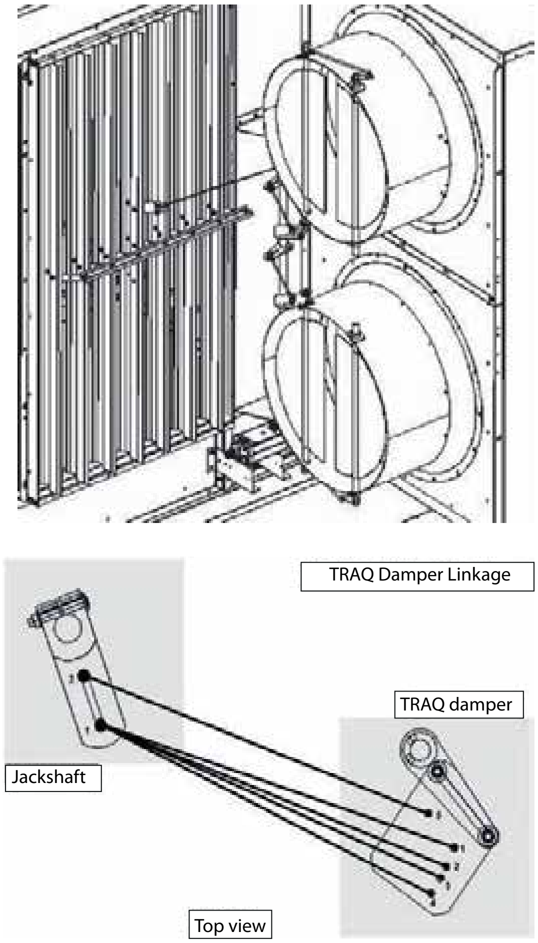


Table 43. Standard unit (no ERW) (economizer) outside air damper travel adjustment/pressure drop (*inches w.c.*)

| | Damper Position | | | | | |
|---|---|---|---|---|---|---|
| **Economizer Linkage Set-up** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Jackshaft rod end location** | **1** | **1** | **2** | **2** | **2** | **2** |
| **Damper lever configuration** | **A** | **B** | **B** | **B** | **B** | **B** |
| **Damper lever rod end location** | **1** | **2** | **3** | **4** | **5** | **6** |
| **120-162 Ton w/Economizer (includes mist eliminator)** | | | | | | |
| **CFM** | **Pressure Drop (*inches w.c.*)** | | | | | |
| 58500 | 0.80 | 1.64 | 2.96 | - | - | - |
| 54000 | 0.68 | 1.40 | 2.52 | - | - | - |
| 45500 | 0.48 | 0.99 | 1.79 | 2.22 | 2.62 | - |
| 42000 | 0.41 | 0.85 | 1.53 | 1.89 | 2.23 | 2.69 |
| 38000 | 0.34 | 0.69 | 1.25 | 1.55 | 1.83 | 2.20 |
| 34000 | 0.27 | 0.56 | 1.00 | 1.24 | 1.46 | 1.76 |
| 30000 | 0.21 | 0.43 | 0.78 | 0.97 | 1.14 | 1.37 |
| **90-118 Ton w/Economizer (includes mist eliminator)** | | | | | | |
| **CFM** | **Pressure Drop (*inches w.c.*)** | | | | | |
| 47250 | 0.81 | 1.88 | - | - | - | - |
| 40500 | 0.60 | 1.39 | 2.62 | - | - | - |
| 36750 | 0.49 | 1.14 | 2.16 | 2.71 | - | - |
| 31500 | 0.36 | 0.84 | 1.59 | 1.99 | 2.36 | 2.87 |
| 28000 | 0.28 | 0.66 | 1.25 | 1.57 | 1.87 | 2.27 |
| 25000 | 0.22 | 0.53 | 1.00 | 1.25 | 1.49 | 1.81 |
| 23000 | 0.19 | 0.45 | 0.85 | 1.06 | 1.26 | 1.53 |
| | **Damper Position** | | | | | |
| **Jackshaft rod end location** | **1** | **1** | **1** | **2** | **1** | |
| **Damper lever rod end location** | **1** | **2** | **3** | **5** | **4** | |
| **Jackshaft rod end location** | **1** | **1** | **1** | **2** | **1** | |
| **120-162 Ton w/TRAQ™ Damper (includes mist eliminator)** | | | | | | |
| **CFM** | **Pressure Drop (*inches w.c.*)** | | | | | |
| 58500 | 1.10 | 1.52 | 2.16 | 2.73 | | |
| 54000 | 0.93 | 1.28 | 1.83 | 2.33 | | |
| 45500 | 0.64 | 0.89 | 1.28 | 1.64 | 2.14 | |
| 42000 | 0.54 | 0.75 | 1.09 | 1.40 | 1.83 | |
| 38000 | 0.44 | 0.60 | 0.88 | 1.14 | 1.50 | |
| 34000 | 0.35 | 0.47 | 0.69 | 0.90 | 1.20 | |
| 30000 | 0.27 | 0.35 | 0.53 | 0.69 | 0.93 | |
| **90-118 Ton w/TRAQ™ Damper (includes mist eliminator)** | | | | | | |
| **CFM** | **Pressure Drop (*inches w.c.*)** | | | | | |
| 47250 | 1.37 | 1.89 | 2.72 | | | |
| 40500 | 0.99 | 1.35 | 1.97 | 2.54 | | |
| 36750 | 0.80 | 1.09 | 1.60 | 2.08 | 2.74 | |
| 31500 | 0.58 | 0.77 | 1.15 | 1.51 | 2.01 | |
| 28000 | 0.46 | 0.59 | 0.89 | 1.17 | 1.58 | |
| 25000 | 0.37 | 0.45 | 0.69 | 0.92 | 1.24 | |
| 23000 | 0.31 | 0.37 | 0.57 | 0.76 | 1.04 | |

## Standard Unit with Energy Recovery Wheel

### Economizer Damper Adjustment - ERW units

### Outside & Return Air Damper Operation

The outside air and return air damper actuators are accessible through from the filter section of the unit. The outside air and return air dampers have individual actuators that are linked electronically. The actuators are preset to 0 degrees from the factory. Refer to Table 44, p. 148 for the appropriate actuator position for the unit and operating airflow (CFM).

### To Adjust Damper Travel

1. Drill a 1/4" hole through the unit casing up stream of the return air dampers and below the energy recovery wheel. Use a location that will produce an accurate reading with the least amount of turbulence. Several locations may be necessary, and average the reading.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the applicable programming manual for applications for the SERVICE TEST screens and programming instructions.
5. Use Table 29, p. 77 to program the following system components for operation by scrolling through the displays:

   Supply Fan (On)

   VFD Cmd (100%, if applicable)

   RTM Occ/Unocc Output

   (Unoccupied)

   OA Damper Pos (0%)

   Outside Air Bypass Damper Pos (0%)

   Exhaust Air Bypass Damper Pos (0%)

6. Once the configuration for the components is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
8. With the outside air dampers fully closed and the supply fan operating at 100% airflow requirements, measure the return static pressure at the location determined in step 1.
9. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.
10. Open the field supplied main power disconnect switch upstream of the rooftop unit. Lock the disconnect switch in the "Open" position while working on the dampers.
11. Locate the static pressure reading in Table 44, p. 148 and determine which damper needs to be adjusted and the degree reading. Proceed to the appropriate damper actuator procedure.

### To Adjust the Outside Air Damper Actuators:

12. Remove the shaft coupling from the damper shaft by loosening the bolt and removing the retainer clip. Be careful not to rotate the shaft.
13. Position the shaft coupling so that the indicator points to the degree value obtained from step 11. The shaft coupling is adjustable in 5 degree increments.
14. Replace the retainer clip and tighten the shaft coupling on the shaft (120-180 in-lbs).
15. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
16. Rotate the actuator control signal dial to Auto-Adapt. The actuator will drive open and then closed to determine the new open and closed positions.
17. Return the actuator control signal dial to 2-10 VDC Modulating input signal position.
18. Plug the holes drilled in the cabinet after the proper airfow has been established.

### To Adjust the Return Damper Actuators:

19. Support or secure the damper blades in the wide open position.

***Note:*** *Gravity will cause the damper to close. Support or secure the damper blades while removing the actuator to prevent unexpected damper rotation.*

20. Do not remove the shaft coupling from the shaft. Remove the retainer clip from the shaft coupling.
21. Unscrew the actuator bracket from the damper wall.
22. Slide the actuator down the damper shaft off of the shaft coupling.
23. Rotate the actuator and reinstall the shaft coupling in the actuator so that the indicator points to the degree value obtained in Step 11. The shaft coupling is adjustable in 5 degree increments.
24. Replace the retainer clip and remove the blade stops to allow the blades to rotate.
25. Rotate the actuator to the original position and reattach the actuator bracket to the damper wall.
26. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
27. Rotate the actuator control signal dial to Auto-Adapt. The actuator will drive open and then closed to determine the new open and closed positions.
28. Return the actuator control signal dial to the factory set input signal position.
29. Plug the holes drilled in the cabinet after the proper airfow has been established.

**Table 44. Standard units with ERW — field measured plenum pressure**

**Low CFM ERW — 90-162 Tons**

**90 / 100 Ton Low CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 | 50 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 16000 | 1.29 | — | 0.87 | 1.52 | 0.71 | 1.05 | 0.64 | 0.84 | 0.60 | 0.64 | 0.58 | 0.63 | 0.46 | 0.45 | 0.43 | 0.41 | 0.38 | 0.35 | 0.32 | 0.20 |
| 20000 | 1.99 | — | 1.34 | 2.34 | 1.09 | 1.62 | 0.98 | 1.28 | 0.92 | 0.97 | 0.89 | 0.96 | 0.69 | 0.68 | 0.65 | 0.62 | 0.57 | 0.52 | 0.48 | 0.29 |
| 25000 | — | — | 2.07 | — | 1.68 | 2.49 | 1.50 | 1.97 | 1.41 | 1.49 | 1.36 | 1.47 | 1.04 | 1.02 | 0.99 | 0.93 | 0.86 | 0.78 | 0.71 | 0.42 |
| 30000 | — | — | 2.94 | — | 2.39 | — | 2.13 | 2.79 | 1.99 | 2.09 | 1.93 | 2.08 | 1.46 | 1.43 | 1.37 | 1.30 | 1.19 | 1.08 | 0.98 | 0.56 |
| 33000 | — | — | — | — | 2.86 | — | 2.54 | — | 2.38 | 2.50 | 2.30 | 2.48 | 1.73 | 1.70 | 1.63 | 1.54 | 1.41 | 1.28 | 1.15 | 0.65 |
| 36000 | — | — | — | — | — | — | 3.00 | — | 2.80 | 2.94 | 2.71 | 2.92 | 2.02 | 1.98 | 1.91 | 1.79 | 1.64 | 1.48 | 1.34 | 0.74 |
| 40000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.46 | 2.41 | 2.32 | 2.18 | 1.98 | 1.79 | 1.61 | 0.87 |

**105 / 118 Ton Low CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 | 50 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 19000 | 1.80 | — | 1.22 | 2.12 | 0.99 | 1.46 | 0.89 | 1.16 | 0.83 | 0.88 | 0.81 | 0.88 | 0.63 | 0.62 | 0.59 | 0.56 | 0.52 | 0.48 | 0.44 | 0.27 |
| 23000 | 2.63 | — | 1.76 | — | 1.44 | 2.12 | 1.29 | 1.68 | 1.21 | 1.27 | 1.17 | 1.26 | 0.90 | 0.88 | 0.85 | 0.80 | 0.74 | 0.68 | 0.62 | 0.37 |
| 28000 | — | — | 2.57 | — | 2.09 | — | 1.86 | 2.45 | 1.74 | 1.84 | 1.69 | 1.82 | 1.28 | 1.25 | 1.21 | 1.14 | 1.05 | 0.95 | 0.86 | 0.50 |
| 33000 | — | — | — | — | 2.86 | — | 2.54 | | 2.38 | 2.50 | 2.30 | 2.48 | 1.73 | 1.70 | 1.63 | 1.54 | 1.41 | 1.28 | 1.15 | 0.65 |
| 38000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.24 | 2.20 | 2.11 | 1.98 | 1.81 | 1.64 | 1.48 | 0.81 |
| 43000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.80 | 2.74 | 2.64 | 2.47 | 2.25 | 2.03 | 1.83 | 0.97 |
| 45000 | — | — | — | — | — | — | — | — | — | — | — | — | 3.04 | 2.98 | 2.86 | 2.68 | 2.44 | 2.20 | 1.97 | 1.04 |

**120 / 128 Ton Low CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 | 50 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 21000 | 1.54 | — | 1.08 | 1.69 | 0.90 | 1.08 | 0.82 | 0.89 | 0.78 | 0.87 | 0.76 | 0.75 | 0.58 | 0.56 | 0.54 | 0.50 | 0.44 | 0.39 | 0.34 | 0.14 |
| 26000 | 2.33 | — | 1.62 | 2.56 | 1.35 | 1.62 | 1.23 | 1.33 | 1.16 | 1.30 | 1.13 | 1.11 | 0.84 | 0.82 | 0.78 | 0.72 | 0.64 | 0.56 | 0.49 | — |
| 31000 | — | — | 2.26 | — | 1.88 | 2.25 | 1.70 | 1.85 | 1.61 | 1.80 | 1.56 | 1.53 | 1.15 | 1.12 | 1.07 | 0.98 | 0.87 | 0.75 | 0.65 | — |
| 36000 | — | — | 2.99 | — | 2.48 | 2.98 | 2.24 | 2.44 | 2.11 | 2.37 | 2.05 | 2.00 | 1.50 | 1.46 | 1.38 | 1.27 | 1.11 | 0.96 | 0.81 | — |
| 41000 | — | — | — | — | — | — | 2.85 | — | 2.68 | — | 2.60 | 2.54 | 1.89 | 1.84 | 1.74 | 1.59 | 1.39 | 1.19 | 1.00 | — |
| 46000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.31 | 2.24 | 2.12 | 1.93 | 1.68 | 1.42 | 1.19 | — |
| 51000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.77 | 2.69 | 2.54 | 2.31 | 2.00 | 1.69 | 1.40 | — |
| 54000 | — | — | — | — | — | — | — | — | — | — | — | — | 3.16 | 3.06 | 2.89 | 2.64 | 2.29 | 1.94 | 1.61 | — |

**continued on next page**

## Table 44. Standard units with ERW — field measured plenum pressure (continued)

**130-162 Ton Low CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 23000 | 1.82 | — | 1.27 | — | 1.06 | 1.27 | 0.96 | 1.05 | 0.91 | 1.02 | 0.89 | 0.87 | 0.67 | 0.65 | 0.62 | 0.57 | 0.51 | 0.44 | 0.39 |
| 26000 | 2.31 | — | 1.60 | — | 1.33 | 1.60 | 1.21 | 1.32 | 1.14 | 1.28 | 1.11 | 1.09 | 0.83 | 0.81 | 0.77 | 0.71 | 0.63 | 0.54 | 0.47 |
| 30000 | — | — | 2.10 | — | 1.74 | 2.09 | 1.57 | 1.71 | 1.49 | 1.67 | 1.44 | 1.41 | 1.06 | 1.03 | 0.98 | 0.90 | 0.79 | 0.69 | 0.59 |
| 35000 | — | — | 2.80 | — | 2.32 | 2.79 | 2.09 | 2.28 | 1.97 | 2.22 | 1.91 | 1.87 | 1.39 | 1.36 | 1.29 | 1.18 | 1.03 | 0.88 | 0.75 |
| 40000 | — | — | — | — | 2.97 | — | 2.68 | 2.92 | 2.52 | 2.84 | 2.45 | 2.39 | 1.77 | 1.72 | 1.62 | 1.48 | 1.29 | 1.10 | 0.92 |
| 45000 | — | — | — | — | — | — | — | — | — | — | — | 2.96 | 2.17 | 2.11 | 1.99 | 1.81 | 1.57 | 1.33 | 1.10 |
| 50000 | — | — | — | — | — | — | — | — | — | — | — | — | 2.62 | 2.54 | 2.39 | 2.17 | 1.87 | 1.57 | 1.30 |
| 55000 | — | — | — | — | — | — | — | — | — | — | — | — | 3.09 | 3.00 | 2.82 | 2.56 | 2.20 | 1.83 | 1.50 |
| 58000 | — | — | — | — | — | — | — | — | — | — | — | — | 3.40 | 3.29 | 3.10 | 2.80 | 2.40 | 1.99 | 1.62 |

**Standard CFM ERW — 90-162 Tons**

**90/100 Ton Standard CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 | 50 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 16000 | 1.26 | | 0.84 | 1.49 | 0.68 | 1.02 | 0.61 | 0.81 | 0.57 | 0.61 | 0.55 | 0.60 | 0.43 | 0.42 | 0.40 | 0.38 | 0.35 | 0.32 | 0.29 | 0.17 |
| 20000 | 1.95 | | 1.30 | 2.30 | 1.05 | 1.57 | 0.93 | 1.24 | 0.88 | 0.93 | 0.85 | 0.92 | 0.64 | 0.63 | 0.61 | 0.57 | 0.52 | 0.48 | 0.43 | 0.25 |
| 25000 | | | 2.00 | | 1.62 | 2.42 | 1.43 | 1.90 | 1.34 | 1.42 | 1.30 | 1.41 | 0.97 | 0.95 | 0.92 | 0.86 | 0.79 | 0.71 | 0.64 | 0.35 |
| 30000 | | | 2.84 | | 2.28 | | 2.02 | 2.69 | 1.89 | 1.99 | 1.82 | 1.97 | 1.35 | 1.32 | 1.27 | 1.19 | 1.08 | 0.97 | 0.87 | 0.46 |
| 33000 | | | | | 2.74 | | 2.42 | | 2.26 | 2.38 | 2.18 | 2.36 | 1.61 | 1.58 | 1.51 | 1.42 | 1.29 | 1.16 | 1.03 | 0.53 |
| 36000 | | | | | | | 2.86 | | 2.67 | 2.81 | 2.57 | 2.78 | 1.89 | 1.85 | 1.77 | 1.66 | 1.50 | 1.35 | 1.20 | |
| 40000 | | | | | | | | | | | | | 2.28 | 2.23 | 2.14 | 2.00 | 1.81 | 1.61 | 1.44 | |

**105/118 Ton Standard CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 | 50 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 19000 | 1.76 | | 1.17 | 2.07 | 0.95 | 1.42 | 0.84 | 1.12 | 0.79 | 0.84 | 0.76 | 0.83 | 0.58 | 0.57 | 0.55 | 0.52 | 0.47 | 0.43 | 0.39 | 0.22 |
| 23000 | 2.55 | | 1.69 | | 1.36 | 2.05 | 1.21 | 1.61 | 1.13 | 1.20 | 1.09 | 1.19 | 0.82 | 0.80 | 0.77 | 0.73 | 0.66 | 0.60 | 0.54 | 0.30 |
| 28000 | | | 2.47 | | 1.99 | 3.00 | 1.76 | 2.34 | 1.64 | 1.73 | 1.59 | 1.72 | 1.18 | 1.15 | 1.11 | 1.04 | 0.94 | 0.85 | 0.76 | 0.40 |
| 33000 | | | | | 2.72 | | 2.40 | | 2.24 | 2.36 | 2.16 | 2.34 | 1.59 | 1.55 | 1.49 | 1.39 | 1.26 | 1.13 | 1.01 | |
| 38000 | | | | | | | | | 2.92 | | 2.82 | | 2.05 | 2.01 | 1.92 | 1.80 | 1.62 | 1.45 | 1.29 | |
| 43000 | | | | | | | | | | | | | 2.57 | 2.51 | 2.41 | 2.24 | 2.02 | 1.80 | 1.59 | |
| 45000 | | | | | | | | | | | | | 2.80 | 2.73 | 2.62 | 2.44 | 2.19 | 1.95 | 1.73 | |

continued on next page

**Table 44. Standard units with ERW — field measured plenum pressure (continued)**

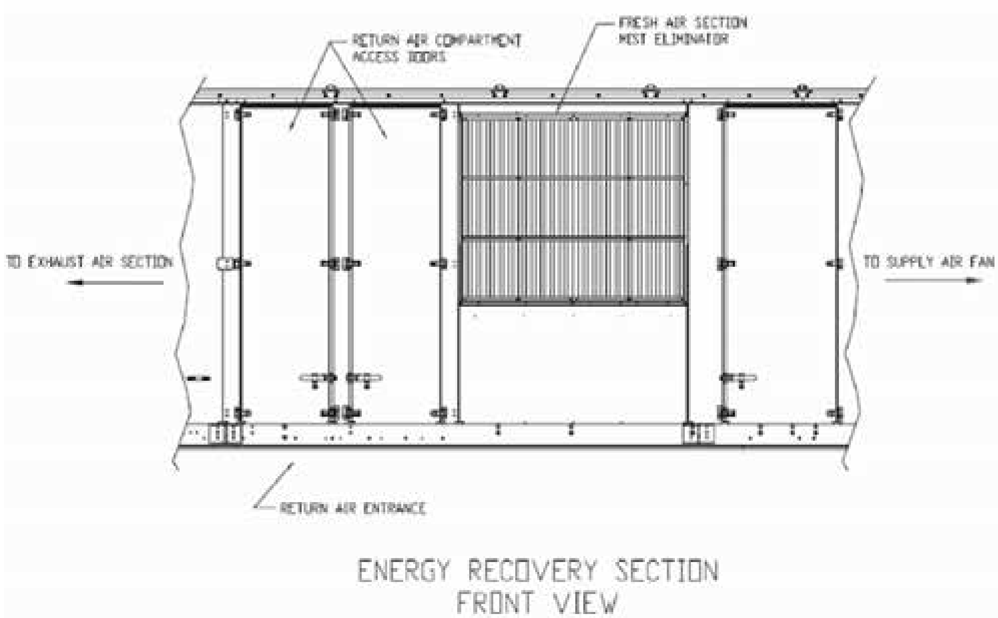
**120/128 Ton Standard CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 21000 | 1.48 | | 1.02 | 1.63 | 0.84 | 1.02 | 0.76 | 0.83 | 0.72 | 0.81 | 0.70 | 0.68 | 0.51 | 0.50 | 0.47 | 0.44 | 0.38 | 0.33 | 0.28 |
| 26000 | 2.23 | | 1.53 | 2.47 | 1.26 | 1.52 | 1.13 | 1.24 | 1.07 | 1.21 | 1.04 | 1.01 | 0.75 | 0.73 | 0.69 | 0.63 | 0.55 | 0.47 | 0.40 |
| 31000 | | | 2.13 | | 1.75 | 2.12 | 1.57 | 1.72 | 1.48 | 1.67 | 1.43 | 1.40 | 1.02 | 0.99 | 0.94 | 0.85 | 0.74 | 0.62 | 0.52 |
| 36000 | | | 2.83 | | 2.31 | 2.81 | 2.07 | 2.27 | 1.95 | 2.20 | 1.89 | 1.84 | 1.34 | 1.29 | 1.22 | 1.11 | 0.95 | 0.79 | 0.65 |
| 41000 | | | | | 2.95 | | 2.63 | 2.89 | 2.47 | 2.80 | 2.39 | 2.33 | 1.68 | 1.62 | 1.53 | 1.38 | 1.18 | 0.98 | |
| 46000 | | | | | | | | | | | 2.96 | 2.88 | 2.06 | 1.99 | 1.87 | 1.68 | 1.43 | 1.17 | |
| 51000 | | | | | | | | | | | | | 2.47 | 2.39 | 2.24 | 2.01 | 1.70 | 1.39 | |
| 54000 | | | | | | | | | | | | | 2.74 | 2.65 | 2.48 | 2.22 | 1.87 | 1.52 | |

**130-162 Ton Standard CFM ERW - Field measured plenum pressure (inches wc)**

| | OA Actuator Reading [Degrees] | | | | | | | | | | | | RA Actuator Reading [Degrees] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | | 50 | | 40 | | 30 | | 20 | | 10 | | 0 | 10 | 20 | 30 | 35 | 40 | 45 |
| CFM | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | Econ | TRAQ | E/T | E/T | E/T | E/T | E/T | E/T | E/T |
| 23000 | 1.73 | | 1.18 | 1.92 | 0.97 | 1.18 | 0.87 | 0.96 | 0.82 | 0.93 | 0.80 | 0.78 | 0.58 | 0.56 | 0.53 | 0.48 | 0.42 | 0.35 | 0.30 |
| 26000 | 2.19 | | 1.49 | 2.43 | 1.22 | 1.48 | 1.09 | 1.20 | 1.03 | 1.16 | 1.00 | 0.97 | 0.71 | 0.69 | 0.65 | 0.59 | 0.51 | 0.43 | 0.35 |
| 30000 | 2.89 | | 1.95 | | 1.59 | 1.94 | 1.42 | 1.56 | 1.34 | 1.52 | 1.29 | 1.26 | 0.91 | 0.88 | 0.83 | 0.75 | 0.64 | 0.54 | 0.44 |
| 35000 | | | 2.59 | | 2.11 | 2.58 | 1.88 | 2.07 | 1.76 | 2.01 | 1.71 | 1.66 | 1.19 | 1.15 | 1.08 | 0.97 | 0.82 | 0.67 | |
| 40000 | | | | | 2.71 | | 2.41 | 2.66 | 2.26 | 2.57 | 2.18 | 2.12 | 1.50 | 1.45 | 1.36 | 1.22 | 1.02 | 0.83 | |
| 45000 | | | | | | | 3.00 | | 2.80 | | 2.71 | 2.63 | 1.84 | 1.78 | 1.66 | 1.49 | 1.24 | 1.00 | |
| 50000 | | | | | | | | | | | | | 2.23 | 2.15 | 2.01 | 1.79 | 1.49 | 1.19 | |
| 55000 | | | | | | | | | | | | | 2.65 | 2.55 | 2.38 | 2.11 | 1.75 | | |
| 58000 | | | | | | | | | | | | | 2.91 | 2.80 | 2.61 | 2.31 | 1.91 | | |

Figure 104. IntelliPak II energy wheel section




## Energy Recovery Wheel (ERW)

The IntelliPak™ II energy wheel section consists of the energy wheel cassette assembly, return air, outside air, and bypass dampers, and outside air mist eliminators. Double opposing large access doors are provided on both sides of the section for service access into the return/ exhaust air compartment, see Figure 104.

**⚠WARNING**

**Toxic Hazards!**

**Do not use an energy wheel in an application where the exhaust air is contaminated with harmful toxins or biohazards. Failure to follow this instruction could result in death or serious injury.**

The two access doors are accessible from either side of the rooftop. The horizontally oriented energy wheel cassette is permanently installed in the section. The individual segments of the energy wheel are removable for cleaning or replacement. Two additional access doors are provided for service access into the filter / evaporator section.

### Operation

**⚠CAUTION**

**Motor Failure!**

**Do not install a variable frequency drive (VFD) to control the energy wheel speed. This could result in failure of the energy wheel motor.**

**⚠WARNING**

**Confined Space Hazards!**

**Do not work in confined spaces where refrigerant or other hazardous, toxic or flammable gas may be leaking. Refrigerant or other gases could displace available oxygen to breathe, causing possible asphyxiation or other serious health risks. Some gases may be flammable and or explosive. If a leak in such spaces is detected, evacuate the area immediately and contact the proper rescue or response authority. Failure to take appropriate precautions or to react properly to such potential hazards could result in death or serious injury.**

**⚠WARNING**

**Hazardous Voltage!**

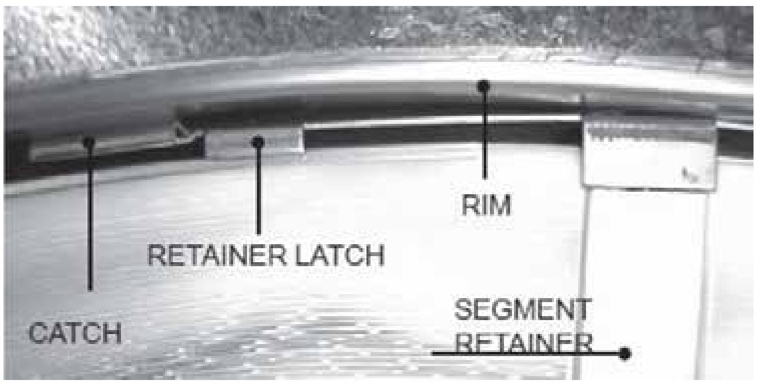
**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

**Figure 105. Segment retainers**




## ERW Startup

1. Turn the energy wheel clockwise (as viewed from the pulley side) by hand to verify that the wheel turns freely through a full rotation.
2. Confirm that all wheel segments are fully engaged in the wheel frame and that the segment retainers are completely fastened. See Figure 106, p. 154.
3. Manually rotate the energy wheel clockwise through several rotations to confirm the seal adjustment and proper belt tracking on the wheel rim. Correct belt tracking is approximately midway between the seal plate and the outer edge of the rim.

***Note:*** *The drive belt is a urethane stretch belt designed to provide constant tension throughout the life of the belt. No periodic adjustment is required. Inspect the belt annually for proper tracking and tension. A properly tensioned belt will turn the wheel immediately, with no visible slippage, when power is applied.*

4. If the wheel has difficulty starting, turn off the power and inspect the wheel for excessive interference between the wheel surface and the four diameter seals.To correct interference, loosen the diameter seal adjusting screws and back the diameter seals away from the surface of the wheel. Apply power to confirm free wheel rotation. Re-adjust and tighten the seals according to instructions in the "Service and Repair" section.

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

## Damper Actuators

Stroke the actuators to observe full open and full closure of the dampers.

## Routine Maintenance

**⚠CAUTION**

**Cleaning Damage!**

**Do not use acid based cleaners, aromatic solvents, steam, or temperatures in excess of 170°F. Doing so could cause damage to the wheel!**

**⚠CAUTION**

**Cleaning Damage!**

**Do not use a pressure washer to clean energy wheel segments. Doing so could cause damage to the wheel!**

## Cleaning the Energy Wheel

Disconnect all electrical power, then use a vacuum or brush to remove accumulated material from the face of the wheel. Examine the energy wheel monthly for material build-up on the wheel. If more aggressive cleaning is needed, removed the wheel segments and follow these steps:

1. Wash the segments or the wheel in a five-percent solution of non-acid-base coil cleaner (part no.

CHM00021 at your local Trane parts center) or in an alkaline detergent and warm water.

2. Soak the segments in the solution until grease, oil, and tar deposits are loosened.
3. Before removing the cleaner, rapidly run your fingers across the surface of segments to separate polymer strips for better cleaning action.
4. Rinse the dirty solution from the segments and remove the excess water before re-installing the segments in the wheel.

**Note:** *Some permanent staining of the desiccant may remain but is not harmful to performance.*

### Cleaning Frequency

In reasonably clean office or school buildings, cleaning with a coil cleaner solution may not be required for several years. If the energy wheel is exposed to air streams containing, for example, high levels of occupant tobacco smoke, cooking facility exhaust air, or oil-based aerosols found in machine shop areas, annual or more frequent cleaning may be required to remove these contaminants and restore performance. Periodic inspection of the wheel should be done to determine the cleaning intervals.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

High-maintenance applications may benefit from keeping a spare set of clean segments on hand. This allows for rapid change-out of clean segments with minimal downtime. The dirty segments can then be cleaned at a convenient time.

### Segment Removal

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

Wheel segments for the low CFM energy recovery option for the 90, 105, and 120 ton units are secured to the wheel frame by a segment retainer that pivots on the wheel rim and is held in place by a segment retaining catch. All other units have larger sized wheels and have inner and satellite segments. The satellite segments are secured to the wheel frame by a segment retainer in the same fashion as the outer segments for the above mentioned smaller low CFM recovery wheels. The inner segments are secured to the wheel center hub with a screw.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

### Outer and Satellite Segment Removal Procedure:

1. Disconnect all electrical power.
2. Secure wheel from rotation.
3. Pry the segment retainer latch out from the catch. See Figure 106. For the first or for an individual segment removal, it will be necessary to do so on both sides of the segment.
4. Remove the forked segment retainer(s). See Figure 106. Again, for the first or for an individual segment removal, it will be necessary to do so on both sides of the segment.
5. Remove the segment from the wheel frame. It may be necessary to gently pry the segment out of the wheel with a screwdriver.
6. Pull the segment up and out of the wheel frame.
7. Close any open segment retainer prior to rotating the wheel. Failure to close the retainer may damage the retainer, seals, or segments.
8. Rotate the wheel and continue this procedure to remove all segments. See Figure 107, p. 154.

Figure 106. Segment Retainers

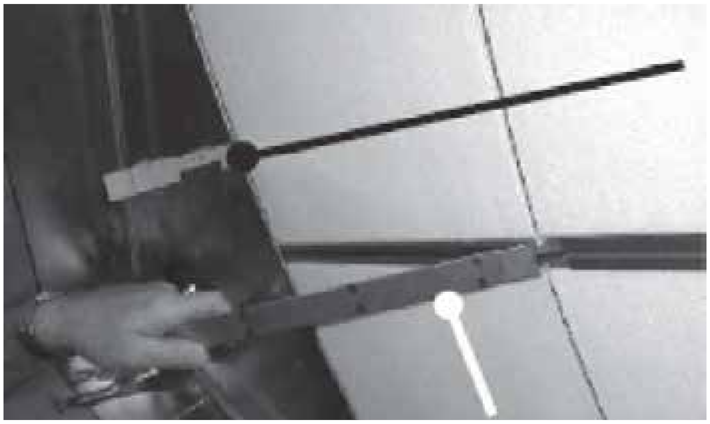


Figure 107. Segment Removal

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

### Inner Segment Removal Procedure:

1. Disconnect all electrical power.
2. Secure wheel from rotation.

**⚠CAUTION**

**Sharp Edges!**

**The service procedure described in this document involves working around sharp edges. To avoid being cut, technicians MUST put on all necessary Personal Protective Equipment (PPE), including gloves and arm guards. Protect hands and the belt from possible sharp edges of the hole in the bearing support beam. Failure to follow recommendations could result in minor to moderate injury or product damage.**

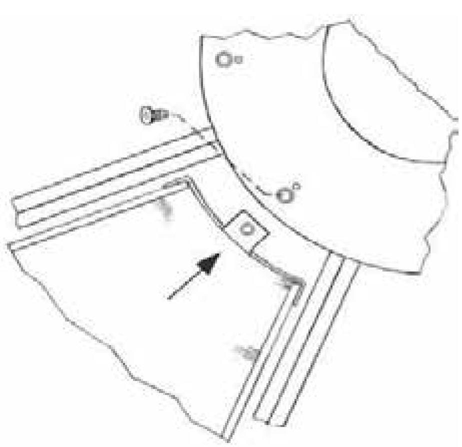
**⚠CAUTION**

**Added Support Required!**

**Before laying across the energy wheel, place a rigid board across the span of the energy wheel cassette. Failure to do so could result in personal injury and/or damage to the energy wheel.**

3. Support segment with one hand while removing ¼ - 20 flat head retaining screw in the wheel hub with 5/32" Allen wrench, see Figure 108.

**Figure 108. Inner Segment Removal**



4. Carefully slide the segment out from between the hub plates, and remove from the wheel.
5. Reinsert the ¼ - 20 screw in the removed segment nose to avoid loss.
6. Rotate the wheel and continue this procedure to remove all segments.

### Segment Replacement

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

### Inner Segment Replacement

1. Disconnect all electrical power.
2. Secure wheel from rotation.

**⚠CAUTION**

**Sharp Edges!**

**The service procedure described in this document involves working around sharp edges. To avoid being cut, technicians MUST put on all necessary Personal Protective Equipment (PPE), including gloves and arm guards. Protect hands and the belt from possible sharp edges of the hole in the bearing support beam. Failure to follow recommendations could result in minor to moderate injury or product damage.**

**⚠CAUTION**

**Added Support Required!**

**Before laying across the energy wheel, place a rigid board across the span of the energy wheel cassette. Failure to do so could result in personal injury and/or damage to the energy wheel.**

3. Remove ¼ - 20 flat head retaining screw from the inner segment nose with 5/32" Allen wrench.
4. Rest the edge of the segment on the support flange on one wheel spoke and slide it until the segment nose is fitted firmly in the wheel hub and the segment screw hole is aligned with the hub slot.
5. Reinsert ¼ - 20 screw into the hub / inner segment and tighten until the screw is firmly seated, see Figure 108.

## Outer or Satellite Segment Replacement

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

1. Disconnect all electrical power.
2. Secure wheel from rotation.
3. Rotate out the two segment retainer latches, one for each side of the selected segment opening, such that they are 90° from the wheel rim. See Figure 108, p. 155.
4. Set the segment in the gap between the segment retainer latches, pressing it toward the center of the wheel and inward against the spoke flanges. See Figure 111, p. 158. If hand pressure does not fully seat the segment, insert the flat tip of a screwdriver between the wheel rim and the outer corners of the segment and apply gentle force while guiding the segment into place. Be careful not to bend the wheel frame or the segment frame with the screwdriver.
5. Reinstall forked segment retainer(s)

***Note:*** *Only applies when there is an adjacent segment in place.*

6. Close each segment retainer latch under the segment retaining catch.
7. Rotate the wheel and repeat this sequence with the remaining segments.

Removing and replacing the segments with a spare set can be accomplished more quickly. Remove the dirty segment, replace it with a clean segment, then move to the next segment.

## Filtration

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

Galvanized steel permanent filters are provided to prevent debris from entering the energy wheel section.The return air filters are mounted in a filter rack underneath the energy recovery wheel, and are accessible from either side by means of the double access doors.The outside air filter rack is attached to the energy recovery cassette. Use the unit filter / evaporator coil access doors to service the energy recovery outside air filters.

1. Disconnect all electrical power.
2. Remove all filter media from the vertical filter rack providing air filtration for the unit evaporator coil.
3. Remove the sheet metal screws in the hinged access panel beneath the bypass damper assembly.
4. Rotate the access panel downwards.
5. Reach in past the damper wall to access the flexible filter puller(s). Pull them towards the evaporator coil enough to reach the second filter in each slot of the filter rack. Refer to Table 45, p. 156 for filter information.

**Table 45. ERW Filter Information**

| Galvanized Steel Filter Information | 90-118T Low CFM ERW Units (in.) | 90-162T Low CFM ERW Units (in.) | 90-162T Standard CFM ERW Units (in.) |
|---|---|---|---|
| RA Filters (size, number) | 24x24x1, 10 | 24x24x1, 10 | 24x24x1, 10 |
| FA Filters (size, number | 224x24x1, 8 | 24x24x1, 6 | 24x24x1, 8 |
| | | 12x24x1, 2 | |

***Note:*** *Inspect these filters monthly and clean them as necessary.*

### Bearing and Motor Lubrication

The wheel drive motor and wheel support shaft bearings are permanently lubricated and no further lubrication is necessary.

## Service and Repair

### Drive Belt Replacement

The drive belt is a urethane stretch belt designed to provide constant tension throughout the life of the belt. No periodic adjustment is required. Inspect the belt annually for proper tracking and tension. A properly tensioned belt will turn the wheel immediately, with no visible slippage, when power is applied.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠CAUTION**

**Added Support Required!**

**Before laying across the energy wheel, place a rigid board across the span of the energy wheel cassette. Failure to do so could result in personal injury and/or damage to the energy wheel.**

1. Disconnect all electrical power.
2. Confirm the model number on the belt replacement kit matches the model number on the label by the motor pulley. Remove all remnants of the old belt.
3. Uncoil the belt as necessary. The belt must not twist when being feed around the wheel rim.
4. At a location near the motor pulley, tape the hook end of the belt to the wheel rim, see Figure 110, p. 157 and Figure 107, p. 154. The tape should cover the hook and belt.
5. Manually rotate the wheel clockwise while feeding the belt onto the wheel rim, taking care that the belt does not twist.

***Note:*** *If for any reason the belt were to become flipped or twisted 90° in either direction, belt failure will be imminent.*

6. Upon feeding the belt completely through, remove the tape and join the link with the belt positioned around the wheel rim, see Figure 110, p. 157. Keep light tension on the belt, as a slack belt may be prone to twist.
7. Manually rotate the wheel clockwise until the linked belt ends are approximately 180° from the motor pulley location.
8. Insert the right angle belt retainer from the replacement kit at the pulley location. Place it between the segment retainer latch pivot point and the wheel spoke, see Figure 111, p. 158 (left of the spoke).

***Important:*** *To avoid release of the segment latch do not insert retainer on the other side of spoke.*

9. Manually rotate the wheel counter-clockwise to position the belt retainer clip close to the center beam and diameter seals.
10. In a section between the retainer clip and the motor pulley, remove the belt from the wheel rim and then place it over the pulley.
11. Manually rotate the wheel clockwise until the belt is fully stretched around the wheel rim and motor pulley.
12. Remove the belt retainer clip and manually rotate the wheel clockwise at least two full rotations while verifying the belt is not twisted on the wheel rim or as it enters the pulley(s).

**Figure 109. Link belt installation**

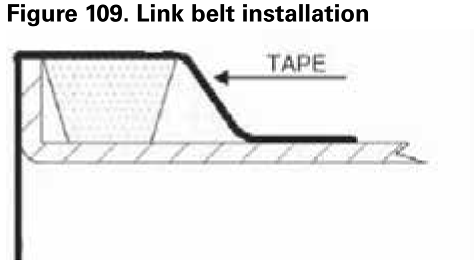



**Figure 110. Link belt installation**

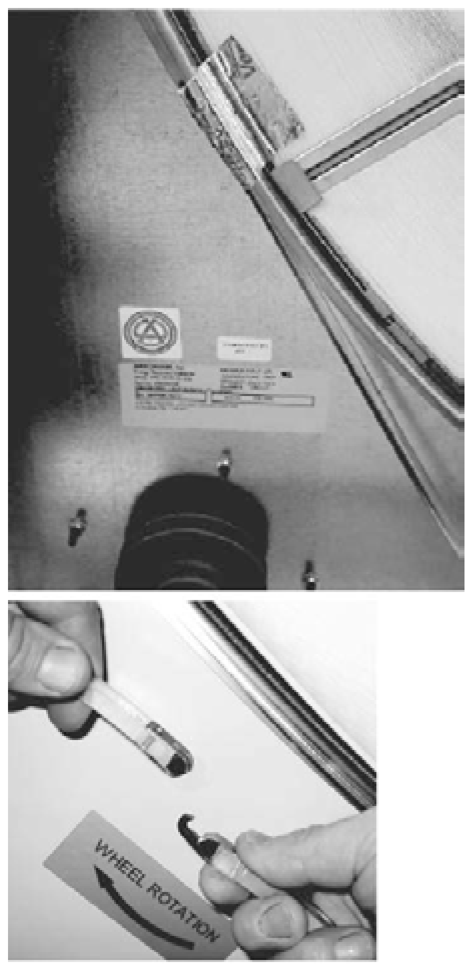
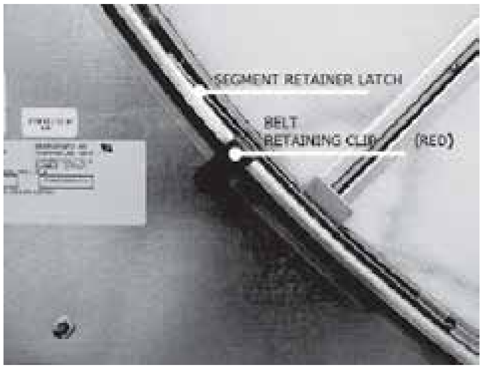


**Figure 111. Retaining clip location**




***Note:*** *Pile seal brackets are fixed with a single screw to the cassette frame near the ends of the wheel bearing beam. Because the height of the belt link is slightly higher than that of the urethane belt, a rare interference may occur when it passes the seal bracket. If this occurs, remove the interfering bracket(s). No measurable change of performance will occur.*

## Seal Adjustment

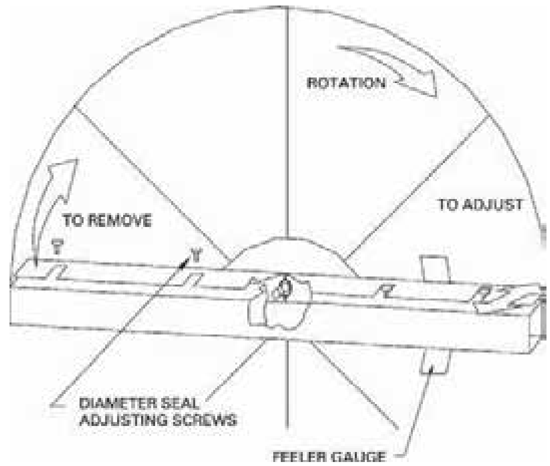
**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

1. Disconnect all electrical power.
2. Loosen the diameter seal adjustment screws and back the seals away from the wheel surface, see Figure 112.
3. Rotate the wheel clockwise until two opposing spokes are hidden behind the bearing support beam.

**Figure 112. Wheel rotation**




4. Using a folded piece of paper as a feeler gauge, position the paper between the wheel surface and the diameter seals.
5. Adjust the seals toward the wheel surface until slight friction on the paper feeler gauge is felt when the gauge is moved along the length of the spoke.
6. Check the seal adjustment through a full rotation of the wheel. Re-tighten the adjusting screws and recheck the clearance with the paper-feeler gauge.

## Drive Motor and Pulley Replacement

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

1. Disconnect all electrical power.
2. Remove the belt from the pulley and position it temporarily around the wheel rim.
3. Measure and record the distance from the inner edge of the pulley to the mounting wall.
4. Loosen the set screw in the wheel drive pulley using an Allen wrench and remove the pulley from the motor drive shaft.
5. While supporting the weight of the drive motor in one hand, loosen and remove the four mounting bolts.
6. Install a replacement motor with the hardware kit supplied.
7. Install the pulley and adjust it to the distance recorded earlier in this procedure.

8. Tighten the set screw to the drive shaft.
9. Stretch the belt over the pulley and engage it in the groove.

## Compressor Startup

**NOTICE:**

**Compressors Failure!**

**Unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started. This will protect the compressors from premature failure.**

1. Ensure that the “System” selection switch at the remote panel is in the “Off” position.
2. Before closing the disconnect switch, ensure that the compressor discharge service valve and the liquid line service valve for each circuit is back seated.

**⚠CAUTION**

**Compressor Damage!**

**Do not allow liquid refrigerant to enter the suction line. Excessive liquid accumulation in the liquid lines could result in compressor damage.**

**COMPRESSOR SERVICE VALVES MUST BE FULLY OPENED BEFORE STARTUP (SUCTION, DISCHARGE, LIQUID LINE, AND OIL LINE).**

3. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch to allow the crankcase heater to operate a minimum of 8 hours before continuing.
4. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the “On” position.
5. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the applications programming guide for applications for the SERVICE TEST screens and programming instructions.
6. Use Table 37, p. 110 to program the following system components for operation by scrolling through the displays;

### Compressors

Compressor 1A (On)

Compressor 1B (Off)

Compressor 2A(Off)

Compressor 2B (Off)

### Condenser Fans

1. Attach a set of service gauges onto the suction and discharge gauge ports for each circuit.
   See Figure 115, p. 163 for the various compressor locations.
2. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

3. Press the TEST START key to start the test. Remember that the delay designated in step 8 must elapse before the system will begin to operate.
4. Once each compressor or compressor pair has started, verify that the rotation is correct. If a scroll compressor is rotating backwards, it will not pump and a loud rattling sound can be observed. Check the electrical phasing at the load side of the compressor contactor. If the phasing is correct, before condemning the compressor, interchange any two leads to check the internal motor phasing. If the compressor runs backward for an extended period (15 to 30 minutes), the motor winding can over heat and cause the motor winding thermostats to open. This will cause a “compressor trip” diagnostic and stop the compressor.
5. Press the STOP key at the Human Interface Module in the unit control panel to stop the compressor operation.
6. Repeat steps 5 through 11 for each compressor stage and the appropriate condenser fans.

### Refrigerant Charging

1. Attach a set of service gauges onto the suction and discharge gauge ports for each circuit.
   See Figure 115, p. 163 for the various compressor locations.
2. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the applications programming guide for CV or VAV applications for the SERVICE TEST screens and programming instructions.

3. Use Table 37, p. 110 to program the following system components for the number 1 refrigeration circuit by scrolling through the displays;

   Supply Fan (On)

   VFD (100%, if applicable)

   OCC/UNOCC Relay (Unoccupied for VAV units)

   All Compressors for each circuit (On)

   Condenser Fans for each circuit (On)

4. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

5. Press the TEST START key to start the test. Remember that the delay designated in step 4 must elapse before the system will begin to operate.

6. After all of the compressors and condenser fans for the number 1 circuit have been operating for approximately 30 minutes, observe the operating pressures. Use the appropriate pressure curve beginning with Figure 84, p. 134 to determine the proper operating pressures. For superheat and subcooling guidelines, refer to “Thermostatic Expansion Valves and Charging by Subcooling” at the end of this section.

**Note:** *Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all Federal, State and local laws.*

7. Verify that the oil level in each compressor is correct. The oil level may be down to the bottom of the sightglass but should never be above the sightglass.

8. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

9. Repeat steps 1 through 8 for the number 2 refrigeration circuit.

10. After shutting the system off, check the compressor oil appearance. Discoloration of the oil indicates that an abnormal condition has occurred. If the oil is dark and smells burnt, it has overheated because: the compressor is operating at extremely high condensing temperatures; high superheat; a compressor mechanical failure; or, occurrence of a motor burnout.

    If the oil is black and contains metal flakes, a mechanical failure has occurred. This symptom is often accompanied by a high compressor amperage draw.

    If a motor burnout is suspected, use an acid test kit to check the condition of the oil. Test results will indicate an acid level exceeding 0.05 mg KOH/g if a burnout occurred.

    The scroll compressor uses Trane OIL00079 (one quart container) or OIL00080 (one gallon container) without substitution. The appropriate oil charge for CSHN250 and CSHN315 scroll compressors is 14.2 pints. For CSHN374 scroll compressor, use 15.2 pints.

### Compressor Crankcase Heaters

Each scroll compressor is equipped with a 160-watt crankcase heater.

## Compressor Operational Sounds

Because of the scroll compressor design, it emits a higher frequency tone (sound) than a reciprocating compressor. It is designed to accommodate liquids, both oil and refrigerant, without causing compressor damage. The following discussion describes some of the operational sounds that differentiate it from those typically associated with a reciprocating compressor. These sounds do not affect the operation or reliability of the compressor.

### At Shutdown

When a Scroll compressor shuts down, the gas within the scroll expands and causes momentary reverse rotation until the discharge check valve closes. This results in a “flutter” type sound.

### At Low Ambient Startup

When the compressor starts up under low ambient conditions, the initial flow rate of the compressor is low due to the low condensing pressure. This causes a low differential across the thermal expansion valve that limits its capacity. Under these conditions, it is not unusual to hear the compressor rattle until the suction pressure climbs and the flow rate increases.

**Note:** *Evaporative Condensers ordered with sump heaters will have low ambient down to 10 deg as standard*

## Evaporative Condenser Startup

**Important:** *Water treatment by a qualified water treatment expert is required to ensure proper equipment life and product performance. Dolphin Water Care™ is an option offered by Trane that is NOT a subsitute for regular water treatment by a qualified water treatment professional. If a water treatment system is not operating on the unit, do not proceed.*

Startup for evaporative and air-cooled condensers is initially the same. In addition, the following is required for evaporative condensers prior to startup:

- All water and drain connections must be checked and verified
- Evaporative condensers will ship with a fan support channel to reduce damage caused by vibration during shipment. The shipping support brackets must be removed prior to unit startup. See "To remove shipping brackets," p. 161 and Figure 113, p. 162 for removal instructions.
- Verify that inlet water pressure is 35-60 PSIG, dynamic pressure (measured with the valve open)
- Verify that drain valve is set to "drain during power loss" or "hold during power loss" per job specification
- Upon a call for cooling, the sump will fill with water. Verify that the sump fills to a level within the slot on the max float bracket as shown in Figure 114, p. 162.

### *To remove shipping brackets*

**Important:** *Remove fan shipping brackets before startup. Failure to remove brackets could result in fan damage.*

Evaporative condensers are shipped with fan shipping brackets to reduce damage caused by vibration during shipment. The fan shipping brackets must be removed prior to unit startup.
To remove the shipping brackets start from the side opposite to the drain actuator:

1. Loosen the screw for the bracket that holds the inlet louvers below the door side.
2. Remove inlet louvers and set to the side.

**Note:** *Service technician may need to step on the horizontal surface of FRP coated base. Step with care.*

3. Unscrew the bolt in the middle of the door. Keep the bolt in a safe place.
4. Lift one door with handle until it touches the top. Swivel bottom of door to remove it from the door opening and set it to the side.
5. Slide and remove the middle mist eliminator section so that the shipping bracket is visible.
6. Use screw gun to unscrew the two screws that hold the fan shipping bracket. The bracket should drop down but still remain engaged with a hook on the bracket.
7. Go to the other side of the unit and follow the procedure for inlet louver and door removal (see steps 1 - 6).
8. Hold the bracket with one hand and remove remaining two screws.
9. Remove the bracket and all the removed screws from the unit.

**Important:** *Make sure there are no screws remaining in the coil area.*

10. Reinstall inlet louvers, mist eliminators and louvers.
11. Check that the direction of arrow on the inlet louver is correct

**Figure 113. Fan shipping bracket removal**

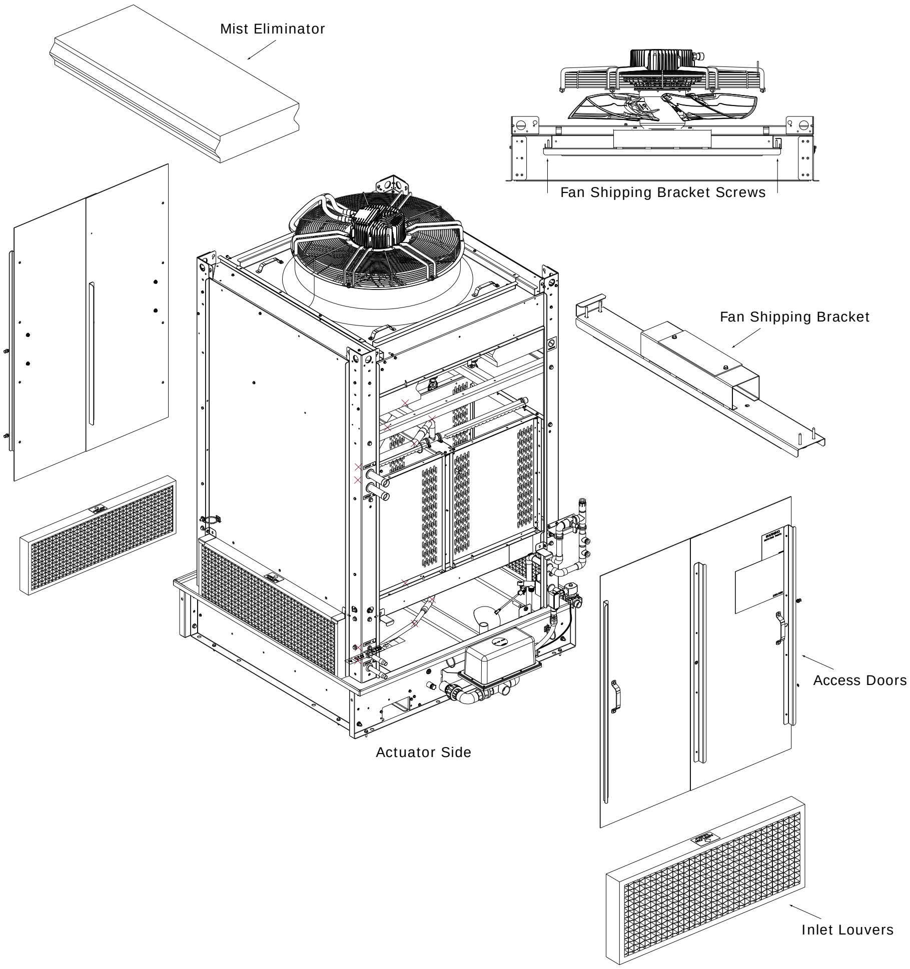



**Figure 114. Float bracket setting**

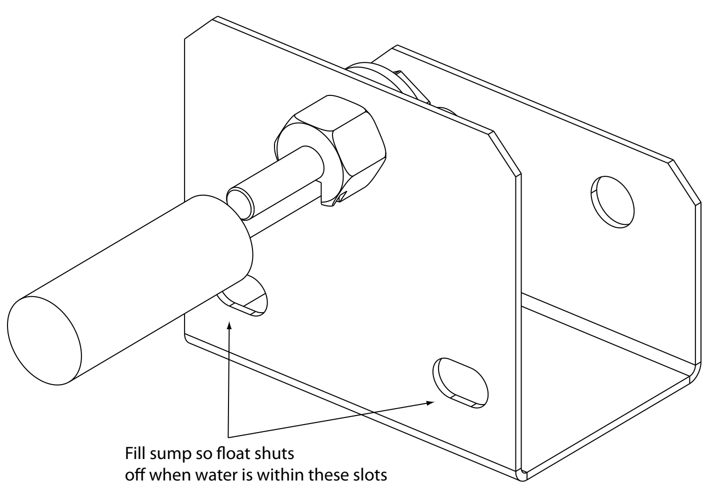


**Figure 115. Compressor locations and staging sequence**

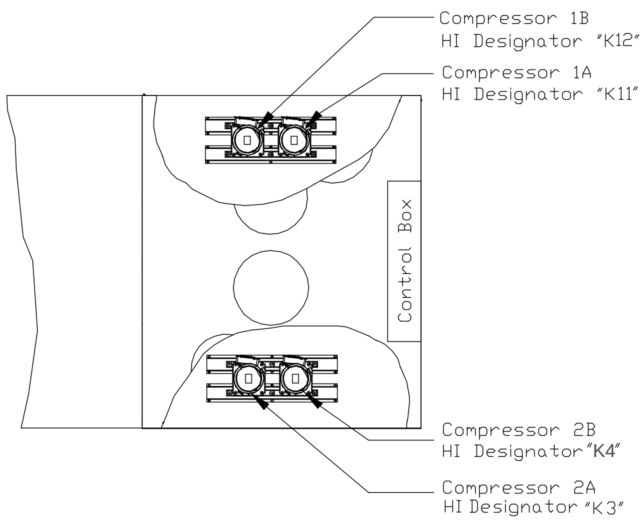



**Table 46. Staging sequence**

| | Compressor Staging (Lead) | | | | Compressor Staging (Lag) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1A | 1B | 2A | 2B | 1A | 1B | 2A | 2B |
| **Stage 1** | | | X | | X | | | |
| **Stage 2** | X | | X | | X | | X | |
| **Stage 3** | X | | X | X | X | X | X | |
| **Stage 4** | X | X | X | X | X | X | X | X |

## Thermostatic Expansion Valves

The reliability and performance of the refrigeration system is heavily dependent upon proper expansion valve adjustment. Therefore, the importance of maintaining the proper superheat cannot be over emphasized.

On air-cooled units, the expansion valves shipped installed were factory set to control between 14-18°F at the ARI full load rating conditions (approximately 45°/125°F saturated suction/discharge). On evaporative condenser units, the expansion valves shipped installed were factory set to control between 18-22°F at the ARI full load rating conditions (approximately 45°/105°F saturated suction/discharge). At part load, expect lower superheat. Systems operating with lower superheat could cause serious compressor damage due to refrigerant floodback.

Pressure curves, included in the IOM, are based on outdoor ambient between 65° & 105°F, relative humidity above 40 percent. Measuring the operating pressures can be meaningless outside of these ranges.

## Measuring Superheat

1. Measure the suction pressure at the suction line gauge access port located near the compressor.
2. Using a Refrigerant/Temperature chart, convert the pressure reading to a corresponding saturated vapor temperature.
3. Measure the suction line temperature as close to the expansion valve bulb, as possible. Use a thermocouple type probe for an accurate reading.
4. Subtract the saturated vapor temperature obtained in step 2 from the actual suction line temperature obtained in step 3. The difference between the two temperatures is known as "superheat".

When adjusting superheat, recheck the system subcooling before shutting the system "Off".

***Note:*** *If unit includes the modulating reheat dehumidification option, adjust superheat only in the cooling mode of operation.*

## Charging by Subcooling

The outdoor ambient temperature must be between 65 and 105°F and the relative humidity of the air entering the evaporator must be above 40 percent. When the temperatures are outside of these ranges, measuring the operating pressures can be meaningless. Make sure hot gas bypass (if applicable) is not flowing when taking performance measurements. With the unit operating at "Full Circuit Capacity", acceptable subcooling ranges for air-cooled units is between 14°F to 22°F.
For evaporative condenser units, acceptable subcooling range is between 8°F to 14°F.

### Measuring Subcooling

1. At the liquid line service valve, measure the liquid line pressure. Using a Refrigerant R410A pressure/temperature chart, convert the pressure reading into the corresponding saturated temperature.
2. Measure the actual liquid line temperature as close to the liquid line service valve as possible. To ensure an accurate reading, clean the line thoroughly where the temperature sensor will be attached. After securing the sensor to the line, insulate the sensor and line to isolate it from the ambient air. Use a thermocouple type probe for an accurate reading.

***Note:*** *Glass thermometers do not have sufficient contact area to give an accurate reading.*

3. Determine the system subcooling by subtracting the actual liquid line temperature (measured in step 2) from the saturated liquid temperature (converted in step 1).

## Standard Ambient Units

The following Table gives the minimum starting temperatures for Standard Ambient Units. Do not start the unit in the cooling mode if the ambient temperature is below the recommended operating temperatures.

Table 47. Minimum ambient

| Minimum Starting Ambient | | |
|---|---|---|
| | Standard Ambient | |
| Unit Size | with HGBP | without HGBP |
| 90-162 | 40 | 55 |

Notes:
1. Minimum starting ambients in degrees F and is based on unit operating at min. step of unloading, and unloading and 5 mph wind across condenser

## Electric, Steam and Hot Water Startup

### (Constant Volume & Variable Air Volume Systems)

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Do not open the service access doors while the unit is operating. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 37, p. 110 to program the following system components for operation by scrolling through the Human Interface displays;

### Electric Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Heat Stages 1 & 2 (On)

### Steam or Hot Water Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Hydronic Heat Actuator (100% Open)

Open the main steam or hot water valve supplying the rooftop heater coils.

6. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
8. Once the system has started, verify that the electric heat or the hydronic heat system is operating properly by using appropriate service technics; i.e. amperage readings, delta tees, etc.
9. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

## Gas Furnace Startup

### (Constant Volume and Variable Air Volume Systems)

It is important to establish and maintain the appropriate air/fuel mixture to assure that the gas furnace operates safely and efficiently.

Since the proper manifold gas pressure for a particular installation will vary due to the specific BTU content of the local gas supply, adjust the burner based on carbon dioxide and oxygen levels.

The volume of air supplied by the combustion blower determines the amount of oxygen available for combustion, while the manifold gas pressure establishes fuel input. By measuring the percentage of carbon dioxide produced as a by-product of combustion, the operator can estimate the amount of oxygen used and modify the air volume or the gas pressure to obtain the proper air/fuel ratio.

Arriving at the correct air/fuel mixture for a furnace results in rated burner output, limited production of carbon monoxide, and a steady flame that minimizes nuisance shutdowns.

**⚠WARNING**

**Hazardous Gases and Flammable Vapors!**

**Exposure to hazardous gases from fuel substances have been shown to cause cancer, birth defects or other reproductive harm. Improper installation, adjustment, alteration, service or use of this product could cause flammable mixtures and result in a fire. To avoid hazardous gases and flammable vapors follow proper installation and set up of this product and all warnings as provided in this manual. Failure to follow all instructions could result in death or serious injury.**

**⚠WARNING**

**Hazardous Pressures!**

**When using dry nitrogen cylinders for pressurizing units for leak testing, always provide a pressure regulator on the cylinder to prevent excessively high unit pressures. Never pressurize unit above the maximum recommended unit test pressure as specified in applicable unit literature. Failure to properly regulate pressure could result in a violent explosion, which could result in death or serious injury or equipment or property-only-damage.**

## Two Stage Gas Furnace

### High-Fire Adjustment

1. Use Table 37, p. 110 to program the following system components for operation by scrolling through the Human Interface displays;

### Gas Heat

Supply Fan (On)

Return Fan (On, if supplied)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Heat Stages 1 & 2 (On)

Turn the 115 volt control circuit switch 4S24 located in the heater control panel to the “On” position.

Open the manual gas valve, located in the gas heat section.

2. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.
3. Press the TEST START key to start the test. Remember that the delay designated in step 2 must elapse before the system will begin to operate.
4. Once the system has started, check the appearance of the flame through the sight glass provided on the front of the heat exchanger. In appearance, a normal flame has a clearly defined shape, and is primarily (75%) blue in color with an orange tip.
5. Check the manifold gas pressure by using the manifold pressure port on the gas valve. Refer to Table 48, p. 166 for the required manifold pressure for high-fire operation. If it needs adjusting, remove the cap covering the high-fire adjustment screw on the gas valve. Refer to Figure 118, p. 167 for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.
6. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 117, p. 167. Take several samples to assure that an accurate reading is obtained. Refer to Figure 116, p. 166 for the proper carbon dioxide levels. A carbon dioxide level exceeding the listed range indicates incomplete combustion due to inadequate air or excessive gas.

### Combustion Air Adjustment ($O_2$)

7. Use an oxygen analyzer and measure the percentage of oxygen in the flue gas. Take several samples to assure an accurate reading. Compare the measured oxygen level to the combustion curve in Figure 116, p. 166. The oxygen content of the flue gas should be 4% to 5%. If the oxygen level is outside this range, adjust the combustion air damper to increase or decrease the amount of air entering the combustion chamber. Refer to Figure 120, p. 169 for the location of the combustion air damper.
8. Recheck the oxygen and carbon dioxide levels after each adjustment. After completing the high-fire checkout and adjustment procedure, the low-fire setting may require adjusting.

### Low-Fire Adjustment

### (850 & 1100 MBH only)

1. Use the TEST initiation procedures outlined in the previous section to operate the furnace in the low-fire state (1st Stage).
2. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 116, p. 166, Inset A. Take several samples to assure that an accurate reading is obtained. Refer to Table 48, p. 166 for the proper carbon dioxide levels. If the measured carbon dioxide level is within the listed values, no adjustment is necessary. A carbon dioxide level exceeding the listed range indicates incomplete combustion due to inadequate air or excessive gas.
3. Check the manifold gas pressure by using the manifold pressure port on the gas valve. Refer to Table 48, p. 166

for the required manifold pressure during low-fire operation. If it needs adjusting, remove the cap covering the low-fire adjustment screw on the gas valve. Refer to Figure 118, p. 167 for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.

***Note:*** *Do not adjust the combustion air damper while the furnace is operating at low-fire.*

4. Check the carbon dioxide levels after each adjustment.
5. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

**Figure 116. Natural gas combustion curve (ratio of oxygen to carbon dioxide in percent)**

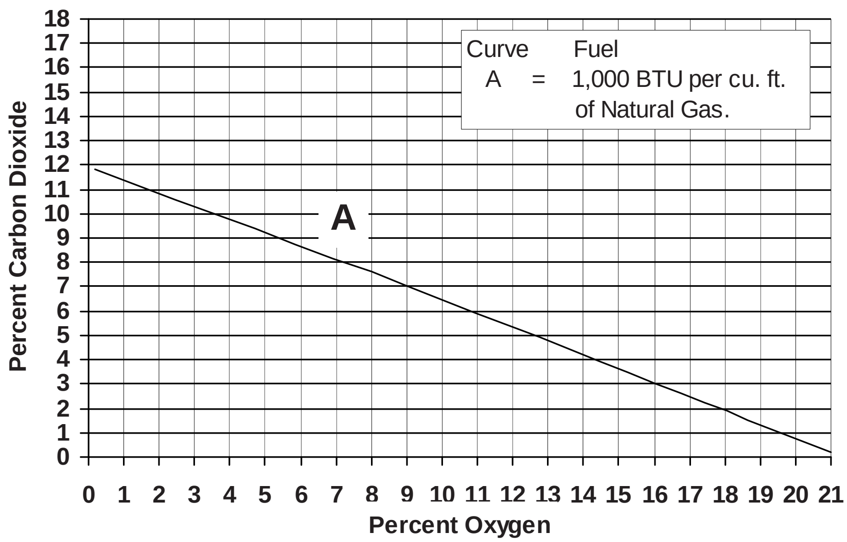



**Table 48. Recommended manifold pressures and $CO_2$ levels during furnace operation**

| 2-STAGE | | | | | | MODULATING | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MBH | FIRING RATES | % CO2 NAT GAS | MANIF PRESS "W.C. | % CO2 PROPANE | MANIF PRESS "W.C. | MBH | FIRING RATE | % CO2 NAT GAS | MANIF PRESS "W.C. | % CO2 PROPANE | MANIF PRESS "W.C. |
| 850 | 100% | 8.0-9.0 | 3.0-3.5 | 9.0-10.0 | 3.0-3.5 | 850 | 100% | 8.0-9.0 | 3.0- 3.5 | 7.8-8.4 | 1.7-2.2 |
| 510 | 60% | 5.0 -7.0 | 0.8-0.95 | 5.0-7.0 | 1.5-3.0 | 85 | 10% | 5.0 -7.0 | 0.8- 0.9.5 | 2.0-3.0 | .1-.2 |
| 1100 | 100% | 8.0-9.0 | 3.0-3.3 | 9.0-10.0 | 3.0-3.3 | 1100 | 100% | 7.0-9.0 | .8-.9 | 8.5-9.5 | .5-.75 |
| 550 | 50% | 5.0 -7.0 | 0.8-0.95 | 5.0-7.0 | 0.8-0.95 | 55 | 5% | 1.5-3.0 | .05-1.0 | 1.5-2.5 | .02-.04 |
| 1800 | 100% | 7.0- 8.0 | 1.5- 1.8 | N/A | N/A | 1800 | 100% | 7.0-9.0 | 1.5- 1.8 | N/A | N/A |
| 900 | 50% | 5.0- 7.0 | 0.5- 0.7 | N/A | N/A | 90 | 5% | 1.5-3.0 | .05-1.0 | N/A | N/A |
| 2500 | 100% | 7.5- 8.5 | 2.0- 2.5 | N/A | N/A | 2500 | 100% | 7.0-9.0 | 2.0- 2.5 | N/A | N/A |
| 1250 | 50% | 5.0- 7.0 | 0.5- 0.7 | N/A | N/A | 125 | 5% | 1.5-3.0 | .05-1.0 | N/A | N/A |

Figure 117. Flue gas carbon dioxide and oxygen measurements

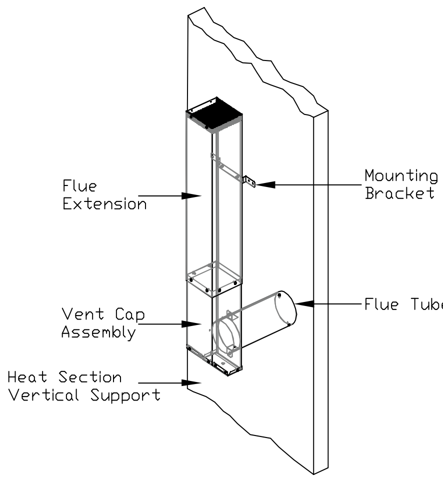
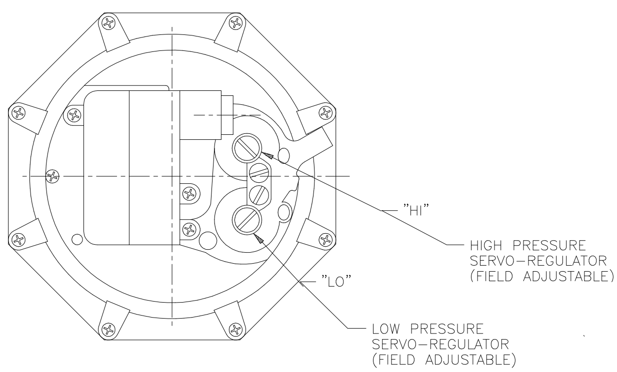



Figure 118. High/low pressure regulator




## Full Modulating Gas Furnace

Full Modulating gas heaters are available for the 850, 1100, 1800, 2500 MBH heater sizes.

- The firing rate of the 850 MBH modulating heater can vary from 10% to 100% of the 850 MBH.
- The firing rate of the 1100, 1800 and 2500 MBH can vary from 5% to 100% of it's nameplate value.

### Heat Exchanger

The heat exchanger drum, tubes and front and rear headers are constructed from stainless steel alloys.

### Unit Control

The unit is controlled by a supply air temperature sensor located in the supply air stream for VAV units. CV units have two sensors, one located in the supply air stream and the zone sensor. The temperature sensor signal is sent to the Heat module of the IntelliPak™ II Unit Control. The control signal from the Heat Module signal is directly proportional 0-10 VDC. The higher the voltage signal, the lower the call for heat.

The 0-10 VDC signal controls the air damper actuator which is mounted on the end of the air damper shaft. As the actuator rotates clockwise, more combustion air passes through the combustion air blower. In turn, the gas butterfly valve opens more through a directly connected linkage, resulting in a higher rate of firing.

1. Use Table 37, p. 110 to program the following system components for operation by scrolling through the Human Interface displays;

### Gas Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

High Fire (90%)

Turn the 115 volt control circuit switch 4S24 located in the heater control panel to the "On" position.

Open the manual gas valve, located in the gas heat section.

2. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.
3. Press the TEST START key to start the test. Remember that the delay designated in step 2 must elapse before the system will begin to operate.

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

4. Once the system has started, check the appearance of the flame through the sight glass provided on the front of the heat exchanger. In appearance, a normal flame has a clearly defined shape, and is primarily (75%) blue in color with an orange tip.
5. Check the inlet gas pressure at the modulating gas valve. The inlet pressure should be 6" to 8" w.c.
6. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 117, p. 167. Take several samples to assure that an accurate reading is obtained. The $CO_2$ level should fall in the ranges shown in the guide values Table 48, p. 166

***Note:*** *The burner capacity is controlled by the movement of the air damper. This has been preset at the factory and normally does not need field adjustment. The combustion quality (air/gas) is controlled by the setup of the air damper and butterfly valve linkage relationship.*

7. Use Table 37, p. 110 to program the minimum (5%) firing rate. Allow the system to operate for approximately 10 minutes.
8. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. If the measured carbon dioxide level is in the ranges shown in the Guide Values Table 48, p. 166, no adjustment is necessary.

***Note:*** *It is normal for the low fire $CO_2$ to be lower than the high fire.*

9. If the measured carbon dioxide level is below the recommended values for low heat, return the burner to 90% fire rate and repeat step 6, to achieve optimum combustion.
10. Program the burner for 100% operation and recheck the $CO_2$ or $O_2$ value.
11. Check the flue gas values at several intermediate output levels. If corrections are necessary;
    – Adjust butterfly linkage
12. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

**Figure 119. Modulating gas regulator**

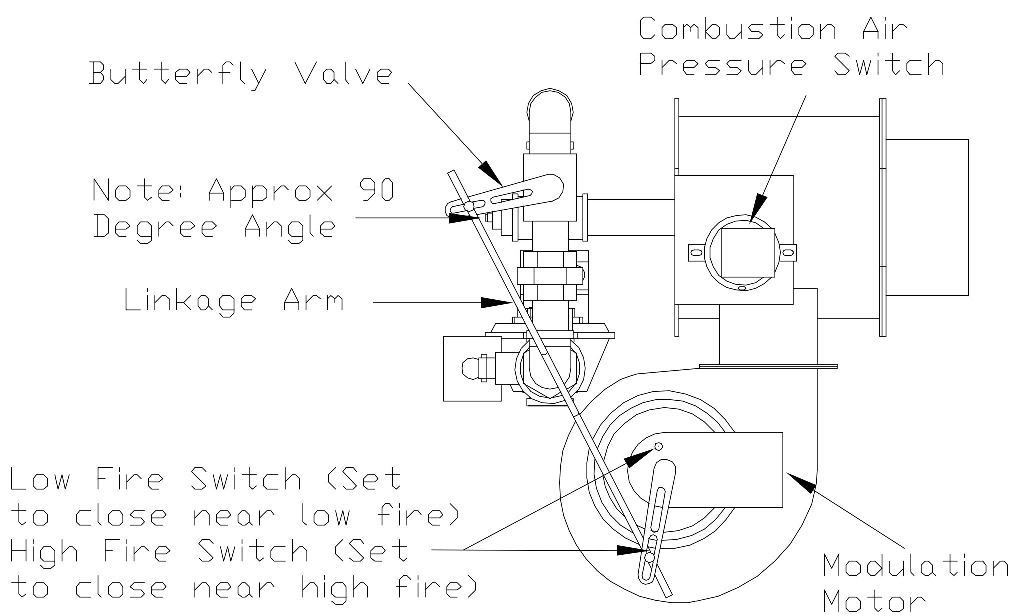
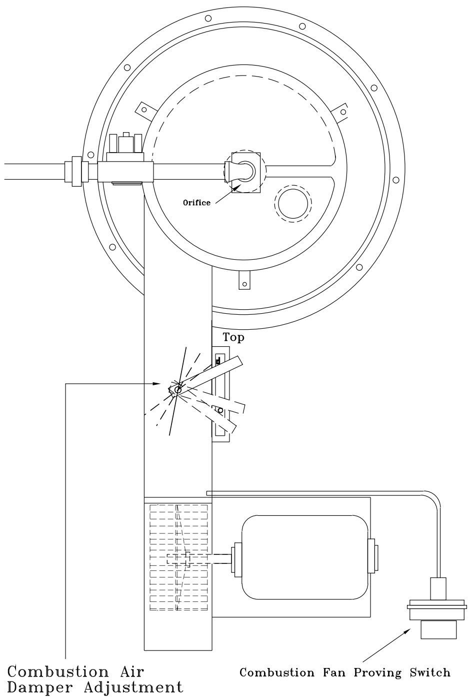


**Figure 120. 850-1100 MBH**




## Final Unit Checkout

After completing all of the checkout and startup procedures outlined in the previous sections (i.e., operating the unit in each of its Modes through all available stages of cooling and heating), perform these final checks before leaving the unit:

[ ] Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

[ ] Turn the 115 volt control circuit switch “Off”.

[ ] Turn the 24 volt control circuit switch to the “On” position.

[ ] At the Human Interface Module, press the “SETUP” key. The LCD screen will display various preset “parameters of operation” based on the unit type, size, and the installed options. Compare the factory preset information to the specified application requirements. If adjustments are required, follow the step-by-step instructions provided in the appropriate programming manual for CV or VAV applications.

[ ] Program the Night Setback (NSB) panel (if applicable) for proper unoccupied operation. Refer to the programming instructions for the specific panel.

[ ] Verify that the Remote panel “System” selection switch, “Fan” selection switch, and “Zone Temperature” settings for constant volume systems are correct.

[ ] Verify that the Remote panel “System” selection switch and the “Supply Air Temperature” settings for variable air volume systems are correct.

[ ] Inspect the unit for misplaced tools, hardware, and debris.

[ ] Turn the 115 volt control circuit switch “On”.

[ ] Press the “AUTO” key at the Human Interface Module to begin system operation. The system will start automatically once the dampers modulate and a request for either heating or cooling has been given.

[ ] Verify that all exterior panels including the control panel doors and condenser grilles are secured in place.

## Multi-piece Unit—Trane Startup

Once the IntelliPak II multi-piece unit has been installed, all shipped with items have been installed, all utilities and drain pipes have been connected, the refrigeration piping has been reconnected and refrigerant charge has been adequately distributed throughout the system, and all ductwork has been attached to the unit, Trane will provide unit startup.

Trane startup of multi-piece units will review the overall unit for exterior damage (dents, bends, missing panels, doors work properly), verify that the unit interior is free from debris/obstructions, ensure that the panels and doors are secured properly and verify that all wiring connections are tight.

The overall installation will be reviewed to ensure the unit clearances are adequate to avoid air recirculation and all unit drain lines and traps are properly installed.

The unit main power will be reviewed to ensure the unit is properly grounded, the main power feed wire gauge is adequately sized, the correct voltage is supplied to unit and electric heaters, and the incoming voltage is phase balanced. Verification will be performed to ensure that all field installed control wiring is applied to the correct terminals, all automation and remote controls installed/ wired and control wiring for CV, SZVAV and VAV controls is completed.

The refrigeration system will be reviewed to ensure the coil fins are straightened, the removal of shipping hardware and plastic covers for compressors, proper oil level in the compressors, crankcase heaters have been operational for at least 12 hours time prior to Trane startup being performed. The proper compressor voltage and amperage, correct position of service valves prior to startup and proper system subcooling and superheat will be verified.

The unit fans will be checked to ensure that the condenser fan blade set-screws to the motor shaft are tight, that the hold down bolts and channels from fan sections have been removed, proper adjustment of fan section spring isolators, proper fan belts tension, adequate fan bearings grease, alignment of fan sheaves, adequate tightness of supply and exhaust fan pulley bolts, proper fan rotation, and proper fan motor amperage.

A check will be made to ensure both piping to the condenser and air handler side of the system have been completed and interconnecting refrigerant tubing has been evacuated by the contractor prior to Trane performing the startup. All damper linkages will be checked for proper adjustment, and proper damper operation and outside air pressure sensors verified.

Units equipped with electric heaters will be checked to ensure that the heating system matches the unit nameplate and for correct voltage supply to the heaters.

Units equipped with gas heaters will be checked to ensure that the flue assembly is secure and properly installed, sufficient gas pressure exists according to pipe size, no leaks exist in gas supply line, the gas heat piping includes a drip leg, condensate line and the combustion air CO2 and O2 levels are normal.

Units equipped with hot water heat will be checked to ensure that the hot water pipes are properly routed, sized and leak free; for the presence of swing joints or flexible connectors next to the hot water coil; proper gate valve installation in the supply and return branch line; proper three way modulating valve installation, and proper coil venting will be verified.

Units equipped with steam heat will be checked to ensure that the hot water pipes are properly routed, sized and leak free; proper swing check vacuum breaker installation; proper 2-way modulating valve installation; proper steam trap installation.

Units equipped with energy recovery wheels will be checked to ensure proper rotation and operation of the wheel. The service test guide will be used to check proper component operation.

Finally, the program set points for proper unit operation will be validated through human interface module. Once the IntelliPak II multi-piece unit has been started, a communication will be provided of startup activities and the associated operating log.

Table 49. **Trane startup checklist**

***Important:*** *This checklist is not intended as a substitution for the contractor's installation instruction.*

This checklist is intended to be a guide for the Trane technician just prior to unit 'startup'. Many of the recommended checks and actions could expose the technician to electrical and mechanical hazards. Refer to the appropriate sections in the this manual for appropriate procedures, component specifications and safety instructions.

| | |
|---|---|
| Job Name | Serial # |
| Job Location | Model # |
| Sales Order # | Ship Date |
| Unit DL # (special units) | Date |
| Starting Sales Office | Technician |

***Important:*** *Except where noted, it is implied that the Trane technician is to use this checklist for inspection/verification of prior tasks completed by the general contractor at installation. Use the line item content to also record the associated values onto the Trane unitary packaged equipment log.*

| | Complete |
|---|---|
| 1. Crankcase heaters working for 8 hours prior to arrival of Trane technician performing startup | |
| 2. Correct voltage supplied to unit and electric heaters | |
| 3. Unit exterior inspected | |
| 4. Disconnect all power, Unit interior free from debris/obstructions etc. | |
| 5. Open all access doors to verify all open and close fully without any binding | |
| 6. All wiring connections tight | |
| 7. Unit properly grounded | |
| 8. Copper power wiring meets sizing requirement | |
| 9. All field control wiring for CV, SZVAV or VAV controls completed | |
| 10. All automation and remote controls installed/wired | |
| 11. Unit clearances adequate for service and to avoid air recirculation etc. | |
| 12. All unit drain lines and traps proper | |
| 13. All coil fins inspected and straightened | |
| 14. Shipping hardware for compressors removed | |
| 15. Hold down bolts and channels from fan sections removed | |
| 16. Fan section spring isolators checked/adjusted | |
| 17. Damper linkages tight/adjusted | |
| 18. Rail connector splice brackets installed on low side base rail | |
| **Where applicable: Evaporative condenser** | |
| 19. Verify incoming water pressure is between 35-60psig, dynamic pressure (measured with valve open) for min flow rate of 30 GPM | |
| 20. Verify fan shipping brackets between fans and mist eliminators above spray distribution system have been removed | |
| 21. Verify water treatment system has been installed and approved - discontinue start-up if proof of active water treatment does not exist | |
| **Continued on next page** | |
| 22. Verify conductivity controller calibration has been documented | |
| 23. Verify conductivity controller min and max setpoints have been setup | |
| 24. Verify all water and drain connections are complete | |
| 25. Verify the sump fills to within 1" of the overflow | |
| 26. Verify drain valve is set to "drain during power loss" or "hold during power loss" per job specification | |
| **Where applicable: Electric Heat** | |
| 27. Electric heat circuits have continuity | |
| **Where applicable: Gas Heat** | |
| 28. Gas heat piping includes drip leg previously installed by controlling contractor | |
| 29. Gas heat flue assembly fully installed | |

**Table 49. Trane startup checklist (continued)**

| | |
|---|---|
| 30. Gas heat condensate line + heat tape installed where applicable | |
| **Where applicable: HW/Steam Heat** | |
| 31. Modulating valve and actuator (HW and Steam) installed/wired | |
| 32. Steam heat swing check vacuum breakers installed per IOM direction | |
| 33. Steam heat condensate trap provided | |
| 34. O/A pressure sensor installed and piped | |
| 35. High side to low side piping to be completed prior to Trane technician arriving for startup | |
| 36. Space sensor and pneumatic tubing installed properly | |
| | **Complete** |
| 37. Compressor discharge service valves, oil valves and liquid lines valves open/back seated (excludes Schrader valves) | |
| 38. Compressor oil levels (½ -¾ high in glass) proper | |
| 39. Verify power wires are connected in the high voltage power box | |
| 40. Verify field installed control wiring landed on correct terminals | |
| 41. All fan belts tensioned and bearings greased | |
| 42. Heat wheel rotates freely by hand | |
| 43. Reenergize power. Phase sequence (A-B-C) proper for compressor rotation | |
| 44. Incoming voltage balanced | |
| 45. All panels/doors secured prior to startup | |
| **Start unit** | |
| 46. Service test guide used to operate unit components | |
| 47. Fan amperages within nameplate specs | |
| 48. Verify system airflow | |
| 49. Dampers open and close properly | |
| 50. Adjust outside air damper travel | |
| 51. On evaporative condenser models: Verify the sump fills to within 1.5” below the overflow, which is within the slot on the max float bracket (see Figure 114, p. 162) | |
| 52. Compressor operation normal and within amperage rating | |
| 53. Superheat (14-18°F) and subcooling (14-22°F) normal for air-cooled units | |
| 54. Electric, hot water and steam heating operation checked | |
| 55. Gas heating startup sequence of operation per IOM has been followed | |
| 56. Gas heat operation has been verified with combustion analyzer | |
| 57. Incoming gas pressure does not drop below 7" water column when burner is on high fire | |
| 58. Operating log completed | |

# Service and Maintenance

**⚠WARNING**

**Hazardous Voltage and Exposure to Ultraviolet Radiation!**

**This product contains components that emit high-intensity ultraviolet (UV-C) radiation which can be harmful to unprotected eyes and skin. To avoid injury, disconnect all electrical power, including remote disconnects, and make sure the UV lights are off before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in burns or electrocution which could result in death or serious injury.**

**Trane does not recommend field installation of ultraviolet lights in its equipment for the intended purpose of improving indoor air quality. High intensity C-band ultraviolet light is known to severely damage polymer (plastic) materials and poses a personal safety risk to anyone exposed to the light without proper personal protective equipment. Polymer materials commonly found in HVAC equipment that could be susceptible include insulation on electrical wiring, fan belts, thermal insulation, various fasteners and bushings. Degradation of these materials can result in serious damage to the equipment.**

**Trane accepts no responsibility for the performance or operation of our equipment in which ultraviolet devices were installed outside of the Trane factory or its approved suppliers.**

**Table 50. Control Settings and Time Delays**

| Control Description | Elec. Designation | Contacts Open | Contacts Closed |
|---|---|---|---|
| Combustion Airflow Switch (Gas Heat Only) | 4S25 | see note 1 | 0.1 - 0.25" wc rise in press diff |
| Supply Airflow Switch (Gas Heat Only) | 4S38 | 0.03 - 0.12" wc | 0.15 + 0.05" wc rise in press diff |
| Freezestat (Hydronic Heat Only) | 4S12 | (N.O.) Auto Reset | 40 F |
| Gas Heat Units<br>Prepurge Timer: Honeywell | 4U18 | internal timing function | 2 Stage 850/1100 MBH 60—seconds/ All other configurations—30 seconds |
| Sequencing Time Delay Relay | 4DL6 | N.C. - timed to close | 60 seconds ± 20% |

**Notes:** The combustion airflow switch (4S25) differential is 0.02" - 0.08" wc.

**Table 51. Gas Heat—High Limit**

| UNIT TONS | FAN SIZE (IN) | CONFIG. | CONTACTS OPEN | CONTACTS CLOSE |
|---|---|---|---|---|
| **2500 MBH HIGH LIMIT** | | | | |
| 120-162 | 40 | DF | 195 | 155 |
| | 40 | HZ | 240 | 200 |
| | 32 | DF & HORZ | 220 | 180 |
| **1800 MBH HIGH LIMIT** | | | | |
| 120-162 | 32 &40 | DF | 240 | 200 |
| | 32 &40 | HZ | 220 | 180 |
| 90-118 | 32 | DF & HZ | 240 | 200 |
| | 36 | DF & HZ | 240 | 200 |
| | 36 | HZ | 240 | 310 |
| | 25 | DF | 240 | 200 |
| | 25 | HZ | 220 | 180 |
| **1100 MBH HIGH LIMIT** | | | | |
| 120-162 | 32 | DF | 240 | 200 |
| | 32 | HZ | 200 | 160 |
| | 40 | DF & HZ | 240 | 200 |
| 90-118 | 32 | DF | 240 | 200 |
| | 32 | HZ | 200 | 160 |
| | 25 &36 | DF & HZ | 220 | 180 |
| **850 MBH HIGH LIMIT** | | | | |
| 90-118 | 25 &36 | DF & HZ | 240 | 200 |

**Table 52. Electric Heat—Selection Limits**

| Tons | Indoor Fan Option | Electric Heat Option | Supply Discharge | Linear Limit - Open Temp. | Fan Fail Limit - Open Temp. |
|---|---|---|---|---|---|
| 120-162 Ton | High (40") | High (300 kW) | Downflow | 185F | 185F |
| | | | Hz (right) | 185F | 185F |
| | | Low (140 kW) | Downflow | 150F | 185F |
| | | | Hz (right) | 150F | 185F |
| | Low (32") | High (300 kW) | Downflow | 205F | 185F |
| | | | Hz (right) | 185F | 185F |
| | | Low (140 kW) | Downflow | 150F | 185F |
| | | | Hz (right) | 150F | 185F |
| 105/118 Ton | High (36") | High (262.5 kW) | Downflow | 195F | 155F |
| | | | Hz (right) | 195F | 155F |
| | | Low (90 kW) | Downflow | 150F | 175F |
| | | | Hz (right) | 150F | 175F |
| | Low (32") | High (262.5 kW) | Downflow | 225F | 185F |
| | | | Hz (right) | 205F | 185F |
| | | Low (90 kW) | Downflow | 150F | 175F |
| | | | Hz (right) | 150F | 175F |
| 90/105 Ton | High (36") | High (262.5 kW) | Downflow | 195F | 155F |
| | | | Hz (right) | 195F | 155F |
| | | Low (90 kW) | Downflow | 150F | 175F |

**Table 52. Electric Heat—Selection Limits**

| | | | | | |
|---|---|---|---|---|---|
| | | | Hz (right) | 150F | 175F |
| | Low (25") | High (262.5 kW) | Downflow | 215F | 155F |
| | | | Hz (right) | 235F | 155F |
| | | Low (90 kW) | Downflow | 150F | 175F |
| | | | Hz (right) | 150F | 175F |

**Table 53. Compressor Circuit Breaker Electrical Characteristics**

| Unit Size | Compressor Designator | Compressor Size | 460V | | 575V | | 380V | |
|---|---|---|---|---|---|---|---|---|
| | | | Must Hold | Must Trip | Must Hold | Must Trip | Must Hold | Must Trip |
| 90/105 | 1A, 2A | CSHN250 | 41.5 | 47.7 | 33.2 | 38.2 | 41.4 | 47.6 |
| | 1B, 2B | CSHN250 | 41.5 | 47.7 | 33.2 | 38.2 | 41.4 | 47.6 |
| 105/118 | 1A, 2A | CSHN250 | 41.5 | 47.7 | 33.2 | 38.2 | 41.4 | 47.6 |
| | 1B, 2B | CSHN315 | 54.4 | 62.6 | 43.6 | 50.1 | 54.3 | 62.4 |
| 120/128 | 1A, 2A | CSHN315 | 57.7 | 66.4 | 46.3 | 53.2 | 57.3 | 66 |
| | 1B, 2B | CSHN315 | 54.4 | 62.6 | 43.6 | 50.1 | 54.3 | 62.4 |
| 130/140 | 1A, 2A | CSHN315 | 57.7 | 66.4 | 46.3 | 53.2 | 57.3 | 66 |
| | 1B, 2B | CSHN374 | 63.4 | 72.9 | 50.0 | 57.5 | 63.3 | 72.8 |
| 150/162 | 1A, 2A | CSHN374 | 66.7 | 76.7 | 52.7 | 60.6 | 66.4 | 76.3 |
| | 1B, 2B | CSHN374 | 63.4 | 72.9 | 50.0 | 57.5 | 63.3 | 72.8 |

**Table 54. Unit Internal Fuse Replacement Data & VFD Factory Settings**

| FUSE REPLACEMENT TABLE | | | | |
|---|---|---|---|---|
| CONDENSER FAN FUSE 1F10 THRU 1F15 CLASS RK5 | FUSE SIZE | 380V | 460V | 575V |
| | | 15A | 15A | 15A |
| EVAPORATIVE CONDENSING CONDENSER FAN FUSE 1F10 THRU 1F15 CLASS CC | FUSE SIZE | N/A | 460V | N/A |
| | | N/A | 8A | N/A |
| CONTROL POWER FUSES | | | | |
| TRANSFORMER PRIMARY PROTECTION FUSE 1F3 & 1F4 CLASS CC | TRANSFORMER SIZE | 380V | 460V | 575V |
| | 1.00 KVA | 6A | 5A | 4A |
| | 1.50 KVA | 10A | 7A | 6A |
| | 2.00 KVA | 10A | 10A | 7A |
| TRANSFORMER SECONDARY PROTECTION FUSE 1F1 TYPE S OR CLASS CC | TRANSFORMER SIZE | 380V | 460V | 575V |
| | 1.00 KVA | 15A | 15A | 15A |
| | 1.50 KVA | 20A | 20A | 20A |
| | 2.00 KVA | 20A | 20A | 20A |
| CONTROL WIRING PROTECTION FUSE 1F7 & 1F8 TYPE MTH | FUSE SIZE | 380V | 460V | 575V |
| | | 6A | 6A | 6A |
| VFD PROTECTION FUSES 25 | | | | |
| SUPPLY FAN VFD FUSES 1F19, 1F20, 1F21 & OPTIONAL EXHAUST/RETURN FAN VFD FUSES 1F22, 1F23, 1F24 CLASS T | MOTOR HP | 380V | 460V | 575V |
| | 7.5 HP | 45A | 35A | 25A |
| | 10 HP | 50A | 45A | 35A |
| | 15 HP | 90A | 60A | 50A |
| | 20 HP | 100A | 90A | 70A |
| | 25 HP | 125A | 100A | 80A |
| | 30 HP | 150A | 125A | 90A |
| | 40 HP | 200A | 150A | 125A |
| | 50 HP | 225A | 200A | 175A |
| | 60 HP | 350A | 225A | 200A |
| | 75 HP | 350A | 300A | 225A |
| | 100 HP | N/A | 350A | N/A |
| MISCELLANEOUS FUSES | | | | |
| OPTIONAL CONVENIENCE OUTLET FUSES 1F25 AND 1F26 CLASS CC | FUSE SIZE | 380V | 460V | 575V |
| | | N/A | 5A | 4A |
| ENERGY RECOVERY WHEEL MOTOR FUSE 1F39, 1F40, 1F41 CLASS CC | FUSE SIZE | 380V | 460V | 575V |
| | | N/A | 2A | 2A |
| SUMP HEAT FUSE 1F16, 1F17, 1F18 CLASS CC | FUSE SIZE | 380V | 460V | 575V |
| | | N/A | 5A | N/A |

***Note:*** ***See fuse replacement table on VFD panel for VFD power fuses (F40, F41, F42).*

**Table 55. Filter Data**

| Unit Model (AC/ EC) | Filters: Standard 2" High Eff Throwaways — Qty | Size of Each | Face Area (ft2) | 90-95% Bag Filters with Prefilters — Pre-filters Qty | Pre-filters Size | Bag Filters Qty | Bag Filters Size | Face Area (ft2) | 90-95% Cartridge Filters with Prefilters — Prefilters Qty | Prefilters Size | Cartridge Filters Qty | Cartridge Filters Size | Face Area (ft2) | 90-95% Low Pressure Drop Cartridge Filters — Prefilters Qty | Prefilters Size | Low PD Filters Qty | Low PD Filters Size | Face Area (ft2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90/100 | 21 | 20x24x2 | 80 | 21 | 20x24x2 | 21 | 20x24x19 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 |
| | 5 | 15x24x2 | | 5 | 12x24x2 | 5 | 12x24x19 | | 5 | 12x24x2 | 5 | 12x24x12 | | 5 | 12x24x2 | 5 | 12x24x12 | |
| 105/ 118 | 21 | 20x24x2 | 80 | 21 | 20x24x2 | 21 | 20x24x19 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 |
| | 5 | 15x24x2 | | 5 | 12x24x2 | 5 | 12x24x19 | | 5 | 12x24x2 | 5 | 12x24x12 | | 5 | 12x24x2 | 5 | 12x24x12 | |
| 120/ 128 | 28 | 20x24x2 | 93 | 21 | 20x24x2 | 21 | 20x24x19 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 |
| | | | | 5 | 12x24x2 | 5 | 12x24x19 | | 5 | 12x24x2 | 5 | 12x24x12 | | 5 | 12x24x2 | 5 | 12x24x12 | |
| 130/ 140 | 28 | 20x24x2 | 93 | 21 | 20x24x2 | 21 | 20x24x19 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 |
| | | | | 5 | 12x24x2 | 5 | 12x24x19 | | 5 | 12x24x2 | 5 | 12x24x12 | | 5 | 12x24x2 | 5 | 12x24x12 | |
| 150/ 162 | 28 | 20x24x2 | 93 | 21 | 20x24x2 | 21 | 20x24x19 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 | 21 | 20x24x2 | 21 | 20x24x12 | 80 |
| | | | | 5 | 12x24x2 | 5 | 12x24x19 | | 5 | 12x24x2 | 5 | 12x24x12 | | 5 | 12x24x2 | 5 | 12x24x12 | |

Table 56. Final Filter Data

| Unit Model (AC/EC) | Final Filters | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90-95% Low Pressure Drop Cartridge Filters | | | | | 90-95% Bag Filters with Prefilters | | | | | 90-95% Cartridge Filters with Prefilters | | | | |
| | Pre-filters | | Low PD Cartridge Filters | | | Prefilters | | Bag Filters | | | Prefilters | | Cartridge Filters | | |
| | Qty | Size | Qty | Size | Face Area (ft2) | Qty | Size | Qty | Size | Face Area (ft2) | Qty | Size | Qty | Size | Face Area (ft2) |
| 90/100 | 15 | 24x24x4 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x19 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x4 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x19 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 105/118 | 15 | 24x24x4 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x19 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x4 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x19 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 120/128 | 15 | 24x24x4 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x19 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x4 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x19 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 130/140 | 15 | 24x24x4 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x19 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x4 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x19 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 150/162 | 15 | 24x24x4 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x19 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x4 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x19 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| Unit Model (AC/EC) | 90-95% High Temp Cartridge Filters with Prefilters | | | | | HEPA Filters with Prefilters | | | | | High Temp HEPA Filters with Prefilters | | | | |
| | Pre-filters | | High Temp Cartridge Filters | | | Prefilters | | HEPA Filters | | | Prefilters | | High HEPA Temp Filters | | |
| | Qty | Size | Qty | Size | Face Area ($ft^2$) | Qty | Size | Qty | Size | Face Area ($ft^2$) | Qty | Size | Qty | Size | Face Area ($ft^2$) |
| 90/100 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 105/118 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 120/128 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 130/140 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | |
| 150/162 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 | 15 | 24x24x2 | 15 | 24x24x12 | 74 |
| | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | | 7 | 12x24x2 | 7 | 12x24x12 | |

Table 57. Grease Recommendation

| Recommended Grease for Fan Bearings | Recommended Operating Range |
|---|---|
| Exxon Unirex #2 | -20 F to 250 F |
| Mobil 532 | |
| Mobil SHC #220 | |
| Texaco Premium RB | |

Table 58. Air-Cooled Condenser—Refrigerant Coil Fin Data

| Tons | Coil Type | Coil Fin Config. | Tube Dia. | Coil Rows | Fins per foot | Coil Face Area (sq. ft.) | Tube Type |
|---|---|---|---|---|---|---|---|
| 90 | Evaporator | Enhanced | 1/2 | 3 | 168 | 73.75 | Internally Finned |
| | Hi-Cap Evap | Enhanced | 1/2 | 5 | 168 | 73.75 | Internally Finned |
| | Condenser | Enhanced | 25 mm | 1 | 240 | 134 | Microchannel |
| 105 | Evaporator | Internally Finned | 1/2 | 4 | 168 | 73.75 | Internally Finned |
| | Hi-Cap Evap | Internally Finned | 1/2 | 6 | 168 | 73.75 | Internally Finned |
| | Condenser | Enhanced | 25 mm | 1 | 240 | 161 | Microchannel |
| 120 | Evaporator | Internally Finned | 1/2 | 3 | 168 | 106.25 | Internally Finned |
| | Hi-Cap Evap | Internally Finned | 1/2 | 6 | 168 | 106.25 | Internally Finned |
| | Condenser | Enhanced | 18 mm | 2 | 276 | 161 | Microchannel |
| 130 | Evaporator | Internally Finned | 1/2 | 4 | 168 | 106.25 | Internally Finned |
| | Hi-Cap Evap | Internally Finned | 1/2 | 6 | 168 | 106.25 | Internally Finned |
| | Condenser | Enhanced | 18 mm | 2 | 276 | 161 | Microchannel |
| 150 | Evaporator | Internally Finned | 1/2 | 6 | 168 | 106.25 | Internally Finned |
| | Condenser | Smooth | 18 mm | 2 | 276 | 161 | Microchannel |

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

## Fan Belt Adjustment

The supply fan belts and optional exhaust fan belts must be inspected periodically to assure proper unit operation.

Replacement is necessary if the belts appear frayed or worn. Units with dual belts require a matched set of belts to ensure equal belt length.

When removing or installing the new belts, do not stretch them over the sheaves. Loosen the belts using the belt tension adjustment bolts on the motor mounting base.

Once the new belts are installed, using a Browning or Gates tension gauge (or equivalent), see Figure 121, adjust the belt tension as follows:

1. To determine the appropriate belt deflection:
   a. Measure the center-to-center shaft distance (in inches) between the fan and motor sheaves.
   b. Divide the distance measured in Step 1a by 64; the resulting value represents the amount of belt deflection that corresponds to the proper belt tension.

**Figure 121.Tension Gauge**

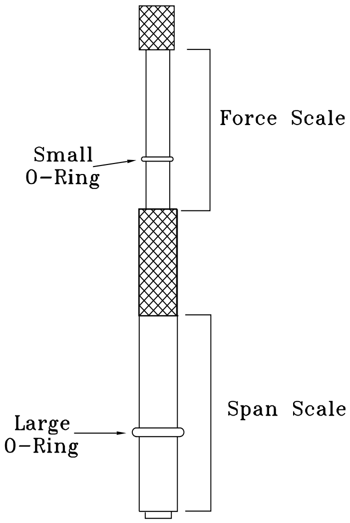
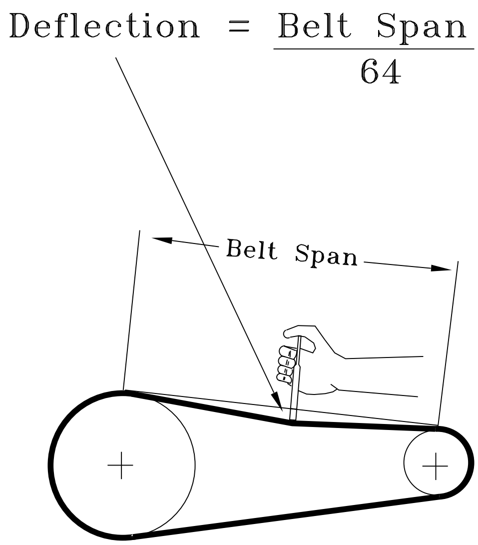



**Figure 122.Belt Tension**




2. Set the large O-ring on the belt tension gauge at the deflection value determined in Step 1b.
3. Set the small O-ring at zero on the force scale of the gauge plunger.
4. Place the large end of the gauge at the center of the belt span; then depress the gauge plunger until the large O-ring is even with the top of the next belt—-or even with a straightedge placed across the fan and motor sheaves. See Table 59, p. 181.
5. Remove the belt tension gauge. The small O-ring now indicates a number other than zero on the plunger's force scale. This number represents the force (in pounds) required to give the needed deflection.
6. Compare the "force" scale reading (Step 5) with the appropriate "force" value listed in Table 59, p. 181. If the "force" reading is outside the range, readjust the belt tension.

***Note:*** *Actual belt deflection "force" must not exceed the maximum "force" value shown in Table 59, p. 181.*

7. Recheck the belt tension at least twice during the first 2 to 3 days of operation. Belt tension will decrease rapidly until the new belts are "run in".

Table 59. Belt Tension Measurement and Deflection Ranges

| Belt Cross Section | Smallest Sheave Diameter Range (In.) | RPM Range | Belt Deflection Force (Lbs.) Super Gripbelts and Unnotched Gripbands Min. | Super Gripbelts and Unnotched Gripbands Max. | Gripnotch Belts and Notched Gripbands Min. | Gripnotch Belts and Notched Gripbands Max. |
|---|---|---|---|---|---|---|
| A, AX | 3.0-3.6 | 1000-2500 | 3.7 | 5.5 | 4.1 | 6.1 |
| | 3.8-4.8 | 1000-2500 | 4.5 | 6.8 | 5.0 | 7.4 |
| | 5.0-7.0 | 1000-2500 | 5.4 | 8.0 | 5.7 | 8.4 |
| B, BX | 3.4 – 4.2 | 860-2500 | -- | -- | 4.9 | 7.2 |
| | 4.4 – 5.6 | 860-2500 | 5.3 | 7.9 | 7.1 | 10.5 |
| | 5.8 – 8.6 | 860-2500 | 6.3 | 9.4 | 8.5 | 12.6 |
| 3V, 3VX | 2.2 - 2.4 | 1000-2500 | -- | -- | 3.3 | 4.9 |
| | 2.65 - 3.65 | 1000-2500 | 3.6 | 5.1 | 4.2 | 6.2 |
| | 4.12 - 6.90 | 1000-2500 | 4.9 | 7.3 | 5.3 | 7.9 |
| 5V, 5VX | 4.4 – 6.7 | 500-1749<br>1750-3000 | -- | -- | 10.2<br>8.8 | 15.2<br>13.2 |
| | 7.1 –10.9 | 500-1740 | 12.7 | 18.9 | 14.8 | 22.1 |
| | 11.8-16.0 | 500-1740 | 15.5 | 23.4 | 17.1 | 25.5 |

## Scroll Compressor Replacement

The compressor manifold system was purposely designed to provide proper oil return to each compressors. The refrigerant manifold system must not be modified in any way.

***Note:*** *Altering the compressor manifold piping may cause oil return problems and compressor failure.*

Should a compressor replacement become necessary and a suction line filter drier is to be installed, install it a minimum of 18 inches upstream of the oil separator tee. See Figure 123, p. 181.

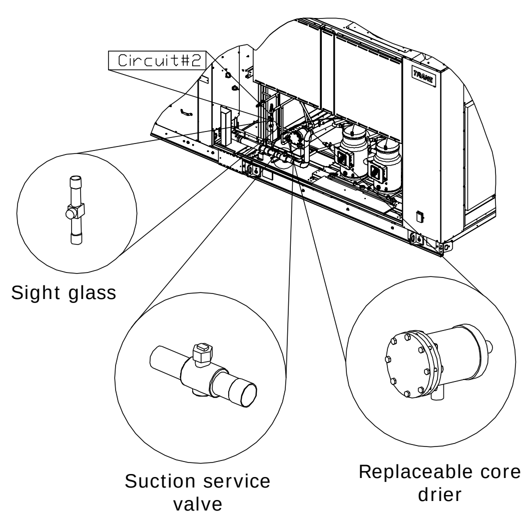
Anytime a compressor is replaced, the oil for each compressor within the manifolded set must be replaced.

The scroll compressor uses Trane OIL00079 (one quart container) or OIL00080 (one gallon container) without substitution. The appropriate oil charge for CSHN250 and CSHN315 scroll compressors is 14.2 pints. For CSHN374 scroll compressor, use 15.2 pints.

The recommended method for evacuation and dehydration is to evacuate both the high side and the low side to 500 microns or less. To establish that the unit is leak-free, use a standing vacuum test. The maximum allowable rise over a 15 minute period is 200 microns. If the rise exceeds this, there is either still moisture in the system or a leak is present.

***Note:*** *Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all Federal, State and local laws.*

**Figure 123.Suction Line Filter/Drier Installation**



## VFD Programming Parameters

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

Units shipped with an optional variable frequency drive (VFD) are preset and run tested at the factory. If a problem with a VFD occurs, ensure that the programmed parameters listed in Table 60, p. 183 have been set before replacing the drive.

***Note:*** *Check to make sure that parameter 1-23 is set to 60 Hz. To check parameter 1-23 press the [Main Menu] button (press [Back] button if the main menu does not display), use the [▼] button to scroll down to Load & Motor, press OK, use the [▼] button to select 1-2, press OK, and finally use the [▼] button until parameter 1-23 is displayed. Parameter 1-23 can then be modified by pressing OK button and using [▲] and [▼] buttons. When the desired selection has been made, press the OK button.*

Should replacing the VFD become necessary, the replacement is not configured with all of Trane's operating parameters. The VFD must be programmed before attempting to operate the unit.

To verify and/or program a VFD, use the following steps:

1. At the unit, turn the 115 volt control circuit switch to the "Off" position.
2. Turn the 24 volt control circuit switch to the "Off' position.

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

**HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.**

3. To modify parameters:
   a. Press Main Menu button (press [Back] button if the main menu does not display)
   b. Use the [▲] and [▼] buttons to find the parameter menu group (first part of parameter number)
   c. Press [OK]
   d. Use the [▲] and [▼] buttons to select the correct parameter sub-group (first digit of second part of parameter number)
   e. Press [OK]
   f. Use the [▲] and [▼] buttons to select the specific parameter
   g. Press [OK]
   h. To move to a different digit within a parameter setting, use the [►◄] buttons (Highlighted area indicates digit selected for change)
   i. Use the [▲] and [▼] buttons to adjust the digit
   j. Press [Cancel] button to disregard change, or press [OK] to accept change and enter the new setting
4. Repeat step (3) for each menu selection setting in Table 60, p. 183.
5. To reset all programming parameters back to the factory defaults:
   a. Go to parameter 14-22 Operation Mode
   b. Press [OK]
   c. Select "Initialization"
   d. Press [OK]
   e. Cut off the mains supply and wait until the display turns off.
   f. Reconnect the mains supply - the frequency converter is now reset.

g. Ensure parameter 14-22 Operation Mode has reverted back to "Normal Operation".

***Notes:***

- *Item 5 resets the drive to the default factory settings. The program parameters listed in Table 60, p. 183 will need to be verified or changed as described in Item 3 and 4.*
- *Some of the parameters listed in the Table are motor specific. Due to various motors and efficiencies available, use only the values stamped on the specific motor nameplate. Do not use the Unit nameplate values.*
- *A backup copy of the current setup may be saved to the LCP before changing parameters or resetting the drive. See LCP Copy in the VFD Operating Instructions for details.*

6. Follow the startup procedures for supply fan in the "Variable Air Volume System" section or the "Exhaust Airflow Measurement" startup procedures for the exhaust fan.
7. After verifying that the VFD(s) are operating properly, press the STOP key at the Human Interface Module to stop the unit operation.
8. Follow the applicable steps in the "Final Unit Checkout" section to return the unit to its normal operating mode.

***Note:*** *If a problem with a VFD occurs, ensure that the programmed parameters listed for supply and exhaust VFD Table 60, p. 183 and Table 61, p. 188 have been set before replacing the drive.*

**Table 60. Supply and Exhaust VFD Programming Parameters**

| Menu | Parameter | Description | Setting | Description |
|---|---|---|---|---|
| Load & Motor | 1-21 | Motor Power | Set Based on Motor Nameplate | Set only for application using 3hp motors. Set to 2.2 kW/3 hp |
| | 1-22 | Motor Voltage | Set Based on Motor Nameplate | Set only for 380/415 50 Hz applications |
| | 1-24 | Motor Current | Set Based on Motor Nameplate | Sets the motor FLA |
| | 1-25 | Motor Speed | Set Based on Motor Nameplate | Sets the motor RPM |
| Limits & Warnings | 4-18 | Current Limit | Rated Current 100% | Limits the maximum current to motor |

**Notes:**
1. These parameters are motor specific and the actual motor nameplate rating must be used. Do not use the unit nameplate.

## Monthly Maintenance

Before completing the following checks, turn the unit OFF and lock the main power disconnect switch open.

**⚠WARNING**

### Hazardous Voltage w/Capacitors!

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

## Filters

Inspect the return air filters. Clean or replace them if necessary. Refer to Table 55, p. 177 and Table 56, p. 178 for filter information.

## Cooling Season

- [ ] Check the unit drain pans and condensate piping to ensure that there are no blockages.
- [ ] Inspect the evaporator and condenser coils for dirt, bent fins, etc. If the coils appear dirty, clean them according to the instructions described in "Coil Cleaning" later in this section.

**⚠WARNING**

### Rotating Components!

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

- [ ] Manually rotate the condenser fans to ensure free movement and check motor bearings for wear. Verify that all of the fan mounting hardware is tight.
- [ ] Inspect the F/A-R/A damper hinges and pins to ensure that all moving parts are securely mounted. Keep the blades clean as necessary.

- [ ] Verify that all damper linkages move freely; lubricate with white grease, if necessary.
- [ ] Check supply fan motor bearings; repair or replace the motor as necessary.
- [ ] Check the fan shaft bearings for wear. Replace the bearings as necessary.
- [ ] Lubricate the supply fan shaft bearings with a lithium based grease. Refer to Table 57, p. 179 for recommended greases.

***Note:*** *The bearings are manufactured using a special synthetic lithium based grease designed for long life and minimum lube intervals. Over lubrication can be just as harmful as not enough.*

Use a hand grease gun to lubricate these bearings; add grease until a light bead appears all around the seal. Do not over lubricate!

After greasing the bearings, check the setscrews to ensure that the shaft is held securely to the bearings and fan wheels. Make sure that all bearing supports are tight.

- [ ] Check the supply fan belt(s). If the belts are frayed or worn, replace them. Refer to the "Fan Belt Adjustment" section for belt replacement and adjustments.
- [ ] Check the condition of the gasket around the control panel doors. These gaskets must fit correctly and be in good condition to prevent water leakage.
- [ ] Verify that all wire terminal connections are tight.
- [ ] Remove any corrosion present on the exterior surfaces of the unit and repaint these areas.
- [ ] Generally inspect the unit for unusual conditions (e.g., loose access panels, leaking piping connections, etc.)
- [ ] Make sure that all retaining screws are reinstalled in the unit access panels once these checks are complete.
- [ ] With the unit running, check and record the:

  ambient temperature;

  compressor oil level (each circuit);

  compressor suction and discharge pressures (each circuit);

  superheat and subcooling (each circuit);

Record this data on an "operator's maintenance log" like the one shown in Table 63, p. 189. If the operating pressures indicate a refrigerant shortage, measure the system superheat and system subcooling. For guidelines, refer to "Charging by Subcooling".

***Note:*** *Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state and local laws.*

## Heating Season

Before completing the following checks, turn the unit OFF and lock the main power disconnect switch open.

**⚠WARNING**

### Hazardous Voltage w/Capacitors!

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

- Inspect the unit air filters. If necessary, clean or replace them.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Lubricate the supply fan shaft bearings with a lithium based grease. Refer to Table 57, p. 179 for recommended greases.

***Note:*** *The bearings are manufactured using a special synthetic lithium based grease designed for long life and minimum lube intervals. Too much lubrication in a bearing can be just as harmful as not enough.*

Use a hand grease gun to lubricate the bearings; add grease until a light bead appears all around the seal. Do not over lubricate!

After greasing the bearings, check the setscrews to ensure that the shaft is held securely. Make sure that all bearing braces are tight.

- [ ] Inspect both the main unit control panel and heat section control box for loose electrical components and terminal connections, as well as damaged wire insulation. Make any necessary repairs.
- [ ] Gas Heat Units only - Check the heat exchanger for any corrosion, cracks, or holes.
- [ ] Check the combustion air blower for dirt. Clean as necessary.

***Note:*** *Typically, it is not necessary to clean the gas furnace. However, if cleaning does become necessary, remove the burner inspection plate from the rear of the heat exchanger to access the drum. Be sure to replace the existing gaskets with new ones before reinstalling the inspection plate.*

- [ ] Open the main gas valve and apply power to the unit heating section; then initiate a "Heat" test using the startup procedure described in "Gas Furnace Startup".

**⚠WARNING**

**Hazardous Gases and Flammable Vapors!**

**Exposure to hazardous gases from fuel substances have been shown to cause cancer, birth defects or other reproductive harm. Improper installation, adjustment, alteration, service or use of this product could cause flammable mixtures or lead to excessive carbon monoxide. To avoid hazardous gases and flammable vapors follow proper installation and set up of this product and all warnings as provided in this manual. Failure to follow all instructions could result in death or serious injury.**

**⚠WARNING**

**Hazardous Pressures!**

**When using dry nitrogen cylinders for pressurizing units for leak testing, always provide a pressure regulator on the cylinder to prevent excessively high unit pressures. Never pressurize unit above the maximum recommended unit test pressure as specified in applicable unit literature. Failure to properly regulate pressure could result in a violent explosion, which could result in death or serious injury or equipment or property-only-damage.**

- [ ] Verify that the ignition system operates properly.

## Air-Cooled Coil Cleaning

Regular coil maintenance, including annual cleaning enhances the unit operating efficiency by minimizing:

- compressor head pressure and amperage draw;
- water carryover;
- fan brake horsepower; and,
- static pressure losses

At least once each year—or more often if the unit is located in a "dirty" environment—clean the evaporator and Microchannel Condenser Coil and Hot Gas Reheat Coil using the instructions outlined below. Follow these instructions as closely as possible to avoid damaging the coils.

**⚠WARNING**

**Hazardous Chemicals!**

**Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin occurs. Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices. Failure to follow all safety instructions could result in death or serious injury.**

### Refrigerant Coils

To clean refrigerant coils, use a soft brush and a sprayer.

***Important:*** *DO NOT use any detergents with microchannel condenser coils. Pressurized water or air ONLY.*

For evaporator and reheat coil cleaners, contact the local Trane Parts Center for appropriate detergents.

1. Remove enough panels from the unit to gain safe access to coils.

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal base. Walking on the base could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

***Important:*** *Bridging between the main supports required before attempting to enter into the unit. Bridging may consist of multiple 2 by 12 boards or sheet metal grating.*

2. Straighten any bent coil fins with a fin comb.
3. For accessible areas, remove loose dirt and debris from both sides of the coil. For dual row microchannel condenser coil applications, seek pressure coil wand extension through the local Trane Parts Center.
4. When cleaning evaporator and reheat coils, mix the detergent with water according to the manufacturer's instructions. If desired, heat the solution to 150° F maximum to improve its cleansing capability.

***Important:*** *DO NOT use any detergents with microchannel coils. Pressurized water or air ONLY.*

5. Pour the cleaning solution into the sprayer. If a high-pressure sprayer is used:
   a. The minimum nozzle spray angle is 15 degrees.
   b. Do not allow sprayer pressure to exceed 600 psi.

c. Spray the solution perpendicular (at 90 degrees) to the coil face.

d. For evaporator and reheat coils, maintain a minimum clearance of 6" between the sprayer nozzle and the coil. For microchannel condenser coils, optimum clearance between the sprayer nozzle and the microchannel coil is 1"-3".

6. Spray the leaving-airflow side of the coil first; then spray the opposite side of the coil. For evaporator and reheat coils, allow the cleaning solution to stand on the coil for five minutes.
7. Rinse both sides of the coil with cool, clean water.
8. Inspect both sides of the coil; if it still appears to be dirty, repeat Steps 6 and 7.
9. Reinstall all of the components and panels removed in Step 1; then restore power to the unit.
10. For evaporator and reheat coils, use a fin comb to straighten any coil fins which were inadvertently bent during the cleaning process.

## Steam or Hot Water Coils

To clean a steam or hot water coil, use a soft brush, a steam-cleaning machine, and water.

1. Verify that switches 1S1 and 1S70 are turned "OFF", and that the main unit disconnect is locked open.

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

2. Remove enough panels and components from the unit to gain sufficient access to the coil.
3. Straighten any bent coil fins with a fin comb. (Use the data in Table 58, p. 179 to determine the appropriate fin comb size.)
4. Remove loose dirt and debris from both sides of the coil with a soft brush.
5. Use the steam-cleaning machine to clean the leaving-air side of the coil first; start at the top of the coil and work downward; then clean the entering-air side of the coil, starting at the top of the coil and working downward.
6. Check both sides of the coil; if it still appears dirty, repeat Step 5.
7. Reinstall all of the components and panels removed in Step 2; then restore power to the unit.

## Evaporative Condenser Coil Cleaning

### Sump Water Management

#### *Water Supply*

Overall performance of any water- cooled device can be affected by suspended particulates, mineral concentration, trash and debris resulting in clogging and heat transfer loss. The unit is designed to greatly minimize problems with these impurities, however, float valves and solenoid valves are used to control the incoming water.

If the incoming water contains contaminants, sand or other objects, it is best to insert an incoming line strainer having a mesh of 80 to 100. The inlet line should be flushed prior to connection to the unit, whether or not there is a strainer.

There is an air gap between the water inlet float valve and sump water level to prevent back flow; however, if local code dictates, a backflow prevention valve may be required (field-provided and installed by a qualified technician).

#### *Water Drain*

Local Site Discharge: Rooftop or simple storm sewer discharge is generally acceptable. Do not routinely direct the sump discharge onto an area that will be adversely affected. For example, continued sump discharge into a flower bed where the input water contains $CaCO_3$ (lime) will eventually decrease the pH of the soil.

Sewer Discharge: The quantities of mineral and debris flushed are actually very small and do not cause problems when diluted in normal sewer flow. However, local, state or federal standards and restrictions must be followed in any given locality.

#### *Traditional Bleed Method*

ASHRAE recommendation for continuous bleed rates:

With good, quality makeup water, the bleed rates (0.8 - 2 GPH/ton) may be as low as one-half the evaporation rate (1.6 -2 GPH), and the total water consumption would range from 2.4 GPH/ton for air conditioning to 3 GPH/ton for refrigeration (Chapter 36.17 of ASHRAE's "Systems and Equipment Handbook")

#### *Operation and Care*

The sump should be inspected at least every 6 months for possible build up of scale pieces that has been shed from the coils. The sump flush frequency or bleed rate should be increased if large amounts of scale are present.

If the water has a "milky or cloudy" appearance, then minerals are concentrating in the sump and the number of flushes should be increased.

If the water remains clear between flushes, then the number of flushes can be decreased. Through field trials, the optimum flush frequency can be determined. Please note that in some areas, water quality can vary during different times of the year. The sump water clarity should be checked periodically.

The evaporative condenser has several design features to reduce the possibility of biological growth in the sump. These features include:

- air inlets constructed to eliminate direct sunlight in the sump
- The sump flush sequence replenishes the sump with fresh water 1 to 12 times per day depending on the flush setting
- The copper tubing in the coils is a natural biocide

***Important:*** *Do not use chlorine tablets directly on stainless steel surface as it can adversely affect its corrosion resistance.*

Always consult local codes for water treatment and waste water removal requirements. Consult a water treatment expert for water analysis and chemical treatment methods and recommendations for specific applications.

If deemed necessary after consultation with local water experts, there are various means of water treatment available which can be field installed.

## Microchannel Condenser Coil Repair and Replacement

If microchannel condenser coil repair or replacement is required, seek HVAC Knowledge Center information or Service Guide document RT-SVB83*-EN for further details.

Table 61. Evaporative Condenser Models—Maintenance and Troubleshooting

| Maintenance Schedule | | | |
|---|---|---|---|
| **Component** | **Action** | **Frequency** | **Comments** |
| Fan Motor | None Required | | Non-grease bearings |
| Sump Pump | Inspect / Clean | 1 – 2 times per year | Clean inlet openings to pump |
| Sump | Inspect / Clean | 1 – 2 times per year depending on water hardness and unit run time | Sump can be drained and hosed out using hose bib provided at water fill solenoid valve. Vacuuming scale out is an alternate method |
| Sump Float Switch | Inspect | 1 – 2 times per year | Float should be free for full float travel |
| Sump Float Make Up Valve | Inspect for proper water level | 1 – 2 times per year | |
| Spray Nozzles | Inspect / Clean | 1 – 2 times per year | Inspection through access panel |
| Conductivity Sensor | Inspect / Clean | 1 – 2 times per year | Clean sensor to ensure accurate readings |
| Conductivity Controller | Inspect / Recalibrate | 1 – 2 times per year | Recalibrate controller |
| **Troubleshooting** | | | |
| **Component** | **Problem** | **Check** | **Fix** |
| Fan Motor | Does not run | Condenser Fan Relay closure and control voltage indicating a call from compressor control panel for the condenser fan to operate. Sump Pump Overload Trip. Fan Motor Overload Trip. Fan fuse trip. | Check each motor overload and reset if necessary. Check amp draw for each leg. |
| Sump Pump | Does not run | Sump Pump Overload Trip Low Water Level or faulty float switch. Unit in 'Dry Mode' Operation | Reset – check amps on each leg to determine if faulty motor. Check and clean debris around float switch. Check Ambient thermostat setting and mode of operation (close on rise). See section 2 for T'stat setup instructions. |
| Sump Pump | Low Flow | Pump may be operating backwards or impeller inlet may be slightly blocked. | Change pumping direction by changing any two legs to the pump motor. Disconnect Power and remove pump to inspect for possible impeller obstruction. |
| Spray Nozzle | Dry area on coil | Check for proper spray pattern over each quadrant. | Remove debris from clogged nozzle. |

# Final Process

Record the unit data in the blanks provided.

Table 62. Unit Data Log

| | |
|---|---|
| **Complete Unit Model Number:** | |
| **Unit Serial Number:** | |
| **Unit "DL" Number ("design special" units only):** | |
| **Wiring Diagram Numbers (from unit control panel):**<br>**-schematic(s)** | |
| | |
| | |
| **-connections** | |
| | |
| | |
| | |
| **Network ID (LCI/BCI):** | |

Table 63. Sample maintenance log

| Date | Current Ambient Temp F/C | Refrigerant Circuit #1 Compr. Oil Level | Refrigerant Circuit #1 Suct. Press. Psig/kPa | Refrigerant Circuit #1 Disch. Press Psig/kPa | Refrigerant Circuit #1 Liquid Press Psig/kPa | Refrigerant Circuit #1 Super-heat F/C | Refrigerant Circuit #1 Sub-cool F/C | Refrigerant Circuit #2 Compr. Oil Level | Refrigerant Circuit #2 Suct. Press. Psig/kPa | Refrigerant Circuit #2 Disch. Press Psig/kPa | Refrigerant Circuit #2 Liquid Press Psig/kPa | Refrigerant Circuit #2 Super-heat F/C | Refrigerant Circuit #2 Sub-cool F/C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | - ok<br>- low | | | | | | - ok<br>- low | | | | | |
| | | - ok<br>- low | | | | | | - ok<br>- low | | | | | |
| | | - ok<br>- low | | | | | | - ok<br>- low | | | | | |
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| | | - ok<br>- low | | | | | | - ok<br>- low | | | | | |
| | | - ok<br>- low | | | | | | - ok<br>- low | | | | | |

# Unit Wiring Diagram Number

***Note:*** *Wiring diagrams can be accessed via e-Library by entering the diagram number in the literature order number search field or by calling technical support.*

**Table 64. Wiring diagram matrix**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| **VAV / SZ VAV** | | | | |
| **Power** | | | | |
| 1-Piece | 2313-0820 | | 90-150T | Schematic, Power - w/Supply VFD |
| | 2313-0821 | | 90-150T | Schematic, Power - w/Exhaust/Return VFD |
| | 2313-0822 | | 90-150T | Schematic, Power - w/Sup & Exh/Rtn VFD |
| | 2313-0832 | | 90T, 105T | Schematic, Power - w/Supply VFD w/Low Ambient |
| | 2313-0833 | | 90T, 105T | Schematic, Power - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0834 | | 90T, 105T | Schematic, Power - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0844 | | 120T,130T,150T | Schematic, Power - w/Supply VFD w/Low Ambient |
| | 2313-0845 | | 120T,130T,150T | Schematic, Power - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0846 | | 120T,130T,150T | Schematic, Power - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0848 | | 120T,130T,150T | Schematic, Power 2-Pc - w/Supply VFD w/Low Ambient |
| | 2313-0864 | | Air Handler | Schematic, Power - w/Supply VFD Air Handler |
| | 2313-0865 | | Air Handler | Schematic, Power - w/Exhaust/Return VFD Air Handler |
| | 2313-0866 | | Air Handler | Schematic, Power - w/Sup & Exh/Rtn VFD Air Handler |
| | | | | |
| **Multi-Piece** | 2313-0824 | | 90-150T | Schematic, Power - w/Supply VFD 2-Pc |
| | 2313-0825 | | 90-150T | Schematic, Power - w/Exhaust/Return VFD 2-Pc |
| | 2313-0826 | | 90-150T | Schematic, Power - w/Sup & Exh/Rtn VFD 2-Pc |
| | 2313-0828 | | 90-150T | Schematic, Power 3-Pc - w/Supply VFD |
| | 2313-0829 | | 90-150T | Schematic, Power 3-Pc - w/Exhaust/Return VFD |
| | 2313-0830 | | 90-150T | Schematic, Power 3-Pc - w/Sup & Exh/Rtn VFD |
| | 2313-0836 | | 90T, 105T | Schematic, Power 2-Pc - w/Supply VFD w/Low Ambient |
| | 2313-0837 | | 90T, 105T | Schematic, Power 2-Pc - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0838 | | 90T, 105T | Schematic, Power 2-Pc - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0840 | | 90T, 105T | Schematic, Power 3-Pc - w/Supply VFD w/Low Ambient |
| | 2313-0841 | | 90T, 105T | Schematic, Power 3-Pc - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0842 | | 90T, 105T | Schematic, Power 3-Pc - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0849 | | 120T,130T,150T | Schematic, Power 2-Pc - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0850 | | 120T,130T,150T | Schematic, Power 2-Pc - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0852 | | 120T,130T,150T | Schematic, Power 3-Pc - w/Supply VFD w/Low Ambient |
| | 2313-0853 | | 120T,130T,150T | Schematic, Power 3-Pc - w/Exhaust/Return VFD w/Low Ambient |
| | 2313-0854 | | 120T,130T,150T | Schematic, Power 3-Pc - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | | 2313-0856 | 100-162T | Schematic, Power 2-Pc - w/Supply VFD |
| | | 2313-0857 | 100-162T | Schematic, Power 2-Pc - w/Exhaust/Return VFD |
| | | 2313-0858 | 100-162T | Schematic, Power 2-Pc - w/Sup & Exh/Rtn VFD |
| | | 2313-0860 | 100-162T | Schematic, Power 3-Pc - w/Supply VFD |
| | | 2313-0861 | 100-162T | Schematic, Power 3-Pc - w/Exhaust/Return VFD |
| | | 2313-0862 | 100-162T | Schematic, Power 3-Pc - w/Sup & Exh/Rtn VFD |
| | | | | |
| **Controls** | | | | |
| 1-Piece | 2309-3652 | | All Tonnages + Air Handler | Notes and Specs |
| | 2309-3901 | | All Tonnages + Air Handler | Schematic/Connection Sup VFD w/o Bypass |

**Table 64. Wiring diagram matrix (continued)**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| | 2309-3902 | | All Tonnages + Air Handler | Schematic/Connection Sup VFD w/Bypass |
| | 2309-3905 | | All Tonnages + Air Handler | Schematic/Connection Exh/Rtn VFD w/o Bypass |
| | 2309-3906 | | All Tonnages + Air Handler | Schematic/Connection Exh/Rtn VFD w/Bypass |
| | 2313-0818 | | All Tonnages + Air Handler | Field Connection VAV |
| | 2313-0869 | | 90-150T | Connection, Control Box - w/Supply VFD |
| | 2313-0870 | | 90-150T | Connection, Control Box - w/Exh/Rtn VFD |
| | 2313-0871 | | 90-150T | Connection, Control Box - w/Sup & Exh/Rtn VFD |
| | 2313-0873 | | 90-150T | Connection, Control Box - w/Supply VFD 2/3-Pc |
| | 2313-0874 | | 90-150T | Connection, Control Box - w/Exh/Rtn VFD 2/3-Pc |
| | 2313-0875 | | 90-150T | Connection, Control Box - w/Sup & Exh/Rtn VFD 2/3-Pc |
| | 2313-0877 | | 90-105T | Connection, Control Box - w/Supply VFD w/Low Ambient |
| | 2313-0878 | | 90-105T | Connection, Control Box - w/Exh/Rtn VFD w/Low Ambient |
| | 2313-0879 | | 90-105T | Connection, Control Box - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0881 | | 90-105T | Connection, Control Box - w/Supply VFD w/Low Ambient 2/3-Pc |
| | 2313-0882 | | 90-105T | Connection, Control Box - w/Exh/Rtn VFD w/Low Ambient 2/3-Pc |
| | 2313-0883 | | 90-105T | Connection, Control Box - w/Sup & Exh/Rtn VFD w/Low Ambient 2/3-Pc |
| | 2313-0885 | | 120-150T | Connection, Control Box - w/Supply VFD w/Low Ambient |
| | 2313-0886 | | 120-150T | Connection, Control Box - w/Exh/Rtn VFD w/Low Ambient |
| | 2313-0887 | | 120-150T | Connection, Control Box - w/Sup & Exh/Rtn VFD w/Low Ambient |
| | 2313-0897 | | Air Handler | Connection, Control Box - w/Supply VFD Air Handler |
| | 2313-0898 | | Air Handler | Connection, Control Box - w/Exh/Rtn VFD Air Handler |
| | 2313-0899 | | Air Handler | Connection, Control Box - w/Sup & Exh/Rtn VFD Air Handler |
| | 2313-0902 | | 90-150T & Air Handler | Connection, Common Control Modules - w/Return VFD |
| | | 2313-0903 | 100-162T | Connection, Common Control Modules - w/Return VFD |
| | 2309-3787 | | 90-150T | Connection, Raceway Devices - Condenser Zone (Air Cooled) |
| | | 2313-0816 | 100-162T | Connection, Raceway Devices - Condenser Zone (Evap Cooled) |
| | 2309-3789 | | Air Handler | Connection, Raceway Devices - Condenser Zone (Air Handler) |
| | 2309-3741 | | Air Handler | Connection, Raceway Devices - Air Handler w/Supply VFD |
| | 2309-3742 | | Air Handler | Connection, Raceway Devices - Air Handler w/Exh/Rtn VFD |
| | 2309-3743 | | Air Handler | Connection, Raceway Devices - Air Handler w/Sup & Exh/Rtn VFD |
| | 2309-3757 | | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Supply VFD |
| | 2309-3758 | | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Exh/Rtn VFD |
| | 2309-3759 | | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Sup & Exh/Rtn VFD |
| | | | | |
| **Multi-Piece** | 2309-3652 | | All Tonnages + Air Handler | Notes and Specs |
| | 2309-3903 | | All Tonnages | Schematic/Connection Sup VFD w/o Bypass 2/3-Pc |
| | 2309-3904 | | All Tonnages | Schematic/Connection Sup VFD w/Bypass 2/3-Pc |
| | 2309-3907 | | All Tonnages | Schematic/Connection Exh/Rtn VFD w/o Bypass 2-Pc |
| | 2309-3908 | | All Tonnages | Schematic/Connection Exh/Rtn VFD w/Bypass 2-Pc |
| | 2309-3909 | | All Tonnages | Schematic/Connection Exh/Rtn VFD w/o Bypass 3-Pc |
| | 2309-3910 | | All Tonnages | Schematic/Connection Exh/Rtn VFD w/Bypass 3-Pc |
| | 2313-0818 | | All Tonnages + Air Handler | Field Connection VAV |
| | 2313-0889 | | 120-150T | Connection, Control Box - w/Supply VFD w/Low Ambient 2/3-Pc |
| | 2313-0890 | | 120-150T | Connection, Control Box - w/Exh/Rtn VFD w/Low Ambient 2/3-Pc |
| | 2313-0891 | | 120-150T | Connection, Control Box - w/Sup & Exh/Rtn VFD w/Low Ambient 2/3-Pc |

**Table 64. Wiring diagram matrix (continued)**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| | 2313-0900 | | 90-150T & AH | Connection, Common Control Modules - w/o Return VFD |
| | | 2313-0901 | 100-162T | Connection, Common Control Modules - w/o Return VFD |
| | 2309-3787 | | 90-150T | Connection, Raceway Devices - Condenser Zone (Air Cooled) |
| | | 2313-0816 | 100-162T | Connection, Raceway Devices - Condenser Zone (Evap Cooled) |
| | 2309-3789 | | Air Handler | Connection, Raceway Devices - Condenser Zone (Air Handler) |
| | | 2313-0893 | 100-162T | Connection, Control Box - w/Supply VFD 2/3-Pc |
| | | 2313-0894 | 100-162T | Connection, Control Box - w/Exh/Rtn VFD 2/3-Pc |
| | | 2313-0895 | 100-162T | Connection, Control Box - w/Sup & Exh/Rtn VFD 2/3-Pc |
| | 2313-0900 | | 90-150T & Air Handler | Connection, Common Control Modules - w/o Return VFD |
| | 2313-0902 | | 90-150T & Air Handler | Connection, Common Control Modules - w/Return VFD |
| | 2309-3787 | | 90-150T | Connection, Raceway Devices - Condenser Zone (Air Cooled) |
| | | 2313-0816 | 100-162T | Connection, Raceway Devices - Condenser Zone (Evap Cooled) |
| | 2309-3789 | | Air Handler | Connection, Raceway Devices - Condenser Zone (Air Handler) |
| | | 2309-3725 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Supply VFD 3-Pc |
| | | 2309-3726 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Exh/Rtn VFD 3-Pc |
| | | 2309-3727 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Sup & Exh/Rtn VFD 3-Pc |
| | 2309-3741 | | Air Handler | Connection, Raceway Devices - Air Handler w/Supply VFD |
| | 2309-3742 | | Air Handler | Connection, Raceway Devices - Air Handler w/Exh/Rtn VFD |
| | 2309-3743 | | Air Handler | Connection, Raceway Devices - Air Handler w/Sup & Exh/Rtn VFD |
| | | 2309-3761 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Supply VFD 2-Pc |
| | | 2309-3762 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Exh/Rtn VFD 2-Pc |
| | | 2309-3763 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Sup & Exh/Rtn VFD 2-Pc |
| | | | | |
| **Option Modules** | | | | |
| **1-Piece** | 2313-0314 | | All Tonnages + Air Handler | Schematic, Controls - RTM w/Supply VFD |
| | 2309-3627 | | All Tonnages + Air Handler | Schematic, Controls - RTM w/Exh/Rtn VFD |
| | 2309-3628 | | All Tonnages + Air Handler | Schematic, Controls - RTM w/Sup & Exh/Rtn VFD |
| | 2309-3633 | | 90-150T | Schematic, Controls - MCM |
| | 2313-0102 | | All Tonnages + Air Handler | Schematic, Controls - HEAT - Elec/ Hydronic Heat |
| | 2309-3638 | | All Tonnages + Air Handler | Schematic, Controls - HEAT - 2-stg / Modulating Gas Heat |
| | 2309-3685 | | All Tonnages + Air Handler | Schematic, Controls - Cooling Only |
| | 2309-3645 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/o Exh or Rtn VFD |
| | 2309-3646 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/Return VFD |
| | 2309-3647 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/Exhaust VFD |
| | 2309-3648 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc, w/o Exh or Rtn VFD |
| | 2313-0867 | | All Tonnages + Air Handler | Schematic, VOM, LCI, IPCB, GBAS 0-5V,GBAS 0-10V, BCI, WCI |
| | | | | |
| **Multi-Piece** | 2313-0316 | | All Tonnages | Schematic, Controls - RTM 2-Pc w/Supply VFD |
| | 2309-3631 | | All Tonnages | Schematic, Controls - RTM 2-Pc w/Exh/Rtn VFD |
| | 2309-3632 | | All Tonnages | Schematic, Controls - RTM 2-Pc w/Sup & Exh/Rtn VFD |
| | 2313-0318 | | All Tonnages | Schematic, Controls - RTM 3-Pc w/Supply VFD |
| | 2309-3770 | | All Tonnages | Schematic, Controls - RTM 3-Pc w/Exh/Rtn VFD |
| | 2309-3771 | | All Tonnages | Schematic, Controls - RTM 3-Pc w/Sup & Exh/Rtn VFD |
| | 2309-3635 | | 90-150T | Schematic, Controls - MCM 2/3-Pc |

**Table 64. Wiring diagram matrix (continued)**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| | | 2313-0809 | 100-162T | Schematic, Controls - MCM 2/3-Pc |
| | 2309-3641 | | All Tonnages | Schematic, Controls - HEAT - Elec/ Hydronic Heat 2/3-Pc |
| | 2309-3642 | | All Tonnages | Schematic, Controls - HEAT - 2-stg / Modulating Gas Heat 2/3-Pc |
| | 2309-3645 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/o Exh or Rtn VFD |
| | 2309-3648 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc, w/o Exh or Rtn VFD |
| | 2309-3649 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc w/Return VFD |
| | 2309-3650 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc w/Exhaust VFD |
| | 2309-3772 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 3-Pc, w/o Exh or Rtn VFD |
| | 2309-3773 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 3-Pc w/Return VFD |
| | 2309-3774 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 3-Pc w/Exhaust VFD |
| | 2313-0867 | | All Tonnages + Air Handler | Schematic, VOM, LCI, IPCB, GBAS 0-5V,GBAS 0-10V, BCI, WCI |
| **CV** | | | | |
| **Power** | | | | |
| **1-Piece** | 2313-0819 | | 90-150T | Schematic, Power - Standard |
| | 2313-0831 | | 90T, 105T | Schematic, Power - Standard w/Low Ambient |
| | 2313-0843 | | 120T,130T,150T | Schematic, Power - Standard w/Low Ambient |
| | 2313-0855 | | 100-162T | Evap Cooled Schematic, Power 2-Pc - Standard |
| | 2313-0863 | | Air Handler | Schematic, Power - Standard Air Handler |
| | | | | |
| **Multi-Piece** | 2313-0823 | | 90-150T | Schematic, Power - Standard 2-Pc |
| | 2313-0827 | | 90-150T | Schematic, Power 3-Pc - Standard |
| | 2313-0835 | | 90T, 105T | Schematic, Power 2-Pc - Standard w/Low Ambient |
| | 2313-0839 | | 90T, 105T | Schematic, Power 3-Pc - Standard w/Low Ambient |
| | 2313-0847 | | 120T,130T,150T | Schematic, Power 2-Pc - Standard w/Low Ambient |
| | 2313-0851 | | 120T,130T,150T | Schematic, Power 3-Pc - Standard w/Low Ambient |
| | | 2313-0859 | 100-162T | Schematic, Power 3-Pc - Standard |
| | | | | |
| **Controls** | | | | |
| **1-Piece** | 2309-3652 | | All Tonnages + Air Handler | Notes and Specs |
| | 2313-0817 | | All Tonnages + Air Handler | Field Connection CV |
| | 2313-0868 | | 90-150T | Connection, Control Box - Standard |
| | 2313-0876 | | 90-105T | Connection, Control Box - Standard w/Low Ambient |
| | 2313-0884 | | 120-150T | Connection, Control Box - Standard w/Low Ambient |
| | 2313-0896 | | Air Handler | Connection, Control Box - Standard Air Handler |
| | 2313-0900 | | 90-150T & Air Handler | Connection, Common Control Modules - w/o Return VFD |
| | | 2313-0901 | 100-162T | Connection, Common Control Modules - w/o Return VFD |
| | 2309-3787 | | 90-150T | Connection, Raceway Devices - Condenser Zone (Air Cooled) |
| | | 2313-0816 | 100-162T | Connection, Raceway Devices - Condenser Zone (Evap Cooled) |
| | 2309-3789 | | Air Handler | Connection, Raceway Devices - Condenser Zone (Air Handler) |
| | 2309-3740 | | Air Handler | Connection, Raceway Devices - Air Handler Standard |
| | | | | |
| **Multi-Piece** | | 2309-3756 | 90-162 Ton | Connection, Raceway Devices - Standard Evap Module |
| | 2309-3685 | | All Tonnages + Air Handler | Schematic, Controls - Cooling Only |
| | 2309-3652 | | All Tonnages + Air Handler | Notes and Specs |
| | 2313-0900 | | 90-150T & Air Handler | Connection, Common Control Modules - w/o Return VFD |
| | 2313-0817 | | All Tonnages + Air Handler | Field Connection CV |

**Table 64. Wiring diagram matrix (continued)**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| | 2313-0872 | | 90-150T | Connection, Control Box - Standard 2/3-Pc |
| | 2313-0880 | | 90-105T | Connection, Control Box - Standard w/Low Ambient 2/3-Pc |
| | 2313-0888 | | 120-150T | Connection, Control Box - Standard w/Low Ambient 2/3-Pc |
| | | 2313-0892 | 100-162T | Connection, Control Box - Standard 2/3-Pc |
| | 2313-0900 | | 90-150T & AH | Connection, Common Control Modules - w/o Return VFD |
| | | 2313-0901 | 100-162T | Connection, Common Control Modules - w/o Return VFD |
| | 2309-3787 | | 90-150T | Connection, Raceway Devices - Condenser Zone (Air Cooled) |
| | | 2313-0816 | 100-162T | Connection, Raceway Devices - Condenser Zone (Evap Cooled) |
| | 2309-3789 | | Air Handler | Connection, Raceway Devices - Condenser Zone (Air Handler) |
| | | 2309-3724 | 90-162 Ton | Connection, Raceway Devices - Evap Module Standard 3-Pc |
| | | 2309-3725 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Supply VFD 3-Pc |
| | | 2309-3726 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Exh/Rtn VFD 3-Pc |
| | | 2309-3727 | 90-162 Ton | Connection, Raceway Devices - Evap Module w/Sup & Exh/Rtn VFD 3-Pc |
| | | 2309-3760 | 90-162 Ton | Connection, Raceway Devices - Evap Module Standard 2-Pc |
| | | | | |
| **Option Modules** | | | | |
| **1-Piece** | 2313-0313 | | All Tonnages + Air Handler | Schematic, Controls - RTM Std |
| | 2309-3633 | | 90-150T | Schematic, Controls - MCM |
| | 2313-0102 | | All Tonnages + Air Handler | Schematic, Controls - HEAT - Elec/ Hydronic Heat |
| | 2309-3638 | | All Tonnages + Air Handler | Schematic, Controls - HEAT - 2-stg / Modulating Gas Heat |
| | 2309-3685 | | All Tonnages + Air Handler | Schematic, Controls - Cooling Only |
| | 2309-3645 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/o Exh or Rtn VFD |
| | 2309-3648 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc, w/o Exh or Rtn VFD |
| | 2309-3772 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 3-Pc, w/o Exh or Rtn VFD |
| | 2313-0867 | | All Tonnages + Air Handler | Schematic, VOM, LCI, IPCB, GBAS 0-5V,GBAS 0-10V, BCI, WCI |
| | | | | |
| **Multi-Piece** | 2313-0315 | | All Tonnages | Schematic, Controls - RTM 2-Pc Std |
| | 2313-0317 | | All Tonnages | Schematic, Controls - RTM 3-Pc Std |
| | 2309-3635 | | 90-150T | Schematic, Controls - MCM 2/3-Pc |
| | | 2313-0809 | 100-162T | Schematic, Controls - MCM 2/3-Pc |
| | 2309-3641 | | All Tonnages | Schematic, Controls - HEAT - Elec/ Hydronic Heat 2/3-Pc |
| | 2309-3642 | | All Tonnages | Schematic, Controls - HEAT - 2-stg / Modulating Gas Heat 2/3-Pc |
| | 2309-3645 | | All Tonnages + Air Handler | Schematic, LHI, ECEM, VCM, MPM w/o Exh or Rtn VFD |
| | 2309-3648 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 2-Pc, w/o Exh or Rtn VFD |
| | 2309-3772 | | All Tonnages | Schematic, LHI, ECEM, VCM, MPM 3-Pc, w/o Exh or Rtn VFD |
| | 2313-0867 | | All Tonnages + Air Handler | Schematic, VOM, LCI, IPCB, GBAS 0-5V,GBAS 0-10V, BCI, WCI |
| **Heat** | | | | |
| **Electric** | 2313-0912 | | All Tonnages + Air Handler | Schematic Electric Heat 90kw (SCCR) |
| | 2313-0913 | | All Tonnages + Air Handler | Schematic Electric Heat 140kw (SCCR) |
| | 2313-0914 | | All Tonnages + Air Handler | Schematic Electric Heat 265kw (SCCR) |
| | 2313-0915 | | All Tonnages + Air Handler | Schematic Electric Heat 300kw (SCCR) |
| | 2313-0916 | | All Tonnages | Schematic Electric Heat 90kw 2/3-Pc (SCCR) |
| | 2313-0917 | | All Tonnages | Schematic Electric Heat 140kw 2/3-Pc (SCCR) |
| | 2313-0918 | | All Tonnages | Schematic Electric Heat 265kw 2/3-Pc (SCCR) |
| | 2313-0919 | | All Tonnages | Schematic Electric Heat 300kw 2/3-Pc (SCCR) |

**Table 64. Wiring diagram matrix (continued)**

| | Air Cooled | Water Cooled | Tonnnage | Description |
|---|---|---|---|---|
| | 2313-0920 | | All Tonnages + Air Handler | Connection Electric Heat 90kw (SCCR) |
| | 2313-0921 | | All Tonnages + Air Handler | Connection Electric Heat 140kw (SCCR) |
| | 2313-0922 | | All Tonnages + Air Handler | Connection Electric Heat 265kw (SCCR) |
| | 2313-0923 | | All Tonnages + Air Handler | Connection Electric Heat 300kw (SCCR) |
| | 2313-0924 | | All Tonnages | Connection Electric Heat 90kw 2/3-Pc (SCCR) |
| | 2313-0925 | | All Tonnages | Connection Electric Heat 140kw 2/3-Pc (SCCR) |
| | 2313-0926 | | All Tonnages | Connection Electric Heat 265kw 2/3-Pc (SCCR) |
| | 2313-0927 | | All Tonnages | Connection Electric Heat 300kw 2/3-Pc (SCCR) |
| | | | | |
| **Gas** | 2309-3669 | | 90-118T LOW-MED, 120-162T LOW | Schematic/Connection - 2-Stage Natural Gas Heat <1800 mbh |
| | 2309-3670 | | 90-118T HIGH, 120-162T MED-HIGH | Schematic/Connection 2-Stage Natural Gas Heat 1800/2500mbh |
| | 2309-3671 | | All Tonnages + Air Handler | Schematic/Connection Modulating Natural Gas Heat 1800/2500 MBH |
| | 2309-3672 | | "90-118T LOW-MED, 120-162T LOW | "Schematic/Connection - 2-Stage Natural Gas Heat <1800 mbh 2/3-Pc |
| | 2309-3673 | | 90-118T HIGH, 120-162T MED-HIGH | Schematic/Connection 2-Stage Natural Gas Heat 1800/2500mbh 2/3-Pc |
| | 2309-3674 | | All Tonnages | Schematic/Connection Modulating Natural Gas Heat1800/2500MBH 2/3-Pc |
| | 2309-3730 | | 90-118T LOW-MED, 120-162T LOW | Schematic/Connection Modulating Natural Gas Heat 850/1100 MBH |
| | 2309-3731 | | 90-118T LOW-MED, 120-162T LOW | Schematic/Connection Modulating Natural Gas Heat 850/1100MBH 2/3-Pc |

# Warranty and Liability Clause

## Commercial Equipment

## Rated 20 Tons and Larger and Related Accessories

PRODUCTS COVERED - This warranty* is extended by Trane Inc. and applies only to commercial equipment rated 20 Tons and larger and related accessories.

The Company warrants for a period of 12 months from initial startup or 18 months from date of shipment, whichever is less, that the Company products covered by this order (1) are free from defects in material and workmanship and (2) have the capacities and ratings set forth in the Company's catalogs and bulletins, provided that no warranty is made against corrosion, erosion or deterioration. The Company's obligations and liabilities under this warranty are limited to furnishing f.o.b. factory or warehouse at Company designated shipping point, freight allowed to Buyer's city (or port of export for shipment outside the conterminous United States) replacement equipment (or at the option of the Company parts therefore) for all Company products not conforming to this warranty and which have been returned to the manufacturer. The Company shall not be obligated to pay for the cost of lost refrigerant. No liability whatever shall attach to the Company until said products have been paid for and then said liability shall be limited to the purchase price of the equipment shown to be defective.

The Company makes certain further warranty protection available on an optional extra-cost basis. Any further warranty must be in writing, signed by an officer of the Company.

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Manager - Product Service

Trane

Clarksville, Tn 37040-1008

PW-215-2688

*A 10 year limited warranty is provided on optional Full Modulation Gas Heat Exchanger.

*Optional Extended Warranties are available for compressors and heat exchangers of Combination Gas-Electric Air Conditioning Units.

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