Installation, Operation, and Maintenance

IntelliPak™ 3 with Symbio™ 800

Commercial Rooftop Air Conditioners

“A” and later design sequence
RA *20, *25, *30, *40, *50, *55, *60, *70, *75



⚠ 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.

October 2026

RT-SVX080D-EN

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠ 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 accidents.

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.

Important 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 according to local rules. For the USA, 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!

Failure to follow code could result in death or serious injury.

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/national electrical codes.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/ sleeves, butyl gloves, safety glasses, hard hat/ bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

©2026 Trane

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

⚠ WARNING

R-454B Flammable A2L Refrigerant!

Failure to use proper equipment or components as described below could result in equipment failure, and possibly fire, which could result in death, serious injury, or equipment damage.

The equipment described in this manual uses R-454B refrigerant which is flammable (A2L). Use ONLY R-454B rated service equipment and components. For specific handling concerns with R-454B, contact your local representative.

⚠ WARNING

Cancer and Reproductive Harm!

This product can expose you to chemicals including lead and bisphenol A (BPA), which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Copyright

This document and the information in it are the property of Trane, and may not be used or reproduced in whole or in part without written permission. Trane reserves the right to revise this publication at any time, and to make changes to its content without obligation to notify any person of such revision or change.

Trademarks

All trademarks referenced in this document are the trademarks of their respective owners.

Factory Training

Factory training is available through Trane University™ to help you learn more about the operation and maintenance of your equipment. To learn about available training opportunities, contact Trane University™.

Online: www.trane.com/traneuniversity

Email: traneuniversity@trane.com

Revision History

Updated A2L chapter.

Table of Contents

Model Number Description 8

General Information 10
- Unit Nameplate 10
- Compressor Nameplate 10
- Gas Heat Nameplate 10
- Unit Description 10

Pre-Installation 11
- Unit Inspection 11
  - Exterior Inspection 11
  - Inspection for Concealed Damage 11
  - Repair 11
- Storage 11
- Unit Clearances 11
- Factory Warranty Information 11
  - All Unit Installations 11
  - Additional Requirements for Units Requiring Disassembly 12

Dimensional Data 13
- Roof Curb 19
- Horizontal Right Supply 24
- Electrical Entry Details 25
- Access Clearances 26

A2L Information and Installation Requirements 28
- Installation/Code Compliance Requirements 28
- A2L Work Procedures 28
  - Servicing 28
  - Leak Detection 29
  - Refrigerant Removal and Evacuation 29
  - Refrigerant Charging 30
  - Decommissioning 30
- A2L Application Considerations 30
  - Ignition Sources in Ductwork 31
  - Ignition Sources in Unit 31
  - Minimum Room Area Limits (Refrigerant charge greater than 3.91 lb per circuit) 31
  - Leak Detection System (Refrigerant charge greater than 3.91 lb per circuit) 32

Installation 33
- Roof Curb and Ductwork 33
- Unit Rigging and Placement 33
- General Installation Requirements 35
  - Setting the Unit 35
  - Main Electrical Power 35
  - Field Installed Control Wiring 35
  - Electric Heat 35
  - Units with 200V or 230V Electric Heat 35
  - Gas Heat 35
  - O/A Pressure Sensor and Tubing Installation 35
  - Voltage Supply 36
- Electrical Data 36
  - Electrical Service Sizing 36
- Main Unit Power Wiring 41
- Supply Fans 43
  - Remove Shipping Tie Down 43
  - O/A Sensor and Tubing Installation 44
- Refrigeration System 45
  - Condensate Drain Connections 45
  - Compressor Crankcase Heaters 46
- Gas Heat Units 46
  - Connecting the Gas Supply Line to the Furnace Gas Train 48
  - Flue Assembly and Rain Shield Installation 52
  - Gas Furnace Condensate Drain 53
- Electric Heat Units 53
- Economizer and Relief Air Damper Adjustment 53
  - Relief Air Dampers 53
  - Outside Air and Return Air Damper Operation 53
  - Adjust the Outside Air Damper Travel 53
- Horizontal Right Supply 60

Startup the Unit 61

Electrical Phasing 61
Verifying Proper Fan Operation 61
Direct-Drive Supply Fan Speed Adjustment 63
System Airflow Measurements 63
VAV and CV Systems with DDP Supply Fan and Motorized Impeller Relief Fan (optional) 63
Traq™ Sensor Airflow Measurement 64
Gas Furnace Startup 64
Staged, Modulating, and Ultra Modulating 64
High-Fire Adjustment 64
Low-Fire Adjustment (250 and 350 MBH Two Staged only) 65
Final Unit Checkout 66
Trane Start-up Checklist 67
Critical Control Parameters and Dry Bulb Changeover Map 68
External Capacity Control 70
Features Not Supported with External Capacity Control. 70
Sequence of Operation (Cooling Example) 70
Sequence of Operation 72
Stop/Off/Auto 72
Power-Up Start Delay 72
Normal Unit Starting 72
Rapid Restart Operation 72
Occupancy 72
Occupancy Status Definitions 72
Timed Override 73
Service Pin Message Request 73
Sensors 73
Heat Cool Mode Status 73
Operating Modes 74
Unit 75
Circuit 75
Unit Sub-Modes 75
Morning Warm Up 75
Pre Cool 76
Night Purge 76
Daytime Warm Up. 76
Idle 76
Supply Fan Control 76
Supply Fan Speed Control 76
Supply Fan Proving Operation and Method 77
Single Fan Operation 77
Supply Fan VFD Bypass Control 77
Entering VFD Bypass Control 77
Exiting Supply Fan VFD Bypass Mode 77
Supply Fan Proving with VFD Bypass 77
Operation during Manual Override and VOM (Emergency Override) Modes 78
Minimum Ventilation Control. 78
Outdoor Air Flow Control (Traq) 78
Outdoor Air Flow Compensation 78
Outdoor Air Minimum Position Control 78
Demand Control Ventilation (DCV) 78
Relief Fan and Space Static Pressure Control 79
Space Static Pressure Control with Statitrac™ 80
Space Static Pressure Control without Statitrac™ 80
Discharge Air Temperature Control. 80
Multi Zone-VAV and Constant Volume - Discharge Temperature Units. 80
Supply Air Tempering 80
Changeover Input 80
VAV Box Relay Output 80
Discharge Air Reset 81
Duct Static Pressure Control. 81
Duct Static Pressure High Limit 81
Space Temperature Control 81
Auto Changeover 81
Space Temperature Control Units 82
Single Zone VAV 82
Constant Volume — Space Temperature Control. 83

Compressor Staging and Timers 83
General Compressor Staging 83
Evaporator Coil Surface Utilization (Two Circuit Units Only) 83
Compressor Lockout and Inhibit 83
Alternate Staging Sequence 84
Compressor Staging with Variable Speed Compressors 84
Balanced Compressor Staging 84
Compressor Protections 85
Low Ambient Lockout 85
Low Compressor Suction Pressure Protection 85
Temperature and Pressure Sensor Failures 85
Oil Management Protection 85
Compressor Discharge Pressure Limit 85
Compressor Discharge Saturated Temperature Limit 86
Compressor Discharge Saturated Temperature Speed Limit 86
High Suction Saturated Temperature Inhibit 86
Compressor Involute Pressure Differential Protection 86
Loss of Charge Detection 86
Superheat High Limit Detection 86
Variable Speed Compressor Modulating Current Limit 86
Compressor Low Suction Saturated Temperature Speed Limit 86
Coil Frost Protection 86
Head Pressure Control 87
Hot Gas Bypass 87
Hot Gas Bypass Control 88
EXV Control (Electronic Expansion Valve) 88
Configuration 89
Functional Description 89
EXV Control Sequence of Operation 89
Operating Modes 90
Economizing 90
Outdoor Air Damper Fault Detection and Diagnostics (FDD) 90
Dehumidification Control - Occupied 91
Relative Humidity 91
Dew Point 91
Discharge Air Control Units 91
Space Temperature Control Units 91
Dehumidification Control - Unoccupied 91
Heat Types 92
Gas Heat 92
Electric Heat - Staged 93
Electric Heat - Modulating 93
Electric Heat Protection 94
External Heat 94
Unoccupied Cooling 94
Unoccupied Heating 94
External Control 94
External Supply Fan Control 94
External Relief Fan Control 95
External Outdoor Air Damper Control 95
Overrides 95
Local Stop 96
Emergency Stop 96
Equipment Stop 96
Manual Control 96
Ventilation Override Mode (VOM) 96
Emergency Override 97
Operating Mode OFF and Normal Operating Modes 98
Heat/Cool Capacity Lockouts and Limits 98
Condensate Overflow 99
Filter Status 99
Refrigerant (R–454B) Detection and Mitigation 100
Heat Cool Mode Status: Off 100
Heat Cool Mode Status: Cool 100
Heat Cool Mode Status: Heat 101
Modbus Addressing Tool and Modbus Addresses 101
Modbus Device Addressing 101
Modbus Addresses 102
Controls 103

Constant Volume System Controls 103
Constant Volume Zone Panel (BAYSENS108*) 103
Compressor Motor Winding Thermostats 103
VZH Variable Speed Compressors 103
Cellular Modem 105
Performance Data 107
Supply Fan Curves 107
Relief Fan Curves 117
Component Static Pressure Drops 127
Refrigeration 130
Electronic Compressor Protection Module (CPM) 130
Low Ambient Condenser Fans 130
Service and Maintenance 131
Monthly Maintenance 134
Filters 134
Cooling Season 134
Heating Season 134
Coil Cleaning 135
Scroll Compressor Replacement 136
Refrigeration System 136
CSHE Compressors 153
CSHP Compressors 154
VZH Variable Speed Compressors 154
Electrical Phasing 154
Variable Speed Manifolded with Fixed Speed Compressors 154
Precision Suction Restrictor 155
VFD Programming Parameters (Supply/Condenser for Low Ambient Option) 155
eFlex™ Compressor VFD Programming Parameters 159
Microchannel Condenser Coil Repair and Replacement 160
Fall Restraint 160
Symbio 800 Replacement 160
Final Process 160
Wiring Diagrams 162
Warranty and Liability Clause 164
COMMERCIAL EQUIPMENT - 20 TONS AND LARGER AND RELATED ACCESSORIES 164

Model Number Description

Digit 1 — Unit Type

R = Packaged Rooftop

Digit 2 — Unit Function

A = DX Cooling, No Heat
E = DX Cooling, Electric Heat
F = DX Cooling, Natural Gas Heat
X = DX Cooling, No Heat, Extended Casing

Digit 3, 4, 5 — Nominal Capacity

020 = 20 Tons
025 = 25 Tons
030 = 30 Tons
040 = 40 Tons
050 = 50 Tons
055 = 55 Tons
060 = 60 Tons
070 = 70 Tons
075 = 75 Tons

Digit 6— Heat Type and Capacity

0 = None
1 = Natural Gas — 250 MBh
2 = Natural Gas — 350 MBh
3 = Natural Gas — 500 MBh
4 = Natural Gas — 850 MBh
5 = Natural Gas — 1200 MBh
7 = External Heat
A = Electric — 30 kW
B = Electric — 60 kW
C = Electric — 90 kW
D = Electric — 120 kW
E = Electric — 150 kW
F = Electric — 190 kW

Digit 7 — Heat Performance

0 = None
1 = Gas — Staged, Aluminized Steel
2 = Gas — Staged, Stainless Steel
3 = Gas — Modulating, Stainless Steel
4 = Gas — Ultra Modulating, Stainless Steel
A = Electric — Staged
B = Electric — SCR Modulating

Digit 8 — Unit Voltage

E = 200/60/3
F = 230/60/3
4 = 460/60/3
5 = 575/60/3

Digit 9 — Refrigeration System Performance

1 = Standard Efficiency and Capacity
2 = High Efficiency and Capacity
3 = eFlex™ – Variable Speed Compressor w/ High Capacity

Digit 10, 11— Design Sequence

AA = Current Design Sequence

Digit 12 — Development Sequence

B = Development Sequence

Digit 13 — Airflow Direction

A = Downflow Supply and Upflow Return
D = Right Side Horizontal Supply and Upflow Return

Digit 14 — System Control

2 = Single Zone VAV (Zone Temperature)
3 = Multi Zone VAV (Discharge Air Temperature)

Digit 15 — Dual Supply Fan - Direct Drive

A = 16.5 inch, 80% width
B = 16.5 inch, 100% width
D = 18.2 inch, 100% width
E = 20.0 inch, 80% width
F = 20.0 inch, 100% width
G = 22.2 inch, 80% width
H = 22.2 inch, 100% width
J = 24.5 inch, 80% width
K = 24.5 inch, 100% width
M = 27.0 inch, 100% width

Digit 16 — Dual Supply Fan Motor Type

1 = ODP w/ RPM greater than or equal to 1600
2 = ODP w/ RPM less than 1600

Digit 17 — Dual Supply Fan Motor

A = 3 hp (1.5 hp per)
B = 6 hp (3 hp per)
C = 10 hp (5 hp per)
D = 15 hp (7.5 hp per)
E = 20 hp (10 hp per)
F = 30 hp (15 hp per)
G = 40 hp (20 hp per)
H = 50 hp (25 hp per)

Digit 18 — Relief Option

0 = None
1 = Barometric Relief
2 = Relief Fan - Direct Drive and Variable Speed

Digit 19 — Relief Fan Motor

0 = None
2 = 6 hp
3 = 8 hp
4 = 12 hp
5 = 15 hp
6 = 16 hp
7 = 23 hp

Digit 20 — Space Pressure Management

0 = None
1 = Statitrac

Digit 21 — Variable Frequency Drive (VFD) Bypass

0 = None
A = Supply

Digit 22 — Future Use

0 = None

Digit 23 — Ventilation Override Mode

0 = None
1 = Yes

Digit 24 — Pre-Evaporator Coil Filter

A = 2–in. MERV 4 Panel
B = 2–in. MERV 8 Panel
C = 4–in. MERV 8 Panel
D = 4–in. MERV 14 Panel
E = 2–in. MERV 8 Panel and MERV 14 Cartridge
F = Rack Only - 2–in. Panel
G = Rack Only - 4–in. Panel
H = Rack Only - 2–in. Panel and Cartridge

Digit 25 — Final Filter

0 = None
1 = 2–in. MERV 8 Panel and MERV 14 Cartridge
2 = Rack Only - 2–in. Panel and Cartridge

Digit 26 — Filter Monitoring

0 = None
A = Pre-Evaporator Filter
C = Pre-Evaporator and Final Filter

Digit 27 — Outside Air

0 = None
1 = 0-25% Manual Damper
2 = 0-100% Economizer
3 = 0-100% Economizer w/Demand Ctrl Ventilation (DCV)
4 = 0-100% Economizer w/Traq and DCV

Digit 28 — Outside Air Control

0 = None
A = Economizer w/Dry Bulb
B = Economizer w/Reference Enthalpy
C = Economizer w/Comparative Enthalpy

Digit 29 — Damper w/ Fault Detection Diagnostics

0 = None
1 = Low Leak
2 = Ultra Low Leak

Digit 30-35 — Future Use

0 = None

Digit 36 — Hinged Access Doors

A = Single Side

Digit 37-38 — Future Use

0 = None

Digit 39 — Ambient Control

0 = Standard
1 = Low Ambient w/Variable Speed Condenser Fan

Digit 40 — Condenser Coil Coating

A = None
B = Corrosion Protected

Digit 41 — Modulating Hot Gas Reheat and Hot Gas Bypass

0 = None
1 = Hot Gas Reheat
3 = Hot Gas Bypass
4 = Hot Gas Reheat and Hot Gas Bypass

Digit 42 — Service Valves

A = Discharge
B = Compressor Isolation (Suction and Discharge)

Digit 43 — Evaporator Coil Drain Pan

1 = Galvanized Steel
2 = Stainless Steel
3 = Galvanized Steel w/Condensate Overflow Switch
4 = Stainless Steel w/Condensate Overflow Switch

Digit 44 — Power Supply

1 = Single Point

Digit 45 — Unit Mounted Power Connection

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/ SCCR and Powered Convenience Outlet

Digit 46 — Communication Protocol

0 = None
1 = BACnet®
2 = Air-Fi® Wireless
3 = LonTalk®
4 = Modbus
6 =External Capacity Control - Communicated (BACnet/Modbus)
7 = External Capacity Control - Wired Voltage
8 = External Capacity Control - Wired Current

Digit 47 — Power Monitor

0 = None
1 = Yes

Digit 48 — Controls Expansion Hardware

0 = None
A = Expansion Module I with Cell Modem
M = None I Cell Modem Delete
N = Expansion Module I Cell Modem Delete

Digit 49 — Rapid Restart

0 = None
1 = Yes

Digit 50-57 — Future Use

0 = None

Digit 58 — Agency Approval

1 = cULus Certification

Digit 59–60 — Future Use

0 = None

General Information

Unit Nameplate

One Mylar unit nameplate is located on the outside of enclosure. It includes the unit model number, serial number, electrical characteristics, refrigerant charge, unit wiring diagram numbers, 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.

Gas Heat Nameplate

The nameplate for the Gas Heater is located on the inside of the gas heat enclosure. Allowable operating values of Min and Max input rate, manifold pressure, and air rise for the heater is listed on the nameplate.

Unit Description

Each single-zone rooftop air conditioner ships fully assembled from the factory. An optional roof curb, specifically designed for the 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 Symbio 800 control system that consists of a network of modules and are referred to as Low Level Intelligent Devices (LLID). The acronym (LLID) 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 panels 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.

Pre-Installation

Unit Inspection

To protect against loss due to damage incurred in transit, perform inspection immediately upon receipt of the unit.

Exterior Inspection

If the job site inspection 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. Notify the appropriate sales representative.

Important: *Do not proceed with installation of a damaged unit without sales representative's approval.*

- Visually inspect the complete exterior for signs of shipping damages to unit or packing material.
- Verify that the nameplate data matches the sales order and bill of lading.
- Verify that the unit is properly equipped and there are no material shortages.
- Verify that the power supply complies with the unit nameplate and electric heater specifications.

Inspection for Concealed Damage

Visually inspect the components for concealed damage as soon as possible after delivery and before it is stored.

Do NOT walk on the sheet metal base pans. Bridging between the unit's main supports may consist of multiple 2 by 12 boards or sheet metal grating.

⚠ WARNING

No Step Surface!

Failure to follow instruction below could result in death or serious injury.

Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse and result in the operator/technician falling.

If concealed damage is discovered:

- Notify the carrier's terminal of the damage immediately by phone and by mail.
- Concealed damage must be reported within 15 days.
- Request an immediate, joint inspection of the damage with the carrier and consignee.
- Stop unpacking the unit.
- Do not remove damaged material from receiving location.
- Take photos of the damage, if possible.
- The owner must provide reasonable evidence that the damage did not occur after delivery.

Repair

Notify the appropriate sales representative before arranging unit installation or repair.

Important: *Do not repair unit until the damage has been inspected by the carrier's representative.*

Storage

Store unit in a level and dry location. Use adequate blocking under the base rail. If unit is not level and supported adequately, damage may occur when removing screws and opening doors.

Take precautions to prevent condensate formation inside the unit electrical components and motors when:

- The unit is stored before it is installed; or,
- The unit is set on the roof curb and temporary auxiliary 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) to minimize ambient air from entering the unit until it is ready for start-up.

Note: *Do not use the unit heater as temporary heat without completing the start-up procedures detailed under Start-up information.*

The manufacturer will not assume responsibility for equipment damage resulting from accumulation of condensate on the unit electrical components.

Unit Clearances

See Dimensional Data for 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.

Factory Warranty Information

Compliance with the following is required to preserve the factory warranty:

All Unit Installations

Start-up MUST be performed by Trane, or an authorized agent of Trane, to VALIDATE this WARRANTY. Contractor must provide a two-week start-up notification and true start date to Trane (or an agent of Trane specifically authorized to perform start-up).

Additional Requirements for Units Requiring Disassembly

When a new fully assembled IntelliPak is shipped and received from our Trane manufacturing location, and, for any reason, it requires disassembly or partial disassembly, which could include but is not limited to the evaporator, condenser, control panel, compressor/motor, factory mounted starter, or any other components originally attached to the fully assembled unit, compliance with the following is required to preserve the factory warranty:

- Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will perform or have direct on-site technical supervision of the disassembly and reassembly work.
- The installing contractor must notify Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, two weeks in advance of the scheduled disassembly work to coordinate the disassembly and reassembly work.
- Start-up must be performed by Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products.

Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will provide qualified personnel and standard hand tools to perform the disassembly work at a location specified by the contractor. The contractor shall provide the rigging equipment, such as chain falls, gantries, cranes, forklifts, etc., necessary for the disassembly and reassembly work and the required qualified personnel to operate the necessary rigging equipment. See “Warranty and Liability Clause,” p. 164 for additional details.

Dimensional Data

Table 1. Unit Dimensions

Tons	Refrigeration System Performance		Unit Function		Relief Option		Outside Air		Pre-Evaporator Coil Filter		Overall Length (in.)	Footprint Length (in.)	H (in.)	W (in.)
	Type	Digit 9	Type	Digit 2	Type	Digit 18	Type	Digit 27	Type	Digit 24				
20-30	Std Eff High Eff eFlex™	1,2,3	No Heat	A	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	220.90	212.90	81.70	90.90
									Cartridge	E,H	240.00	232.00		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	221.00	182.00		
									Cartridge	E,H	240.00	201.00		
					None	0	None	0	Panel	A,B,C,D,F,G	182.00	182.00		
									Cartridge	E,H	201.00	201.00		
		1,2,3	Electric Heat, Gas Heat, No Heat - Extended Casing	E, F, X	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	270.60	262.60		
									Cartridge	E,H	289.60	281.60		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	270.70	231.70		
									Cartridge	E,H	289.60	250.60		
					None	0	None	0	Panel	A,B,C,D,F,G	231.70	231.70		
									Cartridge	E,H	250.60	250.60		
40-55	Std Eff High Eff eFlex™	1,2,3	No Heat	A	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	260.60	260.60	81.70	90.70
									Cartridge	E,H	279.60	279.60		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	229.70	229.70		
									Cartridge	E,H	248.70	248.70		
					None	0	None	0	Panel	A,B,C,D,F,G	229.70	229.70		
									Cartridge	E,H	248.70	248.70		
		1,2,3	Electric Heat, Gas Heat, No Heat - Extended Casing	E, F, X	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	312.90	312.90		
									Cartridge	E,H	331.90	331.90		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	281.90	281.90		
									Cartridge	E,H	300.90	300.90		
					None	0	None	0	Panel	A,B,C,D,F,G	281.90	281.90		
									Cartridge	E,H	300.90	300.90		
60	Std Eff High Eff eFlex™	1,2,3	No Heat	A	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	274.10	266.10	81.70	116.30
									Cartridge	E,H	293.10	285.10		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	268.70	229.70		
									Cartridge	E,H	287.70	248.70		
					None	0	None	0	Panel	A,B,C,D,F,G	229.70	229.70		
									Cartridge	E,H	248.70	248.70		
		1,2,3	Electric Heat, Gas Heat, No Heat - Extended Casing	E, F, X	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	326.40	318.40		
									Cartridge	E,H	345.40	337.40		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	320.90	281.90		
									Cartridge	E,H	339.90	300.90		
					None	0	None	0	Panel	A,B,C,D,F,G	281.90	281.90		
									Cartridge	E,H	300.90	300.90		

Dimensional Data

Table 1. Unit Dimensions (continued)

Tons	Refrigeration System Performance		Unit Function		Relief Option		Outside Air		Pre-Evaporator Coil Filter		Overall Length (in.)	Footprint Length (in.)	H (in.)	W (in.)
	Type	Digit 9	Type	Digit 2	Type	Digit 18	Type	Digit 27	Type	Digit 24				
70-75	Std Eff	1	No Heat	A	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	274.10	266.10	81.70	116.13
									Cartridge	E,H	293.10	285.10		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	268.70	229.70		
									Cartridge	E,H	287.70	248.70		
					None	0	None	0	Panel	A,B,C,D,F,G	229.70	229.70		
									Cartridge	E,H	248.70	248.70		
			Electric Heat, Gas Heat, No Heat - Extended Casing	E, F, X	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	326.40	318.40		
									Cartridge	E,H	345.40	337.40		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	320.90	281.90		
									Cartridge	E,H	339.90	300.90		
					None	0	None	0	Panel	A,B,C,D,F,G	281.90	281.90		
									Cartridge	E,H	300.90	300.90		
	High Eff eFlex™	2, 3	No Heat	A	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	322.10	314.10		
									Cartridge	E,H	353.10	345.10		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	316.70	277.70		
									Cartridge	E,H	347.70	308.70		
					None	0	None	0	Panel	A,B,C,D,F,G	277.70	277.70		
									Cartridge	E,H	308.70	308.70		
			Electric Heat, Gas Heat, No Heat - Extended Casing	E, F, X	Relief Fan	2	Yes	1,2,3,4	Panel	A,B,C,D,F,G	374.40	366.40		
									Cartridge	E,H	405.40	397.40		
					Barometric Relief	1	Yes	1,2,3,4	Panel	A,B,C,D,F,G	368.90	329.90		
									Cartridge	E,H	399.90	360.90		
					None	0	None	0	Panel	A,B,C,D,F,G	329.90	329.90		
									Cartridge	E,H	360.90	360.90		

Notes:

1. Difference between overall length and footprint length is outside air hood.
2. Refrigeration System Performance impacts length in 70 and 75 ton due to staggered coil configuration.

Figure 1. 20 to 30 ton — front view (inches)

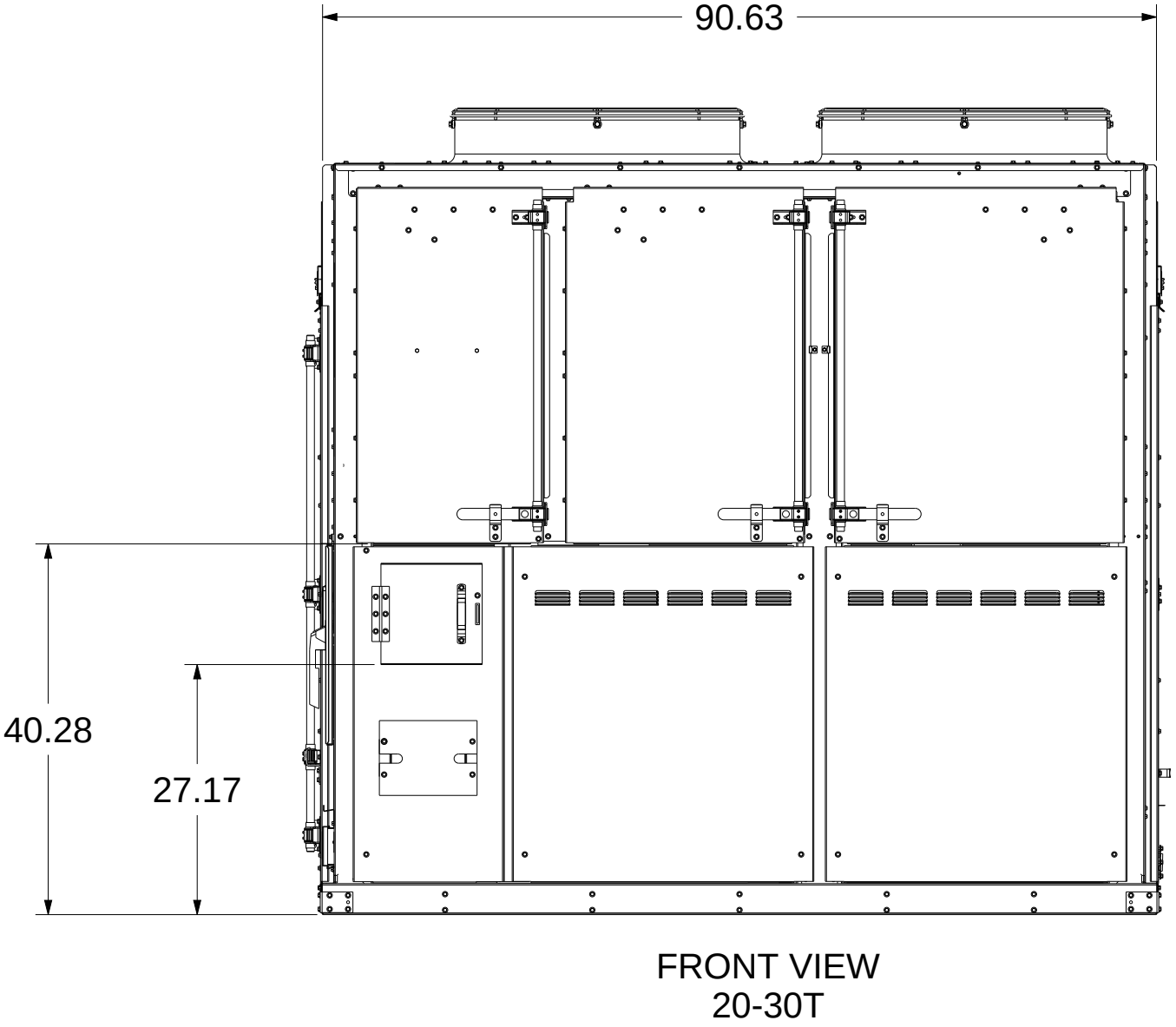
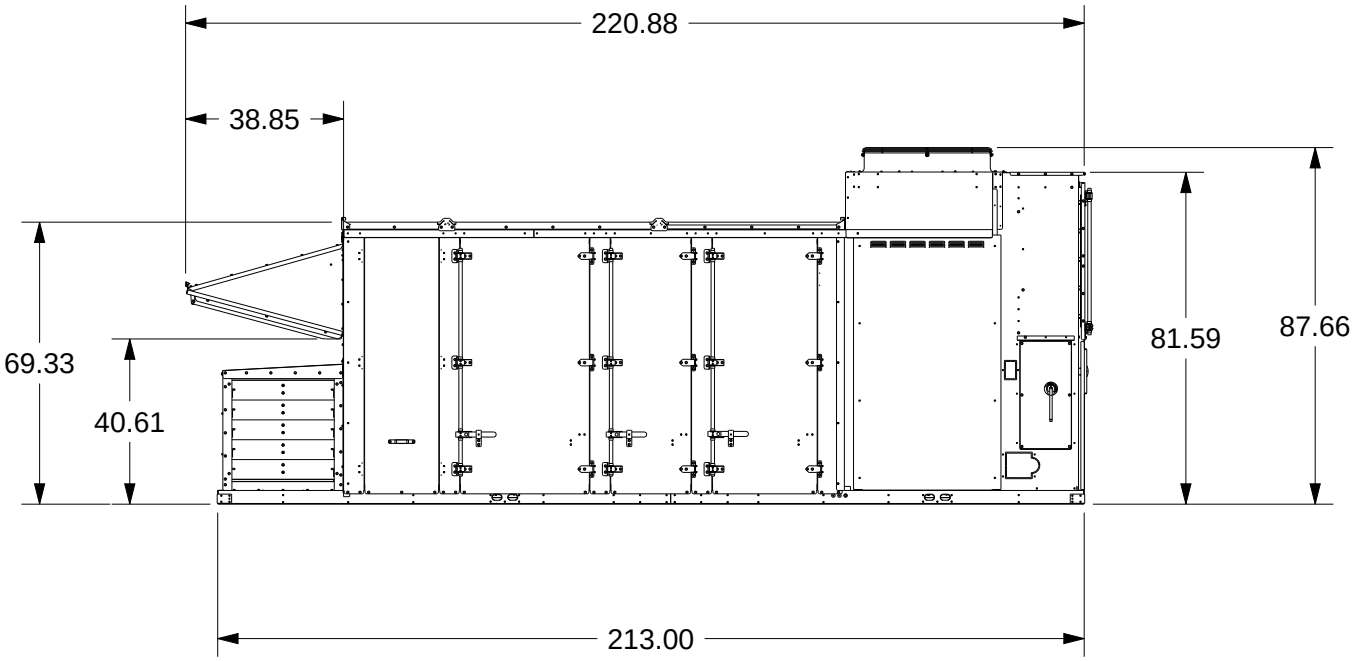


Figure 2. 20 to 30 ton — left view of sample configuration (inches)



LEFT SIDE VIEW
20-30T / NO HEAT / RELIEF FANS / PANEL FILTERS

Figure 3. 40 to 55 ton — front view (inches)

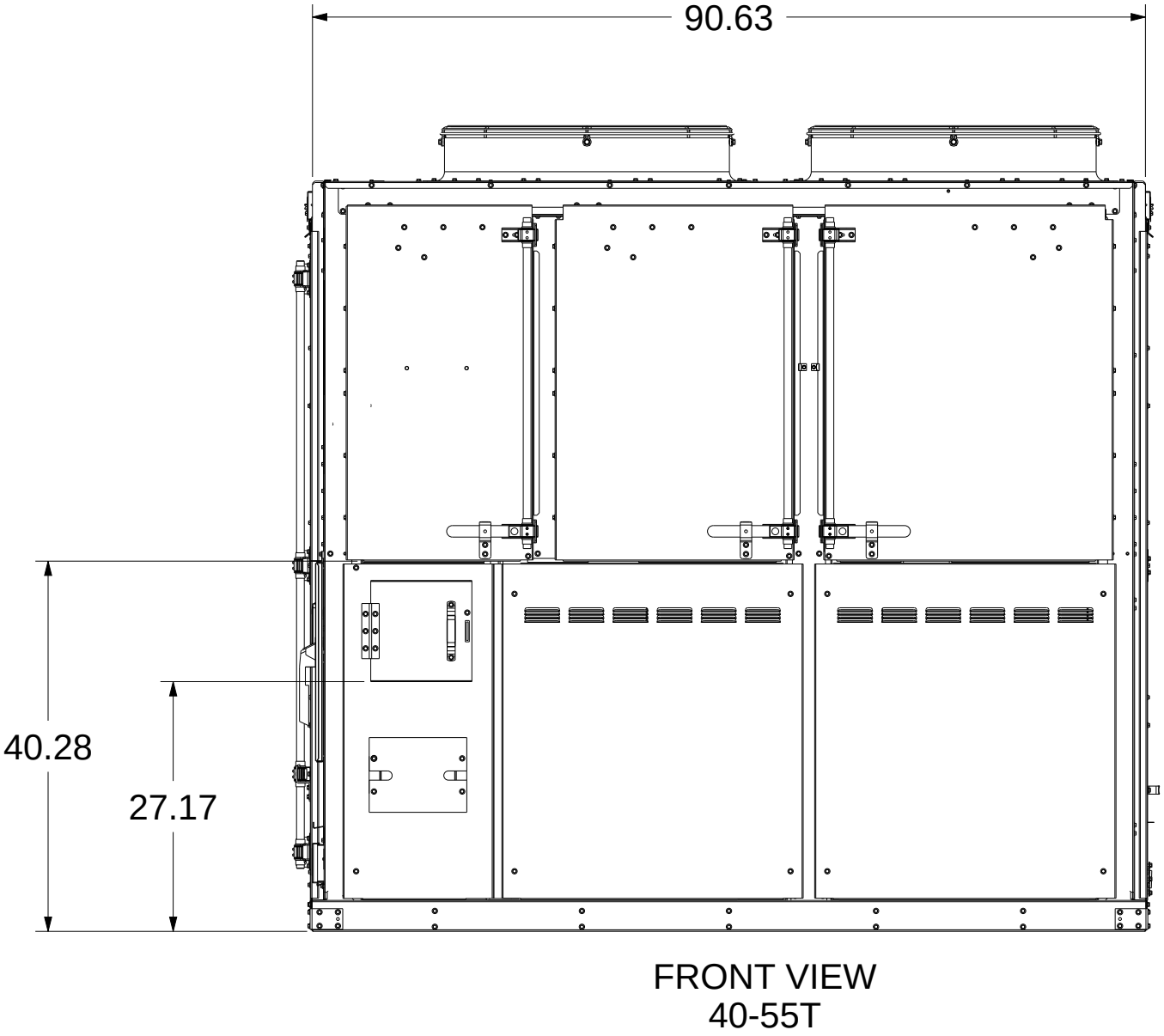
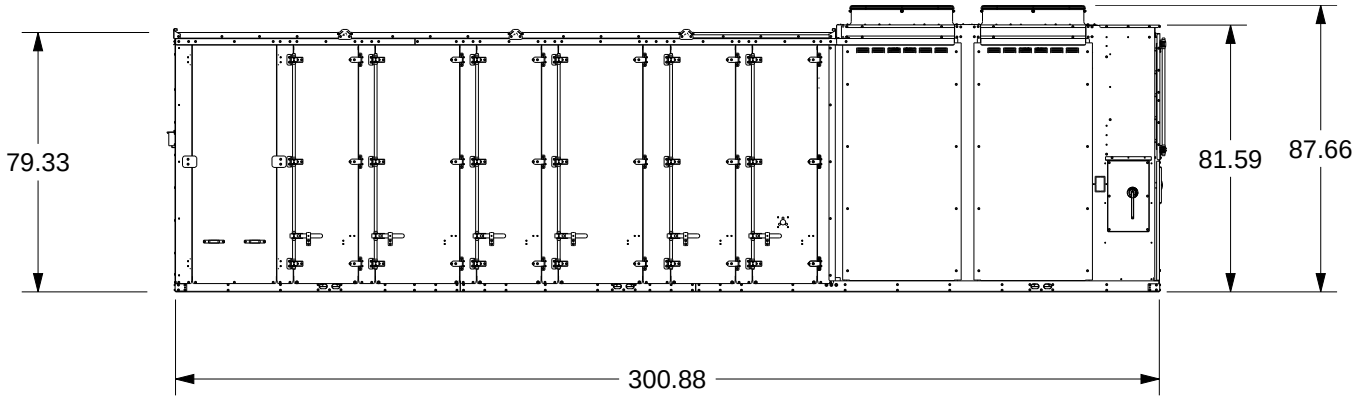
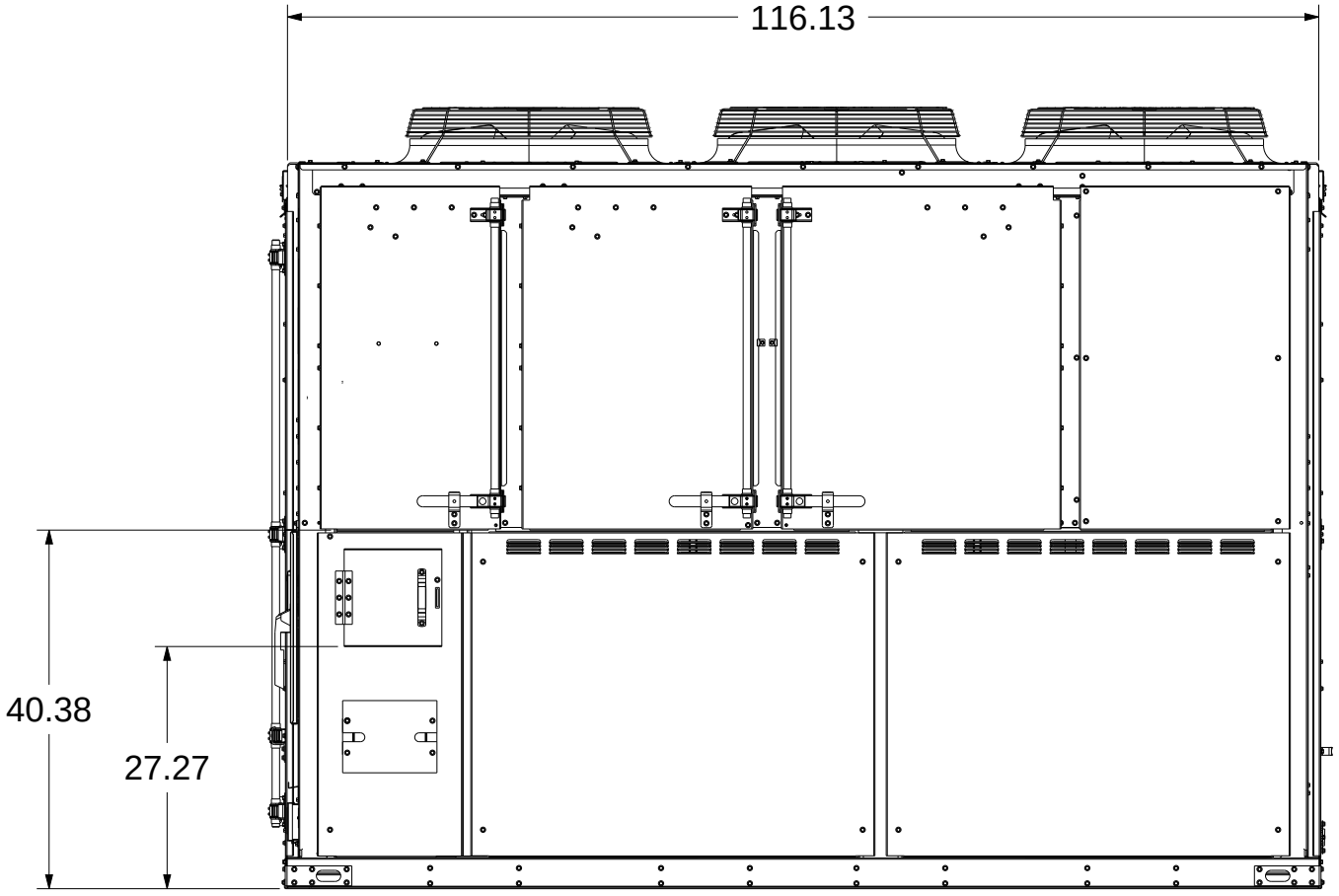


Figure 4. 40 to 55 ton — left view of sample configuration (inches)



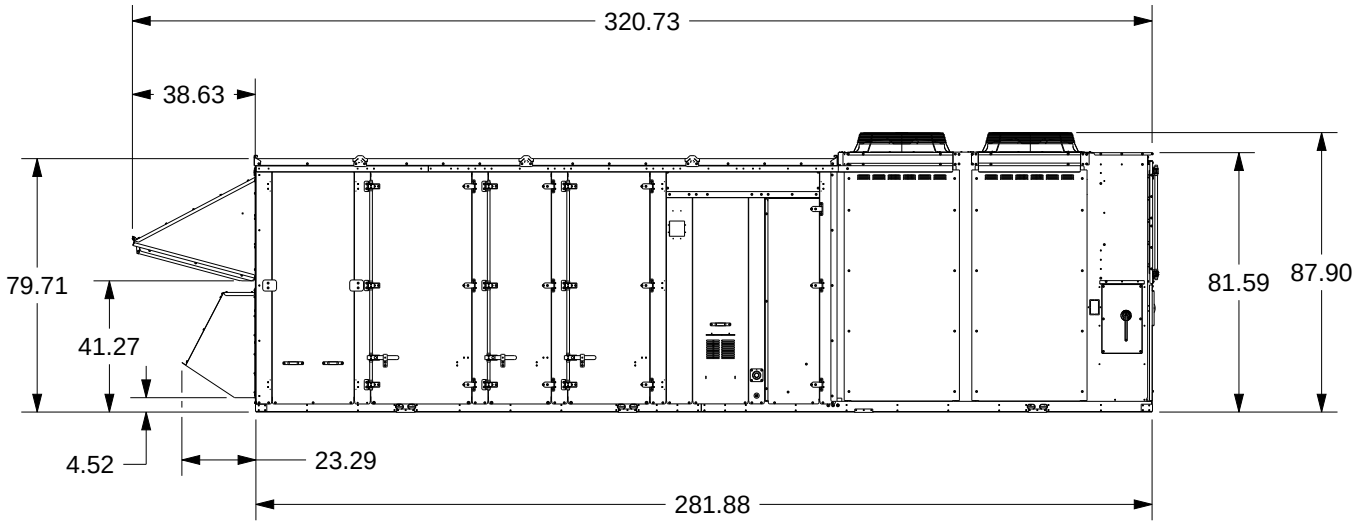
LEFT SIDE VIEW
40-55T / ELECT. HT. / CART. FILTERS

Figure 5. 60 to 75 ton — front view (inches)



FRONT VIEW
60-75T

Figure 6. 60 to 75 ton — left view of sample configuration (inches)



LEFT SIDE VIEW
60-75T / GAS HEAT / BAROMETRIC RELIEF / PANEL FILTERS

Roof Curb

Figure 7. Service clearance

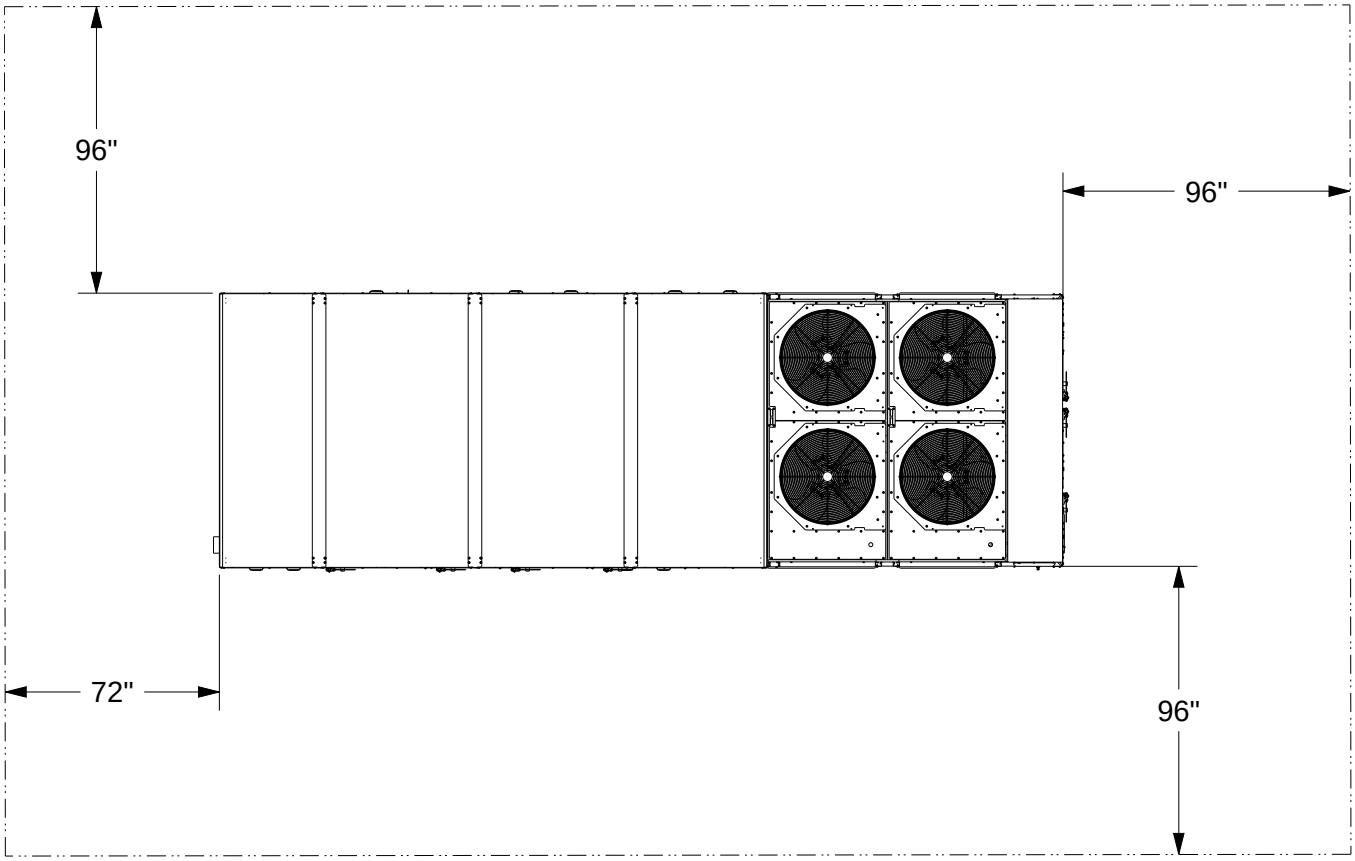


Figure 8. Roof curb dimensions (inches)

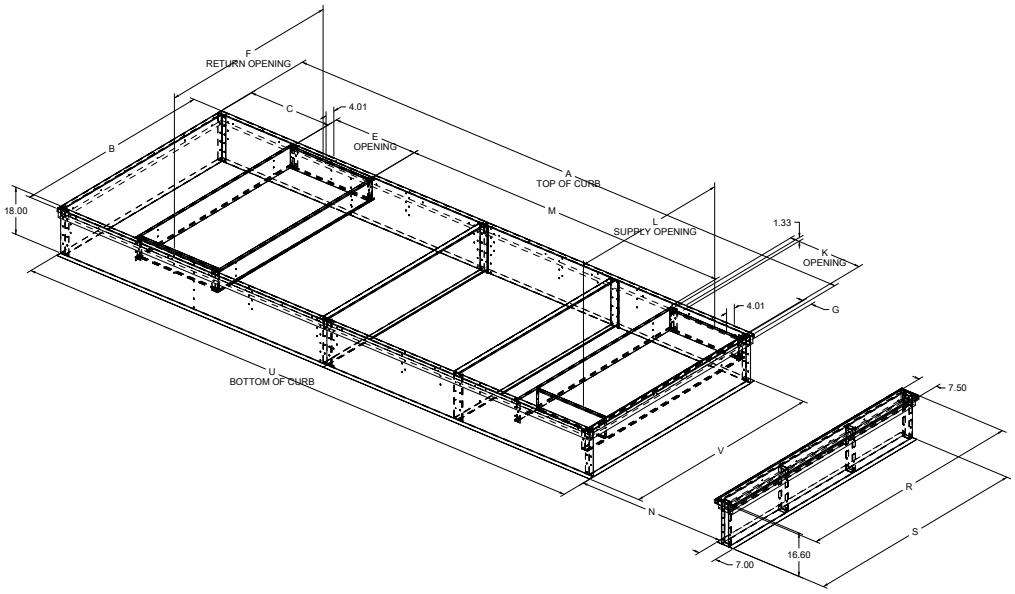


Table 2. Roof curb dimensional data (inches)

Unit Type	Tons	Filter	Relief	Efficiency	A	B	C	E	F	G	K	L	M	N	R	S	U	V	W	X
RE/RF/RX	20-30	PANEL	NONE or BR	STD/HI/ eFlex™	169.99	84.50	3.58	24.62	76.49	3.60	27.00	67.50	111.19	18.97	95.94	94.50	170.31	84.82	59.80	97.89
RE/RF/RX	20-30	PANEL	REL FAN	STD/HI/ eFlex™	200.97	84.50	33.05	26.13	76.49	3.60	27.00	67.50	111.19	18.97	95.94	94.50	201.29	84.82	90.78	128.88
RE/RF/RX	20-30	CART	NONE or BR	STD/HI/ eFlex™	188.99	84.50	3.58	24.62	76.49	3.60	27.00	67.50	130.19	18.97	95.94	94.50	189.31	84.82	80.01	116.89
RE/RF/RX	20-30	CART	REL FAN	STD/HI/ eFlex™	219.97	84.50	33.05	26.13	76.49	3.60	27.00	67.50	130.19	18.97	95.94	94.50	220.29	84.82	111.04	147.88
RA	20-30	PANEL	NONE or BR	STD/HI/ eFlex™	120.26	84.50	3.58	24.62	76.49	23.85	28.50	76.49	39.72	18.97	95.94	94.50	120.58	84.82	60.67	98.55
RA	20-30	PANEL	REL FAN	STD/HI/ eFlex™	151.25	84.50	33.05	26.13	76.49	23.85	28.50	76.49	39.72	18.97	95.94	94.50	151.57	84.82	91.83	129.56
RA	20-30	CART	NONE or BR	STD/HI/ eFlex™	139.26	84.50	3.58	24.62	76.49	23.85	28.50	76.49	58.72	18.97	95.94	94.50	139.58	84.82	79.85	117.58
RA	20-30	CART	REL FAN	STD/HI/ eFlex™	170.25	84.50	33.05	26.13	76.49	23.85	28.50	76.49	58.72	18.97	95.94	94.50	170.57	84.82	110.82	148.56
RE/RF/RX	40-55	PANEL	NONE or BR	STD/HI/ eFlex™	179.99	84.50	3.58	32.12	76.49	3.60	29.50	67.50	111.19	59.12	95.94	94.50	180.31	84.82	67.30	105.39
RE/RF/RX	40-55	PANEL	REL FAN	STD/HI/ eFlex™	210.97	84.50	33.05	33.63	76.49	3.60	29.50	67.50	111.19	59.12	95.94	94.50	211.29	84.82	98.29	136.38
RE/RF/RX	40-55	CART	NONE or BR	STD/HI/ eFlex™	198.99	84.50	3.58	32.12	76.49	3.60	29.50	67.50	130.19	59.12	95.94	94.50	199.31	84.82	87.55	124.39
RE/RF/RX	40-55	CART	REL FAN	STD/HI/ eFlex™	229.97	84.50	33.05	33.63	76.49	3.60	29.50	67.50	130.19	59.12	95.94	94.50	230.29	84.82	118.54	155.38
RA	40-55	PANEL	NONE or BR	STD/HI/ eFlex™	127.76	84.50	3.58	32.12	76.49	23.85	28.50	76.49	39.72	59.12	95.94	94.50	128.08	84.82	68.30	106.05
RA	40-55	PANEL	REL FAN	STD/HI/ eFlex™	158.75	84.50	33.05	33.63	76.49	23.85	28.50	76.49	39.72	59.12	95.94	94.50	159.07	84.82	99.29	137.03
RA	40-55	CART	NONE or BR	STD/HI/ eFlex™	146.76	84.50	3.58	32.12	76.49	23.85	28.50	76.49	58.72	59.12	95.94	94.50	147.08	84.82	87.30	125.05
RA	40-55	CART	REL FAN	STD/HI/ eFlex™	177.75	84.50	33.05	33.63	76.49	23.85	28.50	76.49	58.72	59.12	95.94	94.50	178.07	84.82	118.29	156.03

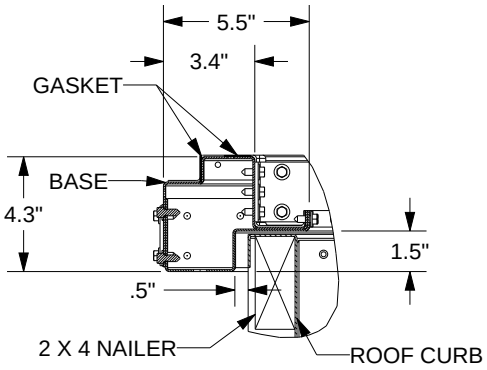
Table 2. Roof curb dimensional data (inches) (continued)

Unit Type	Tons	Filter	Relief	Efficiency	A	B	C	E	F	G	K	L	M	N	R	S	U	V	W	X
RE/RF/RX	60	PANEL	NONE or BR	STD/HI/ eFlex™	179.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	111.19	59.12	121.44	120.00	180.31	110.32		
RE/RF/RX	60	PANEL	REL FAN	STD/HI/ eFlex™	216.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	111.19	59.12	121.44	120.00	216.80	110.32		
RE/RF/RX	60	CART	NONE or BR	STD/HI/ eFlex™	198.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	130.19	59.12	121.44	120.00	199.31	110.32		
RE/RF/RX	60	CART	REL FAN	STD/HI/ eFlex™	235.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	130.19	59.12	121.44	120.00	235.80	110.32		
RA	60	PANEL	NONE or BR	STD/HI/ eFlex™	127.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	39.72	59.12	121.44	120.00	128.08	110.32		
RA	60	PANEL	REL FAN	STD/HI/ eFlex™	164.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	39.72	59.12	121.44	120.00	164.57	110.32		
RA	60	CART	NONE or BR	STD/HI/ eFlex™	146.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	58.72	59.12	121.44	120.00	147.08	110.32		
RA	60	CART	REL FAN	STD/HI/ eFlex™	183.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	58.72	59.12	121.44	120.00	183.57	110.32		
RE/RF/RX	70-75	PANEL	NONE or BR	STD	179.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	111.19	59.12	121.44	120.00	180.31	110.32		
RE/RF/RX	70-75	PANEL	REL FAN	STD	216.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	111.19	59.12	121.44	120.00	216.80	110.32		
RE/RF/RX	70-75	CART	NONE or BR	STD	198.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	130.19	59.12	121.44	120.00	199.31	110.32		
RE/RF/RX	70-75	CART	REL FAN	STD	235.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	130.19	59.12	121.44	120.00	235.80	110.32		
RA	70-75	PANEL	NONE or BR	STD	127.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	39.72	59.12	121.44	120.00	128.08	110.32		
RA	70-75	PANEL	REL FAN	STD	164.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	39.72	59.12	121.44	120.00	164.57	110.32		
RA	70-75	CART	NONE or BR	STD	146.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	58.72	59.12	121.44	120.00	147.08	110.32		
RA	70-75	CART	REL FAN	STD	183.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	58.72	59.12	121.44	120.00	183.57	110.32		
RE/RF/RX	70-75	PANEL	NONE or BR	HI/eFlex™	227.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	159.19	59.12	121.44	120.00	228.31	110.32		
RE/RF/RX	70-75	PANEL	REL FAN	HI/eFlex™	264.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	159.19	59.12	121.44	120.00	264.80	110.32		
RE/RF/RX	70-75	CART	NONE or BR	HI/eFlex™	258.99	110.00	3.58	32.12	101.99	3.60	29.50	93.00	190.19	59.12	121.44	120.00	259.31	110.32		
RE/RF/RX	70-75	CART	REL FAN	HI/eFlex™	295.48	110.00	38.56	33.63	101.99	3.60	29.50	93.00	190.19	59.12	121.44	120.00	295.80	110.32		
RA	70-75	PANEL	NONE or BR	HI/eFlex™	175.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	87.72	59.12	121.44	120.00	176.08	110.32		
RA	70-75	PANEL	REL FAN	HI/eFlex™	212.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	87.72	59.12	121.44	120.00	212.57	110.32		
RA	70-75	CART	NONE or BR	HI/eFlex™	206.76	110.00	3.58	32.12	101.99	22.85	29.50	101.99	118.72	59.12	121.44	120.00	207.08	110.32		
RA	70-75	CART	REL FAN	HI/eFlex™	243.25	110.00	38.56	33.63	101.99	22.85	29.50	101.99	118.72	59.12	121.44	120.00	243.57	110.32		

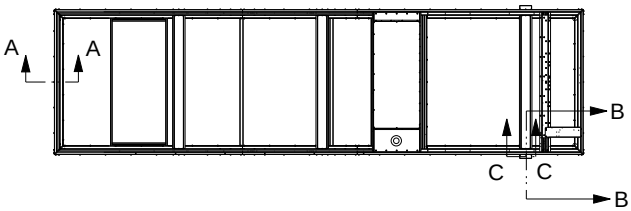
Notes:

1. High efficiency and eFlex™ refrigeration system performance for both 70 and 75 tons have a staggered evaporator coil.
2. There are three relief options - None, Barometric Relief (BR), or Relief Fan (REL FAN).
3. Panel or Cartridge filters refer to the Pre-Evaporator Coil filter selection. Panel Filters are Digit 24 = A,B,C,D,F,G and Cartridge Filters are Digit 24 = E,H

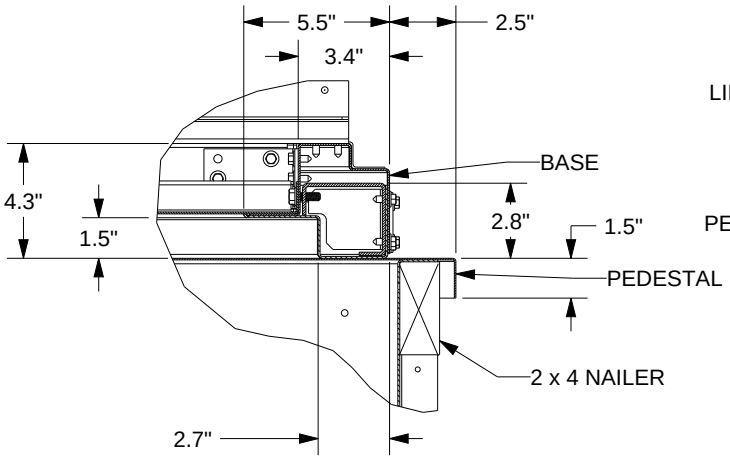
Figure 9. Base and pedestal



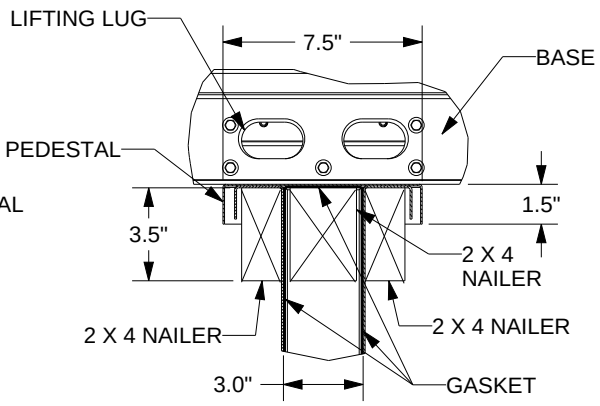
TYPICAL ROOF CURB & BASE DETAIL
SECT. A-A



PLAN VIEW



TYPICAL PEDESTAL & BASE DETAIL
SECT. B-B
(SIDE VIEW OF PEDESTAL)



TYPICAL PEDESTAL & BASE DETAIL
SECT. C-C
(END VIEW OF PEDESTAL)

Horizontal Right Supply

Figure 10. Horizontal right supply

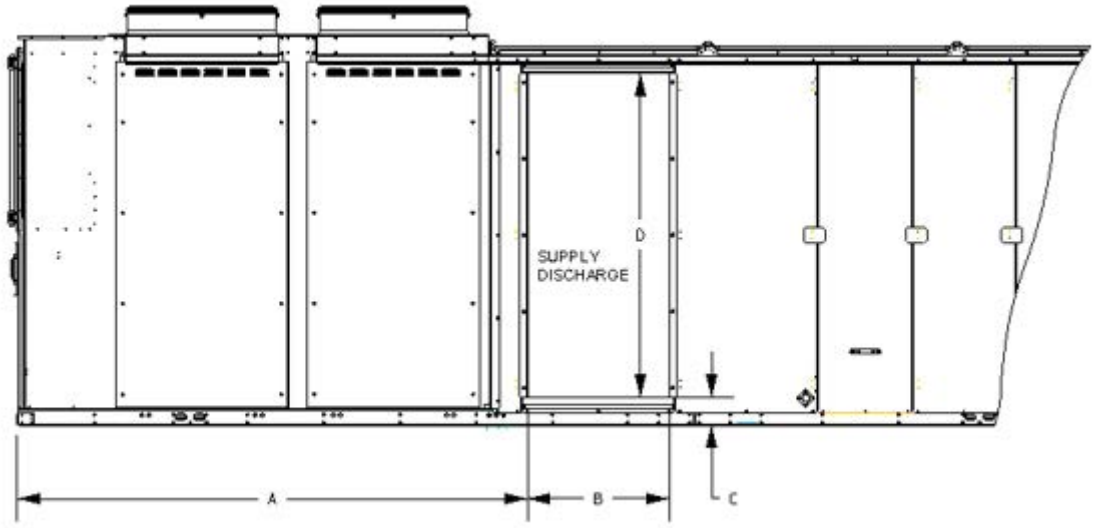


Table 3. Horizontal right supply duct dimensional data (inches)

Unit Type	Tons	A	B	C	D
RA	20-30	66.76	29.75	5.81	57.95
RE/RF/RX	20-30	65.64	27.25	5.81	57.95
RA	40-55	106.91	29.75	5.81	68.01
RE/RF/RX	40-55	105.79	29.75	5.81	68.01
RA	60-75	106.91	29.75	5.81	68.01

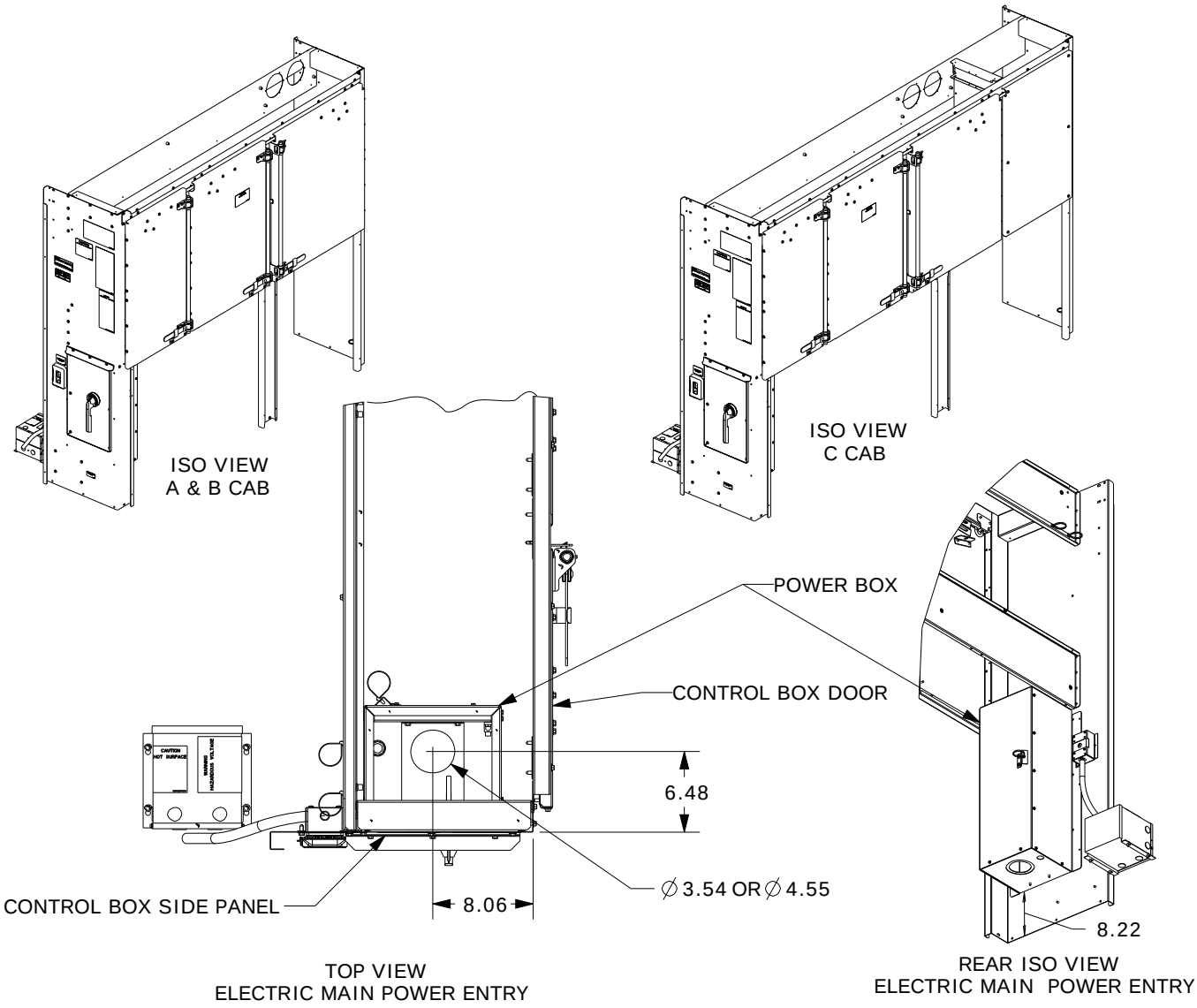
Table 3. Horizontal right supply duct dimensional data (inches) (continued)

Unit Type	Tons	A	B	C	D
RE/RF	60-75	105.79	41.36	5.81	68.01
RX	60-75	105.79	29.75	5.81	68.01

Note: All supply discharge dimensions are to the inside face of the flange and the outside face of base rail.

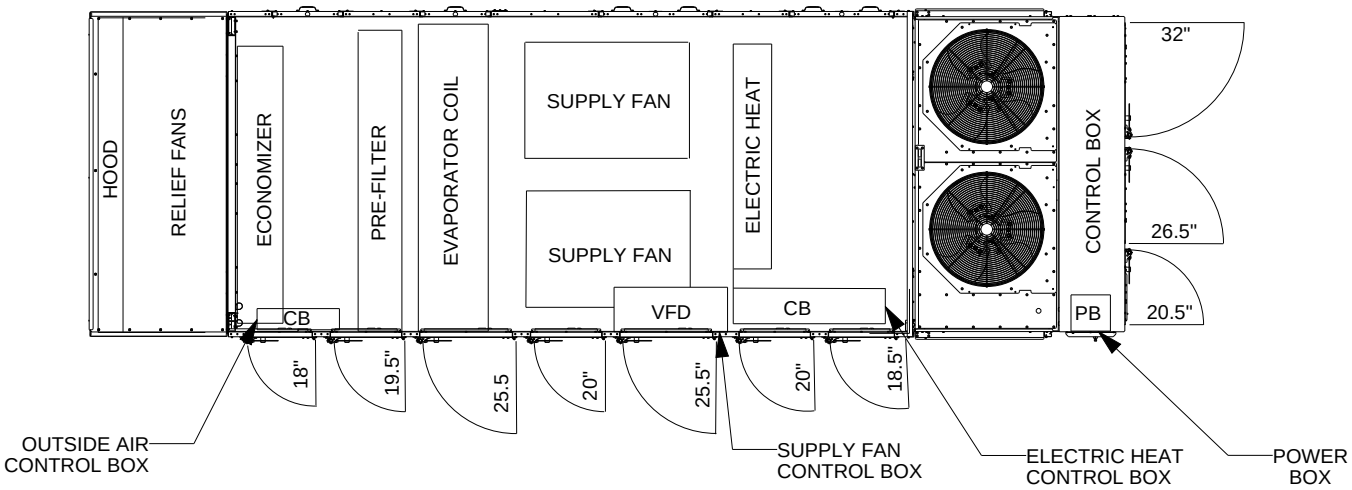
Electrical Entry Details

Figure 11. Electrical connections (inches)



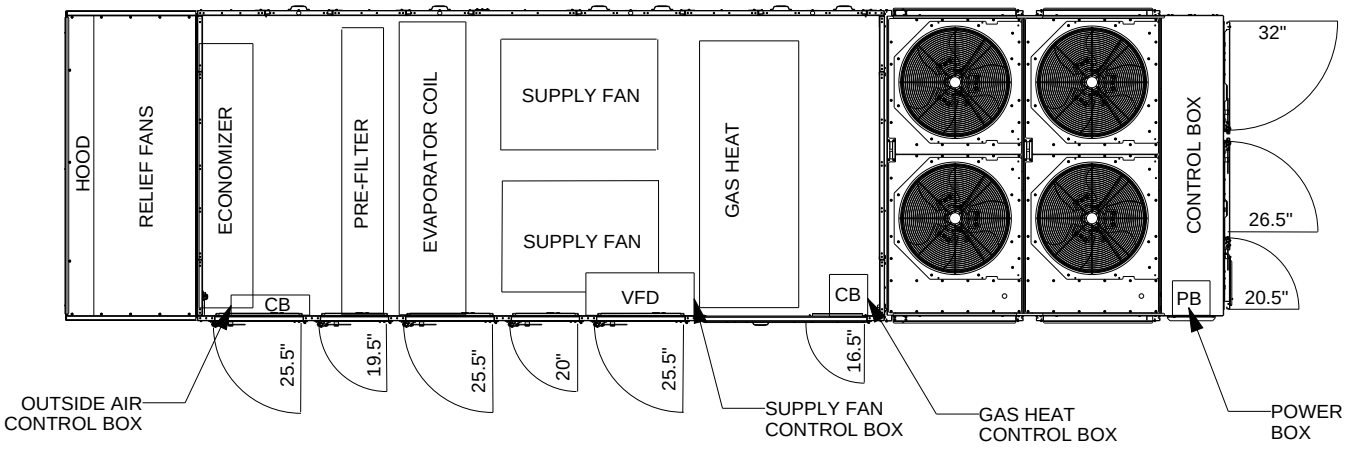
Access Clearances

Figure 12. Minimum access clearances – 20 to 30 ton



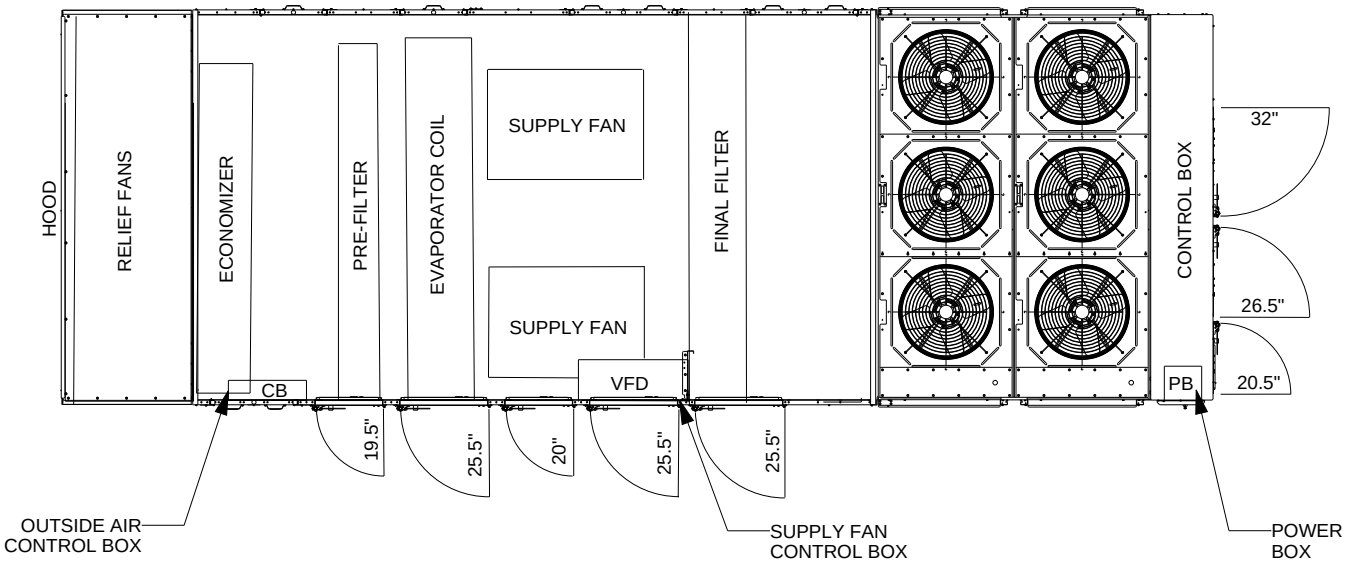
PLAN VIEW
20-30T DOOR LAYOUT

Figure 13. Minimum access clearances – 40 to 55 ton



PLAN VIEW
40-55T DOOR LAYOUT

Figure 14. Minimum access clearances – 60 to 75 ton



PLAN VIEW
60-75T DOOR LAYOUT

A2L Information and Installation Requirements

Installation/Code Compliance Requirements

Building level controls may need to be upgraded/modified to demand leak mitigation actions as described in “Leak Detection System (Refrigerant charge greater than 3.91 lb per circuit),” p. 32. Those actions include, but are not limited to, fully opening damper and VAV boxes (if present), and disabling electric heat in VAV boxes (if present).

Verify the equipment refrigerant charge is in accordance with the room area limitation as described in Minimum Room Area Limits section.

Ensure that there are labels on the equipment stating it contains a flammable refrigerant.

A2L Work Procedures

⚠ WARNING

Risk of Fire — Flammable Refrigerant!

Failure to follow instructions below could result in death or serious injury, and equipment damage.

- **To be repaired only by trained service personnel.**
- **Do not puncture refrigerant tubing.**
- **Dispose of properly in accordance with federal or local regulations.**
- **The equipment shall be stored in a room without continuously operating ignition sources.**

⚠ WARNING

Refrigerant under High Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

The units described in this manual use R-454B refrigerant. Use ONLY R-454B rated service equipment or components with these units. For specific handling concerns with R-454B, contact your local Trane representative.

Installation, repair, removal, or disposal should be performed by trained service personnel.

At all times, Trane’s maintenance and service guidelines shall be followed. If in doubt, contact Trane technical support for assistance.

Servicing

Prior to initiating work on equipment, check the area with an appropriate refrigerant detector. Ensure the service personnel are properly trained regarding work in potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed, or intrinsically safe. Be aware that the refrigerant does not contain an odor.

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available on hand. A dry powder or CO_2 fire extinguisher should be located adjacent to the charging area.

At all times, Trane’s maintenance and service guidelines shall be followed. If in doubt, contact Trane technical support for assistance.

All maintenance staff and others working in the local area shall be instructed on the nature of the work being carried out. Work in confined spaces shall be avoided.

Ignition Source Mitigation

Do not use any sources of ignition when working on the refrigeration system.

Keep all ignition sources, including cigarette smoking, away from the site of installation, repair, removal or disposal, during which refrigerant can potentially be released to the surrounding space.

Survey the area around the equipment before initiating work to ensure no flammable hazards or ignition risks are present.

“No Smoking” signs shall be displayed.

Do not use devices that can be a source of ignition to accelerate defrosting of components. Use only defrost and cleaning procedures recommended by Trane. Do not pierce or burn.

Ventilation

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere. If present, check that the ventilation system, including outlets, are operating adequately and are not obstructed.

Refrigerating Equipment

Refrigerant piping or components should not be installed in locations where substances which may corrode them are present.

Check that equipment hazard markings are visible and legible. Replace them if they are not.

For equipment using secondary fluids, like water or glycol, check that refrigerant is not present in the secondary fluid loop before conducting any hot work.

Electrical Devices

Do not apply power to the circuit if a fault exists which compromises safety. If the fault cannot be corrected immediately, but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- Cabling is not subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. Account for the effects of aging or continual vibration from sources such as compressors or fans.
- Capacitors are discharged. This shall be done in a safe manner to avoid possibility of sparking.
- No live electrical components and wiring are exposed while charging, recovering, or purging the system.
- Verify continuity of earth bonding.
- Replace electrical components with Trane replacement parts, or those meeting the same ratings and qualified for flame arrest protection, UL LZGH2 category.

Leak Detection

Never use an open flame to detect leaks. A halide torch should not be used. Use only approved leak detection methods per this instruction manual.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Verify the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL gas (25% maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

Examples of leak detection fluids are:

- Bubble method
- Fluorescent method agents

If a leak is suspected, all naked flames shall be removed/ extinguished.

If a refrigerant leak is found which requires brazing, all refrigerant shall be recovered from the system, or isolated (by means of shut-off valves) in a part of the system remote from the leak.

Refrigerant Removal and Evacuation

Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (special cylinders for the recovery of refrigerant, for example). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration.

The following procedure shall be adhered to:

1. Safely remove refrigerant following local and national regulations.
2. Evacuate.
3. Purge the circuit with inert gas.
4. Evacuate (optional for A2L).
5. Continuously flush or purge with inert gas when using flame to open circuit.
6. Open the circuit.

Prior to refrigerant removal, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

The recovery equipment shall be in good working order with instructions available. Equipment shall be suitable for the recovery of the flammable refrigerant. For specific handling concerns, contact the manufacturer. Ensure all hose connections are checked for tightness to avoid refrigerant leaks.

In addition, a set of calibrated weighing scales shall be available and in good working order.

The refrigerant shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. Do not mix refrigerants in recovery unit and especially not in cylinders.

Refrigerant recovery unit should be purged with an inert gas after each use or before using with a different refrigerant Class – for example, A2L to A1.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

The system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

The system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

Refrigerant Charging

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment.
- Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the refrigerating system.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Prior to refrigerant charging, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

Verify the equipment refrigerant charge is in accordance with the room area limitation as described in Minimum Room Area Limits section.

Decommissioning

Before carrying out the decommissioning procedure, it is essential that the trained service personnel is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before attempting the procedure, ensure that:
    a. Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
    b. All personal protective equipment is available and being used correctly.
    c. The recovery process is supervised at all times by a competent person.
    d. Recovery equipment and cylinders conform to the appropriate standards.
4. Pump down refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80% volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another refrigerating system unless it has been cleaned and checked.
12. When equipment has been decommissioned, attach a signed and dated label stating it has been decommissioned and emptied of refrigerant.
13. Ensure that there are labels on the equipment stating it contains flammable refrigerant.

A2L Application Considerations

This product is listed to UL standard 60335-2-40, Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, which defines safe design and use strategies for equipment using A2L

refrigerants. This standard limits the refrigerant concentration in a space in the event of a refrigerant leak. To meet the requirements, the UL standard defines minimum room area, refrigerant charge limit, minimum circulation airflow and/or ventilation airflow requirements, and limits the use of ignition sources in spaces. The standard may require a unit refrigerant leak detection system.

For equipment with R-454B and charge amounts less than or equal to 3.91 lbs per circuit, this UL standard does not prescribe a room area limit and does not require a refrigerant leak detection system or any circulation airflow or ventilation airflow mitigation strategies. However, ignition sources in ductwork must be evaluated.

Depending on the application, a specific requirement of ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems, could be more stringent than UL 60335-2-40 requirements. See *Refrigeration Systems and Machinery Rooms Application Considerations for Compliance with ASHRAE® Standard 15-2022 Application Engineering Manual* (APP-APM001*-EN) for more information.

Ignition Sources in Ductwork

Do not install open flames in the ductwork. Hot surfaces exceeding 700°C (1290°F) should not be installed in the ductwork unless the average airflow velocity is not less than 1.0 m\s (200 ft\min) across the heater and proof of airflow is verified before system is energized.

Electric heaters can exceed the surface temperature limit if airflow distribution is poor, or insufficient airflow is provided over the heater.

Surface temperatures of most gas heaters do not exceed the surface temperature limits due to ANSI construction requirements.

Ignition Sources in Unit

This unit does not contain any ignition sources. All potential ignition sources, (including factory or field installed accessory electric heaters, gas heaters, relays, and contactors) were evaluated during product UL listing.

Minimum Room Area Limits (Refrigerant charge greater than 3.91 lb per circuit)

Equipment with R–454B charge amounts greater than 3.91 lb per circuit may require additional circulation or ventilation airflow mitigation strategies. In this case, two minimum room area (A_{min}) thresholds:

- The first threshold defines when equipment serving a single room is required to provide circulation airflow, either continuous or activated by a leak detection system. A ducted system requires circulation airflow unless the smallest room it serves is larger than the adjusted A_{min} threshold. This product contains a leak detection system if a circuit charge is greater than 3.91 lbs. As a result, no further leak detection system evaluation is required.
- The second threshold defines when additional ventilation airflow is required. If the room area, A or TA, is below the adjusted A_{min} or TA_{min} threshold, additional ventilation is required to remove refrigerant in the event of a leak. See the UL 60335-2-40 Clause GG.8 and ANSI\ASHRAE Standard 15 Section 7 for natural and mechanical ventilation requirements.

Table 4. Minimum room area

Tonnage	Efficiency	Minimum Room Area[a]	
		m^2	ft^2
20	V	50	529
25	H	52	559
25	V	68	724
30	S	53	570
30	H	69	735
30	V	64	683
40	S	36	387
40	H	46	495
40	V	46	492
50	S	43	458
50	H	59	630
50	V	55	585
55	S	45	484
55	H	60	645
55	V	56	593
60	S	50	529
60	H	62	668
60	V	62	668
70	S	59	630
70	H	75	803
70	V	77	821
75	S	64	679
75	H	76	814
75	V	81	870

[a] Based 2.2M installation height and maximum refrigerant charge.

Minimum Room Area (A_{min}) Adjustments

Use equation below to adjust the minimum room area, as applicable, based on the unit's installation height, altitude, and occupancy level it serves.

$$A_{min.adj} = \text{Nameplate } A_{min} \times \text{Altitude Adj} \times \text{Height Adj} \times F_{occ}$$

Multiply the altitude adjustment factor in the table below by A_{min} listed on the unit nameplate or in the Installation, Operation, and Maintenance (IOM) manual.

Table 5. Altitude adjustment factor

Altitude (ft)	Sea Level to 2000	2001 to 4000	4001 to 6000	6001 to 8000	8001 to 10000	10001 to 12000	12001 to 14000	14001 to 15000	Over 15000
A_{min} Adjustment	1	1.05	1.11	1.17	1.24	1.32	1.41	1.51	1.57

In addition, A_{min} can be adjusted if the unit is installed in a room at a height that is higher than the minimum height shown on the unit. To adjust A_{min}, multiply by the ratio of the unit minimum release height (in meters) / actual release height (in meters). Use 0.6 m in the ratio for unit minimum installation heights less than or equal to 0.6 m.

For institutional occupancies, ASHRAE Standard 15 applies an additional adjustment factor F_{occ} to the amount of a charge allowed in a space. To calculate the adjusted A_{min} for institutional occupancies, multiply the A_{min} on the nameplate by two.

EXAMPLE 1: 20 Ton Packaged Rooftop Multi-Zone VAV System Serving an Institutional Occupancy Space

The packaged unit serves 7600 ft.^{2} of a nursing home located at an attitude of 4000 ft. The unit has two equally charged 10 ton refrigeration circuits. Each circuit has 12 lbs of refrigerant with a minimum room area requirement of 180 ft.^{2} with a 2.2 m release height.

$$TA_{min.adj} = 180\ ft.^2 \times 1.05 \times 2 = 378\ ft.^2$$

No additional ventilation is required.

EXAMPLE 2: 10 Ton Split System Serving a Single Commercial Occupancy Space

The split system serves a 1500 ft.^{2} manufacturing space at 5000 ft. altitude. The final installed charge of the single circuit 10 ton unit is 20 lb. The unit has an open return with a release height of 1 m and ducted supply air. The unit A_{min} is 660 ft.^{2}.

$$A_{min.adj} = 660\ ft.^2 \times 1.11 = 733\ ft.^2$$

No additional ventilation is required.

Determining Room Area (A or TA)

The room area (A) is the room area enclosed by the projection to the floor of the walls, partitions, and doors of the space that the equipment serves. For ducted systems, total room area (TA) of all rooms connected by ducts, may be used instead of A.

Rooms connected by drop ceilings only are not considered a single room.

Rooms on the same floor of the building, and connected by an open passageway, can be considered part of the same room if the passageway is a permanent opening, extends to the floor and is intended for people to walk through.

Adjacent rooms on the same floor of the building and connected by permanent openings in the walls and/or doors between rooms (including gaps between the wall and the floor), can be considered part of the same room if the openings meet the following criteria.

- The opening is permanent and cannot be closed.
- Openings extending to the floor, such as door gaps, need to be at least 20 mm above the floor covering surface.
- Natural ventilations opening areas must meet the requirements of ANSI\ASHRAE Standard 15-2022, Section 7.2.3.2.

Rooms that are connected by a mechanical ventilation system can be considered a single room area if the mechanical ventilation system meets the requirements of ANSI\ASHRAE Standard 15-2022, Section 7.6.4.

Leak Detection System (Refrigerant charge greater than 3.91 lb per circuit)

The leak detection system consists of one or more refrigerant detection sensors. When the system detects a leak, the following mitigation actions will be initiated until refrigerant has not been detected for at least 5 minutes:

- Energize the supply fan(s) to deliver a required minimum amount of circulation airflow.
- Disable compressor operation.
- Provide an output signal that can be used to fully open zone dampers and/or VAV boxes and disable electric heat in VAV boxes.
- Provide an output signal that can be used to energize additional mechanical ventilation (if needed).
- Units without airflow proving will disable electric heat sources.

Building fire and smoke systems may override this function.

If the refrigerant sensor has a fault, is at the end of its life, or is disconnected, the unit will initiate the mitigation actions. Mitigation actions may be verified by disconnecting the sensor.

The refrigerant sensors do not need service. Use only manufacturer-approved sensors when replacement is required.

Installation

Roof Curb and Ductwork

The roof curbs consist of two main components: a pedestal to support the unit condenser section and a full perimeter enclosure to support the unit's air handler section.

Before installing any roof curb, verify the following:

- It is the correct curb for the unit.
- It includes the necessary gaskets and hardware.
- The purposed installation location provides the required clearance for proper operation.
- 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 is 4-inch end-to-end and 2-inch side-to-side.*

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.*

Unit Rigging and Placement

⚠ WARNING

Heavy Object!

Failure to follow instructions below could result in unit dropping which could result in death or serious injury, and equipment or property-only damage.

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.

1. To configure the unit Center-of-Gravity, utilize Trane Select Assist or contact the local Trane sales office.
2. Test lift the unit to ensure it is properly rigged and balanced, make any necessary rigging adjustments.For 10 foot wide units, remove all shipping supports prior to setting unit on roof curb. Failure to do so will result in roof curb and/or unit damage.
3. 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 below.

Figure 15. Typical unit base and roof curb cross section

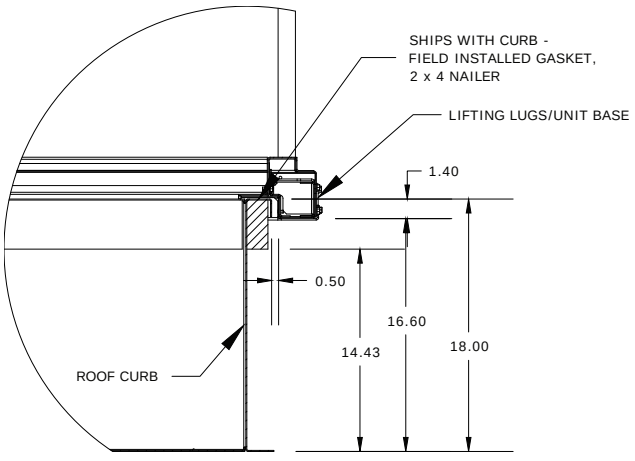
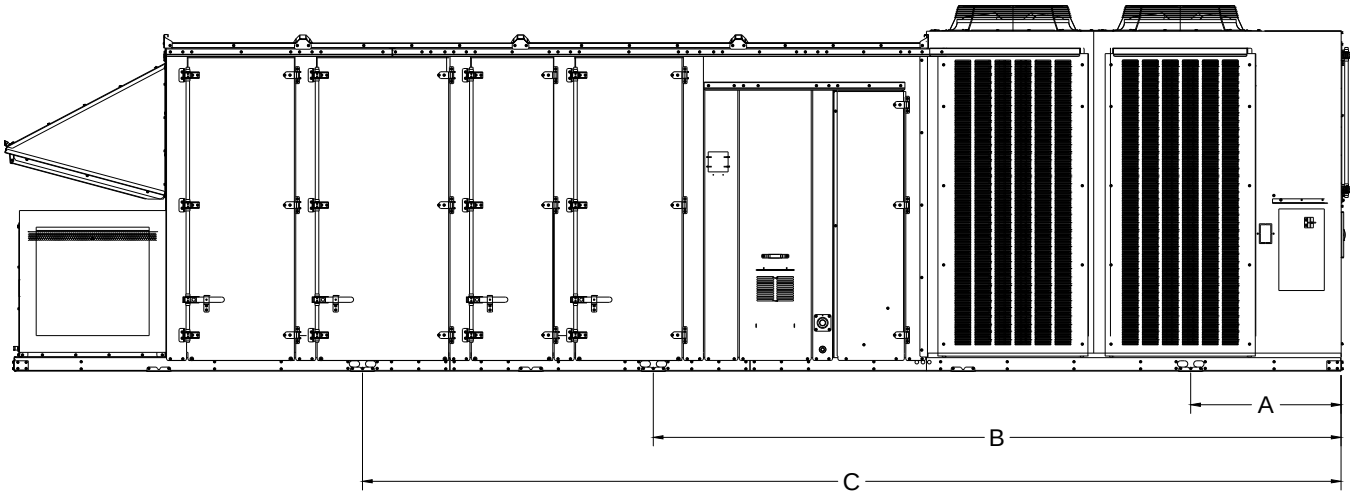


Figure 16. Lug locations



Cabinet	Tonnage	RA/RX	Cartridge Filter	Efficiency	A	B	C
A	20, 25, 30	RA	Yes	All	36	NA	161
			No	All	36	NA	142
		RX	Yes	All	36	NA	211
			No	All	36	NA	192
B	40,50,55	RA	Yes	All	36	NA	202
			No	All	36	NA	183
		RX	Yes	All	36	165	254
			No	All	36	165	235
C	60	RA	Yes	All	36	111	202
			No	All	36	111	183
		RX	Yes	All	36	165	254
			No	All	36	165	235
C	70,75	RA	Yes	High/Eflex	36	165	262
			Yes	Std	36	111	202
			No	High/Eflex	36	165	231
			No	Std	36	111	183
		RX	Yes	High/Eflex	36	165	314
			Yes	Std	36	165	254
			No	High/Eflex	36	165	283
			No	Std	36	165	235

General Installation 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.

- ☐ Complete "Unit Inspection," p. 11 checklist.
- ☐ 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. Do not use the unit to support the weight of the ducting.
- ☐ Install pitch pocket for power supply through building roof. (If applicable).

Setting 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 hold-down bolts from the supply fans.
- ☐ Check all supply fan spring isolators for proper adjustment.
- ☐ Verify all discharge line service valves (one per circuit) are back seated.
- ☐ Energize compressor crankcase heaters. Allow heaters to operate for 8 hours prior to starting the refrigeration system.

Main Electrical Power

NOTICE

Use Copper Conductors Only!

Failure to use copper conductors could result in equipment damage as the equipment was not designed or qualified to accept other types of conductors.

- ☐ Verify that the power supply complies with the unit nameplate specifications. Refer to Main Unit Power Wiring in the Installation chapter.
- ☐ 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 variable air volume controls as applicable.

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

Electric Heat

- ☐ Verify that the power supply complies with the electric heater specifications on the unit and heater nameplate.
- ☐ Inspect the heater terminal plate and control panel; tighten any loose connections.
- ☐ Check electric heat circuits for continuity.

Units with 200V or 230V Electric Heat

Requires separate power supply to heater.

- ☐ Connect properly sized and protected power supply wiring for the electric heat control box from a dedicated, field supplied/installed disconnect to terminal block, or to an optional unit-mounted disconnect switch.
- ☐ Ensure the disconnect cover is reinstalled after connections are made.

Gas Heat

- ☐ Gas supply line properly sized and connected to the unit gas train.
- ☐ Properly sized unit gas regulator installed to regulate pressure from supply.
- ☐ 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 and Burner Tubes are clear of any obstructions.
- ☐ Factory supplied rain shield installed over combustion air inlet panel (40-75T units only).
- ☐ LP (Propane) kit parts or high altitude orifices installed (if required).
- ☐ 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.

O/A Pressure Sensor and Tubing Installation

- ☐ Factory supplied pneumatic tubing installed between the O/A pressure sensor and the connector on the the outside air intake hood..

☐ (Units with StatiTrac) Field supplied pneumatic tubing connected to the proper fitting in the main control box, and the other end routed to a suitable sensing location within the controlled space.

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!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

When it is 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.

Voltage Imbalance

Excessive three phase voltage imbalance between phases will cause motors to overheat and eventually fail. The maximum allowable voltage imbalance is 2 percent. Measure and record the voltage between phases 1, 2, and 3 and calculate the amount of imbalance as follows:

percent Voltage Imbalance =

$$100x\frac{AV - VD}{AV}$$

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:

$$\frac{221 + 230 + 227}{3} = 226\,Avg$$

VD (reading farthest from average) = 221

The percentage of Imbalance equals:

$$100x\frac{226 - 221}{226} = 2.2\%$$

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.

Electrical Data

Electrical Service Sizing

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) and MOP (Maximum Overcurrent Protection). 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.)

Load Definitions	
LOAD 1	Current of the largest motor (compressor or fan motor)
LOAD 2	Sum of the currents of all remaining motors
LOAD 3	Current of electric heaters
LOAD 4	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.*

Set 2: Rooftop units with Electric Heat

Single Source Power units (460V and 575V)

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

heating mode as follows. (Keep in mind when determining LOADS that the compressors and condenser fan motors don't run while the unit is in heating mode).

For units using heaters less than 50 kW:

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

For units using heaters equal to or greater than 50 kW:

MCA = 1.25 x (LOAD1 + LOAD2 + LOAD4) + (1.0 x 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. If the selected MOP value is less than 125 percent of the current rating of the electric heat load, select the next higher 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.*

Dual Source Power units (200–230V with Electric Heat)

These units will have two circuit values shown on the nameplate. The first circuit value will be the refrigeration (cooling mode) values calculated per Set 1. The second set of circuit values shown on the nameplate will be for the electric heating circuit as follows.

For units using heaters less than 50 kW:

MCA = (1.25 x LOAD3)

For units using heaters equal to or greater than 50 kW:

MCA = (1.0 x LOAD3)

MOP = (1.25 x LOAD3)

Select a fuse rating for the electric heating circuit that is equal to the MOP value obtained in the equation above. If the MOP value does not equal a standard fuse size as listed in NEC 240-6, select the next lower standard fuse rating (see note below for exception). If the selected MOP value is less than 125 percent of the current rating of the electric heat load, select the next higher standard fuse rating.

Note: *If the available MOP option is less than the MCA obtained in the equation above, then reselect the lowest standard maximum fuse size which is equal to, or larger, than the MCA, provided the reselected fuse size does not exceed 800 amps.*

Service Sizing Data

Table 6. Compressor electrical service sizing data (20 to 75 tons)

Tons	No. of Compressors	200 V		230 V		460 V		575 V	
		RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)
20V	1[a]	48.4	NA	42.1	NA	21.1	NA	16.9	NA
	1	40.3	267	40.3	267	19.2	142	15.9	103
25H	1	27.8	203	27.8	203	14.6	98	12.6	84
	2	40.3	267	40.3	267	19.2	142	15.9	103
25V	1[a]	56.7	NA	49.3	NA	24.7	NA	19.7	NA
	1	44	304	42.3	304	21.8	147	17.2	122
30S	1	27.8	203	27.8	203	14.6	98	12.6	84
	2	40.3	267	40.3	267	19.2	142	15.9	103
30H	1	27.8	203	27.8	203	14.6	98	12.6	84
	2	44	304	42.3	304	21.8	147	17.2	122
30V	1[a]	63.5	NA	55.2	NA	27.6	NA	22.1	NA
	1	50.7	315	46.4	315	23.2	158	19.2	136
40S	2	34.4	267	31.5	267	17.9	142	15.2	103
	2	40.3	267	40.3	267	19.2	142	15.9	103
40H	2	34.4	267	31.5	267	17.9	142	15.2	103
	2	40.3	267	40.3	267	19.2	142	15.9	103
40V	1[a]	63.5	NA	55.6	NA	27.9	NA	22.3	NA
	2	40.3	267	40.3	267	19.2	142	15.9	103
50S	1	40.3	267	40.3	267	19.2	142	15.9	103
	3	44	304	42.3	304	21.8	147	17.2	122

Table 6. Compressor electrical service sizing data (20 to 75 tons) (continued)

Tons	No. of Compressors	200 V		230 V		460 V		575 V	
		RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)	RLA (ea.)	LRA (ea.)
50H	2	40.3	267	40.3	267	19.2	142	15.9	103
	2	44	304	42.3	304	21.8	147	17.2	122
50V	1[a]	74.4	NA	64.7	NA	32.4	NA	25.9	NA
	2	44	304	42.3	304	21.8	147	17.2	122
55S	2	44	304	42.3	304	21.8	147	17.2	122
	2	45.9	315	45.6	315	21.8	158	19.2	136
55H	4	44	304	42.3	304	21.8	147	17.2	122
55V	1[a]	85.1	NA	74	NA	37	NA	29.6	NA
	2	45.9	315	45.6	315	21.8	158	19.2	136
60S	2	50.7	315	46.4	315	23.2	158	19.2	136
	2	61.5	345	56.3	345	28.2	155	23.2	126
60H	2	50.7	315	46.4	315	23.2	158	19.2	136
	2	61.5	345	56.3	345	28.2	155	23.2	126
60V	1[a]	84.3	NA	73.3	NA	36.7	NA	29.4	NA
	2	61.5	345	56.3	345	28.2	155	23.2	126
70S	4	61.5	345	56.3	345	28.2	155	23.2	126
70H	4	61.5	345	56.3	345	28.2	155	23.2	126
70V	1[a]	80.7	NA	70.1	NA	35.1	NA	28.1	NA
	1	60.1	320	53.3	320	26.7	160	21.3	135
	2	44	304	42.3	304	21.8	147	17.2	122
75S	4	61.5	345	56.3	345	28.2	155	23.2	126
75H	4	61.5	345	56.3	345	28.2	155	23.2	126
75V	1[a]	65	NA	56.9	NA	28.5	NA	22.8	NA
	1	60.1	320	53.3	320	26.7	160	21.3	135
	2	61.5	345	56.3	345	28.2	155	23.2	126

[a] Variable Speed Compressor

Table 7. Condenser fan electrical service sizing data (20-75 ton)

Tonnage	No. of Motors	200 V	230 V	460 V	575 V
		FLA (ea.)	FLA (ea.)	FLA (ea.)	FLA (ea.)
20 Std	2	5.4	5.4	2.7	2.2
20 Low Ambient	1[a]	5.6	5.6	2.9	2.4
	1	5.4	5.4	2.7	2.2
25 Std	2	5.4	5.4	2.7	2.2
25 Low Ambient	1[a]	5.6	5.6	2.9	2.4
	1	5.4	5.4	2.7	2.2
30 Std	2	5.4	5.4	2.7	2.2
30 Low Ambient	1[a]	5.6	5.6	2.9	2.4
	1	5.4	5.4	2.7	2.2
40 Std	4	5.4	5.4	2.7	2.2
40 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	2	5.4	5.4	2.7	2.2
50 Std	4	5.4	5.4	2.7	2.2
50 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	2	5.4	5.4	2.7	2.2
55 Std	4	5.4	5.4	2.7	2.2
55 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	2	5.4	5.4	2.7	2.2
60 Std	6	4.1	4.1	1.8	1.4
60 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	4	4.1	4.1	1.8	1.4
70 Std	6	4.1	4.1	1.8	1.4
70 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	4	4.1	4.1	1.8	1.4

Table 7. Condenser fan electrical service sizing data (20-75 ton) (continued)

Tonnage	No. of Motors	200 V FLA (ea.)	230 V FLA (ea.)	460 V FLA (ea.)	575 V FLA (ea.)
75 Std	6	4.1	4.1	1.8	1.4
75 Low Ambient	2[a]	5.6	5.6	2.9	2.4
	4	4.1	4.1	1.8	1.4

[a] Variable Speed Fan

Table 8. Electrical service sizing data —electric heat module (electric heat units only) — 20 to 75 tons

Module kW	Voltage (Amps)			
	200 V	230 V	460 V	575 V
30	62.5	72.2	36.1	28.9
60	124.9	144.3	72.2	57.7
90	187.4	216.5	108.3	86.6
120	233.2	269.4	144.3	115.5
150	NA	NA	180.4	144.3
190	NA	NA	224.9	182.8

Note: Electric heat FLA are determined at 208, 240, 480 and 600 volts.

Table 9. Electrical service sizing data — Supply fan motors — 20 to 75 tons

	200 V FLA (ea.)	230 V FLA (ea.)	460 V FLA (ea.)	575 V FLA (ea.)
Motor Horsepower	**Supply Fan Motor (4 pole) with VFD Bypass**			
1.5	5.6	5.6	3.5	3.7
3	14.1	14.1	4.7	3.7
5	21.0	14.1	8.3	5.3
7.5	41.0	21.0	11.2	8.7
10	41.0	41.0	15.1	11.9
15	52.7	41.0	22.1	16.5
20	56.1	52.7	29.9	22.5
25	70.1	65.0	35.2	27.0
Motor Horsepower	**Supply Fan Motor (6 pole) with VFD Bypass**			
1.5	6.1	5.6	3.5	3.7
3	14.1	14.1	4.7	3.7
5	21.0	14.8	8.3	5.6
7.5	41.0	22.0	11.2	11.9
10	41.0	41.0	22.1	16.5
15	52.7	41.0	22.1	16.5
20	65.0	54.0	29.9	27.0
Motor Horsepower	**Supply Fan Motor (4 pole) with out VFD Bypass**			
1.5	5.6	5.6	3.5	3.7
3	14.1	14.1	4.7	3.7
5	21.0	14.1	8.3	5.0
7.5	41.0	21.0	11.2	8.7
10	41.0	41.0	15.1	11.9
15	52.7	41.0	22.1	16.5
20	52.7	52.7	29.9	22.5
25	65.0	65.0	35.2	27.0
Motor Horsepower	**Supply Fan Motor (6 pole) with out VFD Bypass**			
1.5	5.6	5.6	3.5	3.7
3	14.1	14.1	4.7	3.7
5	21.0	14.1	8.3	5.0
7.5	41.0	21.0	11.2	11.9
10	41.0	41.0	22.1	16.5
15	52.7	41.0	22.1	16.5
20	52.7	52.7	29.9	27.0

Notes:

1. FLA is for individual motors by HP, not total unit supply and relief fan HP
2. Supply fans selected under 1,600 RPM will have 6-pole motors

Table 10. Electrical service sizing data — Relief fan motors — 20 to 75 tons

Tonnage	HP (Total)	No. of Motors	200 V	230 V	460 V	575 V
			FLA (ea.)	FLA (ea.)	FLA (ea.)	FLA (ea.)
20	6	1	12.8	12.8	6.3	N/A
20	8[a]	1	19.5	19.5	9.0	N/A
25	6	1	12.8	12.8	6.3	N/A
25	8[b]	1	18.2	18.2	9.3	N/A
30	8[b]	1	18.2	18.2	9.3	N/A
30	12	2	12.8	12.8	6.3	N/A
40	8[b]	1	18.2	18.2	9.3	N/A
40	15[a]	2	19.5	19.5	9.0	N/A
50	12	2	12.8	12.8	6.3	N/A
50	16[b]	2	18.2	18.2	9.3	N/A
55	12	2	12.8	12.8	6.3	N/A
55	16[b]	2	18.2	18.2	9.3	N/A
60	16[b]	2	18.2	18.2	9.3	N/A
60	23[a]	3	19.5	19.5	9.0	N/A
70	16[b]	2	18.2	18.2	9.3	N/A
70	23[a]	3	19.5	19.5	9.0	N/A
75	16[b]	2	18.2	18.2	9.3	N/A
75	23[a]	3	19.5	19.5	9.0	N/A

[a] 23" fan diameter
[b] 25.5" fan diameter

Table 11. Electrical service sizing data (amps) - control power transformer heating and cooling modes - 20 to 75 tons

Nom Tons	Digit 2 Unit Function	Voltage			
		200	230	460	575
		FLA	FLA	FLA	FLA
All	All	10	10	4.5	3.5

Table 12. Voltage utilization range

Unit Voltage	Voltage Utilization Range
200/60/3	180-220
230/60/3	207-253
460/60/3	414-506
575/60/3	517-633

Main Unit Power Wiring

Table 13, p. 42 lists the field connection wire ranges for both the main power terminal block 2XD1 and the optional main power disconnect switch 2QB1. Service Sizing Data lists 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 equations listed in the product catalog to determine the following:

- The appropriate electrical service wire size based on Minimum Circuit Ampacity (MCA)
- The Maximum Over Current Protection (MOP) device

⚠ WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

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/national electrical codes.

⚠ WARNING

Electrical Shock Hazard!

Failure to follow instructions below could result in death or serious injury.

Properly connect the system's oversized protective earthing (grounding) terminal(s).

The location of the electrical service entrance is illustrated in Figure 17, p. 42. It is important to complete the unit power wiring connections onto either the main terminal block or the factory mounted, non-fused disconnect switch. The disconnect switch is inside the unit power box. Refer to the diagrams that shipped with the unit for specific termination points.

Provide proper grounding for the unit in accordance with local and national codes.

Figure 17. Typical field power wiring (20 to 75 ton)

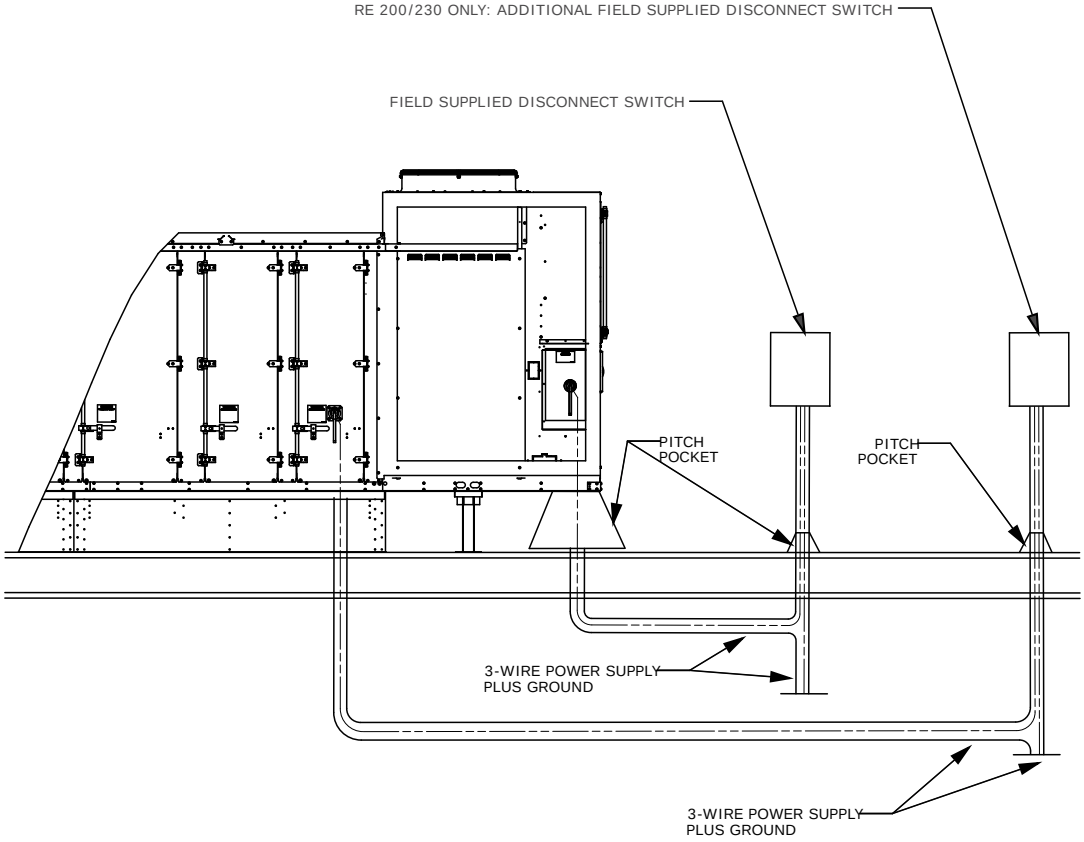


Table 13. Customer connection wire range

Units with Main Power Terminal Block (All Voltages)			Units with Main Power Disconnect Switch (All Voltages)		
Block Size	**Wire Qty**	**Connector Wire Range**	**Block Size**	**Wire Qty**	**Connector Wire Range**
510 AMP	2	#6 — 250 kcmil	250 AMP	1	3/0 - 350 kcmil
760 AMP	2	#4 — 500 MCM	400 AMP	2	2/0 - 500 kcmil
—	—	—	600 AMP	2	2/0 - 500 kcmil

Note: Block size and disconnect size are calculated by selecting the size greater than or equal to 1.15 x (Sum of Unit Loads). See unit literature for unit load values.

250A Disconnect switch wire binding screws

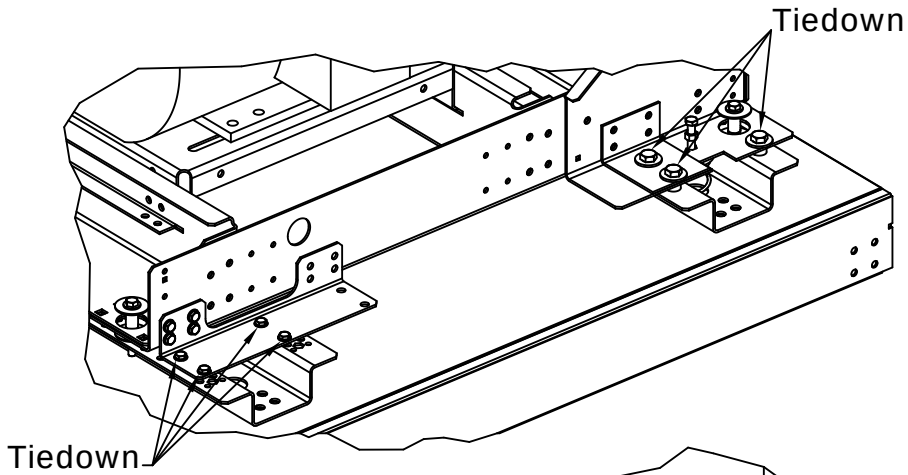
The 250A disconnect switch (standard and high SCCR) installed for main power connection accommodates 4 AWG – 350 kcmil wires on the OFF side. As shipped from the factory, the wire binding screws only accommodate 3/0 AWG – 350 kcmil wires. If 4 AWG – 2/0 AWG field power wiring is used, then the factory installed wire binding screws must be replaced with those that are provided with the kit installed near the disconnect switch (these screws should have a blue top surface). See the kit for instructions on changing the wire binding screws.

Supply Fans

Remove Shipping Tie Down

Remove supply fan shipping tie down hardware. There are four places on each fan where hardware needs to be removed, shown in Figure 18, p. 43. Gently spin each fan to verify there is no wheel-to-cone interference. If adjustment is required, loosen fan shaft set screw and reposition fan to get correct wheel/cone overlap.

Figure 18. Remove shipping tie-downs



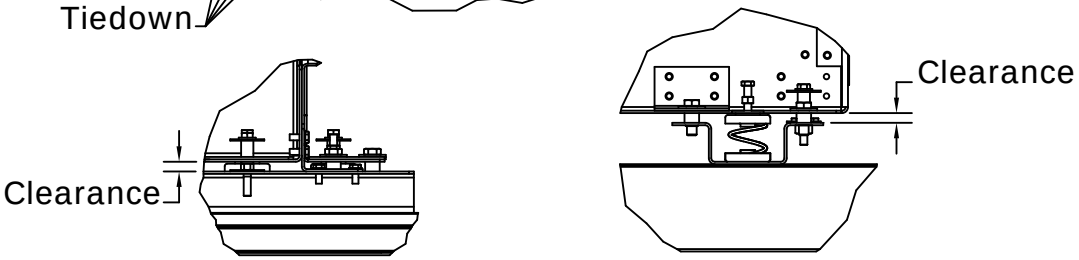
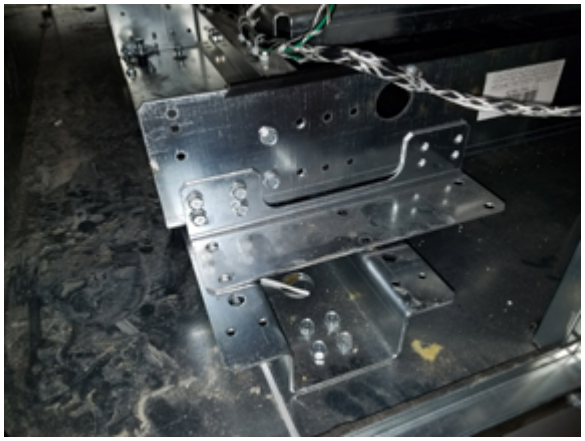


Figure 19. Shipping tie-down



Important: *Do NOT remove electrical ground wire strap.*

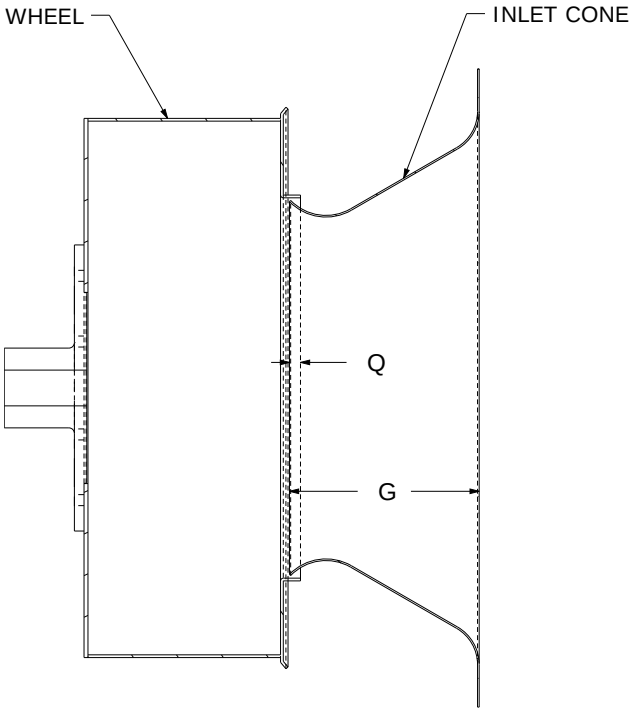
Table 14. Supply fan cone overlap measurements

Fan Size	Cone Width G (in.)	Overlap Q (in.)
165	5.18	0.18
182	6.44	0.38

Table 14. Supply fan cone overlap measurements (continued)

Fan Size	Cone Width G (in.)	Overlap Q (in.)
200	7.05	0.41
222	7.83	0.45
245	8.62	0.50
270	9.45	0.55

Figure 20. Supply fan cone overlap



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 units with modulating relief with 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 range. On CV and VAV units equipped with modulating relief with Statitrac, a space pressure transducer and the outside air sensor is used to control the relief fan and dampers to relieve static pressure to within a customer-specified range, within the controlled space.

Use the following steps and image to install the sensor and the pneumatic tubing.

1. Remove the O/A pressure sensor kit located inside the main control box. The kit contains the following items:
   a. O/A static pressure sensor with slotted mounting bracket
   b. 50 ft. tubing
   c. Mounting hardware
2. Install the O/A static pressure sensor horizontally to the roof rail at the return end of the unit.
3. Remove the dust cap from the tubing connector located below the sensor in the vertical support.
4. Attach one end of the 3/16-inch O.D. factory-provided pneumatic tubing to the sensor's top port. Attach the other end of the tubing to the connector in the side of the O/A intake hood (for units without O/A intake, attach to panel at the return end of the unit).

Note: *Use only what is required and discard excess tubing.*

Image Tag Expected within Figure Tag

Figure 21. Outside air tubing schematic

Units with Statitrac

1. Open the control panel, and locate the Space Pressure tubing connector.
2. Connect one end of the field provided 1/4-inch (length 50-100 ft.) or 3/8-inch (length greater than 100 ft.) O.D. pneumatic tubing for the space pressurization control to the fitting.
3. 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 22. Pressure sensing tube location

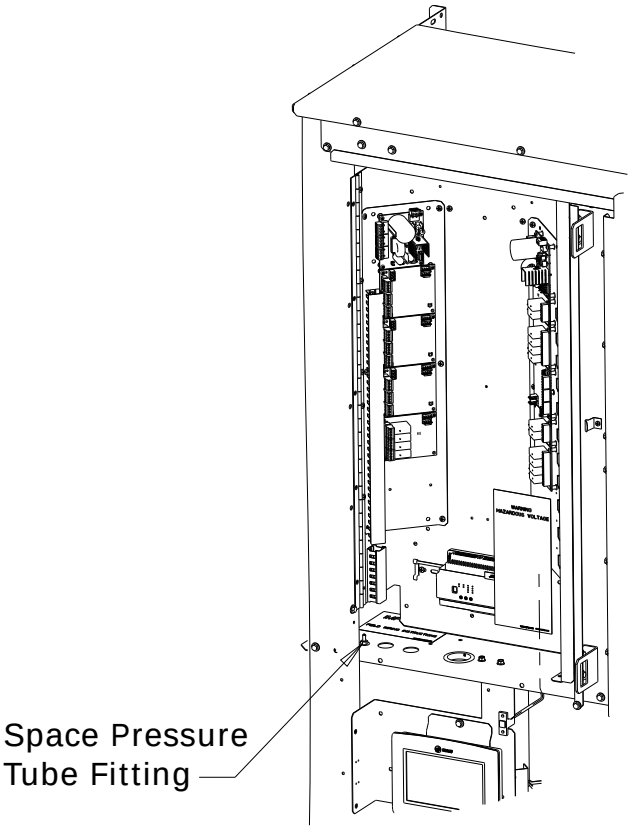
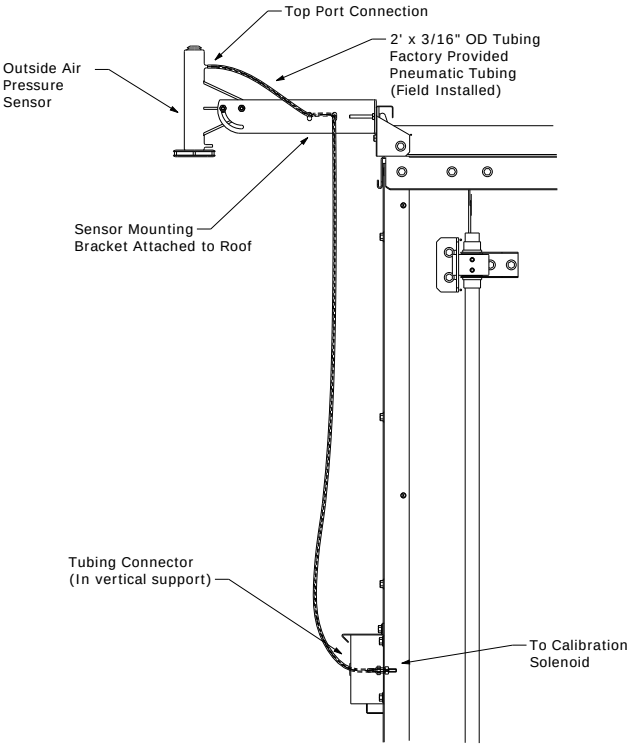


Figure 23. Pressure sensing



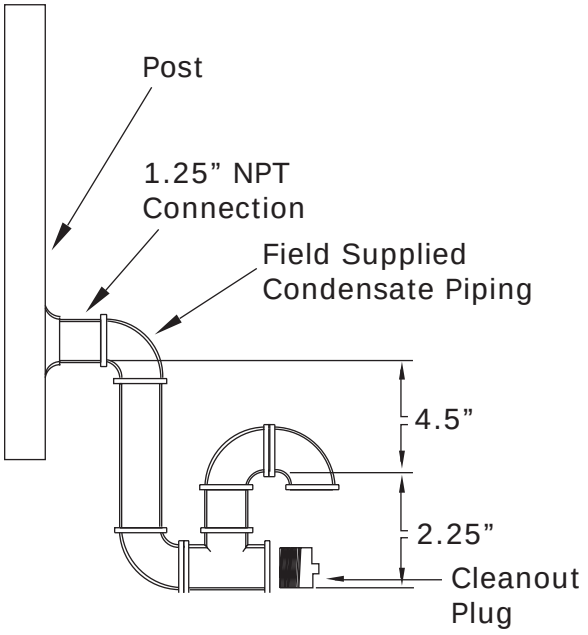
Refrigeration System

Condensate Drain Connections

All condensate drain connections must be connected to the evaporator 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 24, p. 45.

Figure 24. 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”.

Figure 25. Condensate drain locations for units with stacked indoor coils

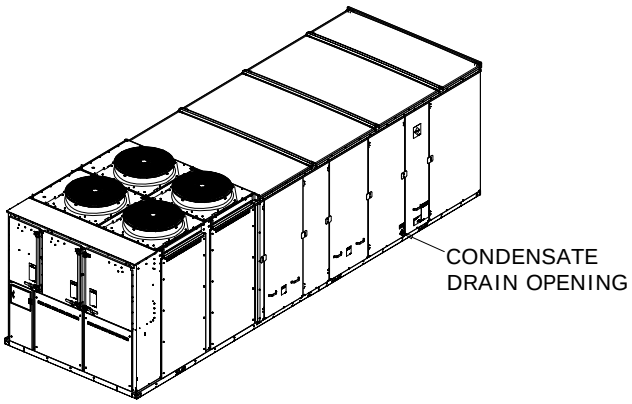
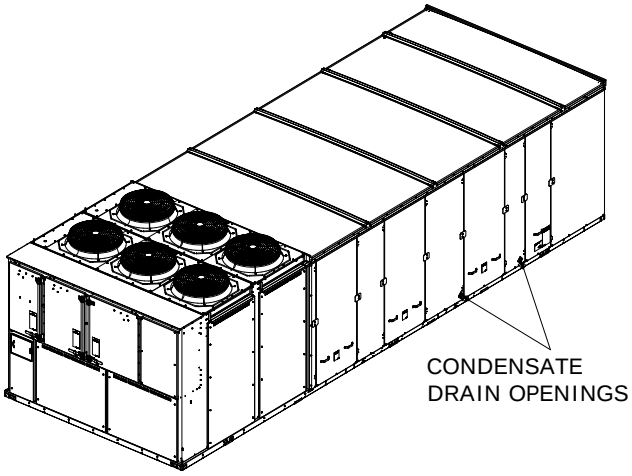


Figure 26. Condensate drain locations for units with staggered indoor coils



Compressor Crankcase Heaters

NOTICE

Compressor Failure!

Failure to follow instruction below could result in compressor failure.

Unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started.

Each scroll compressor is equipped with a crankcase heater.

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.

Table 15. Crankcase heater sizes

Compressor Name	Crankcase Heater Watts
CSHE*	90
VZH088*, VZH117*	
VZH170*	160
CSHP*	

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.

Note: *For conversion from Natural Gas to Propane refer to the LP Converstion Kit (RT-SVN033*-EN) for part numbers and installation instructions.*

⚠ WARNING

Hazardous Gases and Flammable Vapors!

Failure to observe the following instructions could result in exposure to hazardous gases, fuel substances, or substances from incomplete combustion, which could result in death or serious injury. The state of California has determined that these substances may 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 setup of this product and all warnings as provided in this manual.

⚠ WARNING

Explosion Hazard!

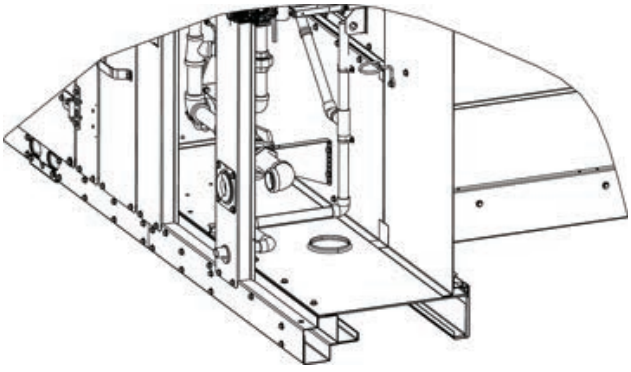
Failure to properly regulate pressure could result in a violent explosion, which could result in death, serious injury, or equipment or property-only-damage.

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.

Access holes are provided on the unit to accommodate a side or bottom pipe entry.

Important: *If bottom pipe entry is used, ensure the opening in the base pan is sealed from water intrusion into the inside of the roof curb.*

Figure 27. 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).*

1. To assure sufficient gas pressure at the unit, use Table 16, p. 48 as a guide to determine the appropriate gas pipe size for the unit heating capacity listed on the unit nameplate.

   Note: *Supply line size should not be sized smaller than the factory piping connection elbow size.*

2. If a gas line already exists, verify that it is sized large enough to handle the additional furnace capacity before connecting to it.
3. 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.
4. 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.
5. Provide a drip leg near the unit.
6. Install a pressure regulator at the unit that is adequate to maintain 7" w.c. for natural gas (or 11" w.c. for propane) while the furnace is operating at full capacity.

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

NOTICE

Gas Valve Damage!

Failure to follow instructions below could result in gas valve damage from incorrect gas pressures, irregular pulsating flame patterns, burner rumble, and potential flame outages.

Use a pressure regulator to properly regulate gas pressure. DO NOT oversize the regulator.

Failure to use a pressure regulating device will result in incorrect gas pressure, which can cause erratic operation due to gas pressure fluctuations as well as damage the gas valve. Oversizing 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. for natural gas (10" w.c. for propane) with all the furnaces operating at full capacity. The gas pressure must not exceed 14" w.c. when the furnaces are off.

7. Provide adequate support for all field installed gas piping to avoid stressing the gas train and controls.

⚠ WARNING

Explosion Hazard!

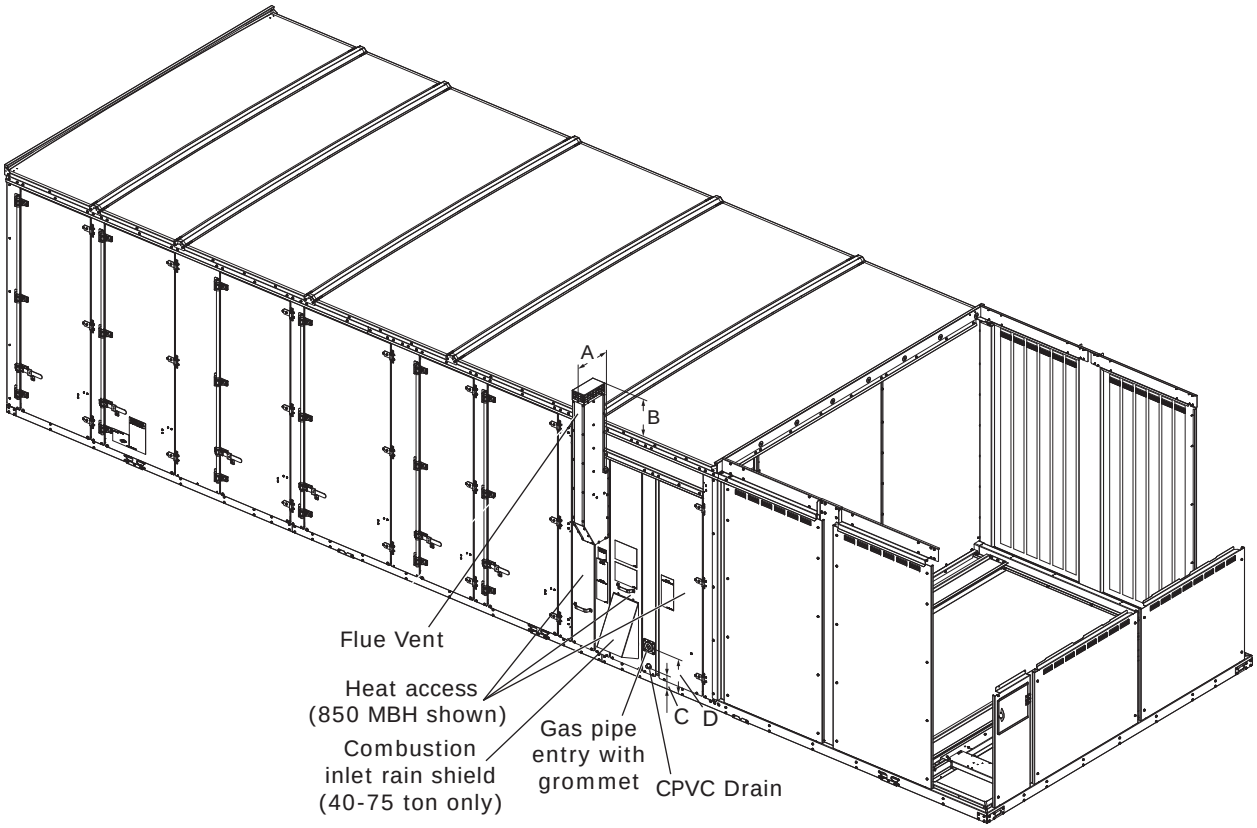
Failure to follow safe leak test procedures below could result in death or serious injury or equipment or property-only-damage.

Never use an open flame to detect gas leaks. Use a leak test solution for leak testing.

8. Leak test the gas supply line using a soap-and-water solution or equivalent before connecting it to the gas train.
9. 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.*

Figure 28. Gas heat component dimensions



Note: See gas piping figures for NPT size

Tonnage	Heater Size	A	B	C	D
20–30	250, 350 & 500 MBh	6.75	7.59	5.29	7.85
40–55	350 MBh	6.75	11.85	5.42	11.58
40–75	500 MBh	6.75	11.85	5.42	11.58
40–75	850 MBh	10.5	18.0	5.42	11.58
60–75	1200 MBh	10.5	13.35	5.42	11.58

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 the following figures, 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 (11" to 14" w.c. for propane).
3. Ensure that the piping is adequately supported to avoid gas train stress.

Table 16. Sizing natural gas pipe mains and branches

Gas SupplyPipe Run (ft)	Gas Input (Cubic Feet/Hour)					
	1¼" Pipe	1½" Pipe	2" Pipe	2½" Pipe	3" Pipe	4" Pipe
10	1,060	1,580	3,050	4,860	8,580	17,500
20	726	1,090	2,090	3,340	5,900	12,000
30	583	873	1,680	2,680	4,740	9,660

Table 16. Sizing natural gas pipe mains and branches (continued)

Gas SupplyPipe Run (ft)	Gas Input (Cubic Feet/Hour)					
	1¼" Pipe	1½" Pipe	2" Pipe	2½" Pipe	3" Pipe	4" Pipe
40	499	747	1,440	2,290	4,050	8,270
50	442	662	1,280	2,030	3,590	7,330
60	400	600	1,160	1,840	3,260	6,640
70	368	552	1,060	1,690	3,000	6,110
80	343	514	989	1,580	2,790	5,680
90	322	482	928	1,480	2,610	5,330
100	304	455	877	1,400	2,470	5,040
125	269	403	777	1,240	2,190	4,460
150	244	366	704	1,120	1,980	4,050
175	224	336	648	1,030	1,820	3,720
200	209	313	602	960	1,700	3,460

Notes:

1. Table is based upon specific gravity of 0.60. Refer to the latest edition of the National Fuel Gas Code, Z223.1, unless superseded by local gas codes.
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. 49
   Cu.Ft/Hour = 850
   The above table 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. Natural gas – high altitude gas input rating reduction orifice chart

Heater size (MBh)	0-2000'	3000'	4000'	5000'	6000'	7000'	8000'	9000'	10000'
250	#34	#36	#36	#37	#37	#38	#39	#40	#42
350	#32	#34	#35	#35	#36	#36	#37	#38	#40
500	#34	#36	#36	#37	#37	#38	#39	#40	#42
850	#34	#36	#36	#37	#37	#38	#39	#40	#42
1200	3.00 mm	#34	#35	#35	#36	#36	#37	#38	#40

Note: Orifice sizes required to reduce input ratings by 4% per every 1000’ above 2000’ per the National Fuel Gas Code Z223.1.

Table 19. Propane (LP) – high altitude rating reduction orifice chart

Heater size (MBh)	0-2000'	3000'	4000'	5000'	6000'	7000'	8000'	9000'	10000'
250	1.75 mm	#51	#51	#51	#52	#52	#52	#53	#53
350	#49	#50	#50	#51	#51	#51	#52	#52	#52
500	#50	#51	#51	#51	#52	#52	#52	#53	#53
850[(a)]	1.65 mm	#52	#53	#53	#53	#53	#54	#54	#54
1200	1.9 mm	#49	#49	#50	#50	#50	#51	#51	#52

Note: Orifice sizes required to reduce input ratings by 4% per every 1000' above 2000' per the National Fuel Gas Code Z223.1.

(a) 850,000 Btu/Hr at Sea Level input is 737,000 Btu/Hr

Figure 29. Unit gas trains 250/350 MBh two stage/ modulating

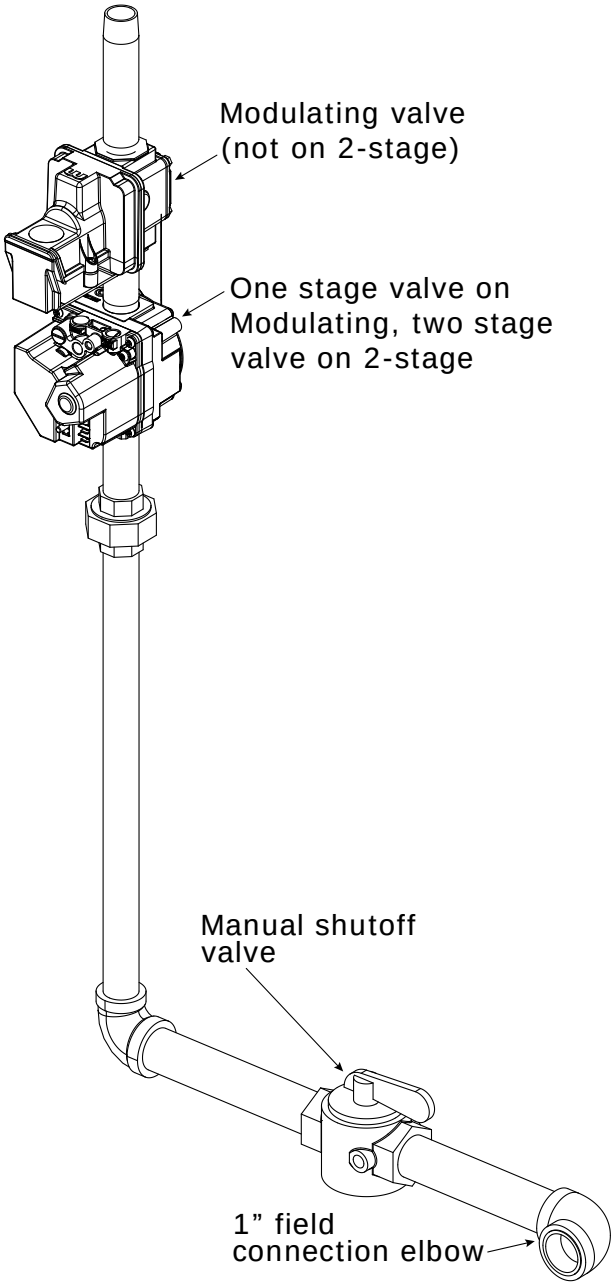


Figure 30. Unit gas trains 250/350 MBh ultra modulating and 500 MBh two stage/modulating

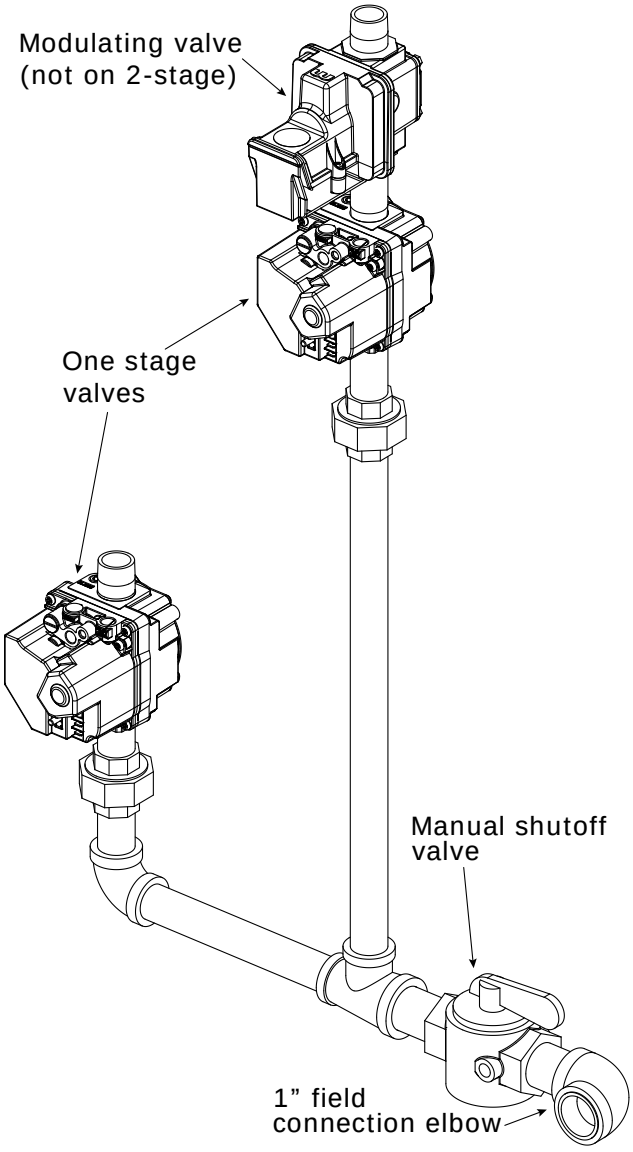


Figure 31. Unit gas trains 500 MBh ultra modulating

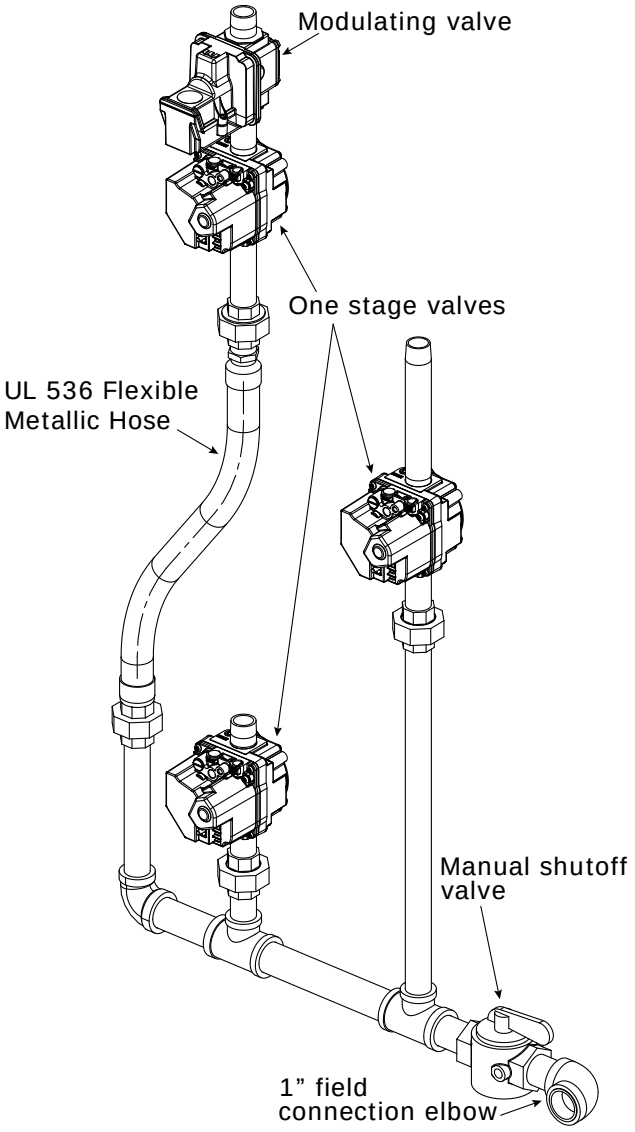
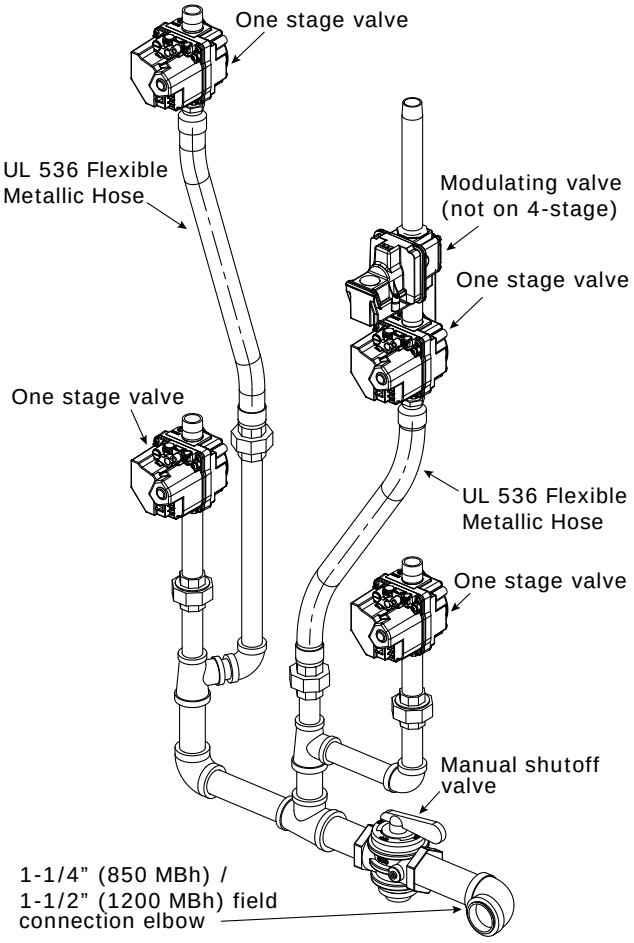


Figure 32. Unit gas trains 850/1200 MBh four-stage/ modulating/ultra modulating



Flue Assembly and Rain Shield Installation

1. Locate the flue vent chimney, vent elbow, and, if required, the rain shield in the supply fan section of the unit.

   Notes:

   1. *Remove shipping covers prior to installation.*
   2. *See the Flue Vent for IntelliPak™ with Symbio™ 800 Controller 20-75Ton Installation Guide RT-SVN030*-EN for more detailed instructions.*

2. Install the flue vent elbow onto the inducer motor housing using the provided sealing caulk and screws.
3. Install the flue vent chimney to the exterior of the flue post.
4. Install the rain shield (40-75 ton units only) over the combustion intake slots on the exterior of the vented access panel.

Gas Furnace Condensate Drain

Units equipped with a gas furnace have a 3/4-inch 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 28, p. 48 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.*

Electric Heat Units

Electric heat units operating on 200/230 volts require two power supplies as illustrated in Figure 17, p. 42. Unless the unit was ordered with the optional factory mounted, non-fused disconnect switches, two field-supplied disconnect switches must be installed per NEC requirements. The power wires for the electric heat are routed into the electric heat control panel using the through-the-base access provided in the heating section. Refer to the unit base layout for dimensional data. For units operating on 460/575 volts, only one field installed disconnect switch is required.

Use the information provided in the Power Wire Sizing and 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.

Economizer and Relief Air Damper Adjustment

Relief Air Dampers

Verify that the relief dampers (if equipped) close tightly when the unit is off.

If relief dampers are not tightly closed with unit off, take the following steps to preload the dampers:

1. Loosen the relief damper actuator clamp from the jackshaft
2. From the unit display, command the actuators to 4% open using the Manual mode. This will cause the actuators to rotate to approximately 5 degrees.
3. Close the dampers by hand and tighten the actuator onto the jackshaft
4. Command the dampers to 0%. This will cause the actuators to rotate back to zero degrees, putting load on the dampers so that they are fully closed at 0% command.
5. Put the relief damper position back into Auto mode.

Outside Air and Return Air Damper Operation

The outside air and return air damper linkage is accessible from the economizer 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.

⚠ WARNING

No Step Surface!

Failure to follow instruction below could result in death or serious injury.

Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse and result in the operator/technician falling.

Note: *Bridging between the unit main supports may consist of multiple 2 x 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 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 or return air damper travel in order to balance the pressure drop between the two air paths.

Adjust the Outside Air Damper Travel

Units with Single Actuators (20 - 55 Ton)

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, then average the reading.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Important: *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 fused disconnect switch to the On position.

⚠ WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

When it is 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.

⚠ WARNING

Rotating Components!

Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

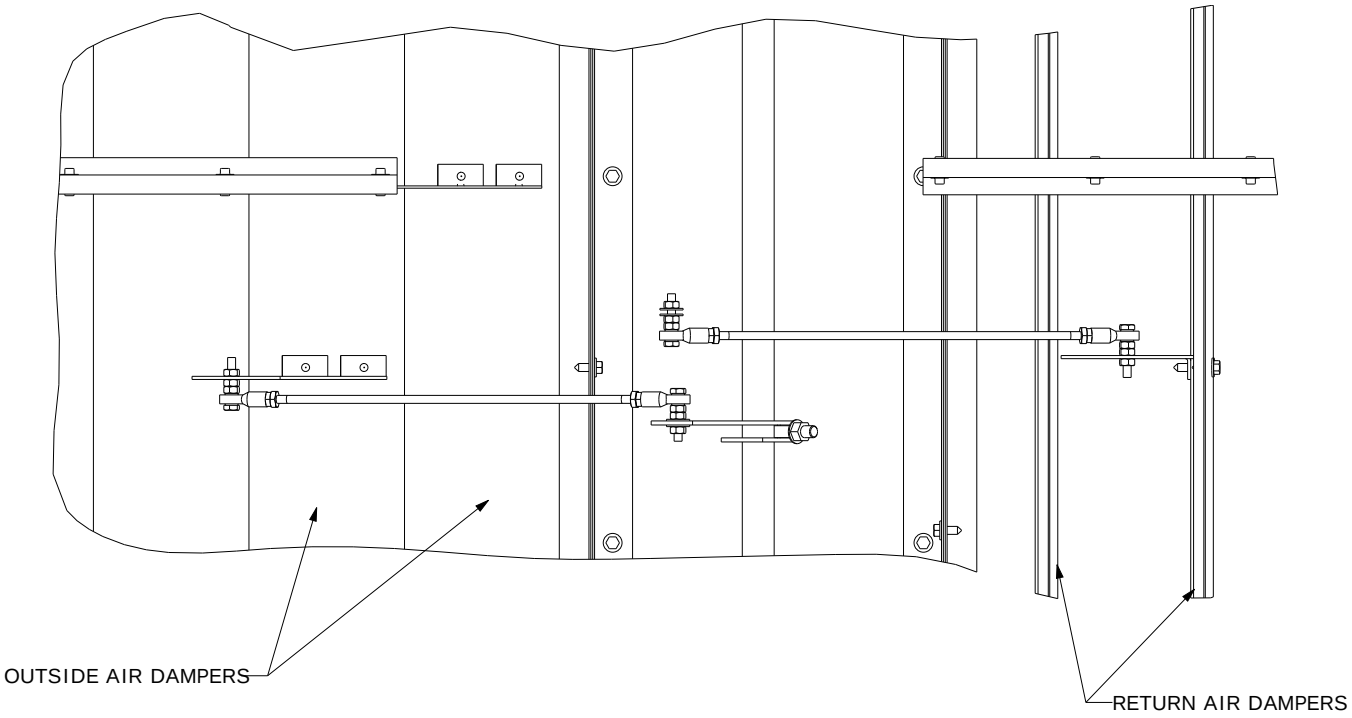
Important: *This procedure is for A&B cabinets (20–55 Ton) only.*

4. Compare the static pressure reading to the static pressure ranges and linkage positions in Table 21, p. 56 or Table 22, p. 57 for the unit configuration, unit size and operating CFM.

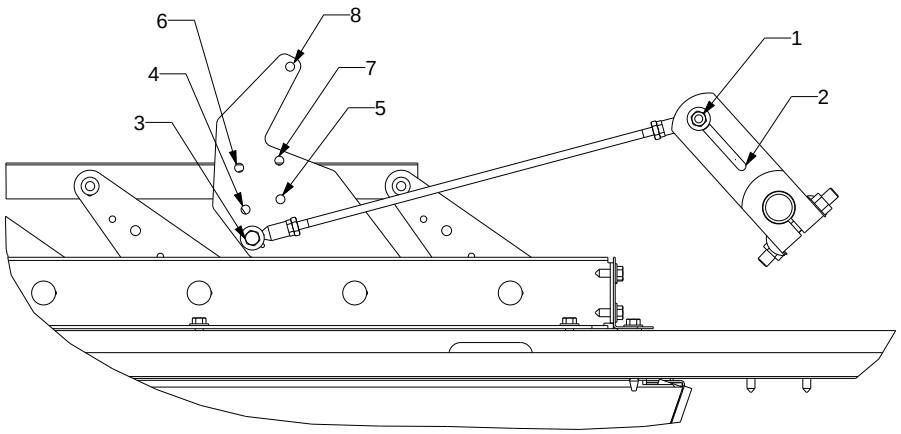
   If the static pressure reading is greater than the pressure listed in Table 21, p. 56 or Table 22, p. 57 for outside air damper position 1 then relocate the outside air connecting rod to balance the outside air damper pressure drop against the return static pressure, using the following steps.

   If the static pressure reading is less than the pressure listed in Table 21, p. 56 or Table 22, p. 57 for outside air damper position 1, then determine the appropriate pressure increase needed. Identify the correct return damper linkage location using Table 23, p. 57. Then, relocate the return air connecting rod to balance the outside air damper pressure drop against the return static pressure using the procedure starting in Step 10. If no adjustment is necessary, proceed to the last step.
5. On the outside air damper remove the drive rod and swivel from the crank arm(s). If only one hole requires changing, loosen only that end.
6. Manually open the outside air dampers to the full open position.
7. Manually close the return air dampers.
8. 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.
9. Tighten the lock nut against the swivel(s). Proceed to the last step.
10. On the return air damper remove the drive rod and swivel from the crank arm(s). If only one hole requires changing, loosen only that end.
11. Manually open the return air dampers to the full open position.
12. Manually close the outside air dampers.
13. 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.
14. Tighten the lock nut against the swivel(s).
15. Plug the holes (made during Step 1) after the proper adjustments have been made.

Figure 33. Outside air damper



BOTTOM VIEW
OUTSIDE AIR DAMPERS



BOTTOM VIEW
RETURN AIR DAMPERS

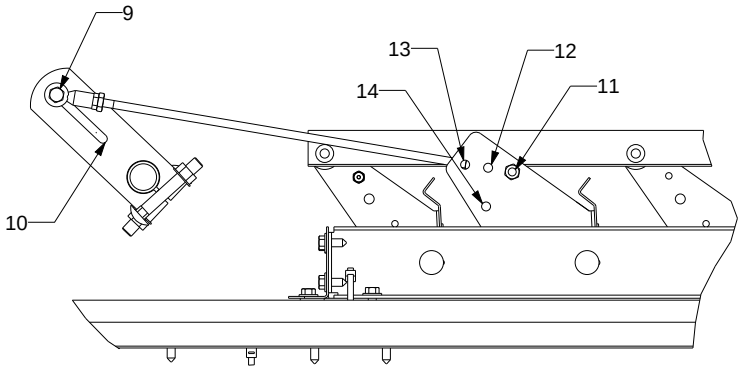


Table 20. Outside air damper travel adjustment

Position	Outside Air Damper Crank Arm Hole Configuration		Return Air Damper Crank Arm Hole Configuration	
1	1 - 3	90°	9 - 11	90°
2	1 - 4	75°	9 - 12	75°
3	1 - 6	60°	9 - 13	65°
4	2 - 5	40°	10 - 14	40°
5	2 - 7	31°		
6	2 - 8	20°		

Table 21. Outside air damper pressure drop — No Traq™

No Traq™						
	Outside Air Damper Position					
CFM	#1	#2	#3	#4	#5	#6
20, 25 and 30 Ton						
4000	0.06	0.07	0.08	0.16	0.24	0.87
6000	0.11	0.14	0.17	0.36	0.60	2.78
7000	0.14	0.21	0.25	0.49	0.83	-
8000	0.18	0.28	0.35	0.65	1.11	-
9000	0.22	0.36	0.46	0.83	1.42	-
10000	0.27	0.45	0.58	1.02	1.78	-
11000	0.32	0.56	0.72	1.24	2.17	-
12000	0.37	0.67	0.88	1.48	2.60	-
13000	0.43	0.80	1.05	1.74	-	-
40, 50 and 55 Ton						
8000	0.17	0.34	0.40	0.84	1.69	-
10000	0.25	0.47	0.56	1.24	2.48	-
12000	0.36	0.60	0.73	1.72	-	-
14000	0.48	0.75	0.93	2.28	-	-
16000	0.62	0.92	1.15	2.91	-	-
18000	0.78	1.09	1.38	-	-	-
20000	0.95	1.28	1.64	-	-	-
22000	1.14	1.49	1.92	-	-	-
24000	1.34	1.71	2.22	-	-	-

Table 22. Outside air damper pressure drop — Traq™

Traq™						
	Outside Air Damper Position					
CFM	#1	#2	#3	#4	#5	#6
20, 25 and 30 Ton						
4000	0.07	0.08	0.09	0.17	0.26	0.89
6000	0.15	0.18	0.21	0.40	0.64	2.82
7000	0.20	0.26	0.31	0.56	0.90	-
8000	0.26	0.35	0.43	0.73	1.19	-
9000	0.32	0.45	0.56	0.93	1.53	-
10000	0.40	0.57	0.71	1.15	1.91	-
11000	0.47	0.70	0.88	1.40	2.33	-
12000	0.56	0.85	1.06	1.67	2.79	-
13000	0.65	1.01	1.27	1.97	-	-
40, 50 and 55 Ton						
8000	0.23	0.40	0.46	0.89	1.75	-
10000	0.35	0.56	0.65	1.33	2.57	-
12000	0.49	0.73	0.86	1.85	-	-
14000	0.66	0.93	1.11	2.45	-	-
16000	0.85	1.15	1.38	-	-	-
18000	1.07	1.39	1.68	-	-	-
20000	1.31	1.64	2.00	-	-	-
22000	1.57	1.92	2.36	-	-	-
24000	1.86	2.23	2.74	-	-	-

Table 23. Return air pressure increase

	Return Air Damper Position			
CFM	#1	#2	#3	#4
20, 25 and 30 Ton				
4000	0.00	0.01	0.06	0.06
6000	0.00	0.02	0.09	0.14
7000	0.00	0.03	0.11	0.19
8000	0.00	0.03	0.13	0.25
9000	0.00	0.04	0.14	0.31
10000	0.00	0.04	0.16	0.38
11000	0.00	0.05	0.18	0.46
12000	0.00	0.05	0.20	0.55
13000	0.00	0.06	0.22	0.65
40, 50 and 55 Ton				
8000	0.00	0.07	0.15	0.17
10000	0.00	0.09	0.19	0.24
12000	0.00	0.10	0.22	0.33

Table 23. Return air pressure increase (continued)

CFM	Return Air Damper Position			
	#1	#2	#3	#4
14000	0.00	0.11	0.25	0.43
16000	0.00	0.13	0.28	0.55
18000	0.00	0.14	0.31	0.67
20000	0.00	0.15	0.33	0.81
22000	0.00	0.16	0.35	0.96
24000	0.00	0.17	0.37	1.13

Units with Dual Actuators (60, 70 and 75 Ton)

The installer can adjust the stroke of the direct drive actuator on the O/A & R/A dampers to compensate for various R/A duct losses. Table 24, p. 58 and Table 25, p. 59 list the pressure drops for various actuator limit positions based on the air flow (CFM) and configuration. The actuator stroke limit can be adjusted between 33% and 100% of full stroke. To adjust the O/A or R/A damper for the correct pressure drop:

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, then average the reading.
2. Measure the return duct static pressure.
3. Compare the static pressure reading to the static pressure ranges and linkage positions in Table 24, p. 58 or Table 25, p. 59 for the unit configuration, unit size and operating CFM.

   If the static pressure reading is greater than the pressure listed in Table 24, p. 58 or Table 25, p. 59 for outside air damper position 100% then adjust the outside air damper actuator to balance the outside air damper pressure drop against the return static pressure, using the following steps.

   If the static pressure reading is less than the pressure listed in Table 24, p. 58 or Table 25, p. 59 for outside air damper position 100%, then determine the appropriate return air pressure drop increase needed. Identify the correct return damper actuator position using Table 26, p. 59. Then, adjust the return air damper actuator to balance the outside air damper pressure drop against the return static pressure using the following steps.

   If no adjustment is necessary, proceed to step 6.
4. To set the actuator stroke limit:
   a. Loosen the screw that secures the angle of rotation limiter on the actuator adjacent to the damper drive shaft clamp.
   b. Move the limiter to the desired % open position and, making sure the limiter teeth are engaged, retighten the screw.
5. After setting the end stop, the actuator needs to be cycled through its auto-adapt feature to re-scale the control range. With 24 VAC power applied to the actuator, turn the control signal reversing switch forward and back again two times. Within a few seconds, the actuator will cycle itself to the new limiter position and then back to zero.

   Note: *This process may take up to 5 minutes.* The actuator will then be set to respond to the 2-10 VDC control signal to cycle within the new range of rotation set by the limiter. Verify that the control signal reversing switch is set back to its original default position - Y = 0, set to CCW, which is the same direction as spring return.
6. Plug the holes (made during Step 1) after the proper adjustments have been made.

Table 24. Outside Air Pressure Drop (inches w.c.) – No Traq™

No Traq™					
CFM	Outside Air Damper Position				
	100%	75%	55%	45%	33%
60, 70 and 75 Ton					
14000	0.16	0.30	0.43	0.60	1.10
16000	0.20	0.39	0.57	0.80	1.52
18000	0.25	0.49	0.73	1.03	2.00
20000	0.29	0.60	0.91	1.29	2.56

Table 24. Outside Air Pressure Drop (inches w.c.) – No Traq™ (continued)

No Traq™					
	Outside Air Damper Position				
CFM	100%	75%	55%	45%	33%
22000	0.35	0.72	1.11	1.58	-
24000	0.40	0.85	1.33	1.90	-
26000	0.47	0.99	1.57	2.24	-
28000	0.53	1.14	1.83	2.61	-
30000	0.60	1.31	2.10	-	-

Table 25. Outside Air Pressure Drop (inches w.c.) – Traq™

Traq™					
	Outside Air Damper Position				
CFM	100%	75%	55%	45%	33%
60, 70 and 75 Ton					
14000	0.34	0.48	0.61	0.78	1.28
16000	0.43	0.62	0.80	1.03	1.75
18000	0.54	0.78	1.02	1.33	2.30
20000	0.66	0.96	1.27	1.65	2.92
22000	0.78	1.15	1.55	2.02	-
24000	0.92	1.37	1.85	2.42	-
26000	1.07	1.60	2.18	2.85	-
28000	1.24	1.85	2.53	-	-
30000	1.41	2.12	2.91	-	-

Table 26. Return Air Pressure Increase (inches w.c.)

	Return Air Damper Position			
CFM	100%	80%	65%	45%
60, 70 and 75 Ton				
14000	0.00	0.02	0.04	0.37
16000	0.00	0.03	0.06	0.53
18000	0.00	0.04	0.08	0.71
20000	0.00	0.05	0.11	0.92
22000	0.00	0.06	0.14	1.15
24000	0.00	0.07	0.17	1.41
26000	0.00	0.08	0.21	1.70
28000	0.00	0.10	0.25	-
30000	0.00	0.11	0.30	-

Figure 34. Actuator stroke limit adjustment

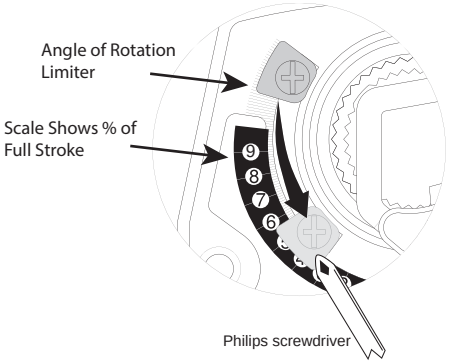
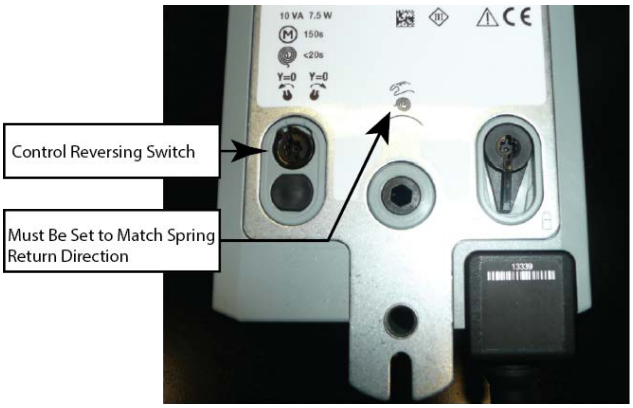


Figure 35. Actuator auto-scaling feature details



Horizontal Right Supply

Note: *The weight of ductwork must be supported to avoid damage to the duct collar and to prevent leakage. It is the installer's responsibility to provide additional waterproof sealant to confirm that no air or water leakage occurs at duct to collar interface.*

1. Confirm that the unit is secured on the roof curb before proceeding.
2. Remove the side panel.

Important: *The panel can weigh up to 65 lbs and requires two people to lift.*

3. Install the gaskets provided in the kit on the edges of the duct opening.
4. Using the hardware provided, secure the duct collars in the specified locations.

Figure 36. Gasket installation

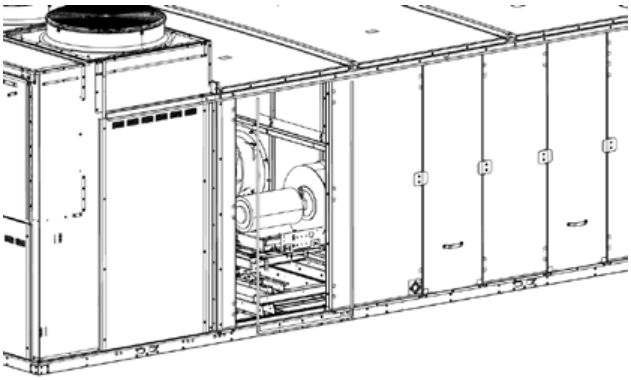
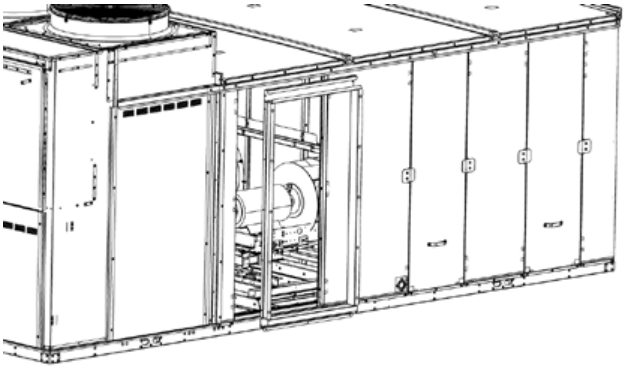


Figure 37. Duct flange installation



Startup the Unit

Use the following in conjunction with the "Trane Start-up Checklist," p. 67, 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.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

- ☐ Turn the optional field supplied disconnect switch, located upstream of the rooftop unit, to the "Off" position.
- ☐ Turn the 115 volt control circuit fused disconnect switch 1S1 to the "Off" position. It is located at the top of the Main Control Box, behind the center door.
- ☐ 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 service valves are open/back seated on each circuit.

NOTICE

Compressor Damage!

Excessive liquid accumulation in the suction lines could result in compressor damage.
Do not allow liquid refrigerant to enter the suction line.

Do not start the unit in the cooling mode if the ambient temperature is below the following minimum recommended operating temperature:

Note: *See for minimum outside air temperature.*

- ☐ Inspect the interior of the unit for tools and debris. Install all panels in preparation for starting the unit.

Electrical Phasing

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Important: *HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.*

All units have a phase monitor installed inside the main control box, behind the center door, in the top row of components. If the phase monitor shows a green LED indicator, all phases are normal. Unit should operate normally. If the phase monitor shows a red LED indicator, there is a phase error. This error could be a loss of phase, phase imbalance, or reversed phasing with customer supplied power wiring. Check for a loss of phase, a phase voltage imbalance of more than 10%, or disconnect all power and reverse any two customer power leads.

Verifying Proper Fan Operation

⚠ WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.
Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

1. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block 2XD1 or the optional unit mounted disconnect switch 2QB1.
2. Turn the 115 volt control fused disconnect circuit switch to the On position.

⚠ WARNING

Rotating Components!

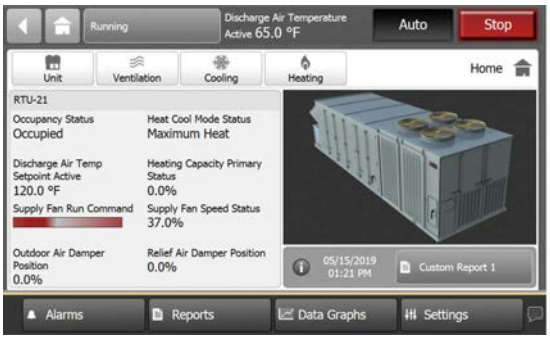
Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.

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.

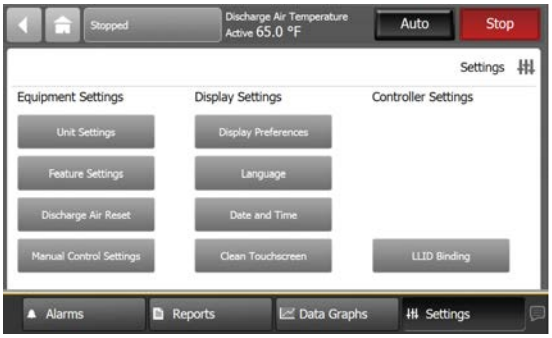
3. Press the Stop button on the user interface. To setup and troubleshoot supply fan operation, navigate to Supply Fan Manual Override by following the steps provided below.

   Note: *The unit's design supply airflow is established when the supply fan is operating at 100% speed command. If the design supply airflow rating of the unit needs to be modified, the new maximum design speed must be set at the supply fan's variable frequency drive (VFD) key pad. The user should identify the maximum speed for the supply fan wheels and ensure those speeds are not exceeded when making entries at the VFD key pads.*

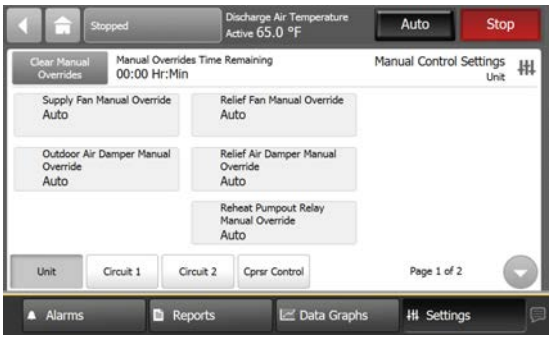
   a. Press Stop and then touch Settings.



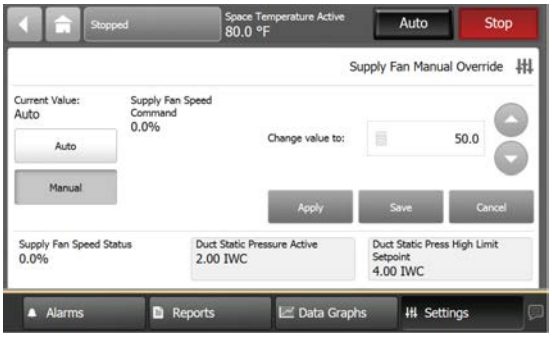
   b. Touch Manual Control Settings in the Settings screen.



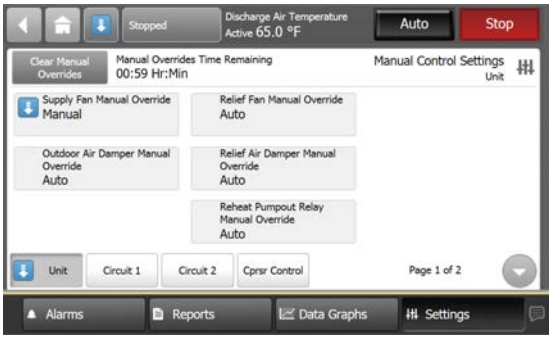
   c. Touch Supply Fan Manual Override in the Manual Control Settings screen.



   d. Touch Manual, then touch Change value to: to adjust the speed setting, press Enter, then press Apply.



   e. When done testing, touch Clear All Manual Overrides or select the individual override and press Auto.



4. The above procedure can be followed for testing and setup of relief fans and condenser fans.

   Note: *Changes to the unit's design relief airflow rating is modified at the user interface by adjusting the Relief Fan Maximum Speed Setpoint located under the Service Settings menu.*

   Check all fans for proper rotation. Supply Fan rotation is indicated by an arrow located on the fan housing (clockwise from motor side of fan). Relief Fan rotation is counter-clockwise when viewed from the motor side of the fan assembly. Condenser Fan rotation is clockwise when viewed from the top.

Direct-Drive Supply Fan Speed Adjustment

Units equipped with a DDP Supply Fan do not use belt/sheave arrangements to adjust fan speed.

This adjustment (if required) is made through the Fan VFD by setting the supply fan Min/Max frequency at each supply fan VFD using Table 27, p. 63.

Table 27. RPM and Hz ranges for DDP supply fan speed adjustments

Fan Speed (RPM)		VFD Frequency Range (Hz)	
Max	Min	Max	Min
2400	888	83	31
2300	851	79	29
2200	814	76	28
2100	777	72	27
2000	740	69	26
1900	703	66	24
1800	666	62	23
1700	629	59	22
1600	592	83	31
1500	555	79	29
1400	518	74	27
1300	481	68	25

Table 28. Piezo airflow calculation

Unit	Fan dia, in	F	C1	A
20,25,30	16.5	1518.6	753.06	0.55
40,50,55	18.2	1821.9	692.03	0.72
20,25,30,40-,50,55	20	2185.8	692.03	0.87
20,25,30,60-,70,75	22.2	2713.9	692.03	1.07
40,50,55	24.5	3285	692.03	1.3
60,70,75	27	3397.6	692.03	1.58

Notes:

1. Measure pressure from inlet side of fan to piezo tap at the cone throat.
2. Fan inlet will be the high pressure side.
3. dP can be up to 25 in h_20.
4. Coefficients are for one fan. For two fans double result or F and C1 values.
5. For standard density of 0.075 lb/ft^3, Supply Fan CFM = CFM = F * √ dP
6. For non-standard density, Supply Fan CFM = CFM = C1 * A * √ (dP / ρ), where dP is the piezo pressure differential and rho is the actual air density.

For relief fans, check the nameplate model number on the fan to determine the K-factor, see table below.

Table 27. RPM and Hz ranges for DDP supply fan speed adjustments (continued)

Fan Speed (RPM)		VFD Frequency Range (Hz)	
Max	Min	Max	Min
1200	444	63	23
1100	407	58	21
1000	370	53	20

Note: *Maximum operating speed cannot exceed fan wheel mechanical limit.*

System Airflow Measurements

VAV and CV Systems with DDP Supply Fan and Motorized Impeller Relief Fan (optional)

Supply and Relief Airflow Measurement

Piezometer pressure taps are available to measure supply and relief airflow. Piezometer pressure taps can interface with customer-supplied airflow monitoring systems using the F or K-factors and equation shown in the tables below. Attach one end of the pressure differential gauge to a connection in the fan cone throat, and the second to the fan inlet plate to read pressure immediately upstream of the fan.

Table 29. K-factor for relief fans

Fan Model	K-factor
K3G500	281
K3G560	348

Use this equation to determine flow for relief fans:

$$9.29 \times K \times \sqrt{\rho s / \rho a \times \Delta P}$$

Where K is determined based on the fan model number, ρ_s is standard air density of 0.075 lb/ft^3, ρ_a is ambient air density, and ΔP is the pressure differential measured by the pressure transducer. The equation gives flow for one fan. Airflow must be multiplied by the number of fans installed in the unit.

Traq™ Sensor Airflow Measurement

(Optional with all units equipped with an economizer)

1. Use 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)
   - Outside Air CFM Setpoint
   - Outside Air Pre-Heater Operation (if applicable)
2. Navigate to Supply Fan Manual Overrides. The supply fan speed will be adjusted through the user interface. With the unit in Stop, touch the Manual Override button for the Supply Fan. Set the Fan Speed to 100%.
3. With the unit operating in the “Manual Override”, the amount of outside air flowing through the Traq™ sensor can be viewed.
4. Navigate to the “ECONOMIZER POSITION” and read the corresponding damper opening percentage (%).

Gas Furnace Startup

Staged, Modulating, and Ultra Modulating

It is important to establish and maintain the appropriate air/fuel mixture to assure that the gas furnace operates safely and efficiently.

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.

Confirming 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.

High-Fire Adjustment

⚠ WARNING

Hazardous Gases and Flammable Vapors!

Failure to observe the following instructions could result in exposure to hazardous gases, fuel substances, or substances from incomplete combustion, which could result in death or serious injury. The state of California has determined that these substances may 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 setup of this product and all warnings as provided in this manual.

⚠ WARNING

Explosion Hazard!

Failure to properly regulate pressure could result in a violent explosion, which could result in death, serious injury, or equipment or property-only-damage.

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.

1. Program the following system components for operation by scrolling through the User Interface displays:

   Gas Heat

   a. Open the manual gas valve, located in the gas heat section.

   b. Navigate to the Gas Heat Manual override screen and set the modulating percentage to 100% or enable the 1st stage. Touch the Auto button.

   c. Turn the Supply Fan on by navigating to the Manual Override Screen. Set the Fan speed to 100%.
2. Once the system has started, check the appearance of each burner's flame. Color should be blue for natural gas with a small amount of visible orange.
3. Check the manifold gas pressure of each gas valve by using the pressure port on the manifold section downstream of the valve. The manifold pressure for each valve at High Fire should be set to 3.5" w.c. (10.0" w.c. for propane).

   Note: *On modulating gas units the one-stage valve just upstream of the modulating valve setting will be approximately 4.5"w.c. to achieve a manifold pressure of 3.5" downstream of the modulating valve on high fire.*

If adjustment is needed, adjust the regulator on the valve. Refer to Figure 40, p. 66 for two stage valve on 250 & 350 MBh two stage, and Figure 39, p. 66 for one stage valve on all other multi-stage and modulating burners, for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.

Combustion Air Analysis

1. Using a flue analyzer make note of the oxygen, carbon dioxide, and the Air Free CO levels. Take several samples to assure an accurate reading.

   Important: *The flue reading should be taken from center of flue and at least 4 inches down from the outlet.*

2. Compare the measured oxygen level to the combustion curve in Figure 38, p. 65. The oxygen content of the flue gas should be 4% to 5%. If the oxygen level is outside this range, contact the Technical Support for assistance.

Low-Fire Adjustment (250 and 350 MBH Two Staged only)

1. Use the TEST initiation procedures outlined in the previous section to operate the furnace in the low-fire state (1st Stage).
2. Check the manifold gas pressure of the valve by using the pressure port on the manifold section downstream of the valve. The manifold pressure for Low Fire First Stage should be set to 1.2" w.c. (3.0" w.c. for propane). If adjustment is needed, adjust the LO regulator on the two stage valve. Refer to Figure 40, p. 66 for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.
3. Check the oxygen, carbon dioxide, and the Air Free CO levels after each adjustment.
4. Tap the STOP button on the User Interface to stop the system operation.

Figure 38. Natural gas combustion curve (ratio of oxygen to carbon dioxide in percent)

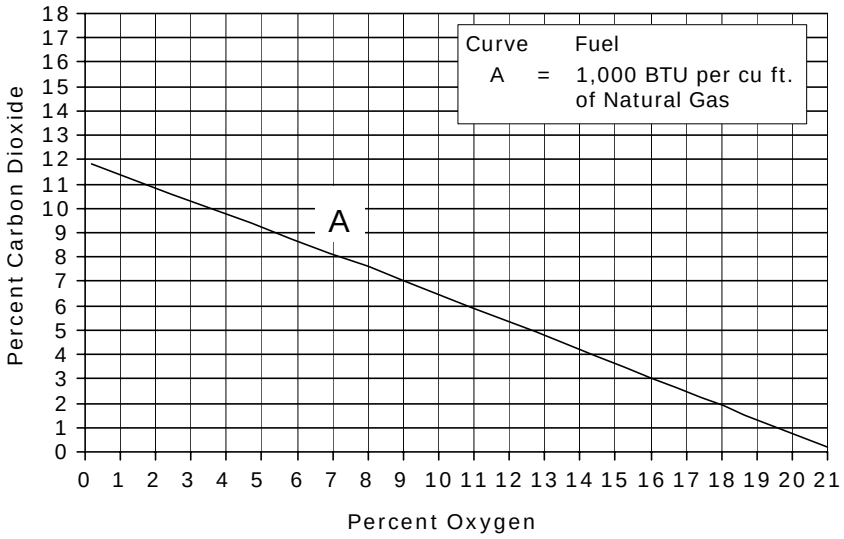


Figure 39. One stage valve adjustment

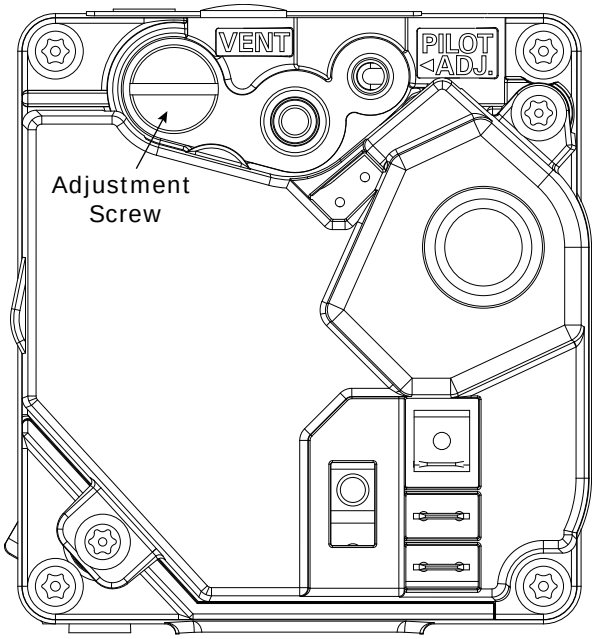
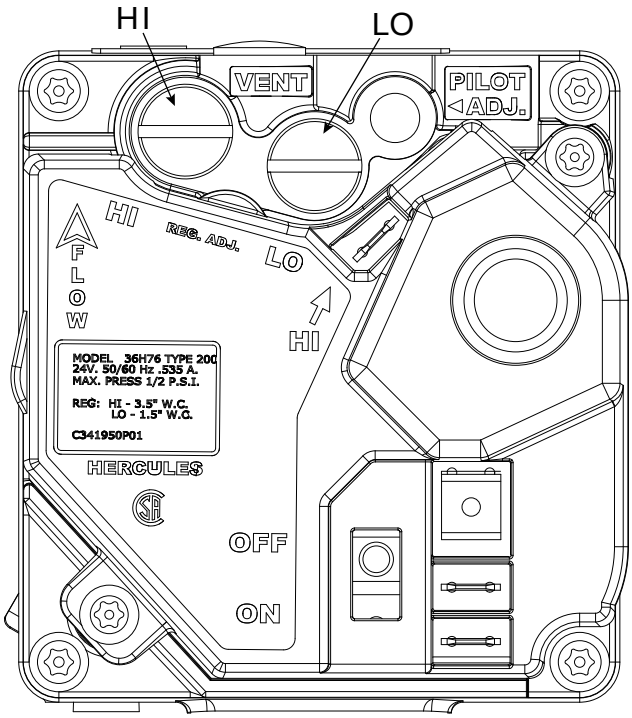


Figure 40. Two stage valve adjustment



Final Unit Checkout

After completing all of the checkout and start-up 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:

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Important: *HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR UNIT DISCONNECT SWITCH.*

- ☐ Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
- ☐ Inspect the unit for misplaced tools, hardware, and debris.
- ☐ Verify that all exterior panels including the control panel doors and condenser grilles are secured in place.

Trane Start-up Checklist

This checklist is intended to be a guide for the Trane technician just prior to unit 'start-up'. 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.

Important: *This checklist is not intended as a substitution for the contractor's installation instruction.*

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.*

Job Name		**Serial #**	
Job Location		**Model #**	
Sales Order #		**Ship Date**	
Unit DL # (special units)		**Date**	
Starting Sales Office		**Technician**	

Table 30. Startup checklist

		Completed?			
General Start-up					
1	Is adequate access/egress provided?		Yes		No
2	Initial site inspection performed?		Yes		No
3	Unit exterior inspected for damage (dents, bends, missing panels, doors work properly)?		Yes		No
4	Unit clearances adequate to avoid air recirculation?		Yes		No
5	Verify crankcase heaters are working and on for 8 hours prior to unit start		Yes		No
6	Verify unit interior is free from debris and obstructions, etc.		Yes		No
7	All unit drain lines and traps are properly installed		Yes		No
8	Verify unit is grounded. Confirm a ground wire is coming from the power source		Yes		No
9	Verify main power feed wire gauge is properly sized for current load		Yes		No
10	Verify all wiring connections are tight		Yes		No
11	Verify all field control wiring for CV, SZVAV or VAV controls are complete		Yes		No
12	Verify hold down bolts from fan sections removed		Yes		No
13	Fan section isolators checked/adjusted (approximately 1/4-inch gap above shipping block)		Yes		No
14	Verify compressor oil levels at proper levels		Yes		No
15	Compressor discharge service valves and optional suction service valves open/back seated		Yes		No
16	Verify fans rotate freely		Yes		No
17	Verify refrigerant charge on each circuit		Yes		No
18	Verify correct voltage supplied to unit and electrical heaters		Yes		No
19	Verify there are no unit phase monitor errors.		Yes		No
20	Verify all fans rotate in proper direction		Yes		No
21	Verify fan amperages within nameplate specs (please document on log sheet)		Yes		No
Unit Configuration and Setup					
1	Verify model number in the UCM configuration matches unit model number on nameplate		Yes		No
2	Configure unit using IOM and critical control parameters using critical control parameters table		Yes		No
3	(If applicable) Verify GeoTab cell modem connection and signal strength		Yes		No
Air Cooled Condenser					
1	All coil fins inspected and straightened		Yes		No
2	Condenser fans are rotating freely		Yes		No
3	Verify the fan blade set-screws to the motor shaft of the condenser fan assemblies are tight		Yes		No
Outside Air and Economizer (if applicable)					
1	Verify damper linkages are tight/adjusted and tip seals are in good condition		Yes		No
2	Outside air pressure sensor installed and tubing connected to fitting on unit exterior		Yes		No
3	Duct pressure tubing connected to duct pressure sensor		Yes		No
4	Tubing from controlled space connected to space pressure fitting (StatiTrac)		Yes		No

Table 30. Startup checklist (continued)

		Completed?			
Electric Heat (if applicable)					
1	Electric heat circuits have continuity		Yes		No
2	Perform electric heat start up procedure		Yes		No
3	Verify heating system matches name plate		Yes		No
Gas Heat (if applicable)					
1	Gas heat piping includes drip leg previously installed by installing contractor		Yes		No
2	Gas heat flue assembly fully installed		Yes		No
3	Gas heat condensate line and heat tape installed where applicable		Yes		No
4	Verify heating system matches name plate		Yes		No
5	Perform Gas Heat start up procedure in IOM		Yes		No
System Checkout					
1	Verify system airflow		Yes		No
2	Verify dampers open and close properly		Yes		No
3	Adjust economizer damper travel		Yes		No
4	Verify compressor operation, voltage and amperage matches name plate information (please document on log sheet)		Yes		No
5	Electric heat operation verified		Yes		No
6	Incoming gas pressure does not drop below 7-inch water column when burner is on high fire		Yes		No
7	Gas heat operation has been verified with combustion analyzer		Yes		No
8	Operating log completed		Yes		No
9	All panels and doors secured		Yes		No
10	Complete all required documentation		Yes		No

Critical Control Parameters and Dry Bulb Changeover Map

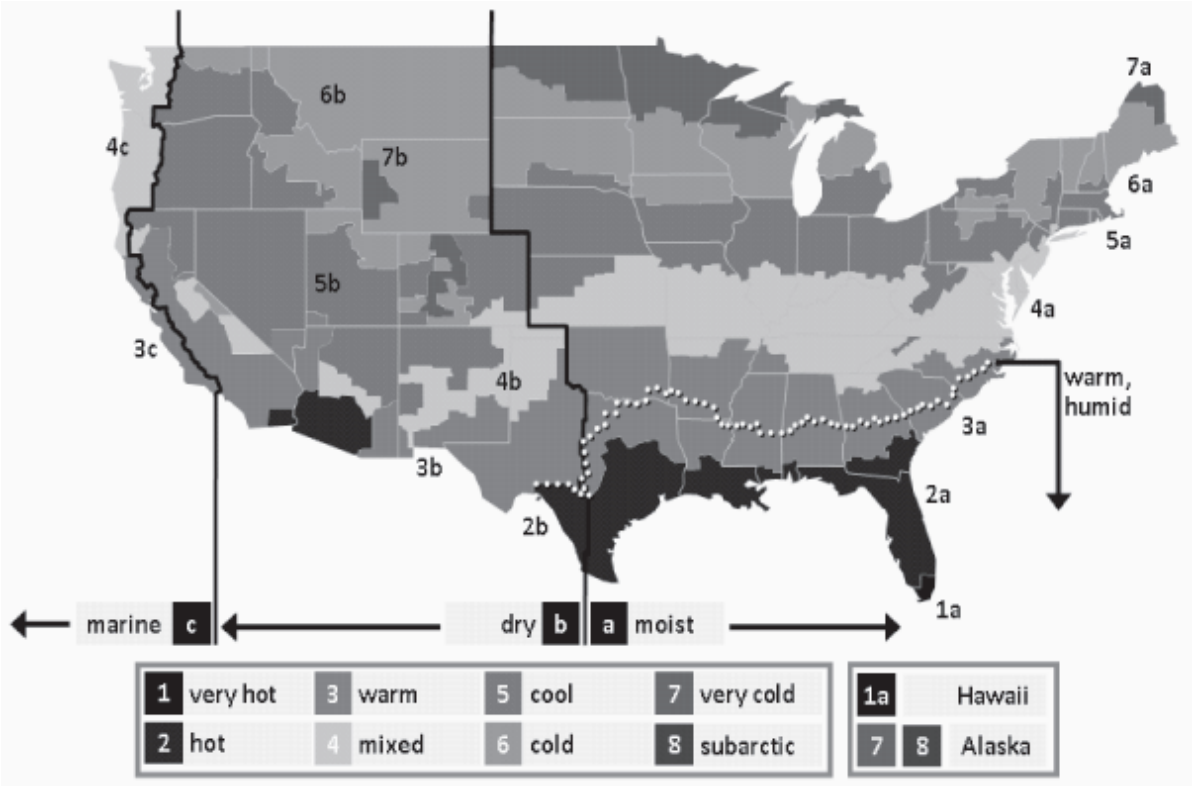
Table 31. Critical control parameters

Description	Suggested Parameter	Economizer Settings						
		Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
Supply Air Temperature Control Setpoint	55°F							
Supply Air Temperature Deadband	8°F							
Supply Air Pressure Setpoint	1.8" w.c.							
Supply Air Pressure Deadband	0.1" w.c.							
Building Static Pressure Setpoint	0.03" w.c.							
Building Static Pressure Deadband	0.04" w.c.							
Standby Freeze Avoidance	20%							
Relief Enable Setpoint	10%							
Economizer Minimum Position Setpoint	10%							
Fixed Dry Bulb Economizer C/O Type a (Moist)*		TOA > 65° F	TOA > 65° F	TOA > 65° F	TOA > 65° F	TOA > 70° F	TOA > 70° F	TOA > 70° F
Fixed Dry Bulb Economizer C/O Type b (Dry)*	TOA > 75°F							
Fixed Dry Bulb Economizer C/O Type c (Marine)*				TOA > 75° F	TOA > 75° F	TOA > 75° F		
Fixed Reference (Enthalpy Changeover)	HOA > 28 Btu							
Differential Comparative (Enthalpy Changeover)	HOA > HRA							

Notes:

1. See map in next figure for dry bulb changeover.
   Examples:
   - Minneapolis, Minnesota is in Region 6 and resides in Moist subregion, thus designation is 6b. Economizer changeover setting should be 75°F.
   - Charleston, South Carolina is in Region 3 and resides in Moist subregion, thus the designation is 3c. Economizer changeover setting should be 65°F.
2. Go to SETUP menu and input setting for parameters listed in the table above.
3. Use the Dry bulb changeover map to determine region of country based on unit site location.
4. Fixed speed compressor units 8°F deadband.
5. eFlex™ compressor units 4°F deadband.

Figure 41. Dry bulb changeover map



External Capacity Control

External Capacity Control allows the user to directly control how much cooling, heating, airflow, and fresh air the unit provides. This is done through wiring that is sent from the building automation system (BAS) or control panel. Trane's control system makes certain that even with this direct control, important safety checks are always active.

- **Customer Command**: The customer can SEND commands to the unit using analog signals (like 2–10V DC voltage) or through BAS. Each command represents a percentage. For example, if the user sends 10V to the cooling input, the user is asking for 100% cooling. If the user sends 6V, that is about 50% cooling.
- **Enable Signals**: There are separate ON/OFF signals for Supply/Relief/Return fans, cooling, heating, and outside air dampers. When the enable is "ON," the unit will listen to capacity commands. This feature allows the inputs to simulate a thermostat input.
- **Wiring Locations**: On the unit, there are terminal blocks (phoenix connectors) on each control board for each input: Cooling, Heating, Supply Fan, Outdoor Damper, Relief/Return Fan, Emergency Stop, and Diagnostic Reset.
- **Feedback Signals**: The unit also sends analog signals BACK to the customer to tell them what is happening—such as the current fan speed, cooling capacity, or alarm status.
- **Safeties and Limits**: The Trane control system monitors the equipment. If anything undesirable is detected (such as no airflow when cooling is requested), it will override customer commands to protect the equipment, such as shutting off cooling to prevent flooding and compressor damage.

Features Not Supported with External Capacity Control

External Capacity Control allows the customers to directly control the outputs of the unit by providing an input signal that represents the output requested. Features that require internal algorithm control are not supported with External Control, because the decision of the output is received from the building management.

An example of an unsupported feature is economizer control methods such as Comparative Enthalpy, Reference Enthalpy, Dry bulb, or Differential Dry bulb. Each of these options determine when to open the economizer. With External Capacity Control, that decision is made by the building management system, when and how much to open the outside air damper. Another example is Statirac, space pressure control, the decision of relief fan speed and damper position is made by the building management system.

Sequence of Operation (Cooling Example)

1. Waiting for input.

- The IPAK unit is powered up but waiting. No cooling or fan outputs are active because the customer has not sent any "enable" or capacity commands.
- The unit feedback signals will show "0%" or "Idle" status.

2. User sends enable signals.

- The building automation system (BAS) sends a signal to enable the supply fan and cooling.
- Separate wires (connected to the right terminal blocks) carry ON signals for "Fan Enable" and "Cooling Enable."

3. User sets capacity commands.

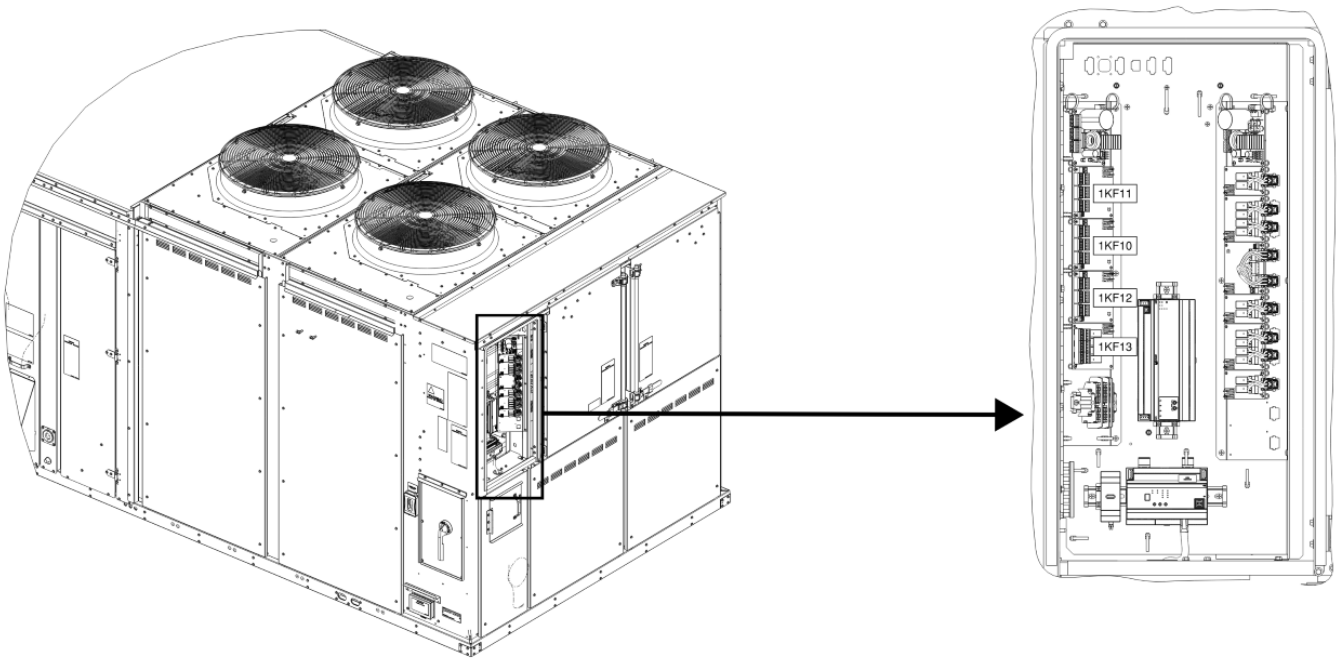
- User sends analog signals:
  - 10V on the "Cooling Capacity Command" terminal = 100% Cooling Request
  - 7.6V on "Supply Fan Speed Command" terminal = 78% Fan Speed Request

4. Controller reads and responds.

- The unit controller checks all signals and safeties (such as duct pressure, airflow).
- If everything is safe, the unit:
  - Ramps up cooling to 100%
  - Ramps up supply fan to 78%
  - Sends feedback signals showing the output percentages to the customer's BAS.

5. If Relief Air Tracking is Enabled, the unit will do normal Outdoor Air Damper tracking control (Relief Air Damper will follow Outdoor Air Damper once past Relief Enable Setpoint). If Relief Air Tracking is disabled, the relief air damper position will track to the relief fan speed.

Figure 42. External capacity controls only board layout



Sequence of Operation

NOTICE

Compressor Failure!

Failure to follow instruction below could result in compressor failure.

Unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started.

Stop/Off/Auto

There are a number of reasons the Symbio 800 controller will have the IntelliPak unit stopped or off. The user interface home screen displays unit mode of Stopped or Auto. Stopped is indicated when an override is preventing operation such as: Local Stop, Emergency Stop or Equipment Stop input is active. Auto is indicated when in automatic control but is currently off in modes such as: Unoccupied, Ventilation Override, Emergency Override.

When Heat Cool Mode Status is Off, unit operation will be prevented; whereas, all other modes allow operation.

Power-Up Start Delay

Anytime power is applied to the unit or the controller is reset, and the unit is able to run, a user adjustable Power-Up Start Delay setting is enforced to allow staggered starts of multiple units. The user interface home screen displays Run Inhibit when active. Power Up Delay Inhibit, with remaining minutes and seconds, will be displayed on user interface operating modes screen. Power-Up Start Delay is also applies to Rapid Restart, or when the controller exits Ventilation Override or Emergency Override modes.

Normal Unit Starting

When Local Stop, Stop modes, overrides, and diagnostic shutdowns are removed, the controller will start unit operation. The supply fan starts and increases to the minimum Hz setting and must prove On. Unit mode Running is displayed on the user interface. The supply fan will run for one minute, with the outdoor air damper closed, before transitioning into an active heat or cool mode.

Rapid Restart Operation

The purpose of rapid restart is to confirm the space temperature recovers from high heating loads once the unit has recovered from a power outage. This is accomplished by utilizing aggressive economizing and/or compressor staging in a user adjustable amount of time. After a Rapid Restart event, the unit can subsequently manage the load using normal capacity control. A typical application is a data center.

The unit configuration must have Rapid Restart configured as “Installed” and the Rapid Restart Enable feature setting must be set to “True” to allow this function to operate. Mechanical cooling (DX) is available for Rapid Restart if the Outdoor Air Temperature is above the Low Ambient Lockout setpoint.

After power-up start delay is satisfied, the unit will override all other forms of time delays (i.e. ICS, VAV Box Stroke Time, Outdoor Air Damper Stroke Time) and allow the Supply Fan to start. Once the Supply Fan has proven, the unit will determine the proper staging sequence by processing outdoor air temperature and return air temperature. The unit will generate a Rapid Restart mode annunciation on the user interface, operating modes screen.

VOM and Emergency Override have higher priority than Rapid Restart. If either occur, Rapid Restart will be terminated and the VOM or Emergency Override will be performed. Demand limit also has priority over Rapid Restart.

The unit will terminate Rapid Restart and will de-energize the VAV Box Relay (if installed), and release to normal unit control when the Cooling Capacity Status meets or exceeds the Rapid Restart Capacity Target or when the Rapid Restart Termination Time expires.

Occupancy

There are many sources and types of occupancy. These have an effect on the operation of the IntelliPak unit. All sources are arbitrated (prioritized) into a final occupancy status.

Sources of Occupancy

- Occupancy Request is a communicated value from a Building Automation System (BAS) schedule.
- Occupancy Input is a local input from the space served by the equipment. These are typically optional local time clocks or occupancy sensors. This is a physical input to the Symbio controller and is field installed.
- Bypass Timer starts because of a user requested occupancy override (also known as Occupied Bypass). The occupant requests temporary occupied comfort heating or cooling during unoccupied scheduled time periods. An example of this would be the Timed Override (TOV) button on the zone sensor. See “Timed Override,” p. 73 for more information.

Occupancy Status Definitions

Occupied Operation: The IntelliPak unit is running in a Normal mode providing temperature and ventilation control to the normal occupied setpoints and comfort demands of the occupants.

Unoccupied Operation: The IntelliPak unit is typically shutdown and is not providing temperature control to the normal occupied setpoints. No ventilation is required or

provided. Temperature control is determined by energy conservation and building protection thresholds.

Occupied Bypass Operation: The IntelliPak unit is temporarily in an Occupied state for some period of time and will automatically return to unoccupied operation when the bypass timer expires. The Occupied Bypass Timer is a user-adjustable field. However setting the timer to 0 minutes effectively disables Timed Override at the equipment controller.

Occupied Standby Operation: Standby does not apply to a discharge air controller (VVDA, CVDA unit type). These units treat Standby as Occupied. Space temperature control units in an Occupied-Standby state are controlling to occupied standby temperature setpoints. Normal operation will resume when Occupancy Status goes to an Occupied state.

Table 32. Occupancy Status

Occupancy Request	Occupancy Input	Bypass Timer	Occupancy Status
Occupied	Occupied	Any Number	Occupied
Occupied	Unoccupied	Zero	Standby
Occupied	Unoccupied	Not Zero	Bypass
Unoccupied	Any State	Zero	Unoccupied
Unoccupied	Any State	Not Zero	Bypass
Bypass	Occupied	Any Number	Occupied
Bypass	Unoccupied	Zero	Standby
Bypass	Unoccupied	Not Zero	Bypass
Standby	Any State	Zero	Standby
Standby	Any State	Not Zero	Bypass
Auto	Occupied	Any Number	Occupied
Auto	Unoccupied	Zero	Unoccupied
Auto	Unoccupied	Not Zero	Bypass

Timed Override

Timed Override (TOV) is a function that allows a user, located in the conditioned space, to temporarily override the IntelliPak operation from unoccupied mode to occupied mode (referred to as Occupied-Bypass). To accomplish this, Trane wired or wireless zone sensor devices are equipped with “On” and “Cancel” push buttons. Some sensors refer to the buttons as “Occupied” and “Unoccupied”. Timed override operation applies, in some way, to all unit types.

On Wired sensors, the timed override request (ON) and timed override cancel (CANCEL) buttons momentary modify the zone temperature thermistor resistance to a value outside the normal zone temperature operating range. The Symbio 800 controller detects this change; however, this momentary button press does not disrupt the space temperature value being used for heating and cooling control. The press duration is 0.5 to 8 seconds.

Wireless sensors process the timed override request/cancel signal at the sensor and communicate the appropriate timed override status (mode).

Service Pin Message Request

A secondary feature of wired zone sensors is Service Pin Message Request, not associated with TOV. An On/Occupied push button press for 8 to 30 seconds can initiate Neuron ID and Program ID message broadcast on a LON network. This function is used to install and troubleshoot LON networks. This feature benefits installation of a LON device by initiating the service pin message from a zone sensor rather than at the equipment.

Sensors

The IntelliPak unit uses many types of sensors. Most sensors are factory installed. Some sensors are field installed and may be wired or wireless. Field installed wired sensors are available from Trane and many other sources. In every case, the correct type of sensor must be used.

All sensors are factory calibrated and require no field re-calibration. See the Product Catalog for more information on sensors.

Heat Cool Mode Status

Heat Cool Mode Status reports the unit mode of operation. The Symbio 800 can receive mode inputs from different external and local input sources that are arbitrated; however, the control active operating mode represents the capacity being delivered to the building and reported via Heat Cool Mode Status.

Heat

In this mode, the controls provide heating capacity per heat type installed, active heat setpoint, and occupancy. Application requirements such as full or modulating air flow are also considered in heating mode. All forms of cooling capacity are effectively disabled.

If Heat is the requested mode when the unit does not have heat capacity configured or heat is disabled, Heat is reported as Heat Cool Mode Status. If the unit cannot provide heat, the supply fan is enabled to operate (as configured) to provide ventilation during occupied modes of operation.

Cool

Cool mode is reported when the control objective is to provide cooling to maintain building comfort. Direct expansion cooling is the primary cooling source. Cool mode is also reported when Economizer cooling, Dehumidification, Pre-Cool, and Night Purge sub-modes of operation are active.

For Discharge Air Control units, heat is allowed (when enabled) to temper cold mixed air conditions to the desired cooling setpoint. See Cool - Tempering sub-mode section for more information.

Fan Only

This mode disables all forms of heating and cooling capacity but operates the fan continuously at minimum speed or modulates to maintain duct static pressure. The outdoor air damper modulates to damper minimum position setpoint or flow setpoint to provide ventilation.

Fan Only is also reported in Emergency Override and Ventilation Override Modes. Heat Cool Mode Request can also command the Fan Only mode.

Maximum Heat

Maximum Heat is a heating mode of operation with the supply fan operating at maximum speed. The controller does not provide maximum heat (as the name infers); instead, the controller provides heat capacity per the Operating Mode and unit type.

- **Multi Zone VAV**

  Multi Zone VAV control units will transition to Maximum Heat operation in heating modes (for example Occupied Heat, Morning Warm Up, Daytime Warm Up) when the installed heating capacity requires full air flow. Maximum Heat can also be a Heat Cool Mode Request command, which Symbio 800 will remain in the mode until the mode is released. On the transition to Maximum Heat the Symbio 800 will reduce the supply fan to minimum speed, energize the VAV Box Relay and wait the duration of the VAV Box Stroke Time (adjustable). The VAV Box Stroke Time allows the VAV boxes in the system to open. The supply fan speed will then increase to 100% or the maximum speed subject to high duct static pressure limit. Once the supply fan reaches its allowed maximum speed, Symbio 800 will enable heating capacity control to Discharge Air Heating Setpoint Active. Ventilation is managed per the operating mode.

  The transition from Maximum Heat back to modulating air flow control modes is as follows:

  1. Heat capacity terminates (if active), a 5 minute post heat timer begins.
  2. Supply fan speed slows to minimum speed, a 3 minute minimum speed timer begins
  3. VAV Box Relay de-energizes
  4. When the 5 minute post heat and 3 minute minimum speed timer expire, modulating air flow control is enabled, operating mode transitions, and capacity control enables.

- **Single Zone VAV (Space Temperature)**

  Single Zone VAV control units will also accept a Maximum Heat command via Heat Cool Mode Request. On this command the Symbio 800 will transition to a heat mode while operating the supply fan at 100% capacity. Heat Cool Mode Status will report Maximum Heat to indicate the mode is active.

Off

Off is the reported mode when unit operation is shutdown due to diagnostics, equipment protections or normal unit operation.

Test

When a Manual Override is Active such that it overrides normal capacity control or limits the ability to provide comfort heating/cooling, Heat Cool Mode Status reports Test. For example, a Manual Override of a relief fan will not be reported as Test. See Programming Guide (RT-SVP011*-EN) for more information.

Table 33. Summary of heat cool modes and sub modes

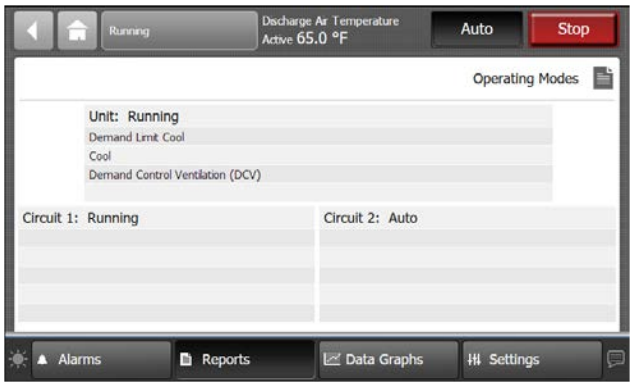
Heat Cool Modes	Sub Modes
Heat	Morning Warm Up
Maximum Heat	Morning Warm [a] Daytime Warm Up
Cool	Cool – Dehumidification Cool – Economizing Cool – Economizing + DX Cool – Tempering Daytime Warm Up[a] Pre Cool Night Purge
All modes	Idle Demand Limit Ventilation Override Mode X Emergency Override Mode X External Supply Fan Control External Relief Fan Control Demand Control Ventilation

[a] CV and MZ-VAV Discharge air temperature units only

Operating Modes

The user interface Operating Modes screen provides Unit and Circuit level mode information valuable to understanding the equipment operating state. Each Unit and Circuit mode provide sub-mode information with valuable details to understand active controls and limits that are affecting operation. For more information, see *IntelliPak™ with Symbio™ 800 – Programming Guide* (RT-SVP011*-EN).

Figure 43. Operating Modes



Unit

Unit modes provide a status of the equipment operating state. Each of the Unit modes will have one or more sub-modes that provide more details about the functions active in the mode.

Stopped

Stopped is a Unit mode when control is prevented from running. For example, if Equipment Stop binary input is active, *Equipment Stop* will be listed as a sub-mode.

Run Inhibit

The unit is currently being inhibited from starting and running. For example, if a Power Up Delay timer is preventing the unit start-up, *Power Up Delay Inhibit (Min: Sec)* will be listed with the remaining minutes and seconds to expire.

Auto

The unit supply fan is typically running to provide ventilation. *Idle* is listed as a sub-mode on start-up when the control is determining an initial heating or cooling demand. Additional sub-modes are listed when gas heat diagnostics are preventing heat operation.

Running

Running is a Unit mode when normal heating, cooling and ventilation control functions are active. The supply fan is running. Up to four Running sub-modes will be listed on the user interface, Operating Modes screen.

Circuit

Circuit modes provide refrigerant circuit level operating state and sub-mode information. When the unit has two circuits, the user interface will provide both Circuit 1 and Circuit 2 mode and sub-mode information.

Stopped

The circuit is not running, and cannot run without removing a condition. For example, *Diagnostic Shutdown – Manual Reset* sub-mode is displayed when a diagnostic has caused a circuit level shutdown and a manual reset is required.

Run Inhibit

The circuit is currently being inhibited from starting (and running), but may be allowed to start if the inhibiting or diagnostic condition is cleared. For example: Start Inhibited by Low Ambient Temp is displayed when outdoor air temperature is below the Low Ambient Lockout Setpoint; the circuit is being inhibited from starting.

Auto

The circuit is not running but expected to start given the proper conditions are satisfied.

Waiting to Start

The circuit is going through the necessary steps to allow the circuit to start; for example, EXV is being commanded to a pre-position prior to starting a compressor.

Running

A compressor on a given circuit is currently running.

Running — Limit

The circuit is currently running; however, the operation of the unit/compressors is actively limited by the controls. Active compressor protection sub-modes will be listed. See Compressor Protections section for more information.

Shutting Down

The circuit is preparing to de-energize the compressor. For example, Diagnostic Shutdown – Manual Reset is displayed when the circuit is shutting down on a latching diagnostic.

Unit Sub-Modes

Morning Warm Up

Morning Warm Up is an optional feature when heat is configured and can be Enabled or Disabled. Morning Warm Up is a mode often used during building unoccupied periods and optimal start applications to rapidly increase the space temperature, as efficiently as possible, before building occupancy. The outdoor air damper minimum position setpoint will be overridden to 0%, ventilation air is not provided during Morning Warm Up.

For Morning Warmup to initiate on a transition from Unoccupied to Occupied, Space temperature control units must be in Heat, Max Heat, or Auto. Discharge air control units can also initiate Morning Warm Up on an Off to Occupied transition.

For all equipment types (Constant Volume, Multi Zone-VAV, and Single Zone VAV): On a transition from Unoccupied to Occupied or Occupied-Standby, and with a valid space temperature 1.5° F below the Morning Warmup Setpoint, morning warm up operation initiates. Heat Cool Mode Status reports maximum heat if the heat type requires full airflow and VAV Box Relay binary output will energize (see Maximum Heat for details). Otherwise, heat types that allow modulating airflow will report heat.

The Symbio 800 operates in a discharge air control mode delivering heating capacity per Discharge Air Heating

Setpoint Active; this provides flexibility when 100% heat capacity in not desired. The supply fan operates at max speed on Constant Volume Units. Variable air volume discharge air control units will operate the supply fan per Duct Static Pressure Setpoint, if the installed heat type allows. (See Heat Types section for more information).

When 60 minutes expires or when space temperature equals or exceeds the Morning Warmup Setpoint, Morning Warm Up mode will terminate.

Morning Warm Up mode can also be commanded via Heat Cool Mode Request from a building automation system or external control. In this case, the unit remains in Morning Warm Up mode indefinitely until the commanded mode is removed or changed. When the space temperature exceeds the Morning Warmup Setpoint, heating capacity is disabled but the supply fan operation continues to circulate air until the Morning Warm Up command is removed. Heat capacity will re-enable if space temperature falls 1.5°F below Morning Warmup Setpoint.

Pre Cool

Pre Cool is a feature of the unit and can be Enabled, or Disabled. Pre Cool is a mode often used during building unoccupied periods and optimal start applications to rapidly decrease the space temperature, as efficiently as possible, before building occupancy. Ventilation air is not provided during Pre Cool.

Space temperature control units must be in Cool or Auto mode to allow Pre Cool operation. Discharge air control units also evaluate Pre Cool operation on transition from Off/Shutdown to Occupied.

All equipment types, a transition from Unoccupied to Occupied mode, if a valid space temperature input is above the Pre Cool Setpoint + 1.5°F, Pre Cool Mode will initiate. Symbio 800 operates in a discharge air control mode providing discharge air per Discharge Air Cooling Setpoint Active until space temperature drops equal or below the Pre Cool Setpoint. In this cooling mode the outdoor air damper minimum position is 0%, but the controller will use compressor and/or economizer cooling when suitable.

Multi Zone-VAV units will modulate fan speed and manage to the duct static pressure setpoint. All other unit types, the supply fan will operate at max speed.

Pre Cool mode can also be commanded via Heat Cool Mode Request. In this case, the Symbio 800 remains in Pre Cool indefinitely until the commanded mode is removed. When space temperature is equal or less than Pre Cool Setpoint, cooling capacity is disabled but the supply fan continues to circulate air until the Pre Cool command is removed. Cooling capacity control will enable if space temperature rises above Pre Cool Setpoint + 1.5°F.

Night Purge

Night Purge mode is typically applied in building unoccupied periods when conditions are suitable for economizer cooling; all other forms of cooling capacity are disabled. This mode is only supported via a commanded Heat Cool Mode Request. The controller will not use local inputs and assume outdoor air is suitable for economizing. The outdoor air damper minimum position setpoint will be overridden to 0%.

When active, the Symbio 800 operates in a discharge air control mode, modulating the outdoor air damper to provide cooling capacity per Discharge Air Cooling Setpoint Active. Night Purge operation is terminated when the Night Purge, Heat Cool Mode Request is removed.

Daytime Warm Up

Daytime Warm Up is a feature of Constant Volume and Multi Zone-VAV Discharge Air Temperature units that can be Enabled, or Disabled. Daytime Warm Up is available with any heat type installed. Daytime Warm Up is a mode used during building occupied periods to recover a critical zone that is too cold. Ventilation air is provided while in Daytime Warm Up mode.

When the Heat Cool Mode Status is Cool (the unit is providing cooling), if a valid space temperature is 3°F below the adjustable Daytime Warmup Setpoint, daytime warm up operation initiates. The unit will operate in a discharge air control mode delivering heating capacity per Discharge Air Heating Setpoint Active. The supply fan operates at max speed on Constant Volume Units. Variable air volume discharge air control units will operate the supply fan to the duct static pressure setpoint and report Heat Cool Mode Status as Heat, if the installed heat type allows modulating air flow. Else if the heat type requires full air flow, Maximum Heat is reported.

When the space temperature rises above the Daytime Warmup Setpoint, daytime warm up operation terminates and the Symbio 800 will transition back to Cool mode. See Maximum Heat for details. If the requested operating mode is no longer Cool, Daytime Warm Up terminates.

Idle

Idle is a sub-mode of Space Temperature Control units configured for supply fan cycling. When there is no demand for heating or cooling the supply fan will cycle off and Idle will be displayed.

Supply Fan Control

All IntelliPak units with the Symbio 800 controller have one or more supply fans installed with VFD drives. All fans are controlled identically. The fans are sent the On/Off command at the same time and commanded to the same speed at all times. It is assumed that the VFDs for each fan are setup identically. Supply fan operation will be confirmed via a method of proving airflow which is explained below.

Supply Fan Speed Control

The controller sends a speed command to each VFD as a value from 0-100%. The VFD interprets the commands as 0% = Minimum frequency and 100% = Maximum frequency. See *IntelliPak™ with Symbio™ 800 –*

Programming Guide (RT-SVP011*-EN), Manual Overrides for more details.

The supply fan speed requested and commanded value will remain at 0% any time the Active Supply Fan Run Command = OFF. Once the Active Supply Fan Run Command = ON and the unit has transitioned into an active Heat/Cool state, the supply fan speed will be controlled as required by unit type.

- Constant Volume units always run the fans at 100% after being proved On. The command is 0% while waiting on proving.
- Multi Zone VAV units modulate the supply fan speed to perform Duct Static Pressure Control after being proved On. During full airflow modes, Adaptive High Duct Static Limit will control supply fan speed to 100% or as high as possible subject to duct static pressure high limit constraints.
- Zone Temperature units can be configured via Supply Fan Configuration Command to cycle the supply fan off when heating or cooling capacity is inactive. A demand for heat or cooling will automatically initiate supply fan operation.
- Single Zone VAV units modulate the supply fan based on capacity control after being proved On.

Supply Fan Proving Operation and Method

Supply Fan Proving is active only after the Supply Fan Run Command is set to ON. Once set to ON, the supply fan is required to prove greater than 90% of minimum fan RPM (VFD minimum Hz setting), within 40 seconds. Fan proving fails anytime the fan is less than 90% of minimum RPM. A diagnostic is generated and operation stops.

Note: *Bypass Mode uses an alternate method of fan proving. See below for more details.*

Single Fan Operation

Unit parallel fans permit single fan operation if one fan fails to prove On. Cooling, external heat and ventilation continue to operate. Gas heat and electric heat are disabled. If the second fan fails to prove On, the unit shuts down.

If the failed fans diagnostic(s) clear, unit operation resumes.

Supply Fan VFD Bypass Control

All units will have a configurable option to provide Supply Fan VFD Bypass control. Whenever the bypass option is installed, the unit will include all of the necessary components to bypass the VFD assembly and allow the supply fan to operate at line frequency.

Entering VFD Bypass Control

- The supply fan must be off and no-discharge air flow (duct static pressure) detected for 40 continuous seconds to enter or leave Supply Fan VFD Bypass Mode.
- Enabling and disabling Supply Fan VFD Bypass Mode can only take place from the unit user interface.
- Both supply fan VFDs will be bypassed and the fans then operate at line frequency.
- During active Supply Fan VFD Bypass Mode
  - The Modbus communicated command for supply fan will be set to OFF, and the communicated speed command will be set to 0%.
  - All supply fan VFD diagnostics will be masked.
  - A warning only, latching “Supply Fan Bypass Enabled” diagnostic will be generated.
  - A duct static pressure sensor, if installed, will be used to perform Duct Static Pressure High Limit protection if enabled for bypass operation.

See *IntelliPak™ with Symbio™ 800 – Programming Guide* (RT-SVP011*-EN) for more information.

Exiting Supply Fan VFD Bypass Mode

- The user will not be allowed to remove the unit from an active *Supply Fan VFD Bypass Mode* at the user interface until all of the following has occurred:
  - The user has requested *Unit Stop Mode* from the user interface.
  - All components have been commanded OFF or CLOSED.
  - The fan proving mechanism indicates a supply fan no-flow condition has existed for 40 continuous seconds.
- When the user removes the unit from active Supply Fan VFD Bypass Mode at the user interface, all of the following will be enforced:
  - The *Supply Fan Bypass Relay* will remain OFF.
  - The *VAV Box Relay* will be commanded OFF (de-energized) to indicate normal airflow mode to the system, and the *VAV Box Stroke Time* will count down.
  - Once the above conditions have been satisfied, the user will be allowed to request *Unit Auto Mode* at the user interface.
- At all times when the unit is not in an active *Supply Fan VFD Bypass Mode*, the *Supply Fan Bypass Relay* will be commanded OFF (de-energized).

Supply Fan Proving with VFD Bypass

Units configured with Supply Fan VFD Bypass option require two modes of supply fan proving. During non-Bypass unit operation supply fan proving will use the fan’s VFD RPM as is used normally. The enabling and disabling of Supply Fan Bypass Mode, as well as unit operation during an active bypass event, requires Duct Static Pressure to be used for supply fan proving.

Note: *The enabling and disabling of VFD Bypass will be dis-allowed until the Duct Static Pressure indicates no flow per the below option.*

Proving criteria for proof of flow: When Duct Static Pressure rises above the Bypass Duct Static Diff Pressure setting, the supply fan will indicate a Flow condition.

Proving criteria for proof of no flow: If this pressure remains below 30% of the Bypass Duct Static Diff Pressure setting for 40 continuous seconds, the supply fan will indicate a No-Flow condition.

Operation during Manual Override and VOM (Emergency Override) Modes

Manual Override, VOM, and Emergency Override modes will operate as defined except for the following modifications:

1. If the fan is ON it will run at line frequency.
2. The VAV Box Relay will follow the defined operation specified in each VOM Mode user interface setting.
3. External fan control in bypass mode is supported. An external Supply Fan Speed Setpoint value = 0% will turn the fan Off, and any value > 0 will turn the fan On. The Supply Fan Speed Status always reports 100% speed during active supply fan bypass operation.

Minimum Ventilation Control

Symbio 800 provides outdoor air minimum ventilation control via options described below. Traq™ outdoor air flow control is the highest priority when installed and enabled. If Traq becomes disabled or inactive, Outdoor Air Flow Compensation will calculate a damper minimum position setpoint (this option should be disabled on constant volume units). If Outdoor Air Flow Compensation is disabled, Outdoor Air Minimum Position Setpoint will calculate damper minimum position setpoint.

Outdoor Air Flow Control (Traq)

The outdoor air damper is modulated to provide outdoor air flow (cfm) required by Outdoor Air Minimum Flow Setpoint. The outdoor air damper will modulate closed and open to maintain the required outdoor air minimum flow rate. See Table 34, p. 79 for additional information and settings.

The provided air flow measurement capabilities include periodic, automatic calibration; however, air flow gain and offset settings are provided for field adjustment.

Outdoor Air Flow Compensation

The outdoor air damper minimum position is modulated to provide outdoor air based on a variable supply fan speed. When supply fan increases speed the outdoor air damper minimum position is reduced, to prevent over ventilation. When supply fan decreases speed the outdoor air damper minimum position is increased to maintain design outdoor air flow requirements. There are three user editable settings to linearize damper position with the fan curve. See Table 34, p. 79 for additional information.

Outdoor Air Minimum Position Control

This function provides a fixed damper position for minimum outdoor airflow requirements. The damper is controlled to a position determined by Economizer Minimum Position Setpoint Active. This feature is available on all unit types with an outdoor air damper, but commonly used on constant volume units.

Demand Control Ventilation (DCV)

Demand control ventilation reduces energy consumption by reducing the outdoor air damper below minimum ventilation based on space CO_2. Decreasing CO_2 levels will decrease damper position to DCV minimum damper position setpoint. Increasing CO_2 level will increase damper position to design minimum setpoint. DCV requires a valid space CO_2 value.

Demand control ventilation setpoints used in all methods.

- Space CO_2 high limit
- Space CO_2 low limit

DCV when enabled with outdoor airflow control (Traq), DCV resets the outdoor air minimum flow setpoint based on space CO_2. DCV enabled with Outdoor Air Flow Compensation, DCV resets the outdoor air damper minimum position based space CO_2 and supply fan speed. DCV enabled with Outdoor Air Minimum Position Control resets the outdoor air damper minimum position based on space CO_2.

Table below summarizes the settings used for each Minimum Damper Position Control and Demand Control Ventilation.

Table 34. Outdoor air damper minimum ventilation control

Traq	Outdoor Air Flow Compensation	Demand Control Ventilation	Description	Outdoor Air Damper Controlling Setpoints
Enabled/Active	Disabled	Disabled	Damper controls to outdoor air minimum flow setpoint	Setpoint: Outdoor Air Minimum Flow Setpoint Active Outdoor Air Minimum Flow Setpoint Status
Enabled/Active	Disabled	Enabled/Active	Outdoor Air Flow setpoint is reset based on space CO_2.	Setpoint: Outdoor Air Minimum Flow Setpoint Status
				Settings: Design Min Outdoor Air Flow Setpoint DCV Min Outdoor Air Flow Setpoint
Disabled	Enabled/Active	Disabled	Outdoor Air Damper Minimum Position is reset based on supply fan speed.	Setpoint: Economizer Minimum Position Setpoint Active
				Settings: Design Min OA Damper Pos Setpoint Max Fan Design Min OA Damper Pos Setpoint Mid Fan Design Min OA Damper Pos Setpoint Min Fan
Disabled	Enabled/Active	Enabled/Active	Outdoor Air Damper Minimum Position is reset based on supply fan speed and space CO2.	Setpoint: Economizer Minimum Position Setpoint Active
				Settings: Design Min OA Damper Pos Setpoint Max Fan Design Min OA Damper Pos Setpoint Mid Fan Design Min OA Damper Pos Setpoint Min Fan DCV Min Outdoor Air Dampr Pos at Max Fan DCV Min Outdoor Air Dampr Pos at Min Fan
Disabled	Disabled	Enabled/Active	Outdoor Air Damper Minimum Position is reset based on space CO_2.	Setpoint: Economizer Minimum Position Setpoint Active
				Settings: Design Min OA Damper Position DCV Min Outdoor Air Damper Pos Setpoint
Disabled	Disabled	Disabled	Outdoor air damper position is controlled by cooling	Setpoint: Economizer Minimum Position Setpoint Active

During normal occupied periods of heating and cooling modes of operation, the outdoor air damper maintains ventilation requirements via the minimum position control methods. However, the following modes of operation will override the damper minimum position setpoint to 0%.

- Morning Warm Up
- Pre cool
- Night Purge
- Unoccupied Heat
- Unoccupied Cool
- Off

Relief Fan and Space Static Pressure Control

The primary role of relief fan is to relieve air from the building to control space static pressure. This is common

when the unit is economizing and bringing in large quantities of outside air.

Space Static Pressure Control with Statitrac™

Statitrac™ is an option. Space static pressure control operation will become active when the supply fan is On and proven, the outdoor air damper position is greater than the relief enable position setpoint and a valid space static pressure value is greater than the active space static pressure setpoint plus half the deadband.

When the activation conditions have been met, the unit will start the relief fan and control relief damper and fan speed to maintain the space static pressure setpoint. Once the relief fan operation is proven, the fan will modulate to track the relief damper position.

Space pressure control operation terminates when the relief damper is closed and the space static pressure is below setpoint minus half the deadband, or space static pressure is within deadband for 30 minutes.

Space Static Pressure Control without Statitrac™

If Statitrac™ is not installed, or the space static pressure sensor has failed, space static pressure control without Statitrac™ becomes active. The relief damper will track to the outdoor air damper position and the relief fan speed will track to the relief damper position when the supply fan is proven On and the outdoor air damper position is greater than the relief enable position setpoint.

Space static pressure control operation will be terminated whenever any of the activation conditions are not true, when the outdoor air damper is fully closed or when the outdoor air damper is less than the relief enable point minus 10%.

If the relief fan or damper is in failure, the relief fan will be commanded Off and the relief damper will be commanded Closed.

Discharge Air Temperature Control

Discharge Air Temperature Control uses available heating and cooling capacity to deliver the required temperature at the discharge of the unit. A discharge air temperature sensor is required for operation.

In cooling modes, the control uses cooling sources to deliver air temperature as required by the Discharge Air Cooling Setpoint. In heating modes, the control uses heat sources to deliver air temperature as required by the Discharge Air Heating Setpoint. Primary heat is never used in conjunction with mechanical cooling.

Multi Zone-VAV and Constant Volume - Discharge Temperature Units

These unit types provide Discharge Air Temperature Control in all heat, cool, and occupancy modes of operation. The typical operating mode is Cooling delivering conditioned air to multiple zones of a building. Multi Zone-VAV units have duct work to supply VAV terminal units. The VAV units modulate to control space comfort.

These units also change over to provide heat (when installed). A building automation system or VAV Box Relay Output can be used when the heat source requires full airflow. See Heat Types for more information. A valid space temperature input must be provided to perform heating modes such as Daytime Warm Up and Morning Warm Up (when enabled).

Supply Air Tempering

Supply Air Tempering is a function of discharge air control Cool mode when DX cooling is off and the outdoor air damper is at minimum position. This function is typically required when outdoor air intake percentage is high and the outdoor air temperature is low. If discharge air temperature falls below the Discharge Air Cooling Setpoint, the control will temper (warm up) the discharge air by initiating heating capacity. Cool – Tempering is displayed on the user interface Operating Mode screen when this function is active. The control will transition back to normal cooling when heat capacity is no longer required. Supply Air Tempering is disabled by default.

Multi Zone-VAV equipment allows supply air tempering when equipped with Modulating Gas, Ultra Modulating Gas, and SCR Electric Heat. Constant Volume – Discharge Air Temperature equipment allow all forms of heating to provide supply air tempering.

Changeover Input

Multi Zone-VAV and Constant Volume Discharge Temperature units configured with heat include a binary Changeover Input. An open input requests discharge air cooling operation. A closed input will change over to discharge air heating. This local input is arbitrated with building management Heat Cool Mode Request commands to determine the active mode of operation.

VAV Box Relay Output

This binary output is provided by the controller to be optionally wired to VAV units in a Multi Zone-VAV system to coordinate system changeover to full airflow heating. The binary output is de-energized when the controller is operating in cooling modes. The binary output energizes when the heat type installed requires full airflow. See Maximum Heat for more details.

Discharge Air Reset

Discharge Air Reset is a method to save energy by resetting the discharge air temperature as heating and cooling building loads increase and decrease.

When enabled, the controller can independently reset the Discharge Air Heating Setpoint Active and/or Discharge Air Cooling Setpoint Active based on Zone (space temperature) or Outdoor Air temperature. The new target setpoints are reported as Discharge Air Setpoint Heating Status and Discharge Air Cooling Setpoint Status.

The user interface display provides settings for the reset temperature range (Zone or Outdoor Air) and discharge air temperature setpoint reset amount over the specified range. For example: the discharge air temperature cooling setpoint shall increase 5°F over an outdoor air temperature range of 90°F to 70°F. If Discharge Air Cooling Setpoint Active is 50°F and Outdoor Air Temperature is 80°F, the reset function calculates and reports Discharge Air Cooling Setpoint Status = 52.5°F. The controller will provide discharge air at 52.5°F.

Duct Static Pressure Control

Multi Zone-VAV equipment have variable speed supply fans and are often used in Variable Air Volume (VAV) systems consisting of ductwork serving multiple building zones and VAV boxes that control space comfort independent of the rooftop air handler. VAV boxes modulate air volume by a damper that opens and closes to maintain space comfort. In response, duct static pressure increases and decreases. The controller will modulate supply fan speed to maintain Duct Static Pressure relative to the Duct Static Pressure Setpoint

Duct Static Pressure High Limit

The controller operates the supply fan to maintain duct static pressure below the Duct Static Pressure High Limit setpoint. In the event that duct static pressure approaches the high limit setpoint, the controller will reduce and limit the supply fan speed.

Space Temperature Control

Space Temperature Control uses available heating and cooling to deliver comfort to a building space. The control requires a valid space temperature and discharge air sensor value; if either input to the control is invalid, the equipment cannot operate.

Space Temperature Control determines the type of load (heating or cooling) in the space based on active cooling and heating setpoints and space temperature. If space temperature is above the cooling setpoint, this represents a space-cooling load. The control will calculate a Discharge Air Temperature Setpoint to satisfy the cooling demand of the space.

The relationship of the calculated discharge air setpoint and discharge air temperature will drive heating and cooling capacity available to satisfy the discharge air temperature setpoint. For Example: As space temperature cooling load increases, space temperature control will calculate a lower Discharge Air Temperature setpoint and therefore will increase cooling capacity. The calculated discharge air cooling setpoint is bound by Discharge Air Temperature Maximum Cool Limit and Discharge Air Temperature Minimum Cool Limit.

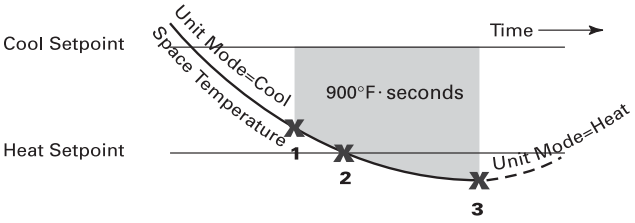
If heat-cool mode input is either not provided or unsupported the mode input is Auto. The controller will automatically determine the appropriate heat or cool mode of operation based on space temperature, setpoints, and heating/cooling configured for the unit. Heat or Cool is reported by Heat Cool Mode Status.

Auto Changeover

When the controller input mode of operation is Auto, the controller will automatically determine space heating and cooling mode, the unit changes from cool to heat or from heat to cool, when the integrated error between the space setpoint and space temperature is 900°F-seconds or greater. The integrated error is calculated once every 10 seconds. See figure below for an example of changing from space cooling to space heating. If Cool is the active mode and space temperature is less than 1°F below the active heating setpoint the system will immediately change to Heat mode. If space temperature is greater than 1°F above the active cooling setpoint, the mode to change to Cool.

Space Dehumidification is a Cool mode sequence of operation if the unit is equipped with hot gas reheat. A unit that has a dehumidification demand will switch from Heat mode to Cool mode if heating capacity is off and space temperature is above the heating setpoint. A unit operating in dehumidification control will inhibit the normal mode transition from Cool mode to Heat mode.

Figure 44. Auto changeover logic



1. This is the point at which the cooling capacity equals 0% and the error integrator starts to add up. Error integration does not begin until the capacity is 0%. The error integrator cannot be less than zero.
2. The Space Temperature must be less than Space Setpoint before the controller can change to Heat. The Space Temperature must rise above the active space Cool Setpoint before the controller can change to Cool.
3. The controller switches to Heat (from cool) after the error integrator exceeds 900°F seconds or Space Temperature <= (Heat Setpoint – 1°F).

Space Temperature Control Units

Single Zone VAV and Constant Volume Space Temperature units use the Space Temperature Control sequence of operation in Occupied Heat and Occupied Cool modes of operation; however, the Discharge Air Control method is used for all other modes. The table below summarizes each mode of operation and the control method applied. See Operating Modes section for more details

Table 35. Mode of operation and applied control method

Heat Cool Mode	Control Method	Discharge Air Temperature Setpoint	Space/Discharge Setpoints
Cool	Space Temperature Control	Calculated (cascade)	Space Temperature Setpoint Active Discharge Air Temperature Setpoint Active
Heat	Space Temperature Control	Calculated (cascade)	Space Temperature Setpoint Active Discharge Air Temperature Setpoint Active
Morning Warm Up	Discharge Air Control	Fixed	Morning Warmup Setpoint Discharge Air Heating Setpoint Active
Pre Cool	Discharge Air Control	Fixed	Pre Cool Setpoint Discharge Air Cooling Setpoint Active
Night Purge	Discharge Air Control	Fixed	
Unoccupied Cool	Discharge Air Control	Fixed	Unoccupied Cooling Setpoint Discharge Air Cooling Setpoint Active
Unoccupied Heat	Discharge Air Control	Fixed	Unoccupied Heating Setpoint Discharge Air Heating Setpoint Active

Single Zone VAV

Single Zone VAV equipment is configured with a variable speed supply fan that modulates with Space Temperature Control to minimize fan energy while maintaining space comfort. When there is no demand for heating or cooling the supply fan operates at the minimum speed setting while providing ventilation according to occupancy setpoints. Alternately, the supply fan can be setup to cycle off when there is no demand for heating or cooling.

Single Zone VAV – Cooling

Cool — When there is a space cooling demand, DX cooling will initialize and increase to satisfy space temperature. The supply fan will continue to operate at a low, fixed speed at low cooling capacities until the cooling capacity requires additional airflow to keep compressor operation optimal. The supply fan speed will increase as the demand for cooling capacity increases. The minimum supply fan speed is calculated by DX cooling capacity. As the space requires additional cooling capacity, Space Temperature Control will calculate a lower discharge air temperature setpoint increasing DX cooling which in turn increases the supply fan speed (to prevent coil frost). Cooling capacity and supply fan speed both can increase to 100%.

If the unit discharge air temperature reduces to the Discharge Air Temperature Minimum Cool Limit setting or DX cooling reaches 100% capacity, cooling capacity increases will hold while the supply fan speed will continue to increase to 100% or modulate to manage space comfort cooling.

Cool Economizer — If the unit is configured for a modulating outdoor air damper and conditions are suitable for economizer cooling, the supply fan will operate at minimum speed while the economizer damper modulates between the Outdoor Air Damper Minimum Position (or Flow) Setpoint and 100% to satisfy the discharge air temperature setpoint. If the economizer damper reaches 100% open and additional cooling capacity is required, the supply fan will then modulate between minimum speed and 100% to provide additional cooling to the space.

Cool Economizer + DX —Cool – Economizer + DX is reported as the Unit sub-mode of operation when both economizer and DX cooling are active. If actively economizing, outdoor air damper is 100% and supply fan speed reaches 100% then DX cooling will be added if the unit is not satisfying space cooling requirements.

If DX cooling is active and economizer cooling enables, the control will transition to increase economizer damper above minimum position (or flow setpoint) to 100% to satisfy space cooling while decreasing DX cooling. DX cooling will steadily be removed as long as economizer cooling is able to satisfy the cooling load. The supply fan operates to the lowest speed possible during the transition.

Single Zone VAV – Heating

The supply fan operates at minimum speed (or will cycle off) when the space has no heating demand. When space temperature control calculates an increasing demand for heat in the space, the calculated discharge air temperature setpoint will increase. When heating capacity initiates, the supply fan will operate at the required minimum speed for

the heat type installed. The minimum fan speed can be 100%. See Heat Types for more information.

As the Discharge Air Temperature Setpoint increases, the heat capacity increases stages and/or modulates. The control manages heating capacity to deliver a discharge air temperature to the Discharge Air Temperature Setpoint within the control deadband. If the unit discharge air temperature reaches the Discharge Air Temperature Maximum Heat Limit, heating capacity will hold and the supply fan will further increase (if possible) to satisfy the space heating demand.

Constant Volume — Space Temperature Control

Constant Volume space temperature control units provide heating and cooling in the same sequence of operation as Single Zone VAV except the supply fan, when On, will operate at its maximum speed. Heating and cooling have the same constant volume, maximum speed.

Compressor Staging and Timers

There are timers associated with compressor staging control to optimize refrigeration system performance:

- Minimum OFF Time
- Minimum ON Time
- Inter-Stage Time

Minimum OFF Time — For each compressor (fixed or variable speed), when the compressor has been turned OFF for any reason, a timer will be started for that compressor(s). The compressor(s) will not be allowed to be turned back ON until their timer has expired.

Minimum ON Time — Once a compressor has been turned ON a timer will be started for that compressor. The compressor will not be allowed to be turned back OFF until its timer has expired. A normal stop request (user interface Stop, normal shutdown diagnostic, Off mode) will honor the Minimum ON Time and keep the compressor on until the timer expires

Important: *Any Immediate stop request or Immediate Shutdown diagnostic will override any minimum on time and shut the compressor off immediately.*

Inter-Stage Time — For normal unit operation the timing between stages will be maintained at a minimum of a fixed Inter-stage Time. The compressor control algorithm may request staging to occur beyond 3 minutes but the time span from one stage turning ON(OFF) until the next compressor stage turning ON(OFF) will be no less than the 3 minute inter-stage time. Rapid Restart and manual compressor control can override this time.

Supply Fan Delay

A 60 second supply fan off delay is enforced after the last compressor de-energizes.

General Compressor Staging

Compressor staging will occur based on the unit's algorithms cooling capacity request and the specific Compressor Staging Table defined per the unit's configuration. When the request is ADD, the next highest stage sequence will identify which compressors will be turned ON, or OFF if a 'Double Swap' is required. When the request is SUBTRACT, the next lowest stage sequence will identify which compressors will be turned OFF, or ON if a 'Double Swap' is required. Capacity Control limits may also affect staging sequence.

Double Swap

To meet efficiency or optimized capacity requirements, it will be necessary on some units, when staging up or down, to turn ON one compressor and, for the same stage, to turn OFF another compressor.

Compressor Proving

- Fixed Speed Compressors: The compressor contactors have an auxiliary contact that is wired to a compressor proving input.
- Variable Speed Compressors: The variable speed compressor VFD has an integrated Run Inhibit binary input wired to a second HPC (High Pressure Cutout) switch. When this HPC switch opens the VFD will be stopped and the run proving status will be communicated back to the controller.

Variable Speed Compressor Optimal Start

This circuit-level feature applies to the variable speed compressor and enforces a maximum speed limit for a fixed time period following start-up. During normal operation the speed range limits are determined based on unit type, efficiency, capacity stage and other limit controls. The maximum speed limit applies to every start-up to maintain oil quality. When this function is active, an indication will be made to the user interface

Evaporator Coil Surface Utilization (Two Circuit Units Only)

All staging sequences performed by the algorithm energize compressors on each circuit as soon as possible to optimize cooling efficiency. If a circuit 1 compressor starts first, a circuit 2 compressor starts second if it is available. If a circuit 2 compressor starts first, a circuit 1 compressor starts second if it is available.

Compressor Lockout and Inhibit

In all cases of Lockouts, Inhibits, and Limits (Compressor Minimum OFF Time is not considered a lockout or inhibit) Alternate Staging Sequences will be substituted.

Compressor Lockouts

Compressor lockouts are typically non-recoverable and require user interaction at the User Interface to clear associated diagnostics that return the compressor(s) to operation. Other compressor lockouts will recover automatically when the lockout command is removed.

Compressor Inhibits

Inhibits of compressors are typically recoverable without requiring user interaction. The inhibit of a compressor will be immediate once the request is issued. Inhibits originate from undesirable refrigeration operating conditions and may or may not be associated with a diagnostic event. Once the condition has recovered, the compressor will be un-inhibited and will be available for staging sequences.

Alternate Staging Sequence

When one or more compressors are unavailable due to Lockouts and Inhibits, an alternate staging sequence will be determined from a rule-based algorithm which selects the best next stage from the available compressors. Double Swaps will not be performed during Alternate Staging Sequence.

Staging Up

On single circuit units, two circuit units with neither circuit active, or two circuit units with both circuits active, the smallest available compressor will be selected to start.

On two circuit units with one circuit active, the smallest available compressor on the non-active circuit will be chosen to start. If none are available on the non-active circuit the next smallest available compressor on the active circuit will be chosen to start.

Staging Down

On single circuit units, or two circuit units with one circuit running, the largest running compressor will be chosen to stop.

On two circuit units with both circuits active, the largest running compressor that will not cause a circuit to stop will be chosen. If there is only one compressor running per circuit the larger of the two compressors will be chosen to stop.

Transition Out of Alternate Staging

Transition to Normal Staging — When all compressors are available on the next request to add or subtract the current state will be evaluated against the Normal staging table. If a match is found, the next staging decision will be made following the Normal staging rules. If the normal table does not contain a match for the current state, then the Alternate Staging sequences will be used to process the command, and the cycle will continue until a match has been found.

Transition to Balanced Compressor Staging — Balanced Compressor Staging is a feature setting, when enabled balanced staging rules will be used to process the next staging request.

20 Ton Standard Exceptions

Due to Oil Management design constraints with the 20S unit, there are specific rules implemented to deal alternate staging to prevent the unit operating in compressor sequences that have the potential to cause oil issues.

Compressor Staging with Variable Speed Compressors

Units with Variable Speed Compressors will always attempt to start the variable speed compressor first. Subsequent stage increases start the preferred compressor next according to the default factory staging sequence. Special consideration during Alternate Staging Sequences are defined as follows:

VSC Available During Alternate Staging Sequences

During inhibited fixed speed compressor operation, the VSC will be utilized over its full range of designed speed operation prior to a stage change. Stage change logic will be determined based on the available compressors following alternate staging rules.

VSC Inhibited During Alternate Staging Sequences

During inhibited VSC operation, stage change logic will be determined based on the available fixed stage compressors. If the circuit with the inhibited VSC also has fixed stage compressors, (FSC) these compressors will be available for the alternate staging sequence. All FSC must be staged OFF before the non-inhibited VSC will become available. When the VSC becomes available, it will be the first compressor turned ON at the next ADD request.

Balanced Compressor Staging

The Balanced Staging function is a user-defined option for fixed-speed compressor units. To perform Wear Balancing, the Symbio 800 controller will keep track of each installed compressor' number of starts, and run-time. The controller will use this information to equalize wear across all compressors installed in the unit. Double Swaps will not be performed during Balanced Compressor Staging The Balanced Compressor Staging function can be Enabled or Disabled at the user interface. When disabled, compressor staging follows the Normal Staging Sequence.

Wear Balancing Calculation

The wear balancing formula for compressor operation is the number of compressor starts multiplied by a factory determined wear factor, plus all of the normal run time. Starting accounts for a significant amount of normal run time wear and adds quickly to the wear calculation sum.

Single Circuit Units

The lowest wear compressor starts first. Subsequent stage increases start the next lowest wear compressor. The final stage increase starts the last compressor. Each stage decrease de-energizes the highest wear compressor first.

Dual Circuit Units

The lowest wear compressor from either circuit starts first. The second stage increase starts the next lowest wear compressor from the "Off" circuit. Subsequent stage increase requests will start the lowest wear compressor available. Stage decreases with both circuits active, the highest wear running compressor that will not cause a circuit to stop will be chosen. If there is only one

compressor running per circuit the compressor with a higher wear calculation will be chosen to stop.

Ties

If multiple compressors with equal wear are available for the next stage, the smallest compressor will start. The largest compressor will stop.

If Balanced Starts is Disabled from the user interface, compressor staging follows the factory staging sequence. The nominal unit size configuration setting maps to the factory staging sequence selection.

Compressor Protections

There are a number of functions which provide protection of the refrigerant systems during compressor operation. These protections typically involve reducing, if not completely removing, one or more compressors from operation on a given refrigeration circuit. There are basically two types. The first are Lockouts which are those associated with diagnostics and are persisted until human intervention or significant unit mode change occurs, The second are Inhibits which are typically temporary, self-correcting, and may not involve a diagnostic.

Working in concert with compressor protection are the general algorithms of compressor staging (timing) as well as refrigeration and electrical capacity control.

Low Ambient Lockout

Low Ambient Lockout prevents compressor operation when Outdoor Air Temperature Active falls below an adjustable setpoint. The low ambient lockout setpoint range and default value is dependent on unit configuration. When the outdoor air temperature rises above the Low Ambient Lockout Setpoint + 5˚F, inhibit will be removed and the compressors will be available.

Low Compressor Suction Pressure Protection

The Low Compressor Suction Pressure diagnostic, Low Compressor Suction Pressure Start Inhibit, and Low Compressor Suction Pressure Limit work together to prevent damage to compressors and suction cooled compressor motors operating with little or no refrigerant charge.

The Low Compressor Suction Pressure diagnostic protects against an inadvertent compressor start when the system is in a vacuum (such as can be produced during service procedures). It also avoids compressor failures and extremely inefficient operation due to total charge loss. The Low Compressor Suction Pressure diagnostic will shut down the affected circuit, if already running, when the circuit's Compressor Suction Refrigerant Pressure measurement drops below a factory determined pressure threshold value for normal operation (normal threshold value). When the circuit is not running, and for a period of time (in seconds) immediately after the circuit starts running, the effective start-up pressure threshold is lower than the normal threshold value. These values are dependent on unit model.

The Low Compressor Suction Pressure Start Inhibit and Low Compressor Suction Pressure Limit work together to reduce the likelihood of Low Compressor Suction Pressure diagnostic, which will lock out the circuit and force a manual diagnostic reset. When either functions are active, an indication will be made to the user interface.

The Low Compressor Suction Pressure Start Inhibit is designed to prevent a circuit from starting when low compressor suction pressure exists, but will not shut down a circuit that is already running. When the function is in the Active state, the circuit will be prevented from operating (locked out). The threshold value for this function is 1.2 times the normal threshold value.

Low Compressor Suction Pressure Limit only applies to circuits which have more than 1 compressor installed. This function prevents the addition of circuit capacity any time the circuit is running and Compressor Suction Refrigerant Pressure is less than 1.4 times the normal threshold value.

Temperature and Pressure Sensor Failures

Each refrigeration circuit has a number of sensors that are required for proper control of compressors and associated head pressure control components. Should these sensors fail, or exceed operational limits, compressors on the given circuit will be inhibited until the sensor values return to normal operational ranges. An indication will be made to the user interface.

Oil Management Protection

Trio Manifolded compressors on single circuit units require an additional level of protection for the fixed speed compressor installed in the "A" position. When the "A" compressor has been energized and an additional compressor has been commanded on, a thirty minute timer is started. When the thirty minute timer has expired, the "A" compressor is de-energized for thirty seconds. At the end of the thirty seconds the compressor is released to normal control. The thirty minute timer is reset at the end of oil management cycle.

Compressor Discharge Pressure Limit

Compressor Discharge Pressure Limit is a control feature of Adaptive Control. This feature prevents a circuit shutdown when the discharge pressure approaches the high pressure cutout switch setting by decreasing compressor capacity. This is done by staging off fixed speed compressors on circuits with high discharge pressure. This feature will provide maximum capacity while preventing a high pressure cutout.

The discharge pressure limit is based on the discharge pressure percentage relative to the high-pressure cutout setting. This limit is active when the circuit is running.

If the discharge pressure limit is preventing loading, holding or forcing unloading, an indication will be made to the user interface.

Note: *The discharge pressure limit function assumes that all available condenser fans are running and limiting compressor capacity is the only option left.*

Compressor Discharge Saturated Temperature Limit

Compressor Discharge Saturated Temperature Limit is a control feature of Adaptive Control for variable speed compressors only. This circuit-level feature applies when the discharge saturated temperature approaches the compressor operating threshold limit for high discharge saturated temperature. Limit control action modifies the normal capacity modulation to decrease capacity by reducing compressor speed.

Compressor Discharge Saturated Temperature Speed Limit

Compressor Discharge Saturated Temperature Speed Limit is a control feature of Adaptive Control for Danfoss VZH variable speed compressors only. This circuit-level feature applies when the discharge saturated temperature approaches the compressor operating threshold limit for high discharge saturated temperature. Limit control action modifies the allowable compressor speed range.

High Suction Saturated Temperature Inhibit

High Suction Saturated Temperature Inhibit is a control feature of Adaptive Control for variable speed compressors. This circuit-level feature applies when the suction saturated temperature exceeds the compressor operating threshold limit for suction saturated temperature. Inhibit control action de-energizes the variable speed compressor when the suction saturated temperature exceeds the operating threshold design limit.

When this function is Active, an indication will be made to the operator.

Compressor Involute Pressure Differential Protection

Compressor Involute Pressure Differential Protection is a control feature of Adaptive Control for variable speed compressors. Scroll compressors have a limitation on the pressure difference between the opposite sides of the involute tip near the center of the scroll (compression ratio). High values of compressor involute pressure differential may cause compressor fatigue. Its associated limit will attempt to allow the unit to run safely at partial capacity without tripping the circuit on a diagnostic. The compressor must be restricted from running in this condition.

When this function is active, an indication will be made to the user interface. Depending on severity, both instant and delayed shutdowns are possible. Shutdowns may be temporary or require a manual reset.

Loss of Charge Detection

This function detects excessive refrigerant leakage. Units can operate in a low charge condition for an extended period where the loss of charge is not enough to trigger the normal loss of charge protection. If the charge continues to fall slowly, a subsequent start could result in variable speed compressor damage. Loss of Charge Detection works in concert with Superheat High Limit Detection.

Superheat High Limit Detection

A unit may experience refrigerant leakage at any point in its service life. Moderate refrigerant loss reduces capacity and causes low suction saturated temperature but excessive refrigerant loss may lead to compressor damage. Excessive refrigerant loss is detected by a suction superheat condition which exceeds a high limit threshold.

This function detects excessive refrigerant loss by comparing suction superheat to a high limit threshold. The detection method reduces the potential for nuisance trips by providing a startup delay time that is a function of the outdoor air temperature.

This approach helps to mitigate false detection trips because low suction saturated temperature and high superheat is normal following startup at low outdoor air temperature conditions.

When this function is active, an indication will be made to the user interface and the circuit will shutdown.

Variable Speed Compressor Modulating Current Limit

This Adaptive Control action will first reduce variable speed compressor RPM which, in turn, reduces discharge pressure. This will reduce the variable speed compressor motor current thus preventing an A49 Speed Limit VFD trip. This function works in concert with Current Limit Staging Command which can subtract, hold or allow adding compressor capacity. When this function is active, an indication will be made to the user interface.

Compressor Low Suction Saturated Temperature Speed Limit

This is an Adaptive Control feature for variable speed compressors. Low suction saturated temperature can occur following startup at low outdoor air temperature conditions. This circuit-level feature applies to variable speed compressors and enforces a minimum and maximum speed limit.

Coil Frost Protection

This is a circuit level protection and is active whenever one or more compressors on a circuit are running. This feature is always available with all compressor types.

As frost builds on a coil, thermal resistance increases and airflow decreases. Frost buildup on the coil can also cause instabilities in superheat control. If suction saturated temperature drops below a threshold, Frost Protection will inhibit capacity in an attempt to melt the frost and allow the unit to run more efficiently. Once the frost is removed the unit will be returned to normal operation. To avoid nuisance trips at startup, a “ignore” time delay is applied. The delay time is variable and is based on outdoor air temperature

Modulating Coil Frost Limit Control applies to circuits with a variable speed compressor. This function will limit variable speed compressor capacity according to evaporator coil frosting conditions. If the suction saturated temperature (SST) is sufficiently above the Coil Frost Threshold, the Symbio 800 reverts to normal control.

Modulating Coil Frost Limit Control is active following compressor startup and is not subject to the ignore time.

There are no diagnostics for this feature. When this function is active, an indication will be made to the user interface.

Head Pressure Control

The refrigeration system will utilize condenser fan control to maintain the discharge pressure of operating compressors on a given circuit to desirable levels. Pressure sensors will be utilized to provide the control signal. As the pressure of the condenser section increases more stages of fan capacity will be used to prevent excessive operating conditions that could open the High Pressure Cutout switch causing nuisance trips of the refrigeration circuit. Condenser fan capacity will be reduced to prevent excessive low pressures that could cause un-stabilized refrigeration conditions. A unit can have up to two refrigeration systems (circuits) that are completely isolated from each other and are controlled independent from each other.

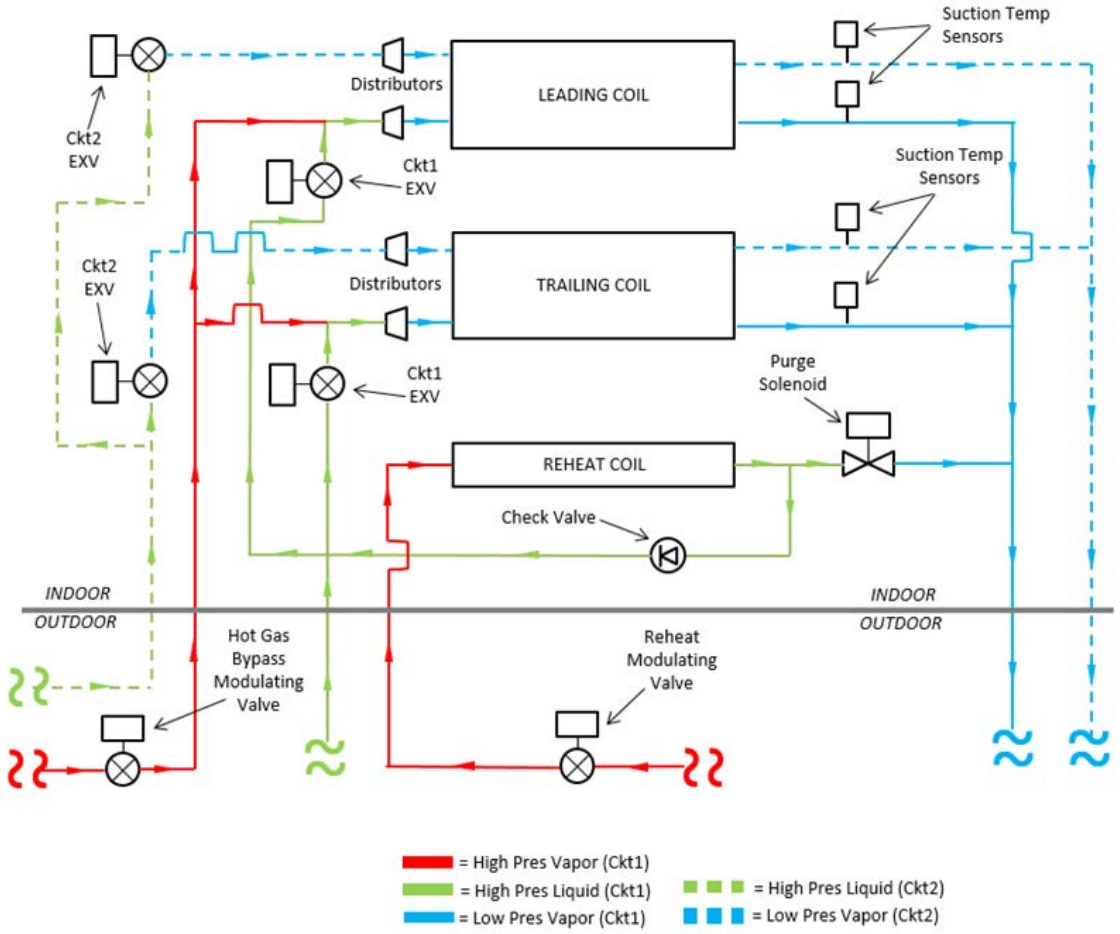
Low Ambient Operation

Units configured with Low Ambient Operation will utilize a VFD for the first condenser fan.

Hot Gas Bypass

Hot gas bypass is a unit configuration option that, at some predetermined suction pressure, initiates a modulated flow of hot refrigerant gas from high side to the low pressure portion of the refrigeration system. This adds “false load” to avoid low suction pressures that would otherwise result in coil frosting. This feature can be disabled, but when enabled is transparent to the normal staging control provided by the Symbio 800 controller. Regardless, Hot Gas Bypass operation indirectly places operating constraints on the system that have to be addressed by the unit controls in the areas of EXV superheat control and dehumidification/reheat operation.

Figure 45. Piping diagram with hot gas bypass



Hot Gas Bypass Control

Activation

If a unit is configured with hot gas bypass, the hot gas bypass system is functional whenever circuit 1is operating. The hot gas bypass valve is closed during normal operation. The valve will open, passing the amount of hot gas required to produce a suction pressure that is high enough to prevent coil frosting, when necessary. If Hot Gas Bypass Enable is Disable, the Hot Gas Bypass valve is always closed.

Interaction

Hot Gas Reheat and Hot Gas Bypass options are installed on circuit 1, however, hot gas bypass is not allowed to operate if the “Hot Gas Reheat Valve Reheat” is open (>0%). The hot gas bypass valve will open when suction pressure is lower than the calculated target. In addition, the valve control has interactions with coil defrost protection, EXV control and condenser fan control.

HGBP Valve Calibration

HGBP valve calibration (also known as overdrive closed) procedure is initiated in the following circumstances:

- Whenever the unit controller is power cycled. This is under the control of the unit controller software, as part of the software start-up procedure. Note: under the most common scenario when both the HGBP valve electronic controller and unit controller are power cycled, HGBP valve recalibration may occur twice.
- When the circuit cycles off and the circuit has run for at least EXV Recalibration Time since the previous calibration.

  Note: *EXV calibration time is used for both HGBP and EXV valve calibration.*
- Whenever the HGBP valve electronic controller is power cycled. The HGBP valve electronic controller does this automatically.

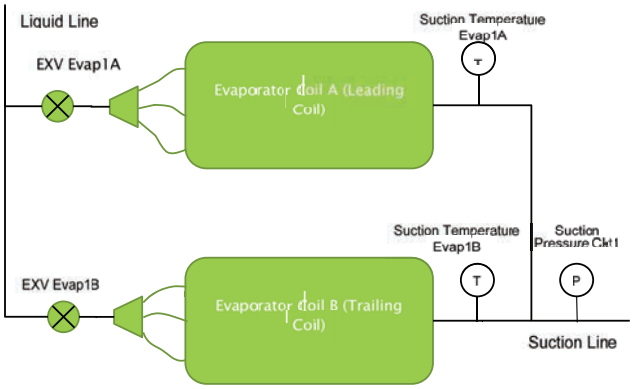
EXV Control (Electronic Expansion Valve)

Electronic expansion valves (EXVs) control suction superheat to ensure the complete and efficient evaporation of refrigerant in the evaporator. Excess liquid refrigerant in the compressor suction (low suction superheat) can be harmful to the compressor, and a deficit of liquid in the

evaporator (high suction superheat) is inefficient. The benefit of EXV control, through controlling suction superheat, suction pressure, suction saturated temperature, or pressure ratio, promotes energy-efficient operation and long-term reliability of the compressor(s).

Suction superheat is the difference between suction temperature and saturated suction temperature. A temperature sensor measures suction temperature. The saturated suction temperature is determined from the measured suction pressure by a refrigerant property calculation. Typically, the EXV control maintains a small, desired amount of suction superheat by opening or closing the EXV(s), which adjusts the refrigerant flow rate into the evaporator.

Figure 46. Component location — Circuit 1 of staggered coil unit



In certain situations such as cold ambient starts, warm supply air starts, or DOAS applications, the EXV control can automatically move into a suction pressure control mode, allowing the suction superheat to deviate from the superheat setpoint. The goal of the suction pressure control mode is to maintain suction pressure or differential pressure within the compressor operating map.

In situations where the superheat rapidly falls to very low values, special control modes are necessary to dry out excess refrigerant liquid in the evaporator, suction line, and compressor sumps, and transition back to normal control.

Configuration

Electronic Expansion Valves are always installed on DX refrigeration circuits. Configuration is used to specify the EXV selection on each refrigeration circuit. EXV selection allows picking of a correlation between EXV steps or EXV percent open, and the flow coefficient (C_V) at each EXV opening.

Functional Description

EXV Calibration

An EXV Calibration (also known as overdrive closed) procedure will be initiated in the following circumstances:

- Whenever the unit controller is power cycled. This is under the control of the unit controller software, as part of the software start-up procedure.

  Note: *Under the most common scenario when both the EXV electronic controller and unit controller are power cycled, EXV Calibration may occur twice.*

- When the circuit cycles off and the circuit has run for at least EXV Recalibration Time since the previous calibration.

  Note: *EXV calibration time is used for both HGBP and EXV valve calibration.*

- Whenever the EXV electronic controller is power cycled. The EXV electronic controller does this automatically.

EXV Manual Override Control

See Programming Guide

EXV Control Sequence of Operation

The EXV control algorithm can be in one of the following states:

Table 36. EXV Control States

Control State	Description
Stopped	EXV closed. Overdrive closed (calibration) performed if criteria are met.
Starting	EXV pre-position is calculated, and the valve arrives at the requested opening before any compressors on the circuit start.
Stopping	EXV commanded to close. Remain in state until EXVs report that they are closed.
Running	EXV operates in pre-start control, or in automatic control after the pre-position hold time expires.
Running Mode Sub-States	**Description**
Running – Wait for Circuit Start	Time after valve arrives at pre-position value, but before a compressor on the circuit starts.
Running – Pre-Position Hold Time	After a compressor on the circuit starts, but before automatic control begins.
Running – Suction Superheat Control	Normal automatic superheat control

Table 36. EXV Control States (continued)

Control State	Description
Running – Suction Pressure Control	Controlling suction pressure instead of suction superheat, to maintain adequate compressor pressure ratio or to limit high suction saturated temperature.
Running – Evaporator Dryout Control	Special version of suction pressure control, to dry out a flooded evaporator and prepare to control suction superheat or suction pressure again.

Operating Modes

Calibrating_EXV

Circuit submode displayed when EXV is going through the calibration process. Most often active when circuit top-level mode is Stopped, Run Inhibit, or Auto.

Prepositioning_EXV

Circuit submode displayed when EXV(s) are moving toward their commanded pre-position opening prior to starting the first compressor on circuit start-up.

Manual_Override_Evaporator

Displayed when performing manual control override on the EXV in the Evaporator position.

Economizing

Symbio 800 supports a common minimum outdoor air and economizer damper (i.e. no separate minimum outdoor air damper). Economizer high-limit decision methods are defined as follows.

Table 37. Economizer high-limit decision methods

Fixed Dry Bulb	Enable	Outdoor Air Temperature < Economizer Outdoor Air Enable Setpoint – 5°F
	Disable	Outdoor Air Temperature > Economizer Outdoor Air Enable Setpoint
Reference Enthalpy + Fixed Dry Bulb	Enable	Outdoor Air Enthalpy < Reference Enthalpy Setpoint – 3 BTU/lb AND Outdoor Air Temperaure < Economizer Outdoor Air Enable Setpoint – 5°F
	Disable	Outdoor Air Enthalpy > Reference Enthalpy Setpoint OR Outdoor Air Temperaure > Economizer Outdoor Air Enable Setpoint
Comparative Enthalpy + Fixed Dry Bulb	Enable	Outdoor Air Enthalpy < Return Air Enthalpy – 3 BTU/lb AND Outdoor Air Temperaure < Economizer Outdoor Air Enable Setpoint – 5°F
	Disable	Outdoor Air Enthalpy > Return Air Enthalpy OR Outdoor Air Temperaure > Economizer Outdoor Air Enable Setpoint
Differential Dry Bulb	Enable	Outdoor Air Temperature < Return Air Temperature
	Disable	Outdoor Air Temperature > Return Air Temperature

When conditions are suitable for economizer operation, the outdoor air damper modulates between Economizer Minimum Position (or Flow) Setpoint and 100% open. Economizing will not allow additional mechanical cooling until the damper position is 100% and supply fan has reached 100% capacity. If economizer cooling becomes disabled, damper will revert to minimum position (or Flow) control, and transition to mechanical cooling.

Given the economizer decision methods above, if Comparative Enthalpy + Fixed Dry Bulb is configured and the return air or humidity sensor goes out of range or fails, a fallback method of Fixed Dry Bulb or Reference Enthalpy + Fixed Dry Bulb is selectable in the user interface Feature Settings screen.

A building automation system can directly command economizer operation via Economizer Airside Enable (auto, enable, disable). If commanded Enable, the controller will start economizer cooling, regardless of outdoor air conditions. If commanded Disable, economizer cooling will be disabled (except if a mode of Night Purge is commanded to the controller). If commanded Auto, the controller will use the configured Economizer high limit method and input values to determine if economizer cooling is available.

Outdoor Air Damper Fault Detection and Diagnostics (FDD)

The outdoor air damper fault will have two fault detection components, faults that are generated when operating in minimum ventilation mode and another set when the damper is being controlled by the economizer:

FDD: Excessive Outdoor Air

In minimum ventilation mode and the damper feedback position is >10% of the damper commanded value for 5 continuous minutes.

FDD: Outdoor Air Damper Not Modulating

In minimum ventilation mode and the damper feedback is <10% of the damper commanded value for 5 continuous minutes.

FDD: Unit Economizing When It Should Not

In economizer cooling mode and the damper feedback is >10% of the damper commanded value for 5 continuous minutes.

FDD: Unit Not Economizing When It Should

In economizer cooling mode and the damper feedback is <10% of the damper commanded value for 5 continuous minutes.

Dehumidification Control - Occupied

Dehumidification control is a sub-mode of Cool when hot gas reheat is configured and the dehumidification feature is enabled. There are two methods for controlling dehumidification: space relative humidity or space dew point. A valid Evaporator Leaving Air Temperature sensor (s) is required for either method.. Two circuit, split coil units will have an Evaporator Leaving Air Temperature sensor installed in each airstream. When a valid space relative humidity value is above the Space Dehumidification Setpoint, dehumidification control is invoked. Economizer cooling disables. The sub-mode *Cool – Dehumidification* is reported on the user interface Operating Modes screen.

Dehumidification control disables when space relative humidity is less than Space Dehumidification Setpoint minus the Occupied Dehumidification Offset, Heat Cool Mode Status is not Cool or a sensor required for dehumidification control is invalid.

Relative Humidity

When a valid space relative humidity value is above the Space Dehumidification Setpoint, dehumidification control is invoked. Economizer cooling disables. The sub-mode Cool – Dehumidification is reported on the user interface Operating Modes screen.

Dehumidification control disables when space relative humidity is less than Space Dehumidification Setpoint minus the Occupied Dehumidification Offset, Heat Cool Mode Status is not Cool, or a sensor required for dehumidification control is invalid.

Dew Point

If space dew point is greater than the space dew point setpoint (default = 60F) and outdoor air dew point is greater than the outdoor air dew point threshold (default = 60F), the unit enters dehumidification.

In addition to a space humidity sensor, an outdoor air humidity sensor is also required.

Discharge Air Control Units

When Dehumidification is active, cooling capacity is controlled by Evaporator Leaving Air Temperature relative to Evaporator Leaving Air Temperature Setpoint. This setpoint is suitable to satisfy the space humidity load. Cooling capacity will first load on circuit 1 to provide hot gas reheat capacity. The Hot Gas Reheat valve modulates to manage reheat capacity to satisfy the Discharge Air Temperature Setpoint.

Optionally, a building automation system can set the Discharge Air Reheat Setpoint. This then becomes the target setpoint for hot gas reheat control, when dehumidification is active. Likewise, Evaporator Leaving Air Temperature Setpoint can be written for dehumidification control.

Space Temperature Control Units

Space temperature units internally use dew point to manage space humidity control. When hot gas reheat is inactive, the cooling control calculates a suitable setpoint to manage both space temperature and space humidity. If space temperature falls below the space cooling setpoint minus a fixed differential, the hot gas reheat valve modulates to maintain space temperature control. The evaporator leaving air temperature setpoint is calculated to control humidity independent of space temperature. Optionally, a building automation system can set the Evaporator Leaving Air Temperature Setpoint to control DX cooling capacity.

Dehumidification Control - Unoccupied

Unoccupied Dehumidification control sequence of operation is the same for all unit types when the controller is in unoccupied mode, hot gas reheat is configured and the unoccupied dehumidification feature is enabled. Typically, dehumidification control will start unit operation under the following conditions:

- When a valid space relative humidity value rises above the Space Dehumidification Unoccupied Setpoint, and Space Temperature is above a fixed 64°F threshold.
- Or, when Space Dew Point is greater than Space Dew Point Unoccupied Setpoint AND Outdoor Air Dew Point is greater than Outdoor Air Dew Point Threshold.

Economizer cooling disables and the sub-mode *Cool – Dehumidification* is reported on the user interface Operating Modes screen.

When Dehumidification is active, cooling capacity is controlled by Evaporator Leaving Air Temperature relative to Evaporator Leaving Air Temperature Setpoint. This setpoint is suitable to satisfy the space humidity load. Cooling capacity will stage to satisfy the evaporator cooling

demand. The hot gas reheat valve modulates to maintain a space temperature setpoint.

Unoccupied Dehumidification control disables when:

- Space relative humidity is less than Space Dehumidification Unoccupied Setpoint minus Unoccupied Dehumidification Offset or Space Temperature falls below a fixed 60°F threshold
- Or, Space Dew Point is less than Space Dew Point Unoccupied Setpoint minus Space Dew Point offset.

Heat Types

Variable speed supply fan operation is different depending on the heat type installed. Some heat types require the supply fan to be at full speed. Other heat types allow modulating supply fan speeds in specific operating modes. Table 38, p. 92 below summarizes Multi Zone-VAV supply fan operation where Modulating means Duct Static Pressure Control.

Table 38. Multi zone-VAV unit – Supply fan operation

	Staged Gas	Modulating Gas	Staged Electric Heat	Modulating Electric Heat	External Heat
Occupied Heat	Full	Modulate	Full	Modulate	Modulate
Maximum Heat	Full	Full	Full	Full	Full
Morning Warm Up	Full	Full	Full	Full	Modulate
Daytime Warm Up	Full	Full	Full	Full	Modulate
Unoccupied Heat	Full	Full	Full	Full	Modulate
Occupied Cool Supply Air Tempering	NA – not allowed	Modulate	NA	Modulate	NA

Single Zone-VAV units have limited supply fan speed modulation in Occupied Heat modes of operation when modulating gas heat or modulating electric heat are configured; otherwise, the supply fan operates at full capacity in all other heat operating mode

All heat types, when the control terminates heating capacity or exists a heating mode; a 5-minute post heat timer is enforced. This keeps supply fan On to remove heat from the unit before transitioning to a cooling mode or cycling the supply fan off.

Gas Heat

There are three types of gas heat available: Staged gas, Modulating gas and Ultra Modulating gas. Each type of gas heat is composed of one or two manifolds, each manifold can have one or more burners. As demand for heat increases, incremental stages of heat are added. All burners on a manifold ignite in sequential order starting with manifold A. When manifold A has staged up to full capacity, staging starts on manifold B (when equipped). As the demand for heat decreases, the highest burner on the highest manifold will turn off first. The Off and Running status of each manifold and burner are provided on the user interface.

When the gas heat is in Warmup or Running state, the Symbio 800 controller will report the status as Running. Burners will not turn on if the heater minimum off timer is active, the heater inter-stage timer (3-minutes) is active, or modulating heater is not at maximum rate. Burners will not turn off if the heater is in process of starting, heater is undergoing a retry or modulating heat is not at a minimum rate.

Modulating and Ultra Modulating gas heat types modulate the first burner on manifold A. The minimum and maximum modulation rates are defined by each stage of heating. The modulating stage controls to maximum modulation rate before another burner stage is added. Likewise, the modulating burner must reach minimum rate before a stage is subtracted.

Staged Gas Heat Sequence

Call for heat initiated

1. A call for heat is initiated by the digital Modbus signal.
2. Draft Inducer is energized, an air pressure switch closes initiating pre-purge for 30 seconds.
3. At end of pre-purge period, Spark and Gas Valve are energized for an ignition trial period for 4 seconds.
4. Burners ignite.
5. Flame detected by flame sensor and control operates in steady state heating condition.
6. Unit continues in operation until the call for heat terminates.
7. The Gas valves are de-energized and unit enters its post-purge for 30 seconds.

If ignition is not achieved within the trial period, the gas valve is shut off; the inducer continues to run for a 30 second post-purge period. Additional ignition trials follow the specified sequence. If 3 attempts for ignition have occurred without flame detection, the control will lock out.

The control board will reset after one hour. Control lockout can be cleared by cycling the power off for a minimum of 5 seconds.

If flame is lost once it has been established, the control will shut off the gas supply within 2.0 seconds and enter the post-purge period. Control will allow a predetermined number of flame losses before lockout.

If flame sensor indicates presence of flame during purge period when no flame should be present, the inducer will remain energized but the gas valve will remain off until the cause of the “false flame” is removed.

If the air pressure switch is closed when the inducer is de-energized, or does not close after the inducer is energized, the control will wait a predetermined time for the air switch to correct itself, if not then lock out. Control will go into lockout with all outputs off.

Modulating Gas Heat Sequence

Call for Heat Initiated

1. A call for heat is initiated by the digital Modbus signal.
2. The gas heat control board will then go through a system check to ensure that the high temperature limit and rollout switches are closed, the air pressure switch is open, and the modulating valve is positioned correctly.
3. The control will then enter the pre-purge cycle where the inducer will run at the programmed purge pressure. During this cycle, the control will look for the air pressure switch to close and open at the correct settings..
4. Once the system check and pre-purge cycles are complete, the control will enter the ignition cycle.
   a. The modulating valve and inducer will go to their “ignition” settings.
   b. The DSI ignition module will be energized and the spark igniter will activate.
   c. The redundant safety valve will open, allowing gas flow.
   d. The burners will ignite and the control will receive a signal from the flame sensor.
   e. The spark igniter will remain active for the duration of the ignition cycle regardless of flame status.
5. If flame is not established during the ignition cycle, the control will perform a post-purge and repeat the pre-purge and ignitions cycles up to three times. After three failed ignition attempts, the board will enter a 1 hour lockout.
6. Once flame has been established, the control will enter a warmup period to ensure flame stabilization and reduce condensation in the heat exchanger.
7. After the warmup period, the gas heat control will enter the run cycle. During the run cycle, the burner firing rate and draft inducer pressure are determined based on the heat demand received by the control via a Modbus signal.

Note: *If the control is paired with a split manifold, steps 1 through 6 pertain to the primary burners. Once the control exits the warmup period and the firing rate is dictated by the rooftop control, the control will ignite the secondary burners and modulate the primary burners based on the demand for heat.*

The run cycle will continue until any of the following conditions are met.

Call for Heat Terminated

1. Any of the safety devices (high limit, air pressure, rollout, etc.) are triggered.
2. Once the run cycle has terminated, the redundant safety valve will close, the modulating valve will return to its set position, and the draft inducer will ramp up to its “ignition” setting for a 30 second post - purge cycle
3. After the conclusion of the post-purge, the gas heat control will enter the “OFF” state. All system outputs are de-energized, but all safety devices are still monitored.

Flame Failure

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.

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 start-up.*

Electric Heat - Staged

When staged electric heat is configured in the unit, the controller manages four binary outputs to provide up to 6-stages of heat control; depending on size of the electric heat installed. If four or less electric heat stages are installed, the binary outputs are energized in sequence to add additional heat capacity. If more than four electric heat stages are configured, the binary outputs are energized in combination to provide increasing heating capacity with each stage.

Electric Heat - Modulating

Modulating Electric Heat provides improved control of electric heat by modulating the first stage of heat. When the first stage of heat reaches 100% capacity, the next binary stage of electric heat is energized. The first modulating stage of heat is reset to 0% capacity and continues to modulate as heating capacity demand increases.

An airflow limit control is applied when modulating electric heat is configured to reduce the risk of high temperature limit switch trips. This feature quickly reduces modulating electric heat capacity when the supply airflow decreases due to duct pressure control or external supply fan control.

Electric Heat Protection

There are three automatic high temperature limit switches that will trip when exposed to a high temperature. They will reset automatically once the temperature drops into an acceptable range. If any one limit switch trips, all stages of heat are turned off. The limits are mounted vertically on the heater terminal plate and all three have the same temperature trip point.

A manual reset temperature limit is also mounted near the top of the terminal plate and serves as backup protection. When exposed to high temperature, it will turn all stages of heat off until the reset button is manually reset. The electric heat protections operate independently of the controller.

External Heat

The Symbio 800 controller supports external field supplied heat sources. There is no factory wiring or coordination between the controller and external heat. When External Heat is configured, the supply fan operates as required in heat modes and provides ventilation defined by the mode.

Single Zone-VAV units have an External Heat Supply Fan Speed Setpoint (adjustable) that defines the supply fan speed in Occupied Heat modes of operation. The supply fan operates at maximum speed for all other heating modes. Continuous and cycling fan modes are both supported.

Multi Zone-VAV units operate the supply fan under duct static pressure control, unless commanded to go to Maximum Heat.

Unoccupied Cooling

Unoccupied Cooling mode is used when the building is unoccupied and the space conditions are exceeding temperature limits. The unit is normally off in unoccupied mode. If a valid space temperature input rises above the Unoccupied Cooling Setpoint, unit operation starts unoccupied cooling to manage space temperature. The controller operates in Discharge Air Control with ventilation disabled while DX or economizer cooling capacity increases to satisfy the Discharge Air Cooling Setpoint. Multi Zone VAV units operate the supply fan with duct static pressure control, other units operate the supply fan at maximum speed. Cooling continues until space temperature is 4°F less than the Unoccupied Cooling Setpoint, the unit will then cycle off.

Unoccupied Cooling Mechanical Enable and Unoccupied Cooling Economizing Enable are settings to enable or disable cooling in unoccupied mode.

Unoccupied Heating

When the unit is in unoccupied mode and the valid space temperature input falls below the Unoccupied Heating Setpoint, unit operation starts unoccupied heating to manage space temperature. The controller operates in Discharge Air Control with ventilation disabled while heating capacity increases to satisfy the Discharge Air Heating Setpoint. The supply fan operates according to heat type installed, see Heat Types for more information. Heating continues until space temperature is 4°F greater than the Unoccupied Heating Setpoint, the unit will then cycle off.

Unoccupied Heating Enable is a setting to enable or disable heating in unoccupied mode at the user interface.

External Control

Symbio 800 provides the ability for an external controller or program to control supply fan, exhaust fan, and outdoor air damper. This capability allows for custom programming suited for specific application needs.

External Supply Fan Control

External supply fan control applies to variable volume supply fan equipment. Supply fan operation must prove running and any unit start-up timing must expire before external control is allowed. Supply Fan Speed Control Enabled provides an enabled status when Supply Fan Speed Setpoint is in control. The controller will annunciate External Supply Fan Control on the user interface, operating modes screen when active.

Supply Fan Speed Setpoint will only override the controller's fan control in occupied Cool, Heat, and Fan Only modes of operation. All other modes (such as Morning Warm Up, Pre Cool, Daytime Warm Up) the supply fan is operated under Symbio 800 control. Supply fan speed will increase under Symbio 800 control according to heating and cooling capacity requirements; space temperature control unit configurations. Supply fan speed will decreases under Symbio 800 control when high duct static pressure limits are approached; discharge air control unit configurations.

Table 39. External supply fan control points

Object Name	Description
Supply Fan Speed Setpoint Enable	Enables supply fan speed setpoint control
Supply Fan Speed Control Enabled	Supply fan speed is control via Supply Fan Speed Setpoint. If disabled/inactive, speed control is under Symbio 800 control
Supply Fan Speed Limited	Supply fan speed is being increased or decreased due to a limit control action.
Supply Fan Speed Setpoint	External supplied supply fan speed setpoint value
Supply Fan Speed Setpoint Active	Active setpoint input to supply fan speed control
Supply Fan Speed Status	Indicates the requested speed to the supply fan, 0% when fan is off.

Table 40. Supply fan speed setpoint summary

Supply Fan Speed Setpoint Enable	Supply Fan Speed Setpoint	Supply fan operation
Disable	NA	Fan under Symbio 800 control
Enable	0%	Commands the fan off
Enable	1% to 37%[a]	Fan operates at drive minimum Hz setting
Enable	38% to 100%	Fan ramps between drive min-Hz and max-Hz setting.

[a] For example, if drive setting is 22 min-Hz and 60 max-Hz, it will correlate to 37% reported fan speed.

External Relief Fan Control

External Relief fan control is allowed anytime a relief fan is configured. Supply fan and relief fan operation is proven before external fan control is allowed. Relief fan operation is effectively interlocked with supply fan operation. No other control limits are applied; building static pressure high limit is not enforced.

Important: *A valid space static pressure sensor is not required for external relief fan control; therefore, proper building static pressure control must be considered.*

The controller will annunciate External Relief Fan Control on the user interface, operating modes screen, when active. All modes of operation are supported, except when supply fan is off. If the supply fan cycles off with capacity, the relief fan will also turn off. External relief fan speed is also interlocked with relief damper position and relief damper diagnostics. The relief damper movement will limit relief fan speed changes accordingly. The controller will impose speed limitations as required.

Table 41. External relief fan control points

Object Name[a]	Description	Object States or values
Exhaust Fan Speed Setpoint Enable	Enables Relief fan speed setpoint control	0 = Disable 1 = Enable
Exhaust Fan Speed Control Enabled	Relief fan speed is control via Exhaust Fan Speed Setpoint. If disabled/inactive, speed control is under local control.	0 = Disabled 1 = Enabled
Exhaust Fan Speed Setpoint	External supplied exhaust fan speed setpoint value	0 to 100%
Exhaust Fan Speed Setpoint Active	Active setpoint input to relief fan speed control	0 to 100%
Exhaust Fan Speed Status	Indicates the requested speed to the relief fan, 0% when fan is off.	0 to 100%

[a] Reference Integration Guide ACC-SVP02B (or later)

Table 42. Exhaust fan speed setpoint summary

Exhaust Fan Speed Setpoint Enable	Exhaust Fan Speed Setpoint	Exhaust fan operation
Disable	NA	Fan under local control
Enable	0%	Commands the fan off
Enable	1% to min speed%	Fan operates at drive minimum setting[a]
Enable	>min speed% to 100%	Fan ramps between motors min-rpm and the Relief Fan Maximum Speed Setpoint (rpm), adjustable at the unit's user interface display, service settings screen.

[a] The drive minimum RPM setting is 10 percent of nameplate rated speed. The min speed% is equal to: 100 x (drive minimum RPM / Relief Fan Maximum Speed Setpoint).

External Outdoor Air Damper Control

To control the outdoor damper directly, via TGP2 or an external control, a setpoint can be written to Economizer Minimum Position Setpoint BAS. The controller will limit the damper movement. The commanded position reports at Outdoor Air Damper Position.

To have complete damper control, the following functions should be disabled or removed from configuration via Tracer TU or user interface display. However, the controller must be configured with an Economizer damper.

- Economizer Airside Enable Default = Disabled
- Demand Control Ventilation Enable = Disabled
- Traq Enable = Disabled
- Outdoor Air Flow Compensation Enable = Disable

Morning Warm Up, Pre-Cool, Night Purge, Unoccupied, and Off modes of operation will override damper minimum position to 0%.

Overrides

The controller normally provides heating, cooling and ventilation for building comfort. The below control functions can intervene or override normal operation. These functions allow control over the IntelliPak unit as well as a means for the Service Technician to accomplish their tasks.

The order of priorities are listed. For example, an Equipment Stop will prevent the unit from performing Ventilation Override.

1. Local Stop
2. Emergency Stop
3. Equipment Stop
4. Manual Control
5. Ventilation Override

6. Emergency Override
7. Operating Mode Off
8. Normal operating modes

If local stop, emergency stop, or equipment stop request a Stop, the unit will shut down and not resume operation until all inputs allow automatic operation.

Local Stop

Local Stop is performed by the user interface Stop button on the user interface display. The controller will perform a Normal Shutdown process unless, the user additionally selects Immediate Shutdown at the user interface when prompted.

Normal Shutdown Process

In a normal shutdown situation, compressors, fans, and other systems of the unit are allowed to go through an orderly shutdown sequence. For example, compressors continue to run for any remaining Minimum Run time.

If a Service Tool requires the unit to be in user interface Stop for an operation, e.g. binding, configuration, or software download, the Service Tool will send the Symbio 800 a user interface Stop command. A Service Tool screen is displayed giving the user an opportunity to allow or cancel the operation. This executes a user interface Stop command as if it had been done from the user interface including storing through a power cycle. After this occurs the only way the unit can be set back to user interface Auto is through the user interface directly.

Immediate Shutdown Process

If an immediate shutdown is selected, compressors, fans, and all other devices are immediately stopped. A normal shutdown already in progress will be expedited. The use of this feature is discouraged since the normal shutdown cycle is provided for the normal shutdown sequence.

Emergency Stop

Symbio 800 accepts a dry contact closure input suitable for customer connection to request Stop or Auto modes from an external device. The Emergency Stop input is normally closed which represents an Auto request.

Contact opening will perform an Immediate Stop and generate a latching diagnostic. To return to Auto operation, the input must be closed and a manual reset must be performed.

Equipment Stop

Symbio 800 accepts a dry contact closure input suitable for customer connection to request Stop or Auto modes from an external device. The Equipment Stop binary input is normally closed which represents an Auto request.

Contact opening will perform an Immediate Stop. The unit will automatically return to Auto operation when the input is closed.

Manual Control

Manual control is intended for servicing the machine. It provides manual control of all of all valves, dampers, actuators, fans, compressors and heating functions. This can be done while fans, compressors and heating systems are operating. Single or multiple, controls may be overridden. Remaining controls set to Auto will enforce the limits to protect the machine from damage. Diagnostics remain active to protect the machine from damage. See Programming Guide (RT-SVP011*-EN) for further information.

Important: *Manual Control is for experienced service personnel.*

Manual Control can be set from the Manual Control Settings page on the user interface. Manual control varies in design but all have an automatic mode which is the default mode for most unit operation.

Once a manual override is set to manual, it will remain in manual until one of the following occur:

- Manual override is set back to automatic control by setting the individual overrides to Auto.
- Power is cycled.
- A Manual Overrides Timer expires and ALL manual overrides are cleared.
- The operator presses a Clear All Manual Overrides from the operator display or Tracer TU.

Ventilation Override Mode (VOM)

Ventilation Override Modes (VOM) give the building controller the ability to override normal unit operation and provide special ventilation operation. VOM is initiated only at the provided five binary inputs (Mode A, Mode B, Mode C, Mode D, Mode E). When any of the normally open contacts are closed, VOM initiates specified functions such as space pressurization, exhaust, purge, purge with supply air pressure control, and unit off when any one of the corresponding binary inputs are activated. The compressors and condenser fans, and all other components not directly controlled via VOM events, are disabled during the ventilation operation. If more than one ventilation sequence is activated, Mode A has highest priority, Mode E has lowest.

This function gives the customer the ability to override normal unit operation via a supervisory controller. Typically, these requests originate from a fire control panel. Flexibility is provided by allowing the customer to re-define each of the five responses at the user interface, along with allowing each individual response to be ‘Locked’ to insure expected operation is not changed. See Programming Guide for more information.

This feature is optional. When configured VOM has priority over Emergency Override, System Mode Off, and normal unit operation. The following overrides will prevent or terminate VOM operation.

- Local Stop

- Equipment Stop
- Emergency Stop
- Manual Control

When any VOM Mode (A, B, C, D, E) input is activated or closed, the VOM mode of operation will begin in less than 10 seconds, and a VOM Relay binary output will energize/close. Heating capacity, cooling capacity, and Rapid Restart will be disabled/terminated.

Refer to the table below summarizing the unit operation in response to VOM binary inputs Modes. VOM inputs are fully configurable; therefore, Table 43, p. 97 provides the factory default settings.

If one or more of the 5 VOM inputs are closed, the unit will enter the VOM mode with the highest priority (A highest, E lowest). Should the unit be in an active VOM mode and a VOM input of higher priority is closed, the unit will immediately transition to the higher priority mode. Should the unit be in an active VOM mode and a VOM input of lower priority is closed, the unit will not change to this lower priority mode until the current (higher priority)VOM mode binary input is opened.

When all VOM inputs are open, within 15 seconds, VOM terminates. All unit components will be reset OFF or CLOSED, and after Unit Power Up Delay is honored the unit will start normal operation.

Table 43. Ventilation override mode

VOM Input	OUTPUT	OPERATION	Heat Cool Mode Status
Mode A (Unit Off)	Supply fan	Off/0%	Off
	Outdoor air damper	Closed	
	Relief fan / Relief damper	Off/Closed	
	VAV Box Relay	De-energized	
Mode B (Pressurize)	Supply fan	On/100%[a]	Fan Only
	Outdoor air damper	100%	
	Relief fan / Relief damper	Off/Closed	
	VAV Box Relay	Energized	
Mode C (Depressurize)	Supply fan	Off/0%	Fan Only
	Outdoor air damper	0%	
	Relief fan / Relief damper	On/Open	
	VAV Box Relay	De-engerized	
Mode D (Purge)	Supply fan	On/100%[a]	Fan Only
	Outdoor air damper	Open	
	Relief fan / Relief damper	On/Open	
	VAV Box Relay	Energized	
Mode E (Purge with Duct Static Pressure Control)	Supply fan	On/Duct Static Pressure Control	Fan Only
	Outdoor air damper	Open	
	Relief fan / Relief damper	On/Open	
	VAV Box Relay	Energized	

[a] Supply fan will operate at full speed or a limited speed not to exceed duct static pressure high limit.

Emergency Override

Emergency override provides the ability for a Building Automation System to override control of the HVAC equipment to pressurize, depressurize, purge, shutdown ventilation to the space for life safety or smoke control systems. Refer to Table 44, p. 98summarizing the unit operation in response to Emergency Override commands.

Ventilation Override Mode v/s. Emergency Override

Ventilation Override inputs/output directly connect to fire smoke control station (FSCS) panel. UUKL 864 requires that firefighters have the ability to manually override automated smoke control equipment. Manual changes from a FSCS panel will take precedence over Emergency Override from the Building Automation System.

Table 44. Emergency override

Emergency Override	Output	Operation	Heat Cool Mode Status
Shutdown	Supply fan	Off/0%	Off
	Outdoor air damper	Closed	
	Relief fan / Relief damper	Off/Closed	
	VAV Box Relay	De-energized	
Pressurize	Supply fan	On/100%[a]	Fan Only
	Outdoor air damper	100%	
	Relief fan / Relief damper	Off/Closed	
	VAV Box Relay	Energized	
Depressurize	Supply fan	Off/0%	Fan Only
	Outdoor air damper	0%	
	Relief fan / Relief damper	On/Open	
	VAV Box Relay	De-energized	
Purge	Supply fan	On/100%	Fan Only
	Outdoor air damper	Open	
	Relief fan / Relief damper	On/Open	
	VAV Box Relay	Energized	
Fire	Supply fan	Off/0%	Off
	Outdoor air damper	Closed	
	Relief fan / Relief damper	Off/Closed	
	VAV Box Relay	De-energized	

[a] Multi Zone-VAV units will perform duct static pressure control.

Operating Mode OFF and Normal Operating Modes

See operating mode off and other normal operating modes in Operating Modes section.

Heat/Cool Capacity Lockouts and Limits

The controller provides the following capabilities to lockout or limit all heat and cool capacity installed in the equipment. These capabilities interact. Capacity Lockouts have highest priority. When Heat Lockout Command and Cool Lockout Command are not locked-out; the control will limit capacity based on active Cooling Capacity Enable, Primary Heat Enable or Demand Limit Setpoint. The lowest commanded value will be honored.

In an example, Heat/Cool Lockouts are not active. Cooling Capacity Enable is 60%, Primary Heat Enable is 50% and Demand Limit Setpoint is 40%; DX cooling and electric heating capacity will be limited to 40%. If the unit had gas heat, heat capacity would be limited to 50%. Review each capability below for details.

Capacity Lockouts

Capacity Lockouts are points available to the building automation network to provide a method to completely disable DX Cooling, Gas Heating and Electric Heating. Cool Lockout Command will disable all DX cooling capacity. Economizer operation is still possible. Heat Lockout Command will disable all gas and electric heating capacity. External heating is not controlled directly by the Symbio800 and will not be locked out with the Heat Lockout Command.

If both points are True (locked out) at the same time, both will be honored. Trane Graphical Programming (TGP2) can be used to control these points.

Cooling Capacity Enable

Cooling Capacity Enable is a building automation interface point used to limit DX cooling capacity of the equipment, it does not limit economizer cooling. The 0-100% value limits the amount of cooling capacity.

Heat Primary Enable

Primary Heat Enable is a building automation interface point used to limit all forms of primary heat installed in the

equipment. The 0-100% value limits the amount of heating capacity.

Demand Limit

Demand Limit is a function with building automation interface points used to limit power consumption of both heating and cooling capacities installed in the equipment. Demand Limit does not apply to economizer cooling, gas heat, external heat nor hot gas reheat.

Demand Limit Request BAS enables and disables the demand limit function. When set to Limit, the Demand Limit Setpoint value (0-100%) is applied to the control capacity calculation. The power consumption result will depend on number of heating and cooling stages installed and how each stage maps to the capacity calculation (0-100%).

Condensate Overflow

The Condensate Drain Pan Level Sensing function monitors an optional water level switch(s) mounted to the evaporator(s) condensate pan. If the drain becomes obstructed, the condensate level will begin to rise and the Condensate Overflow input will be activated.

When a high condensate level is detected, the unit shuts down and a non-latching diagnostic is generated. A 72 hour timer is started at this point. If the condensate overflow input returns to normal, the unit is allowed to restart. If a second condensate high level is detected during the 72 hour timer, the unit will shutdown but restart if the condition returns to normal. A third event, within the 72 hour timer, will generate a latching Condensate Overflow Lockout diagnostic and will require a manual reset.

Filter Status

Filter status is provided by differential pressure monitoring across individual filters in the equipment. This is in the form of an analog signal to the Symbio controller which represents pressure drop. Monitoring is available for individual filters installed in the unit. The customer can monitor filter differential pressure for the purpose of filter maintenance.

No manual calibration is necessary as the transducers are factory calibrated.

Note: *This function does not provide a diagnostic or other form of user notification.*

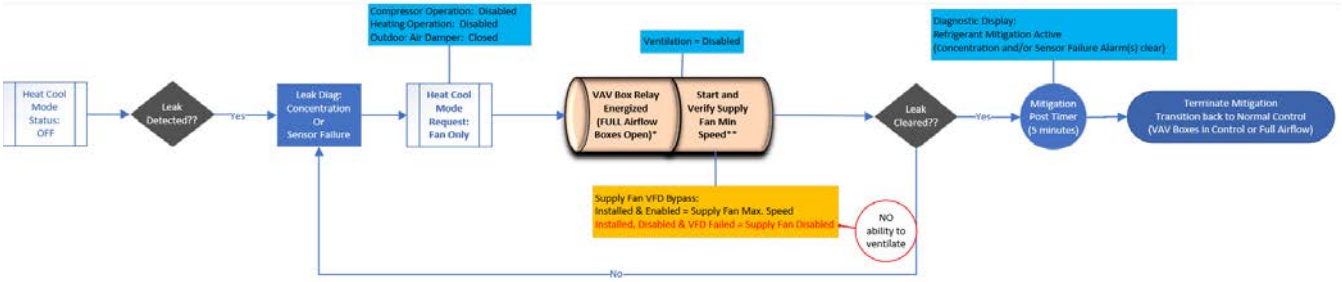
Refrigerant (R–454B) Detection and Mitigation

Equipment with R-454B refrigerant requires a refrigerant detection system based on the refrigerant charge. When the refrigerant detection system is in a normal state, the equipment provides normal heating, cooling, and ventilation.

Heat Cool Mode Status: Off

When the unit is in Off mode and a leak is detected or sensor fails (see the figure below), a diagnostic will trigger. Heat Cool Mode will transition to “Fan Only”. Compressor Operation is disabled, heating operation is disabled, and outdoor air dampers are closed all normal operation for “Off” mode).

Figure 47. Heat Cool Mode Status: Off



The VAV Box Relay will be energized for Full Airflow and supply fan will go to minimum speed.

The unit will stay in this state until the leak has cleared, or the failed sensor has been replaced.

VFD bypass is not a requirement for leak detection. This only explains what action will or will not be taken if a leak is detected. If the unit has Supply Fan VFD Bypass Installed and enabled, the supply fan will go to maximum speed. If the Supply Fan VFD Bypass is installed but disabled AND the VFD has failed, the supply fan will not start.

Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Heat Cool Mode Status: Cool

When the unit is in Cool mode and a leak is detected or sensor fails (see the figure below), the same diagnostics will trigger.

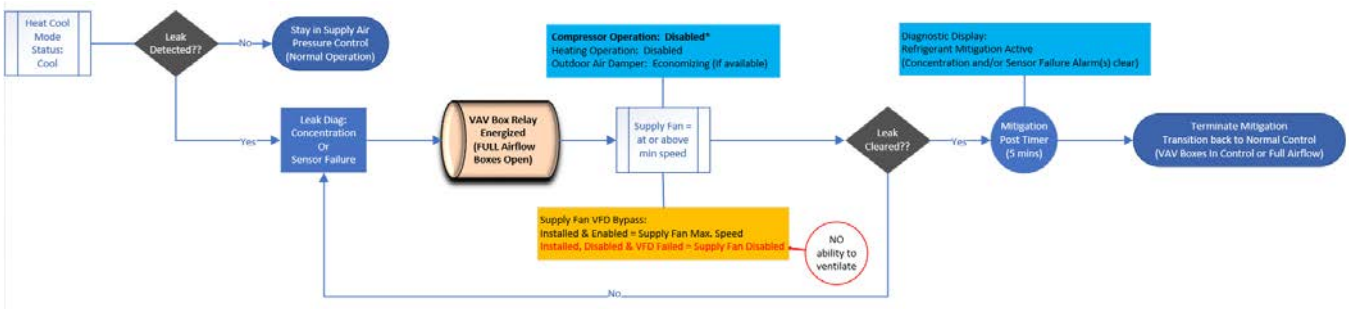
The VAV Box Relay will be energized for Full Airflow and supply fan will stay at the cool mode operating speed which will be at or above minimum speed. DX Cooling will de-energize and compressor operation will be disabled. This is a change to normal operation while in Cool Mode. Heating will remain disabled, and the unit can continue to economize if economizing is installed.

The unit will stay in this state until the leak is cleared, or the failed sensor has been replaced.

VFD bypass is not a requirement for leak detection. This only explains what action will or will not be taken if a leak is detected. If the unit has Supply Fan VFD Bypass Installed and enabled, the supply fan will go to maximum speed. If the Supply Fan VFD Bypass is installed but disabled AND the VFD has failed, the supply fan will not start.

Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Figure 48. Heat Cool Mode Status: Cool



Heat Cool Mode Status: Heat

When the unit is in Heat mode and a leak is detected or sensor fails (see the figure below), the same diagnostics will trigger.

The VAV Box Relay will be energized for Full Airflow and supply fan will stay at the heat mode operating speed which will be at or above minimum speed. Compressor Operation is disabled, heating operation stays enabled & outdoor air dampers are at minimum ventilation (all normal operation for Heat mode).

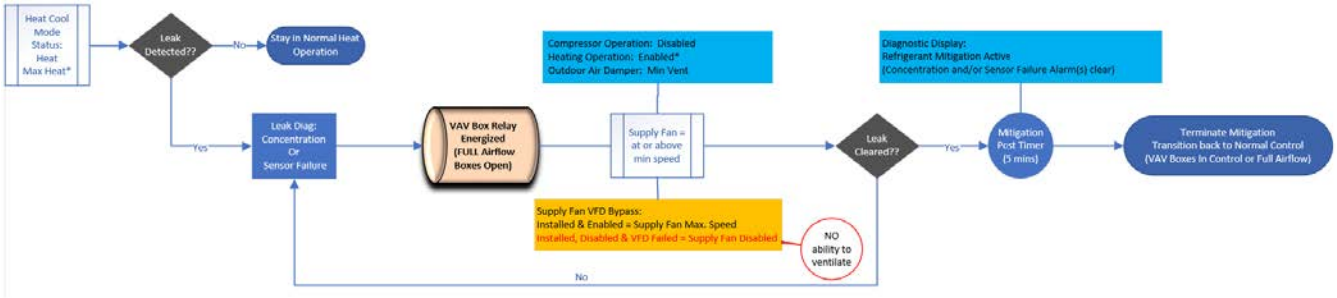
VFD bypass is not a requirement for leak detection. This only explains what action will or will not be taken if a leak is detected. If the unit has Supply Fan VFD Bypass Installed and enabled, the supply fan will go to maximum speed. If the Supply Fan VFD Bypass is installed but disabled AND the VFD has failed, the supply fan will not start.

The unit will stay in this state until the leak is cleared, or the failed sensor has been replaced.

Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Figure 49. Heat Cool Mode Status: Heat

Note: *Refrigerant leak detection and mitigation actions are defined by UL requirements. Therefore, Supply Fan minimum speed is recommended to remain as defined by factory defaults.*



Note: *Refrigerant leak detection and mitigation actions are defined by UL requirements. Therefore, Supply Fan minimum speed is recommended to remain as defined by factory defaults.*

Modbus Addressing Tool and Modbus Addresses

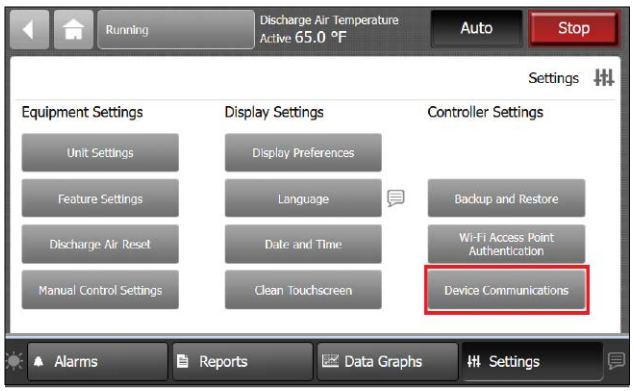
Modbus Device Addressing

Modbus Device Addressing allows the user to set and clear the address of Modbus devices via the user interface.

To set the Modbus Device Address:

1. Press the **Device Communications** button.

Figure 50. Settings — Device Communications



2. Press the **Modbus Device Addressing** button.

Figure 51. Device Communications — Modbus Device Addressing



3. Press the **Set Address** button. If the Modbus address is set, a pop-up indicates the Modbus address was set successfully. If the Modbus address was not set, a pop up alerts the user of the failure condition.

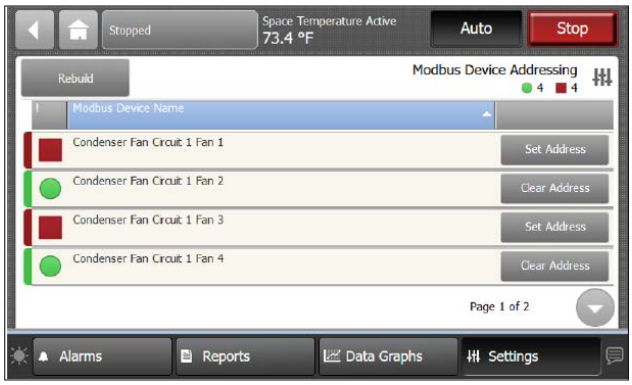
To clear the Modbus device address:

Press the **Clear Address** button. If the Modbus address is cleared, a pop-up will indicate the Modbus address was cleared successfully. If the Modbus address could not be cleared, a pop-up will alert the user of the failure condition.

To rebuild the list of Modbus devices:

Press the **Rebuild** button.

Figure 52. Modbus Device Addressing — Rebuild



Modbus Addresses

Modbus Device	Modbus Address Tool Display Name	RTU Address
Compressor 1A	Not Applicable	3
Condenser Fan 1	Not Applicable	5
Condenser Fan 2	Not Applicable	6
Supply Fan 1	Not Applicable	7
Supply Fan 2	Not Applicable	8
Relief Fan 1	VFD Relief Fan 1	9
Relief Fan 2	VFD Relief Fan 2	10
Relief Fan 3	VFD Relief Fan 3	11
Modulating Gas Heat	Not Applicable	20 (always manifold 1)
Staged Gas Heat	Not Applicable	21 (manifold 1)
		22 (manifold 2)
Refrigerant Leak Detector A	Refrigerant Leak Sensor A	51
Refrigerant Leak Detector B	Refrigerant Leak Sensor B	52
Refrigerant Leak Detector C	Refrigerant Leak Sensor C	53
Refrigerant Leak Detector D	Refrigerant Leak Sensor D	54

Controls

Constant Volume System Controls

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.

Compressor Motor Winding Thermostats

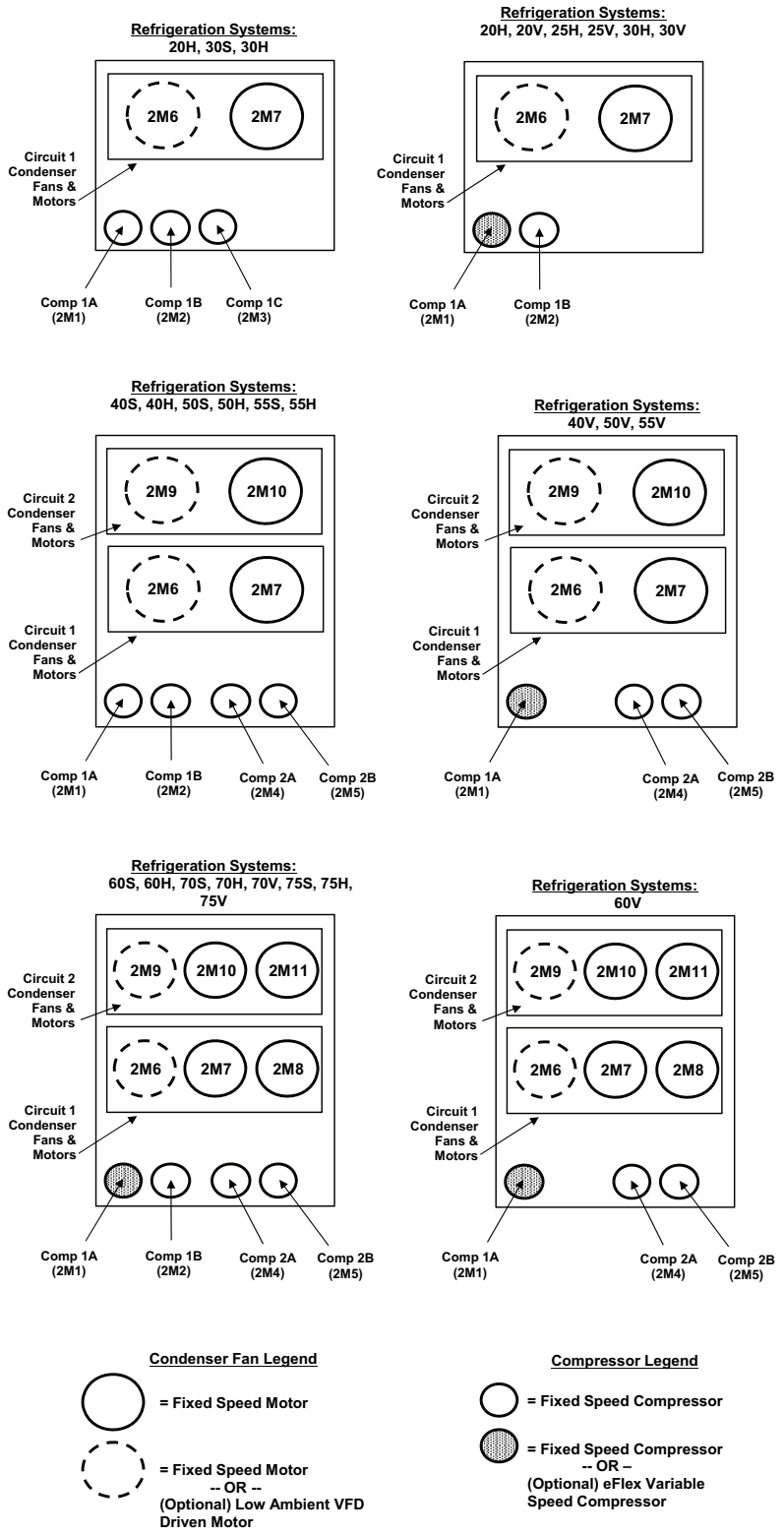
The compressors contain an internal line break overload which stops the compressors under a number of operating conditions that cause excessive motor temperature. These include rapid cycling, loss of charge, abnormally high suction temperatures, excessive amperage, phase loss and low voltage

PTC sensors are embedded in the motor windings of each Scroll compressor. These sensors are wired to the protection module which protects the motor from over temperature that can occur under a number of abnormal operating conditions. These include rapid cycling, loss of charge, abnormally high suction temperatures, low voltage and excessive amperage.

VZH Variable Speed Compressors

Over current and over torque protection for VZH compressors are provided by the inverter.

Figure 53. Compressor and condenser fan locations and names



Note: For Refrigeration system names listed here, please refer to Model Number Digit 9 to differentiate between the 'S', 'H', and 'V' designations

Table 45. Compressor staging — 25H, 30S, 30H

Stage	Comp 1A	Comp 1B	Comp 1C
1	ON	—	—
2	—	ON	—
3	ON	ON	—
4	—	ON	ON
5	ON	ON	ON

Table 46. Compressor staging — 40S, 40H, 50S, 50H, 55S, 55H, 60S, 60H, 70S, 70H, 75S, 75H

Stage	Comp 1A	Comp 1B	Comp 2A	Comp 2B
1	ON	—	—	—
2	ON	—	ON	—
3	ON	ON	ON	—
4	ON	ON	ON	ON

Table 47. Compressor staging — 20V

Capacity Step	Comp 1A [(a)]	Comp 1B	Speed Min	Speed Max
1	ON	—	1800	6000
2	ON	ON	1500	5190

(a) Variable Speed Compressor.

Table 48. Compressor staging — 25V

Capacity Step	Comp 1A [(a)]	Comp 1B	Speed Min	Speed Max
1	ON	—	2040	6000
2	ON	ON	1500	6000

(a) Variable Speed Compressor.

Table 49. Compressor staging — 30V

Capacity Step	Comp 1A [(a)]	Comp 1B	Speed Min	Speed Max
1	ON	—	1740	6000
2	ON	ON	1500	5520

(a) Variable Speed Compressor.

Table 50. Compressor staging — 40V

Capacity Step	Comp 1A[(a)]	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON	—	—	1860	4860
2	ON	ON	—	1740	6000
3	ON	ON	ON	2880	5940

(a) Variable Speed Compressor.

Table 51. Compressor staging — 50V

Capacity Step	Comp 1A[(a)]	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON	—	—	1500	4680
2	ON	ON	—	1500	5220
3	ON	ON	ON	2400	4900

(a) Variable Speed Compressor.

Table 52. Compressor staging — 55V

Capacity Step	Comp 1A[(a)]	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON	—	—	1620	4740
2	ON	ON	—	1500	5700
3	ON	ON	ON	2700	5500

(a) Variable Speed Compressor.

Table 53. Compressor staging — 60V

Capacity Step	Comp 1A[(a)]	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON	—	—	2100	5820
2	ON	ON	—	1500	5700
3	ON	ON	ON	2460	6000

(a) Variable Speed Compressor.

Table 54. Compressor staging — 70V

Capacity Step	Comp 1A[(a)]	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON	—	—	2040	4860
2	ON	ON	—	1800	5460
3	ON	ON	ON	1500	5460
4	ON	ON	ON	1500	5400

(a) Variable Speed Compressor.

Table 55. Compressor staging — 75V

Capacity Step	Comp 1A[(a)]	Comp 1B	Comp 2A	Comp 2B	Speed Min	Speed Max
1	ON		—	—	1980	5340
2	ON		ON	—	1500	5520
3	ON		ON	ON	1980	5400
4	ON	ON	ON	ON	1500	4200

(a) Variable Speed Compressor.

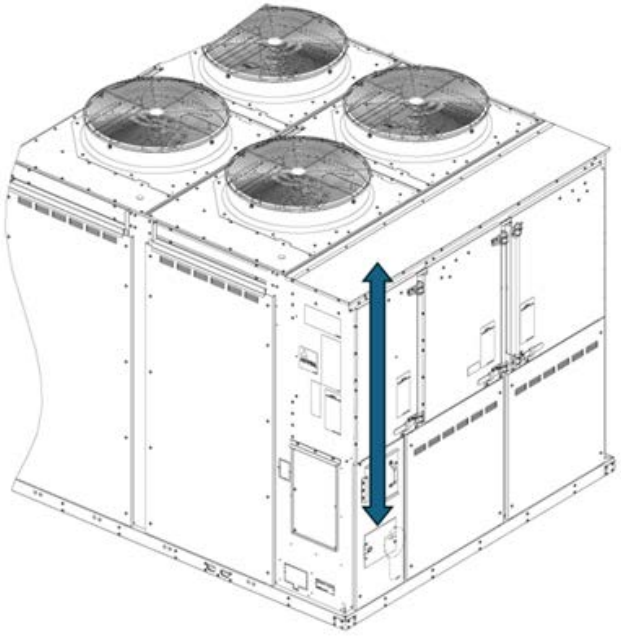
Cellular Modem

The cellular modem provides secure, bidirectional communication with the Trane cloud to support unit health and status monitoring. Powered by a 24 VDC signal from the Symbio 800 controller, the modem transfers data through a USB connection and enables Trane Technical

Support to access the unit remotely through Trane Connect. This allows faster software and data downloads while also supporting real-time unit monitoring.

The factory-installed cellular modem is magnetically mounted within an acrylic-covered, recessed enclosure below the TD7 user interface and low voltage control panel.

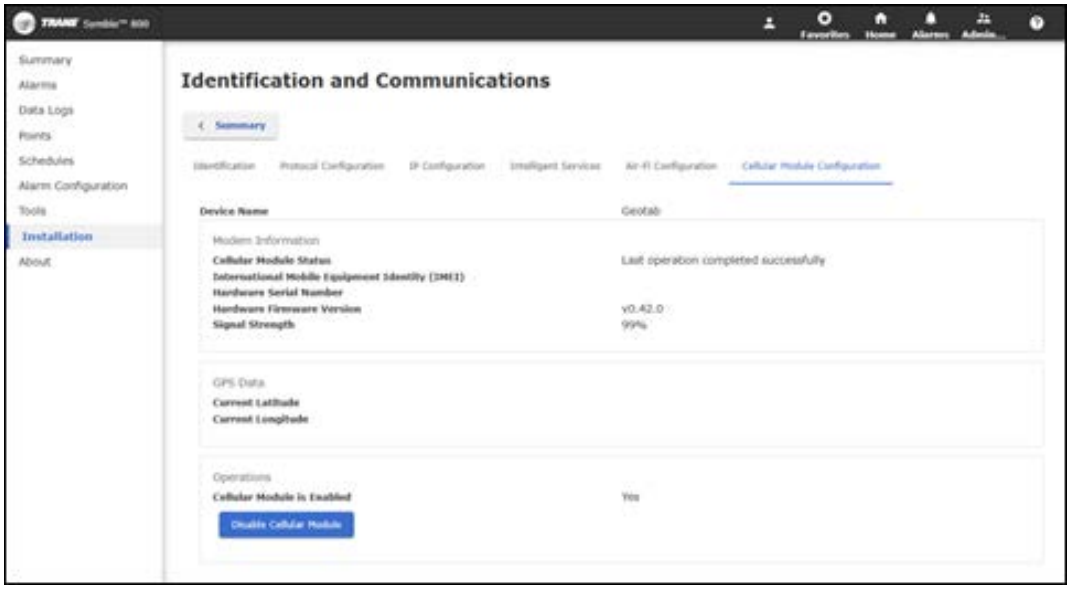
Figure 54. Cellular modem placement



If signal strength is poor, the cover can be removed and remounted after removing and repositioning the modem on the roof or more elevated location. Cut zip tie securing excess harness bundle located behind user interface door to free up slack before repositioning modem. Provide appropriate strain relief and support for exposed cable wiring to prevent cable damage and hinged door interference.

Refer to RT-SVP011*-EN Intellipak with Symbio 800 Programming Guide to check signal strength as shown below.

Figure 55. Symbio 800 cellular modem configuration

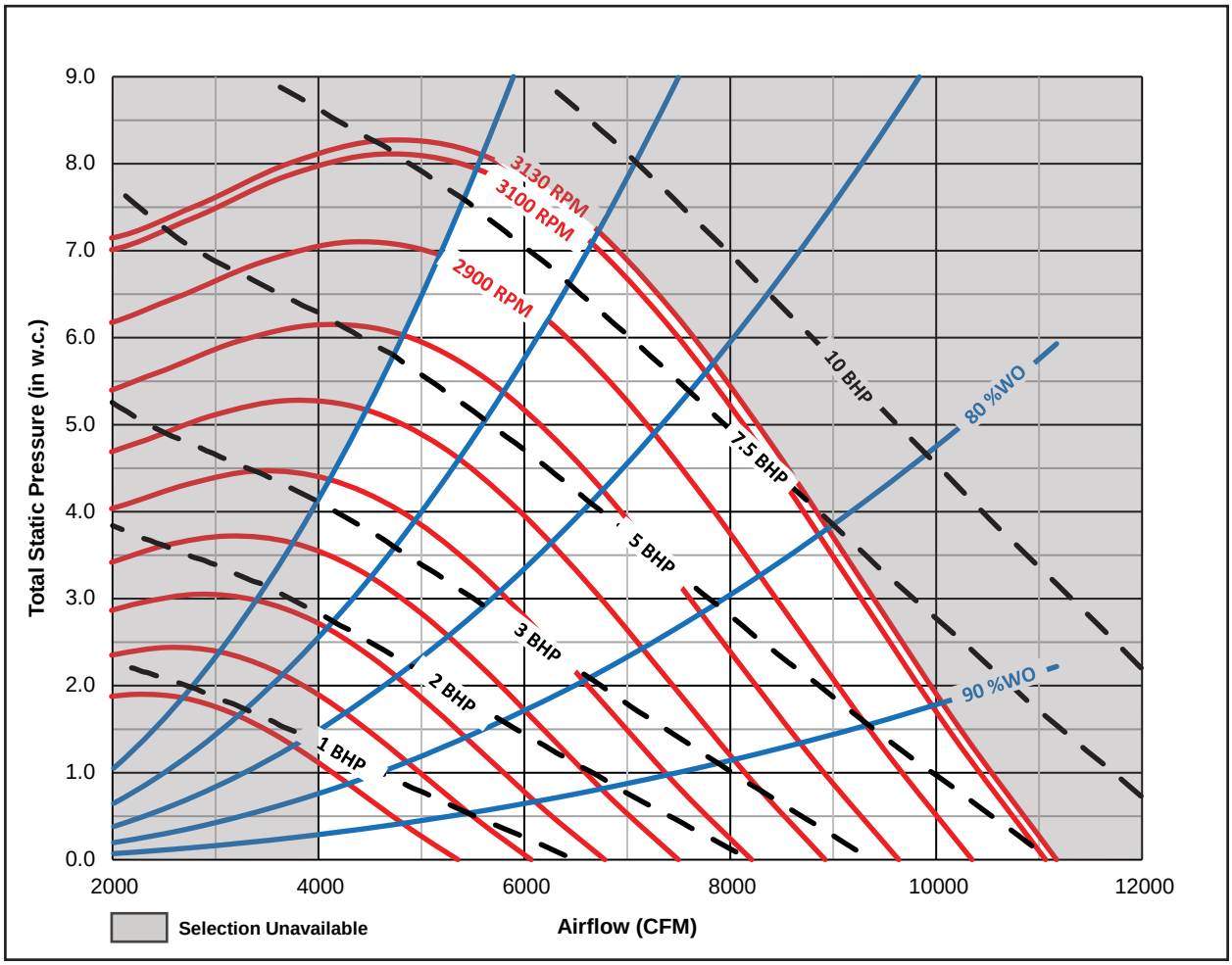


Performance Data

Supply Fan Curves

See notes below for all supply fan curves. For additional information or support, contact your local Trane sales office or Trane representative.

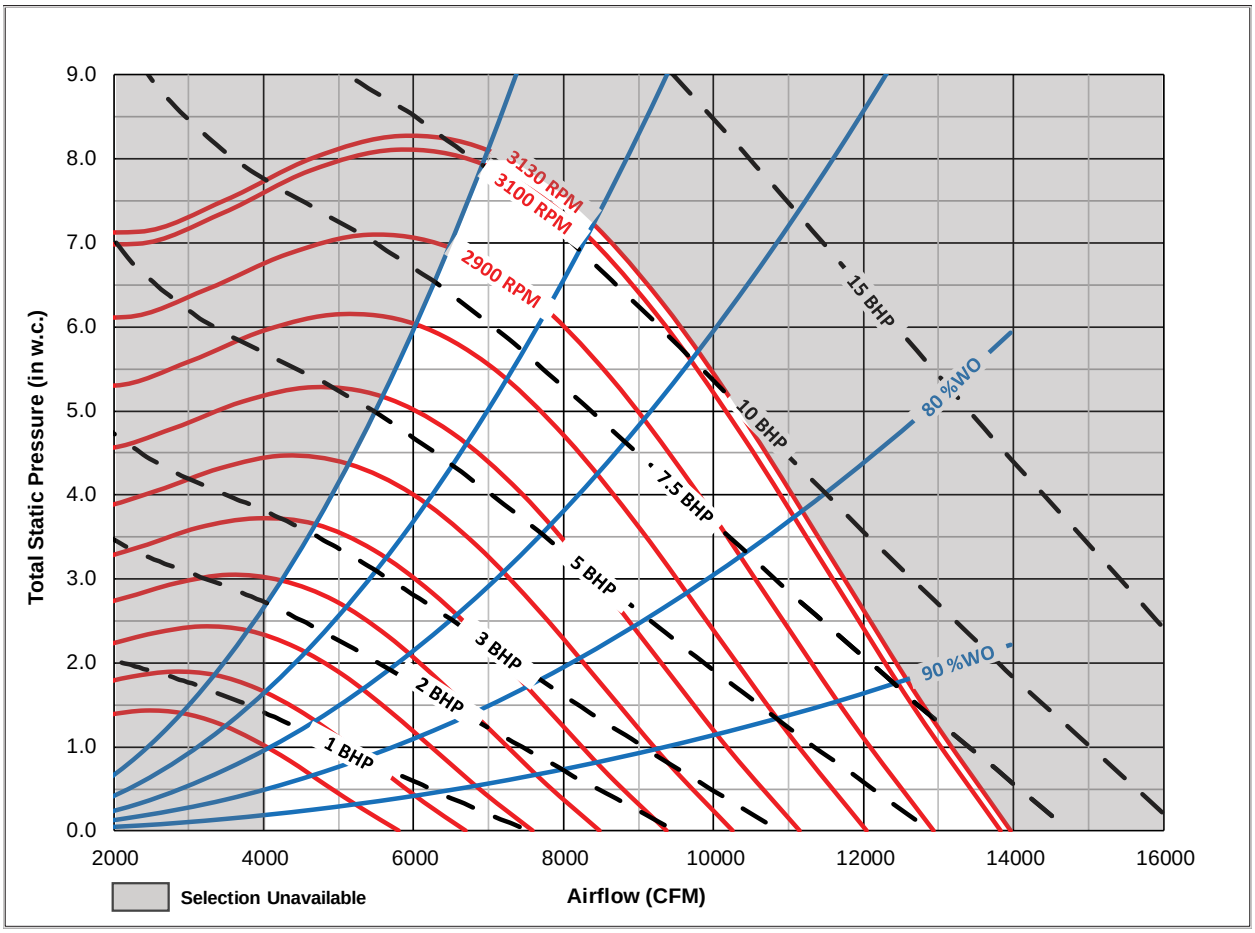
Figure 56. 20, 25 and 30 ton, 16.5 inch - 9 Blade - 80% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

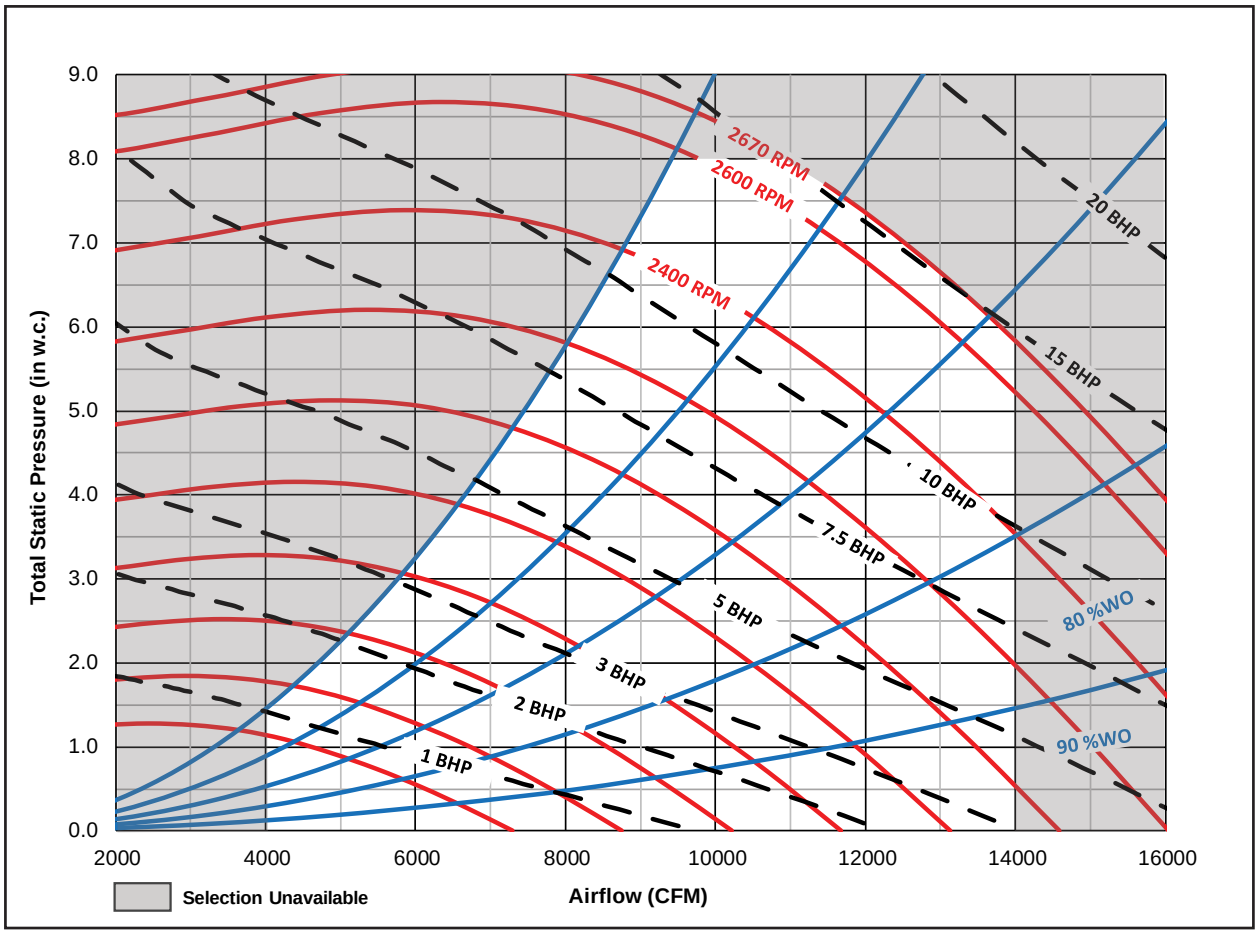
Figure 57. 20, 25 and 30 ton, 16.5 inches - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

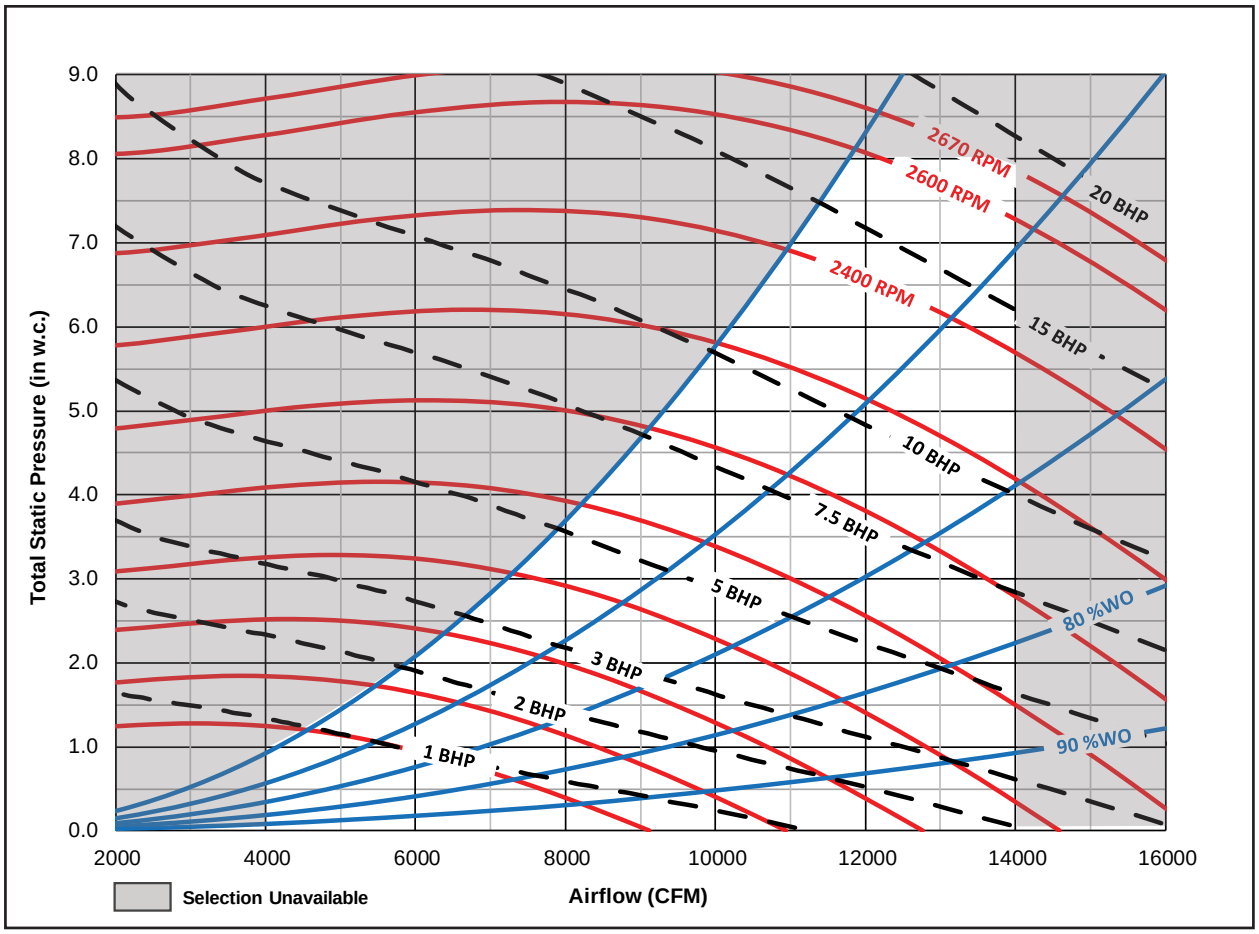
Figure 58. 20, 25 and 30 ton, 20.0 inch - 9 blade - 80% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

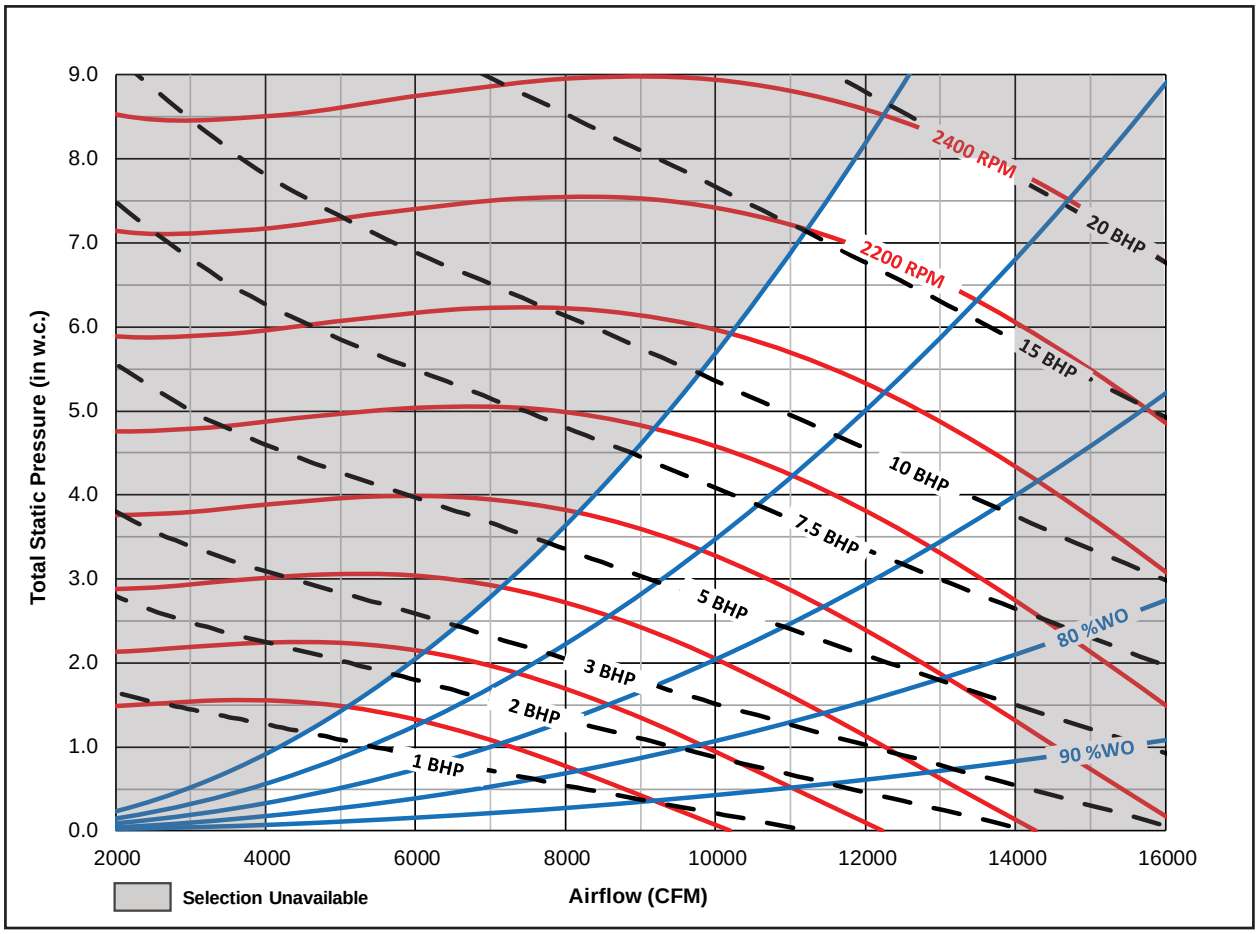
Figure 59. 20, 25 and 30 ton, 20.0 inch - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

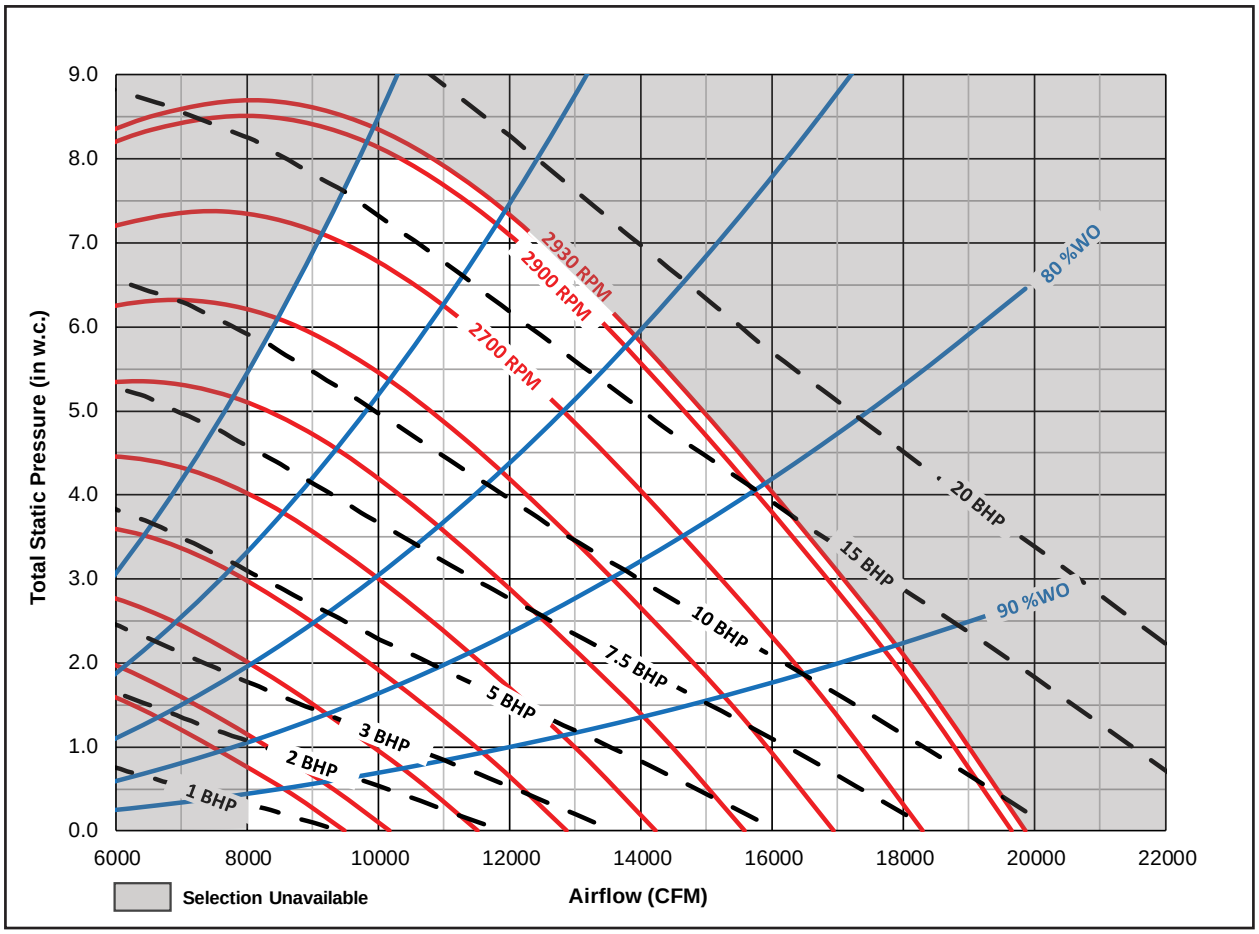
Figure 60. 20, 25 and 30 ton, 22.2 inch - 9 blade - 80% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

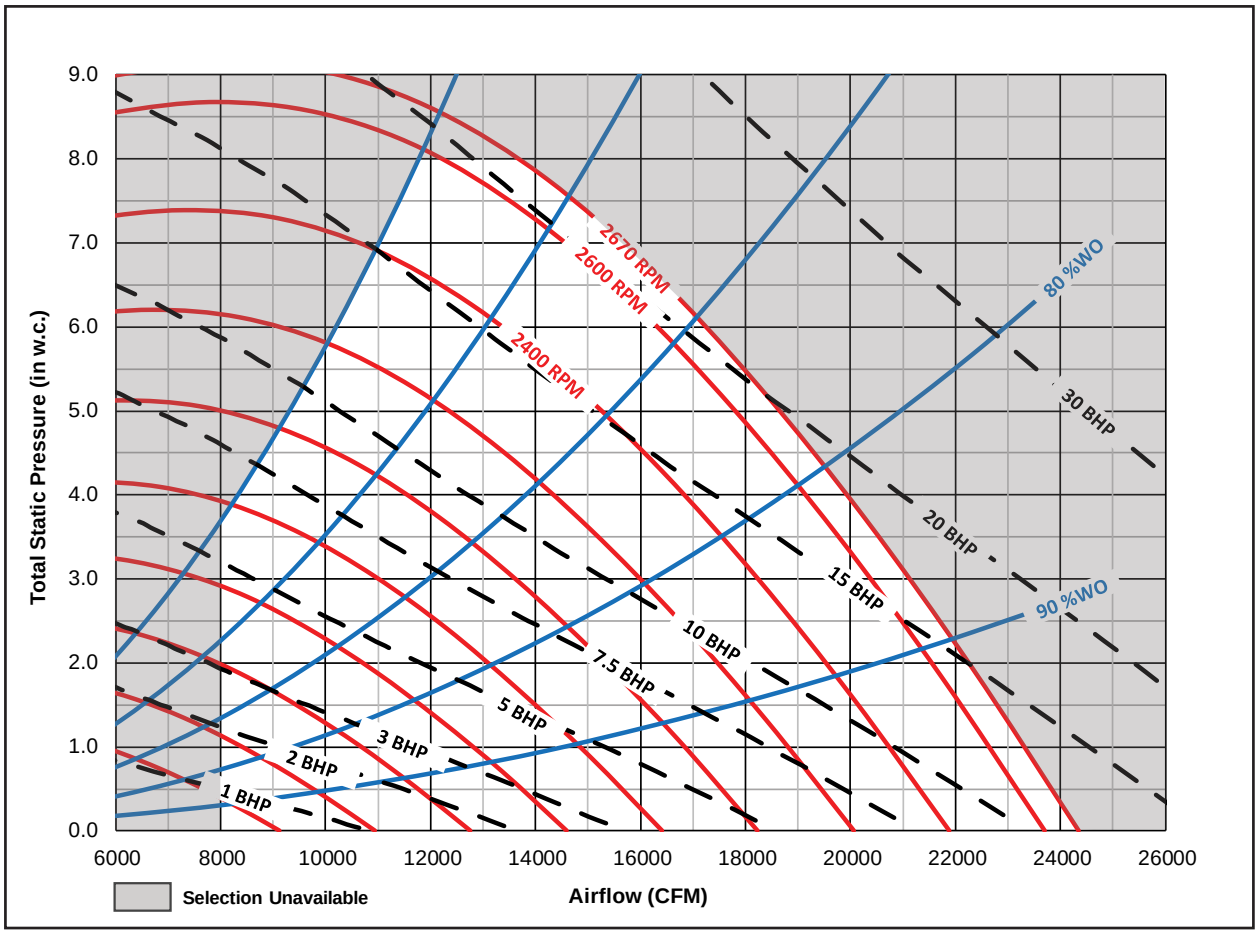
Figure 61. 40, 50 and 55 ton, 18.2 inch - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

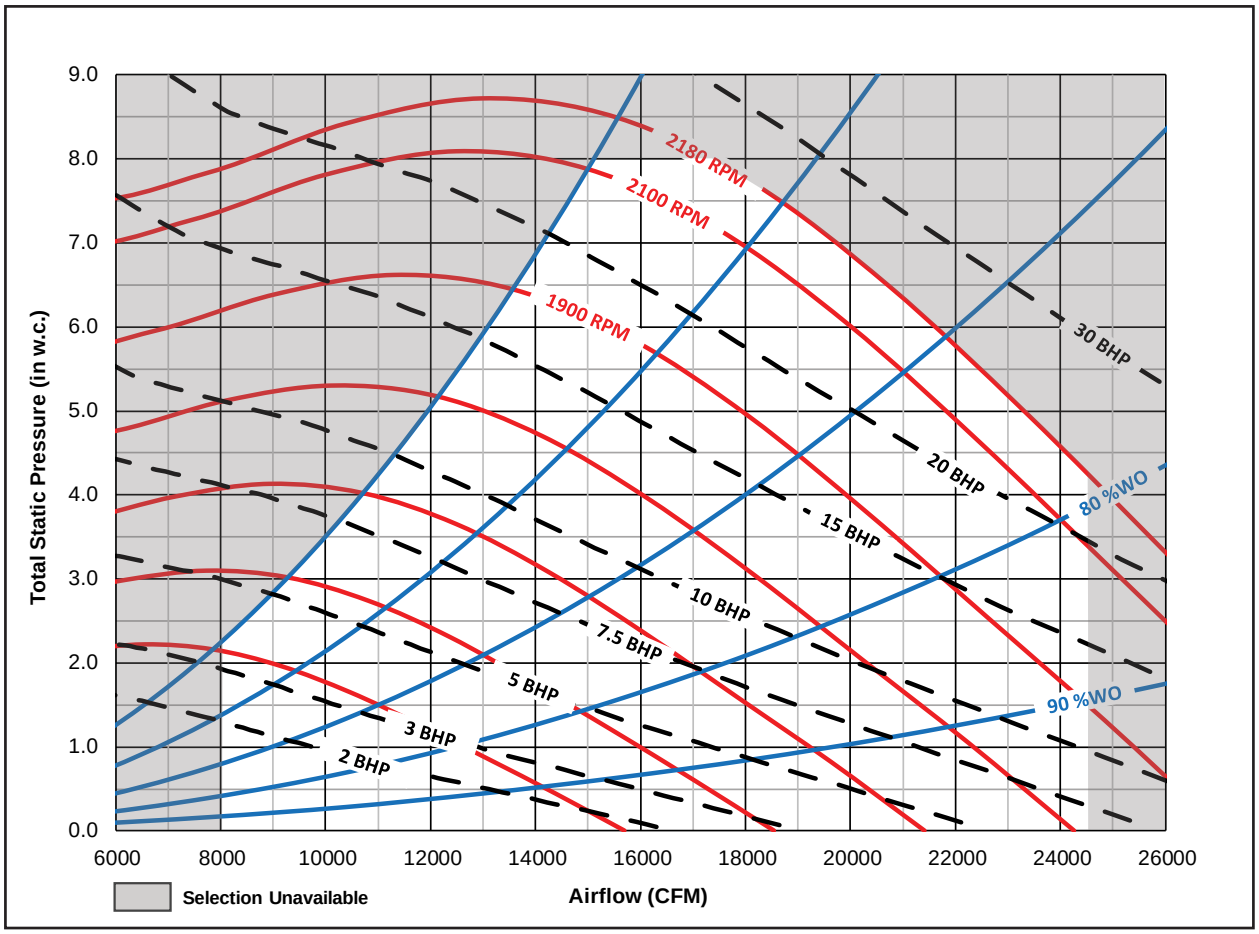
Figure 62. 40, 50 and 55 ton, 20.0 inch - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

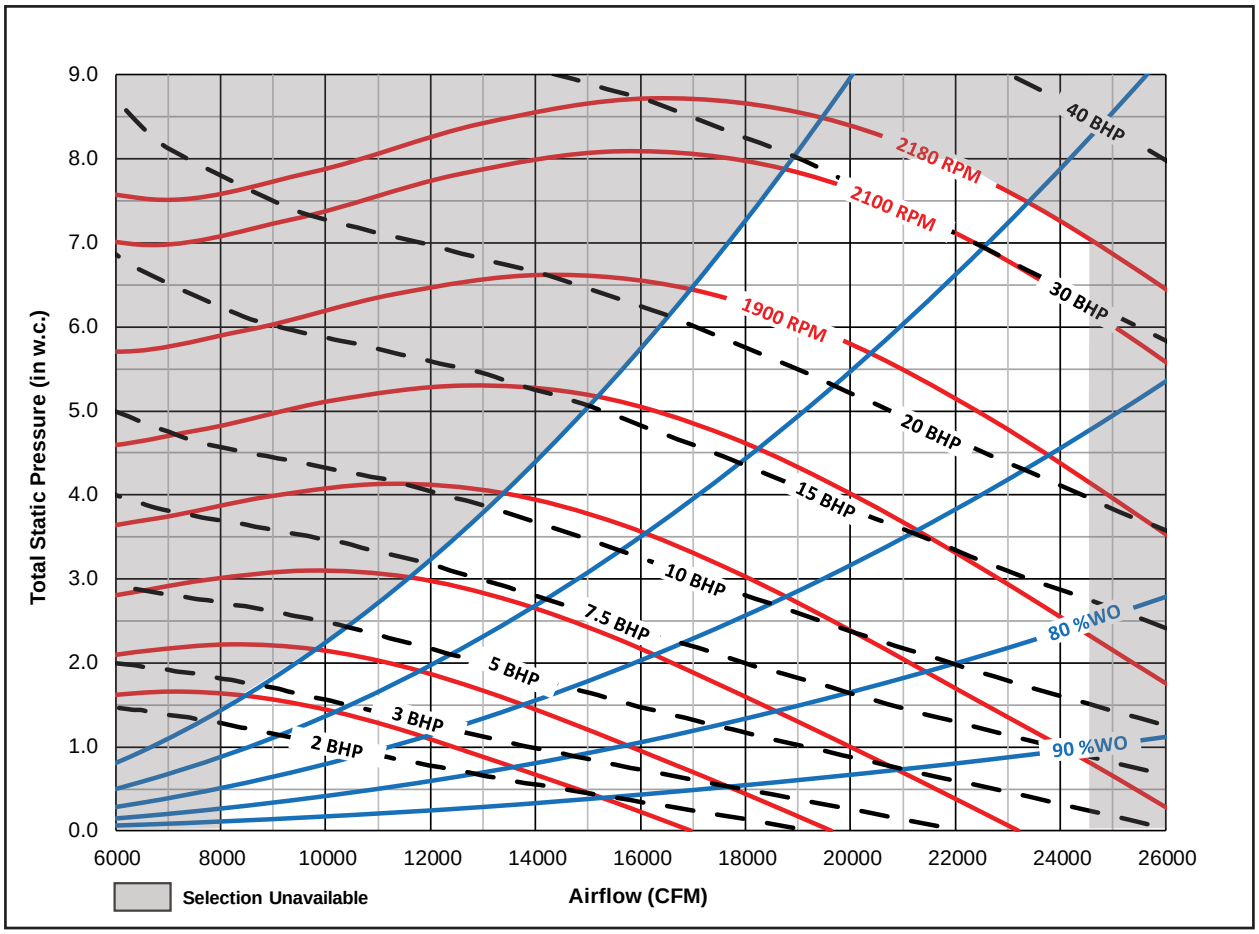
Figure 63. 40, 50 and 55 ton, 24.5 inch - 9 blade - 80% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

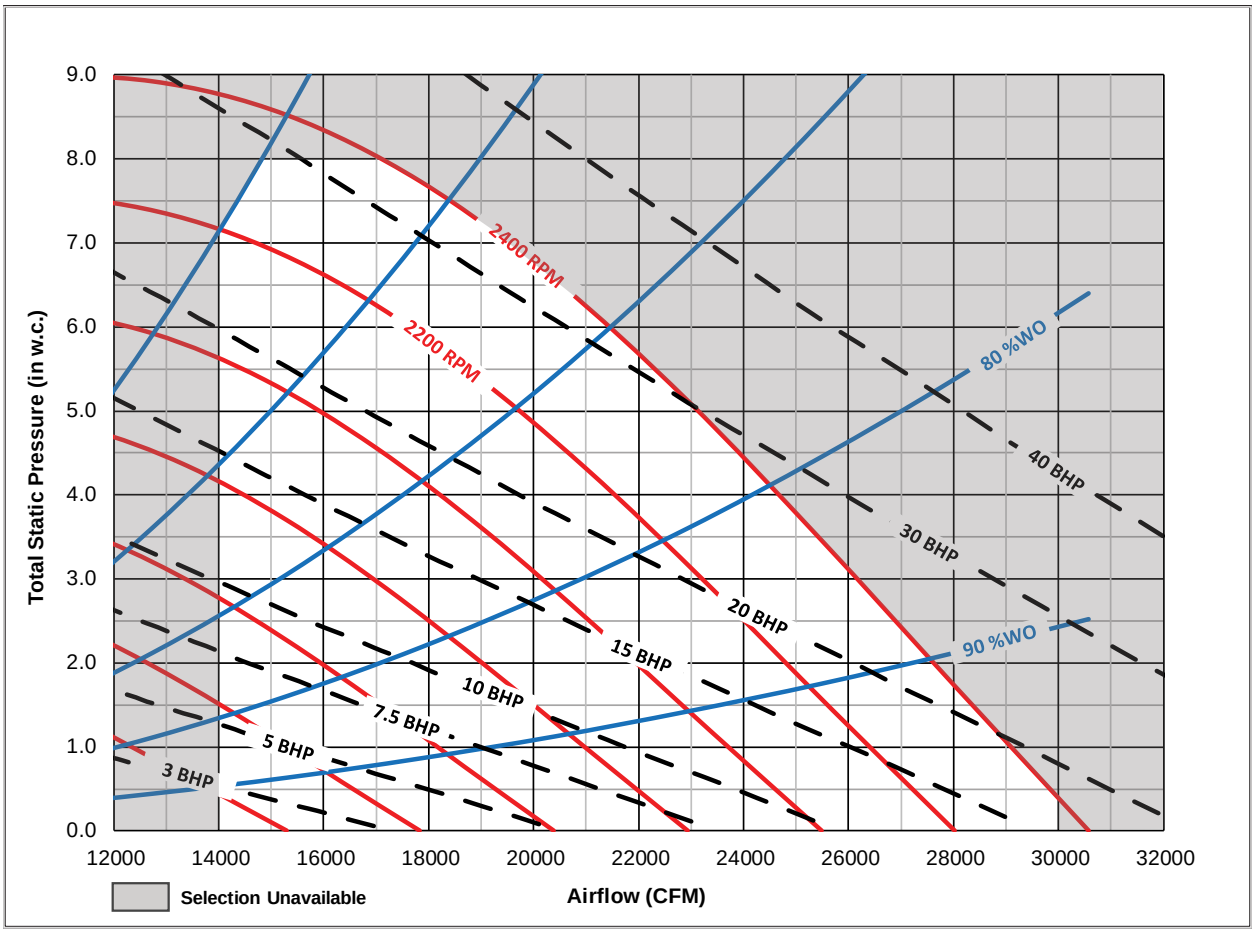
Figure 64. 40, 50 and 55 ton, 24.5 inch - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

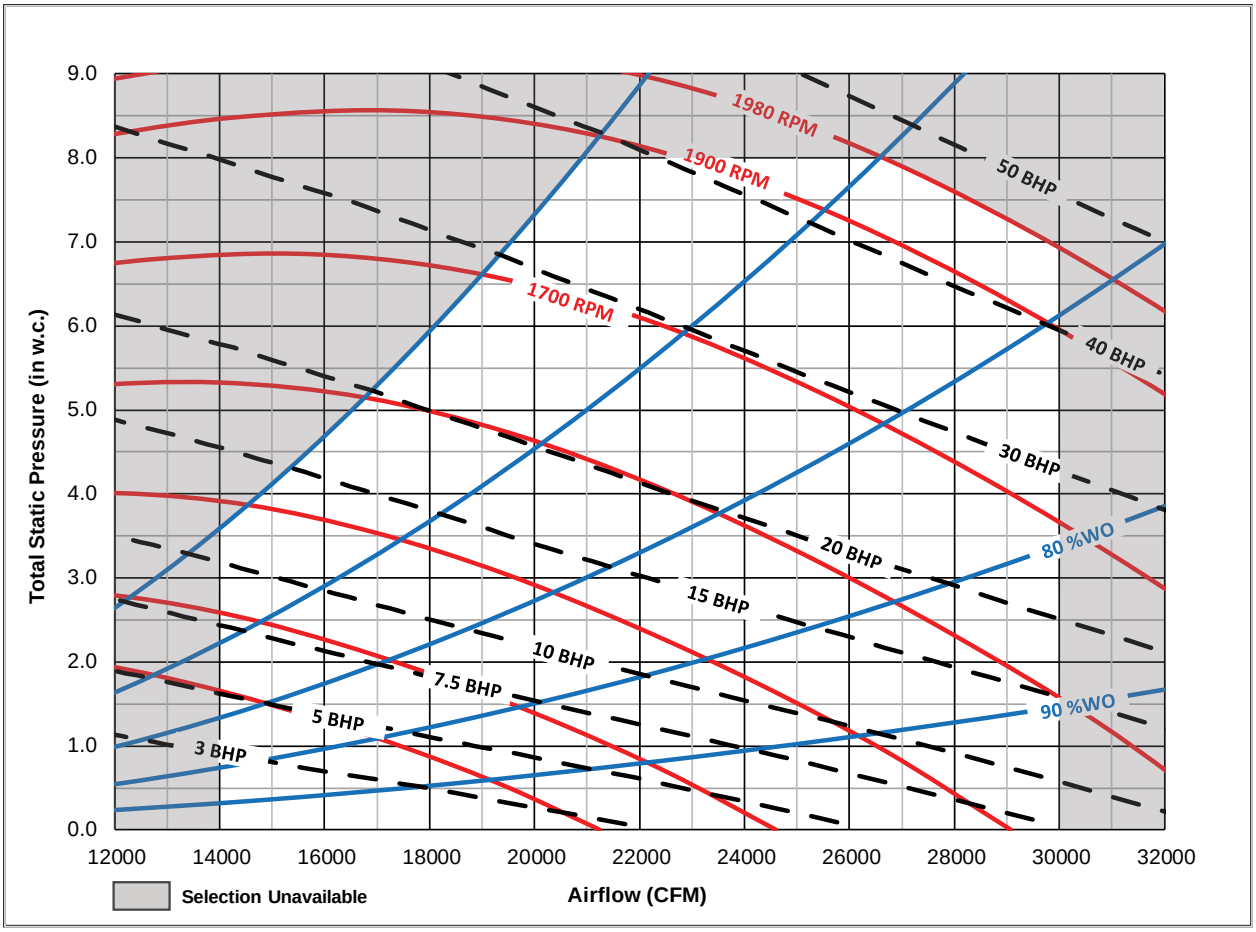
Figure 65. 60, 70 and 75 ton, 22.2 inch - 9 blade - 100% width supply fan



Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

Figure 66. 60 and 75 ton, 27.0 inch - 9 blade - 100% width supply fan



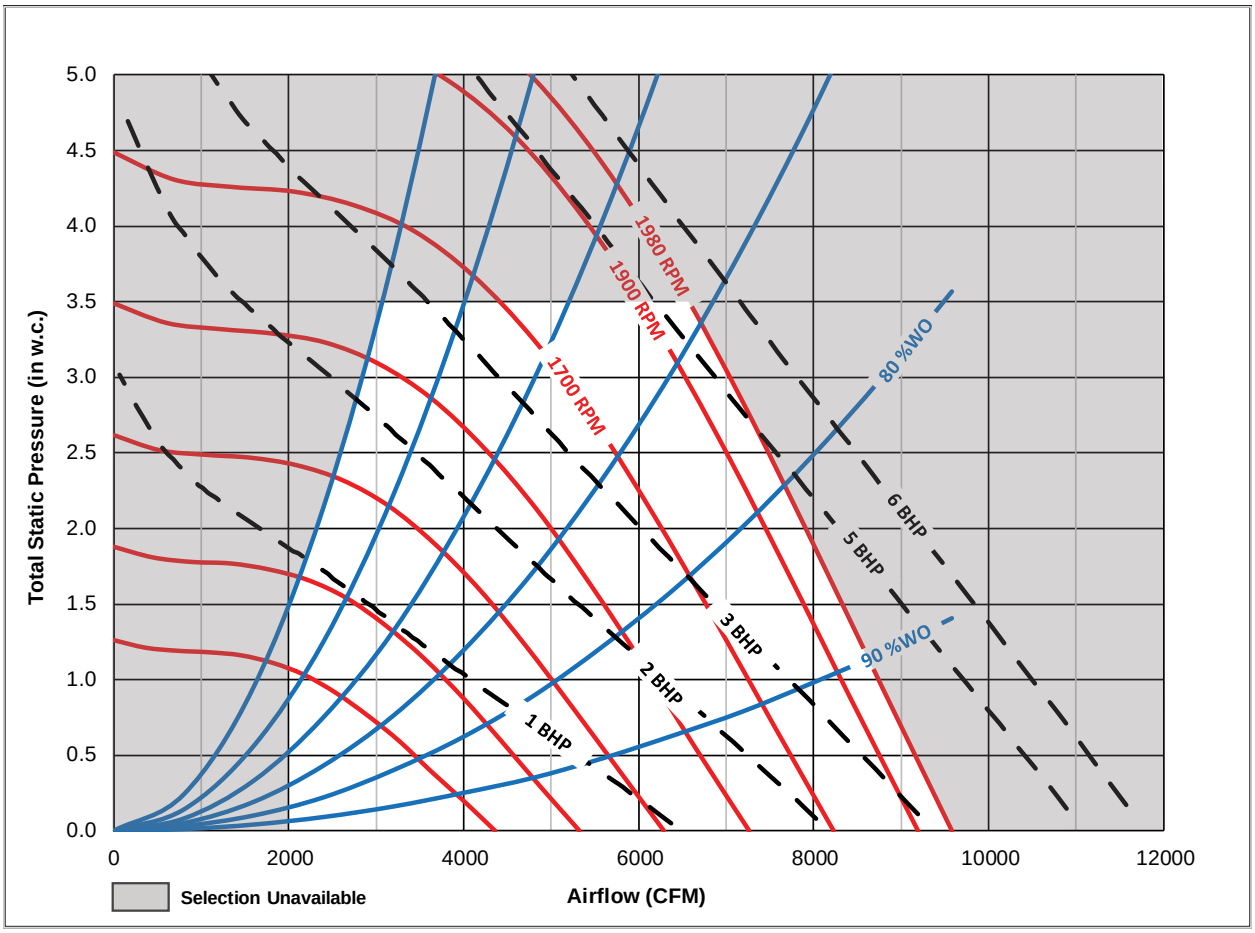
Important:

1. *Supply fan performance curve includes internal resistance of rooftop. For total static pressure determination, system external static must be added to appropriate component (evaporator coil, filters, etc.) static pressure drops.*
2. *Static pressure drops from the supply fan to the space (optional heat + curb + supply ESP) cannot exceed 6.0 in w.c.*
3. *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
4. *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
5. *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
6. *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane® Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations*

Relief Fan Curves

Please see notes below for all supply fan curves. For additional information or support, contact your local Trane sales office or Trane representative.

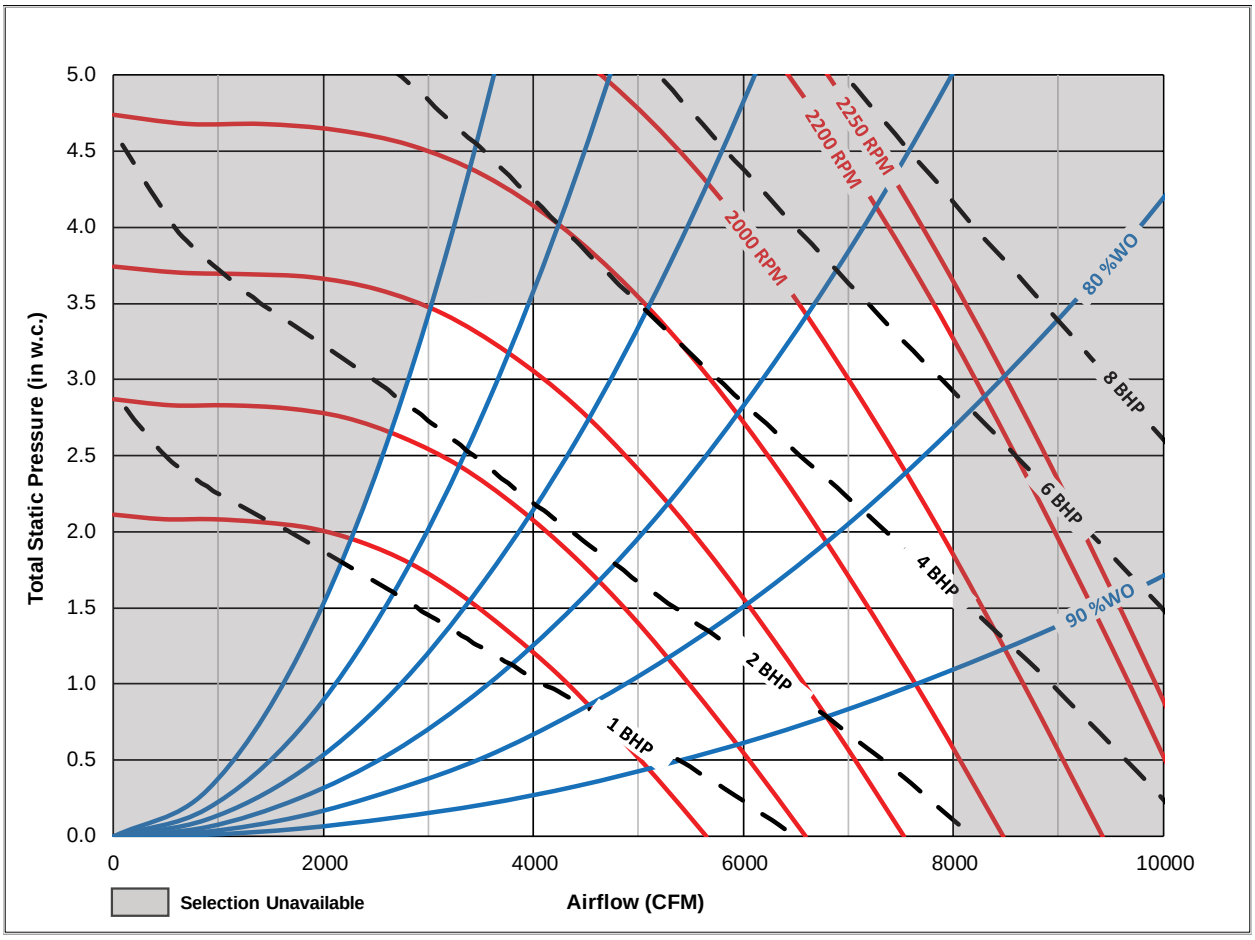
Figure 67. 20 to 25 ton, 6 hp relief fan, single fan



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

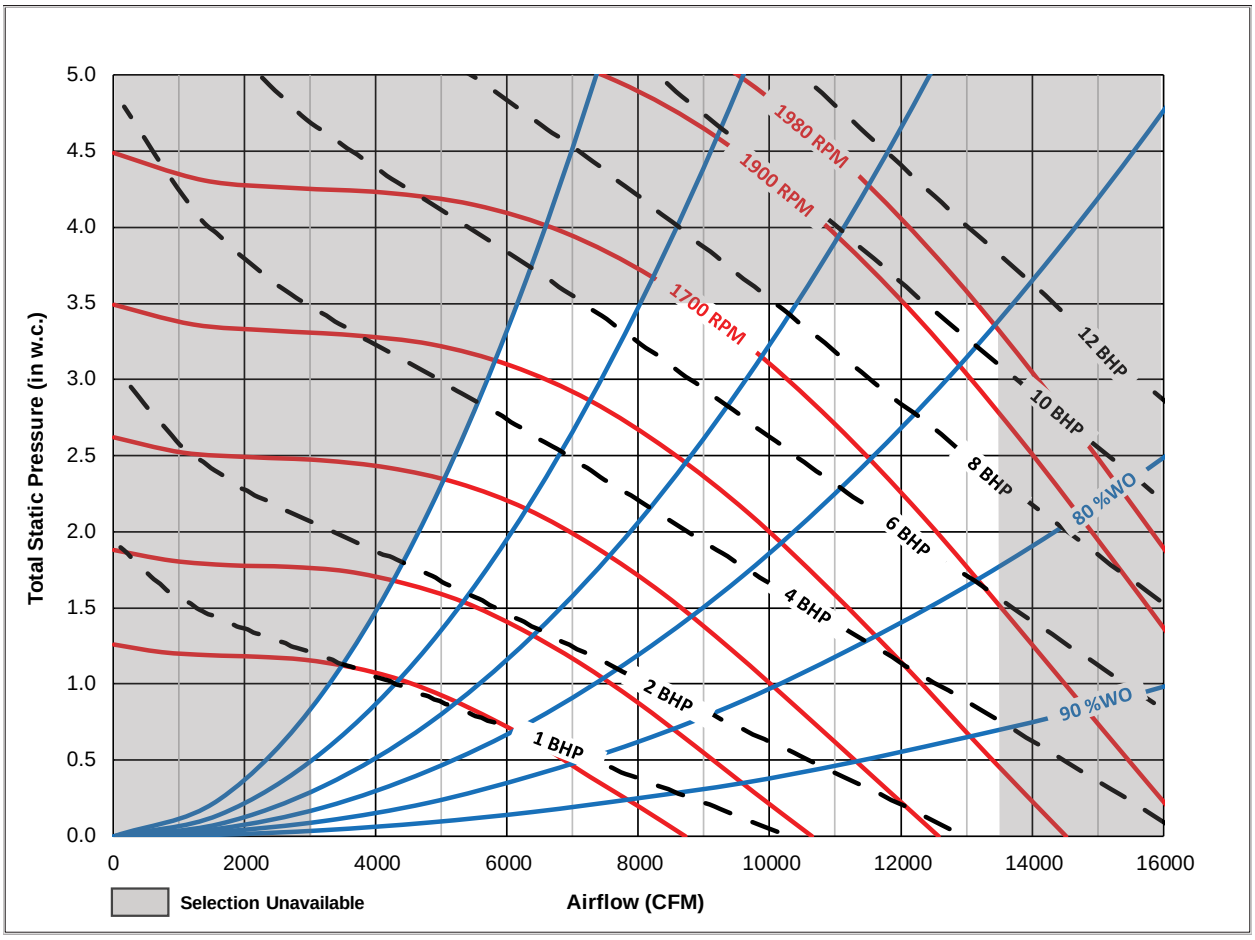
Figure 68. 20 ton, 8 hp relief fan, single fan



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

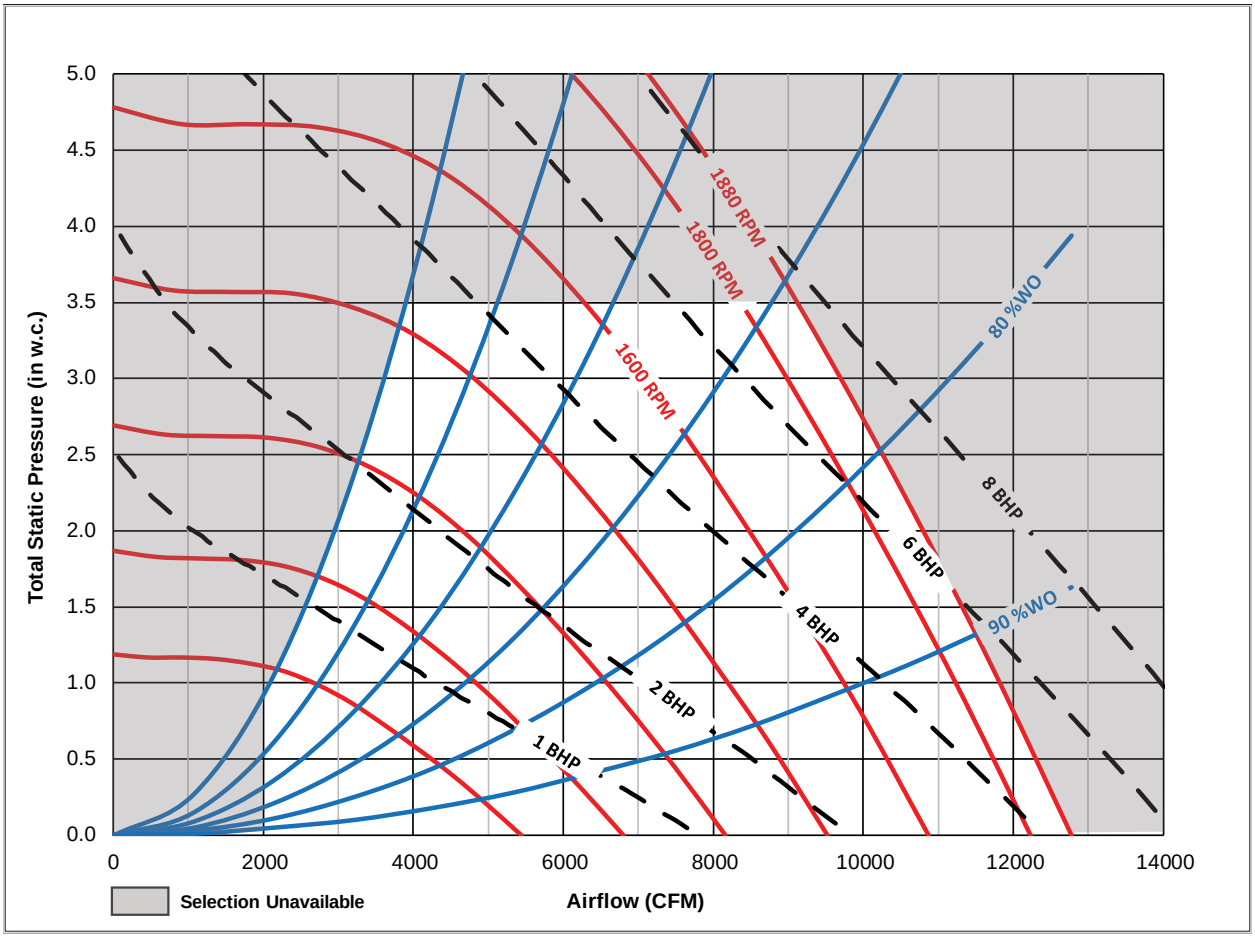
Figure 69. 30 ton, 12 hp relief fan, two-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

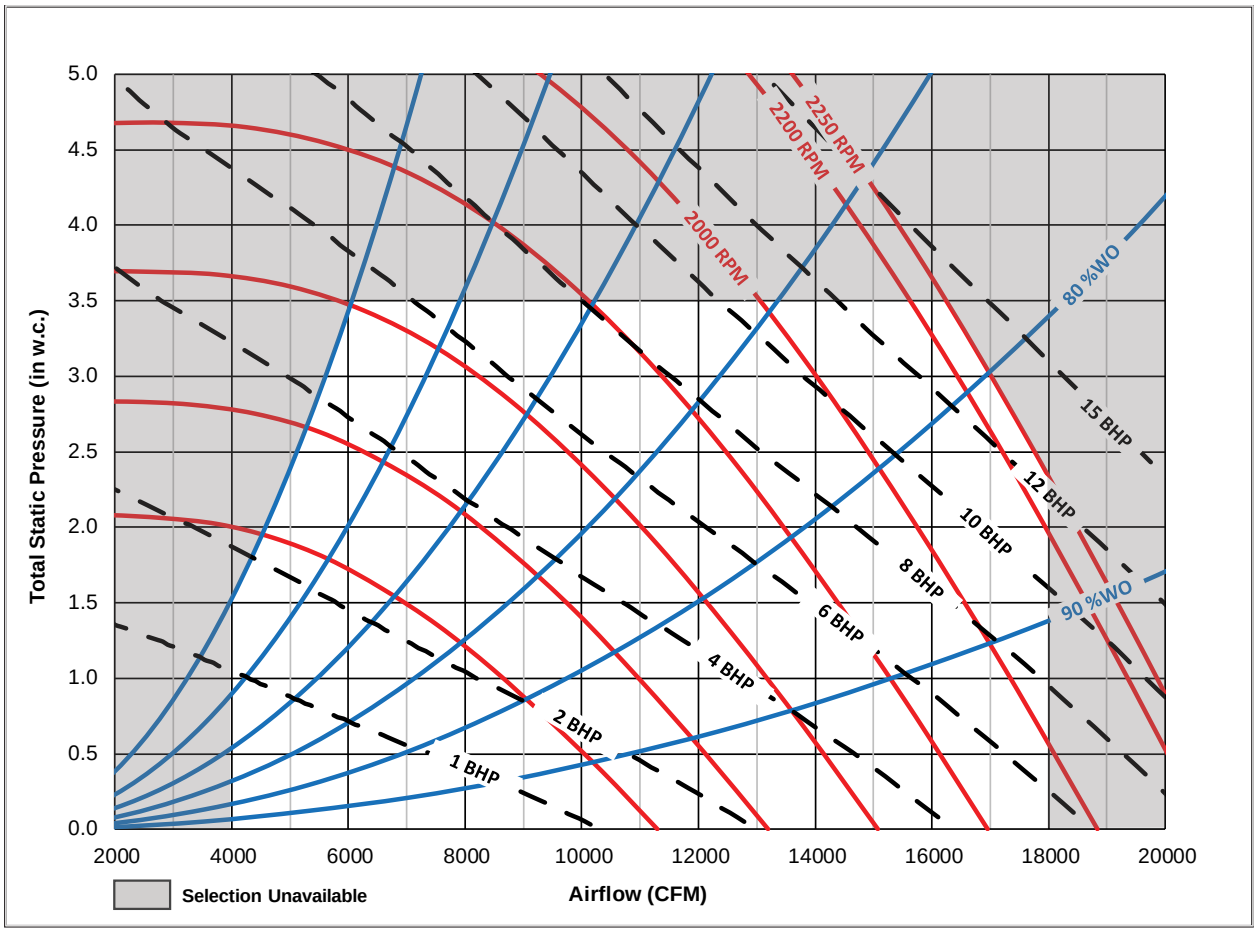
Figure 70. 25, 30 and 40 ton, 8 hp relief fan, single fan



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

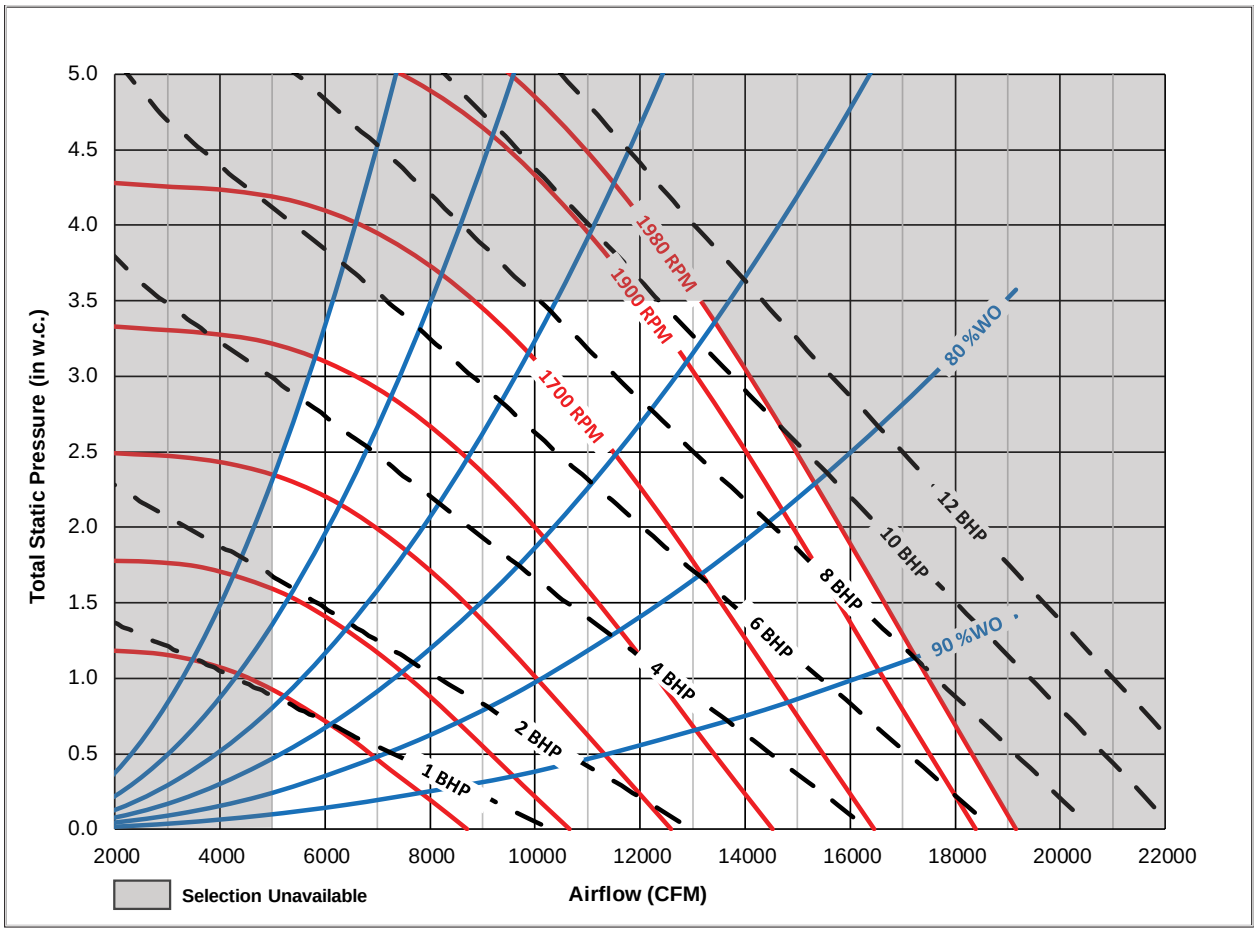
Figure 71. 40 ton, 15 hp relief fan, two-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

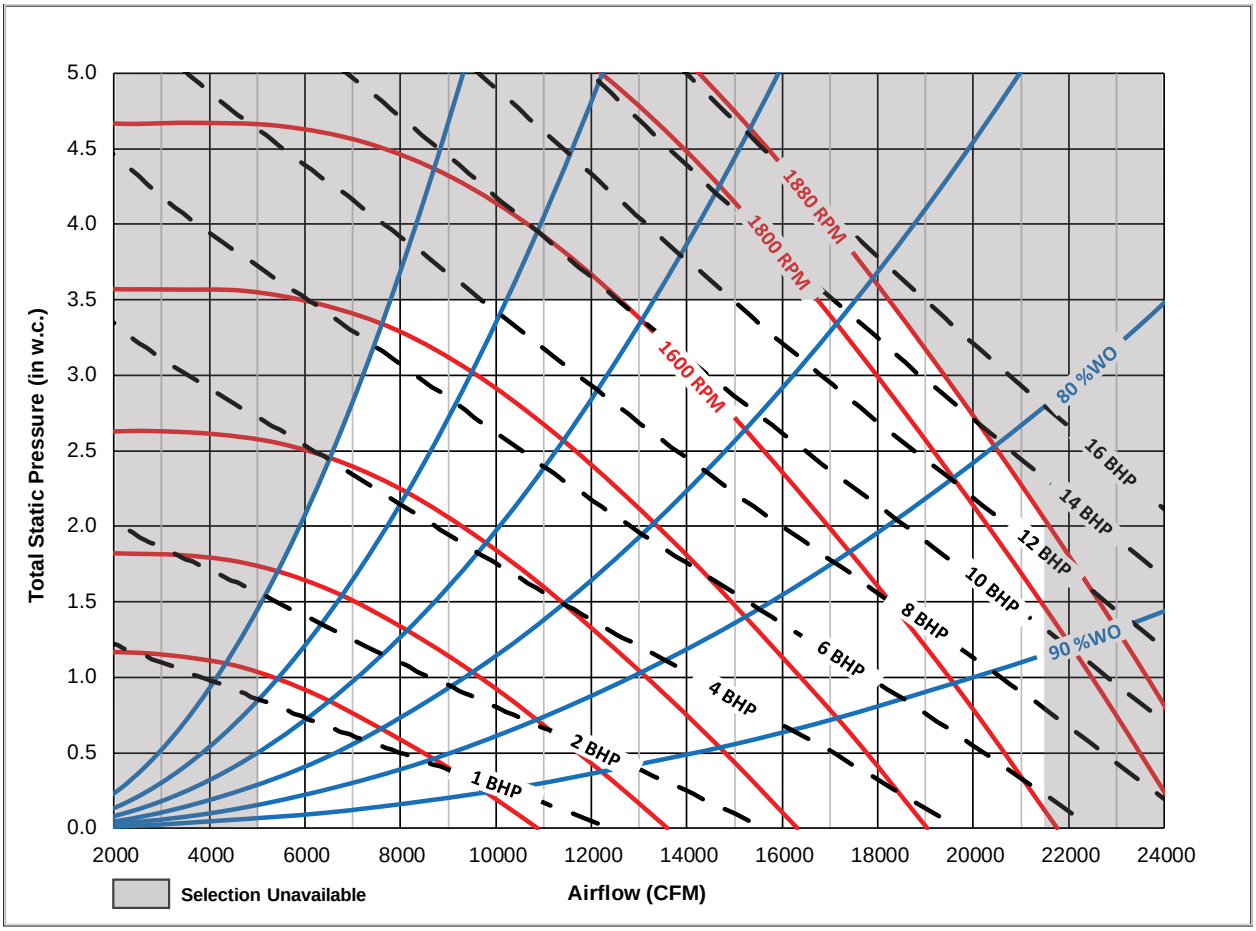
Figure 72. 50 and 55 ton, 12 hp relief fan, two-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

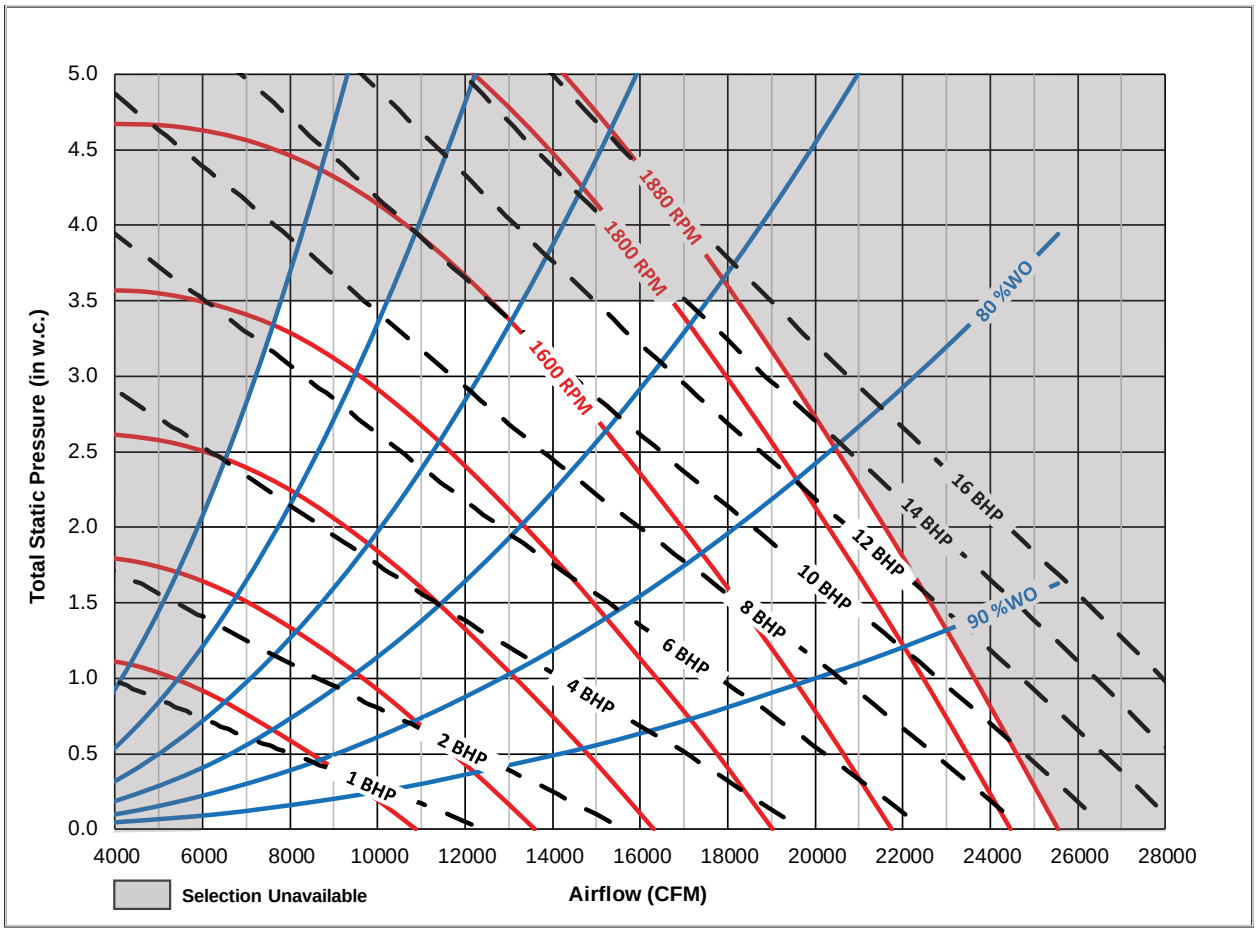
Figure 73. 50 and 55 ton, 16 hp relief fan, two-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

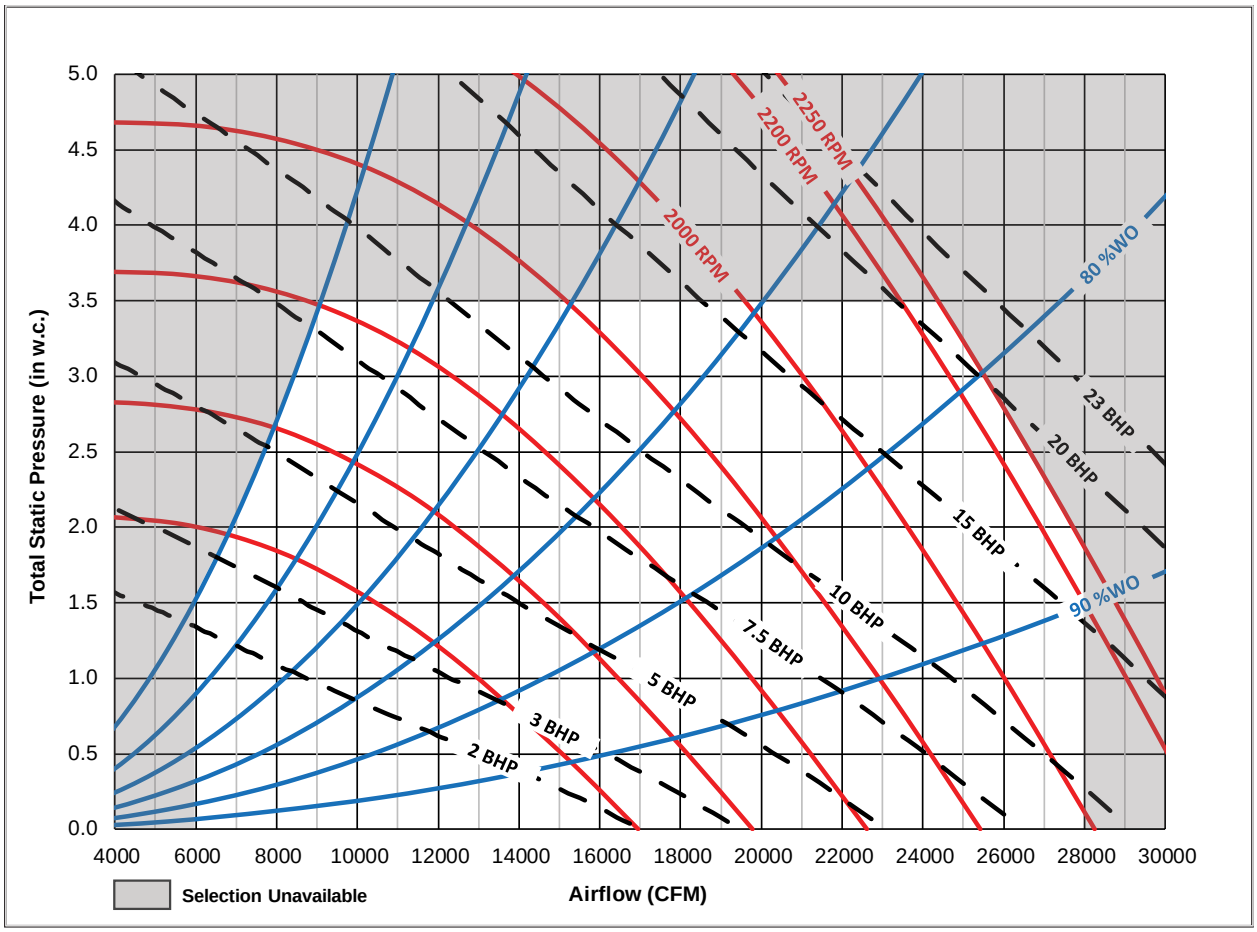
Figure 74. 60, 70 and 75 ton, 16 hp relief fan, two-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

Figure 75. 60, 70 and 75 ton, 23 hp relief fan, three-fan array



Important:

- *Relief fan performance curve includes internal resistance of rooftop. For total static pressure determination, add together return ESP and relief damper pressure drop.*
- *Static pressure drops from the space to the relief fan (relief damper + return ESP) cannot exceed 3.5 in w.c.*
- *Curve can show combined operating min/max for multiple tonnages. Refer to general data for appropriate operating parameters such as motor horsepower and airflow ranges.*
- *Shaded areas represent unavailable selections. Contact your local Trane® representative for more information on selections in these shaded regions.*
- *EC motors are not offered in integral horsepower increments. Fans will be offered with a nominal motor power rated to cover the operating envelope of the fan. Power limitation is indicated by the highest power shown on the curve.*
- *Max RPM is indicated on curve and RPM values are in increments of 200 RPM unless otherwise shown.*
- *Catalog curves represent fan data corrected to the following standard conditions: 70°F dry bulb temperature, barometric pressure of 14.696 psia, and an air density of 0.075 lb/ft^3. Utilize Trane Select Assist™ to generate fan curves for unit-specific operating temperatures and elevations.*

Component Static Pressure Drops

Table 56. Static pressure drops — relief dampers

Nominal Tons	CFM	Relief Damper Pressure Drop (in w.c.)
20-40 Single Fan	2,000	0.04
	4,000	0.16
	6,000	0.37
	8,000	0.65
	10,000	1.02
30-55 Dual Fan	4,000	0.04
	6,000	0.09
	8,000	0.16
	10,000	0.26
	12,000	0.37
	14,000	0.5
	16,000	0.65
	18,000	0.83
	20,000	1.02
	22,000	1.24
60-75 Dual or Three-Fan Array	6,000	0.07
	8,000	0.12
	10,000	0.19
	12,000	0.27
	14,000	0.37
	16,000	0.48
	18,000	0.61
	20,000	0.75
	22,000	0.91
	24,000	1.08
	26,000	1.27
	28,000	1.47

Notes:

1. Relief damper static pressure drop is used only for relief fan selections.
2. Use Relief CFM to determine pressure drop to add to return duct static pressure for relief fan selection.

Table 57. Component static pressure drops (in. H_2O)

Tons	CFM Std	Evap Coil						HGRH	Heating System						Filters						Economizer		
		Standard		High Efficiency		Variable			Gas					Electric	Pre Evap Panel				Pre Evap Cart	Final Cart	Return Air	Outside Air W/O Traq	Outside Air W/ Traq
		Dry	Wet	Dry	Wet	Dry	Wet		250 MBh	350 MBh	500 MBh	850 MBh	1200 MBh	All kW	2" Merv 4	2" Merv 8	4" Merv 8	4" Merv 14					
20	4000			0.08	0.08	0.08	0.08	0.01	0.08	0.05	0.04			0.03	0.03	0.05	0.04	0.09	0.08	0.08	0.05	0.04	0.05
	5000			0.11	0.12	0.11	0.12	0.01	0.12	0.08	0.06			0.04	0.05	0.07	0.07	0.14	0.12	0.12	0.07	0.06	0.07
	6000			0.14	0.16	0.14	0.16	0.02	0.17	0.11	0.09			0.06	0.07	0.10	0.10	0.20	0.18	0.18	0.10	0.08	0.10
	7000			0.17	0.20	0.16	0.20	0.02	0.23	0.15	0.12			0.08	0.10	0.14	0.13	0.28	0.24	0.24	0.14	0.11	0.14
	8000			0.19	0.25	0.19	0.25	0.03	0.30	0.20	0.16			0.11	0.13	0.18	0.17	0.36	0.32	0.32	0.18	0.15	0.18
	9000			0.23	0.30	0.23	0.30	0.04	0.38	0.25	0.20			0.13	0.17	0.23	0.22	0.46	0.40	0.40	0.23	0.19	0.23
25	5000	0.06	0.06	0.11	0.12	0.14	0.15	0.01	0.12	0.09	0.07			0.04	0.05	0.07	0.07	0.14	0.12	0.12	0.07	0.06	0.07
	6250	0.08	0.08	0.15	0.17	0.19	0.21	0.02	0.19	0.13	0.10			0.06	0.08	0.11	0.10	0.22	0.19	0.19	0.11	0.09	0.11
	7500	0.10	0.11	0.19	0.22	0.24	0.28	0.02	0.28	0.19	0.15			0.09	0.12	0.16	0.15	0.32	0.28	0.28	0.16	0.13	0.16
	8750	0.12	0.14	0.22	0.29	0.28	0.36	0.03	0.38	0.26	0.20			0.13	0.16	0.22	0.20	0.44	0.38	0.38	0.22	0.18	0.22
	10000	0.14	0.18	0.27	0.36	0.34	0.44	0.04	0.50	0.34	0.27			0.17	0.21	0.29	0.27	0.57	0.49	0.49	0.28	0.23	0.28
	11250	0.17	0.22	0.33	0.43	0.42	0.53	0.05	0.63	0.44	0.34			0.21	0.26	0.36	0.34	0.72	0.62	0.62	0.36	0.29	0.36
30	6000	0.15	0.15	0.19	0.19	0.18	0.19	0.01	0.17	0.13	0.10			0.06	0.07	0.10	0.10	0.20	0.18	0.18	0.10	0.08	0.10
	7500	0.20	0.22	0.25	0.28	0.25	0.28	0.02	0.26	0.21	0.15			0.09	0.12	0.16	0.15	0.32	0.28	0.28	0.16	0.13	0.16
	9000	0.23	0.29	0.32	0.38	0.31	0.38	0.03	0.38	0.30	0.22			0.13	0.17	0.23	0.22	0.46	0.40	0.40	0.23	0.19	0.23
	10500	0.30	0.38	0.37	0.48	0.37	0.48	0.04	0.52	0.40	0.30			0.18	0.23	0.32	0.29	0.63	0.54	0.54	0.31	0.25	0.31
	12000	0.37	0.47	0.46	0.60	0.46	0.59	0.05	0.68	0.53	0.39			0.24	0.30	0.41	0.38	0.82	0.71	0.71	0.41	0.33	0.41
	14000	0.48	0.59	0.59	0.75	0.59	0.75	0.07	0.92	0.72	0.53			0.33	0.41	0.56	0.52	1.12	0.97	0.97	0.56	0.45	0.55
40	8000	0.14	0.14	0.22	0.24	0.20	0.22	0.02		0.24	0.17	0.19		0.09	0.05	0.08	0.07	0.20	0.16	0.19	0.08	0.02	0.02
	10000	0.19	0.20	0.30	0.34	0.31	0.34	0.02		0.37	0.26	0.30		0.14	0.08	0.13	0.12	0.31	0.26	0.29	0.13	0.03	0.03
	12000	0.23	0.27	0.36	0.46	0.45	0.49	0.03		0.53	0.37	0.43		0.20	0.11	0.19	0.17	0.45	0.37	0.42	0.19	0.05	0.05
	14000	0.27	0.35	0.45	0.58	0.61	0.67	0.05		0.72	0.50	0.59		0.28	0.15	0.25	0.23	0.62	0.51	0.57	0.26	0.07	0.07
	16000	0.34	0.43	0.56	0.72	0.79	0.87	0.06		0.94	6.50	0.76		0.36	0.20	0.33	0.30	0.80	0.66	0.74	0.34	0.09	0.09
	18000	0.41	0.53	0.68	0.85	1.00	1.10	0.08		1.19	0.81	0.97		0.46	0.25	0.42	0.37	1.02	0.84	0.94	0.43	0.11	0.11
50	10000	0.25	0.27	0.38	0.41	0.31	0.34	0.02		0.38	0.26	0.32		0.14	0.08	0.13	0.12	0.31	0.26	0.29	0.13	0.03	0.03
	12500	0.34	0.39	0.50	0.58	0.42	0.48	0.04		0.59	0.40	0.50		0.22	0.12	0.20	0.18	0.49	0.40	0.45	0.21	0.05	0.05
	15000	0.41	0.52	0.60	0.78	0.52	0.65	0.05		0.85	0.57	0.72		0.32	0.17	0.29	0.26	0.71	0.58	0.65	0.30	0.08	0.08
	17500	0.52	0.67	0.77	1.00	0.65	0.83	0.07		1.16	0.77	0.98		0.43	0.23	0.40	0.35	0.96	0.79	0.89	0.41	0.11	0.11
	20000	0.64	0.83	0.96	1.22	0.80	1.02	0.09		1.51	1.00	1.29		0.57	0.31	0.52	0.46	1.26	1.03	1.16	0.53	0.14	0.14
	22500	0.78	0.99	1.17	1.46	0.98	1.22	0.12		1.91	1.26	1.63		0.72	0.39	0.65	0.59	1.59	1.31	1.47	0.67	0.17	0.17
55	11000	0.36	0.39	0.43	0.47	0.36	0.39	0.03		0.46	0.31	0.39		0.17	0.09	0.16	0.14	0.38	0.31	0.35	0.16	0.04	0.04
	13750	0.49	0.57	0.57	0.68	0.47	0.57	0.04		0.71	0.48	0.61		0.27	0.14	0.24	0.22	0.59	0.49	0.55	0.25	0.07	0.07
	16500	0.59	0.76	0.70	0.91	0.59	0.76	0.06		1.03	0.69	0.88		0.39	0.21	0.35	0.31	0.86	0.70	0.79	0.36	0.09	0.09
	19250	0.75	0.96	0.91	1.16	0.75	0.97	0.09		1.40	0.94	1.19		0.52	0.28	0.48	0.43	1.16	0.96	1.08	0.49	0.13	0.13
	22000	0.94	1.18	1.13	1.42	0.94	1.19	0.11		1.83	1.22	1.56		0.68	0.37	0.63	0.56	1.52	1.25	1.41	0.64	0.17	0.17
	24750	1.14	1.40	1.37	1.69	1.14	1.41	0.14		2.31	1.55	1.97		0.87	0.47	0.79	0.71	1.93	1.58	1.78	0.81	0.21	0.21
60	12000	0.17	0.18	0.34	0.36	0.33	0.36	0.03			0.36	0.44	0.40	0.17	0.05	0.09	0.08	0.24	0.22	0.25	0.14	0.16	0.16
	15000	0.23	0.26	0.45	0.51	0.44	0.51	0.05			0.56	0.69	0.63	0.26	0.08	0.14	0.13	0.38	0.34	0.38	0.22	0.25	0.25
	18000	0.29	0.34	0.53	0.69	0.56	0.69	0.07			0.80	1.00	0.90	0.38	0.11	0.21	0.18	0.55	0.49	0.55	0.32	0.36	0.36
	21000	0.34	0.44	0.68	0.88	0.68	0.88	0.09			1.10	1.36	1.23	0.52	0.15	0.28	0.25	0.74	0.66	0.75	0.44	0.49	0.49
	24000	0.43	0.55	0.85	1.07	0.85	1.07	0.12			1.43	1.78	1.60	0.68	0.20	0.37	0.33	0.97	0.87	0.98	0.57	0.63	0.63
	27000	0.52	0.66	1.03	1.28	1.03	1.27	0.15			1.81	2.25	2.03	0.86	0.25	0.47	0.41	1.23	1.10	1.24	0.73	0.80	0.80
70	14000	0.35	0.38	0.21	0.24	0.21	0.24	0.03			0.48	0.61	0.55	0.23	0.07	0.13	0.11	0.33	0.29	0.33	0.20	0.22	0.22
	17200	0.46	0.53	0.27	0.33	0.26	0.33	0.04			0.73	0.92	0.82	0.35	0.10	0.19	0.17	0.50	0.45	0.50	0.29	0.33	0.33
	20400	0.54	1.44	0.30	0.43	0.32	0.43	0.05			1.03	1.30	1.16	0.49	0.14	0.27	0.24	0.70	0.63	0.71	0.41	0.46	0.46
	23600	0.69	0.88	0.38	0.54	0.38	0.54	0.07			1.37	1.74	1.55	0.65	0.19	0.36	0.32	0.94	0.84	0.95	0.55	0.61	0.61
	26800	0.85	1.07	0.48	0.66	0.48	0.66	0.09			1.77	2.24	2.00	0.84	0.25	0.46	0.41	1.21	1.08	1.22	0.72	0.79	0.79
	30000	1.02	1.26	0.57	0.78	0.57	0.78	0.12			2.22	2.81	2.50	1.06	0.31	0.58	0.51	1.52	1.35	1.53	0.90	0.99	0.99

Table 57. Component static pressure drops (in. H_2O) (continued)

Tons	CFM Std	Evap Coil						HGRH	Heating System						Filters						Economizer		
		Standard		High Efficiency		Variable			Gas					Electric	Pre Evap Panel				Pre Evap Cart	Final Cart	Return Air	Outside Air W/O Traq	Outside Air W/ Traq
		Dry	Wet	Dry	Wet	Dry	Wet		250 MBh	350 MBh	500 MBh	850 MBh	1200 MBh	All kW	2" Merv 4	2" Merv 8	4" Merv 8	4" Merv 14					
75	15000	0.47	0.51	0.24	0.26	0.24	0.26	0.03			0.56	0.70	0.63	0.26	0.08	0.14	0.13	0.38	0.34	0.38	0.22	0.25	0.25
	18000	0.58	0.00	0.29	0.35	0.28	0.35	0.04			0.80	1.01	0.90	0.38	0.11	0.21	0.18	0.55	0.49	0.55	0.32	0.36	0.36
	21000	0.68	0.88	0.32	0.45	0.34	0.45	0.06			1.09	1.38	1.23	0.52	0.15	0.28	0.25	0.74	0.66	0.75	0.44	0.49	0.49
	24000	0.85	1.08	0.39	0.55	0.39	0.55	0.08			1.42	1.80	1.60	0.68	0.20	0.37	0.33	0.97	0.87	0.98	0.57	0.63	0.63
	27000	1.03	1.29	0.48	0.67	0.48	0.67	0.10			1.80	2.28	2.03	0.86	0.25	0.47	0.41	1.23	1.10	1.24	0.73	0.80	0.80
	30000	1.22	1.51	0.57	0.79	0.57	0.79	0.12			2.22	2.81	2.50	1.06	0.31	0.58	0.51	1.52	1.35	1.53	0.90	0.99	0.99

Notes:

1. Static pressure drops of accessory components must be added to determine total static pressure for fan selections.
2. Gas heat section maximum temperature rise of 60°F.
3. Economizer static pressure value for sizing supply fan is the highest of the following: a) Return air static pressure drop plus customer return duct static pressure and b) Outside air static pressure drop.

Refrigeration

Electronic Compressor Protection Module (CPM)

The CSHN*** compressors come equipped with a compressor protection device (CPM) capable of detecting phase reversal, phase loss, and motor overheating. When a fault is identified, the output relay will open. Depending on the fault, the CPM may either auto-reset or it may lock-out. The CPM can be manually reset by cycling control power.

Note: *If the compressor has tripped due to an overheated windings condition, the motor winding temperature sensor resistance (PTC) will be 4500 ohms or greater; the resistance must be less than 2750 ohms before the 5 minute reset timer becomes enabled.*

Low Ambient Condenser Fans

Operation

Table 58. Minimum outside air temperature

Low Ambient Unit Minimum Outside Air Temperature for Mechanical Cooling	
With or Without Hot Gas Bypass	0°F

Standard Ambient Condenser Fans

Standard ambient units stage condenser fans down to a minimum of one fan per circuit. All standard ambient units ship with the Symbio™ controller set to allow mechanical cooling down to 50°F outdoor temperature. This setting is adjustable. Below table lists the minimum recommended mechanical cooling setting for standard ambient units by application and unit type.

Table 59. Minimum outside air temperature

Standard Unit Minimum Outside Air Temperature for Mechanical Cooling	Std & High Cap units	eFlex™ units	
		20, 60, 70, 75 ton	25, 30, 40, 50, 55 ton
Economizer - A/C Applications	45°F	45°F	50°F
No Economizer - 80/67F design return air	45°F	45°F	55°F
No Economizer - 90/78F design return air	50°F	50°F	70°F

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, and cause serious damage to the equipment.

Failure to disconnect power before servicing could result in burns or electrocution which could result in death or serious 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 cannot be inadvertently energized.

Trane does not recommend field installation of ultraviolet lights in its equipment for the intended purpose of improving indoor air quality. 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.

Compressor Circuit Breakers

Every fixed speed compressor is protected by a circuit breaker. If replacement is necessary, please refer to the circuit breaker nameplate to identify the part number and manufacturer. Contact the circuit breaker manufacturer to locate the datasheet for the circuit breaker to find the "must hold / must trip" values.

Supply and Relief/Return Fan Overloads

When the VFD bypass option is selected, each supply and relief/return fan is protected by a motor overload when in VFD bypass mode. On 60-75T units with dual DDP supply fan motors (with or without VFD bypass option), each supply fan motor is protected by a motor overload in both standard operation and VFD bypass mode. The motor overloads are factory set to the motor FLA value and should not be adjusted. If the current to the motor exceeds the overload dial setting value, the overload relay auxiliary contacts will trip and interrupt the control signal to the run and bypass contactor coils. This will remove power from the fan motor and stop operation.

Table 60. Filter data

Unit Tons	Evaporator Filters											Final Filters				
	2" Panel Filters (MERV 4 or MERV 8)			4" Panel Filters (MERV 8 or MERV 14)			2" Prefilters		Cartridge Filters			2" Prefilters		Cartridge Filters		
	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Qty	Size of Each	Face Area (ft^2)
20	4	16x20x2	32.2	4	16x20x4	32.2	4	16x20x2	4	16x20x12	33.3	4	16x20x2	4	16x20x12	33.3
	6	20x20x2		6	20x20x4		4	20x20x2	4	20x20x12		4	20x20x2	4	20x20x12	
	2	20x24x2		2	20x24x4		4	20x24x2	4	20x24x12		4	20x24x2	4	20x24x12	
25	4	16x20x2	32.2	4	16x20x4	32.2	4	16x20x2	4	16x20x12	33.3	4	16x20x2	4	16x20x12	33.3
	6	20x20x2		6	20x20x4		4	20x20x2	4	20x20x12		4	20x20x2	4	20x20x12	
	2	20x24x2		2	20x24x4		4	20x24x2	4	20x24x12		4	20x24x2	4	20x24x12	
30	4	16x20x2	32.2	4	16x20x4	32.2	4	16x20x2	4	16x20x12	33.3	4	16x20x2	4	16x20x12	33.3
	6	20x20x2		6	20x20x4		4	20x20x2	4	20x20x12		4	20x20x2	4	20x20x12	
	2	20x24x2		2	20x24x4		4	20x24x2	4	20x24x12		4	20x24x2	4	20x24x12	
40	3	20x20x2	39.7	3	20x20x4	39.7	2	20x20x2	2	20x20x12	41.6	4	20x20x2	4	20x20x12	39.1
	7	20x24x2		7	20x24x4		6	20x24x2	6	20x24x12		6	20x24x2	6	20x24x12	
	2	24x24x2		2	24x24x4		4	24x24x2	4	24x24x12		2	24x24x2	2	24x24x12	
50	3	20x20x2	39.7	3	20x20x4	39.7	2	20x20x2	2	20x20x12	41.6	4	20x20x2	4	20x20x12	39.1
	7	20x24x2		7	20x24x4		6	20x24x2	6	20x24x12		6	20x24x2	6	20x24x12	
	2	24x24x2		2	24x24x4		4	24x24x2	4	24x24x12		2	24x24x2	2	24x24x12	

Table 60. Filter data (continued)

Unit Tons	Evaporator Filters											Final Filters				
	2" Panel Filters (MERV 4 or MERV 8)			4" Panel Filters (MERV 8 or MERV 14)			2" Prefilters		Cartridge Filters			2" Prefilters		Cartridge Filters		
	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Qty	Size of Each	Face Area (ft^2)	Qty	Size of Each	Qty	Size of Each	Face Area (ft^2)
55	3	20x20x2	39.7	3	20x20x4	39.7	2	20x20x2	2	20x20x12	41.6	4	20x20x2	4	20x20x12	39.1
	7	20x24x2		7	20x24x4		6	20x24x2	6	20x24x12		6	20x24x2	6	20x24x12	
	2	24x24x2		2	24x24x4		4	24x24x2	4	24x24x12		2	24x24x2	2	24x24x12	
60	2	20x20x2	52.9	2	20x20x4	52.9	2	20x20x2	2	20x20x12	52.9	4	20x20x2	4	20x20x12	49.8
	7	20x24x2		7	20x24x4		7	20x24x2	7	20x24x12		8	20x24x2	8	20x24x12	
	6	24x24x2		6	24x24x4		6	24x24x2	6	24x24x12		3	24x24x2	3	24x24x12	
70S	2	20x20x2	52.9	2	20x20x4	52.9	2	20x20x2	2	20x20x12	52.9	4	20x20x2	4	20x20x12	49.8
	7	20x24x2		7	20x24x4		7	20x24x2	7	20x24x12		8	20x24x2	8	20x24x12	
	6	24x24x2		6	24x24x4		6	24x24x2	6	24x24x12		3	24x24x2	3	24x24x12	
70H/V	12	20x24x2	72.0	12	20x24x2	72.0	2	20x20x2	2	20x20x12	52.9	4	20x20x2	4	20x20x12	49.8
	8	24x24x2		8	24x24x2		7	20x24x2	7	20x24x12		8	20x24x2	8	20x24x12	
	—	—		—	—		6	24x24x2	6	24x24x12		3	24x24x2	3	24x24x12	
75S	2	20x20x2	52.9	2	20x20x4	52.9	2	20x20x2	2	20x20x12	52.9	4	20x20x2	4	20x20x12	49.8
	7	20x24x2		7	20x24x4		7	20x24x2	7	20x24x12		8	20x24x2	8	20x24x12	
	6	24x24x2		6	24x24x4		6	24x24x2	6	24x24x12		3	24x24x2	3	24x24x12	
75H/V	12	20x24x2	72.0	12	20x24x2	72.0	2	20x20x2	2	20x20x12	52.9	4	20x20x2	4	20x20x12	49.8
	8	24x24x2		8	24x24x2		7	20x24x2	7	20x24x12		8	20x24x2	8	20x24x12	
	—	—		—	—		6	24x24x2	6	24x24x12		3	24x24x2	3	24x24x12	

Filter Layouts

Table 61. 2" and 4" panel filters (20-30 ton)

16x20	16x20	16x20	16x20
20x20	20x20	20x20	20x24
20x20	20x20	20x20	20x24

Table 62. 2" and 4" panel filters (40-55 ton)

20x20	20x20	20x20	20x24
20x24	20x24	20x24	24x24
20x24	20x24	20x24	24x24

Table 63. 2" and 4" panel filters (60S, 60H/V, 70S ton)

20x20	20x20	20x24	20x24	20x24
20x24	20x24	24x24	24x24	24x24
20x24	20x24	24x24	24x24	24x24

Table 64. 2" and 4" panel filters (70H/V, 75S, 75H/V ton)

20x24	20x24	20x24	24x24	24x24
20x24	20x24	20x24	24x24	24x24

Table 65. Cartridge filters (20-30 ton)

16x20	16x20	16x20	16x20
20x20	20x20	20x24	20x24
20x20	20x20	20x24	20x24

Table 66. Cartridge filters (40-55 ton)

20x20	20x20	20x24	20x24
20x24	20x24	24x24	24x24
20x24	20x24	24x24	24x24

Table 67. Cartridge filters (60-75 ton)

20x20	20x20	20x24	20x24	20x24
20x24	20x24	24x24	24x24	24x24
20x24	20x24	24x24	24x24	24x24

Table 68. Final filters (20-30 ton)

16x20	16x20	16x20	16x20
20x20	20x20	20x24	20x24
20x20	20x20	20x24	20x24

Table 69. Final filters (40-55 ton)

20x20	20x20	20x24	20x24
20x20	20x20	20x24	20x24
20x24	20x24	24x24	24x24

Table 70. Final filters (60-75 ton)

20x20	20x20	20x24	20x24	20x24
20x20	20x20	20x24	20x24	20x24
20x24	20x24	24x24	24x24	24x24

Monthly Maintenance

⚠ WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

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 a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

Before completing the following checks, turn the unit **OFF** and lock the main power disconnect switch open.

Filters

Inspect the return air filters. Clean or replace them if necessary. Refer to the Service and Maintenance chapter for filter information.

Cooling Season

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

- ☐ Check the unit's drain pans and condensate piping to ensure that there are no blockages.
- ☐ Check that the condensate overflow switch float moves freely.
- ☐ 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.
- ☐ Inspect the economizer outside air and return air damper hinges and pins to ensure that all moving parts are securely mounted. Keep the blades clean as necessary.

⚠ WARNING

Rotating Components!

Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.

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.

- ☐ 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.
- ☐ Check that all compressor crankcase heaters are working. Repair any that are not working and wait 8 hours before starting the associated refrigeration circuit.
- ☐ 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.
- ☐ With the unit running, check and record the following:
  - 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 77, p. 161. If the operating pressures indicate a refrigerant shortage, measure the system superheat and system subcooling. For guidelines, refer to .

Important: *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. Refer to general service bulletin MSCU-SB-1 (latest edition).*

Heating Season

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Before completing the following checks, turn the unit **OFF** and lock the main power disconnect switch open.

- ☐ Inspect the unit air filters. If necessary, clean or replace them.
- ☐ Check supply fan motor bearings; repair or replace the motor as necessary.
- ☐ 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 units only - Check the heat exchanger(s) for any corrosion, cracks, or holes.
- ☐ Gas units only - Check the combustion air blower and venting system for dirt or blockage from animals or insects. Clean as necessary.
- ☐ Gas units only - Check that burner, tubes, and orifices are free of debris or blockage from insects.
- ☐ Check gas piping for leaks.
- ☐ Gas units only - Open the main gas valve and apply power to the unit heating section; then initiate a "Heat" test using the start-up procedure described in "Staged, Modulating, and Ultra Modulating," p. 64.

⚠ WARNING

Hazardous Gases and Flammable Vapors!

Failure to observe the following instructions could result in exposure to hazardous gases, fuel substances, or substances from incomplete combustion, which could result in death or serious injury. The state of California has determined that these substances may 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 setup of this product and all warnings as provided in this manual.

Coil Cleaning

Regular coil maintenance, including annual cleaning enhances the unit's operating efficiency by minimizing the following:

- Compressor head pressure and amperage draw
- Water carryover
- Fan brake horsepower
- Static pressure losses

At least once each year—or more often if the unit is located in a "dirty" environment—clean the evaporator coils using the instructions outlined below. Be sure to follow these instructions as closely as possible to avoid damaging the coils.

⚠ WARNING

Hazardous Chemicals!

Failure to follow this safety precaution could result in death or serious injury. Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin or eyes 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.

Refrigerant Coils

To clean refrigerant coils, use a soft brush and a sprayer.

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!

Failure to follow instruction below could result in death or serious injury.

Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse and result in the operator/technician falling.

Note: *Before attempting to enter the unit, bridge between the main supports. 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-inch between the sprayer nozzle and the coil. For microchannel condenser

coils, optimum clearance between the sprayer nozzle and the microchannel coil is 1 to 3-inch.

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.

Scroll Compressor Replacement

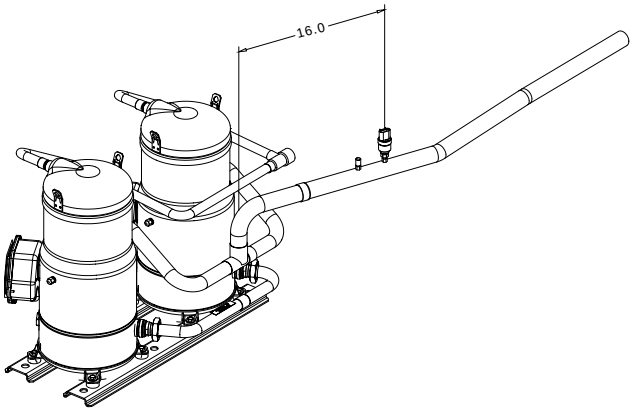
The compressor manifold system was purposely designed to provide proper oil return to each compressor. The refrigerant manifold system must not be modified in any way.

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 is to be installed, install it a minimum of 16 or 25 inches upstream of the oil separator tee. See Figure 76, p. 136.

Important: *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. Refer to general service bulletin MSCU-SB-1 (latest edition).*

Figure 76. Suction line filter installation



Refrigeration System

⚠ WARNING

R-454B Flammable A2L Refrigerant!

Failure to use proper equipment or components as described below could result in equipment failure, and possibly fire, which could result in death, serious injury, or equipment damage.
The equipment described in this manual uses R-454B refrigerant which is flammable (A2L). Use ONLY R-454B rated service equipment and components. For specific handling concerns with R-454B, contact your local representative.

⚠ WARNING

Refrigerant under High Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.
System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

Refrigerant Evacuation and Charging

NOTICE

Compressor Damage!

Failure to follow instructions below result in permanent damage to the compressor.
The unit is fully charged with R-454B refrigerant from the factory. However, if it becomes necessary to remove or recharge the system with refrigerant, it is important that the following actions are taken.

Important: *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.*

- *To prevent cross contamination of refrigerants and oils, use only dedicated R-454B service equipment.*
- *Disconnect unit power before evacuation and do not apply voltage to compressor while under vacuum. Failure to follow these instructions will result in compressor failure.*
- *Due to the presence of POE oil, minimize system open time. Do not exceed 1 hour.*
- *When recharging R-454B refrigerant, it should be charged in the liquid state.*
- *The compressor should be off when the initial refrigerant recharge is performed.*
- *Charging to the liquid line is required prior to starting the compressor to minimize the potential damage to the compressor due to refrigerant in the compressor oil sump at startup.*
- *If suction line charging is needed to complete the charging process, only do so with the compressor operating. Do not charge liquid refrigerant into the suction line with the compressor off! This increases both the probability that the compressor will start with refrigerant in the compressor oil sump and the potential for compressor damage.*
- *Allow the crankcase heater to operate a minimum of 8 hours before starting the unit.*

Charge Storage

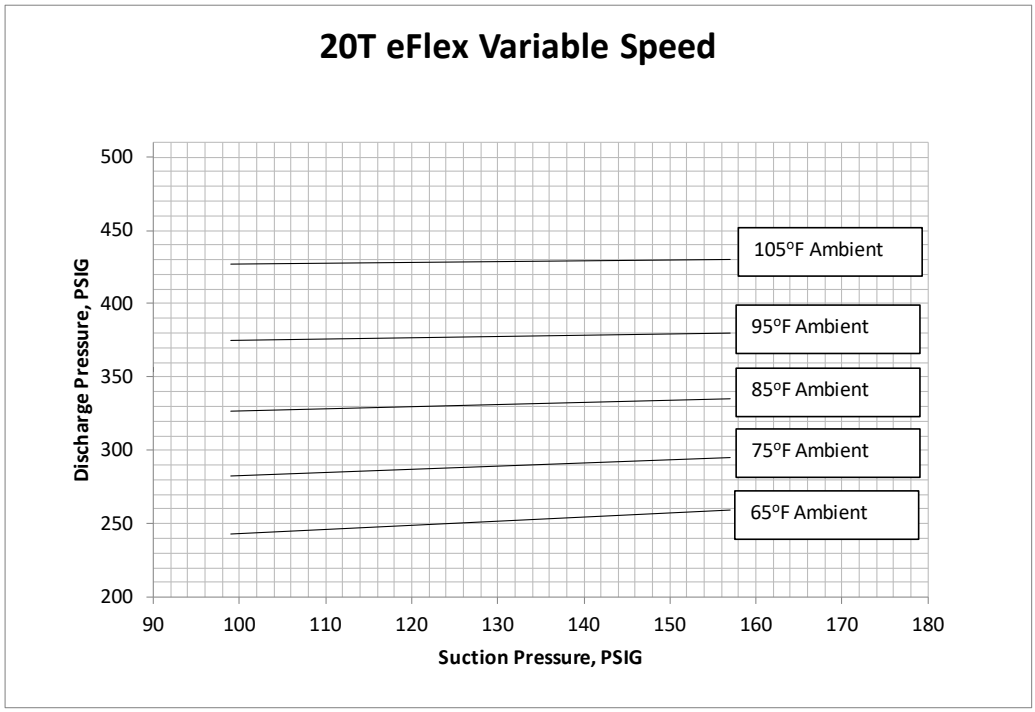
Due to the reduced capacity of the microchannel condenser coil compared to the round tube plate fin evaporator coil, pumping refrigerant into the condenser coil to service the refrigerant system is no longer an option

Measuring Subcooling

1. At the liquid line service port, measure the liquid line pressure. Using an R-454B 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 port 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.
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.)

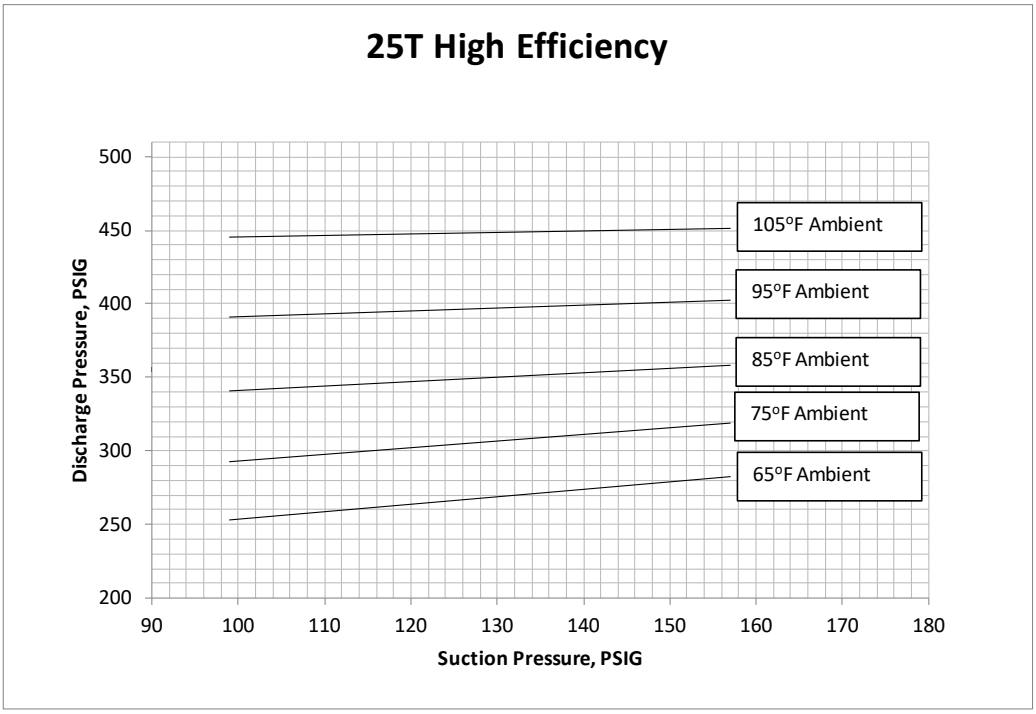
Pressure Curves

Figure 77. Pressure curve — 20 tons eFlex variable speed



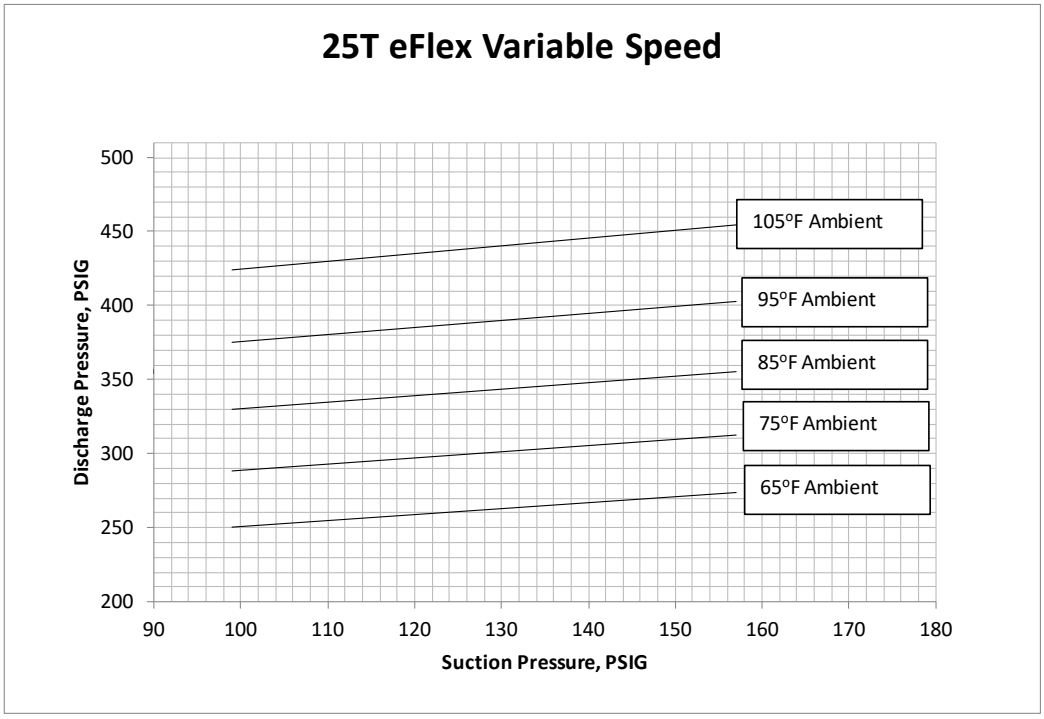
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 78. Pressure curve — 25 tons high efficiency



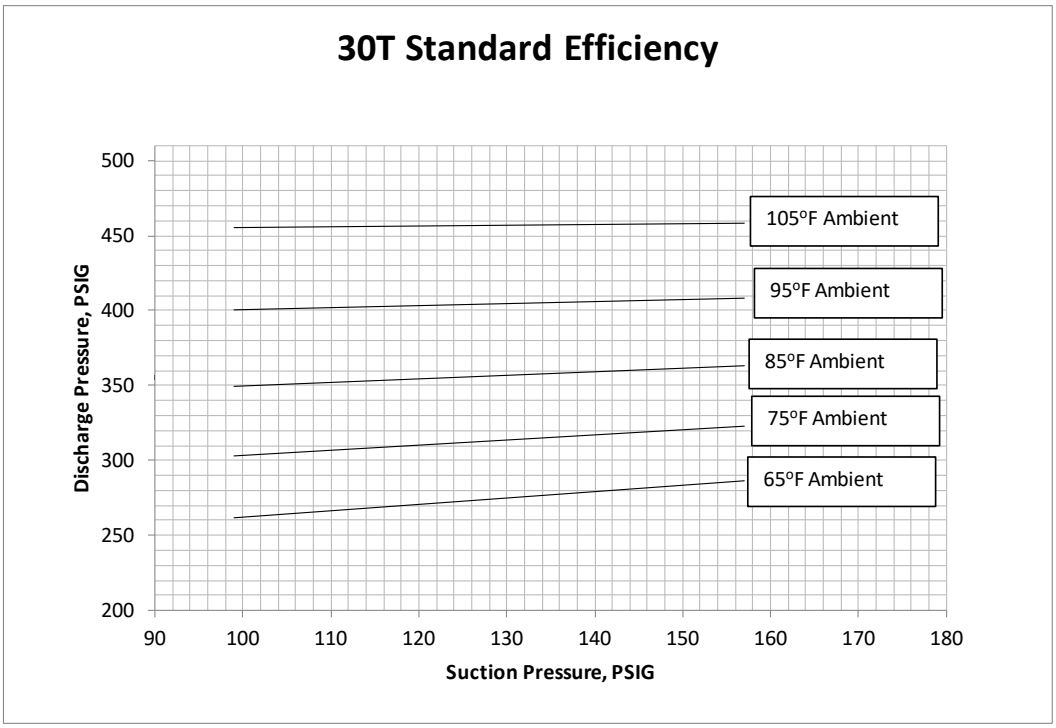
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 79. Pressure curve — 25 tons eFlex variable speed



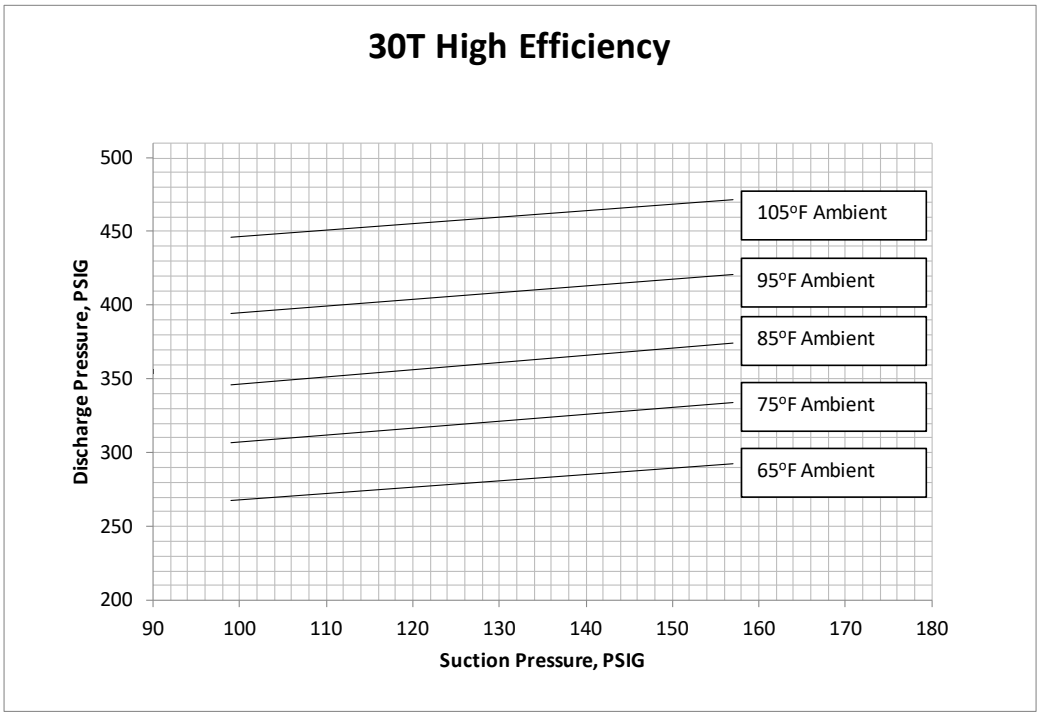
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 80. Pressure curve — 30 tons standard efficiency



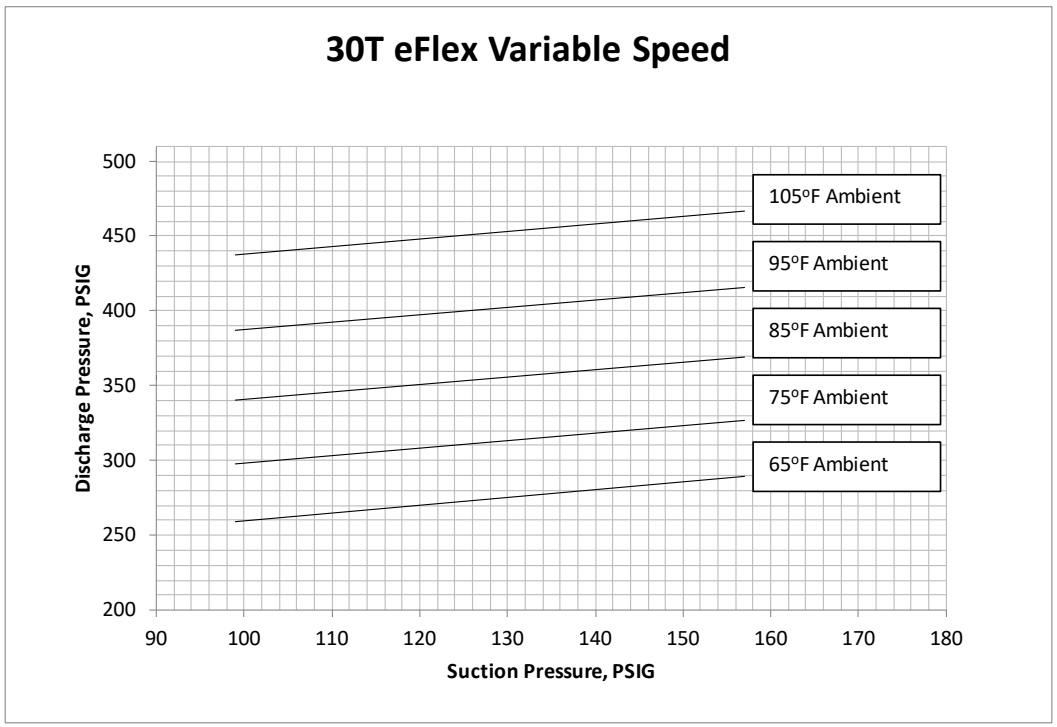
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 81. Pressure curve — 30 tons high efficiency



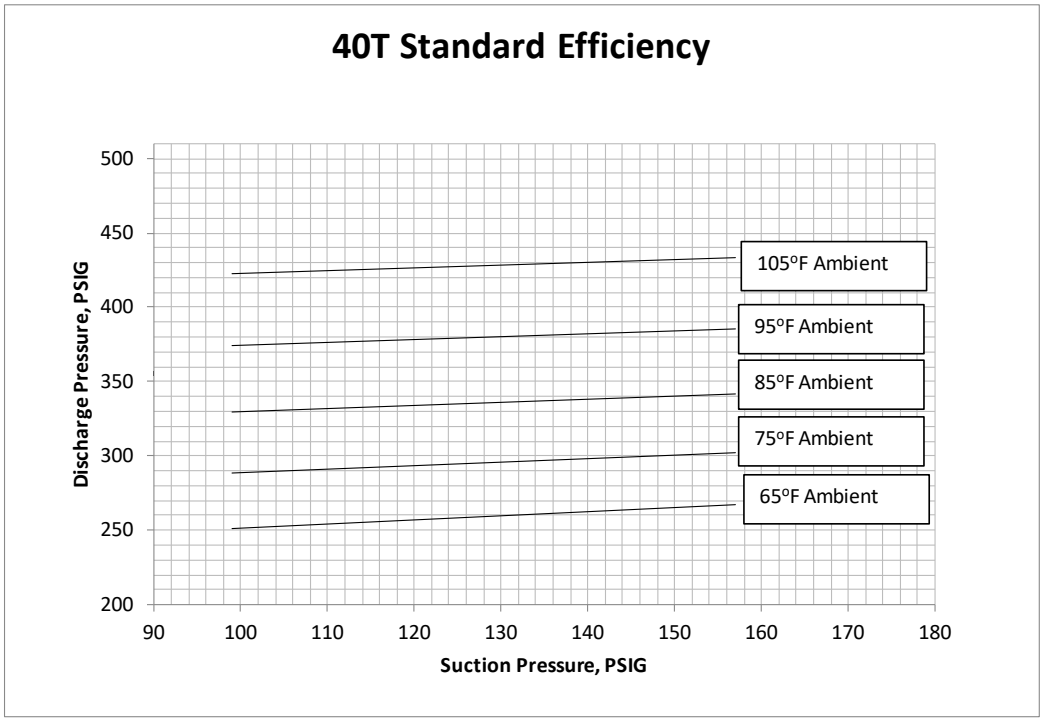
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 82. Pressure curve — 30 tons eFlex variable speed



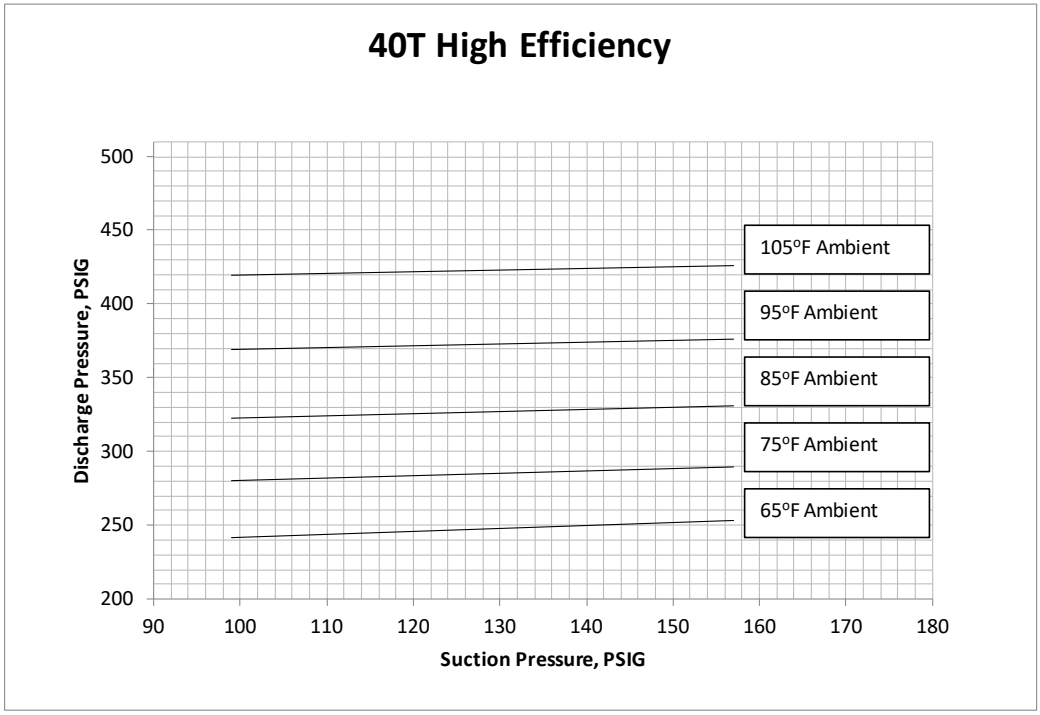
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 83. Pressure curve — 40 tons standard efficiency



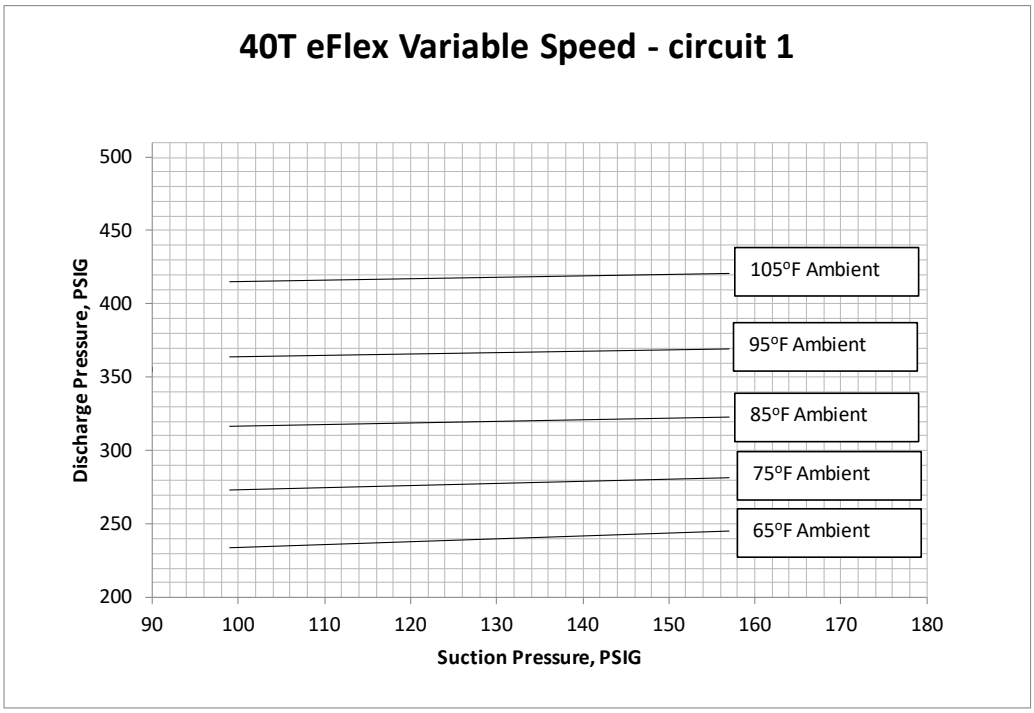
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 84. Pressure curve — 40 tons high efficiency



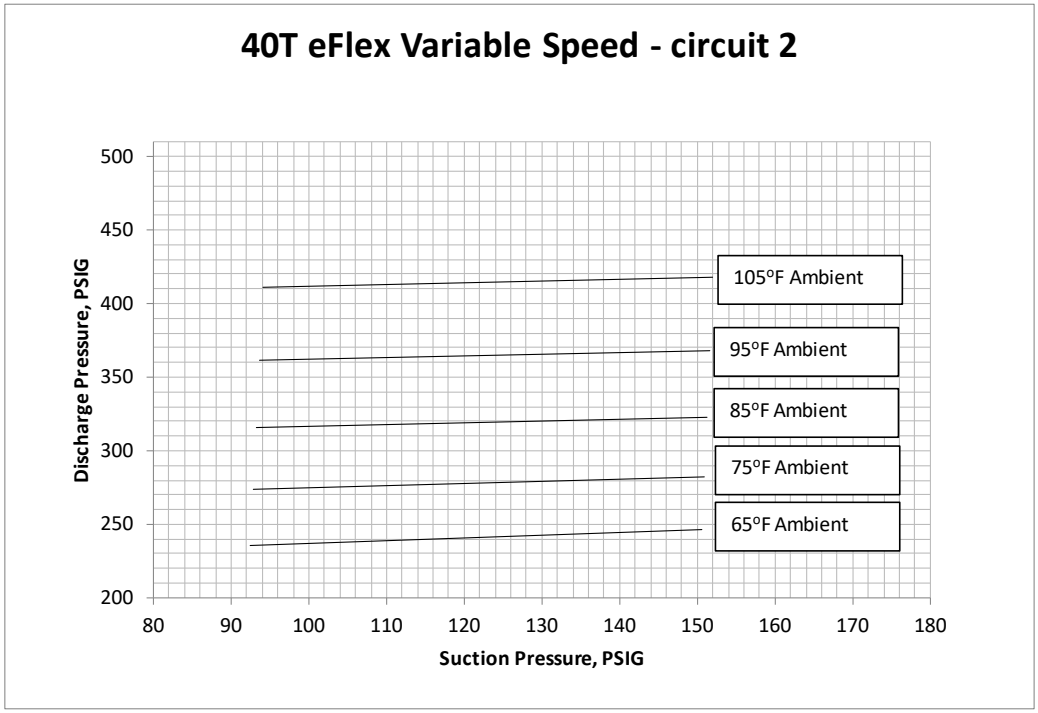
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 85. Pressure curve — 40 tons eFlex variable speed — circuit 1



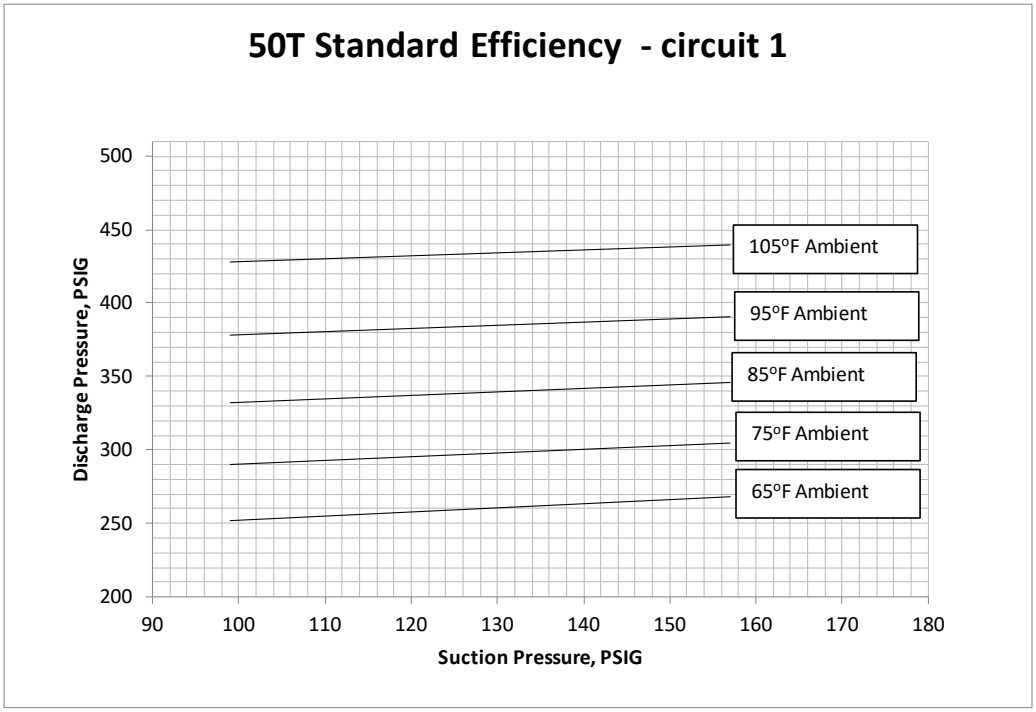
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 86. Pressure curve — 40 tons eFlex variable speed — circuit 2



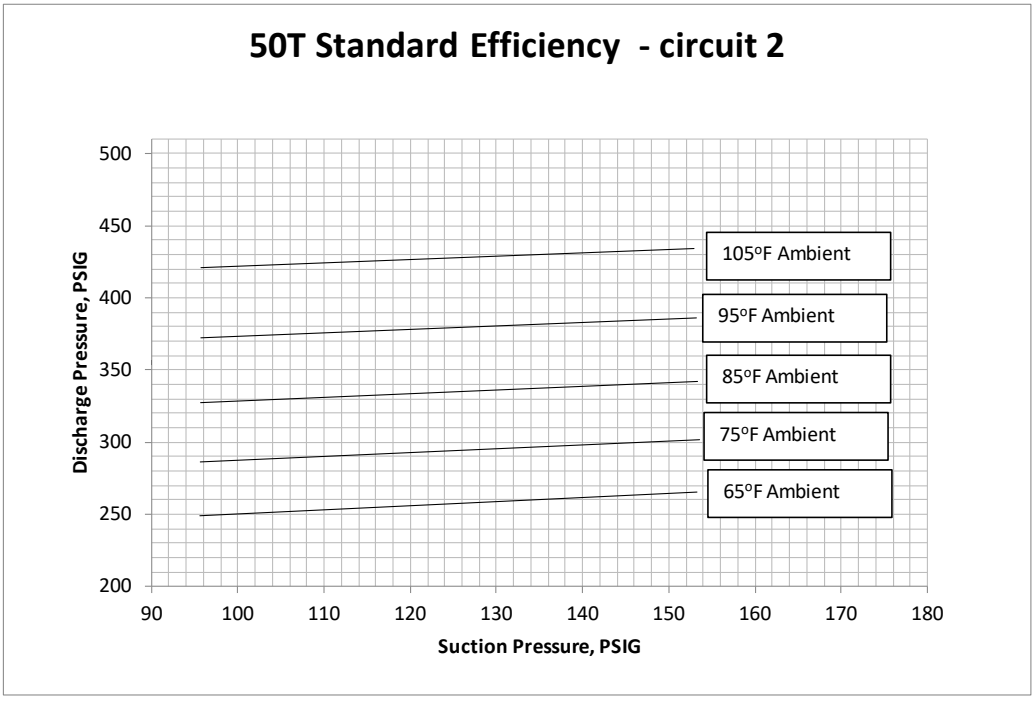
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 87. Pressure curve — 50 tons standard efficiency— circuit 1



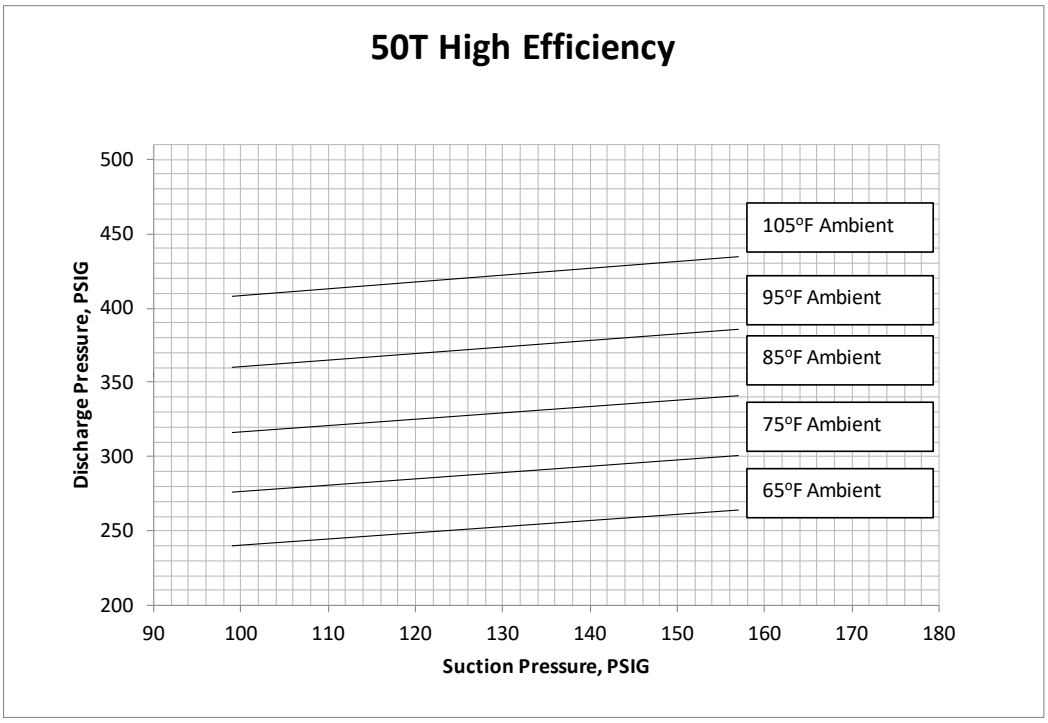
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 88. Pressure curve — 50 tons standard efficiency— circuit 2



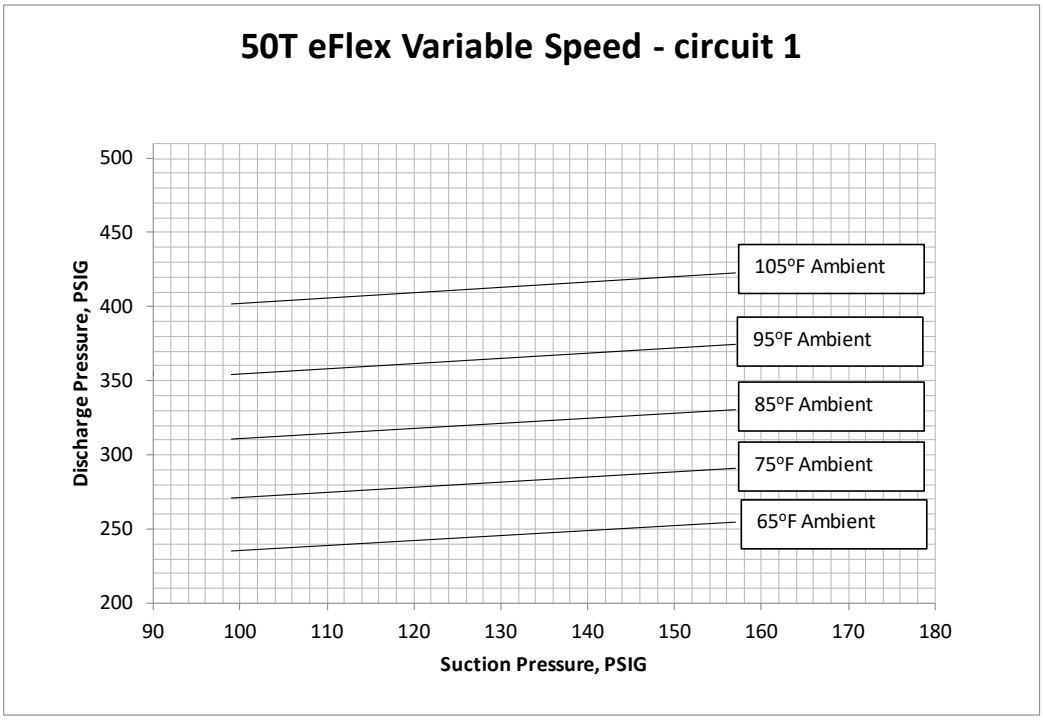
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 89. Pressure curve — 50 tons high efficiency



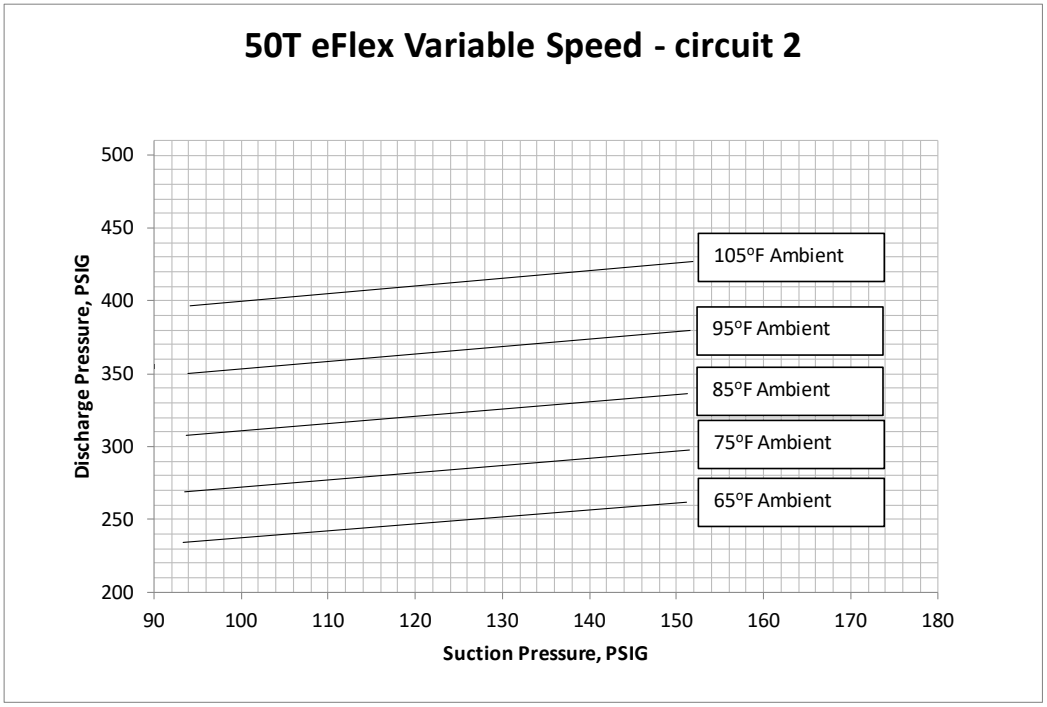
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 90. Pressure curve — 50 tons eFlex variable speed — circuit 1



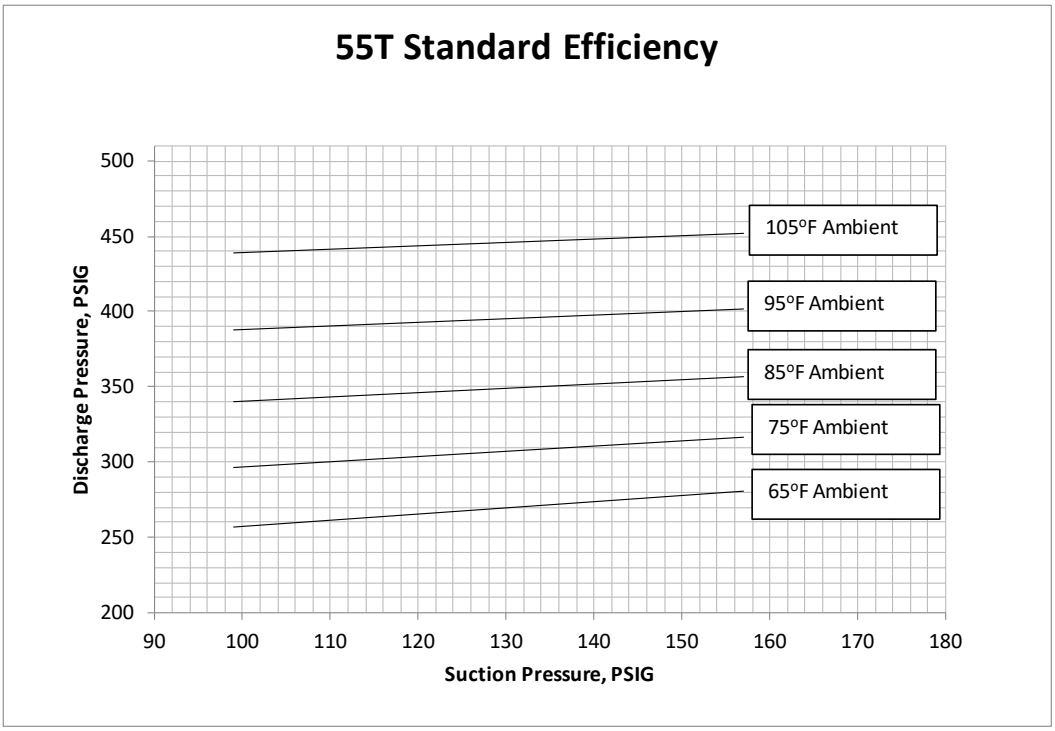
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 91. Pressure curve — 50 tons eFlex variable speed — circuit 2



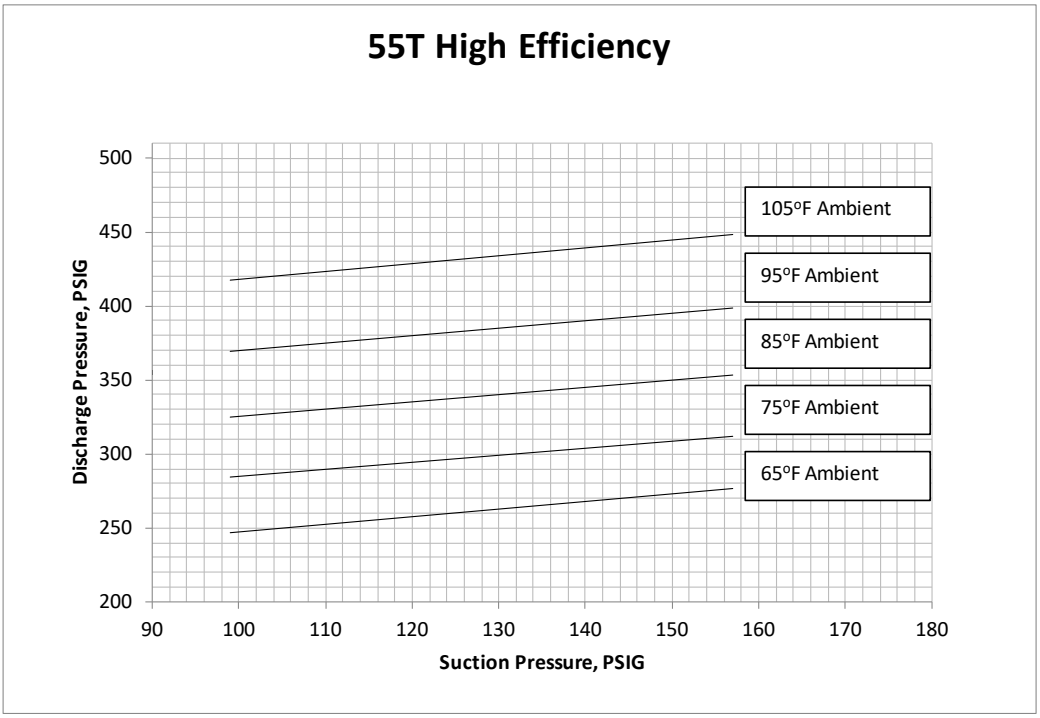
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 92. Pressure curve — 55 tons standard efficiency



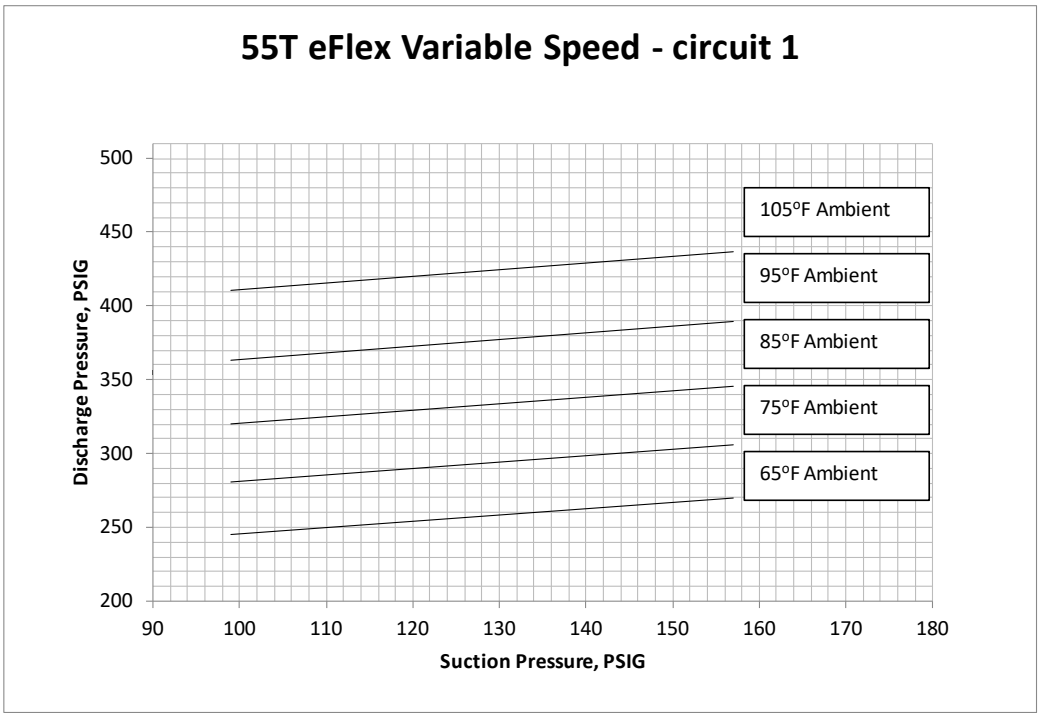
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 93. Pressure curve — 55 tons high efficiency



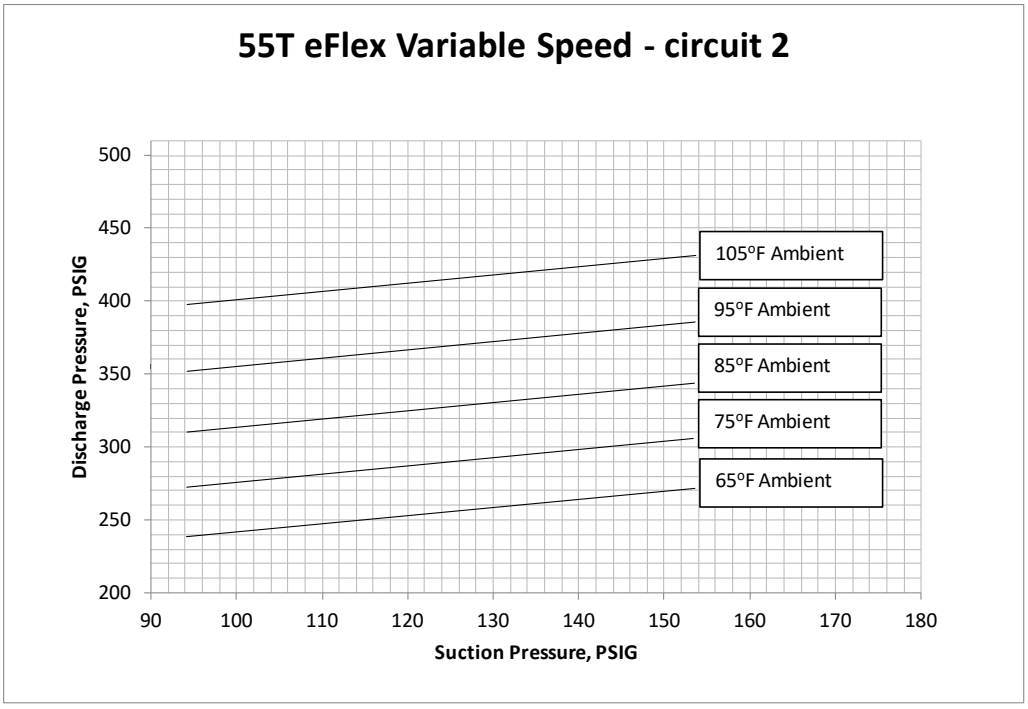
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 94. Pressure curve — 55 tons eFlex variable speed — circuit 1



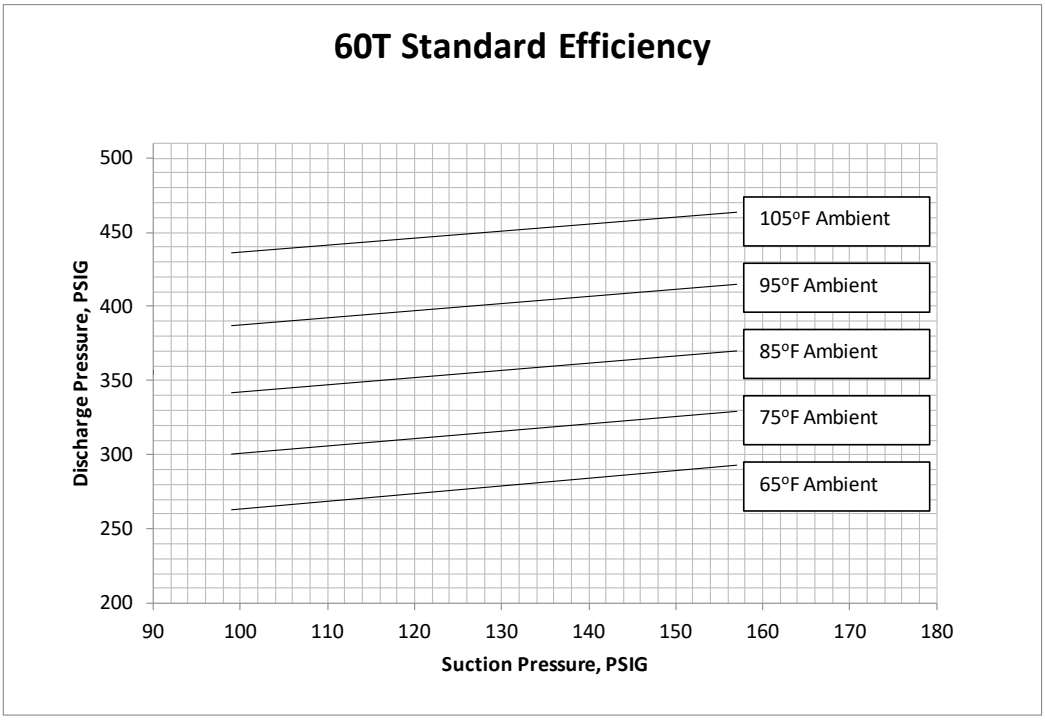
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 95. Pressure curve — 55 tons eFlex variable speed — circuit 2



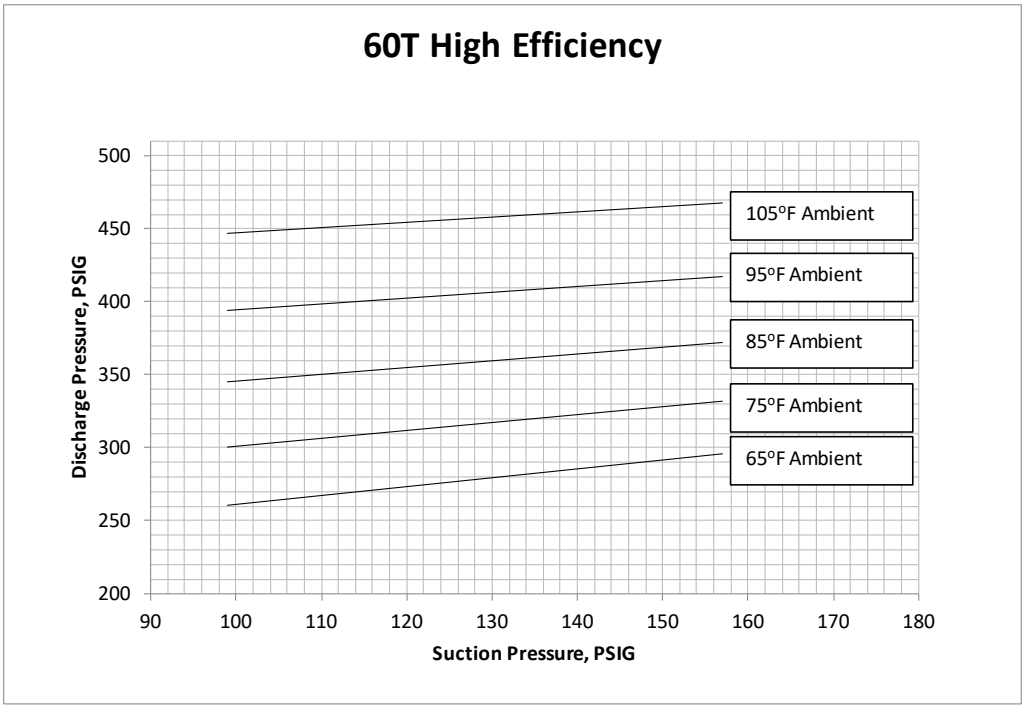
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 96. Pressure curve — 60 tons standard efficiency



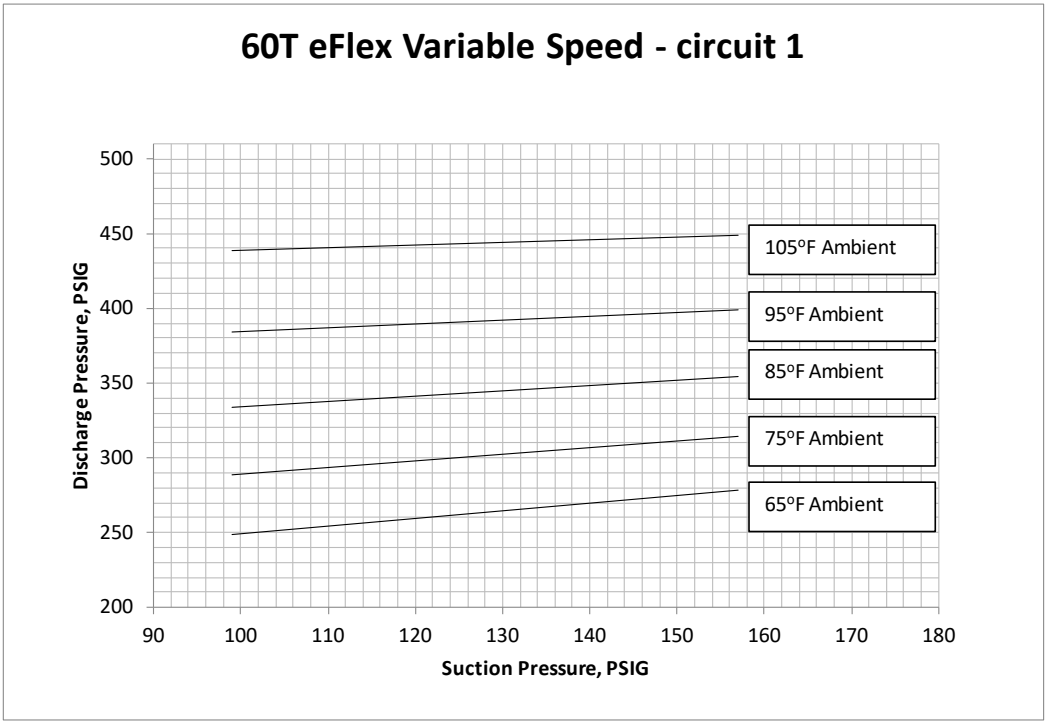
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 97. Pressure curve — 60 tons high efficiency



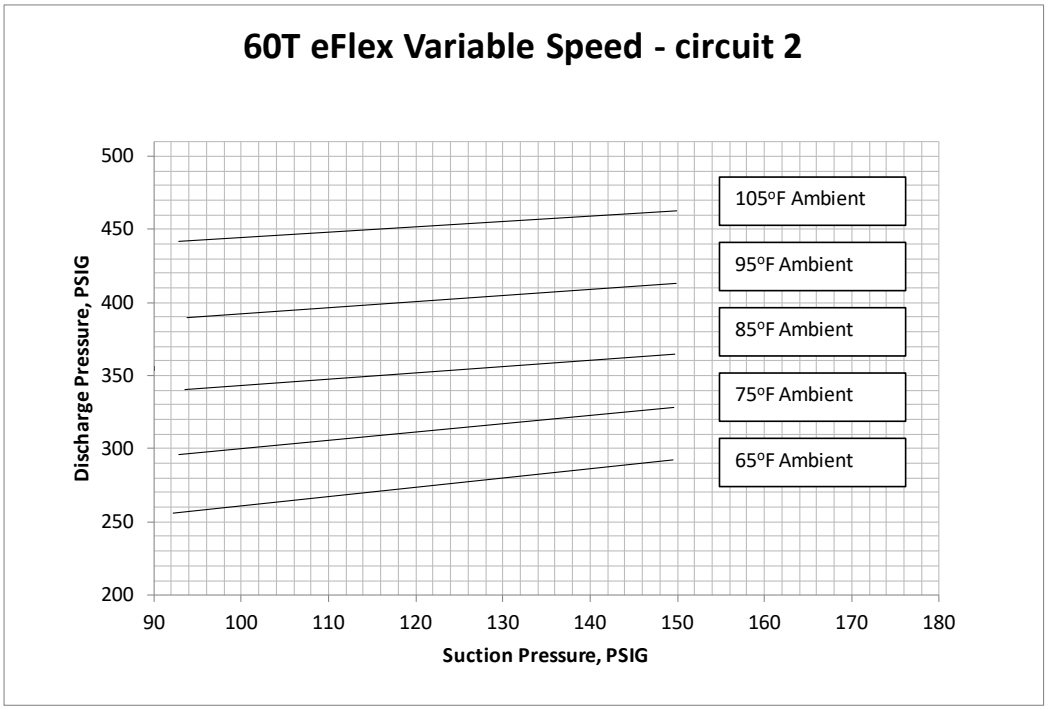
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 98. Pressure curve — 60 tons eFlex variable speed — circuit 1



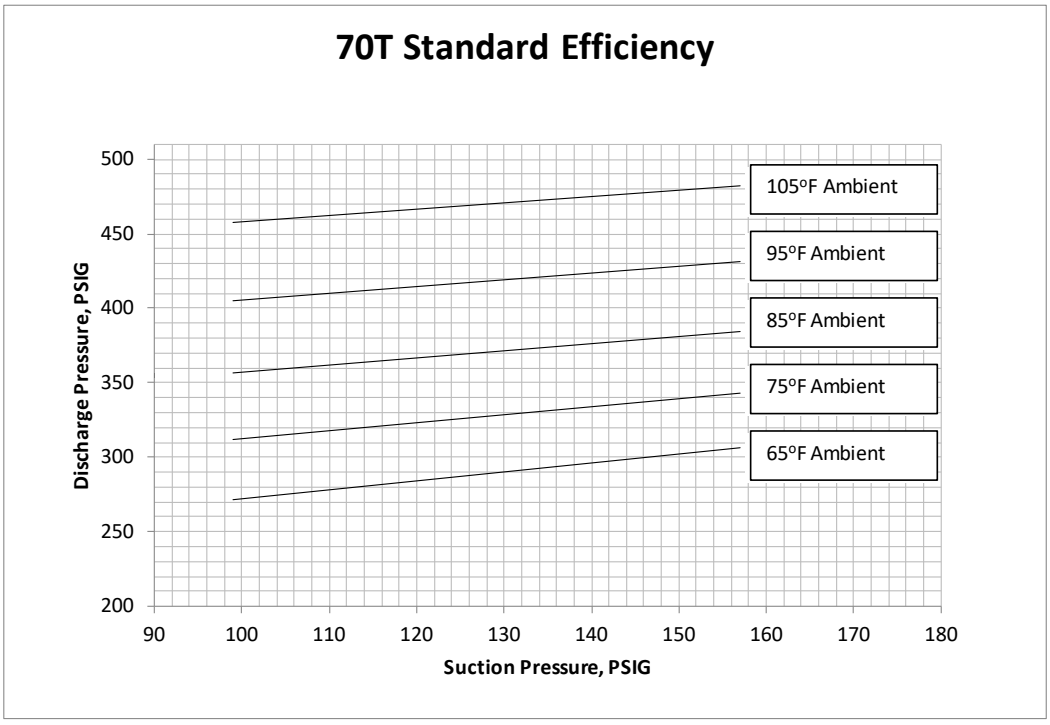
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 99. Pressure curve — 60 tons eFlex variable speed — circuit 2



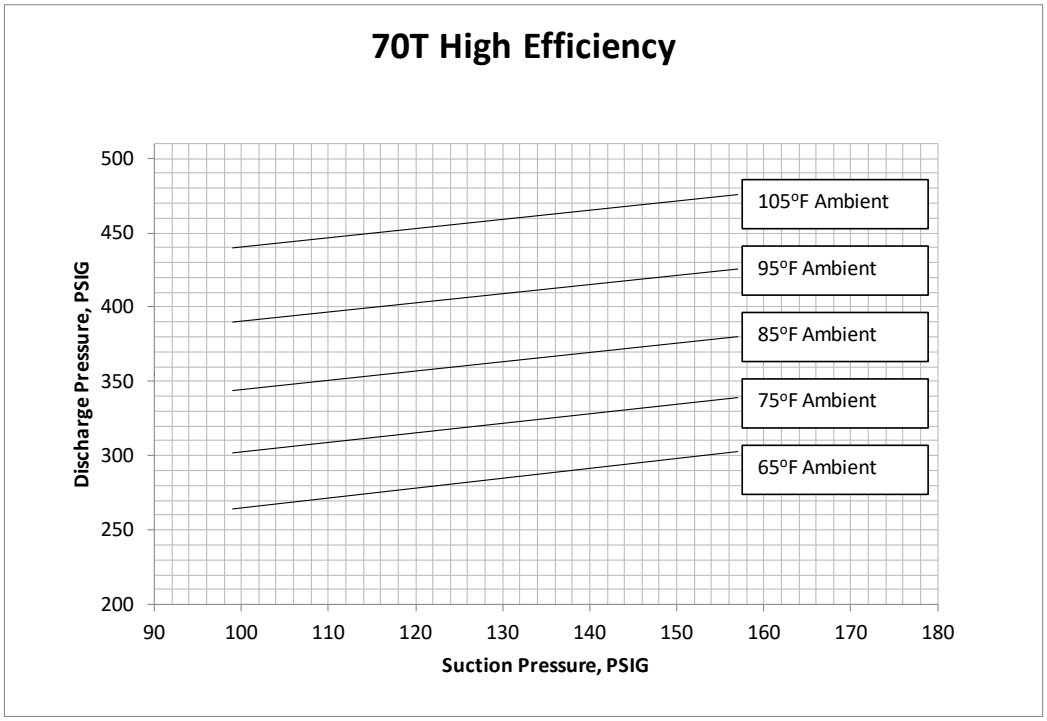
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 100. Pressure curve — 70 tons standard efficiency



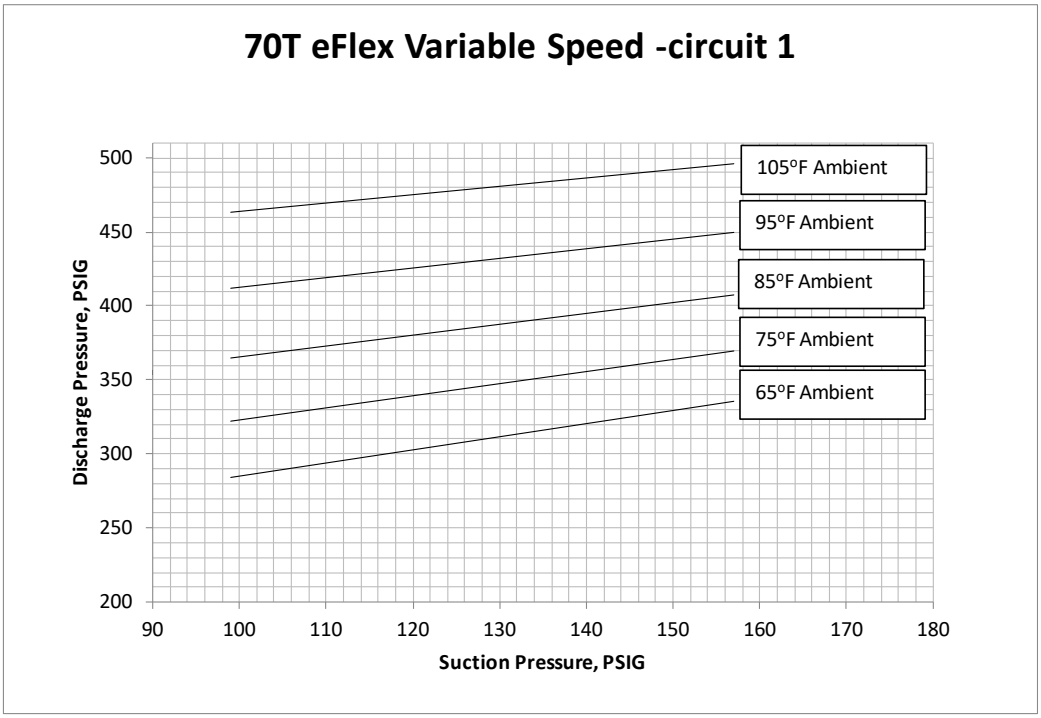
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 101. Pressure curve — 70 tons high efficiency



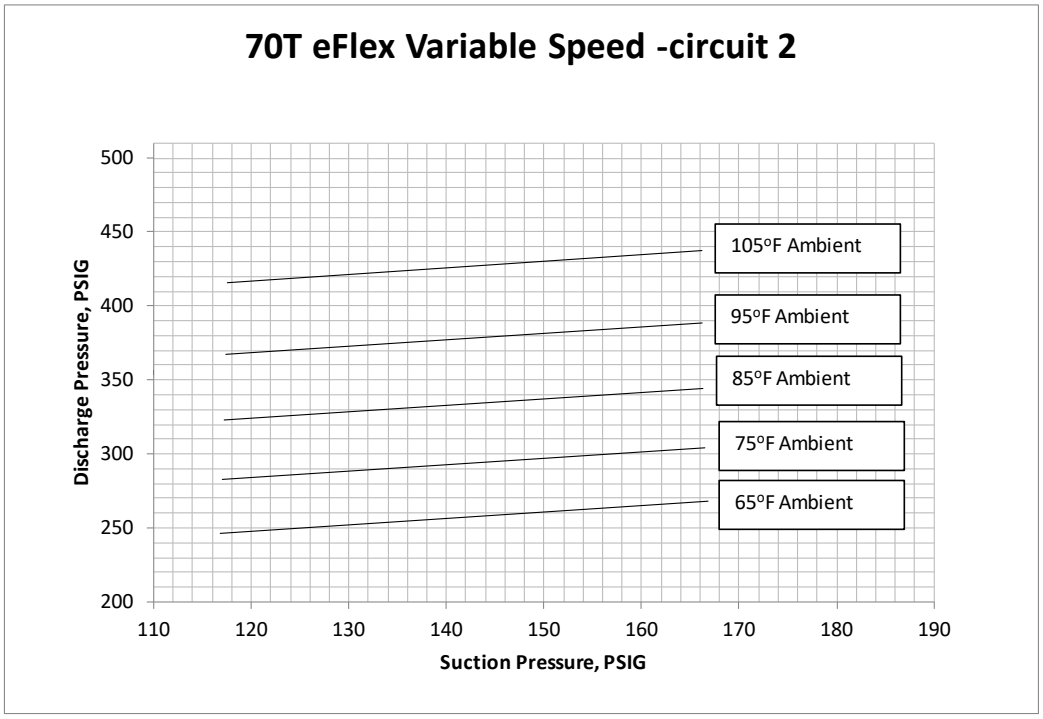
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 102. Pressure curve — 70 tons eFlex variable speed — circuit 1



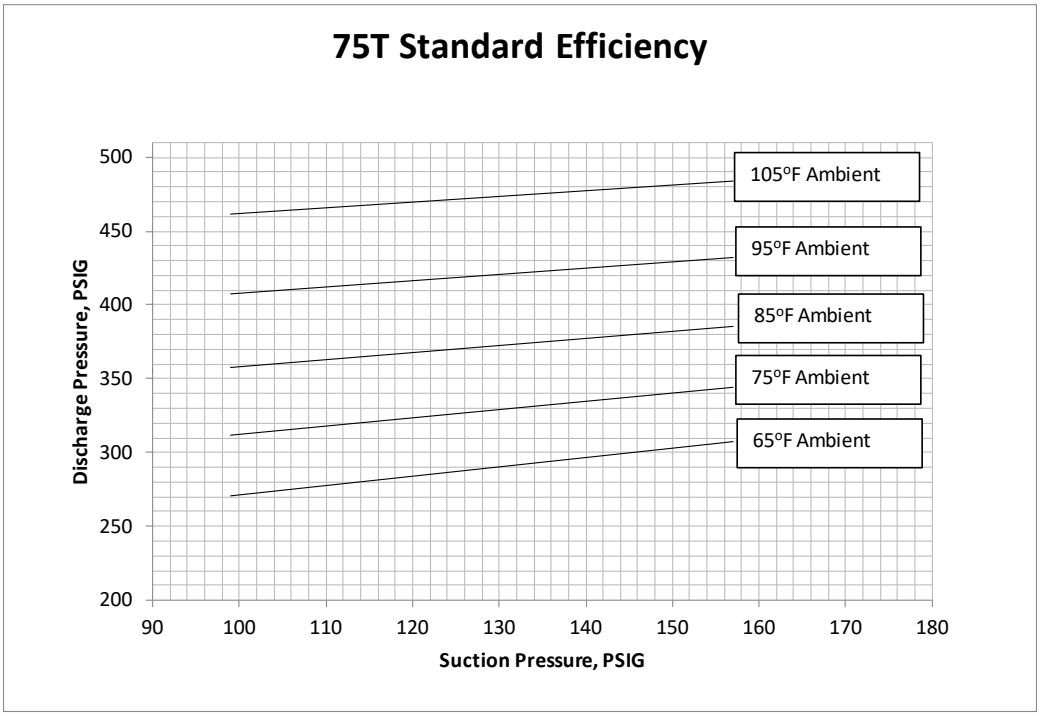
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 103. Pressure curve — 70 tons eFlex variable speed — circuit 2



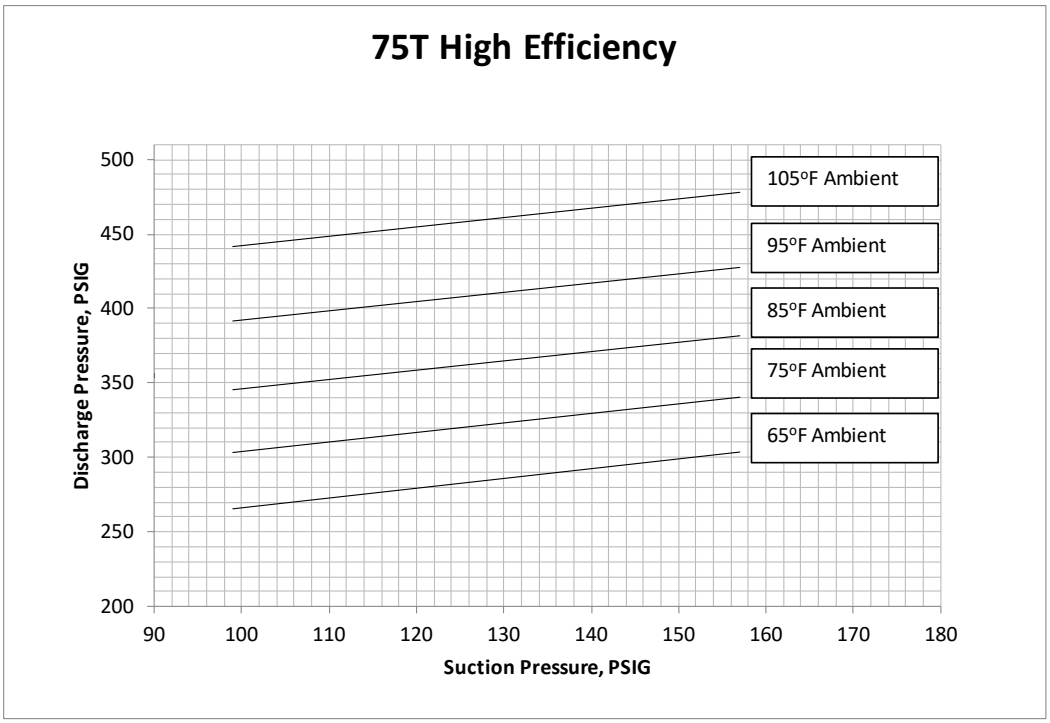
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 104. Pressure curve — 75 tons standard efficiency



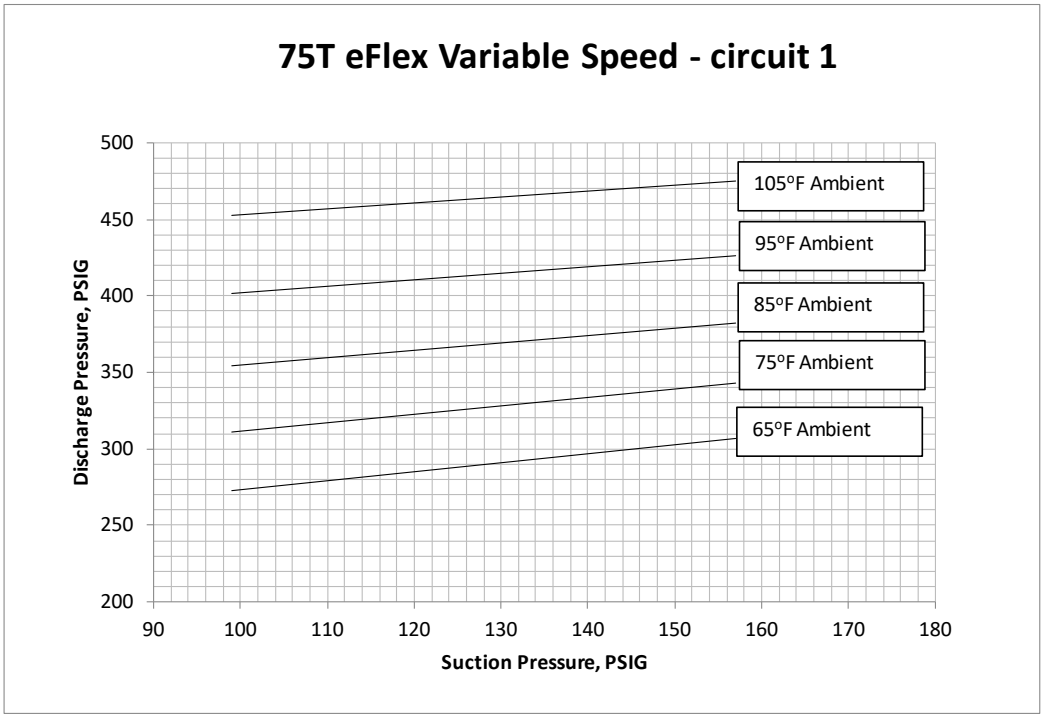
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 105. Pressure curve — 75 tons high efficiency



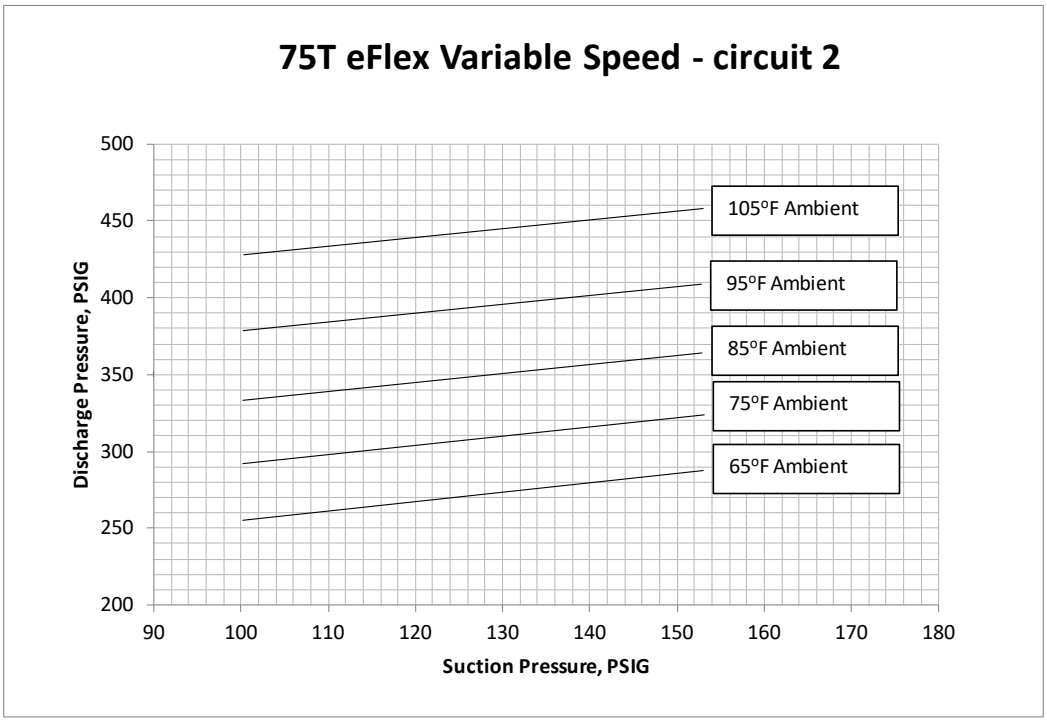
Note: *Full load acceptable subcooling range: 13-23°F*

Figure 106. Pressure curve — 75 tons eFlex variable speed — circuit 1



Note: *Full load acceptable subcooling range: 13-23°F*

Figure 107. Pressure curve — 75 tons eFlex variable speed — circuit 2



Note: *Full load acceptable subcooling range: 13-23°F*

Compressor Oil

Refer to for the appropriate scroll compressor oil charge. Remove and measure oil from any compressor replaced. Adjust oil in replacement compressor to prevent excessive oil in system. Anytime a compressor is replaced, the oil for each compressor within the manifold must be replaced.

The scroll compressor uses Trane OIL00079 (one quart container) or OIL00080 (one gallon container) without substitution. Discoloration of the oil indicates that an abnormal condition has occurred. If the oil is dark and smells burnt, it has overheated because of the following:

- Compressor operating at extremely high condensing temperatures
- High superheat
- A compressor mechanical failure
- Occurrence of a motor burnout.

If a motor burnout is suspected, use an acid test kit (KIT15496) to check the condition of the oil. Test results will indicate an acid level has exceeded the limit if a burnout occurred. Oil test kits must be used for POE oil (OIL00079 for a quart container or OIL00080 for a gallon container) to determine whether the oil is acidic. If a motor burnout has occurred, change the oil in both compressors in a tandem set.

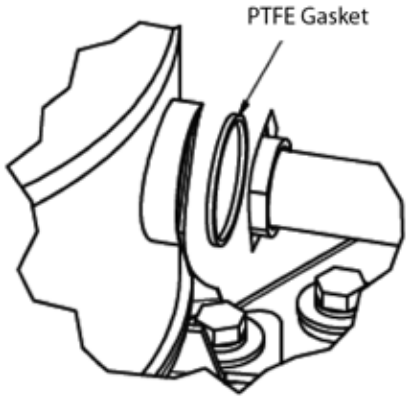
CSHE Compressors

CSHE compressors include a lower shell shraeder fitting that can be used to reduce the sump oil level below the bottom of the equalizer line Rotolock fitting. This fitting does not allow removal of all the sump oil, but just enough to prevent oil spills when the equalizer line Rotolock fitting is removed.

Prior to reinstalling the oil equalizer line to each compressor, replace the PTFE gasket on the oil equalizer Rotolock fitting on each compressor. See Figure 108, p. 154. Torque Rotolock nut to the values listed in .

Charge the new oil into the Schrader valve on the shell of the compressor. Due to the moisture absorption properties of POE oil, do not use POE oil from a previously opened container. Also discard any excess oil from the container that is not used.

Figure 108. PTFE gasket

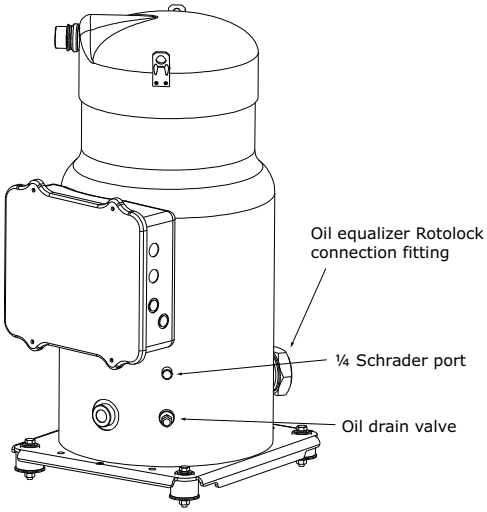


CSHP Compressors

CSHP compressors have an oil drain valve which allows the oil to be drained out of the compressor. After the refrigerant has been recovered, pressurize the system with nitrogen to help remove the oil from the compressor.

Charge the new oil into the Schrader valve or oil drain valve on the shell of the compressor. Due to the moisture absorption properties of POE oil, do not use POE oil from a previously opened container. Also discard any excess oil from the container that is not used.

Figure 109. CSHP



VZH Variable Speed Compressors

Refer to "CSHP Compressors," p. 154 for VZH117 oil removal procedures.

VZH variable speed compressors include the addition of an oil injection solenoid valve (2L11) to provide supplemental oil flow from an internal gear pump to the scrolls. The solenoid is de-energized at low compressor speeds to allow supplemental oil flow and better seal scrolls. The solenoid is energized at high compressor speeds to stop supplemental lubrication. This prevents excessive oil circulation to the system. The solenoid is controlled by the inverter and switches at 3900 RPM for the VZH088, 3300 RPM for the VZH117, and 2700 RPM for the VZH170.

The 24 VAC solenoid coil operation can be checked on one of the solenoid leads with a clamp on amp meter. Above 3300 RPM (VZH117) /2700 RPM (VZH170), the amp meter should read about 0.5 amps to indicate supplemental flow has been stopped.

Table 71. Oil charge per compressor

Compressor	Pints
CSHE071-088	6.3
CSHE097-152	7
CSHE177	7.6
CSHP178	14.2
VZH088C	8
VZH117C	8.7
VZH170C	16.3

Table 72. Torque requirements for rotolock fittings

CSHE* VZH088 and VZH117	64+/- 12 ft-lbs
CSHP* and VZH170	100+/- 10 ft-lbs

Note: *Always replace gasket when reassembling oil equalizer lines.*

Electrical Phasing

If it becomes necessary to replace a compressor, it is very important to review and follow the Electrical Phasing procedure described in the start-up procedure of the IOM.

If the compressors are allowed to run backward for even a very short period of time, internal compressor damage may occur and compressor life may be reduced. If allowed to run backwards for an extended period of time the motor windings can overheat and cause the motor winding thermostats to open. This will cause a "compressor trip" diagnostic and stop the compressor

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 compressor terminal box. If the phasing is correct, before condemning the compressor, interchange any two leads to check the internal motor phasing.

Variable Speed Manifolded with Fixed Speed Compressors

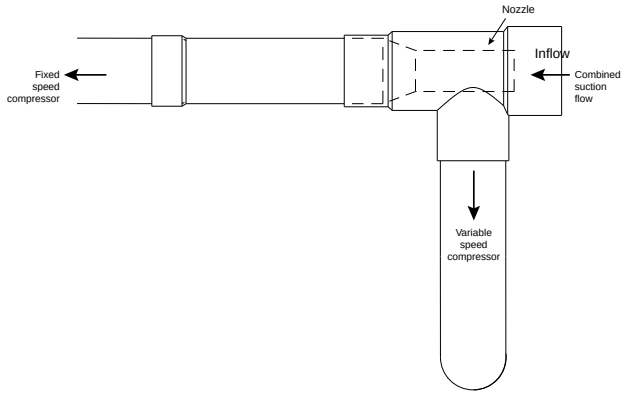
Some models use an eFlex™ variable speed compressor manifolded with a fixed speed compressor. It uses a patented manifold design that is different from fixed speed tandems as follows:

1. The variable speed compressor is always first on and located upstream in the suction line in position 1A;

2. A nozzle in the suction tee, directly upstream of the manifold set, separates suction oil return to the upstream variable speed compressor. It also provides a sump pressure difference to move excess oil from the variable speed to the fixed speed compressor when both compressors are running. The nozzle is specifically sized for this variable speed manifold compressor combination and must not be removed.

   Suction restrictors are not used, and a smaller 3/8" OD oil equalizer line is used to help maintain the sump pressure differential.

Figure 110. eFlex variable speed tandem

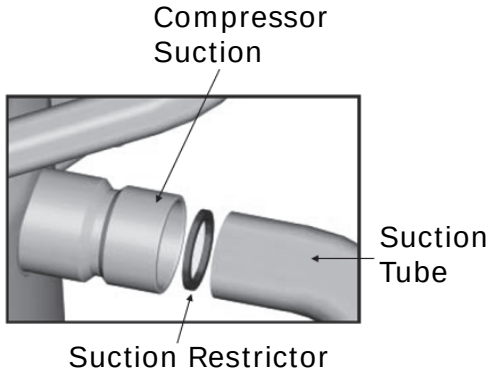


Precision Suction Restrictor

Tandem manifold compressors that have unequal capacity sizes use a precision suction restrictor to balance the oil levels in the compressors (see figure below). This restrictor is placed in the smaller capacity compressor. When replacing this compressor, it is imperative that the proper restrictor is selected from those provided with the replacement compressor.

When the compressors are restarted, verify that correct oil levels are obtained with both compressors operating.

Figure 111. Precision suction restrictor



VFD Programming Parameters (Supply/ Condenser for Low Ambient Option)

Units shipped with variable frequency drives (VFD) are preset and run tested at the factory. If a problem with a VFD occurs, ensure that the programmed parameters listed in Table 73, p. 156 and Table 74, p. 158 for supply fan VFDs and for condenser fan VFDs (if low ambient option is installed), have been set before replacing the drive.

Verify Parameters

Verify parameter 1-23 is set to motor nameplate frequency.

1. To check parameter 1-23 press the Main Menu button twice (press the Back button if the main menu does not display)
2. Scroll down to Load & Motor, press OK
3. Select 1-2, press OK
4. Press down until parameter 1-23 is displayed. Parameter 1-23 can then be modified by pressing OK and pressing the Up and Down buttons.
5. When the desired selection has been made, press OK .

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.

Important: *HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK OR OPTIONAL UNIT DISCONNECT SWITCH.*

2. To modify parameters:
   a. Press Main Menu twice (press Back if the main menu does not display)
   b. Use the Up and Down buttons to find the parameter menu group (first part of parameter number)
   c. Press OK
   d. Use the Up and Down buttons to select the correct parameter sub-group (first digit of second part of parameter number)
   e. Press OK
   f. Use the Up and Down buttons to select the specific parameter
   g. Press OK
   h. To move to a different digit within a parameter setting, use the Left and Right buttons (Highlighted area indicates digit selected for change)
   i. Use the Up and Down buttons to adjust the digit
   j. Press Cancel to disregard change, or press OK to accept change and enter the new setting
3. Repeat Table 73, p. 156 and Table 74, p. 158 for supply fan VFDs and for condenser fan VFDs (if low ambient option is installed).
4. 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 9 resets the drive to the default factory settings. The program parameters listed in Table 73, p. 156 and Table 74, p. 158 for supply fan VFDs and for condenser fan VFDs (if low ambient option is installed), will need to be verified or changed as described in Item8.*
- *Some of the parameters listed in the table are motor and application specific. Due to various motors and efficiencies available, use only the values stamped on the specific motor nameplate.*
- *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.*

5. Follow the start-up procedures for supply fan .
6. After verifying that the VFD(s) are operating properly, press the STOP key to stop the unit operation.
7. Follow the applicable steps in the “Final Unit Checkout” section to return the unit to its normal operating mode.

If a problem with a VFD occurs, ensure that the programmed parameters listed for supply and condenser fan VFDs have been set before replacing the driveTable 73, p. 156 and Table 74, p. 158 for supply fan VFDs and for condenser fan VFDs (if low ambient option is installed).

Table 73. Supply fan VFD programming parameters

ID	Description	Parameter Setting
0-01	Language	[0] English US
0-03	Regional Settings	[1] North American
0-06	Grid Type	Set to applicable unit power supply [102] 200-240V/60Hz for 200 & 230V/60Hz units [122] 440-480V/60Hz for 460V/60Hz units [132] 525-600V/60Hz for 575V/60Hz units [12] 380-440V/50Hz for 380 & 415V/50Hz supply For IT Grid (no ground connections) or Corner grounded Delta power supply systems, the applicable voltage/Hz and IT-Grid or Delta should be selected.
0-40	[Hand on] Key on LCP	[0] Disabled
1-20	Motor Power	Per Motor Nameplate HP
1-22	Motor Voltage (V)	Per Motor Nameplate Voltage
1-23	Motor Frequency (Hz)	Per Motor Nameplate Frequency
1-24	Motor Current (A)	Per Motor Nameplate FLA
1-25	Nominal Speed (RPM)	Per Motor Nameplate Rated Speed
1-73	Flying Start	[1] Enabled
1-90	Motor Thermal Protection	[4] ETR Trip1
2-00	DC Hold/Preheat Current (%)	[0] 0%

Table 73. Supply fan VFD programming parameters (continued)

ID	Description	Parameter Setting
2-01	DC Brake Current (%)	[0] 0%
2-04	DC Brake Cut In Speed (Hz)	[10] 10Hz
3-02	Minimum Reference (Hz)	Per Unit Nameplate - Evap Fan VFD Min Hz
3-03	Maximum Reference (Hz)	Per Unit Nameplate - Evap Fan VFD Max Hz
3-15	Reference 1 Source	[1] Local bus reference
3-16	Reference 2 Source	[0] No function
3-17	Reference 3 Source	[0] No function
3-41	Ramp 1 Ramp Up Time (s)	[30] 30s
3-42	Ramp 1 Ramp Down Time (s)	[30] 30s
4-12	Motor Speed Low Limit (Hz)	[20] 20Hz for 4 Pole [18] 18Hz for 6 Pole
4-14	Motor Speed High Limit (Hz)	See Table 18 for value
4-18	Current Limit (%)	[100] 100%
4-19	Max Output Frequency (Hz)	[120] 120Hz
5-10	Terminal 18 Digital Input	[0] No Operation
5-12	Terminal 27 Digital Input	[0] No Operation
5-13	Terminal 29 Digital Input	[0] No Operation
8-30	Protocol	[2] Modbus RTU
8-31	Address	Set address per unit component location diagram [7] for 4TB1 [8] for 4TB2
8-32	Baud Rate	[7] 115200 Baud
8-33	Parity / Stop Bits	[0] Even Parity, 1 Stop Bits
8-01	Control Site	[2] Controlword only
8-03	Control Timeout Time (s)	[15] 15s
8-04	Control Timeout Function	[2] Stop
14-01	Switching Frequency (kHz)	[8] 8.0 KHz
14-11	Mains Voltage Fault level	Set based on motor nameplate voltage [177] for 200V motor [196] for 230V motor [391] for 460V motor [489] for 575V motor
14-12	Function at Main Imbalance	[3] Derate
14-20	Reset Mode	[5] Automatic reset x 5
14-50	RFI Filter	[0] Off
14-61	Function at Inverter Overload	[1] Derate

Table 74. Value for Parameter 4-14 (Motor Speed High Limit (Hz)

Digit# 3,4,5 Unit Tonnage	Digit# 15 Fan Size	Digit# 16 = 1 (4 Pole)	Digit# 16 =2 (6 Pole)
F20,F25,F30	A,B	[119]	[120]
	E,F	[92]	[120]
	G	[82]	[120]
F40,F50,F55	C	[100]	[120]
	F	[92]	[120]
	J,K	[75]	[114]
F60,F70,F75	H	[82]	[120]
	M	[68]	[103]

Table 75. Condenser fan VFD programming parameters

ID	Descrtiption	Parameter Setting				
0-01	language	[0] English US				
0-03	Regional Settings	[1] North American				
0-06	Grid Type	Set to applicable unit power supply [102] 200-240V/60Hz for 200 & 230V/60Hz units [122] 440-480V/60Hz for 460V/60Hz units [132] 525-600V/60Hz for 575V/60Hz units [12] 380-440V/50Hz for 380 & 415V/50Hz supply For IT Grid (no ground connections) or Corner grounded Delta power supply systems, the applicable voltage/Hz and IT-Grid or Delta should be selected.				
0-40	[Hand on] Key on LCP	[0] Disabled				
1-20	Motor Power (kW/HP)	Per Motor Nameplate KW- HP [7] 0.75kW - 1.0HP [8] 1.1kW - 1.5HP				
1-22	Motor Voltage (V)		[200] 200V	[230] 230V	[460] 460V	[575] 575V
1-23	Motor Frequency (Hz)	[60] 60 Hz				
1-24	Motor Current (A)	1-20=[7]	[4.1] 4.1A	[4.1] 4.1A	[1.8] 1.8A	[1.4] 1.4A
		1-20=[8]	[5.4] 5.4A	[5.4] 5.4A	[2.7] 2.7A	[2.05] 2.05A
1-25	Motor Nominal Speed (RPM)	[1140] 1140RPM				
1-73	Flying Start	[1] Enabled				
1-82	Min Speed for function at Stop (Hz)	0.1				
1-90	Motor Thermal Protection	[4] ETR Trip1				
2-00	DC Hold/Preheat Current (%)	[0] 0%				
2-02	DC Braking time (s)	[0] 0s				
2-10	Brake Function	[2] AC Brake is Active				
3-03	Maximum Reference (Hz)	[60] 60Hz				
3-15	Reference 1 Source	[1] Local bus reference				
3-16	Reference 2 Source	[0] No function				
3-17	Reference 3 Source	[0] No function				
3-41	Ramp 1 Ramp Up Time (s)	[10] 10s				
3-42	Ramp 1 Ramp Down Time (s)	[10] 10s				

Table 75. Condenser fan VFD programming parameters (continued)

ID	Descrtiption	Parameter Setting
4-10	Motor Speed Direction	[0] Clockwise
4-12	Motor Speed Low Limit (Hz)	[6] 6Hz
4-14	Motor Speed High Limit (Hz)	[60] 60Hz
4-18	Current Limit (%)	[140] 140% for 1HP Motor [100] 100% for 1.5HP Motor
5-10	Terminal 18 Digital Input	[0] No Operation
5-12	Terminal 27 Digital Input	[0] No Operation
5-13	Terminal 29 Digital Input	[0] No Operation
8-30	Protocol	[2] Modbus RTU
8-31	Address	Set address per unit component location diagram [5] for 1TB4 [6] for 1TB5
8-32	Baud Rate	[7] 115200 Baud
8-33	Parity / Stop Bits	[0] Even Parity, 1 Stop Bits
8-01	Control Site	[2] Controlword only
8-03	Control Timeout Time (s)	[15] 15s
8-04	Control Timeout Function	[2] Stop
14-01	Switching Frequency (kHz)	[5] 5.0 kHz
14-11	Mains Voltage Fault level (V)	Set based on motor nameplate voltage [177] for 200V motor [196] for 230V motor [391] for 460V motor [489] for 575V motor
14-12	Function at Main Imbalance	[3] Derate
14-20	Reset Mode	[3] Automatic reset x 3
14-21	Automatic Restart Time	[5] 5
14-50	RFI Filter	[0] Off
14-61	Function at Inverter Overload	[1] Derate

eFlex™ Compressor VFD Programming Parameters

⚠ WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

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 a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

A factory-shipped TRV200 should not be modified in the field. It is specifically matched to the compressor.

Should replacing a VFD become necessary, refer to Table 76, p. 160. All other parameters will be appropriately set in field replacement VFDs. Do not use any other type or brand of VFD when replacing the VFD.

Note: *Failure to set parameter 4-18 Current Limit on a field replacement VFD will not allow the compressor to start and result in A18 Start Failed or A49 Speed Limit on the VFD.*

To verify and/or set parameters in the Compressor VFD:

1. Press **Quick Menu**.
2. Press **My Personal Menu**.
3. Navigate through the options using the **Up** and **Down** arrows to parameter.
4. Adjust the value as shown in Table 76, p. 160.
5. Press [OK].

Note: *Parameter '4-18 Current Limit' for field installed TRV200 drives must be set according to the table for proper operation and to meet overload protection requirements. Replacement drive will not run the compressor until set properly. Factory installed drives are programmed properly for unit operation. Parameter 4-18 is available via the quick menu.*

Table 76. TRV200 Drive Current Limit (Parameter 4-18)

Unit Tonnage	200V	230V	460V	575V
20–25	80%	70%	75%	80%
30–40	90%	78%	84%	83%
50–55	105%	93%	86%	88%
60–70	107%	93%	95%	94%
75	105%	93%	86%	88%

Microchannel Condenser Coil Repair and Replacement

If microchannel condenser coil repair or replacement is required, see *Unitary Light and Large Commercial Units General Service Bulletin* (RT-SVB83*-EN) for further details.

Fall Restraint

⚠ WARNING

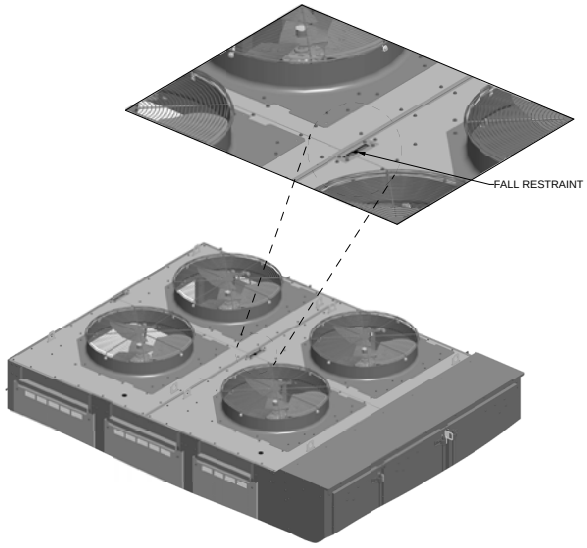
Falling Off Equipment!

Failure to follow instructions below could result in death or serious injury.

This unit is built with fall restraint slots located on unit top that MUST be used during servicing. These slots are to be used with fall restraint equipment that will not allow an individual to reach the unit edge. However such equipment will NOT prevent falling to the ground, as they are NOT designed to withstand the force of a falling individual.

The fall restraint is located approximately 3 feet from the unit edge.

Figure 112. Fall restraint



Symbio 800 Replacement

See Programming Guide (RT-SVP011*-EN) Symbio UI section for instructions to replace and upgrade the Symbio 800 controller.

Final Process

Record the unit data in the blanks provided.

Table 77. Sample maintenance log

Date	Current Ambient Temp F/C	Refrigerant Circuit #1						Refrigerant Circuit #2					
		Compr. Oil Level	Suct. Press. Psig/kPa	Disch. Press Psig/kPa	Liquid Press Psig/kPa	Super-heat F/C	Sub-cool F/C	Compr. Oil Level	Suct. Press. Psig/kPa	Disch. Press Psig/kPa	Liquid Press Psig/kPa	Super-heat F/C	Sub-cool F/C
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					
		- ok - low						- ok - low					

Wiring Diagrams

Table 78. Wiring diagram matrix

Number	Description
Power	
1213-4995	POWER SCHEMATIC, 20T-75T - AIRFLOW AND CONTROLS
1213-4996	POWER SCHEMATIC, 20T-75T - AIRFLOW AND CONTROLS W/ VFD BYPASS
1213-4997	POWER SCHEMATIC, 40T-75T - REFRIGERATION
1213-4998	POWER SCHEMATIC, 40T-75T - REFRIGERATION WITH COMPRESSOR VFD
1213-4999	POWER SCHEMATIC, 40T-75T - REFRIGERATION WITH COND FAN VFD
1213-5000	POWER SCHEMATIC, 40T-75T - REFRIGERATION WITH COMPRESSOR AND COND FAN VFD
1213-5001	POWER SCHEMATIC, 20T-30T - REFRIGERATION
1213-5002	POWER SCHEMATIC, 20T-30T - REFRIGERATION WITH COMPRESSOR VFD
1213-5003	POWER SCHEMATIC, 20T-30T - REFRIGERATION WITH COND FAN VFD
1213-5004	POWER SCHEMATIC, 20T-30T - REFRIGERATION WITH COMPRESSOR AND COND FAN VFD
Controls	
1213-4631	CONTROLS SCHEMATIC, 20T-75T - FIELD WIRING AND CONDENSER CONTROLS
1213-5053	CONTROLS SCHEMATIC, 20T-75T - FIELD WIRING AND CONDENSER CONTROLS, EXTERNAL CAPACITY CONTROLS
1213-2582	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS
1213-5007	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS WITH VARIABLE SPEED COMPRESS
1213-2584	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS WITH VARIABLE SPEED COND FAN
1213-2585	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS WITH VSC AND VCF
1213-5005	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS
1213-5006	CONTROLS SCHEMATIC, 20T-75T - REFRIGERATION SYSTEMS WITH VARIABLE SPEED COND FAN
1213-4630	CONTROLS SCHEMATIC, 20T-75T - RETURN SECTION #1
1213-5008	CONTROLS SCHEMATIC, 20T-75T - RETURN SECTION 2 OF 2
Gas Heat	
1213-2827	SCHEMATIC/LAYOUT - STAGED GAS HEAT - 250 & 350 MBH
1213-2828	SCHEMATIC/LAYOUT - STAGED GAS HEAT - 500 MBH
1213-2829	SCHEMATIC/LAYOUT - STAGED GAS HEAT - 850 & 1200 MBH
1213-2830	SCHEMATIC/LAYOUT - MODULATING GAS HEAT - 250, 350 MBH STD
1213-2831	SCHEMATIC/LAYOUT - MODULATING GAS HEAT - 250 & 350 MBH ULTRA/500 MBH STD
1213-2832	SCHEMATIC/LAYOUT - MODULATING GAS HEAT - 500 MBH ULTRA
1213-2833	SCHEMATIC/LAYOUT - MODULATING GAS HEAT - 850 & 1200 MBH STD/ULTRA
Electric Heat	
1213-2835	SCHEMATIC - ELECTRIC HEAT - 30KW - 480V/600V
1213-2836	SCHEMATIC - ELECTRIC HEAT - 30KW - 208V/240V
1213-2837	SCHEMATIC - ELECTRIC HEAT - 60KW - 480V/600V
1213-2838	SCHEMATIC - ELECTRIC HEAT - 60KW - 208V/240V, 120KW & 150KW - 480V/600V
1213-2839	SCHEMATIC - ELECTRIC HEAT - 90KW - 480V/600V
1213-2840	SCHEMATIC - ELECTRIC HEAT - 90KW - 208V/240V, 190KW - 480V/600V
1213-2841	SCHEMATIC - ELECTRIC HEAT - 120KW - 208V/240V
1213-2842	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 30KW - 480V
1213-2843	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 30KW - 208V/240V

Table 78. Wiring diagram matrix (continued)

Number	Description
1213-2844	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 60KW - 480V
1213-2845	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 60KW - 208V/240V, 120KW & 150KW - 480V
1213-2846	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 90KW - 480V
1213-2847	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 90KW - 208V/240V, 190KW - 480V
1213-2848	SCHEMATIC - ELECTRIC HEAT WITH SCR MODULATING - 1200KW - 208V/240V
1213-2849	CONTROLS SCHEMATIC, MODULATING ELECTRIC HEAT - 30KW -190KW - 208V/240V & 480V
Component Layout - Control Panels	
1213-3320	COMPONENT LAYOUT - UNIT CONTROLS PANEL
1213-5009	COMPONENT LAYOUT - MAIN CONTROL PANEL
1213-5010	COMPONENT LAYOUT - SUPPLY VFD PANEL
1213-2646	COMPONENT LAYOUT - RETURN CONTROLS PANEL
Unit Device Locations	
1213-5011	COMPONENT LAYOUT - UNIT SENSOR LOCATIONS
Component Layout - Electric Heat	
1213-2852	COMPONENT LAYOUT - ELECTRIC HEAT - 30 KW - ALL VOLTAGE, 60 KW & 90 KW - 460V/575V
1213-2855	COMPONENT LAYOUT - ELECTRIC HEAT - 60KW & 90KW - 200V/230V, 120KW - ALL VOLTAGES, 150KW & 190KW - 460V/575V
12133418	COMPONENT LAYOUT - ELECTRIC HEAT WITH SCR MODULATING - 30KW -190KW - 200V/230V & 460V
Expansion Module	
1213-3321	SCHEMATIC - EXPANSION MODULE

Warranty and Liability Clause

COMMERCIAL EQUIPMENT - 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 start-up 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.

The warranty and liability set forth herein are in lieu of all other warranties and liabilities, whether in contract or in negligence, express or implied, in law or in fact, including implied warranties of merchantability and fitness for particular use. In no event shall the Company be liable for any incidental or consequential damages.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Manager - Product Service

Trane

Clarksville, Tn 37040-1008

PW-215-2688

*A 10 year limited warranty is provided on all stainless steel Gas Heat Exchangers.

*Optional Extended Warranties are available for compressors and heat exchangers of Combination Gas-Electric Air Conditioning Units.

*A 5 year limited warranty is provided on optional 0-100% Economizer

Notes

Trane - by Trane Technologies (NYSE: TT), a global innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

Trane has a policy of continuous product and product data improvements and reserves the right to change design and specifications without notice. We are committed to using environmentally conscious print practices.

RT-SVX080D-EN 24 Oct 2026
Supersedes RT-SVX080C-EN (January 2026)

©2026 Trane