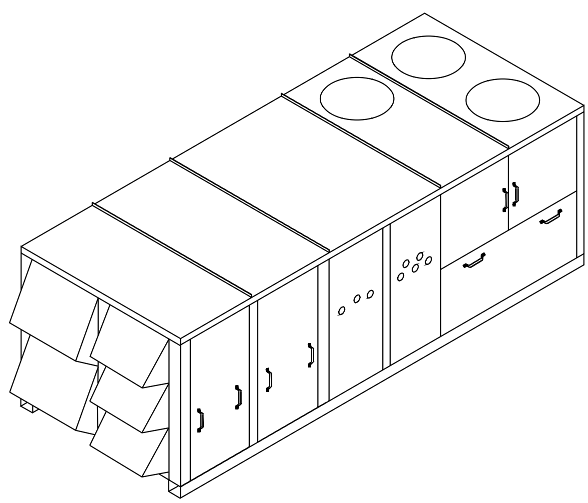
Installation, Operation, and Maintenance

Packaged Rooftop Air Conditioners Voyager™ Commercial with ReliaTel™ Controls

Including eStage™
27½ to 50 Tons - 60 Hz
22.9 to 41.7 Tons (81-148 kW) - 50 Hz

"B" and later design sequence

TC*, TE*, YC*330B, 360B, 420B, 480B, 600B (60 Hz/3 phase)
TC*, TE*, YC*275B, 305B, 350B, 400B, 500B (50 Hz/3 phase)



⚠ 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.

February 2019 RT-SVX34N-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-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

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 Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS/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.**

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⚠ WARNING

Follow EHS Policies!

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

- **All Ingersoll Rand personnel must follow Ingersoll Rand Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. All policies can be found on the BOS site. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Ingersoll Rand personnel should always follow local regulations.**

Overview of Manual

One copy of the appropriate service literature ships inside the control panel of each unit. The procedures discussed in this manual should only be performed by qualified, experienced HVAC technicians.

Note: *Do not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state, and local laws.*

This booklet describes the proper installation, startup, operation, and maintenance procedures for TC_, TE_, and YC_22.9 to 50 Ton CV (Constant Volume), VAV (Variable Air Volume), and SZ VAV (Single Zone Variable Air Volume) applications.

By carefully reviewing the information within this manual and following the instructions, the risk of improper operation and/or component damage will be minimized.

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

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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

Phone: 855-803-3563

Email: traneuniversity@trane.com

Revision History

- Added eStage™ to front cover.
- Updated the electrical service sizing data tables.
- Updated the fan sequencing table.

Table of Contents

TRANE

Model Number Description

60 Hz Description

Digit 1, 2 — Unit Function

TC = DX Cooling, No Heat
TE = DX Cooling, Electric Heat
YC = DX Cooling, Natural Gas Heat

Digit 3 — Unit Airflow Design

D = Downflow Supply and Upflow Return
H = Horizontal Supply and Horizontal Return
F = Horizontal Supply and Upflow Return
R = Downflow Supply and Horizontal Return

Digit 4, 5, 6 — Nominal Cooling Capacity

330 = 27½ Tons
360 = 30 Tons
420 = 35 Tons
480 = 40 Tons
600 = 50 Tons

Digit 7 — Major Development Sequence

B = R-410A Refrigerant

Digit 8 — Power Supply[1]

E = 208/60/3
F = 230/60/3
4 = 460/60/3
5 = 575/60/3

Digit 9 — Heating Capacity[2]

0 = No Heat (TC Only)
L = Low Heat (YC Only)
H = High Heat (YC Only)
J = Low Heat-Stainless Steel Gas Heat Exchanger (YC Only)
K = High Heat-Stainless Steel Gas Heat Exchangers (YC Only)
M = Low Heat-Stainless Steel Gas Heat Exchanger w/ Modulating Control (27.5-35 Tons YC only)
P = High Heat-Stainless Steel Gas Heat Exchangers w/ Modulating Control (27.5-35 Tons YC Only)
R = Low Heat-Stainless Steel Gas Heat Exchanger w/ Modulating Control (40-50 Tons YC Only)
T = High Heat-Stainless Steel Gas Heat Exchangers w/ Modulating Control (40-50 Tons YC Only)

Note: *When second digit is "E" for Electric Heat, the following values apply in the ninth digit.*

A = 36 kW (27 kW for 208v)
B = 54 kW (41 kW for 208v)
C = 72 kW
D = 90 kW
E = 108 kW

Digit 10 — Design Sequence

A = First

Digit 11 — Exhaust[4]

0 = None
1 = Barometric Relief (Available w/ Economizer only)
2 = 100% Power Exhaust Fan (Available w/ Economizer Only)
3 = 50% Power Exhaust Fan (Available w/ Economizer Only)
4 = 100% Fresh Air Tracking Power Exhaust Fan (Available w/ Economizer Only)
5 = 50% Fresh Air Tracking Power Exhaust Fan (Available w/ Economizer Only)
6 = 100% Power Exhaust w/ Statitrac™
7 = 100% Power Exhaust Fan w/ Ultra Low Leak Exhaust Damper (Available w/ Economizer Only)
8 = 50% Power Exhaust Fan w/ Ultra Low Leak Exhaust Damper (Available w/ Economizer Only)
9 = 100% Power Exhaust w/ Ultra Low Leak Exhaust Damper w/ Statitrac™

Digit 12 — Filter

A = 2" MERV 4, Std Eff, Throwaway Filters
B = 2" MERV 8, High Eff, Throwaway Filters
C = 4" MERV 8, High Eff, Throwaway Filters
D = 4" MERV 14, High Eff, Throwaway Filters

Digit 13 — Supply Fan Motor, HP

1 = 7.5 HP
2 = 10 HP
3 = 15 HP
4 = 20 HP

Digit 14 — Supply Air Fan Drive Selections

A = 550 RPM
B = 600 RPM
C = 650 RPM
D = 700 RPM
E = 750 RPM
F = 790 RPM
G = 800 RPM
H = 500 RPM
J = 525 RPM
K = 575 RPM
L = 625 RPM
M = 675 RPM
N = 725 RPM

Digit 15 — Outside Air Selection

A = No Outside Air
B = 0-25% Manual Damper
C = 0-100% Economizer, Dry Bulb Control
D = 0-100% Economizer, Reference Enthalpy Control
E = 0-100% Economizer, Differential Enthalpy Control
F = "C" Option and Low Leak Fresh Air Damper
G = "D" Option and Low Leak Fresh Air Damper
H = "E" Option and Low Leak Fresh Air Damper
J = "C" Option and Ultra Low Leak Outside Air Damper
K = "D" Option and Ultra Low Leak Outside Air Damper
L = "E" Option and Ultra Low Leak Outside Air Damper
1 = Option "C" with Traq
2 = Option "D" with Traq
3 = Option "E" with Traq
4 = Option "F" with Traq
5 = Option "G" with Traq
6 = Option "H" with Traq
7 = Option "C" with Traq w/ Ultra Low Leak Outside Air Damper
8 = Option "D" with Traq w/ Ultra Low Leak Outside Air Damper
9 = Option "E" with Traq w/ Ultra Low Leak Outside Air Damper

Digit 16 — System Control

1 = Constant Volume w/ Zone Temperature Control
2 = Constant Volume w/ Discharge Air Control
4 = VAV Supply Air Temperature Control w/ Variable Frequency Drive w/o Bypass
5 = VAV Supply Air Temperature Control w/ Variable Frequency Drive and Bypass
6 = Single Zone VAV w/ VFD w/o Bypass
7 = Single Zone VAV w/ VFD w/ Bypass
A = VAV Supply Air Temperature Control w/ VFD w/o Bypass w/ Motor Shaft Grounding Ring
B = VAV Supply Air Temperature Control w/ VFD w/ Bypass w/ Motor Shaft Grounding Ring
C = Single Zone VAV w/ VFD w/o Bypass w/ Motor Shaft Grounding Ring
D = Single Zone VAV w/ VFD w/ Bypass w/ Motor Shaft Grounding Ring

Note: *Zone sensors are not included with option and must be ordered as a separate accessory.*

Miscellaneous Options

Digit 17

0 = No Service Valves

A = Service Valves

Std efficiency units excluding 40/50T std efficiency CV: *If Digit 17 = 0, no valves will be provided. If Digit 17= A, service valves will be provided in the suction and discharge lines.* ***High efficiency units including 40/ 50T std efficiency CV:*** *Digit 17 is not selectable. Suction and discharge service valves are included.*

Digit 18

B = Through the Base Electrical Provision

Digit 19

C = Non-Fused Disconnect Switch w/ External Handle

Digit 20

D = Factory-Powered 15A GFI Convenience Outlet and Non-Fused Disconnect Switch w/ External Handle

Digit 21

E = Field-Powered 15A GFI Convenience Outlet

Digit 22

F = Trane Communication Interface (TCI)

Digit 23

G = Ventilation Override

Digit 24

H = Hinged Service Access

Digit 25

H = Condenser Hail Guards
J = Condenser Coil Guards

Digit 26

K = LCI (LonTalk)
B = BACnet Communications Interface (BCI)

Digit 27

0 = 5kA SCCR
D = High Fault 65kA SCCR Disconnect[5]
E = High Fault 65kA SCCR Disconnect w/ Powered Convenience Outlet[5]

Digit 28

0 = Standard Drain Pan
M = Stainless Steel Drain Pan
1 = Standard Drain Pan w/ Condensate Overflow Switch
2 = Stainless Steel Drain Pan w/ Condensate Overflow Switch

Digit 29 — Efficiency/ Condenser Coil Options

0 = Standard Efficiency Unit
J = Standard Efficiency Unit w/ Corrosion Protected Condenser Coil
K = High Efficiency Unit (eStage)
L = High Efficiency Unit (eStage) w/ Corrosion Protected Condenser Coil

Digit 30, 31 — Miscellaneous Options

P = Discharge Temperature Sensor
R = Clogged Filter Switch

Digit 32 — Modulating Hot Gas Reheat Option

T = Modulating Hot Gas Reheat

Digit 33 — Human Interface

5 = Touchscreen Human Interface, 5"

Model Number Notes

Notes:

1. All voltages are across the line starting only.
2. Electric Heat KW ratings are based upon voltage ratings of 208/240/480/ 600 V. For a 240 V heater derated to 208 V, the resulting kW rating decreases from 36 kW to 27 kW, and from 54 kW to 41 kW. Voltage offerings are shown in following table (see Table 22, p. 56 for additional information).
3. The service digit for each model number contains 33 digits; all 33 digits must be referenced.
4. Ventilation override exhaust mode is not available for the exhaust fan with fresh air tracking power exhaust. VOM is available for the exhaust fan without fresh air tracking power exhaust.
5. 575 VAC option is 25kA.

Tons	Elec. Heater Rated Volt.	KW				
		27/36	41/54	72	90	108
27½ to 35	208	x	x			
	240	x	x			
	480	x	x	x	x	
	600		x	x	x	
40 and 50	208		x			
	240		x			
	480		x	x	x	x
	600		x	x	x	x

50 Hz Description

Digit 1, 2 — Unit Function

TC = DX Cooling, No Heat
TE = DX Cooling, Electric Heat
YC = DX Cooling, Natural Gas Heat

Digit 3 — Unit Airflow Design

D = Downflow Supply and Upflow Return
H = Horizontal Supply and Horizontal Return
F = Horizontal Supply and Upflow Return
R = Downflow Supply and Horizontal Return

Digit 4, 5, 6 — Nominal Cooling Capacity

275 = 22.9 Tons (82 kW)
305 = 25.4 Tons (89 kW)
350 = 29.2 Tons (105 kW)
400 = 33.3 Tons (120 kW)
500 = 41.7 Tons (148 kW)

Digit 7 — Major Development Sequence

B = R-410A Refrigerant

Digit 8 — Power Supply[1]

C = 380/50/3
D = 415/50/3

Digit 9 — Heating Capacity[2]

0 = No Heat (TC Only)
L = Low Heat (YC Only)
H = High Heat (YC Only)

Note: *When second digit is "E" for Electric Heat, the following values apply in the ninth digit.*

380V / 415V

A = 23 kW / 27 kW
B = 34 kW / 40 kW
C = 45 kW / 54 kW
D = 56 kW / 67 kW
E = 68 kW / 81 kW

Digit 10 — Design Sequence

A = First

Digit 11 — Exhaust[4]

0 = None
1 = Barometric Relief (Available w/ Economizer only)
2 = 100% Power Exhaust Fan (Available w/ Economizer Only)
3 = 50% Power Exhaust Fan (Available w/ Economizer Only)
4 = 100% Fresh Air Tracking Power Exhaust Fan (Available w/ Economizer Only)
5 = 50% Fresh Air Tracking Power Exhaust Fan (Available w/ Economizer Only)
6 = 100% Power Exhaust w/ Statitrac™
7 = 100% Power Exhaust Fan w/ Ultra Low Leak Exhaust Damper (Available w/ Economizer Only)
8 = 50% Power Exhaust Fan w/ Ultra Low Leak Exhaust Damper (Available w/ Economizer Only)
9 = 100% Power Exhaust w/ Ultra Low Leak Exhaust Damper w/ Statitrac™

Digit 12 — Filter

A = 2" (51mm) MERV 4, Std Eff, Throwaway Filters
B = 2" MERV (51mm) 8, High Eff, Throwaway Filters
C = 4" (102mm) MERV 8, High Eff, Throwaway Filters
D = 4" (102mm) MERV 14, High Eff, Throwaway Filters

Digit 13 — Supply Fan Motor, HP

1 = 7.5 HP (5.6 Kw)
2 = 10 HP (7.5 kW)
3 = 15 HP (10 kW)
4 = 20 HP (15 kW)

Digit 14 — Supply Air Fan Drive Selections

A = 458 RPM
B = 500 RPM
C = 541 RPM
D = 583 RPM
E = 625 RPM
F = 658 RPM
G = 664 RPM
H = 417 RPM
J = 437 RPM
K = 479 RPM
L = 521 RPM
M = 562 RPM
N = 604 RPM

Digit 15 — Outside Air Selection

A = No Outside Air
B = 0-25% Manual Damper
C = 0-100% Economizer, Dry Bulb Control
D = 0-100% Economizer, Reference Enthalpy Control
E = 0-100% Economizer, Differential Enthalpy Control
F = "C" Option and Low Leak Fresh Air Damper
G = "D" Option and Low Leak Fresh Air Damper
H = "E" Option and Low Leak Fresh Air Damper
J = "C" Option and Ultra Low Leak Outside Air Damper
K = "D" Option and Ultra Low Leak Outside Air Damper
L = "E" Option and Ultra Low Leak Outside Air Damper
1 = Option "C" with Traq
2 = Option "D" with Traq
3 = Option "E" with Traq
4 = Option "F" with Traq
5 = Option "G" with Traq
6 = Option "H" with Traq
7 = Option "C" with Traq w/ Ultra Low Leak Outside Air Damper
8 = Option "D" with Traq w/ Ultra Low Leak Outside Air Damper
9 = Option "E" with Traq w/ Ultra Low Leak Outside Air Damper

Digit 16 — System Control

1 = Constant Volume w/ Zone Temperature Control
2 = Constant Volume w/ Discharge Air Control
4 = VAV Supply Air Temperature Control w/ Variable Frequency Drive w/o Bypass
5 = VAV Supply Air Temperature Control w/ Variable Frequency Drive and Bypass
6 = Single Zone VAV w/ VFD w/o Bypass
7 = Single Zone VAV w/ VFD w/ Bypass
A = VAV Supply Air Temperature Control w/ VFD w/o Bypass w/ Motor Shaft Grounding Ring
B = VAV Supply Air Temperature Control w/ VFD w/ Bypass w/ Motor Shaft Grounding Ring
C = Single Zone VAV w/ VFD w/o Bypass w/ Motor Shaft Grounding Ring
D = Single Zone VAV w/ VFD w/ Bypass w/ Motor Shaft Grounding Ring

Note: *Zone sensors are not included with option and must be ordered as a separate accessory.*

Miscellaneous Options

Digit 17

0 = No Service Valves

A = Service Valves

Std efficiency units excluding 400/500 std efficiency CV: *If Digit 17 = 0, no valves will be provided. If Digit 17= A, service valves will be provided in the suction and discharge lines.* ***High efficiency units including 400/500 std efficiency CV:*** *Digit 17 is not selectable. Suction and discharge service valves are included.*

Digit 18

B = Through the Base Electrical Provision

Digit 19

C = Non-Fused Disconnect Switch w/ External Handle

Digit 20

***** = Unused Digit

Digit 21

***** = Unused Digit

Digit 22

F = Trane Communication Interface (TCI)

Digit 23

G = Ventilation Override

Digit 24

H = Hinged Service Access

Digit 25

H = Condenser Hail Guards
J = Condenser Coil Guards

Digit 26

K = LCI (LonTalk)
B = BACnet Communications Interface (BCI)

Digit 27

0 = 5kA SCCR
D = High Fault 65kA SCCR Disconnect

Digit 28

0 = Standard Drain Pan
M = Stainless Steel Drain Pan
1 = Standard Drain Pan w/ Condensate Overflow Switch
2 = Stainless Steel Drain Pan w/ Condensate Overflow Switch

Digit 29 — Efficiency/ Condenser Coil Options

0 = Standard Efficiency Unit
J = Standard Efficiency Unit w/ Corrosion Protected Condenser Coil
K = High Efficiency Unit (eStage)
L = High Efficiency Unit (eStage) w/ Corrosion Protected Condenser Coil

Digit 30, 31 — Miscellaneous Options

P = Discharge Temperature Sensor
R = Clogged Filter Switch

Digit 32 — Modulating Hot Gas Reheat Option

T = Modulating Hot Gas Reheat

Digit 33 — Human Interface

5 = Touchscreen Human Interface, 5"

Model Number Notes

Notes:

1. All voltages are across the line starting only.
2. Electric Heat KW ratings are based upon voltage ratings of 380/415 V. Heaters A, B, C, D are used with 22.9-29.2 ton (82-105 kW) units only and heaters B, C, D, E are used with 33.3-41.7 ton (120-148 kW) units only.
3. The service digit for each model number contains 33 digits; all 33 digits must be referenced.
4. Ventilation override exhaust mode is not available for the exhaust fan with fresh air tracking power exhaust. VOM is available for the exhaust fan without fresh air tracking power exhaust.

General Information

About the Unit

Overall unit dimensional data is illustrated in "Unit Dimensions and Weights," p. 13. Each package rooftop unit ships fully assembled and charged with the proper refrigerant quantity from the factory. They are controlled by a microelectronic unit control processor. Several solid state modules are grouped to form the "Control System". The number of modules within any given control system will be dependent upon the options and accessories ordered with the unit. Acronyms are used extensively throughout this manual when referring to the "Control System".

Basic unit components include:

- Scroll compressors
- One (1) Intertwined Evaporator Coil
- One (1) Supply Fan
- Three (3) to Four (4) Condenser Fans
- Microchannel Condenser Coils
- Filters (type is dependent on option selection)

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 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 startup.

Note: *Do not use the unit heater as temporary heat without completing the startup procedures detailed under Startup information.*

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

Unit Dimensions and Weights

Recommended Clearances

Adequate clearance around and above each Voyager Commercial unit is required to ensure proper operation and to allow sufficient access for servicing.

If the unit installation is higher than the typical curb elevation, a field constructed catwalk around the unit is recommended to provide safe, easy access for maintenance and servicing. Table 1, p. 19 lists the recommended clearances for single and multiple unit installation. These clearances are necessary to assure adequate serviceability, cataloged capacities, and peak operating efficiency.

If the clearances available on the job site appear to be inadequate, review them with your Trane sales representative.

Roof Curb and Ductwork

The curbs for the 27.5 to 50 Tons commercial rooftop units enclose the entire unit base area. They are referred to as "full perimeter" type curbs.

Step-by-step instructions for the curb assembly and installation with curb dimensions and curb configuration for "A", "B", and "C" cabinets ship with each Trane accessory roof curb kit. (See the latest edition of the curb installation guide) Follow the instructions carefully to assure proper fit when the unit is set into place.

The S/A and R/A ductwork adjoining the roof curb must be fabricated and installed by the installing contractor before the unit is set into place. Trane curbs include flanges around the openings to accommodate duct attachment.

Ductwork installation recommendations are included in the instruction booklet that ships with each Trane accessory roof curb kit.

Note: *For sound consideration, cut only the holes in the roof deck for the supply and return duct penetration. Do not remove the roof decking from the inside perimeter of the curb.*

If a Trane curb accessory kit is not used:

- The ductwork can be attached directly to the S/A and R/A openings. Be sure to use a flexible duct connector at the unit.
- For "built-up" curbs supplied by others, gaskets must be installed around the curb perimeter flange, Supply Air opening, and Return Air openings.
- Insulation must be installed on the bottom of the condenser section of the unit.

Horizontal Ductwork

When attaching the ductwork to a horizontal supply or horizontal return unit, provide a water tight flexible connector at the unit to prevent noise transmission from the unit into the ductwork. Refer to figures beginning on page for the S/A and R/A opening dimensions.

All outdoor ductwork between the unit and the structure should be weather proofed after installation is completed.

If optional power exhaust is selected, an access door must be field-installed on the horizontal return ductwork to provide access to exhaust fan motors.

Unit Dimensions

Figure 1. 60 Hz 27½-35, 50 Hz 23-29 Tons (TCD, TED, YCD low heat)

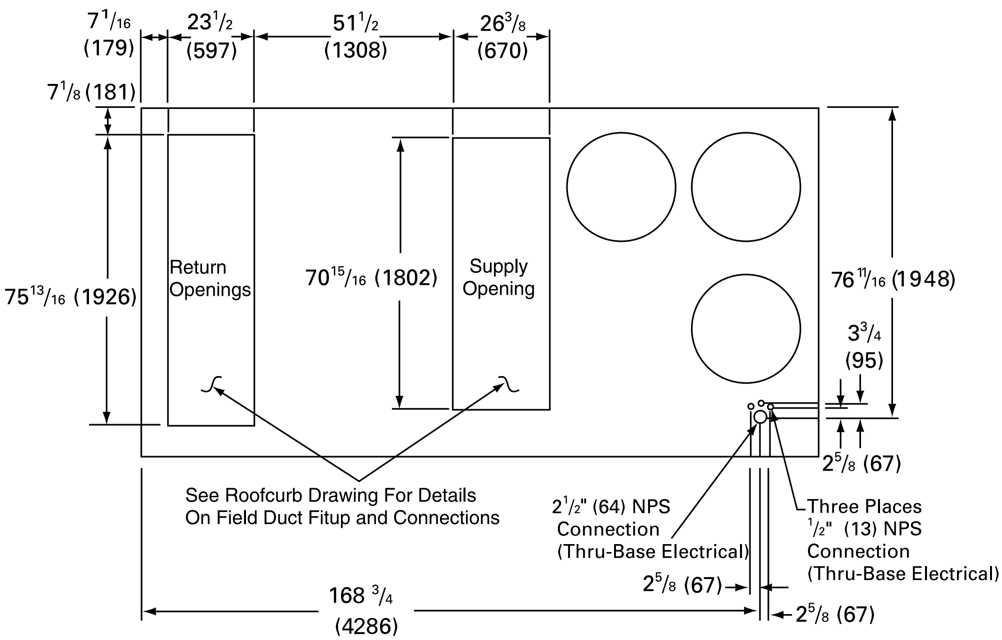
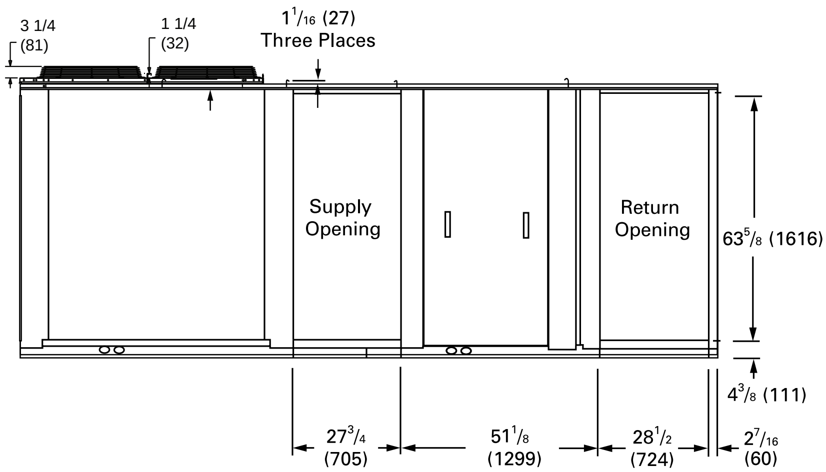


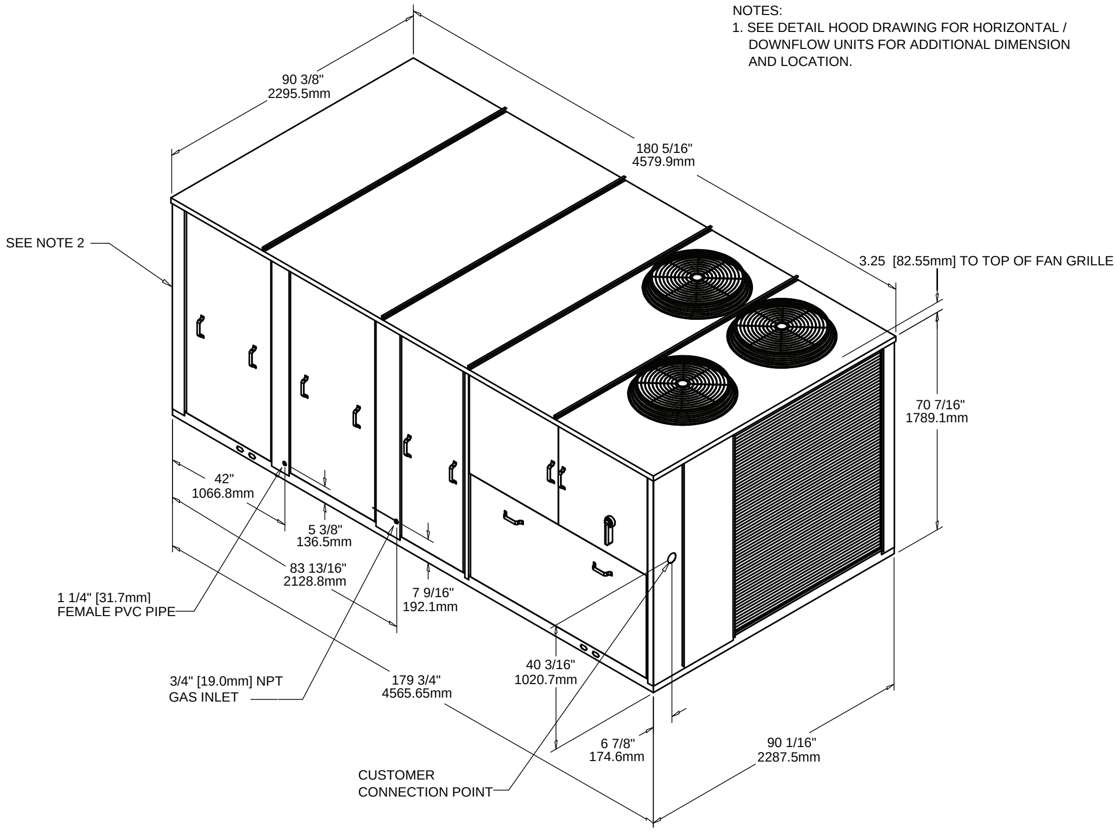
Figure 2. Rear view showing duct openings for horizontal supply and return, 60 Hz 27½-35, 50 Hz 23-29 Tons (TCH, TEH, YCH low heat)



Notes:

- *On horizontal units, the VFD is located between the supply and return ductwork, which makes access limited.*
- *For combination of horizontal and downflow openings (digit 3 = F or R) see for appropriate downflow/upflow dimensions and Figure 2, p. 14 for appropriate horizontal dimensions.*

Figure 3. 60 Hz 27½-35, 50 Hz 23-29 Tons (TC, TE, YC low heat)



Note: *Dimensions in ( ) are mm, 1"= 25.4 mm.*

Figure 4. 60 Hz 27½-35, 50 Hz 23-29 Tons (YCD high heat)

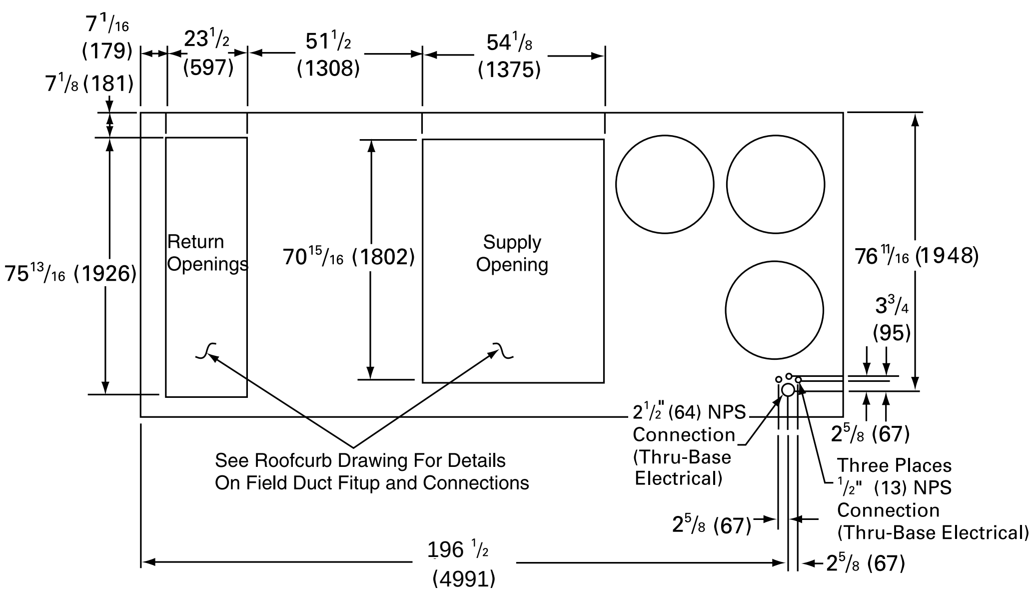
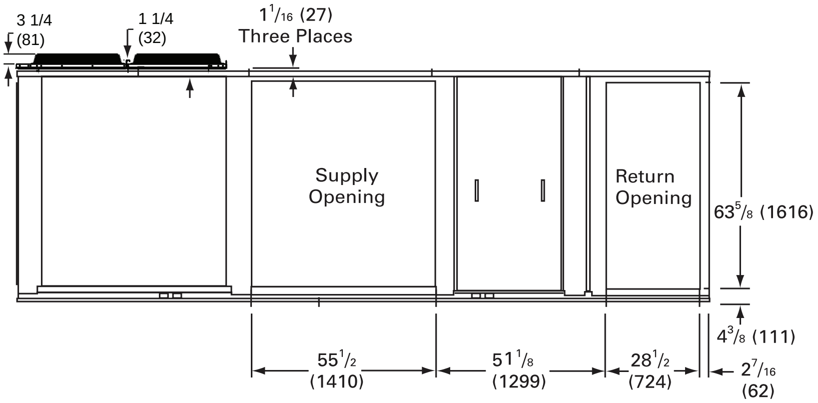


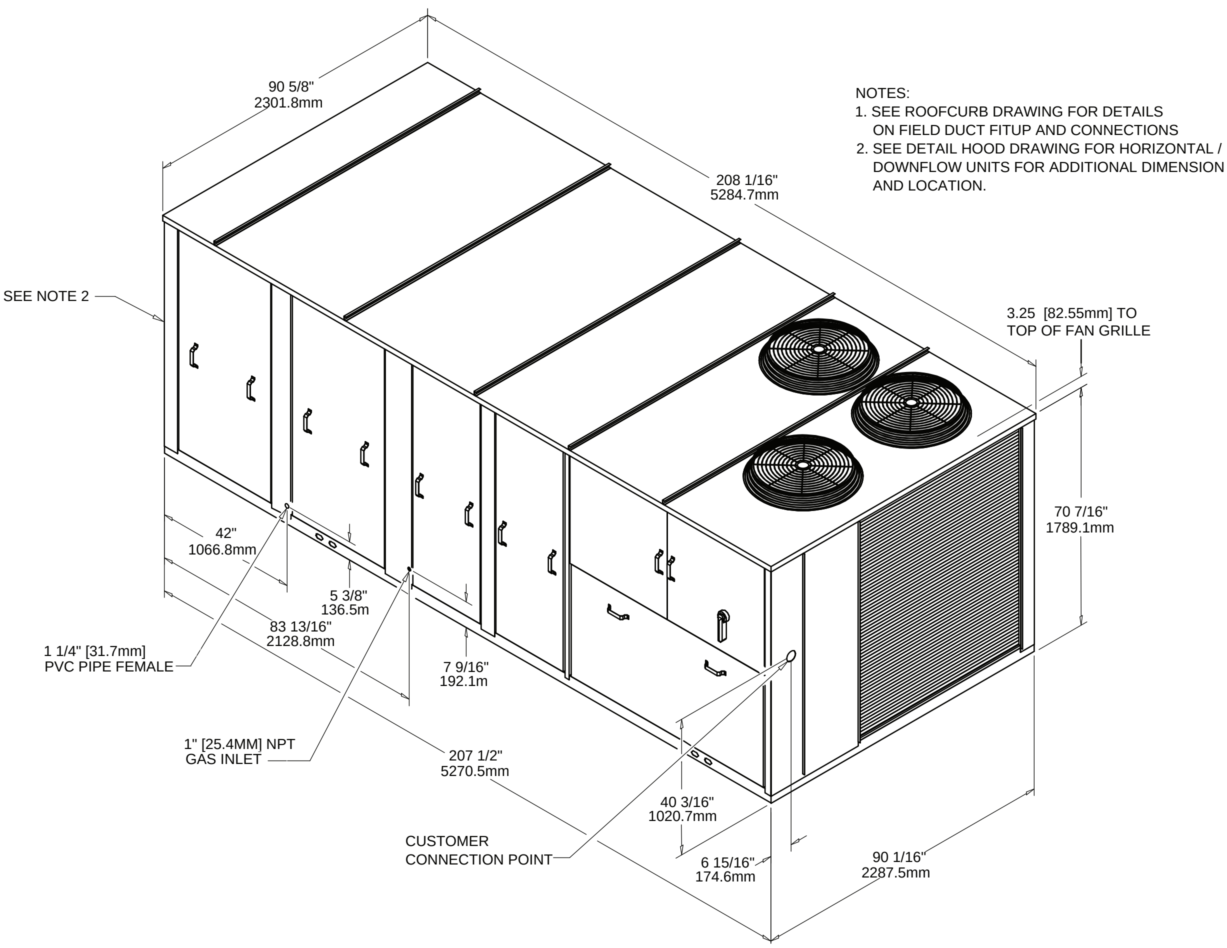
Figure 5. Duct openings, 60 Hz 27½-35, 50 Hz 23-29 Tons (YCH high heat)



Notes:

- *On horizontal units, the VFD is located between the supply and return ductwork, which makes access limited.*
- *For combination of horizontal and downflow openings (digit 3 = F or R) see Figure 4, p. 15 for appropriate downflow/upflow dimensions and Figure 5, p. 16 for appropriate horizontal dimensions.*

Figure 6. 60 Hz 27½-35, 50 Hz 23-29 Tons (YC high heat)



Note: *Dimensions in ( ) are mm, 1"= 25.4 mm.*

Figure 7. 60 Hz 40-50, 50 Hz 33-42 Tons (TCD, TCD, YCD low and high heat)

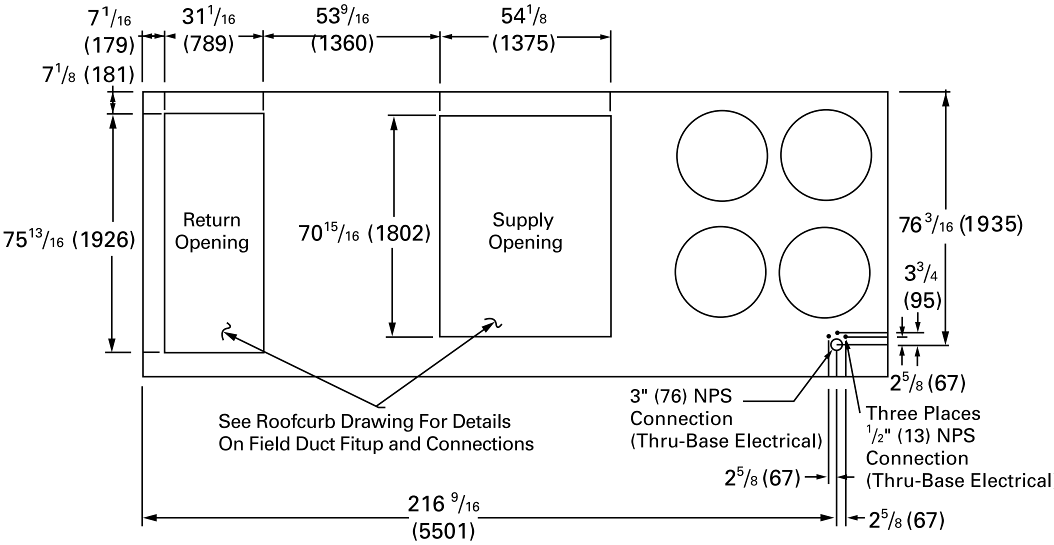
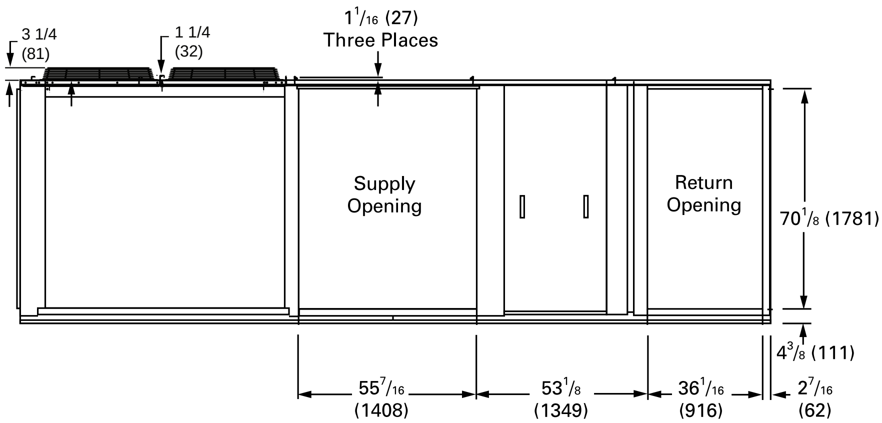


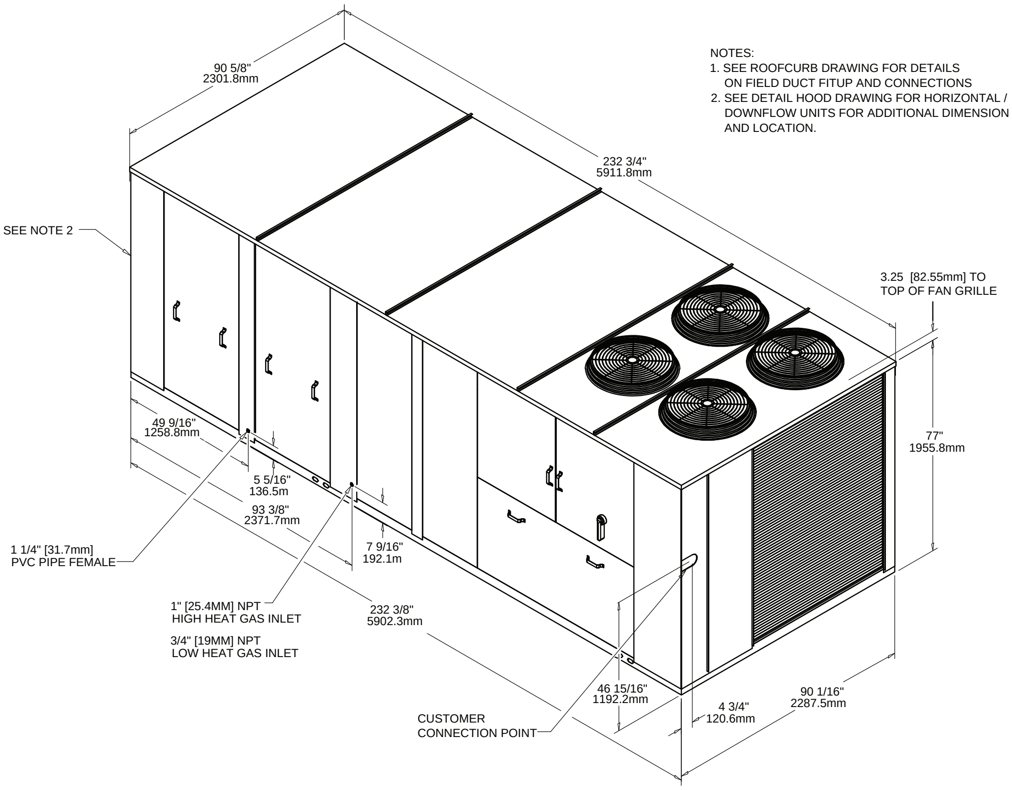
Figure 8. Duct openings, 60 Hz 40-50, 50 Hz 33-42 Tons (TH, TH, YH low and high heat)



Notes:

- *On horizontal units, the VFD is located between the supply and return ductwork, which makes access limited.*
- *For combination of horizontal and downflow openings (digit 3 = F or R) see Figure 7, p. 17 for appropriate downflow/upflow dimensions and Figure 8, p. 17 for appropriate horizontal dimensions.*

Figure 9. 60 Hz 40-50, 50 Hz 33-42 Tons (TC, TE, YC low and high heat)



Note: *Dimensions in ( ) are mm, 1"= 25.4 mm.*

Figure 10. Side view showing fresh air and power exhaust hoods for downflow return (TC*, TE*, and YC* units)

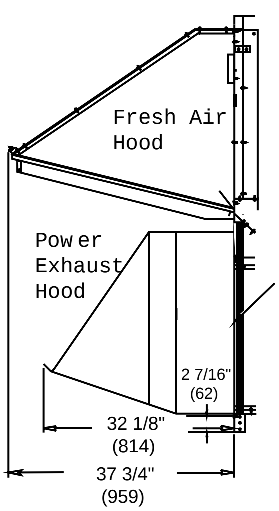


Figure 11. Side view showing power exhaust hoods for horizontal return (TC*, TE*, and YC* units)

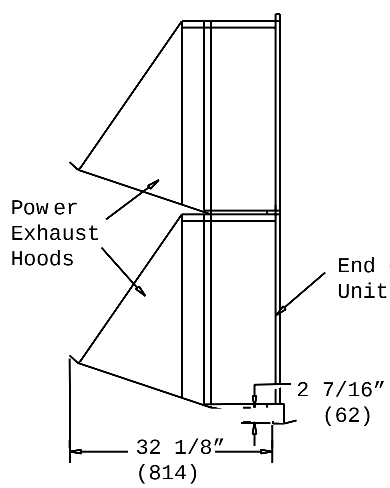
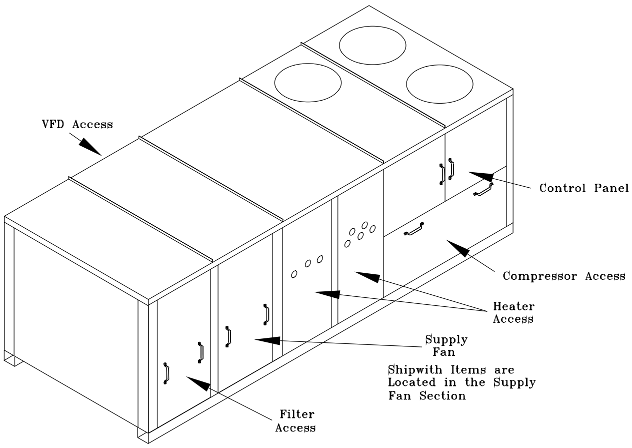


Figure 12. Location of "Ship With" items for TC*, TE*, and YC* units



Unit Rigging and Placement

Use spreader bars as shown in the diagram. Refer to the Installation manual or nameplate for unit weight. Refer to the Installation instructions located inside the control panel for further rigging information.

Verify that the roof curb has the proper gaskets installed and is level and square to assure an adequate curb-to-unit seal.

The units must be as level as possible in order to assure proper condensate flow out of the unit. The maximum side-to-side and end-to-end slope allowable in any application is listed in Table 2, p. 19.

Figure 13. Unit rigging

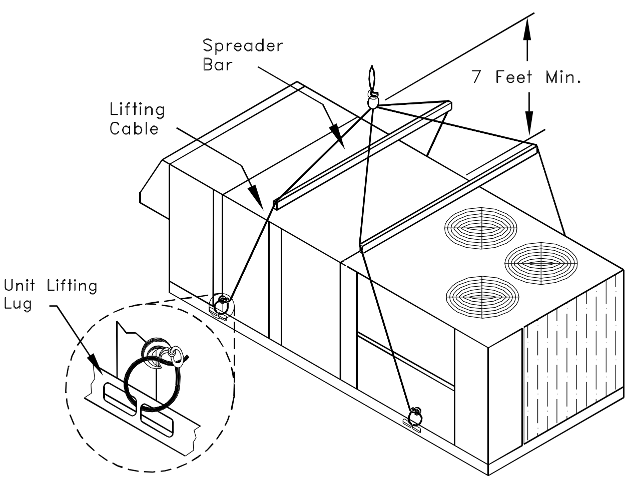


Table 1. Minimum operating clearances installation (horizontal, downflow, and mixed airflow configurations)

	Economizer/ Exhaust End	Condenser Coil Orientation End/Side	Service Side Access
Single Unit (Clearance)	6 feet	8 feet	4 feet
Multiple Units (Distance between Units)	12 feet	16 feet	8 feet

Note: Condenser coil is located at the end and side of the unit.

Table 2. Maximum slope

Cabinet	End to End (inches)	Side to Side (inches)
"A" (27.5 - 35 Ton Low Heat)	3 1/2	1 5/8
"B" (27.5 - 35 Ton High Heat)	4	1 5/8
"C" (All 40 and 50 Ton Units)	4 1/2	1 5/8

Note: Do not exceed these allowances. Correct the improper slope by building up the curb base. The material used to raise the base must be adequate to support both the curb and the unit weight.

Table 3. Center of gravity

Unit Model	Center-of-Gravity (inches)								
	YC Low Heat Dimension			YC High Heat Dimension			TC/TE Dimension		
	X	Y	Z	X	Y	Z	X	Y	Z
***330/ 275*	41	76	33	41	84	33	42	76	33
***360/ 305*	43	77	33	43	85	33	44	77	33
***420/ 350*	42	78	33	42	86	33	43	78	33
***480/ 400*	42	1-11	35	42	1-11	35	42	1-11	35
***600/ 500*	43	1-08	35	43	1-08	35	43	1-08	35

Notes:

1. Center-of-gravity dimensions are approximate, and are based on the unit equipped with: standard efficiency coils, standard efficiency motors, economizer, and throwaway filters.
2. Z dimension is upward from the base of the unit.
3. Example: Locating the center-of-gravity for a YC-360 MBH High Heat unit with 100% exhaust; X = 43 inches inward from the control panel side/ Y = 85 inches inward from the compressor end/ Z = 33 inches upward from the base

Figure 14. Center of gravity

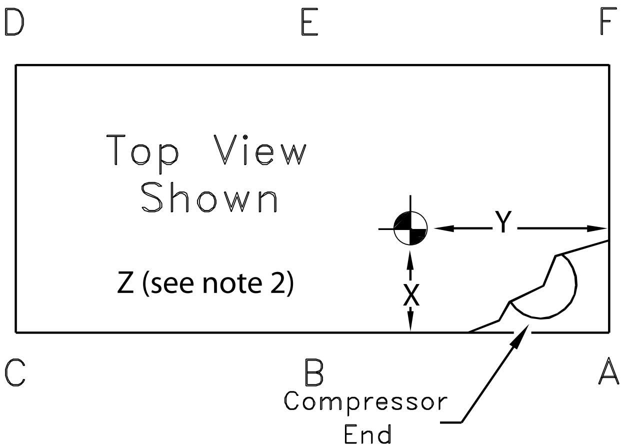


Table 4. Approximate units operating weights — lbs./kg

Unit Model (60Hz/ 50Hz)	Basic Unit Weights			
	YC Low Heat	YC High Heat	TC	TE
330/275	3720 / 1687	4150 / 1882	3590 / 1628	3610 / 1637.5
360/305	3795 / 1721	4225 / 1916	3665 / 1662	3685 / 1671.5
420/350	3876 / 1758	4306 / 1953	3746 / 1699	3766 / 1708
480/400	4825 / 2189	4950 / 2245	4565 / 2071	4600 / 2086.5
600/500	5077 / 2303	5202 / 2360	4827 / 2189.5	4852 / 2201

Note: Weights shown represent approximate operating weights and have a ±10% accuracy. To calculate weight for a specific unit configuration, utilize TOPSS™ or contact the local Trane® sales representative. ACTUAL WEIGHTS ARE STAMPED ON THE UNIT NAMEPLATE.

Table 5. Point loading average weight— lbs./kg

Unit Model (60Hz/ 50Hz)	A	B	C	D	E	F
330/275	852 / 386	695 / 315	754 / 342	740 / 335	602 / 273	504 / 228
360/305	878 / 398	681 / 309	750 / 340	713 / 323	577 / 262	622 / 282
420/350	841 / 381	842 / 382	669 / 303	735 / 333	582 / 264	634 / 287
480/400	835 / 378	869 / 394	950 / 431	748 / 339	769 / 349	776 / 352
600/500	882 / 400	931 / 422	954 / 433	740 / 336	844 / 382	847 / 384

Notes:

1. Point loading is identified with corner A being the corner with the compressors. As you move clockwise around the unit as viewed from the top, mid-point B, corner C, corner D, mid-point E and corner F.
2. Point load calculations provided are based on the unit weight for YC high heat gas models.

Table 6. Approximate operating weights— optional components — lbs./kg

Unit Model (60Hz/50Hz)	Baro. Relief	Power Ex-haust	0-25% Man Damp-er	Econ.	Var. Freq. Drives (VFD's) W/O Bypass	Var. Freq. Drives (VFD's) With Bypass	Serv. Valves	Thru-the base Elec.	Non-Fused Discon. Switch	Factory GFI with Discon. Switch	Roof Curb Lo	Roof Curb Hi	HGRH Coil
**(D,F)330/275	110/50	165/74	50/23	260/117	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(H,R)330/275	145/65	200/90	50/23	285/128	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(D,F)360/305	110/50	165/74	50/23	260/117	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(H,R)360/305	145/65	200/90	50/23	285/128	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(D,F)420/350	110/50	165/74	50/23	260/117	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(H,R)420/350	145/65	200/90	50/23	285/128	85/39	115/52	18/8	6/3	30/14	85/38	310/141	330/150	107/49
**(D,F)480/400	110/50	165/74	50/23	290/131	115/52	150/68	18/8	6/3	30/14	85/38	365/169	365/169	112/51
**(H,R)480/400	145/65	200/90	50/23	300/135	115/52	150/68	18/8	6/3	30/14	85/38	365/169	365/169	112/51
**(D,F)600/500	110/50	165/74	50/23	290/131	115/52	150/68	18/8	6/3	30/14	85/38	365/169	365/169	112/51
**(H,R)600/500	145/65	200/90	50/23	300/135	115/52	150/68	18/8	6/3	30/14	85/38	365/169	365/169	112/51

Unit Model (60Hz/50Hz)	Con-denser Hail Guards	Ultra Low Leak Econ	Ultra Low Leak 50% Ex-haust	Ultra Low Leak 100% Ex-haust	High Effi-ciency
**(D,F)330/275	105/48	112/51	34 / 15	74 / 34	326/148
**(H,R)330/275	105/48	78/35	34 / 15	77 / 35	326/148
**(D,F)360/305	105/48	112/51	34 / 15	74 / 34	255/116
**(H,R)360/305	105/48	78 /35	34 / 15	77 / 35	255/116
**(D,F)420/350	105/48	112/51	34 / 15	74 / 34	173/78
**(H,R)420/350	105/48	78/35	34 / 15	77 / 35	173/78
**(D,F)480/400	130/59	114/52	34 / 15	74 / 34	241/109
**(H,R)480/400	130/59	100/45	34 / 15	84 / 38	241/109
**(D,F)600/500	130/59	114/52	34 / 15	74 / 34	-25/-11
**(H,R)600/500	130/59	100/45	34 / 15	84 / 38	-25/-11

Note: Basic unit weight includes minimum horsepower supply fan motor.

Pre-Installation

The checklist listed below is a summary of the steps required to successfully install a Voyager 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.

General Unit Requirements

Downflow/Upflow Models

- An optional roof curb, specifically designed for the Voyager commercial rooftop units is available from Trane. The roof curb kit must be field assembled and installed according to the latest edition of the curb installation guide.
- Assemble and install the roof curb, including necessary gaskets. Make sure the curb is level.
- Install and secure the ductwork to the curb.

All Units

- Check unit for shipping damage and material shortage. (Refer to “General Information,” p. 12).
- Rigging the unit. Refer to Figure 13, p. 19.
- Placing the unit on curb; check for levelness.
- Ensure that the unit-to-curb seal is tight and without buckles or cracks.
- Install an appropriate drain line to the evaporator condensate drain connections, as required. Refer to Figure 15, p. 23.
- Service Valve Option; See “Starting the Compressor,” p. 88.
- Return/Fresh-air damper adjustment. Refer to “Economizer (O/A) Dampers,” p. 84.
- Exhaust Fan Damper Stop Adjustment. Refer to Exhaust Damper Adjustment figures, beginning with Figure 55, p. 83.

Electrical Requirements

⚠ 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.

- Verify that the electrical power supply characteristics comply with the unit nameplate specifications.
- Inspect all control panel components; tighten any loose connections.
- Connect properly sized and protected power supply wiring to a field supplied/installed disconnect and unit power terminal block HTB1, or to the optional unit-mounted disconnect switch.
- Properly ground the unit.

Field Installed Control Wiring

Refer to Figure 21, p. 34 and Figure 22, p. 35.

Complete the field wiring connections for the constant volume and variable air volume controls as applicable. Refer to “Low Voltage Wiring,” p. 32.

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

Gas Heat Requirements

Refer to “Installation Piping,” p. 40.

- Gas supply line properly sized and connected to the unit gas train.
- All gas piping joints properly sealed.
- Drip leg Installed in the gas piping near the unit.
- Gas piping leak checked with a soap solution. If piping connections to the unit are complete, do not pressurize piping in excess of 0.50 psig or 14 inches w.c. to prevent component failure.
- Main supply gas pressure adequate.
- Flue Tubes clear of any obstructions.

Installation General Requirements

Condensate Drain Connection

Each commercial rooftop unit is equipped with one (1) 1-1/4 inch Female NPT (threaded) drain connection.

Refer to "Unit Dimensions and Weights," p. 13 for the location of the connector. A condensate trap must be installed due to the drain connection being on the "negative pressure" side of the fan. Install a P-Trap at the unit using the guidelines in Figure 15, p. 23.

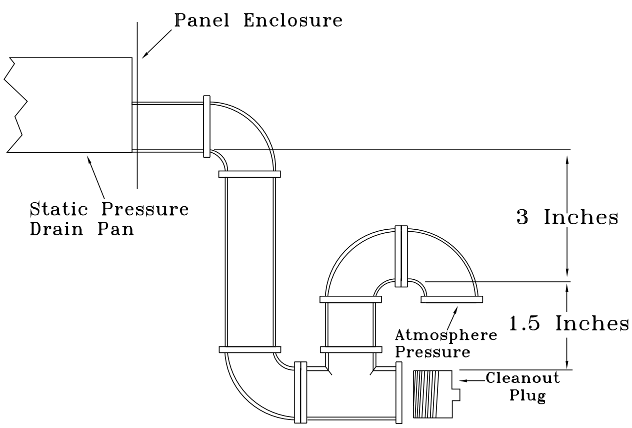
Pitch the drain line at least 1/2 inch for every 10 feet of horizontal run to assure proper condensate flow.

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

Notes:

- *For units with optional Condensate Overflow Switch (COF), the switch will not work properly if unit is not level or slightly sloped toward switch.*
- *To ensure proper condensate flow during operation the unit and the curb must be level.*

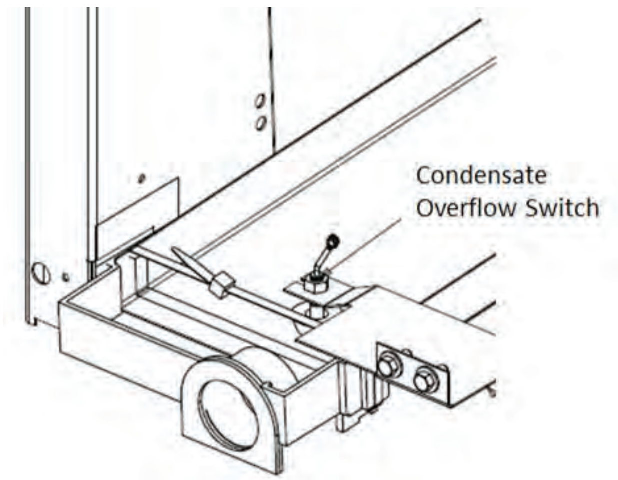
Figure 15. Condensate trap installation



Condensate Overflow Switch

This switch protects building from condensate overflow damage. It is factory-installed and tested.

Figure 16. Condensate overflow switch location



O/A Sensor & Tubing Installation

An Outside Air Pressure Sensor is shipped with all units designed to operate on traditional variable air volume applications (non-SZ VAV) and units with Statitrac™.

A duct pressure transducer and the outside air sensor is used to control the discharge duct static pressure to within a customer-specified controlband. Refer to the illustration in Figure 17, p. 24 and the following steps to install the sensor and the pneumatic tubing.

1. Remove the O/A pressure sensor kit located inside the fan section. The kit contains the following items;

- an O/A static pressure sensor
- a sensor mounting bracket
- 50' of 3/16" O.D. pneumatic tubing
- mounting hardware

2. Using two #10-32 x 1-3/4" screws provided, install the sensor's mounting bracket to the factory provided bracket (near the fan section).
3. Using the #10-32 x 1/2" screws provided, install the O/A static pressure sensor vertically to the sensor bracket.
4. Remove the dust cap from the tubing connector located below the sensor in the vertical support.
5. Attach one end of the 50' x 3/16" O.D. factory provided pneumatic tubing to the sensor's top port, and the other end of the tubing to the connector in the vertical support. Discard any excess tubing.

Units with Statitrac™

1. Open the filter access door, and locate the Statitrac Transducer Assembly illustrated in Figure 18, p. 25. There are two tube connectors mounted on the left of the solenoid and transducers. Connect one end of the field provided 1/4” (length 50-100 ft.) or 3/8” (length greater than 100 ft.) O.D. pneumatic tubing for the space pressurization control to the fitting indicated in the illustration.
2. Route the opposite end of the tubing to a suitable location inside the building. This location should be the largest open area that will not be affected by sudden static pressure changes.

Figure 17. Pressure tubing

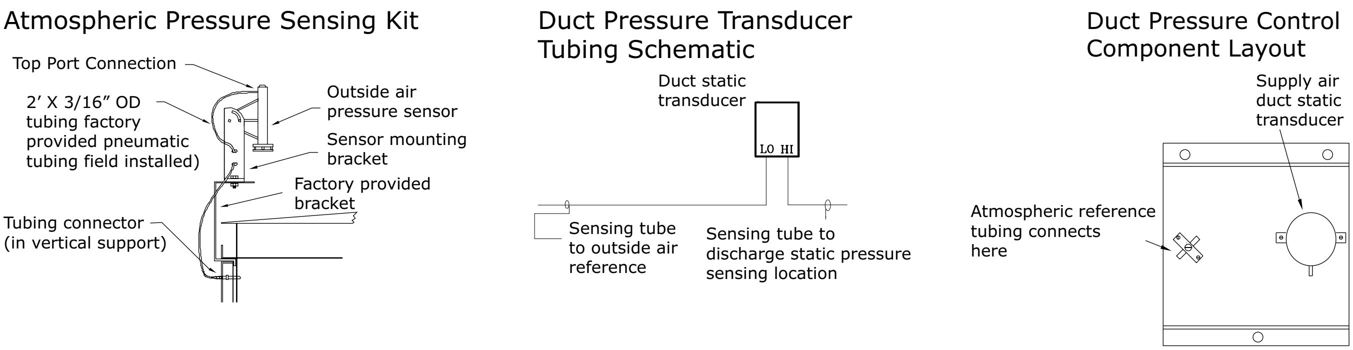
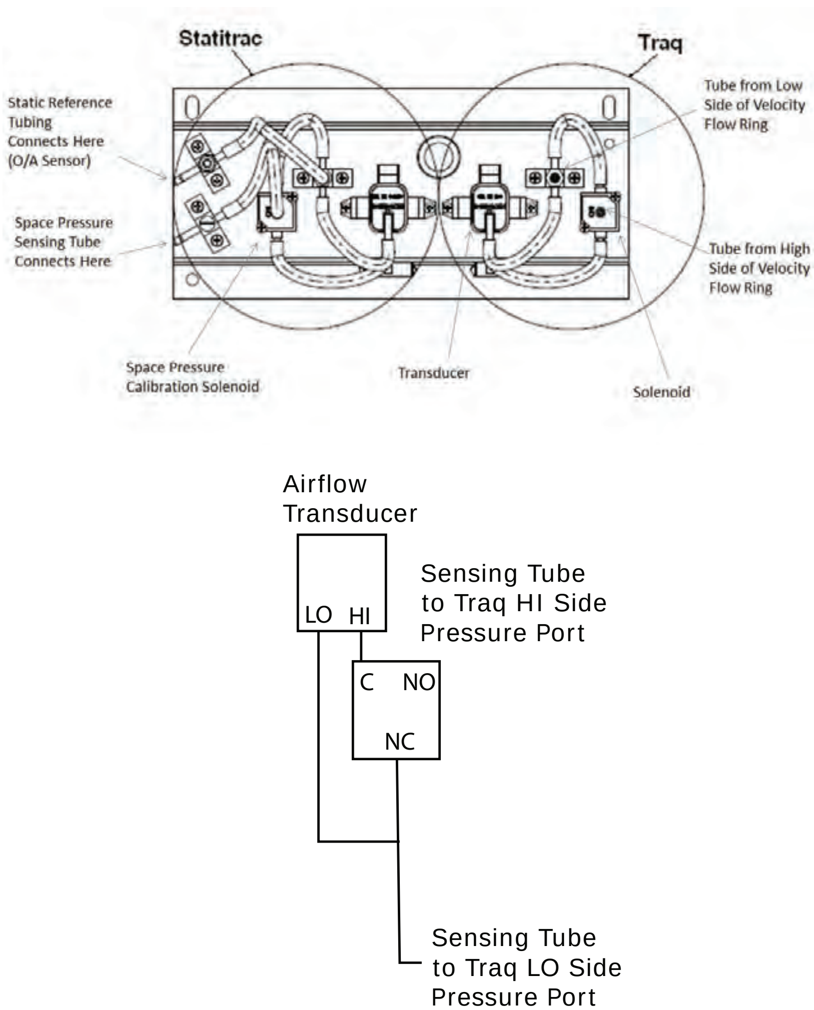


Figure 18. Transducer assembly



Note: *Statitrac and Traq transducer assembly shown.*

Installation Electrical

⚠ 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.

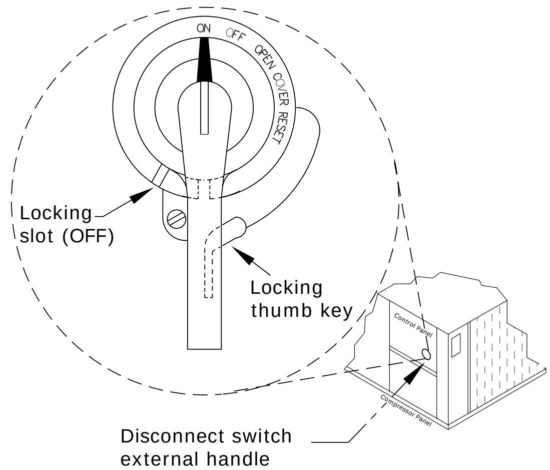
Disconnect Switch External Handle (Factory Mounted Option)

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

- ON - Indicates that the disconnect switch is closed, allowing the main power supply to be applied at the unit.
- OFF - Indicates that the disconnect switch is open, interrupting the main power supply at the unit.
- OPEN COVER/RESET - Turning the handle to this position releases the handle from the disconnect switch, allowing the control panel door to be opened.

Once the door has been opened, it can be closed with the handle in any one of the three positions outlined above, provided it matches the disconnect switch position. The handle can be locked in the “OFF” position. While holding the handle in the “OFF” position, push the spring loaded thumb key, attached to the handle, into the base slot. Place the lock shackle between the handle and the thumb key. This will prevent it from springing out of position.

Figure 19. Disconnect switch



An overall layout of the field required power wiring is illustrated in . To insure that the unit supply power wiring is properly sized and installed, follow the guidelines outlined below.

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

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

Main Power Wiring

⚠ 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.

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.

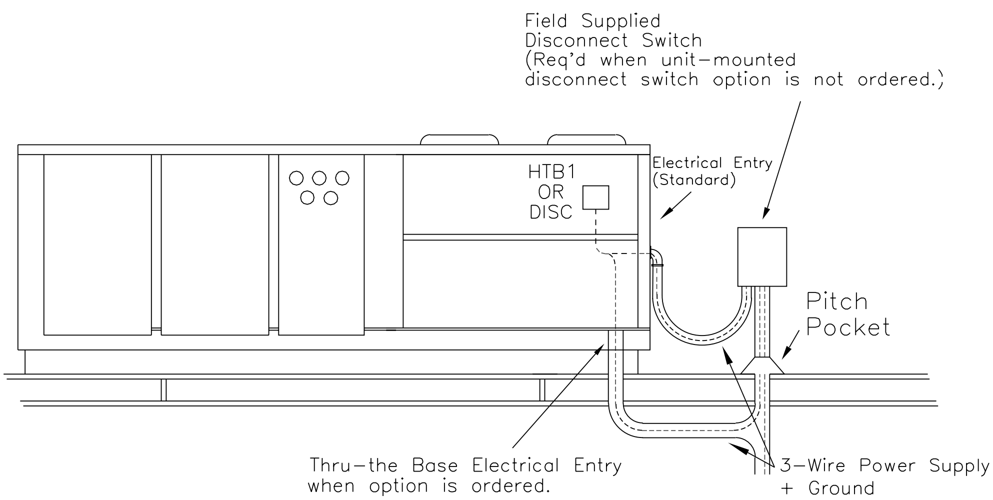
- to Table 14, p. 31 list the electrical service sizing data. The electrical service must be protected from over current and short circuit conditions in accordance with NEC requirements. Protection devices must be sized according to the electrical data on the nameplate. Refer to "Electrical Wire Sizing and Protection Device Equations," p. 31 for determining:
  – The appropriate electrical service wire size based on "Minimum Circuit Ampacity" (MCA),
  – The "Maximum Over current Protection" (MOP) device.
  – The "Recommended Dual Element fuse size" (RDE).
- If the unit is not equipped with an optional factory installed Nonfused disconnect switch, a field supplied disconnect switch must be installed at or near the unit in accordance with the National Electrical Code (NEC latest edition). Refer to DSS calculations "Electrical Wire Sizing and Protection Device Equations," p. 31 for determining correct size.

  Location for the electrical service entrance is shown in the unit dimensional drawings beginning with Figure 1, p. 14. Complete the unit's power wiring connections onto either the main terminal block HTB1, or the factory mounted nonfused disconnect switch inside the unit control panel.

Note: *When the factory installed through-the-base option is not used, the installing contractor is required to seal any holes made in the base of the unit to prevent water from leaking into the building.*

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

Figure 20. Typical field power wiring



⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

FAILURE TO DISCONNECT POWER BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

⚠ AVERTISSEMENT

VOLTAGE HASARDEUX!

DECONNECTEZ TOUTES LES SOURCES ELECTRIQUES INCLUANT LES DISJONCTEURS SITUES A DISTANCE AVANT D'EFFECTUER L'ENTRETIEN.

FAUTE DE DECONNECTER LA SOURCE ELECTRIQUE AVANT D'EFFECTUER L'ENTRETIEN PEUT ENTRAINER DES BLESSURES CORPORELLES SEVERES OU LA MORT.

⚠ CAUTION

USE COPPER CONDUCTORS ONLY!

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

FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

CUSTOMER CONNECTION WIRE RANGE

UNITS WITH MAIN POWER TERMINAL BLOCK (ALL VOLTAGES)

BLOCK SIZE	WIRE QTY.	CONNECTOR WIRE RANGE
310 AMP	1	#6-350 MCM

UNITS WITH MAIN POWER DISCONNECT SWITCH

200-208-230 VOLT UNITS

DISCONNECT SIZE	WIRE QTY.	CONNECTOR WIRE RANGE
225 AMP	1	#1-300 MCM
B 400 AMP (≤310 MCA)	1	250-500 MCM
B 400 AMP (>310 MCA)	2	3/0-250 MCM

380-415-460-480-575 VOLT UNITS

DISCONNECT SIZE	WIRE QTY.	CONNECTOR WIRE RANGE
100 AMP	1	#14-1/0
250 AMP	1	#4-350 MCM

NOTES

A. BLOCK SIZE & DISCONNECT SIZE IS CALCULATED BY SELECTING THE SIZE GREATER THAN OR EQUAL TO 1.15 X (SUM OF UNIT LOADS). SEE UNIT LITERATURE FOR UNIT LOAD VALUES.

B 400 AMP DISCONNECT SELECTED BY EQUATION GIVEN IN NOTE A, AND BY THE UNIT MCA VALUE. SEE UNIT LITERATURE FOR APPROPRIATE MCA EQUATION.

Through-the-Base Electrical (Optional Accessory)

Liquid-tight conduit couplings are secured to the base of the unit for both power and control wiring. Liquid-tight conduit must be field installed between the couplings and the unit control box to prevent water leaks into the building.

Note: *If the unit is set on the roof curb and temporary auxiliary heat is provided in the building, it is recommended that the electrical and control wiring conduit opening in the control box be temporarily sealed to provide a vapor barrier.*

Electrical Service Sizing Data

Table 7. 27½-35 ton electrical service sizing data—60Hz

Model	Elec. Specs	Allowable Voltage Range	Comp. Std Eff			Comp. High Eff, eStage			Fan Motors: Supply		Fan Motors: Condenser			Fan Motors: Exhaust			
			No/Ton	RLA (Ea.)	LRA (Ea.)	No/Ton	RLA (Ea.)	LRA (Ea.)	HP	FLA	No	HP	FLA (Ea.)	50% No.	100% No.	HP	FLA (Ea.)
TC/TE/YC*330	208/60/3	187-229	1/12, 1/13	44.0/ 50.5	304/ 315	1/6, 2/9	28.0, 37.1	203, 267	7.5, 10.0	22.2, 29.5	3	1.1	7	1	2	1.0	4.1
	230/60/3	207-253	1/12, 1/13	44.0/ 50.5	304/ 315	1/6, 2/9	28.0, 37.1	203, 267	7.5, 10.0	19.5, 25.2	3	1.1	7	1	2	1.0	4.1
	460/60/3	414-506	1/12, 1/13	21.0/ 23.0	147/ 158	1/6, 2/9	14.1, 16.8	98, 142	7.5, 10.0	9.8, 12.6	3	1.1	3.5	1	2	1.0	1.8
	575/60/3	517-633	1/12, 1/13	17.5/ 19.0	122/ 136	1/6, 2/9	12.2, 14.7	84, 103	7.5, 10.0	7.8, 10.1	3	1.1	2.8	1	2	1.0	1.4
TC/TE/YC*360	208/60/3	187-229	0.15-38	50.5	315/ 315	1/6, 2/10	28.0, 40.9	203, 267	7.5, 10.0, 15.0	22.2, 29.5, 42.4	3	1.1	7	1	2	1.0	4.1
	230/60/3	207-253	0.15-38	50.5	315/ 315	1/6, 2/10	28.0, 40.9	203, 267	7.5, 10.0, 15.0	19.5, 25.2, 36.0	3	1.1	7	1	2	1.0	4.1
	460/60/3	414-506	0.15-38	23	158/ 158	1/6, 2/10	14.1, 18.6	98, 142	7.5, 10.0, 15.0	9.8, 12.6, 18.0	3	1.1	3.5	1	2	1.0	1.8
	575/60/3	517-633	0.15-38	19	136/ 136	1/6, 2/10	12.2, 15.4	84, 103	7.5, 10.0, 15.0	7.8, 10.1, 15.1	3	1.1	2.8	1	2	1.0	1.4
TC/TE/YC*420	208/60/3	187-229	1/13, 1/15	50.5/ 56.0	315/ 351	1/6, 2/11	28.0, 44.9	203, 304	7.5, 10.0, 15.0	22.2, 29.5, 42.4	3	1.1	7	1	2	1.0	4.1
	230/60/3	207-253	1/13, 1/15	50.5/ 56.0	315/ 351	1/6, 2/11	28.0, 44.9	203, 304	7.5, 10.0, 15.0	19.5, 25.2, 36.0	3	1.1	7	1	2	1.0	4.1
	460/60/3	414-506	1/13, 1/15	23.0/ 27.5	158/ 197	1/6, 2/11	14.1, 19.2	98, 147	7.5, 10.0, 15.0	9.8, 12.6, 18.0	3	1.1	3.5	1	2	1.0	1.8
	575/60/3	517-633	1/13, 1/15	19.0/ 23.0	136/ 146	1/6, 2/11	12.2, 16.6	84, 122	7.5, 10.0, 15.0	7.8, 10.1, 15.1	3	1.1	2.8	1	2	1.0	1.4

Notes:

1. All customer wiring and devices must be installed in accordance with local and national electrical codes.
2. 100% Power Exhaust is with or without Statitrac™.

Table 8. 40-50 ton electrical service sizing data—60Hz

Model	Elec. Specs	Allowa-ble Voltage Range	Comp. Std Eff VAV Only			Comp. Std Eff CV & High Eff eStage			Fan Motors								
									Supply		Condenser			Exhaust			
			No/ Ton	RLA (Ea.)	LRA (Ea.)	No/ Ton	RLA (Ea.)	LRA (Ea.)	HP	FLA	No	HP	FLA (Ea.)	50% No.	100% No.	HP	FLA (Ea.)
TC/TE/ YC*480	208/60/3	187-229	1/13, 1/20	50.5/ 83.9	315/ 485	1/8, 2/13	31.1, 50.5	203, 315	10.0, 15.0	29.5, 42.4	4	1.1	7	1	2	1.5	5.4
	230/60/3	207-253	1/13, 1/20	50.5/ 83.9	315/ 485	1/8, 2/13	31.1, 50.5	203, 315	10.0, 15.0	25.2, 36.0	4	1.1	7	1	2	1.5	5.4
	460/60/3	414-506	1/13, 1/20	23.0/ 34.0	158/ 215	1/8, 2/13	14.1, 23.0	98, 158	10.0, 15.0	12.6, 18.0	4	1.1	3.5	1	2	1.5	2.7
	575/60/3	517-633	1/13, 1/20	19.0/ 27.3	136/ 175	1/8, 2/13	11.5, 19.0	84, 136	10.0, 15.0	10.1, 15.1	4	1.1	2.8	1	2	1.5	2.2
TC/TE/ YC*600	208/60/3	187-229	2/13, 1/15	50.5/ 56.0	315/ 351	1/10, 2/15	40.9, 58.5	267, 351	10.0, 15.0, 20.0	29.5, 42.4, 56.1	4	1.1	7	1	2	1.5	5.4
	230/60/3	207-253	2/13, 1/15	50.5/ 56.0	315/ 351	1/10, 2/15	40.9, 58.5	267, 351	10.0, 15.0, 20.0	25.2, 36.0, 49.4	4	1.1	7	1	2	1.5	5.4
	460/60/3	414-506	2/13, 1/15	23.0/ 27.5	158/ 197	1/10, 2/15	18.6, 27.5	142, 197	10.0, 15.0, 20.0	12.6, 18.0, 24.7	4	1.1	3.5	1	2	1.5	2.7
	575/60/3	517-633	2/13, 1/15	19.0/ 23.0	136/ 146	1/10, 2/15	15.4, 23.0	103, 135	10.0, 15.0, 20.0	10.1, 15.1, 19.6	4	1.1	2.8	1	2	1.5	2.2

Notes:

1. All customer wiring and devices must be installed in accordance with local and national electrical codes.
2. 100% Power Exhaust is with or without Statitrac™.

Table 9. Electrical service sizing data — electric heat module (electric heat only) — 60 Hz

Models: TE(D,H,F,R) 330—600 Electric Heat FLA						
Nominal Unit Size (Tons)	Nominal Unit Voltage	KW Heater (FLA)				
		36	54	72	90	108
27.5-35	208	74.9	112.4	NA	NA	NA
	230	86.6	129.9	NA	NA	NA
	460	43.3	65	86.6	108.3	NA
	575	NA	52	69.3	86.6	NA
40-50	208	NA	112.4	NA	NA	NA
	230	NA	129.9	NA	NA	NA
	460	NA	65	86.6	108.3	129.9
	575	NA	52	69.3	86.6	103.9

Note: All FLA in this table are based on heater operating at 208, 240, 480, and 600 volts.

Table 10. Electrical service sizing data — crankcase heaters (heating mode only) — 60Hz

Nominal Unit Size (Tons)	FLA Add Unit Voltage			
	200	230	460	575
27½ - 35	1	1	1	1
40, 50	2	2	1	1

Table 11. Electrical service sizing data — 275–350 units – 50Hz

Model	Elec. Specs	Comp. Std Eff			Comp. High Eff, eStage			Fan Motors								
								Supply		Condenser			Exhaust			
		No/ Ton	RLA (Ea.)	LRA (Ea.)	No/ Ton	RLA (Ea.)	LRA (Ea.)	HP (kW)	FLA	No	HP (kW)	FLA (Ea.)	50% No.	100% No.	HP (kW)	FLA (Ea.)
TC/TE/ YC*275	380/415/ 50/3	1/10, 1/11	21.0/ 23.0	147/ 158	1/6, 2/ 9	14.1, 16.8	98, 142	7.5 (5.6), 10 (6.8)	13.6/ 14.1, 16.0/ 15.5	3	0.75 (0.56)	4.4	1	2	0.75 (0.56)	1.7
TC/TE/ YC*305	380-415/ 50/3	0.1818	23	158	1/6, 2/ 10	14.1, 18.6	98, 142	7.5 (5.6), 10 (6.8)	13.6/ 14.1, 16.0/ 15.5	3	0.75 (0.56)	4.4	1	2	0.75 (0.56)	1.7
TC/TE/ YC*350	380-415/ 50/3	1/11, 1/12	23.0/ 27.5	158/ 197	1/6, 2/ 11	14.1, 19.2	98, 147	7.5 (5.6), 10 (6.8), 15 (10.5)	13.6/ 14.1, 16.0/ 15.5, 24.0/ 26.0	3	0.75 (0.56)	4.4	1	2	0.75 (0.56)	1.7

Notes:

1. All customer wiring and devices must be installed in accordance with local and national electrical codes.
2. Allowable voltage range for the 380V unit is 342-418V, allowable voltage range for the 415V unit is 373-456.
3. 100% Power Exhaust is with or without Statitrac™.
4. All condenser fan motors are single phase.

Table 12. Electrical service sizing data — 400–500 – 50Hz

Model	Elec. Specs	Comp. Std Eff VAV Only			Comp. Std Eff CV & High Eff eStage			Fan Motors								
								Supply		Condenser			Exhaust			
		No/ Ton	RLA (Ea.)	LRA (Ea.)	No/ Ton	RLA (Ea.)	LRA (Ea.)	HP (kW)	FLA	No	HP (kW)	FLA (Ea.)	50% No.	100% No.	HP (kW)	FLA (Ea.)
TC/TE/ YC*400	380-415/ 50/3	1/11, 1/17	23.0/ 34.0	158/ 215	1/8, 2/ 13	14.1, 23.0	98, 158	10 (6.8), 15 (10.5)	16.0/ 15.5, 24.0/ 26.0	4	0.75 (0.56)	4.4	1	2	1.0 (0.75)	2.5
TC/TE/ YC*500	380-415/ 50/3	2/11, 1/12	23.0/ 27.5	158/ 197	1/10, 2/15	18.6, 27.5	142, 155	10 (6.8), 15 (10.5), 20 (12.8)	16.0/ 15.5, 24.0/ 26.0, 29.0/ 28.0	4	0.75 (0.56)	4.4	1	2	1.0 (0.75)	2.5

Notes:

1. All customer wiring and devices must be installed in accordance with local and national electrical codes.
2. Allowable voltage range for the 380V unit is 342-418V, allowable voltage range for the 415V unit is 373-456.
3. 100% Power Exhaust is with or without Statitrac™.
4. All condenser fan motors are single phase.

Table 13. Electrical service sizing data – electric heat module (electric heat units only)—50Hz

Models: TE(D,H,F,R) 275 through 500 Electric Heat FLA						
Nominal Unit Size (Tons)	Nominal Unit Voltage	KW Heater (380/415V)				
		23/ 27	34/ 40	45/ 54	56/ 67	68/ 81
23-29	380	34.5	51.1	68.9	85.5	–
	415	37.6	55.6	–	–	–
33, 42	380	–	51.1	68.9	85.5	103-.4
	415	–	55.6	75.1	93.2	112-.7

Note: *All FLA in this table are based on heater operating at 380 or 415 volts as shown above.*

Table 14. Electrical service sizing data — crankcase heaters (heating mode only) — 50Hz

Nominal Unit Size (Tons)	FLA Add Unit Voltage	
	380	415
23 - 29	1	1
33 - 42	1	1

Electrical Wire Sizing and Protection Device Equations

To correctly size the main power wiring based on MCA (Minimum Circuit Ampacity), use the appropriate equation listed below. Read the definitions that follow and then use Calculation #1 for determining MCA (Minimum Circuit Ampacity), MOP (Maximum Over current Protection), and RDE (Recommended Dual Element fuse size) for TC (Cooling Only) units and YC (Cooling with Gas Heat) units. Use Calculation #2 for TE (Cooling with Electric Heat) units.

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 = FLA (Full Load Amps) OF THE ELECTRIC HEATER
- LOAD 4 = ANY OTHER LOAD RATED AT 1 AMP OR MORE
- CRANKCASE HEATERS FOR HEATING MODE ONLY:
  - 208/230 VOLT
    - 27.5 - 35 Ton Units, Add 1 Amp
    - 40 - 50 Ton Units, Add 2 Amps
  - 460/575 VOLT
    - 27.5 - 35 Tons Units, Add 1 Amp
    - 40 - 50 Ton Units, Add 1 Amp

Calculation #1 - TC*, YC* - 27.5 to 50 Ton Units

- MCA = (1.25 x Load 1) + Load 2 + Load 4
- MOP = (2.25 x Load 1) + Load 2 + Load 4 (See Note 1)

  Note: *Select an over current protection device equal to the MOP value. If the calculated MOP value does not equal a standard size protection device listed in NEC 240-6, select the next lower over current protection device. If the calculated MOP value is less than the MCA value, select the lowest over current protection device which is equal to or larger than the MCA, providing the selected over current device does not exceed 800 amps.*

- RDE = (1.5 x Load 1) + Load 2 + Load 4 (See Note 2)

  Note: *Select a Dual Element Fuse equal to the RDE value. If the calculated RDE value does not equal a standard dual element fuse size listed in NEC 240-6, select the next higher fuse size. If the calculated RDE value is greater than the MOP value, select a Dual Element fuse equal to the calculated MOP (Maximum Over current Protection) value.*

Calculation #2 - TE* - 27.5 to 50 Ton Units

Note: *The following applies to single source power units (all voltages).*

To calculate the correct MCA (Minimum Circuit Ampacity), MOP (Maximum Over current Protection), and RDE (Recommended Dual Element fuse size), two (2) sets of calculations must be performed:

- Calculate the MCA, MOP and/or RDE values using the above equation as if the unit is operating in the cooling mode.
- Calculate the MCA, MOP and/or RDE values as if the unit is operating in the heating mode, as follows:

Note: *When determining loads, the compressors and condenser fan motors do not operate during the heating cycle.*

Units with Less than 50 KW Heaters

MCA = 1.25 x (Load 1 + Load 2 + Load 4) + (1.25 x Load 3)

Units with 50 KW or Larger Heaters

- MCA = 1.25 x (Load 1 + Load 2 + Load 4) + Load 3

  Note: *The MCA value stamped on the nameplate is the largest of the two calculated values.*

- MOP = (2.25 x Load 1) + Load 2 + Load 3 + Load 4

  Note: *The MOP value stamped on the nameplate is the largest of the two calculated values.*

- RDE = (1.5 x Load 1) + Load 2 + Load 3 + Load 4

Note: *Select an over current protection device equal to the MOP value. If the calculated MOP value does not equal a standard size protection device listed in NEC 240-6, select the next lower over current protection device. If the calculated MOP value is less than the MCA value, select the lowest over current protection device which is equal to or larger than the MCA, providing the selected over current device does not exceed 800 amps.*

Note: *Select a Dual Element Fuse equal to the RDE value. If the calculated RDE value does not equal a standard dual element fuse size listed in NEC 240-6, select the next higher fuse size. If the calculated RDE value is greater than the MOP value, select a Dual Element fuse equal to the calculated MOP (Maximum Over current Protection) value.*

Disconnect Switch Sizing (DSS)

- Calculation A — YC*, TC*, and TE* units:
  - DSS = 1.15 X (LOAD1 + LOAD2 + LOAD4)

  Note: *For TE* units, use calculations A and B.*

- Calculation B — TE* units:
  - DSS = 1.15 X (LOAD3 + Supply Fan FLA + Exhaust Fan FLA).

Note: *Use the larger value of calculations A or B to size the electrical disconnect switch.*

Low Voltage Wiring

An overall layout of the various control options available for a Constant Volume application is illustrated in Figure 21, p. 34. Figure 22, p. 35 illustrates the various control options for a Variable Air Volume application. The required number of conductors for each control device are listed in the illustration.

A typical field connection diagram for the sensors and other options are shown in the following section "Remote Panels and Sensors". These diagrams are representative of standard applications and are provided for general reference only. Always refer to the wiring diagram that shipped with the unit for specific electrical schematic and connection information.

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

Control Power Transformer

⚠ 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 24 volt control power transformers are equipped with internal circuit breakers. They are to be used only with the accessories called out in this manual. If a circuit breaker trips, be sure to turn off all power to the unit before attempting to reset it.

On units equipped with the VFD option, an additional control power transformer is used. The secondary is protected with fuses. Should the fuse blow, be sure to turn off all power to the unit before attempting to replace it.

Field Installed AC Control Wiring

⚠ 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.

⚠ 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.

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.

NOTICE

Component Failure!

Resistance in excess of 3 ohms per conductor could result in component failure due to insufficient AC voltage supply.
Do not exceed three (3) ohms per conductor for the length of the run.

Before installing any connecting wiring, refer to Table 15, p. 33 for conductor sizing guidelines and;

- Use copper conductors unless otherwise specified.
- Ensure that the AC control voltage wiring between the controls and the unit's termination point does not exceed three (3) ohms/conductor for the length of the run.
- Refer to dimensional information beginning with Figure 1, p. 14 for the electrical access locations provided on the unit.
- Do not run the AC low voltage wiring in the same conduit with the high voltage power supply wiring.

Be sure to check all loads and conductors for grounds, shorts, and miswiring. After correcting any discrepancies, reset the circuit breakers by pressing the black button located on the left side of the transformer.

Table 15. AC conductors size

Distance from unit to control	Recommended wire size
000-460 feet	18 gauge
461-732 feet	16 gauge
733-1000 feet	14 gauge

Field Installed DC Control Wiring

⚠ 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.

⚠ 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.

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.

Before installing the connecting wiring between the components utilizing a DC analog output/input signal and the unit, refer to Table 16, p. 33 for conductor sizing guidelines and;

- Use standard copper conductor thermostat wire unless otherwise specified.
- Ensure that the wiring between the controls and the unit's termination point does not exceed two and a half (2-1/2) ohms/conductor for the length of the run.

  Note: *Resistance in excess of 21/2 ohms per conductor can cause deviations in the accuracy of the controls.*
- Refer to dimensional drawings beginning with Figure 1, p. 14 for the electrical access locations provided on the unit.
- Do not run the electrical wires transporting DC signals in or around conduit housing high voltage wires.

Table 16. DC conductors

Distance from unit to control	Recommended wire size
000-150 feet	22 gauge
151-240 feet	20 gauge
241-385 feet	18 gauge
386-610 feet	16 gauge
611-970 feet	14 gauge

Units equipped with the Trane Communication Interface (TCI) option, which utilizes a serial communication link;

- Must be 18 AWG shielded twisted pair cable Belden 8760 or equivalent).
- Must not exceed 5,000 feet maximum for each link.
- Must not pass between buildings.

Figure 21. Typical field wiring requirements for CV and SZ VAV control options

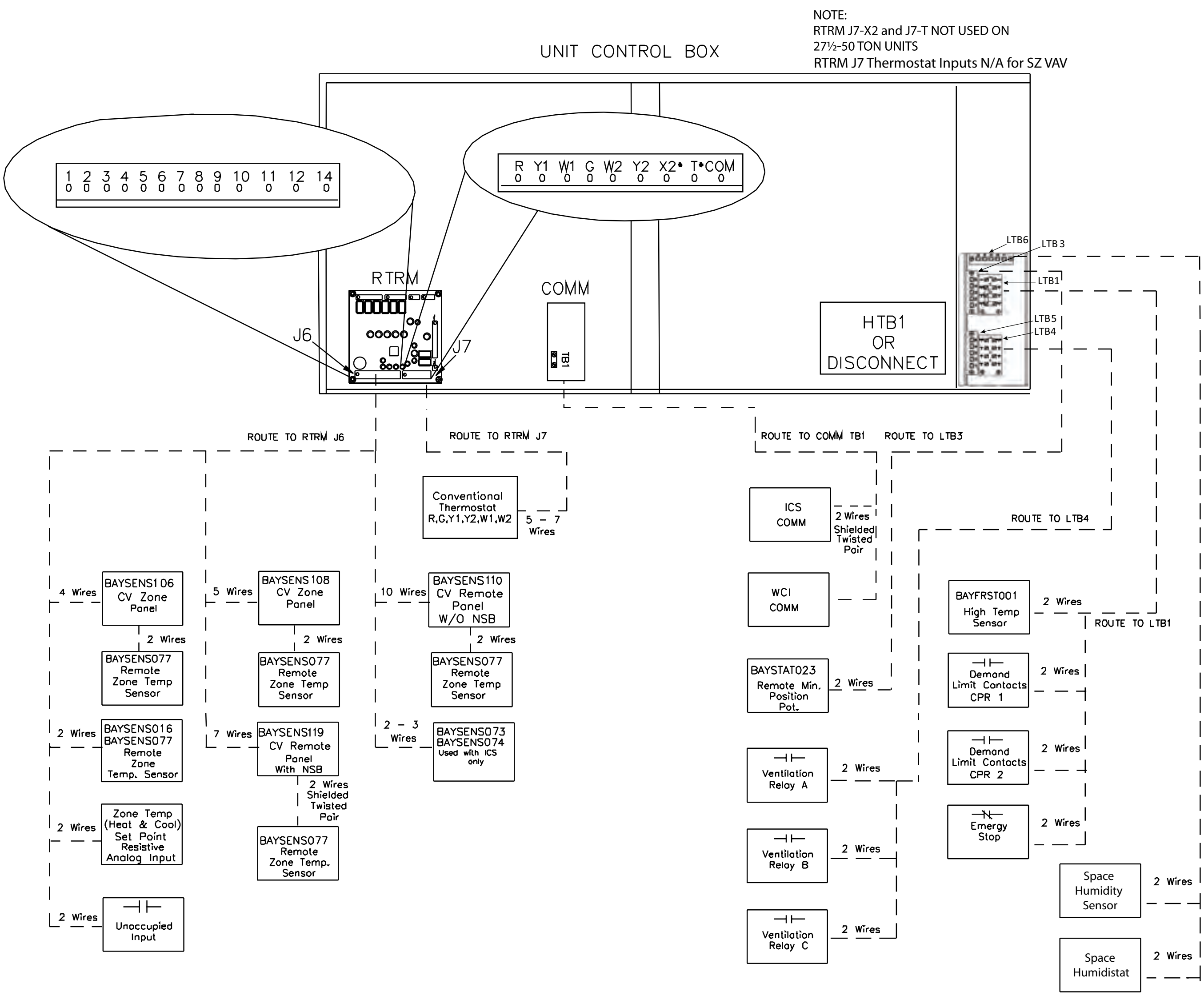
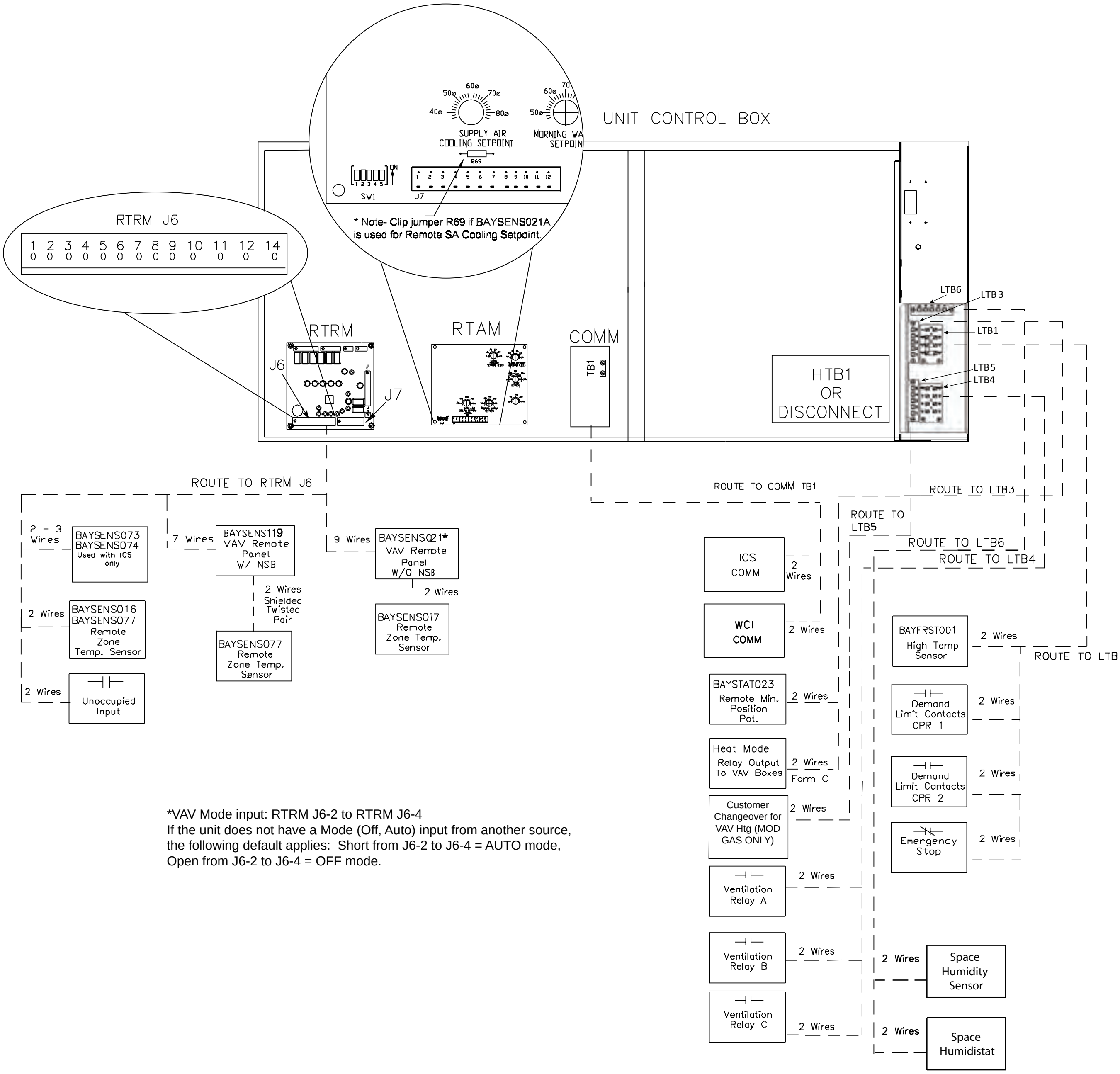
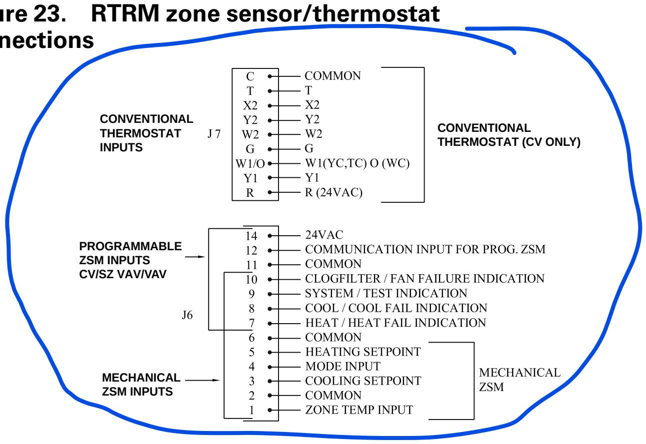


Figure 22. Typical field wiring requirements for traditional VAV control options



*VAV Mode input: RTRM J6-2 to RTRM J6-4
If the unit does not have a Mode (Off, Auto) input from another source, the following default applies: Short from J6-2 to J6-4 = AUTO mode, Open from J6-2 to J6-4 = OFF mode.

Figure 23. RTRM zone sensor/thermostat connections



Remote Panels and Sensors

Constant Volume and Single Zone VAV Control Options

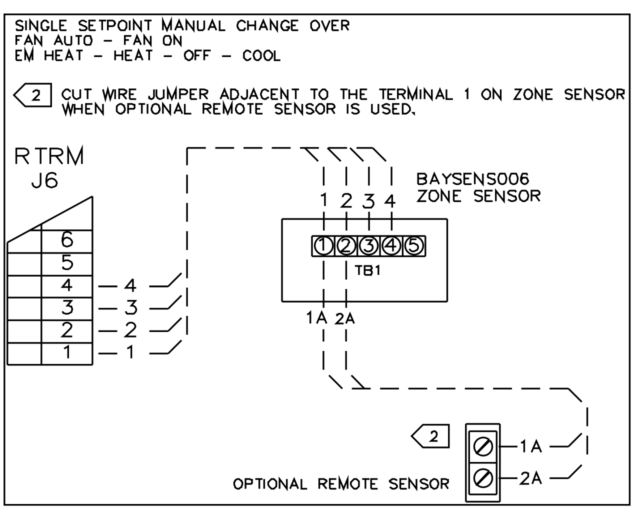
The RTRM must have a zone sensor or conventional thermostat (CV only) to operate the rooftop unit. If using a zone sensor, mode capability depends upon the type of sensor and/or remote panel selected to interface with the RTRM. The possibilities are: Fan selection ON or AUTO, System selection HEAT, COOL, AUTO, and OFF. Refer to Figure 23, p. 36 for conventional thermostat connections on Constant Volume units.

The following controls are available from the factory for field installation on Constant Volume or Single Zone VAV units.

Zone Panel (BAYSENS106*)

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

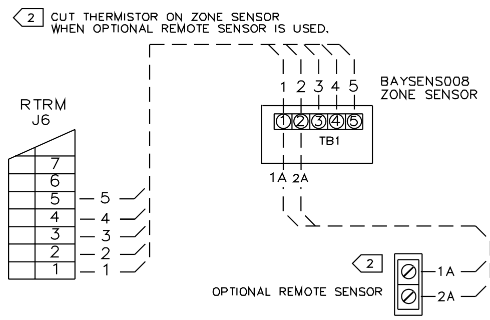
Figure 24. Zone panel (BAYSENS106*)



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 auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

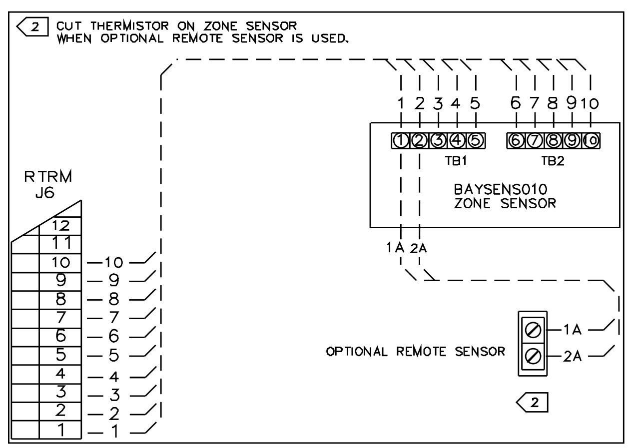
Figure 25. Zone panel (BAYSENS108*)



Remote Panel W/O NSB (BAYSENS110*)

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto) with four system status LED's. It is a manual or auto changeover control with dual setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Figure 26. Remote panel W/O NSB (BAYSENS110*)



Variable Air Volume (non-SZ VAV) Control Options

The RTRM must have a mode input in order to operate the rooftop unit. The normal mode selection used with a remote panel with or without night setback, or ICS is AUTO and OFF. Table 17, p. 37 lists the operating sequence should a CV/SZ VAV zone sensor be applied to a traditional VAV system having selectable modes; i. e. Fan selection ON or AUTO. System selection HEAT, COOL, AUTO, and OFF.

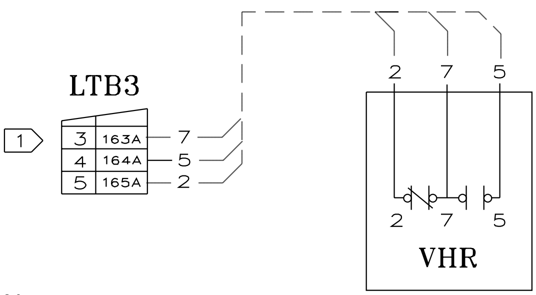
Default Mode Input for Discharge Air Control

For unit stand-alone operation without a remote panel or an ICS connected, jumper between terminals J6-2 and J6-4 on RTRM.

VHR Relay Output

For stand alone VAV unit operation, the VHR output should be wired to drive VAV boxes to maximum position during all heating modes and unoccupied periods. The VHR contacts are shown in the de-energized position and will switch (energize) during the above mentioned operating modes.

Figure 27. VHR relay output



Note:
1 Heat mode/unoccupied mode relay output to VAV

Table 17. Variable air volume mode operation

System Mode		Fan "Auto"	Fan "On"
Heat	DWU Active	DWU(a)	DWU(a)
	DWU Off	Off(b)	VAV Heating (b)
Cool		VAV Cooling (c)	VAV Cooling
Auto	DWU Active	DWU or Cooling(c)(a)(b)(d)	DWU or Cooling(c)(a)(b)(d)
	DWU Off	VAV Cooling (c)	VAV Cooling or Heating(c)
Off		Off (b)	Off (b)

(a) If Daytime Warmup is Activated, the supply fan will run continuously.
(b) The fan will be Off any time the system selection switch is "Off".
(c) If Cooling is selected the supply fan will run continuously. If VAV Heating is activated the supply fan will run continuously.
(d) Auto changeover between Cooling and Daytime Warmup depends upon the DWU initiate setpoint.

VAV Controls Available from the Factory for Field Installation

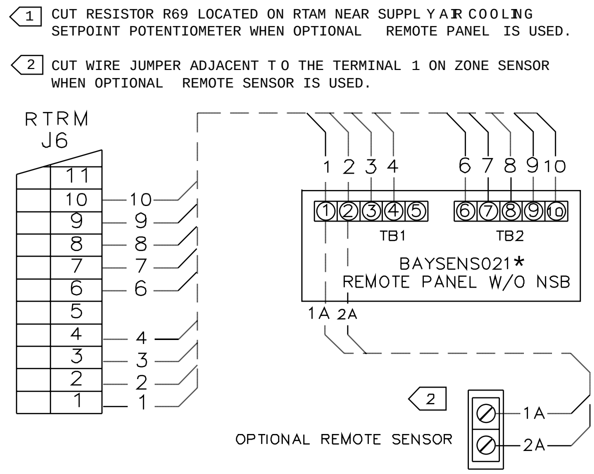
Remote Zone Sensor (BAYSENS016*)

This bullet type temperature sensor can be used for; outside air (ambient) sensing, return air temperature sensing, supply air temperature sensing, remote temperature sensing (uncovered), and for VAV zone reset. Wiring procedures vary according to the particular application and equipment involved. Refer to the unit wiring diagrams, engineering bulletins, and/or any specific instructions for connections.

Remote Panel W/O NSB (BAYSENS021*)

This electronic sensor features two system switch settings (Auto and Off), four system status LED's with single setpoint capability. It can be used with a remote zone temperature sensor BAYSENS077*.

Figure 28. Remote panel W/O NSB (BAYSENS021*)

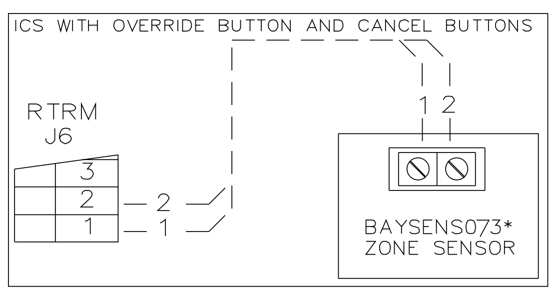


Constant Volume or VAV (Traditional or Single Zone) Controls Available from the Factory for Field Installation

Remote Zone Sensor (BAYSENS073*)

This electronic sensor features remote zone sensing and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

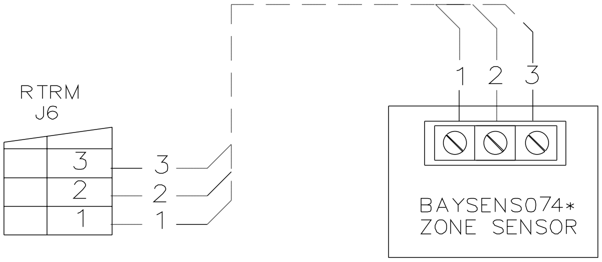
Figure 29. Remote zone sensor (BAYSENS073*)



Remote Zone Sensor (BAYSENS074*)

This electronic sensor features single setpoint capability and timed override with override cancellation. It is used with a Trane Integrated Comfort™ building management system.

Figure 30. Remote zone sensor (BAYSENS074*)



Remote Zone Sensor (BAYSENS077*)

This electronic sensor can be used with BAYSENS106*, 108*, 110*, 119*, or 021* Remote Panels. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to the specific Remote Panel for wiring details.

Remote Panel with NSB (BAYSENS119*)

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

The front panel allows selection of Occupied/Unoccupied periods with two temperature inputs (Cooling Supply Air Temperature and Heating Warm-up temperature) per occupied period. The occupied supply air cooling setpoint ranges between 40° and 80° F. The warm-up setpoint ranges between 50° and 90° F with a 2 degrees deadband. The unoccupied cooling setpoint ranges between 45° and 98°F. The unoccupied heating setpoint ranges between 43° and 96°F.

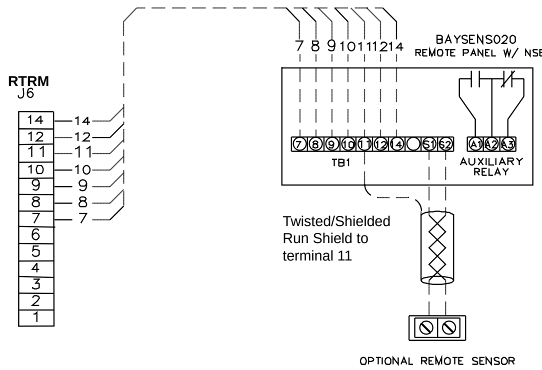
***Note:** In modulating gas heat units, the supply air heating setpoint is the active setpoint with a BAYSENS119* and must be set for the heater to function properly. The modulating furnace will not react to the Discharge Heating Setpoint on the NSB.*

The liquid crystal display (LCD) displays zone temperature, temperature setpoints, week day, time, and operational mode symbols.

The options menu is used to enable or disable these applicable functions: Morning warm-up, economizer minimum position override during unoccupied status, heat installed, remote zone temperature sensor, 12/24 hour time display, and daytime warm-up. See Table 18, p. 39 for the Temp vs Resistance coefficient if an optional remote sensor is used.

During an occupied period, an auxiliary relay rated for 1.25 amps @ 30 volts AC with one set of single pole double throw contacts is activated.

Figure 31. Remote sensor with night setback BAYSENS119

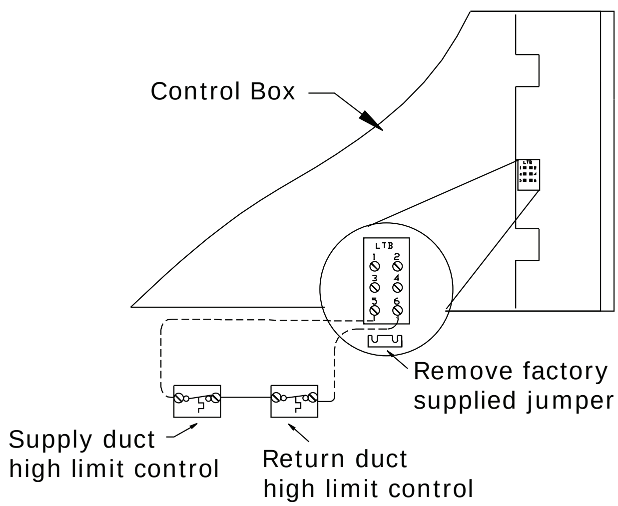


High Temperature Sensor (BAYFRST003*)

Provides high limit “shutdown” of the unit.

The sensor is used to detect high temperatures due to fire in the air conditioning or ventilation ducts. The sensor is designed to mount directly to the sheet metal duct. Each kit contains two sensors. The return air duct sensor (X1310004001) is set to open at 135ºF. The supply air duct sensor (X1310004002) is set to open at 240ºF. The control can be reset after the temperature has been lowered approximately 25ºF below the cutout setpoint.

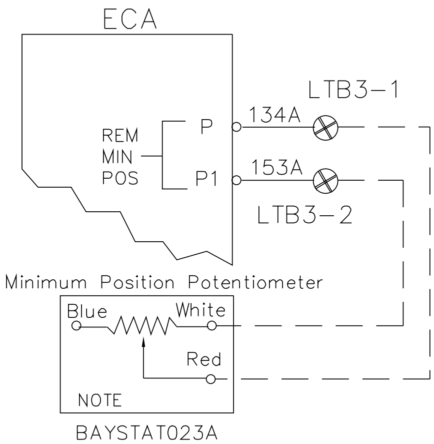
Figure 32. High temperature sensor (BAYFRST003*)



Remote Minimum Position Potentiometer (BAYSTAT023*)

This device can be used with units with an economizer. It allows the operator to remotely set the position of the economizer dampers from 0% to 50% of fresh air entering the space.

Figure 33. Remote minimum position potentiometer (BAYSTAT023)



Space Temperature Averaging

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

The fewest number of sensors required to accomplish space temperature averaging is four. Example #1 illustrates two series circuits with two sensors in each circuit wired in parallel. Any number squared, is the number of remote sensors required. Example #2 illustrates three sensors squared in a series/parallel circuit. NSB panel remote sensors must use twisted/ shielded cable.

Figure 34. Space temperature averaging

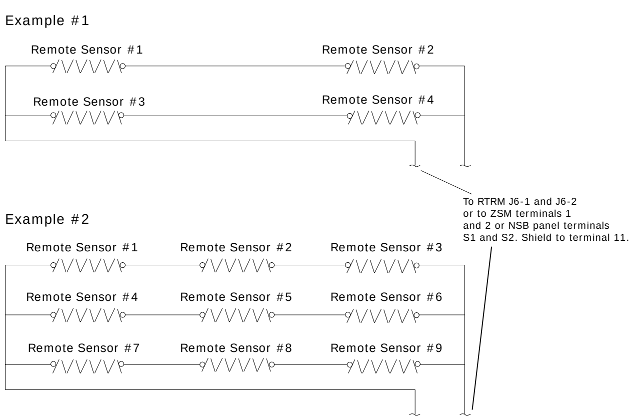


Table 18. Temperature vs. resistance (temperature vs. resistance coefficient is negative)

Degrees F°	Nominal Resistance
-20°	170.1 K - Ohms
-15°	143.5 K - Ohms
-10°	121.4 K - Ohms
-5°	103.0 K - Ohms
0°	87.56 K - Ohms
5°	74.65 K - Ohms
10°	63.80 K - Ohms
15°	54.66 K - Ohms
20°	46.94 K - Ohms
25°	40.40 K - Ohms
30°	34.85 K - Ohms
35°	30.18 K - Ohms
40°	26.22 K - Ohms
45°	22.85 K - Ohms
50°	19.96 K - Ohms
55°	17.47 K - Ohms
60°	15.33 K - Ohms
65°	13.49 K - Ohms
70°	11.89 K - Ohms
75°	10.50 K - Ohms
80°	9.297 K - Ohms
85°	8.247 K - Ohms
90°	7.330 K - Ohms
95°	6.528 K - Ohms
100°	5.824 K - Ohms

Installation Piping

General Requirements

⚠ 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.

All internal gas piping for YC* rooftop units are factory installed and leak tested. Once the unit is set into place, a gas supply line must be field installed and connected to the gas train located inside the gas heat compartment.

Access holes are provided on the unit as shown in Figure 12, p. 19 to accommodate side panel 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 to determine the appropriate gas pipe size for the heating capacity listed on the unit's nameplate.

   If a gas line already exists, verify that it is sized large enough () to handle the additional furnace capacity.
2. Take all branch piping from any main gas line from the top at 90 degrees or side at 45 degrees to prevent moisture from being drawn in with the gas.
3. 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.
4. Provide a drip leg near the unit.

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.

5. Install a pressure regulator at the unit that is adequate to maintain 6" w.c. for natural gas and 11" w.c. for LP gas while the unit is operating in the “High Heat” mode. A minimum inlet gas pressure of 2.5" w.c. for natural gas and 8" w.c. for LP gas is required while operating in the “High Heat” mode.

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

⚠ 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.

6. Leak test the gas supply line using a soap-and-water solution or equivalent before connecting it to the gas train.
7. Pressure test the supply line 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 gas train shutoff valves to isolate the unit while conducting gas pressure/leak test. These valves are not designed to withstand pressures in excess of 14" w.c. or 0.5 psig.*

Connecting the Gas Supply Line to the Furnace Gas Train

Follow the steps below to complete the installation between the supply gas line and the furnace. Refer to Figure 35, p. 41 for the 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. Provide adequate support for the field installed gas piping to avoid stressing the gas train and controls.
3. Adjust the inlet supply gas pressure to the recommended 6" for natural gas or 11" w.c. for LP gas.

Table 19. Specific gravity multiplier

Specific Gravity	Multiplier
0.5	1.1
0.55	1.04
0.6	1
0.65	0.96

Table 20. Sizing natural gas pipe mains and branches

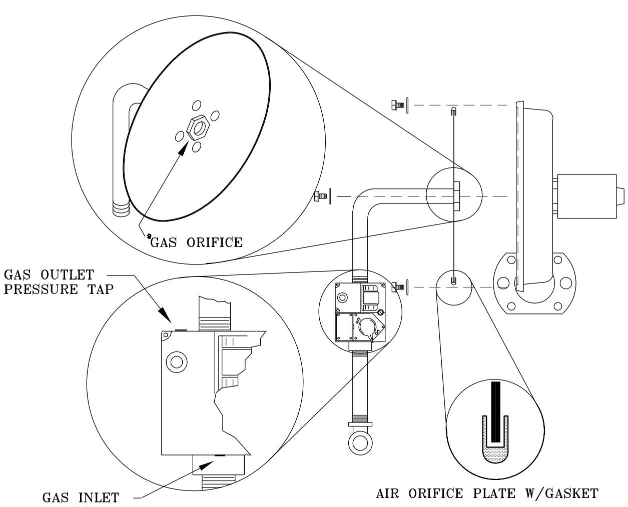
Gas Supply Pipe Run (ft)	Gas Input (Cubic Feet/Hour)[a]					
	1-1/4″ Pipe	1-1/2″ Pipe	2" Pipe	2-1/2″ Pipe	3"Pipe	4"Pipe
10	1050	1600	3050	4800	8500	17500
20	730	1100	2100	3300	5900	12000
30	590	890	1650	2700	4700	9700
40	500	760	1450	2300	4100	8300
50	440	670	1270	2000	3600	7400
60	400	610	1150	1850	3250	6800
70	370	560	1050	1700	3000	6200
80	350	530	990	1600	2800	5800
90	320	490	930	1500	2600	5400
100	305	460	870	1400	2500	5100
125	275	410	780	1250	2200	4500
150	250	380	710	1130	2000	4100
175	225	350	650	1050	1850	3800
200	210	320	610	980	1700	3500

Notes:

1. 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.
2. Obtain the Specific Gravity and BTU/Cu.Ft. from the gas company.
3. 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 500 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. Cu.Ft/Hour = 500. This table indicates that a 1-1/4″ pipe is required.

(a) Table is based on a specific gravity of 0.60. Use previous table or the specific gravity of the local gas supply.

Figure 35. Gas train configuration for low heat units (high heat units utilize two gas trains.)



Startup

Unit Control Modules

RTRM - ReliaTel™ Refrigeration Module

The RTRM is the main information receiving module. It interprets the information received from all other unit modules, sensors, remote panels, customer binary contacts and responds by activating the various unit components to satisfy the applicable request for economizing, cooling, heating, exhaust, ventilation. The RTRM configuration is set through the wire harness to function within one of six system applications:

- Constant Volume Supply Air with No Heat.
- Constant Volume Supply Air with Gas or Electric Heat.
- Variable Supply Air Volume with No Heat.
- Variable Supply Air Volume with Gas or Electric Heat.
- Single Zone Variable Supply Air Volume with No Heat.
- Single Zone Variable Supply Air Volume with Gas or Electric Heat.

ECA/RTEM - Economizer Actuator/ ReliaTel Economizer Module (Optional)

The ECA/RTEM monitors the mixed air temperature, return air temperature, minimum position setpoint (local or remote), ambient dry bulb/enthalpy sensor or comparative humidity (return air humidity against ambient humidity) sensors, if selected, to control the dampers to an accuracy of +/- 5% of the stroke. The actuator is spring returned (FA closed, RA opened) any time power is lost to the unit. Refer to “Mechanical Cooling with an Economizer ,” p. 58 for the proper potentiometer settings for dry bulb/Enthalpy control.

Note: *The ECA/RTEM control module is mounted on the actuator. Units with the ultra-low-leak economizer option have their ECA control module mounted to a panel adjacent to the RA damper.*

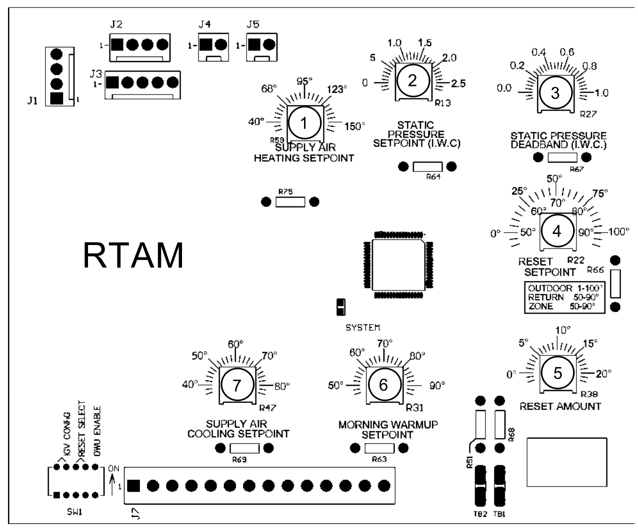
EBA - Exhaust Blade Actuator (Optional)

If the unit is ordered with tracking power exhaust, the EBA will track the economizer damper position as long as the active exhaust fan setpoint has been exceeded - set via RTOM, through BAS, or calculated (SZ VAV only). The actuator limits the maximum travel of the exhaust barometric damper. The exhaust blade actuator is spring returned and is closed any time power is lost to the unit.

RTAM - ReliaTel Air Handler Module (Standard with Traditional VAV)

The RTAM receives information from the supply duct static pressure transducer. Attached to the module are the supply air heating potentiometer, supply air cooling setpoint potentiometer, supply pressure setpoint potentiometer, static pressure deadband potentiometer, morning warm-up setpoint potentiometer, reset setpoint potentiometer, and 5 DIP switches. See following figure.

Figure 36. RTAM module



1 = Supply Air Heating Setpoint
2 = Static Pressure Setpoint (iwc)
3 = Static Pressure Deadband (iwc)
4 = Reset Setpoint
5 = Reset Amount
6 = Morning Warmup Setpoint
7 = Supply Air Cooling Setpoint

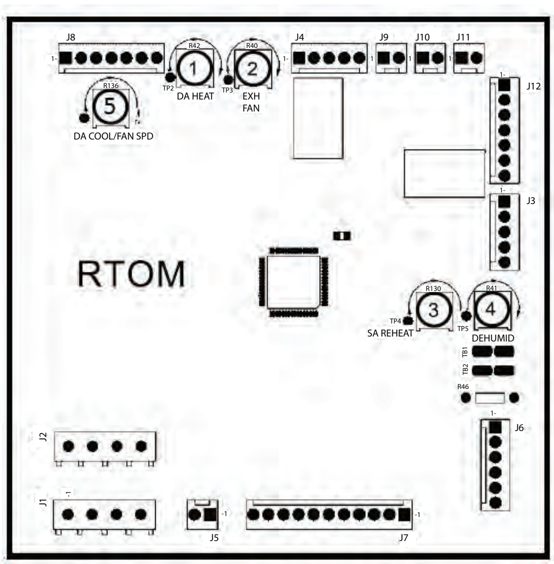
DIP Switches:

- Switch 1 is “ON” for VFD's.
- Switch 2 is “OFF” for VAV.
- Switch 3 and 4 operation are explained under “supply air temperature reset”.
- Switch 5 is “OFF” for DWU Disabled and “ON” for DWU Enabled.

The RTAM module provides a 0 to 10 Vdc output to control the Variable Frequency Drive. DIP switches located on the RTAM configures the unit to use the output for a VFD. Customer changeover input from Low Voltage Terminal Board (LTB5) activates VAV heating. The Supply Air Heating setpoint must be set to the desired discharge air temperature for heating. This VAV heating mode is available only with modulating gas heat units. In this mode the gas heaters modulate and the supply air pressure control remains active to satisfy the zone settings.

For constant volume (CV) units with modulating gas heat using a conventional thermostat or for Single Zone VAV units with modulating gas heat, the Discharge Air SP on the RTOM must be set to desired discharge air temperature in order for the unit to function properly. For VAV units with modulating gas heat, the Supply Air Heating Setpoint on the RTAM is used to control the heat setpoint in the changeover heating mode.

Figure 37. RTOM module



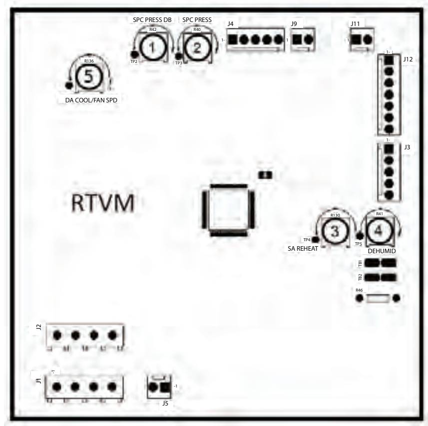
1 = Discharge Air Heat Setpoint**
2 = Exhaust Fan Enable Setpoint
3 = Supply Air Reheat Setpoint
4 = Dehumidification (%) Setpoint
5 = Discharge Air Cool Setpoint LL***

**Discharge Air Heat Setpoint is required for Single Zone VAV units with modulating heat or traditional Constant Volume units with modulating heat and a conventional thermostat control.

***Discharge Air Cool Setpoint is required for Single Zone VAV operation.

ReliaTel Ventilation Module (RTVM)

Figure 38. RTVM module



1 = Space Pressure Deadband (iwc)
2 = Space Pressure Setpoint (iwc)
3* = R130 = Design minimum OA flow Setpoint
4* = R41 =DCV Minimum OA flow Setpoint

3** = R130 (SA REHEAT SP) = Design Minimum Position at Minimum Fan Speed Command
4** = R41 (DEHUMID) = DCV Minimum Position at Minimum Fan Speed Command
5** = R136 (DA COOL/FAN SPD) = Design Minimum Position at 50% Fan Speed Command

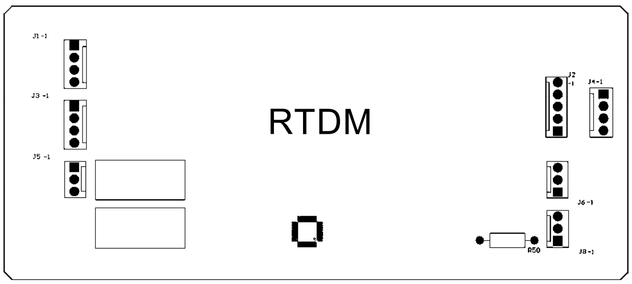
* Setpoints for units with TRAQ
** Setpoints only required for Single Zone VAV units with Demand Controlled Ventilation installed.

The RTVM (Ventilation Module) provides a 2 to 10 Vdc signal to control the Exhaust Blade Actuator in order to relieve positive building pressure. The signal output will be modulated based on the measured values from the Space Pressure Transducer. The Space Pressure Calibration Solenoid will ensure that the RTVM reads a differential pressure between the building pressure and atmospheric pressure. The Space Pressure Setpoint and Space Pressure Deadband are set by adjusting potentiometers located on the RTVM. Also, units configured for Single Zone VAV control with Demand Controlled ventilation will require an RTVM for the additional, required Outside Air damper minimum position setpoint potentiometers.

Units configured with the Fresh Air Measurement (Traq) option will require a RTVM for required sensors and setpoints to perform Traq airflow control. The Airflow Sensor input, Minimum Outside Air CFM Setpoints (Design and DCV), and Outside Airflow Adjustment Setpoint are all provided by the RTVM. The RTVM takes the airflow sensor voltage, converts it to airflow (CFM) and calculates a Traq outside air minimum OA damper position to maintain the desired adjustable CFM setpoint value. The airflow can be adjusted for altitude differences with the Outside Airflow Adjustment Setpoint.

ReliaTel Dehumidification Module (RTDM)

Figure 39. RTDM module



The RTDM provides a pulsed signal output to control the Cooling and Reheat Modulating Valves. The RTDM will also monitor the Entering Evaporator Temperature as well as protect against a low refrigerant pressure in the reheat circuit.

Conventional Thermostat Connections (Available Only with CV)

This feature allows conventional thermostats to be used in conjunction with the RTRM on Constant Volume Applications only. It utilizes the conventional wiring scheme of R, Y1, Y2, W1, W2/X, and G. Refer to Figure 23, p. 36 for conventional thermostat connections. Applicable thermostats to be used with the conventional thermostat inputs are:

Table 21. Thermostats

Vendor	Part #	Trane Part #
Honeywell	T7300	
Honeywell	T874D1082	BAYSTAT011
Enerstat	MS-1N	BAYSTAT003

TCI - Trane Communication Interface (Optional)

This module is used when the application calls for an ICS building management type control system. It allows the control and monitoring of the system through a Trane Tracer™ panel. The module can be ordered from the factory or ordered as a kit to be field installed. Follow the installation instructions that ship with each kit when field installation is necessary.

LCI - LonTalk® Communication Interface (Optional)

This module is used when the application calls for a LonTalk building management type control system. It allows the control and monitoring of the system through a Trane Tracer Summit panel or 3rd party LonTalk system. The module can be ordered from the factory or ordered as a kit to be field installed. Follow the installation instructions that ship with each kit when field installation is necessary.

BCI - BACnet® Communication Interface (Optional)

This module is used when the application calls for a BACnet building management type control system. It allows the control and monitoring of the system through a Trane Tracer SC panel or 3rd party BACnet system. The module can be ordered from the factory or ordered as a kit to be field installed. Follow the installations instructions that ship with each kit when field installation is necessary.

WCI - Trane Air-Fi™ Wireless Comm Interface (Optional)

The Trane® Air-Fi Wireless Comm Interface (WCI) is the perfect alternative to Trane's BACnet™ wired communication links (for example, Comm links between a Tracer™ SC and a Tracer UC400). Minimizing communication wire used between terminal products, zone sensors, and system controllers has substantial benefits. Installation time and associated risks are reduced. Projects are completed with fewer disruptions. Future re-configurations, expansions, and upgrades are easier and more cost effective.

TD5 Display - 5" Touchscreen Display

The Tracer TD5 display is an optional display module that operates in conjunction with the ReliaTel Controller and allows you to view data and make operational changes. More information on the Tracer TD5 Display can be found in Installation, Operation, and Maintenance Manual, RT-SVX49*-EN.

System Operation

Economizer Operation with a Conventional Thermostat (CV Only)

If the ambient conditions are suitable for economizer operation, the economizer is activated as the 1st step of cooling from Y1. The dampers are controlled to provide a supply air temperature of 50° F +/- 5° F. If the economizer is disabled due to ambient conditions, the 1st stage of mechanical cooling is activated.

While economizing, if an additional stage of cooling is activated from Y2, the 1st stage of mechanical cooling is activated. If the economizer is disabled due to ambient conditions, the 2nd stage of mechanical cooling is activated.

The supply fan is activated from the G terminal and will cycle with a call for heat or cooling if in the “Auto” mode. It will run continuously in the “On” mode regardless of any other system demand.

On gas heat units, first and second stages are activated by the W1 and W2 terminals on the CTI. On electric heat units, only two stages of heat are available. If the W2 terminal is activated without activating the W1 terminal, the RTRM will bring on both stages of electric heat.

The conventional thermostat connections can also be utilized as a generic building automation system interface for constant volume ICS applications. Due to the limited heating and cooling steps when using a conventional thermostat, compressor staging will vary on units with three compressors.

Note: *If a conventional thermostat is used with a unit that has modulating gas heat, the unit will control to the Discharge Air SP potentiometer on the RTOM when heating with a W1 call only. The unit will go to high fire with W1 + W2.*

Microelectronic Control Features

Anti Short Cycle Timer (ASCT)

Compressor operation is programmed for 3 minutes of minimum “ON” time, and 3 minutes of minimum “OFF” time. Enhances compressor reliability, and ensures proper oil return.

Note: *Compressor cycle rate minimization, extends compressor life expectancy, minimizes damaging compressor inrush current, and guards against short cycling.*

Delay Between Stages Timer

When combined with a standard Zone Sensor Module, the Reliatel Refrigeration Module (RTRM) provides a 10 second minimum “ON” delay for compressor staging.

Built-in Fan Delay Relay (Constant Volume and Single Zone VAV Units)

When the fan mode switch on the Zone Sensor Module is set in the auto position, the RTRM provides individual supply fan timing sequences for each system in heating and cooling. The RTRM provides different timing sequences for Gas Heat units and Cooling only units.

Low Ambient Cooling

Low ambient cooling to 0°F with Frostat™ .

Built-in Electric Heat Staging

Provides a 10 second “ON” delay between resistance heat stages.

Economizer Preferred Cooling

Allows fully integrated economizer operation with mechanical cooling if actually needed.

On Constant Volume and Single Zone VAV applications, a 3 minute delay allows the RTRM to evaluate the rate of change in the zone. If the zone temperature is dropping faster than acceptable parameters, the compressor(s) will not be required to operate.

Free Night Setback

Allows the unit to enter an unoccupied mode by simply shorting across terminals RTRM J6-11 and J6-12. The short can be achieved by a set of dry contacts or a time clock. Once this short has been made the unit will close the economizer dampers, go from continuous fan to auto fan operation.

ON CV or SZ VAV units with mechanical ZSM:

- If the unit has a valid cooling and heating setpoint, the setup/setback is a minimum of 7°F.
- If the unit does not have both setpoints, the setup/ setback is 0°.
- If the unit has neither setpoint, the unoccupied cooling/heating setpoints will be 74°F/71°F.
- If the unit is configured as a Constant Volume unit and a conventional thermostat is used, this input is ignored and the unit will respond to thermostat requests as during normal occupied mode.
- VAV unit w/o ICS or NSB energizes heating if the space temperature drops to 10°F below the MWU setpoint but not less than 50°F.
- This option can not be used with programmable ZSM or with an ICSTM system.

Low Pressure Cutouts

Low pressure cutouts on all compressors have been added to insure compressor reliability in low refrigerant flow situations. The compressor(s) will lockout after four consecutive low pressure control trips during the compressor minimum 3 minute “on” time. The lockout will have to be manual reset as explained in this document.

Economizer Operation with CV Controls

The control point for the economizer is designed to control at least 1.5°F below the cooling setpoint or 1.5° F above the heating setpoint, whichever produces the highest economizer control setpoint.

Example:

Heating Setpoint = 68°F

Cooling Setpoint = 70°F

The control temperature for the economizer will be 1.5° F above the heating setpoint due to it producing the least amount of offset.

Heating Setpoint = 55°F

Cooling Setpoint = 75°F

Because of the spread between the heating and cooling setpoints, the control will choose to control the economizer at an offset temperature of 1.5°F below the cooling setpoint. This will be the highest resulting control setpoint temperature while maintaining the least amount of offset.

The percentage that the economizer dampers open is based on two factors:

- The zone temperature minus the economizer setpoint, and,
- The zone temperature minus the outdoor air temperature.

Note: *The following table lists the percentages the dampers will open based on these conditions.*

Table 22. Percent of damper travel

Zone - ODT	Zone Temp - Econ Setpoint °F					
	0.0-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-5.0	>-5.0
0 - 7°F	0%	3%	9%	30%	90%	10-0%
7 - 14°F	0%	2%	6%	20%	60%	10-0%
> 14°F	0%	1%	3%	10%	30%	10-0%

While economizing, if the supply air temperature falls below 50°F, the damper will not be allowed to open any further until the supply air temperature rises above 50° F. If the supply air temperature falls below 45°F, the dampers will be driven to minimum position and held there until the supply air temperature rises above 50°F.

The mechanical cooling is disabled while in an economizing state until two conditions are met:

- The economizer dampers have been fully open for three minutes, and;
- The calculated rate of change in the zone temperature is less than 12°F per hour.

If the economizer is disabled due to unsuitable conditions, the economizer is at the selected minimum position when the supply fan is **"On"**, and is closed when the supply fan is **"Off"**. The mechanical cooling will cycle as though the unit had no economizer.

Modulating Power Exhaust

If the unit is equipped with the modulating power exhaust option, the power exhaust actuator will follow the position of the economizer actuator.

Mechanical Cooling without an Economizer (CV and SZ VAV)

Mechanical cooling is used to maintain the zone temperature. The RTRM is designed to limit the compressor cycle rates to within 10 cycles per hour based on the minimum compressor "on" and "off" times.

It stages the mechanical cooling to control the zone temperature to within +/- 2°F of the sensor setpoint at the sensed location. Table 23, p. 46 lists the compressor staging sequence for standard efficiency units.

For high efficiency units there are three separate staging sequences which determine the staging of 3 compressors within each sequence. Each call for cool will operate within a given sequence and the next call for cool will operate in the next sequence. Lead/Lag operation is taken into consideration with these 3 staging sequences and will be active when Lead/Lag is configured. Table 24, p. 47 lists the compressor staging sequence for high efficiency units.

Table 23. Compressor staging with lead/lag disabled - std efficiency units (excluding 40–50T CV units)

Unit Model	"ON"			"OFF"		
	Step 1	Step 2	Step 3	Step 3	Step 2	Step 1
27.5 - 35	CPR 1 (a)	CPR 1, 2	N/A	N/A	CPR 1, 2	CPR 1
40	CPR 1 (b)	CPR 2 (c)	CPR 1, 2	CPR 1, 2	CPR 2 (c)	CPR 1 (b)
50	CPR 1 (b)	CPR 2,3(d)	CPR 1, 2, 3	CPR 1, 2, 3	CPR 2, 3(d)	CPR 1 (b)

(a) Single circuit, dual manifolded compressors
(b) Number one refrigeration circuit, Standalone compressor, is "On".
(c) First stage is off. Number two refrigeration circuit, standalone compressor, is "On"
(d) First Stage is "Off", Number two refrigeration circuit, manifolded compressor pair operating simultaneously, is "On".

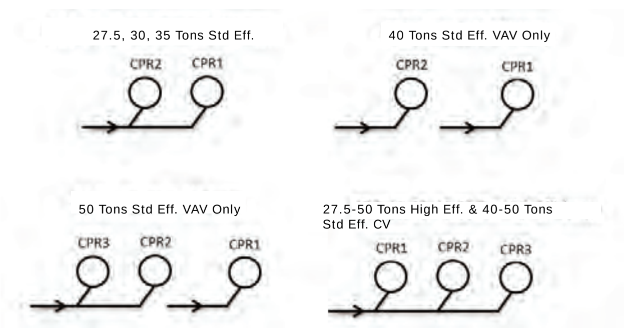
Table 24. Compressor staging sequence - high efficiency units and std eff. 40–50T CV units)

Sequence 1			
Sta-ge	CPR 1	CPR 2	CPR 3
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	ON	ON
5	ON	ON	ON

Sequence 2			
Sta-ge	CPR 1	CPR 2	CPR 3
1	Start at Stage 2		
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	ON	ON
5	ON	ON	ON

Sequence 3			
Sta-ge	CPR 1	CP-R2	CP-R3
1	Start at Stage 2		
2	OFF	OFF	ON
3	ON	OFF	ON
4	OFF	ON	ON
5	ON	ON	ON

Figure 40. Compressors



Zone Temperature - Occupied Cooling (CV and SZVAV)

When the unit is in the cooling mode and the zone temperature raises above the cooling setpoint control band, the economizer and the compressor stages will be cycled as required by the zone sensor, remote panel, or Tracer®. For SZ VAV control, the fan capacity will also be controlled in order to meet the zone cooling demand.

Zone Temperature - Occupied Heating (CV and SZVAV)

When the unit is in the heating mode and the zone temperature falls below the heating setpoint control band, the necessary stages of heat will cycle to raise the temperature to within the setpoint control band. For SZ VAV, the fan capacity will also be controlled in order to meet the zone heating demand.

Supply Fan (CV and SZ VAV)

When the Fan Selection Switch is in the “AUTO” position and a call for cooling is initiated, the supply fan will delay starting for approximately one second on traditional CV units. For SZ VAV units, the supply fan will be controlled ON based on the zone cooling demand. Once ON, the unit will begin staging cooling capacity (economizer and/or compressors) in order to meet the discharge air requirements. Once the zone has been satisfied, the supply fan will be controlled OFF. When the Fan Selection Switch is in the “ON” position, the supply fan will run continuously. If airflow through the unit is not proven by the differential pressure switch (factory setpoint 0.15“w.c.) within 40 seconds nominally, the RTRM will shut off all mechanical operations, lock the system out, send a diagnostic to ICS, and the SERVICE LED output will pulse. The system will remain locked out until a reset is initiated either manually or through ICS or a mode transition from OFF to a non-OFF mode.

Supply Air Tempering (CV and SZ VAV)

CV Units with Staged Heat

This function allows the supply air temperature to be maintained within a low limit parameter during minimum ventilation periods. For CV units configured with a Staged Heat design (Electric or Gas) and Supply Air Tempering operation enabled, if the following items are true, the unit will enter Supply Air Tempering mode:

- The supply fan is ON.
- The unit is in Occupied mode.
- Zone Temp. is less than the active Cooling setpoint.
- The unit is in Heat mode but is not actively heating OR
- The unit is in AUTO-COOL mode but not actively cooling and cooling capacity has been OFF for 5 minutes.

Once the above conditions are met, if the supply air temperature drops to 10°F BELOW the Occupied Heating Zone Temperature Setpoint, the SA Tempering function will bring ON one stage of gas or electric heat.

Once SA Tempering is active, heating will be turned OFF if the Supply Air Temperature rises to 10°F ABOVE the Active Occupied Zone Heating Setpoint, or the Zone Temperature rises to the Active Zone Cooling Setpoint. Also, if the Zone Heat Control function is calling for 1 or more stages of Heat, Tempering will be discontinued and the unit will stage additional heating to meet the current demand.

When an economizer is installed, air tempering is allowed with ICSTM when the fan system switch is in the “ON” position with no call for heating. The same conditions must be met as described above for entering and leaving Tempering operation.

CV Units with Modulating Heat

On units with Modulating Gas Heat, Supply Air Tempering is inherent to the Modulating Heat design and does not require any additional configuration/ enabling. Modulating Heat Tempering is accomplished by allowing the unit to return to heating if the Zone is marginally satisfied and the Supply Air temperature begins to fall. The following conditions must be true to enable the unit to perform “Tempering”:

- The supply fan is ON.
- The unit is in Occupied mode.
- Zone Temp. is less than the active Cooling setpoint.
- The unit is in Heat mode but is not actively heating OR
- The unit is in AUTO-COOL mode but not actively cooling and cooling capacity has been OFF for 5 minutes.

Once the above conditions are met, and the supply air temperature drops below the ZHSP - 10°F, the unit will transition back into active heating operation and will begin to control the modulating heat output to maintain the supply air temperature.

Once the unit has entered into Tempering mode, the unit will leave active heating either by normal heat termination as determined by the heating control algorithm or when the Zone Temperature reaches the active ZCSP.

SZ VAV Units with Staged Heat

For SZ VAV units configured with a Staged Heating type, the Supply Air Tempering function will operate as on a CV unit with Staged Heat.

SZ VAV Units with Modulating Heat

For units configured with a Modulating Heat type, “Tempering” is an extension of normal Heating control which allows a transition from inactive “Auto-Cool” mode to Heating based on supply air temperature if the Zone Temperature is in control. The following conditions must be true to allow the unit to enter Supply Air Tempering:

- Supply Fan is ON.
- The unit is in Occupied mode.
- The unit is operating in Auto-Cool Mode.
- Cooling has been inactive for 5 minutes.

When the above conditions are true, Tempering will be allowed when the Supply Air Temperature falls below the user selectable Minimum Supply Air Cooling Setpoint (minus deadband) as long as the Zone Temperature is < ZCSP - 1°F. Once the unit transitions into “Tempering” the unit will transition to normal heating control and will control the supply air temperature between the minimum and maximum supply air setpoints.

If the Zone Temperature rises above the ZCSP during “Tempering” the unit will de-energize Heating and “Tempering” will be disabled until conditions allow for it again. Normal Auto-Changeover requirements will be in control to allow the unit to transition into Active Cool mode.

Variable Air Volume Applications (SZ VAV)

Supply Fan Output Control

Units configured for Single Zone VAV will include a VFD controlled supply fan motor which will be controlled via the 0-10Vdc Indoor Fan Speed output located on the RTOM and the RTRM Supply Fan output. With the RTRM Supply Fan output energized and the RTOM Indoor Fan Speed output at 0Vdc the fan speed output is 33% (20Hz) for cooling mode and 58% (35Hz) for heating modes from the VFD motor and at 10Vdc the fan speed output is 100% (60Hz). The control will scale the 0-10Vdc output from the RTOM linearly to control to 38%-100% controllable range based on the space heating or cooling demand.

Minimum Supply Fan Output

Refer to the table below for details on minimum supply fan output signals associated with each unit function. Note that each value represents the actual Fan Output %.

Table 25. Fan output - standard efficiency

Function	Minimum Fan Output %
Ventilation Only	58%
Economizer Cooling	58%
Cool 1 (C1 Energized)	58%
Cool 2 (C1 or C2)	67%
Cool 3 (C1 + C2 Energized)	67%
SZVAV Modulating Heat	58%
CV Staged Heat	100%
SZVAV Modulating Heat Tempering	58%
CV Staged Heat Tempering	100%
Modulating Reheat	80%

Table 26. Fan output - high efficiency

Function	Minimum Fan Output %
Ventilation Only	45%
Economizer Cooling	45%

Table 26. Fan output - high efficiency (continued)

Function	Minimum Fan Output %
Cool 1	45%
Cool 2	58%
Cool 3	67%
Cool 4	75%
Cool 5	75%
SZVAV Modulating Heat	58%
CV Staged Heat	100%
SZVAV Modulating Heat Tempering	58%
CV Staged Heat Tempering	100%
Modulating Reheat	80%

Supply Fan Mode Operation

Units configured for Single Zone VAV control will utilize Supply Fan Mode selection as is currently implemented into ReliaTel controls for normal Zone Control and will be selectable between AUTO and ON via a connected Zone Sensor module or through BAS/ Network controllers.

Supply Fan Mode "Auto" Operation

For active Cooling, Heating, and Hot Gas Reheat operation the Supply Fan will be commanded ON and will ramp up to the appropriate minimum speed once the unit determines that there is a request for capacity control. Once the active request is cleared and all capacity is de-energized normal supply fan off delays as implemented on constant volume units will be in effect. During the Supply Fan Off-Delay, the supply fan will remain energized for the predetermined time at the previous unit function's minimum speed. All other cases which would bring the Supply Fan ON will function as on non-Single Zone VAV units.

Supply Fan Mode "ON" Operation

For active unit control with the Supply Fan Mode set to ON, the unit will energize the Supply Fan and hold the Fan Speed output at minimum speed until there is a request for the fan speed to increase. This will hold true for all cases except during Unoccupied periods in which the Supply Fan Mode is forced to AUTO and will operate the Supply Fan as described above for all Cooling, Heating, and Hot Gas Reheat requests.

Setpoint Arbitration

Single Zone VAV units will require traditional Zone Heating (if heat installed) and Cooling setpoints that are used for constant volume units in addition to two new setpoints: Discharge Air Cool (DA Cool - Fan SPD) and Discharge Air Heat (DA Heat) Setpoint limits. The zone Heating and Cooling setpoints will be selectable via the existing RTRM customer connections for a zone sensor panel and the DA Heat and Cool setpoints will be customer selectable via two onboard potentiometers on the RTOM with ranges 50-150°F and 40-90°F respectively.

Table 27, p. 49 and Table 28, p. 49 can be used as a reference when setting the DA Heat (R42) and DA Cool - Fan SPD (R136) setpoints on the RTOM.

Note: *The recommended settings for these setpoints is 100°F for the DA Heat Setpoint and 50°F for the DA Cool - Fan SPD Setpoint.*

Table 27. DA cool - fan SPD setpoint

°F	VDC
40	<0.1
41	0.2
42	0.3
43	0.45
44	0.55
45	0.7
46	0.8
47	0.95
48	1.05
49	1.15
50	1.25
51	1.3
52	1.35
53	1.45
54	1.55
55	1.65
56	1.7
57	1.75
58	1.83
59	1.9
60	1.95
61	2
62	2.05
63	2.1
64	2.13
65	2.17
66	2.21
67	2.27
68	2.3
69	2.35
70	>2.40

Note: The potentiometer voltage readings can be verified via the provided test points located next to each potentiometer. Use a DC voltmeter to the Vdc reading between those points and common.

Table 28. DA heat setpoint

Voltage (Vdc)	Setpoint (°F)
0	50
0.09	51
0.13	52
0.16	53
0.2	54
0.24	55
0.28	56

Table 28. DA heat setpoint (continued)

Voltage (Vdc)	Setpoint (ºF)
0.31	57
0.35	58
0.42	60
0.46	61
0.5	62
0.53	63
0.57	64
0.61	65
0.65	66
0.68	67
0.72	68
0.76	69
0.79	70
0.83	71
0.87	72
0.9	73
0.94	74
0.98	75
1	76
1.03	77
1.06	78
1.08	79
1.11	80
1.13	81
1.16	82
1.18	83
1.21	84
1.23	85
1.26	86
1.28	87
1.31	88
1.33	89
1.36	90
1.38	91
1.41	92
1.43	93
1.46	94
1.48	95
1.51	96
1.53	97
1.56	98
1.58	99
1.61	100
1.63	101
1.66	102
1.69	103
1.71	104
1.72	105
1.74	106
1.76	107
1.78	108
1.79	109
1.81	110
1.83	111
1.84	112
1.86	113
1.88	114
1.89	115
1.91	116
1.93	117
1.95	118
1.96	119
1.98	120

Table 28. DA heat setpoint (continued)

Voltage (Vdc)	Setpoint (ºF)
2	121
2.01	122
2.03	123
2.05	124
2.06	125
2.08	126
2.09	127
2.11	128
2.12	129
2.13	130
2.13	131
2.14	132
2.16	133
2.17	134
2.19	135
2.2	136
2.21	137
2.23	138
2.24	139
2.25	140
2.26	141
2.28	142
2.29	143
2.3	144
2.32	145
2.33	146
2.34	147
2.36	148
2.37	149
2.4	150

Note: *The above potentiometer voltage readings can be verified via the provided test points located next to each potentiometer. Use a DC voltmeter to the Vdc reading between those points and common.*

Units Configured with the Outside Air Measurement (Traq) Option

To make a minor correction to the Traq airflow (CFM) reading that is calculated internally by the ReliaTel system, an adjustment pot is available on the RTVM. This pot can be used to correct for static “local” factors such as altitude. Variable factors such as drift, temperature, humidity, and other changing atmospheric conditions are corrected as part of the conversion calculation.

The adjustment will typically be made in Service Test mode in a step where the OA damper is being commanded to the Traq OA Minimum Position Request with all required Traq control inputs valid (i.e. sensors, setpoints, RTVM board). The OA flow adjustment setpoint potentiometer (R136) on the RTVM will be used to adjust the value up to a factor of +/- 20% (0.80 to 1.20) Full counter-clockwise will be – 20% and full clockwise will be + 20%. The potentiometer will be set to the middle position (between full CCW and full CW) in a “Deadband” area representing no adjustment 0% (factor of 1.00) by default. The adjustment will be applied linearly across the sensing range of the airflow sensor which may produce inaccuracies at airflow levels not close to the value at which the calibration adjustment was made.

Sequence for Setting Calibration

- If unit is configured with DCV, disconnect CO_2 sensor prior to powering unit. After calibration remove power from unit and reconnect CO_2 sensor.
- Adjust the Design Minimum OA Flow Setpoint potentiometer (R130/R41) on the RTVM to your desired flow rate for minimum ventilation (See).
- Initiate service test and step to the minimum ventilation step. This will set the unit into a constant ID fan speed and OA damper request to minimum position. Minimum position will be from the Traq calculation to maintain the OA flow at the setpoint.
- Allow the damper position to settle to the desired flow rate set by the setpoint.
- Measure the OA flow rate via an air balancing instrument.
- Adjust the OA flow adjustment setpoint potentiometer (R136) clockwise or counter-clockwise to “dial in” the flow to match the instrument in (See Table 30, p. 52).

Table 29. Design minimum OA flow setpoint

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
1000	1000	0.2
1100	1100	0.22
1200	1200	0.24
1300	1300	0.26
1400	1400	0.28
1500	1500	0.3
1600	1600	0.32
1700	1700	0.34
1800	1800	0.36
1900	1900	0.38
2000	2000	0.4
2100	2100	0.42
2200	2200	0.44
2300	2300	0.46
2400	2400	0.48
2500	2500	0.5
2600	2600	0.52
2700	2700	0.54
2800	2800	0.56
2900	2900	0.58
3000	3000	0.6
3100	3100	0.62
3200	3200	0.64
3300	3300	0.66
3400	3400	0.68
3500	3500	0.7
3600	3600	0.72
3700	3700	0.74
3800	3800	0.76

Table 29. Design minimum OA flow setpoint (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
3900	3900	0.78
4000	4000	0.8
4100	4100	0.82
4200	4200	0.84
4300	4300	0.86
4400	4400	0.88
4500	4500	0.9
4600	4600	0.92
4700	4700	0.94
4800	4800	0.96
4900	4900	0.98
5000	5000	1
5100	5100	1.01
5200	5200	1.02
5300	5300	1.03
5400	5400	1.04
5500	5500	1.05
5600	5600	1.06
5700	5700	1.07
5800	5800	1.08
5900	5900	1.09
6000	6000	1.1
6100	6100	1.11
6200	6200	1.12
6300	6300	1.13
6400	6400	1.15
6500	6500	1.17
6600	6600	1.18
6700	6700	1.19
6800	6800	1.2
6900	6900	1.22
7000	7000	1.23
7100	7100	1.24
7200	7200	1.25
7300	7300	1.26
7400	7400	1.27
7500	7500	1.28
7600	7600	1.29
7700	7700	1.3
7800	7800	1.31
7900	7900	1.32
8000	8000	1.34
8100	8100	1.36
8200	8200	1.38
8300	8300	1.39
8400	8400	1.4
8500	8500	1.41
8600	8600	1.42
8700	8700	1.43
8800	8800	1.44
8900	8900	1.45
9000	9000	1.46
9100	9100	1.47
9200	9200	1.48
9300	9300	1.5
9400	9400	1.52
9500	9500	1.53
9600	9600	1.54
9700	9700	1.55

Table 29. Design minimum OA flow setpoint (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
9800	9800	1.57
9900	9900	1.58
10000	10000	1.59
10100	10100	1.6
10200	10200	1.61
10300	10300	1.63
10400	10400	1.65
10500	10500	1.67
10600	10600	1.68
10700	10700	1.69
10800	10800	1.7
10900	10900	1.71
11000	11000	1.72
11100	11100	1.73
11200	11200	1.74
11300	11300	1.74
11400	11400	1.75
11500	11500	1.76
11600	11600	1.77
11700	11700	1.78
11800	11800	1.79
11900	11900	1.8
12000	12000	1.81
12100	12100	1.82
12200	12200	1.83
12300	12300	1.84
12400	12400	1.85
12500	12500	1.86
12600	12600	1.87
12700	12700	1.88
12800	12800	1.89
12900	12900	1.89
13000	13000	1.89
13100	13100	1.9
13200	13200	1.91
13300	13300	1.92
13400	13400	1.93
13500	13500	1.94
13600	13600	1.95
13700	13700	1.96
13800	13800	1.97
13900	13900	1.98
14000	14000	1.99
14100	14100	2
14200	14200	2.01
14300	14300	2.02
14400	14400	2.03
14500	14500	2.04
14600	14600	2.05
14700	14700	2.06
14800	14800	2.07
14900	14900	2.08
15000	15000	2.09
15100	15100	2.1
15200	15200	2.11
15300	15300	2.12
15400	15400	2.13
15500	15500	2.14
15600	15600	2.15

Table 29. Design minimum OA flow setpoint (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
15700	15700	2.16
15800	15800	2.17
15900	15900	2.18
16000	16000	2.19
16100	16100	2.2
16200	16200	2.21
16300	16300	2.22
16400	16400	2.23
16500	16500	2.24
16600	16600	2.25
16700	16700	2.26
16800	16800	2.27
16900	16900	2.28
17000	17000	2.29
17100	17100	2.3
17200	17200	2.31
17300	17300	2.32
17400	17400	2.33
17500	17500	2.34
17600	17600	2.35
17700	17700	2.36
17800	17800	2.37
17900	17900	2.38
18000	18000	2.39
18100	18100	2.4
18200	18200	2.41
18300	18300	2.42
18400	18400	2.43
18500	18500	2.44
18600	18600	2.45
18700	18700	2.46
18800	18800	2.47
18900	18900	2.48
19000	19000	2.49

Table 30. OA flow adjustment setpoint

OA Flow Adjustment (R136)	Voltage Reading
Multiplier/ Adjustment	Vdc
0.8	0
0.81	0.05
0.82	0.14
0.83	0.22
0.84	0.3
0.85	0.35
0.86	0.43
0.87	0.51
0.88	0.57
0.89	0.64
0.9	0.72
0.91	0.78
0.92	0.88
0.93	0.94
0.94	1
0.95	1.06
0.96	1.1

Table 30. OA flow adjustment setpoint (continued)

OA Flow Adjustment (R136)	Voltage Reading
Multiplier/ Adjustment	Vdc
0.97	1.18
0.98	1.22
0.99	1.25
1	1.3 - 1.84
1.01	1.86
1.02	1.89
1.03	1.92
1.04	1.96
1.05	2
1.06	2.03
1.07	2.06
1.08	2.1
1.09	2.12
1.1	2.14
1.11	2.16
1.12	2.18
1.13	2.2
1.14	2.24
1.15	2.26
1.16	2.28
1.17	2.3
1.18	2.34
1.19	2.36
1.2	2.4

Ventilation Control

Units configured for Single Zone VAV control require special handling of the OA Damper Minimum Position control in order to compensate for the non-linearity of airflow associated with the variable supply fan speed and damper combinations.

Demand Controlled Ventilation

Units configured for SZVAV and Demand Controlled Ventilation (CO_2 sensor value available) require a new control scheme comprised of 2 existing schemes that have been traditionally mutually exclusive; DCV and OA CFM Compensation.

Units configured with DCV will invoke the new Demand Controlled Ventilation scheme which allows variable Bldg. Design and DCV Minimum Positions and OA Damper Position Target setpoints based on the supply fan speed and space CO_2 requirements.

This new scheme will require the setting of 5 OA Damper position setpoints; 3 more than on non-SZ VAV. These new setpoints are located on the RTVM module:

- Design Min Position @ Minimum Fan Speed Command (RTVM R130)
- Design Min Position @ Middle Fan Speed Command (RTVM R136)
- Design Min Position @ Full Fan Speed Command (RTEM Design Min Position)
- DCV Min Position @ Minimum Fan Speed Command (RTVM R41)
- DCV Min position @ Full Fan Speed Command (RTEM DCV Min Position)

As the supply fan speed command varies between minimum and maximum, the Building Design and DCV Minimum Position Targets will be calculated linearly between the user selected setpoints based on the instantaneous supply fan speed. The Bldg. Design and DCV Minimum Position Targets will be used to calculate the Active OA Damper Minimum Position Target, as on traditional units, based on the Space CO_2 relative to the active Design and DCV CO_2 setpoints. Refer to Figure 41, p. 54 for additional details on the design.

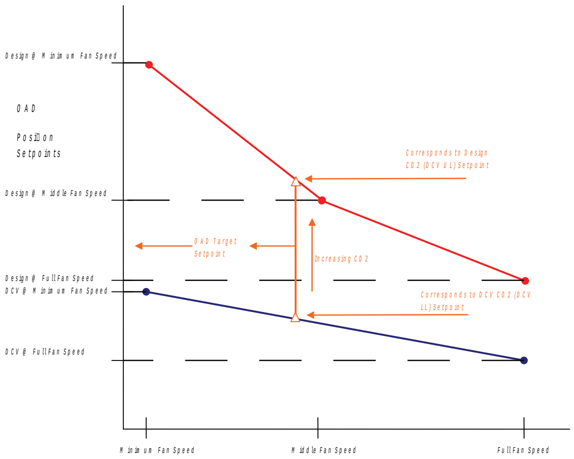
The Design Minimum and DCV Minimum OA Damper Position setpoints at Minimum Fan Speed Command and the Design Minimum OA Damper Position setpoint at Middle Fan Speed Command will have a range of 0-100% while the Design Minimum and DCV Minimum OA Damper Position setpoints at Full fan speed will have a range of 0-50%. Note that as on non-Single Zone VAV units, a 10% offset will be enforced between the Design and DCV Minimum Positions throughout the fan speed range.

By default, the Design Minimum Position schedule (red line below) will be a linear line through all user selectable Design Minimum Position setpoints. The user will have the ability to set the Design Minimum Position at Middle fan speed command to a point that would be lower than the calculated linear line between the Design Minimum Position setpoints at 0% and 100% fan speed command in order to compensate for the non-linear outside airflow through the fan and damper modulation range. However, if the Design Minimum Position at Middle fan speed command is set to a point that would be higher than the calculated linear line between the Design Minimum Position setpoints at Minimum and Full fan speed command, the minimum position will be limited to the point that would make the Design Minimum Position schedule linear.

Provisions have been made in Service Test Mode to allow for proper damper minimum position setup:

- To set the Design and DCV Minimum Position setpoints at Minimum Fan Speed, set the unit to operate at Step 1 (Fan ON) or Step 2 (Economizer Open) and make the proper adjustments.
- To set the Design Minimum Position setpoint at Middle Fan Speed, set the unit to operate at Step 3 (Cool 1) and make the proper adjustment.
- To set the Design and DCV Minimum Position setpoints at Full Fan Speed, set the unit to operate at Step 4 (Cool 2) and make the proper adjustments.

Figure 41. SZVAV DCV with OA CFM compensation

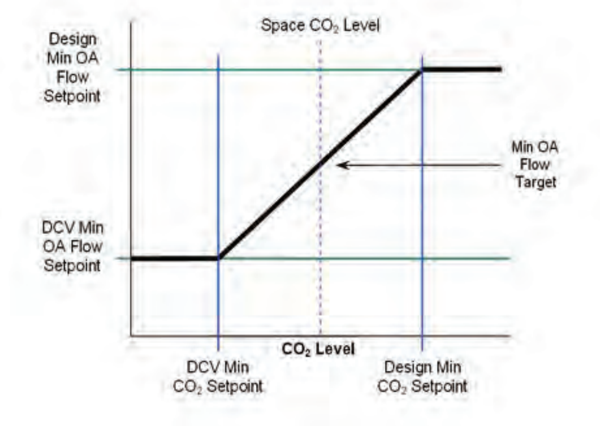


Units with Traq Sensor

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

For units with Traq, when the optional CO_2 sensor is installed and Demand Controlled Ventilation is enabled the Minimum Outside Air CFM Setpoint will be adjusted linearly between two airflow setpoints, the Design Minimum Outside Air (OA) CFM Setpoint (R130) and the DCV Minimum Outside Air CFM (OA) Setpoint (R41). The resulting calculated setpoint is the Minimum OA CFM Target which is the setpoint used for active airflow control. The Minimum OA CFM Target Setpoint will vary proportionally between the DCV Minimum OA Flow CFM Setpoint and the Design Minimum OA CFM Setpoint as CO_2 varies between the CO_2 Lower Limit Setpoint and the CO_2 Upper Limit Setpoint as shown in the following figure. The CO_2 setpoints are set on the RTEM as with normal DCV control without Traq option.

Figure 42. Minimum outside air CFM setpoint



Outside Air Damper Minimum Positions without DCV

For units not configured with DCV (no CO_2 sensor value available), additional minimum position setpoints to increase outdoor airflow accuracy will be supported. The operation will be similar to OA CFM Compensation on Traditional VAV units with the addition of a Design Minimum Position setpoint at Middle Fan Speed Command. The following setpoint potentiometers will be used on the RTEM:

- Design Min at Minimum Fan Speed Command (RTEM DCV Min)
- Design Min at Middle Fan Speed Command (RTEM DCV Setpoint LL)
- Design Min at Full Fan Speed Command (RTEM Design Min)

The controller will calculate the active OA Damper Minimum position linearly between the user-selected setpoints based on the supply fan speed command. The range for the Design Min setpoints at Minimum and Middle Fan Speed Command will be 0-100% while the range for the Design Min at Full Fan Speed Command setpoint will be 0-50%.

By default, the Design Minimum Position schedule (red line below) will be a linear line through all user selectable Design Minimum Position setpoints. As with Demand Controlled Ventilation, if the Design Minimum Position at Middle fan speed command is set to a point that would be higher than the calculated linear line between the Design Minimum Position setpoints at Minimum and Maximum fan speed command, the minimum position will be limited to the point that would make the Design Minimum Position schedule linear.

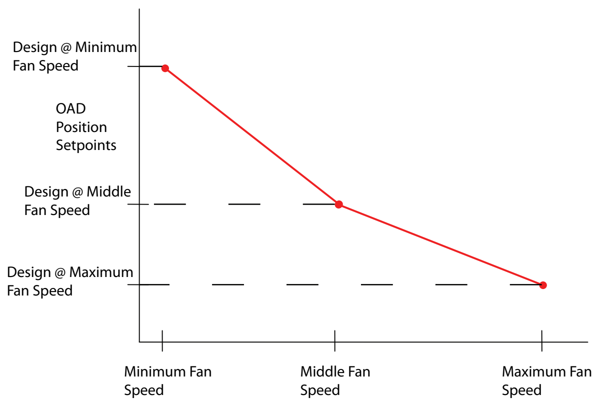
Provisions have been made in Service Test Mode to allow for proper damper minimum position setup:

- To set the Design Minimum Position setpoint at Minimum Fan Speed, set the unit to operate at Step

1 (Fan ON) or Step 2 (Economizer Open) and make the proper adjustment.

- To set the Design Minimum Position setpoint at Middle Fan Speed, set the unit to operate at Step 3 (Cool 1) and make the proper adjustment.
- To set the Design Minimum Position setpoint at Full Fan Speed, set the unit to operate at Step 4 (Cool 2) and make the proper adjustment.

Figure 43. SZVAV OA damper min position w/ OA CFM compensation



Space Pressure Control

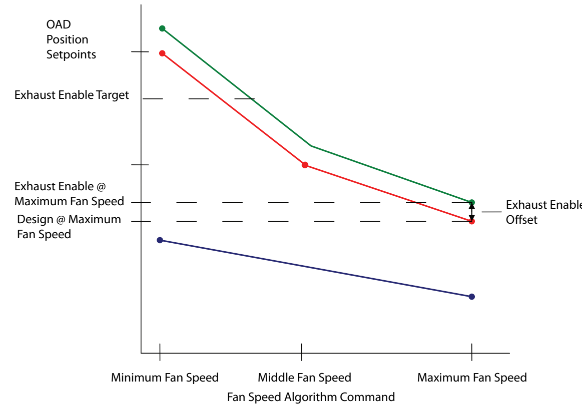
For units configured with an exhaust fan, with or without Statitrac, the control described previously for economizer minimum position handling requires additional changes to the existing Space Pressure Control scheme. The overall scheme will remain very similar to non-Single Zone VAV units with Space Pressure Control with the exception of a dynamic Exhaust Enable Setpoint.

For Single Zone VAV the user will select an Exhaust Enable Setpoint during the Maximum Fan Speed Command. Once selected, the difference between the Exhaust Enable Setpoint and Design OA Damper Minimum Position at Maximum Fan Speed Command will be calculated. The difference calculated will be used as an offset to be added to the Active Building Design OA Minimum Position Target to calculate the dynamic Exhaust Enable Target to be used throughout the Supply Fan Speed/OA Damper Position range.

The Exhaust Enable Target could be above or below the Active Bldg Design OA Min Position Target Setpoint based on the Active Exhaust Enable Setpoint being set above or below the Bldg Design Min Position at Full Fan Speed Command.

Note: *An Exhaust Enable Setpoint of 0% will result in the same effect on Exhaust Fan control as on non-Single Zone VAV applications with and without Statitrac.*

Figure 44. Space pressure control graph



Traq Overrides and Special Considerations

Traq functionality is not used in unoccupied mode since fresh air control is an occupied ventilation function. Damper position will be set to 0% minimum in Unoccupied as with other types of unit configuration.

If the Remote Minimum Position pot on the RTEM is shorted (as with NOVAR controls) the Traq minimum damper position will be overridden to 0% as with other unit configurations.

Traq functions and sensor value are only valid during active Supply Fan operation therefore a value of "0 CFM" will be substituted for any low level (bleed through) sensor value that may be sensed on the OA Flow Sensor during "Fan OFF" periods. OA Damper Minimum Position is only valid during active fan operation in all configurations.

The Design Min OA Flow Setpoint will be limited to a lower limit of 1,000 CFM and an upper limit of 20,000 CFM. Setting of values outside of this range, except for "0 CFM", will result in the setting being clamped within the range. A value of "0" CFM will be allowed and will result in initialization of the Traq OA Damper Min Position calculation, and an active value of “0%” will be sent as the Active Traq setpoint. This allows the user to set the damper closed by setting the flow setpoint to 0 CFM.

If Demand Controlled Ventilation is configured then the lower limit of the Design Min OA Flow Setpoint will be 1,500 CFM to allow a gap to the DCV Min OA Flow Setpoint of 500 CFM making its lower limit 1,000 CFM. When the Design Min OA Flow Setpoint is greater than 1,500 CFM a minimum of 500 CFM offset will be enforced between the DCV Min OA Flow Setpoint and the Design Min OA Flow Setpoint.

If configured for Traq operation and OA CFM Compensation, the unit will perform Traq control since it will be the most accurate method of control. This situation might occur if a unit is upgraded to Traq control, but the OA CFM Compensation config jumper on the RTEM is left on. It will be assumed by the presence of a valid OA CFM Flow Sensor and the RTVM version that supports Traq is accompanied by all the necessary unit equipment upgrades.

Supply Air Temperature Control - Heating and Cooling

For Cooling, Heating (Modulating Heat Only), and Hot Gas Reheat operation the unit will control the active capacity outputs to meet a varying, calculated Discharge Air Setpoint that is calculated based on zone conditions in order to maintain the Zone Temperature to the active Zone Setpoint. Note that this setpoint will be clamped between the user selected DA Heat and DA Cool - Fan Speed setpoints that are set on the RTOM for compressor and economizer control. In general, as the zone temperature rises above the ZCSP, the Active Discharge Air Setpoint will be calculated down and as the zone temperature falls below the ZHSP Tset will be calculated upward. This calculated setpoint is a direct indication of space demand and is also used to determine the proper supply fan speed to meet the space requirements. During active capacity control, the unit will utilize a +/- 3.5°F deadband around the active Discharge Air Setpoint to determine when to request additional heating or cooling capacity similarly to traditional VAV control, as described below. If the unit is maintaining the discharge air temperature within the +/- 3.5°F deadband around the calculated discharge air setpoint requirements, no additional capacity will be requested.

The calculated setpoint will also be used for active economizer control, but the economizer will utilize a tighter control deadband (+/- 1.5°F) than that is used for compressor output control. Also, as on Traditional VAV units, mechanical cooling will be inhibited if economizing is enabled until the economizer has been full open for 3 minutes.

Variable Air Volume Applications (Traditional VAV)

Supply Air Temperature Control - Occupied Cooling and Heating

The RTRM is designed to maintain a selectable supply air temperature of 40°F to 90°F with a +/- 3.5°F deadband. In cooling, if supply air temperature is more than 3.5 degrees warmer than the selected temperature, a stage of cooling will be turned “On” (if available). Then if the supply air temperature is more than 3.5 degrees cooler than the selected temperature, a stage of cooling will be turned “Off”.

At very low airflows the unit may cycle stages “On” and “Off” to maintain an average discharge air temperature outside the 7 degree deadband.

If the unit has modulating heat, the unit can be made to do discharge heating with VAV control. This is done by placing a contact closure across the “Changeover Input” on the RTAM. During this mode, the unit will heat to the Supply Air Heating Setpoint +/- 3.5°F. During low load or low airflow conditions the actual temperature swing of the discharge air will likely be greater.

The RTRM utilizes a proportional and integral control scheme with the integration occurring when the supply air temperature is outside the deadband. As long as the supply air temperature is within the setpoint deadband, the system is considered to be satisfied and no staging up or down will occur.

Supply Air Temperature Control with an Economizer

The economizer is utilized to control the supply air cooling at +1.5°F around the supply air temperature setpoint range of 40°F and 90°F providing the outside air conditions are suitable.

While economizing, the mechanical cooling is disabled until the economizer dampers have been fully open for three minutes. If the economizer is disabled due to unsuitable conditions, the mechanical cooling will cycle as though the unit had no economizer.

VHR Relay Output

During unoccupied mode, daytime warm-up (DWU) and morning warm-up (MWU) the VFD will open to 100%. All VAV boxes must be opened through an ICS program or by the VHR wired to the VAV boxes. The RTRM will delay 100% fan operation approximately 6.5 minutes when switching from occupied cooling mode to a heating mode.

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Cooling

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and RTRM J6-12, both the economizer and the mechanical cooling will be disabled.

Zone Temperature Control without a Night Setback Panel or ICS - Unoccupied Heating

When a field supplied occupied/unoccupied switching device is connected between RTRM J6-11 and J6-12 and DWU is enabled, the zone temperature will be controlled at 10°F below the Morning Warm-up setpoint, but not less than 50°F, by cycling one or two stages of either gas or electric heat, whichever is applicable.

Morning Warm-up (MWU) Control

Morning Warm-up is activated if the zone temperature is at least 1.5°F below the MWU setpoint whenever the system switches from Unoccupied to Occupied status. The MWU setpoint may be set from the unit mounted potentiometer or a remotely mounted potentiometer. The setpoint ranges are from 50°F to 90°F. When the zone temperature meets or exceeds the MWU setpoint, the unit will switch to the "Cooling" mode. The economizer will be held closed during the morning warm-up cycle.

Daytime Warm-up (DWU) Control

Daytime Warm-up is applicable during occupied status and when the zone temperature is below the initiation temperature. It can be activated or deactivated through ICS or a night setback zone sensor. If ICS or a night setback zone sensor is not utilized, DWU can be activated by setting the DWU enable DIP switch (RTAM) to ON and supplying a valid morning warm-up setpoint.

The unit is shipped with a Morning Warm-up setpoint configured and the Daytime Warm-up function is activated (switch on). Opening the DWU enable switch will disable this function.

If the system control is local, the DWU initiation setpoint is 3°F below the Morning Warm-up setpoint. The termination setpoint is equal to the Morning Warm-up setpoint.

If the system control is remote (Tracer™), the DWU setpoint is equal to the Tracer Occupied heating setpoint. The initiation and termination setpoints are selectable setpoints designated by Tracer.

When the zone temperature meets or exceeds the termination setpoint while the unit is in an Occupied, "Auto" Mode or switched to the "Cooling" Mode, the unit will revert to the cooling operation.

If an Occupied "Heating" Mode is selected, the unit will only function within the DWU perimeters until the system is switched from the "Heat" Mode or enters an Unoccupied status.

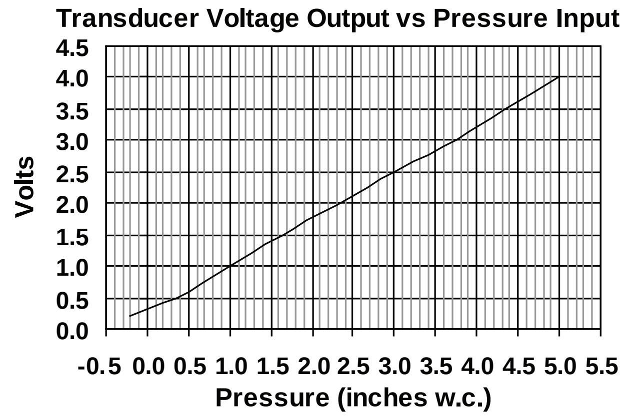
Note: *When a LCI is installed on a VAV unit, the MWU setpoint located on the RTAM board is ignored. The MWU and DWU setpoints come from the higher priority LCI-R DAC.*

Supply Duct Static Pressure Control

The supply duct static pressure is measured by a transducer with a 0.25 to 2.125 Vdc proportional output which corresponds to an adjustable supply duct static pressure of 0.3" w.c. to 2.5" w.c. respectively with a deadband adjustment range from 0.2" w.c. to 1.0" w.c. The setpoint is adjustable on the RTAM Static Pressure Setpoint potentiometer or through ICS.

Example:
Supply Duct Static setpoint = 2.0" w.c. (RTAM)
Deadband = 0.2" w.c. (RTAM)
Duct Static Control Range = 1.9" w.c. to 2.1" w.c.

Figure 45. Output vs. input



Supply Air Temperature Reset

The supply air temperature can be reset by using one of four DIP switch configurations on the RTAM or through ICS when a valid supply air reset setpoint with a supply air reset amount is given. A selectable reset amount of 0° F to 20°F via RTAM potentiometer or ICS is permissible for each type of reset.

The amount of change applied to the supply air temperature setpoint depends on how far the return air, zone, or outdoor air temperature falls below the reset temperature setpoint. If the return air, zone, or outdoor air temperature is equal to or greater than the reset temperature setpoint, the amount of change is zero.

If the return air, or zone temperature falls 3°F below the reset temperature setpoint, the amount of reset applied to the supply air temperature will equal the maximum amount of reset selected.

If the outdoor air temperature falls 20°F below the reset temperature setpoint, the amount of reset applied to the supply air temperature will equal the maximum amount of reset selected. The four DIP switch configurations are as follows:

- None - When RTAM DIP Switch #3 and #4 are in the "Off" position, no reset will be allowed.
- Reset based on Return Air Temperature - When RTAM DIP Switch #3 is "Off" and Switch #4 is "On", a selectable supply air reset setpoint of 50°F to 90°F via a unit mounted potentiometer or Tracer™ is permissible.
- Reset based on Zone Temperature - When RTAM DIP Switch #3 is "On" and Switch #4 is "Off", a selectable supply air reset setpoint of 50°F to 90°F via RTAM potentiometer or Tracer is permissible.
- Reset based on Outdoor Air Temperature - When DIP Switch #3 and #4 are "On", a selectable supply

air reset setpoint of 0°F to 100°F via RTAM potentiometer or Tracer is permissible.

VAV Supply Air Tempering (Only Available with Modulating Gas Heat)

The gas heater will be modulated to prevent the Discharge Air Temperature from falling below the Discharge Temperature Deadband. Upon satisfying the Supply Air Tempering requirements, a 5 minute SA Tempering Delay timer will start whenever the modulating gas heat combustion blower is commanded to 0 and must time out before the unit will be allowed to re-enter “Cool” mode. This timer will be reset to 5 minutes whenever there is an active call for “Supply Air Tempering”. Tempering will be discontinued whenever;

- The 5 minutes “Supply Air Tempering Delay” timer has timed-out and;
- There is an active cooling request for VAV Occupied Cooling.

Constant Volume or Variable Air Volume Applications (Single Zone or Traditional)

Off Mode

This mode is set at the zone sensor or by ICS. During this status, no heating, ventilation, or mechanical cooling is being performed. When switching the “System” selector to the **“Off”** mode from any other mode, any diagnostic data and diagnostic indication signal will be retained as long as the system remains in the **“Off”** status. Switching the “System” selector from the **“Off”** mode back to any other mode of operation will reset all diagnostics.

Zone Temperature - Unoccupied Cooling (CV or SZ VAV Only)

While a building is in an unoccupied period as designated by a remote panel with night setback, ICS or RTRM J6-11 and J6-12, the necessary cooling capacity will be controlled to maintain the zone temperature to within the unoccupied setpoint deadband. If an economizer is enabled, it will modulate in an attempt to maintain the zone temperature to within the setpoint deadband.

Note: *On SZ VAV units, the Supply Air Fan Speed will be controlled as during normal occupied conditions in order to meet the requirements of the zone. Unoccupied mode does not require full airflow on a SZ VAV unit during Cooling operation.*

Zone Temperature - Unoccupied Heating

While a building is in an unoccupied period as designated by a remote panel with night setback or ICS, the necessary heating capacity will be controlled to maintain the zone temperature to within the unoccupied setpoint deadband. For traditional VAV systems, the VFD will operate at 100% during this mode. It will be necessary to drive VAV boxes to their maximum position through ICS programming or the factory provided VHR relay. For SZ VAV systems, the Supply Air Fan VFD will remain in control as during normal occupied periods and will be controlled in order to meet the space requirements. The minimum fan speed will be based on the configured unit heating type. For Modulating Heat units, Full Airflow is not required for SZ VAV applications during Unoccupied periods. For all Staged Heating types, the Supply Fan will be controlled at maximum fan speed during active heating operation as during Occupied periods.

Mechanical Cooling with an Economizer

The economizer is utilized to control the zone temperature when the outside air conditions are suitable. The method used to determine economizer effectiveness, depending on the available data, is described below in descending order of complexity. The most sophisticated method available is always used.

Table 31. Economizer effectiveness

Method used to determine economizer effectiveness	Required
Comparative Enthalpy	OAT, OAH, RAT, RAH
Reference Enthalpy	OAT, OAH
Reference Dry Bulb	OAT
Unable to determine effectiveness	OAT data is invalid or unavailable

Two of the three methods for determining the suitability of the outside air can be selected utilizing the potentiometer on the Economizer Actuator, as described below:

- Ambient Temperature - controlling the economizing cycle by sensing the outside air dry bulb temperature. Table 32, p. 59 lists the selectable dry bulb values by potentiometer setting.
- Reference Enthalpy - controlling the economizer cycle by sensing the outdoor air humidity. Table 32, p. 59 lists the selectable enthalpy values by potentiometer setting. If the outside air enthalpy value is less than the selected value, the economizer is allowed to operate.
- Comparative Enthalpy - By utilizing a humidity sensor and a temperature sensor in both the return air stream and the outdoor air stream, the

economizer will be able to establish which conditions are best suited for maintaining the zone temperature, i.e., indoor conditions or outdoor conditions.

Table 32. Economizer configuration

Potentiometer Setting Point	Dry bulb changeover Point	Reference Enthalpy
A	73°F	27 BTU/lb.
B	70°F	25 BTU/lb.
C[a]	67°F	23 BTU/lb.
D	63°F	22 BTU/lb.
E	55°F	19 BTU/lb.

(a) Factory setting

Gas Heat Control

The ignition sequence and timing are provided by a separate heat control module. The RTRM only provides the heating outputs to initiate 1st and 2nd stages and control the combustion blower relays. Both stages of the furnace, when initiated after each cycle, will start and operate for one minute then cycle back if only one stage is required. Units with modulating heat capabilities will light on high fire for one minute and then modulate to the appropriate heating rate for the building load present.

When the fan selection switch is in the **"AUTO"** mode and the unit is configured as a Constant Volume with staged or modulating gas heat, or SZVAV with staged gas heat, the fan will be delayed from coming on for approximately 30 seconds after a call for heat has been initiated. The fan will remain on for approximately 90 seconds after the heating setpoint has been satisfied. If the unit is configured for SZ VAV with modulating heat, the fan will be energized with the call for heating in order to begin circulating airflow through the unit for discharge air temperature control. Once the call for heating is removed, the fan will remain on for approximately 90 seconds.

Electric Heat Control

The RTRM provides two heating outputs for 1st and 2nd stages that will be controlled with at least a 10 seconds delay between each stage. When the fan selection switch is in the **"AUTO"** mode and the unit is configured for Constant Volume, the fan will start approximately 1 second before the 1st heater stage is activated. The fan and heater will cycle off after the heating setpoint has been satisfied. If the unit is configured for SZ VAV control, the Supply Fan will energize approximately 5 seconds prior to energizing the electric heat outputs. Once the Zone Heating requirements have been satisfied, the fan and heat outputs will be controlled off.

Clogged Filter Option

The unit mounted clogged filter switch monitors the pressure differential across the return air filters. It is mounted in the filter section and is connected to the RTOM. The switch is adjustable and can be set for a particular application. The clogged filter switch is normally open and will automatically close when the pressure differential across the filters falls below the clogged filter setpoint. The RTOM will generate a SERVICE diagnostic that will be sent to the zone sensor or remote panel when the clogged filter switch has been closed for at least 2 minutes during supply fan operation. The system will continue to operate regardless of the status of the clogged filter switch.

Ventilation Override

Note: *Applying 24 volts to one of the three Ventilation Override Inputs manually activates ventilation override. One input is provided to request the Pressurize Mode, the second input the Purge Mode, and the third input the Exhaust Mode.*

When the Pressurize Mode is selected, activating Ventilation Override will cause the supply fan to run, the economizer to open to 100%, the exhaust fan to turn (remain) off, or the VFD to run at full speed (SZ VAV and Traditional VAV), and the VAV boxes to fully open.

When Purge is selected, activating Ventilation Override will cause the supply fan to run, the economizer to open to 100%, the exhaust fan to run, or the VFD to run at full speed (SZ VAV or Traditional VAV), and the VAV boxes to fully open.

When Exhaust is selected, activating Ventilation Override will cause the supply fan to turn off, the economizer to close to 0%, the exhaust fan to run (exhaust damper at 100% if configured for Statitrac), or the VFD to stop, and the VAV boxes to operate normally.

If more than one mode is requested at the same time, the Pressurize request will have priority followed by Purge. When any Ventilation Override Mode is active, all heating and cooling is turned off. For the case where the unit is required to turn off, the Emergency Stop input is used. The ICS can also initiate any ventilation override mode. Table 33, p. 59 lists the sequence of events within the system for each ventilation mode. Refer to the unit wiring diagram for contact switching and wiring.

Note: *Fresh air tracking will not work with VOM.*

Table 33. Ventilation override sequence

Affected Function	Mode and Priority		
	Pressurize	Purge	Exhaust[a]
	1	2	3
Heat/Cool	off	off	off

Table 33. Ventilation override sequence (continued)

Affected Function	Mode and Priority		
	Pressurize	Purge	Exhaust[(a)]
VFD	full speed	full speed	full speed
Supply Fan	on	on	off
Exhaust Fan	off	on[(b)]	on
Economizer	open	open	closed
VAV Boxes	forced open	forced open	normal operation

(a) Exhaust mode 3 is not available with the tracking power exhaust option.
(b) For units configured with the Statitrac option, the Exhaust Damper will open during Ventilation Override modes that request the exhaust fan to operate.

Emergency Stop

When this binary input is opened, all outputs are immediately turned off and the system will not be allowed to restart until the binary input is closed for approximately 5 seconds minimum. The shut down is communicated to Tracer™ if applicable and the Heat and Cool LED outputs (RTRM J6-7 and J6-8) will blink at a nominal rate of 1 blink per second.

Phase Monitor

The Phase Monitor is a 3 phase line monitor module that protects against phase loss, phase reversal and phase unbalance. It is intended to protect compressors from reverse rotation. It has an operating input voltage range of 190-600 VAC, and LED indicators for ON and FAULT. There are no field adjustments and the module will automatically reset from a fault condition.

Low Pressure Control

This input incorporates the low pressure cutout of each refrigeration circuit and can be activated by opening a field supplied contact.

If this circuit is open before a compressor(s) is started, neither compressor in that circuit will be allowed to operate.

Anytime this circuit is opened for 5 continuous seconds, the compressor(s) in that circuit are turned off immediately. The compressor(s) will not be allowed to restart for a minimum of 3 minutes.

If four consecutive open conditions occur during the first three minutes of operation, the compressor(s) in that circuit will be locked out, a diagnostic communicated to Tracer, and a manual reset will be required to restart the compressor(s).

The hot gas reheat option has one reheat low pressure cutout (RLP). The RLP is located on the reheat circuit.

Hot Gas Reheat Low Pressure Control

The RLP has been added to insure proper refrigerant management during active modulating hot gas reheat operation.

The RLP will be ignored for the first 10 minutes of compressor run time during active hot gas reheat operation. Anytime this circuit is opened for 5 continuous seconds, the compressor(s) in that circuit are turned off immediately. The compressor(s) will not be allowed to restart for a minimum of 3 minutes. If four consecutive open conditions occur during active hot gas reheat, the compressor(s) in that circuit will be locked out.

High Pressure Cutout and Temperature Discharge Limit

The high pressure controls and temperature discharge limit are wired in series between the compressor outputs on the RTRM and the compressor contactors. On 27.5, 30, and 35 Ton units, if the high pressure safety switch or temperature discharge limit opens, the RTRM senses a lack of current while calling for cooling and locks both compressors out with an auto reset. On 40 and 50 Ton units, if the high pressure safety or temperature discharge limit opens, the compressor(s) on the affected circuit is locked out. If the compressor output circuit is opened four consecutive times during compressor operation, the RTRM will generate a manual reset lockout.

Power Exhaust Control (Standard)

The power exhaust fan is started whenever the position of the economizer dampers meets or exceed the power exhaust setpoint when the supply fan is on.

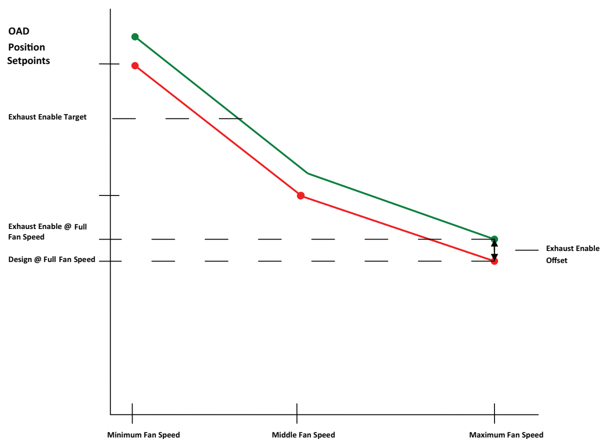
The setpoint potentiometer is on the RTOM and is factory set at 25% for traditional constant volume and variable air volume units.

For SZ VAV units the default power exhaust enable setpoint will be 25% as on non-SZ VAV units. However, for SZ VAV the Exhaust Enable Setpoint will need to be adjusted for the proper setpoint during the maximum Fan Speed Command for the unit. Once selected, the difference between the Exhaust Enable Setpoint and Design OA Damper Minimum Position at Full Fan Speed Command will be calculated. The difference calculated will be used as an offset to be added to the Active Building Design OA Minimum Position target to calculate the Dynamic Exhaust Enable Target to be used throughout the Supply Fan Speed/OA Damper Position range:

Exhaust Enable Target = Active Bldg Design OA Min Position Target + (Active Exhaust Enable Setpoint – Active Bldg Design OA Min Position @ Full Fan Speed Command)

The Exhaust Enable Target could be above or below the Active Bldg Design OA Min Position Target Setpoint based on the Active Exhaust Enable Setpoint being set above or below the Bldg Design Min Position at Full Fan Speed Command. Note that an Exhaust Enable Setpoint of 0% will result in the same effect on Exhaust Fan control as on non-Single Zone VAV applications with and without Statitrac; Exhaust Fan ON. See Figure 46, p. 61 for how the exhaust enable setpoint is modified throughout the OA damper operating range.

Figure 46. SZ VAV exhaust

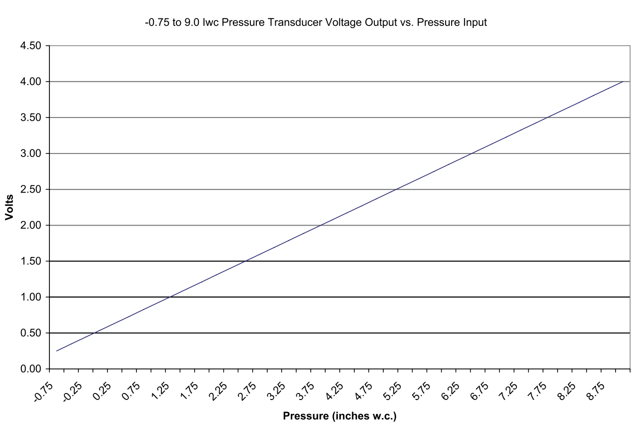


Space Pressure Control - Statitrac

A pressure transducer is used to measure and report direct space (building) static pressure. The user-defined control parameters used in this control scheme are Space Pressure Setpoint and Space Pressure Deadband. As the Economizer opens, the building pressure rises and enables the Exhaust Fan. The Exhaust dampers will be modulated to maintain Space Pressure within the Space Pressure Deadband.

Note: *The Exhaust Enable setpoint will need to be selected as on units with standard power exhaust control.*

Figure 47. Transducer voltage output vs. pressure input for building pressure



Power Exhaust Control (Tracking)

The power exhaust dampers proportionally track or follow the fresh air (economizer) damper position. The offset between the fresh air and the exhaust damper(s) is adjustable, see figures beginning with Figure 55, p. 83. Refer to Power Exhaust Fan Performance” tables beginning with Table 51, p. 82.

Lead/Lag Control

Lead/Lag is a selectable input located on the RTRM. On 2 & 3 stage standard efficiency units, the RTRM is configured from the factory with the Lead/Lag control disabled. To activate the Lead/Lag function, simply remove the jumper connection J3-8 at the RTRM Lead/ Lag input. When it is activated, each time the designated lead compressor(s) is shut off due to the load being satisfied, the lead compressor or refrigeration circuit switches. On the 5 stage high efficiency units, the RTRM is configured from the factory with the Lead/Lag control enabled. With it active, each time the designated lead compressor is shut off due to the load being satisfied, the controls will switch to the next staging sequence. When the RTRM is powered up, i.e. after a power failure, the control will default to the number one compressor.

Table 34. Capacity steps with lead/lag enabled - std Efficiency

Unit Size		Step 1	Step 2	Step 3
TC*330	LEAD	48%	100%	
	LAG	52%	100%	
TC*360	LEAD	50%	100%	
	LAG	50%	100%	
TC*420	LEAD	47%	100%	
	LAG	53%	100%	
TC*480 VAV only	LEAD	40%	60%	100%
	LAG	60%	100%	
TC*600 VAV only	LEAD	32%	68%	100%
	LAG	68%	100%	

Table 35. Capacity staging sequence - high Efficiency & 40–50 tons std eff CV

		Steps				
Unit Size	Sequence	1	2	3	4	5
TC*330	1	25	37	63	75	100
	2		37	63	75	100
	3		37	63	75	100
TC*360	1	24	38	62	76	100
	2		38	62	76	100
	3		38	62	76	100

Table 35. Capacity staging sequence - high Efficiency & 40–50 tons std eff CV (continued)

		Steps				
Unit Size	**Sequence**	**1**	**2**	**3**	**4**	**5**
TC*420	1	22	39	61	78	100
	2		39	61	78	100
	3		39	61	78	100
TC*480	1	23	39	61	77	100
	2		39	61	77	100
	3		39	61	77	100
TC*600	1	25	38	62	75	100
	2		38	62	75	100
	3		38	62	75	100

Coil Frost Protection

The Frostat™ control monitors the suction line temperature to prevent the evaporator from freezing due to low operating temperatures whenever there is a demand for cooling. When a closed circuit has occurred for 5 seconds minimum, the RTRM turns off all of the cooling outputs. The Supply Fan will be held **"On"** until the Frostat has been open for 5 continuous seconds or for 60 seconds after the last compressor was shut **"Off"**, whichever is the longest. The compressor shutdown is communicated to Tracer, if applicable. There is no local diagnostic for this condition.

Modulating Hot Gas Reheat Frost Protection

Two control schemes will be active on units configured for Modulating Hot Gas Reheat. The first employs the use of the Frostat function. The second scheme takes precedence over Frostat. Operation will be as described below.

The second scheme is in control during active hot gas reheat or cooling and includes the use of an Entering Evaporator Temperature sensor (EET). If the EET drops below 35°F for 10 continuous minutes compressors will stage off. For dual circuit units one circuit will be staged off initially, and then if the EET remains below 35ºF for an additional 10 minutes, the second circuit will be staged off. For single circuit units one compressor will be staged off initially, and then if the EET remains below 35ºF for an additional 10 minutes, the second circuit will be staged off. When the unit is operating in hot gas reheat mode, only the reheat circuit will be re-enabled if the EET rises above 45ºF. The cooling circuit will not be re-enabled during hot gas reheat until the unit leaves the current hot gas reheat cycle or a dehumidification purge is initiated. If the unit is operating in Cooling, the first circuit that de-energized will be re-enabled when the EET rises above 45ºF. The second compressor will be allowed to re-energize at 10 minutes after the EET rises above 45ºF or if a purge cycle is initiated.

Drain Pan Condensate Overflow Switch (Optional)

This input incorporates the Condensate Overflow Switch (COF) mounted on the drain pan and the ReliaTel Options Module (RTOM). When the condensate level reaches the trip point for 6 continuous seconds, the RTOM will shut down all unit function until the overflow condition has cleared. The unit will return to normal operation after 6 continuous seconds with the COF in a non-tripped condition. If the condensate level causes the unit to shutdown more than 2 times in a 3 day period, the unit will be locked-out of operation. A manual reset of the diagnostic system through the Zone Sensor or Building Automation System (BAS) will be required. Cycling unit power will also clear the fault.

VFD Programming Parameters

See System Troubleshooting section.

Condenser Fan Sequencing Control

The condenser fans are cycled according to the outdoor air temperature and the number of cooling steps that are operating. and Table 37, p. 64list the temperatures at which the A and B Condenser Fan Outputs on the RTRM switches the fans "Off". The fans are switched back "ON" when the outdoor temperature rises approximately 5° F above the "Off" temperature.

Figure 48, p. 62 shows the condenser fans as viewed from the top of the unit facing the control panel. Whenever a condenser fan is cycled back "On", the condenser fan Outputs A and B and the compressor steps are de-energized for approximately seven seconds to prevent problems with fan windmill.

Figure 48. Condenser fan location

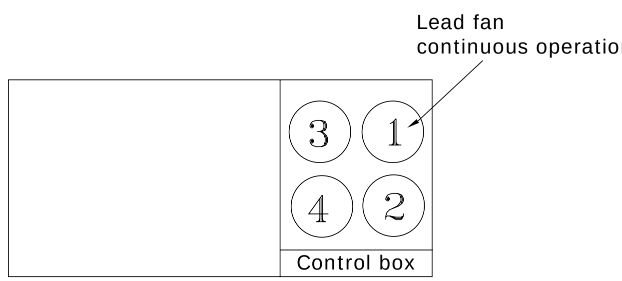


Table 36. Condenser fan/compressor sequence - std efficiency

Unit Size (Ton)	Compressor Staging Sequence			Condenser Fan Output		O/A Temp. (°F)
	Step 1	Step2	Step 3	Output A	Output B	Fans "Off"
27.5 - 30	CPR1[a]		NA	Fan #2		70
					Fan #3	90
		CPR1, 2		Fan #2		-10
					Fan #3	60
35	CPR1[a]		NA	Fan #2		65
					Fan #3	85
		CPR1, 2		Fan #2		-20
					Fan #3	55
40 VAV only	CPR1[b]			Fan #2		50
					Fan #3, 4	70
		CPR2[c]		Fan #2		20
					Fan #3, 4	60
			CPR1, 2	Fan #2		-30
					Fan #3, 4	50
50 VAV only	CPR1[b]			Fan #2		20
					Fan #3, 4	60
		CPR2, 3[d]		Fan #2		-10
					Fan #3, 4	55
			CPR1, 2, 3	Fan #2		-30
					Fan #3, 4	50

Notes:

1. The compressor(s) listed under each step are the operating compressors. On 27.5 to 35 Ton units with Lead/Lag, CPR1 will alternate but the fan sequence will remain the same. On 40 & 50 Ton units with Lead/Lag, the compressor (s) in step 2 & 3 will alternate and the fan sequence listed for that step will be in operation.
2. Conventional thermostat sequence: Y1=CPR1, Y2=CPR2 (40 CPR 2 & 50 CPR 2,3), Y1 + Y2 = CPR1,2 (40 CPR 1,2 & 50 CPR 1,2,3)
3. During active hot gas reheat all compressors will be staged "On". For units equipped with four condenser fans (40 and 50 Ton), the condenser fan output states will be controlled based on the O/A temperature. If O/A is above 85°F, all condenser fan outputs will be energized. If O/A falls below 80°F, Output B will de-energize and will not re-energize again until the O/A rises above 85°F. For units configured with three condenser fans (27.5 to 35 Ton), a maximum of two condenser fans will energize. Output A will energize above 85°F and de-energize when the O/A falls below 80°F; Output B will remain de-energized during active hot gas reheat. If O/A falls below 80°F, Output A will de-energize and will not re-energize again until O/A rises above 85°F.

[a] Single circuit, manifolded compressors pair.
[b] First Stage, Number one refrigeration circuit, Standalone compressor is "On".
[c] First Stage is "Off", Number two refrigeration circuit, standalone compressor is "On".
[d] First stage is "Off", Number two refrigeration circuit, manifolded compressor pair is "On" operating simultaneously.

Table 37. Condenser fan/compressor sequence - high efficiency

27.5-35 Ton High Efficiency									
Compressor Stage 1					**Compressor Stage 2**				
Fan #1	**Fan #2**	**Fan #3**	**Ambient Range (F)**	**# Cond Fans On**	**Fan #1**	**Fan #2**	**Fan #3**	**Ambient Range (F)**	**# Cond Fans On**
ON	OFF	OFF	0-70	1	ON	OFF	OFF	0-58	1
	OFF	OFF	70-75	1 or 2		OFF	OFF	58-63	1 OR 2
	ON	OFF	75-80	2		ON	OFF	63-70	2
	ON	OFF	80-85	2 or 3		ON	OFF	70-75	2 OR 3
	ON	ON	85-115	3		ON	ON	75-115	3
27.5-35 Ton High Efficiency									
Compressor Stages 3 or 4					**Compressor Stage 5**				
Fan #1	**Fan #2**	**Fan #3**	**Ambient Range (F)**	**# Cond Fans On**	**Fan #1**	**Fan #2**	**Fan #3**	**Ambient Range (F)**	**# Cond Fans On**
ON	OFF	OFF	0-60	1	ON	OFF	OFF	0-50	1
	OFF	OFF	60-65	1 OR 2		OFF	OFF	50-55	1 OR 2
	ON	OFF	65-70	2		ON	OFF	55-60	2
	ON	OFF	70-75	2 OR 3		ON	OFF	60-65	2 OR 3
	ON	ON	75-115	3		ON	ON	65-115	3
40 Ton High Eff. and Std Eff. CV									
Compressor Stages 1 & 2					**Compressor Stages 3 & 4**				
Fan #1	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**	**Fan #1**	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**
ON	OFF	OFF	0-65	1	ON	OFF	OFF	0-40	1
	OFF	OFF	65-70	1 or 2		OFF	OFF	40-45	1 OR 2
	ON	OFF	70-80	2		ON	OFF	45-75	2
	ON	OFF	80-85	2 or 4		ON	OFF	75-80	2 OR 4
	ON	ON	85-115	4		ON	ON	80-115	4
40 Ton High Eff. and Std Eff. CV					**50 Ton High Eff. and Std Eff. CV**				
Compressor Stage 5					**Compressor Stages 1 & 2**				
Fan #1	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**	**Fan #1**	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**
ON	OFF	OFF	0-40	1	ON	OFF	OFF	0-60	1
	OFF	OFF	40-45	1 OR 2		OFF	OFF	60-65	1 or 2
	ON	OFF	45-65	2		ON	OFF	65-75	2
	ON	OFF	65-70	2 OR 4		ON	OFF	75-80	2 or 4
	ON	ON	70-115	4		ON	ON	80-115	4
50 Ton High Eff. and Std Eff. CV									
Compressor Stages 3 & 4					**Compressor Stage 5**				
Fan #1	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**	**Fan #1**	**Fan #2**	**Fan #3 & 4**	**Ambient Range (F)**	**# Cond Fans On**
ON	OFF	OFF	0-35	1	ON	OFF	OFF	0-35	1
	OFF	OFF	35-40	1 OR 2		OFF	OFF	35-40	1 OR 2
	ON	OFF	40-70	2		ON	OFF	40-60	2
	ON	OFF	70-75	2 OR 4		ON	OFF	60-65	2 OR 4
	ON	ON	75-115	4		ON	ON	65-115	4

Notes:

1. Condenser fan will de-energize at 5ºF below the energizing temperature
2. Compressor Stage 1 = CPR1
3. Compressor Stage 2 = CPR2 or CPR3 depending on staging sequence
4. Compressor Stage 3 = CPR1 & CPR2 or CPR2 & CPR3 depending on staging sequence
5. Compressor Stage 4 = CPR2 & CPR3
6. Compressor Stage 5 = CPR1 & CPR2 & CPR3
7. Conventional three stage thermostat sequence: Y1=CPR1 (Stage 1), Y2=CPR1&2 (Stage 3), Y1 + Y2 = CPR1,2,3 (Stage 5)
8. During active hot gas reheat all compressors will be staged "On". For units equipped with four condenser fans (40 and 50 Ton), the condenser fan output states will be controlled based on the O/A temperature. If O/A is above 85°F, all condenser fan outputs will be energized. If O/A falls below 80°F, Output B will de-energize and will not re-energize again until the O/A rises above 85°F. For units configured with three condenser fans (27.5 to 35 Ton), a maximum of two condenser fans will energize. Output A will energize above 85° F and de-energize when the O/A falls below 80°F; Output B will remain de-energized during active hot gas reheat. If O/A falls below 80°F, Output A will de-energize and will not re-energize again until O/A rises above 85°F.

Preparing the Unit for Operation

Be sure to complete all of the procedures described in this section before starting the unit for the first time.

Use the checklist provided below in conjunction with the “Installation Checklist” to ensure that the unit is properly installed and ready for operation.

⚠ 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 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 may be above the sight glass prior to the initial start. Use appropriate lighting (flashlight) to verify the presence of oil.
- Prior to unit startup allow the crankcase heater to operate a minimum of 8 hours to remove liquid refrigerant from the compressor sump.
- Optional Service Valves - Verify that the discharge service valve and suction service valve fully open on each circuit.

  Note: *High Efficiency units come standard with discharge service valves.*
- Check the supply fan belts for proper tension and the fan bearings for sufficient lubrication. If the belts require adjustment, or if the bearings need lubricating, refer to the Maintenance section of this manual for instructions.
- Inspect the interior of the unit for tools and debris and install all panels in preparation for starting the unit.

Electrical Phasing

Unlike traditional reciprocating compressors, scroll compressors are phase sensitive. Proper phasing of the electrical supply to the unit is critical for proper operation and reliability.

The compressor motor is internally connected for clockwise rotation with the incoming power supply phased as A, B, C. Proper electrical supply phasing can be quickly determined and corrected before starting the unit by using an instrument such as an Ideal - Sperry 61-520 Phase Sequence Indicator and following the steps below:

⚠ 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.

- Open the disconnect switch or circuit protector switch that provides the supply power to the unit's power terminal block or to the unit mounted disconnect switch.
- To be consistent with the compressor leads, connect the phase sequence indicator leads to the terminal block or unit mounted disconnect switch as follows;

Table 38. Phase sequence leads

Phase Sequence Leads	Unit Power Terminal
Red (phase A)	L1
Blue (phase B)	L2
Black (Phase C)	L3

- Turn the “System” selection switch to the “Off” position and the “Fan” selection switch (if Applicable) to the “Auto” position.
- Close the disconnect switch or circuit protector switch that provides the supply power to the unit's power terminal block or unit mounted disconnect switch.

⚠ 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.

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK HTB1 OR UNIT DISCONNECT SWITCH.

- Observe the ABC and CBA phase indicator lights on the face of the sequencer. The ABC indicator light will glow if the phase is ABC. If the CBA indicator light glows, open the disconnect switch or circuit protection switch and reverse any two power wires.
- Restore main electrical power and recheck phasing. If the phasing is correct, open the disconnect switch or circuit protection switch and remove the phase sequence indicator.

Voltage Supply and Voltage Imbalance

Supply Voltage

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.

Voltage Imbalance

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

% Voltage Imbalance = [(AV – VD)/AV] x 100 where;

AV (Average Voltage) = (Volt 1 + Volt 2 + Volt 3) / 3

Volt 1, Volt 2, Volt 3 = 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: (221 + 230 + 227) / 3 = 226 Avg
- VD (reading farthest from average) = 221
- The percentage of imbalance equals: [(226–221) / 226] x 100 = 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 at the job site is over 2%, notify the proper agencies to correct the voltage problem to within 2.0% before operating this equipment.

Starting the Unit

Before closing the main power disconnect switch, insure that the “System” selection switch is in the “Off” position and the “Fan” selection switch for Constant Volume or SZ VAV units is in the “Auto” position.

Close the main power disconnect switch and the unit mounted disconnect switch, if applicable.

⚠ 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.

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK HTB1 OR UNIT DISCONNECT SWITCH.

Upon power initialization, the RTRM performs self-diagnostic checks to insure that all internal controls are functional. It also checks the configuration parameters against the components connected to the system. The LED located on the RTRM module is turned “On” within one second of power-up if internal operation is okay. The economizer dampers are driven open for 5 seconds then fully closed (if applicable).
When an economizer is installed DO NOT ENTER the TEST mode until all calibration startup functions have been completed. Otherwise, the economizer actuator and power exhaust output may not function properly during any of the test mode steps. Allow 2 minutes after unit power up to complete economizer calibration before entering the test mode function. Use the following “Test” procedure to bypass some time delays and to start the unit at the control panel. Each step of unit operation can be activated individually by temporarily shorting across the “Test” terminals for two to three seconds. The LED located on the RTRM module will blink when the test mode has been initiated. The unit can be left in any “Test” step for up to one hour before it will automatically terminate, or it can be terminated by opening the main power disconnect switch. Once the test mode has been terminated, the LED will glow continuously and the unit will revert to the “System” control, i.e. zone temperature for constant volume units or discharge air temperature for variable air volume units.

Test Modes

There are three methods in which the “Test” mode can be cycled at LTB1-Test 1 and LTB1-Test 2.

Note: *For Constant Volume or Variable Air Volume test steps, test modes, and step resistance values to cycle the various components, refer to* *Table 39, p. 68 - Table 44, p. 73**.*

Step Test Mode

This method initiates the different components of the unit, one at a time, by temporarily shorting across the two test terminals for two to three seconds.

For the initial startup of either a Constant Volume or Variable Air Volume (Single Zone or Traditional) unit, this method allows the technician to cycle a component “on” and have up to one hour to complete the check.

Resistance Test Mode

This method can be used for startup providing a decade box for variable resistance outputs is available. This method initiates the different components of the unit, one at a time, when a specific resistance value is placed across the two test terminals. The unit will remain in the specific test mode for approximately one hour even though the resistance is left on the test terminals.

Auto Test Mode

This method is not recommended for startup due to the short timing between individual component steps. This method initiates the different components of the unit, one at a time, when a jumper is installed across the test terminals. The unit will start the first test step and change to the next step every 30 seconds. At the end of the test mode, control of the unit will automatically revert to the applied “System” control method.

Service Test Switch Location

A toggle service switch is offered as a standard feature to provide hassle free startup option for the service person in the field. This toggle switch is located in the low voltage section of the control box.

Figure 49. Service test switch

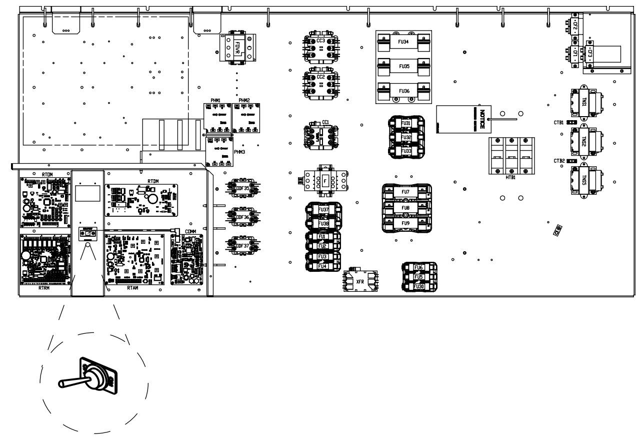


Table 39. Test mode states for traditional VAV units with modulating hot gas reheat and staged heat

TEST STEP	MODE	FAN	VFD COMMAND	ECON	COMP 1	COMP 2	COMP 3	HEAT 1	HEAT 2	PUMP-OUT	COOL VAL-VE	RE-HEAT VALVE	VAV BOX
1	VFD SIGNAL 100%	OFF	100% (10VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	VFD SIGNAL 0%	OFF	0% (0 VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	MIN VENT	ON	IN-CONTROL	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
4	ECON TEST OPEN	ON	IN-CONTROL	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
5	COOL 1	ON	IN-CONTROL	MIN	ON	OFF	OFF	OFF	OFF	IN-CON-TROL	100%	0%	ON
6	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	OFF	IN-CON-TROL	100%	0%	ON
7	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CON-TROL	100%	0%	ON
8	REHEAT	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CON-TROL	50%	50%	ON
9	HEAT 1	ON	IN-CONTROL	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%	ON
10	HEAT 2	ON	IN-CONTROL	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%	ON
11	RESET												

Notes:2 & 3 stage standard efficiency units (excluding 40–50T std eff. CV):

1. For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on Supply Air Pressure Requirements. For SZ VAV units, the VFD Command will be at discrete points during Test Mode.
2. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
4. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.
5. Heating will not be energized during Service Test until the 6 minute VAV Box ON timer has expired.

Notes:5 stage high efficiency units (including 40–50T std eff. CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 40. Test mode states for CV units with modulating hot gas reheat and staged heat

TEST STEP	MODE	FAN	ECON	COMP 1	COMP 2	COMP 3	HEAT 1	HEAT 2	PUMPOUT	COOL VAL-VE	RE-HEAT VALVE	VAV BOX
1	FAN ON	ON	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	ECONO-MIZER	ON	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	COOL 1	ON	MIN	ON	OFF	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
4	COOL 2	ON	MIN	ON	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
5	COOL 3	ON	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
6	REHEAT	ON	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	50%	50%	ON
7	HEAT 1	ON	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%	ON
8	HEAT 2	ON	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%	ON
9	RESET											

Notes:2 & 3 stage standard efficiency units (excluding 40–50T std eff. CV):

1. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
2. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
3. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.
4. Heating will not be energized during Service Test until the 6 minute VAV Box ON timer has expired.

Notes:5 stage high efficiency units (including 40–50T std eff. CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 41. Test mode states for SZ VAV units with modulating hot gas reheat and staged heat

TEST STEP	MODE	FAN	VFD COMMAND	ECON	COMP 1	COMP 2	COMP 3	HEAT 1	HEAT 2	PUMP-OUT	COOL VAL-VE	RE-HEAT VALVE
1	FAN ON	ON	45% (0 VDC)	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%
2	ECONO-MIZER	ON	45% (0 VDC)	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%
3	COOL 1	ON	80% (6.67 VDC)	MIN	ON	OFF	OFF	OFF	OFF	IN-CON-TROL	100%	0%
4	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	OFF	IN-CON-TROL	100%	0%
5	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CON-TROL	100%	0%
6	REHEAT	ON	73% (5.24 VDC)	MIN	ON	ON	ON	OFF	OFF	IN-CON-TROL	50%	50%
7	HEAT 1	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%
8	HEAT 2	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%
9	RESET											

Notes:2 & 3 stage standard efficiency units (excluding 40-50T Std Efficiency CV):

1. For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on Supply Air Pressure Requirements. For SZ VAV units, the VFD Command will be at discrete points during Test Mode.
2. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
4. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.

Notes:5 stage high efficiency units (including 40-50T Std Efficiency CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 42. Test mode states for traditional VAV units with modulating hot gas reheat and modulating heat

TEST STEP	MODE	FAN	VFD COMMAND	ECON	COMP 1	COMP 2	COMP 3	HEAT OUTPUT	PUMP-OUT	COOL VAL-VE	RE-HEAT VALVE	VAV BOX
1	VFD SIGNAL 100%	OFF	100% (10VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	VFD SIGNAL 0%	OFF	0% (0 VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	MIN VENT	ON	IN-CONTROL	MIN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
4	ECON TEST OPEN	ON	IN-CONTROL	OPEN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
5	COOL 1	ON	IN-CONTROL	MIN	ON	OFF	OFF	OFF	IN-CON-TROL	100%	0%	ON
6	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	IN-CON-TROL	100%	0%	ON
7	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	IN-CON-TROL	100%	0%	ON
8	REHEAT	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	IN-CON-TROL	50%	50%	ON
9	HEAT 1	ON	IN-CONTROL	MIN	OFF	OFF	OFF	50%	OFF	100%	0%	ON
10	HEAT 2	ON	IN-CONTROL	MIN	OFF	OFF	OFF	100%	OFF	100%	0%	ON
11	RESET											

Notes:2 & 3 stage standard efficiency units (excluding 40-50T Std Efficiency CV):

1. For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on Supply Air Pressure Requirements. For SZ VAV units, the VFD Command will be at discrete points during Test Mode.
2. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
4. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.
5. Heating will not be energized during Service Test until the 6 minute VAV Box ON timer has expired.

Notes:5 stage high efficiency units (including 40-50T Std Efficiency CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 43. Test mode states for CV units with modulating hot gas reheat and modulating heat

TEST STEP	MODE	FAN	ECON	COMP 1	COMP 2	COMP 3	HEAT OUTPUT	PUMP-OUT	COOL VALVE	RE-HEAT VALVE	VAV BOX
1	FAN ON	ON	MIN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	ECONO-MIZER	ON	OPEN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	COOL 1	ON	MIN	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
4	COOL 2	ON	MIN	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
5	COOL 3	ON	MIN	ON	ON	ON	OFF	IN-CONTROL	100%	0%	ON
6	REHEAT	ON	MIN	ON	ON	ON	OFF	IN-CONTROL	50%	50%	ON
7	HEAT 1	ON	MIN	OFF	OFF	OFF	50%	OFF	100%	0%	ON
8	HEAT 2	ON	MIN	OFF	OFF	OFF	100%	OFF	100%	0%	ON
9	RESET										

Notes:2 & 3 stage standard efficiency units (excluding 40-50T Std Efficiency CV):

1. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
2. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
3. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.
4. Heating will not be energized during Service Test until the 6 minute VAV Box ON timer has expired.

Notes:5 stage high efficiency units (including 40-50T Std Efficiency CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 44. Test mode states for SZ VAV units with modulating hot gas reheat and modulating heat

TEST STEP	MODE	FAN	VFD COMMAND	ECON	COMP 1	COMP 2	COMP 3	HEAT OUTPUT	PUMP-OUT	COOL VALVE	RE-HEAT VALVE
1	FAN ON	ON	45% (0 VDC)	MIN	OFF	OFF	OFF	0%	OFF	100%	0%
2	ECONO-MIZER	ON	45% (0 VDC)	OPEN	OFF	OFF	OFF	0%	OFF	100%	0%
3	COOL 1	ON	80% (6.67 VDC)	MIN	ON	OFF	OFF	0%	IN-CON-TROL	100%	0%
4	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	0%	IN-CON-TROL	100%	0%
5	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	0%	IN-CON-TROL	100%	0%
6	REHEAT	ON	73% (5.24 VDC)	MIN	ON	ON	ON	0%	IN-CON-TROL	50%	50%
7	HEAT 1	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	50%	OFF	100%	0%
8	HEAT 2	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	100%	OFF	100%	0%
9	RESET										

Notes:2 & 3 stage standard efficiency units (excluding 40-50T Std Efficiency CV):

1. For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on Supply Air Pressure Requirements. For SZ VAV units, the VFD Command will be at discrete points during Test Mode.
2. For 27.5-35T units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. The Reheat Pumpout relay will be energized any time the Reheat circuit is energized in active Cooling Mode.
4. For units with Statitrac installed, the Exhaust Damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the Economizer rises above the Exhaust Enable Setpoint.

Notes:5 stage high efficiency units (including 40-50T Std Efficiency CV):

1. Compressor 1 is the smaller compressor on the circuit.
2. Condenser fans are controlled as defined for normal operation.
3. Exhaust fan operates as defined for normal operation based on economizer position.
4. When Compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Verifying Proper Fan Rotation

⚠ 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.

Using Table 39, p. 68 to Table 44, p. 73 as a reference, momentarily jump across the test terminals to start the Minimum Ventilation Test.

The Exhaust Fan will start anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.

The economizer will drive to the minimum position setpoint, exhaust fans may start at random, and the supply fan will start.

Once the supply fan has started, check for proper rotation. The direction of rotation is indicated by an arrow on the fan housing.

If the fan is rotating backwards, open the main power disconnect switch upstream of the unit terminal block or the unit factory mounted disconnect switch.

⚠ 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.

Interchange any two of the field connected power wires at the unit terminal block or factory mounted disconnect switch.

Note: *Interchanging "Load" side power wires at the supply fan contactor will only affect the Fan Rotation. Ensure that the voltage phase sequence at the main unit terminal block or the unit mounted disconnect switch is ABC as outlined in "Electrical Phasing," p. 65.*

Verifying Proper Air Flow (CFM) - CV or VFD's

1. All systems - Set the minimum position setting for the economizer to 0° using the setpoint potentiometer located on the Economizer Actuator in the return section with the supply fan "On" and rotating in the proper direction:

   CV applications - Measure the amperage at the supply fan contactor and compare it with the full load amp (FLA) rating stamped on the motor nameplate.

   VFD's - With the O/A dampers fully closed, read the amperage displayed on the VFD screen and compare it to the motor nameplate.

   Note: *On VAV applications, the VFD will be under control of the discharge Static Pressure setpoint for the first six minutes of this test mode. Verify that the VFD output is at 60 Hz before measuring the fan motor amps.*

   If the actual amperage exceeds the nameplate value, static pressure is less than design and air flow is too high. If the actual amperage is below the nameplate value, static pressure is greater than design and air flow is too low.

2. To determine the actual CFM (within + 5%), plot the fan's operating RPM and the theoretical BHP onto the appropriate Fan Performance Curve in Figure 50, p. 74 to Figure 53, p. 76.

   Theoretical BHP Formula: [(Actual Motor Amps)/(Motor Nameplate Amps)] x 100

   Where the two points intersect, read straight down to the CFM line. Use Table 46, p. 78 or Table 50, p. 81 to select a new fan drive if the CFM is not within specifications.

Figure 50. Supply fan performance curves 27.5 - 35 ton — 60Hz

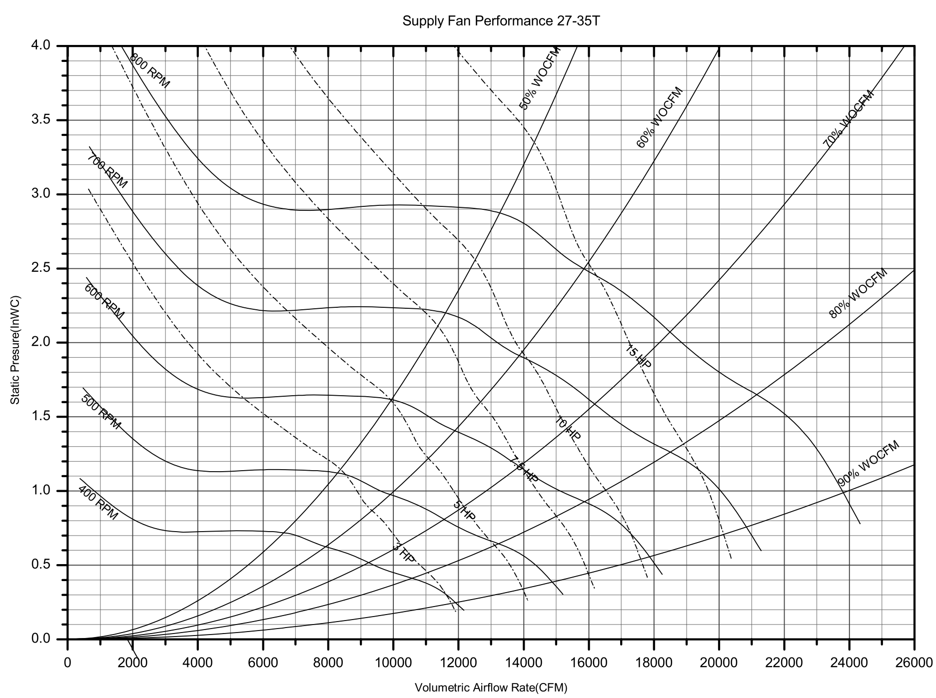


Figure 51. Supply fan performance curves 40 and 50 ton — 60Hz

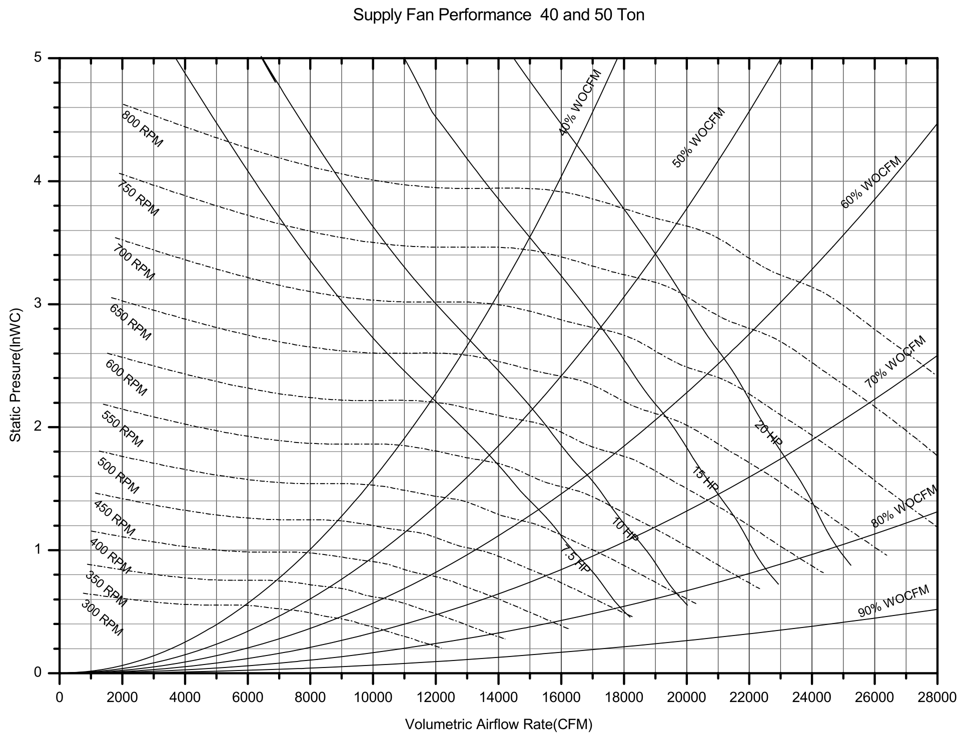


Figure 52. Supply fan performance — 22.9-29.2 Tons — 50Hz

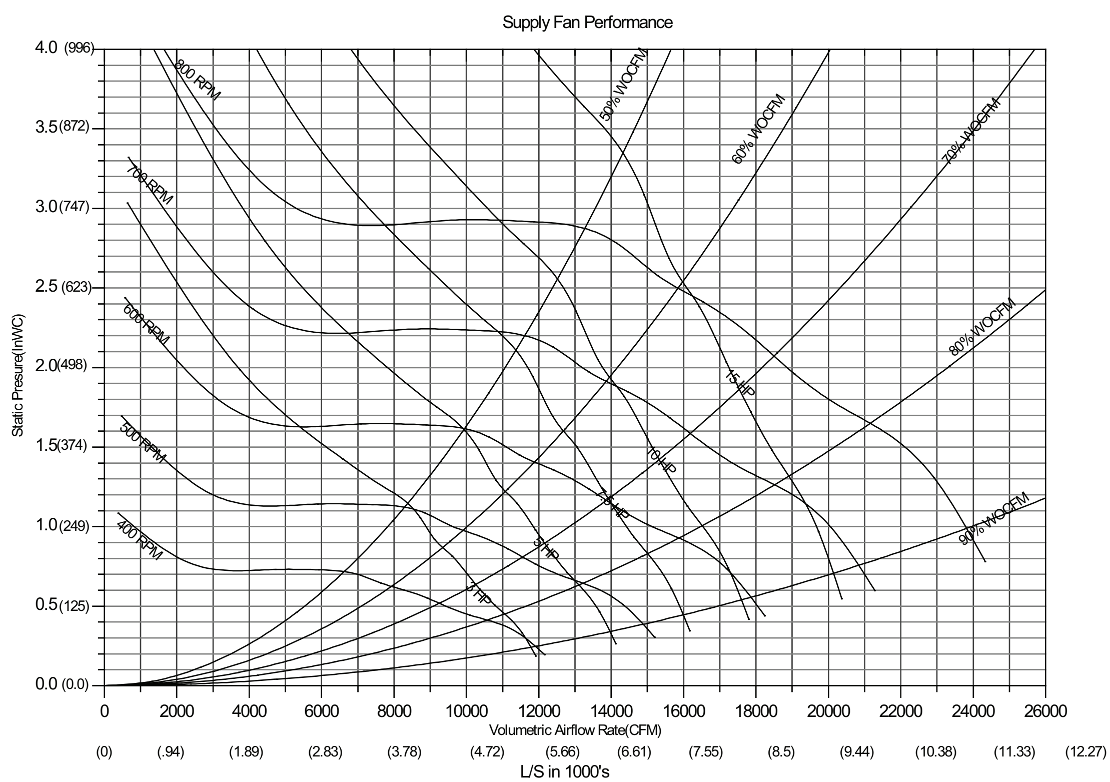


Figure 53. Supply fan performance — 33.3 and 41.7 Ton (IP) — 50Hz

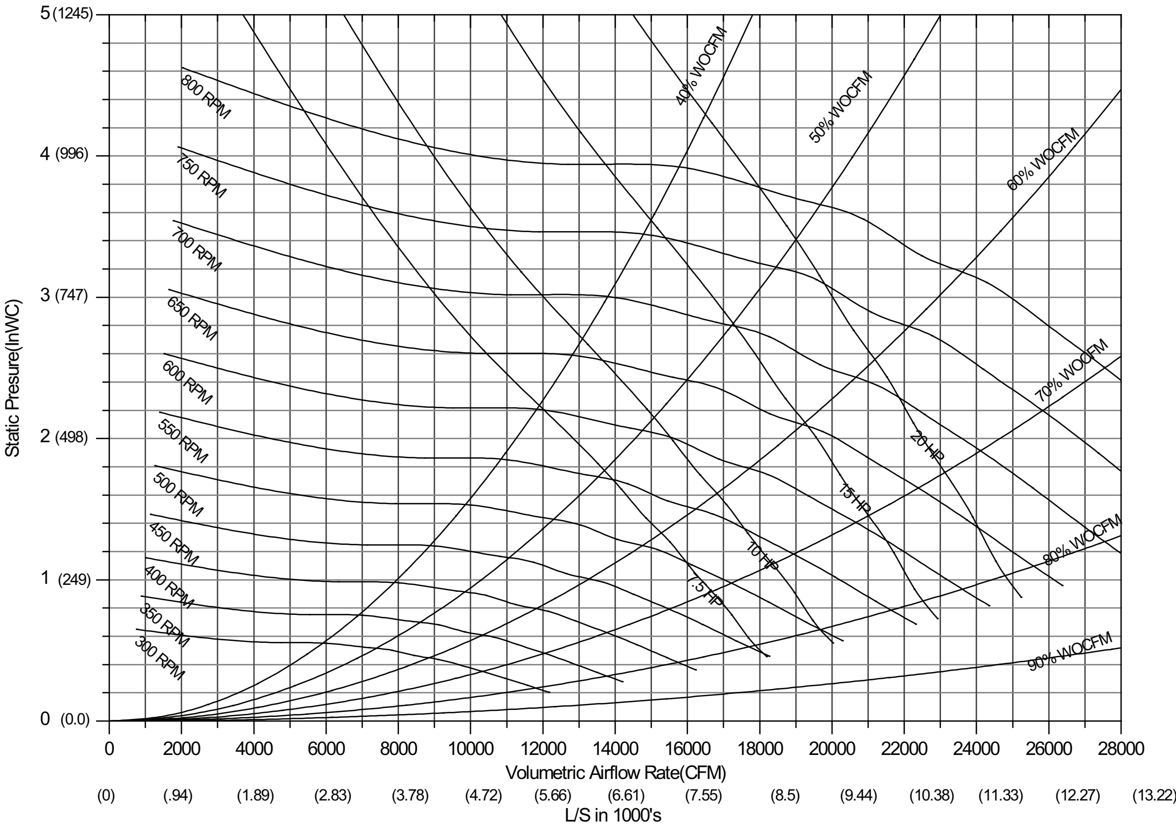


Table 45. TC*/YC*300–600 MBH economizer (R/A) damper pressure drop – 60Hz

Unit Capacity	Airflow (CFM)	Pressure Drop (iwc)
	8000	0.035
	8500	0.038
	9000	0.042
	9500	0.046
	10000	0.051
	10500	0.056
	11000	0.061
	11500	0.067
	12000	0.073
	12500	0.080
30	9000	0.042
	9500	0.046
	10000	0.051
	10500	0.056
	11000	0.061
	11500	0.067
	12000	0.073
	12500	0.080
	13000	0.087
35	10000	0.051
	10500	0.056
	11000	0.061
	11500	0.067
	12000	0.073
	12500	0.095
	14000	0.103
	14500	0.111

Table 45. TC*/YC*300–600 MBH economizer (R/A) damper pressure drop – 60Hz (continued)

Unit Capacity	Airflow (CFM)	Pressure Drop (iwc)
40	12000	0.072
	12500	0.075
	13000	0.079
	13500	0.083
	14000	0.087
	14500	0.092
	15000	0.098
	15500	0.104
	16000	0.110
	16500	0.117
	17000	0.124
	17500	0.132
	18000	0.140
50	15000	0.098
	15500	0.104
	16000	0.110
	16500	0.117
	17000	0.124
	17500	0.132
	18000	0.140
	18500	0.149
	19000	0.159
	19500	0.168
	20000	0.179

Notes:

1. Static pressure drops for the return air damper must be added to the system external static pressure as an accessory when using the fan performance tables and the fan curves to determine actual fan performance.
2. Pressure drops are listed in inches of water column.

Table 46. Supply air fan drive selections — 60 Hz

Nominal Tons	7.5 HP		10 HP		15 HP		20 HP	
	RPM	Drive No.	RPM	Drive No.	RPM	Drive No.	RPM	Drive No.
27½	550	A						
	600	B						
	650	C						
			700	D				
			750[a]	E				
30	550	A						
	600	B						
	650	C						
			700	D				
			750	E	750	E		
					790[b]	F		
					800[a]	G		
35	600	B						
			650	C				
			700	D				
			750	E	750	E		
					790[b]	F		
					800[a]	G		
40			500	H				
			525	J				
			575	K				
					625	L		
					675	M		
					725	N		
50			525	J				
			575	K				
					625	L		
					675	M	675	M
							725	N

(a) For YC gas heat units only.
(b) For TC/TE Cooling only and Electric Heat units only.

Table 47. Component static pressure drops (in. W.G.) — 60Hz

Nom. Tons	CFM Std Air	Heating System				Standard Efficiency ID Coil		High Efficiency ID Coil		Filters				Econo-mizer	Hot Gas Reheat Coil
		Gas Heat		Electric Heat						Throw-away	MERV 8 High Eff		MERV 14 High Eff		
		Low	High	1 Ele-ment	2 Ele-ments	Dry	Wet	Dry	Wet	2"	2"	4"	4"		
27½	8000	0.08	0.06	0.05	0.06	0.12	0.19	0.16	0.25	0.08	0.12	0.11	0.33	0.04	0.08
	9000	0.1	0.08	0.07	0.07	0.14	0.22	0.19	0.29	0.09	0.14	0.13	0.39	0.04	0.10
	10000	0.13	0.1	0.08	0.09	0.17	0.26	0.23	0.34	0.1	0.16	0.15	0.45	0.05	0.12
	11000	0.15	0.12	0.1	0.11	0.20	0.30	0.27	0.39	0.12	0.2	0.17	0.52	0.06	0.14
	12000	0.18	0.14	0.12	0.13	0.23	0.34	0.31	0.45	0.13	0.21	0.2	0.59	0.07	0.17
30	9000	0.1	0.08	0.07	0.07	0.14	0.22	0.19	0.29	0.09	0.14	0.13	0.39	0.04	0.10
	10000	0.13	0.1	0.08	0.09	0.17	0.26	0.23	0.34	0.1	0.16	0.15	0.45	0.05	0.12
	11000	0.15	0.12	0.1	0.11	0.20	0.30	0.27	0.39	0.12	0.2	0.17	0.52	0.06	0.14
	12000	0.18	0.14	0.12	0.13	0.23	0.34	0.31	0.45	0.14	0.23	0.21	0.59	0.07	0.17
	13000	0.21	0.16	0.14	0.15	0.27	0.38	0.35	0.50	0.15	0.26	0.23	0.66	0.09	0.20
35	10500	0.14	0.11	0.09	0.1	0.25	0.37	0.25	0.37	0.11	0.18	0.16	0.48	0.06	0.13
	11500	0.17	0.13	0.11	0.12	0.29	0.42	0.29	0.42	0.13	0.21	0.19	0.55	0.07	0.16
	12500	0.2	0.15	0.13	0.14	0.33	0.48	0.33	0.48	0.14	0.24	0.21	0.62	0.08	0.18
	13500	0.23	0.18	0.15	0.16	0.38	0.53	0.38	0.53	0.15	0.26	0.23	0.70	0.1	0.22
	14500	0.26	0.2	0.18	0.19	0.42	0.59	0.42	0.59	0.17	0.3	0.27	0.77	0.11	0.25
40	12000	0.01	0.03	0.08	0.13	0.24	0.36	0.30	0.45	0.1	0.19	0.17	0.48	0.07	0.06
	13000	0.01	0.04	0.1	0.15	0.28	0.41	0.35	0.51	0.12	0.23	0.2	0.53	0.08	0.07
	14000	0.02	0.05	0.11	0.18	0.31	0.46	0.39	0.57	0.13	0.25	0.22	0.59	0.09	0.08
	15000	0.02	0.05	0.13	0.2	0.35	0.50	0.44	0.63	0.14	0.28	0.24	0.66	0.1	0.09
	16000	0.02	0.06	0.15	0.23	0.39	0.55	0.49	0.69	0.15	0.31	0.27	0.72	0.11	0.10
	17000	0.02	0.07	0.17	0.26	0.43	0.60	0.54	0.75	0.17	0.35	0.3	0.79	0.12	0.11
50	15000	0.02	0.05	0.13	0.2	0.44	0.63	0.44	0.63	0.14	0.28	0.24	0.66	0.1	0.09
	16000	0.02	0.06	0.15	0.23	0.49	0.69	0.49	0.69	0.15	0.31	0.27	0.72	0.11	0.10
	17000	0.02	0.07	0.17	0.26	0.54	0.75	0.54	0.75	0.17	0.35	0.3	0.79	0.12	0.11
	18000	0.03	0.08	0.19	0.29	0.59	0.82	0.59	0.82	0.18	0.38	0.33	0.85	0.14	0.13
	19000	0.03	0.08	0.21	0.32	0.65	0.89	0.65	0.89	0.19	0.42	0.35	0.92	0.16	0.14
	20000	0.03	0.09	0.23	0.36	0.71	0.96	0.71	0.96	0.2	0.45	0.38	0.99	0.18	0.16

Note: Static pressure drops of accessory components must be added to external static pressure to enter fan selection tables.

Table 48. Component static pressure drops in. W.G (I-P) — 50Hz

Nom. Tons	CFM Std Air	Heating System				Standard Efficiency ID Coil		High Efficiency ID Coil		Filters				Econo-mizer	Hot Gas Reheat Coil
		Gas Heat		Electric Heat						Throw-away	MERV 8 High Eff		MERV 14 High Eff		
		Low	High	1 Ele-ment	2 Ele-ments	Dry	Wet	Dry	Wet	2"	2"	4"	4"		
23 (80)	6670	0.07	0.05	0.04	0.05	0.09	0.14	0.12	0.19	0.05	0.08	0.07	0.20	0.331	0.05
	7500	0.08	0.07	0.06	0.06	0.11	0.17	0.14	0.23	0.07	0.11	0.1	0.24	0.04	0.07
	8330	0.1	0.08	0.07	0.08	0.13	0.20	0.17	0.26	0.08	0.13	0.12	0.28	0.049	0.08
	9170	0.13	0.1	0.08	0.09	0.15	0.23	0.20	0.30	0.09	0.15	0.14	0.32	0.059	0.10
	10000	0.15	0.12	0.1	0.11	0.17	0.26	0.23	0.34	0.11	0.18	0.16	0.37	0.07	0.12
25 (88)	7500	0.08	0.07	0.06	0.06	0.11	0.17	0.14	0.23	0.07	0.11	0.1	0.24	0.04	0.07
	8330	0.1	0.08	0.07	0.08	0.13	0.20	0.17	0.26	0.08	0.13	0.12	0.28	0.049	0.08
	9170	0.13	0.1	0.08	0.09	0.15	0.23	0.20	0.30	0.09	0.15	0.14	0.32	0.059	0.10
	10000	0.15	0.12	0.1	0.11	0.17	0.26	0.23	0.34	0.11	0.18	0.17	0.37	0.07	0.12
29 (103)	8750	0.11	0.09	0.08	0.08	0.18	0.28	0.18	0.28	0.09	0.15	0.13	0.30	0.054	0.09
	9580	0.14	0.11	0.09	0.1	0.21	0.32	0.21	0.32	0.1	0.17	0.16	0.34	0.065	0.11
	11200	0.19	0.15	0.13	0.14	0.28	0.41	0.28	0.41	0.12	0.21	0.19	0.43	0.077	0.15
	12100	0.22	0.17	0.15	0.16	0.31	0.46	0.31	0.46	0.13	0.22	0.21	0.48	0.091	0.17

Table 48. Component static pressure drops in. W.G (I-P) — 50Hz (continued)

Nom. Tons	CFM Std Air	Heating System				Standard Efficiency ID Coil		High Efficiency ID Coil		Filters				Econo-mizer	Hot Gas Reheat Coil
		Gas Heat		Electric Heat						Throw-away	MERV 8 High Eff		MERV 14 High Eff		
		Low	High	1 Ele-ment	2 Ele-ments	Dry	Wet	Dry	Wet	2"	2"	4"	4"		
33 (118)	10000	0.01	0.03	0.07	0.11	0.18	0.28	0.22	0.35	0.11	0.18	0.16	0.37	0.070	0.04
	10800	0.01	0.03	0.08	0.13	0.20	0.31	0.25	0.39	0.12	0.21	0.18	0.41	0.076	0.05
	11700	0.01	0.04	0.1	0.15	0.23	0.35	0.29	0.44	0.13	0.23	0.2	0.46	0.085	0.05
	12500	0.01	0.04	0.11	0.17	0.26	0.39	0.32	0.48	0.14	0.26	0.23	0.50	0.096	0.06
	13300	0.02	0.05	0.12	0.19	0.29	0.42	0.36	0.53	0.15	0.28	0.25	0.55	0.107	0.07
	14200	0.02	0.06	0.14	0.22	0.32	0.46	0.40	0.58	0.17	0.32	0.28	0.61	0.12	0.08
42 (146)	12500	0.01	0.04	0.11	0.17	0.33	0.48	0.33	0.48	0.14	0.26	0.23	0.50	0.095	0.06
	13300	0.02	0.05	0.12	0.19	0.36	0.53	0.36	0.53	0.15	0.28	0.25	0.55	0.108	0.07
	14200	0.02	0.06	0.16	0.24	0.40	0.58	0.40	0.58	0.17	0.34	0.29	0.61	0.12	0.08
	15800	0.02	0.07	0.18	0.27	0.48	0.68	0.48	0.68	0.19	0.38	0.34	0.71	0.136	0.10
	16700	0.03	0.08	0.2	0.3	0.53	0.74	0.53	0.74	0.2	0.41	0.36	0.77	0.155	0.11

Note: Static pressure drops of accessory components must be added to external static pressure to enter fan performance tables.

Table 49. Component static pressure drops Pa (SI) — 50 Hz

Nom. Std Tons (kW)	L/s Std Air	Heating System				Standard Efficiency ID Coil		Filters				Econo-mizer
		Gas Heat		Electric Heat				Throw-away	MERV 8 High Eff		MERV 14 High Eff	
		Low	High	1 Element	2 Elements	Dry	Wet	Adder	50mm	100mm	100mm	
80 (23)	3150	17	13	11	12	21	34	12	19	17	38	8
	3540	21	16	14	15	26	41	17	26	24	45	10
	3930	26	20	17	19	30	48	19	31	29	50	12
	4320	31	24	21	23	36	55	22	36	34	57	15
	4720	37	29	25	27	41	62	26	43	38	65	17
88 (25)	3540	21	16	14	15	26	41	17	26	24	45	10
	3930	26	20	17	19	30	48	19	31	29	50	12
	4320	31	24	21	23	36	55	22	36	34	57	15
	5120	44	34	29	32	41	62	26	43	41	67	17
103 (29)	4130	29	22	19	21	44	68	22	36	31	55	13
	4520	34	27	23	25	51	78	24	41	38	62	16
	4920	41	32	27	29	66	97	29	50	46	77	19
	5310	47	37	32	34	75	109	31	53	50	86	23
118 (33)	4720	2	7	18	27	43	67	26	43	38	65	17
	5120	3	8	21	32	49	75	29	50	43	69	19
	5510	3	10	24	37	56	84	31	55	48	77	21
	5900	4	11	27	42	62	92	34	62	55	84	24
	6290	4	12	31	48	69	101	36	67	60	88	27
	6680	5	14	35	54	77	111	41	77	67	98	30

Table 49. Component static pressure drops Pa (SI) — 50 Hz (continued)

Nom. Std Tons (kW)	L/s Std Air	Heating System				Standard Efficiency ID Coil		Filters				Econo-mizer
		Gas Heat		Electric Heat				Throw-away	MERV 8 High Eff		MERV 14 High Eff	
		Low	High	1 Element	2 Elements	Dry	Wet	Adder	50mm	100mm	100mm	
146 (42)	5900	4	11	27	42	78	115	34	62	55	84	24
	6290	4	12	31	48	86	126	36	67	60	88	27
	6680	5	14	35	54	96	139	41	82	72	100	30
	7070	5	16	39	60	115	162	46	91	82	112	34
	7470	6	18	44	67	126	176	48	98	86	124	39

Note: Static pressure drops of accessory components must be added to external static pressure to enter fan selection tables.

Table 50. Supply air fan drive selections — 50 Hz

Nominal Tons (kW)	7.5 hp (5.6 kW)		10 hp (7.5 kW)		15 hp (10 kW)		20 hp (15 kW)	
	rpm	Drive No	rpm	Drive No	rpm	Drive No	rpm	Drive No
23 (80)	458	A	—	—	—	—	—	—
	500	B	—	—	—	—	—	—
	541	C	—	—	—	—	—	—
	583	—	583	D	—	—	—	—
	625	—	625[a]	E	—	—	—	—
25 (88)	458	A	—	—	—	—	—	—
	500	B	—	—	—	—	—	—
	541	C	—	—	—	—	—	—
	583	—	583	D	—	—	—	—
	625	—	625	E	—	—	—	—
29 (103)	500	B	—	—	—	—	—	—
	541	—	541	C	—	—	—	—
	583	—	583	D	—	—	—	—
	658	—	—	—	658[b]	F	—	—
	664	—	—	—	664[c]	G	—	—
33 (118)	417	—	417	H	—	—	—	—
	437	—	437	J	—	—	—	—
	479	—	479	K	—	—	—	—
	521	—	—	—	521	L	—	—
	562	—	—	—	562	M	—	—
	604	—	—	—	604	N	—	—
42 (146)	437	—	437	J	—	—	—	—
	479	—	479	K	—	—	—	—
	521	—	—	—	521	L	—	—
	562	—	—	—	562	M	—	—
	604	—	—	—	—	—	604	N

(a) For YC gas/electric only.
(b) For TC and TE Cooling only and with electric Heat units only.
(c) For YC gas/electric only.

Exhaust Fan Operation

To start the optional power exhaust fans, use the economizer test procedures in Table 39, p. 68 - Table 44, p. 73 to drive the economizer dampers to the open position. The exhaust fans will start when the damper position is equal to or greater than the exhaust fan setpoint. If optional power exhaust is selected, an access door must be field-installed on the horizontal return ductwork to provide access to exhaust fan motors.

The exhaust fan will start anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.

⚠ WARNING

Rotating Components!

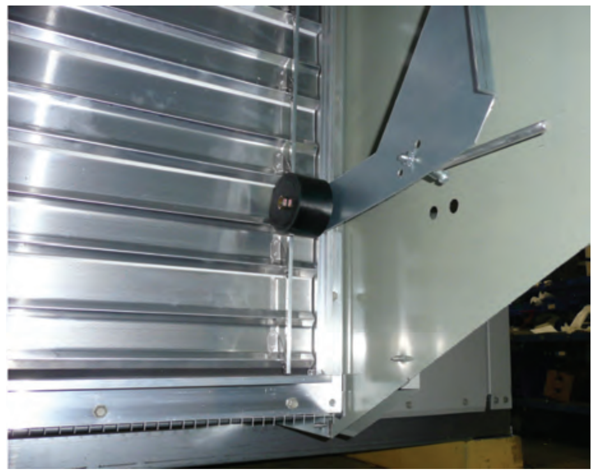
Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can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

Verify that the fans are operating properly and the CFM is within the job specifications. Refer to power exhaust fan performance tables beginning with Table 51, p. 82 for the exhaust fan performance characteristics.

Available power adjustments:

- The power exhaust fan(s) comes on based on the position of the of the exhaust fan setpoint potentiometer on the RTOM (Reliatel Options Module). The setpoint is factory set at 25%. The exhaust fan(s) will come on anytime the economizer damper position is equal to or greater than the active exhaust fan setpoint.
- Physical damper blade stops limit the amount of exhaust airflow by limiting the maximum opening of the damper blades. These stops (sliding brackets secured with wing-nuts) are present under the rain hood on the non-modulating power exhaust option. There is one stop on each side of each damper. The practical range of blade position control is between 1.5" and 4.0" blade opening. The damper is wide-open at 4.0". The stops on each side of a damper must be in the same position, such that the damper blade connecting member contacts the stops at the same time.
- The modulating power exhaust actuator tracks the position of the economizer damper actuator such that the power exhaust dampers proportionally follow or track the fresh air damper position.
- When the Statitrac option is selected, the exhaust actuator will operate independently of the economizer in order to relieve positive building pressure. If a Space Pressure Transducer failure occurs, the unit will revert back to fresh air tracking control.
- The proportional offset between the dampers is adjustable. The adjustment is made under the rain hood by hole position selection on the power exhaust actuator jack shaft on the damper linkage arm (Figure 54, p. 82). With direct-drive ultra-low-leak exhaust options, actuator stroke can be adjusted as described in "Economizer (O/A) Dampers," p. 84. The stroke limit can be set between 33% and 100% of full stroke.

Figure 54. Exhaust damper linkage arm



Note: *The barometric damper continues to function as a pressure relief damper up to the maximum stop position.*

To adjust the damper blade stops, refer to figures Figure 55, p. 83 to Figure 58, p. 84.

If the fan speed needs to be changed from the current operating speed, refer to the unit wiring diagram and the XTB1 and XTB2 terminal strip located in the economizer section.

Table 51. Power exhaust fan performance— 27.5-35 Ton — 60 Hz

Return Duct Static (in. wc)	Power Exhaust Selection			
	50% (min)		100% (max)	
	Damper Blade Open Distance (in)			
	(min)	(max)	(min)	(max)
	CFM			
0.0	3812	6866	7624	13742
0.1	3497	5296	6995	10591
0.2	3190	4458	6325	9000
0.3	2884	3812	5768	7635
0.4	2621	3359	5241	6719
0.5	2342	2885	4683	5771

Table 52. Power exhaust fan performance — 40-50 Ton — 60 Hz

Return Duct Static (in. wc)	Power Exhaust Selection			
	50% (min)		100% (max)	
	Damper Blade Open Distance (in)			
	(min)	(max)	(min)	(max)
	CFM			
0.0	4854	8035	9708	16069
0.1	4575	7410	9151	14820
0.2	4262	6450	8552	13496
0.3	4011	6027	8021	12054
0.4	3718	5526	7436	11051
0.5	3467	5186	6933	10373

Table 53. Power exhaust fan performance — 22.9 - 29.2 Ton — 50 Hz

Return Duct Static (Pa)	Power Exhaust Selection			
	50% (min)		100% (max)	
	Damper Blade Open Distance (mm)			
	(min)	(max)	(min)	(max)
	L/s			
0.0	1499	2701	2999	5405
24.9	1375	2083	2751	4166
49.8	1255	1753	2488	3540
74.7	1134	1499	2269	3003
99.6	1031	1321	2061	2643
124.5	921	1135	1842	2270

Table 54. Power exhaust fan performance — 33.3 - 41.7 Ton — 50 Hz

Return Duct Static (Pa)	Power Exhaust Selection			
	50% (min)		100% (max)	
	Damper Blade Open Distance (mm)			
	(min)	(max)	(min)	(max)
	L/s			
0.0	1909	3160	3818	6321
24.9	1800	2915	3599	5829
49.8	1676	2537	3364	5308
74.7	1577	2371	3155	4741
99.6	1462	2173	2925	4347
124.5	1364	2040	2727	4080

Figure 55. (Upflow) Tracking exhaust damper adjustment

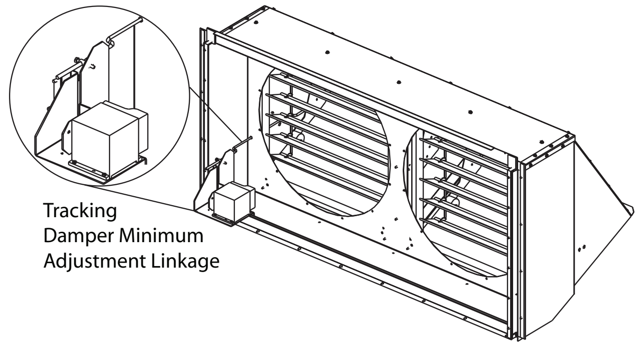


Figure 56. (Horizontal) Tracking exhaust damper adjustment

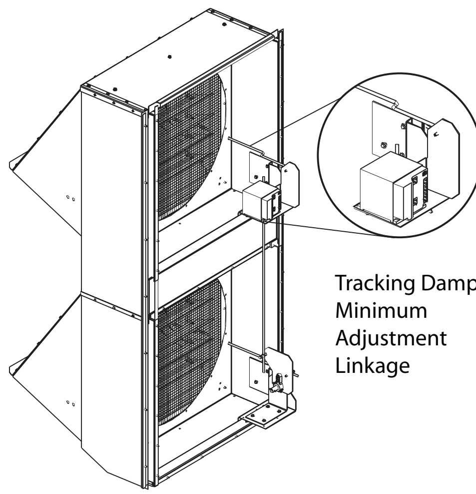


Figure 57. (Upflow) Standard exhaust maximum damper position

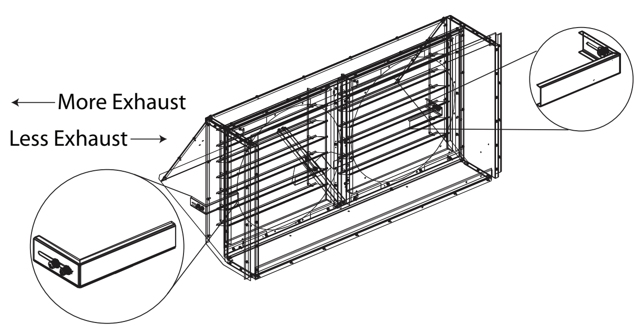
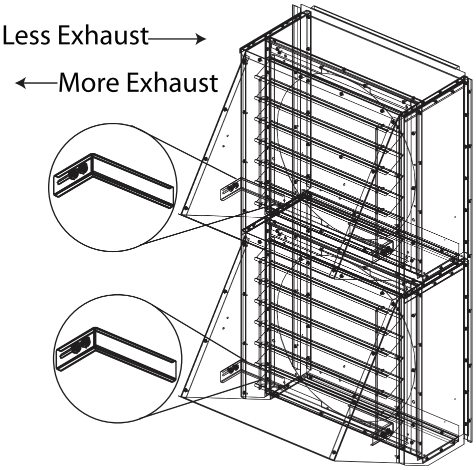


Figure 58. (Horizontal) Standard exhaust maximum damper position



Economizer Damper Adjustment

Economizer (O/A) Dampers

Arbitrarily adjusting the outside air dampers to open fully when the return air dampers are fully closed can overload the supply fan motor or deliver higher CFM to the space than designed. This causes higher operating duct static pressures and over pressurization of the space when the unit is operating in the “economizer” mode.

The purpose of adjusting the amount of O/A damper travel is to maintain a balance or equal pressure between the
O/A dampers and the pressure drop of the return air system. For models with standard or low-leak economizers, the O/A and R/A damper linkage is attached to a plate with a series of holes that allows the installer or operator to modify the O/A damper travel to compensate for various RA duct losses. Figure 59, p. 84 illustrates the damper assembly and Table 55, p. 84 through Table 58, p. 85 list the various damper positions based on the air flow (CFM) and the return duct losses (static pressure) for Downflow and Horizontal units.

To adjust the O/A damper for the correct pressure drop:

1. Measure the return duct static pressure.
2. Enter the calculated CFM from the previous section “Verifying Proper Airflow” to obtain the return air damper pressure drop.
3. Add the measured return duct static pressure and the return air damper pressure drop together to obtain the Total Return Static Pressure. Apply this calculation and the calculated CFM to the appropriate Table 55, p. 84 through Table 58, p. 85.
4. Set the drive rod swivel to the appropriate hole according to Table 55, p. 84 through Table 58, p. 85. The units are shipped using hole “A” with no reference to any specific operating condition.

Figure 59. Economizer (O/A) damper assembly

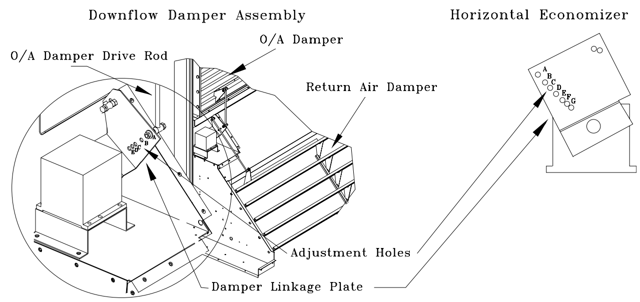


Table 55. 27.5 - 35 Ton downflow economizer (O/A) damper static pressure setup

System Design CFM	Return Air Duct Static + Return Air Damper Static (Inches of Water)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	Drive Rod Position						
8000	B	E	E	E	E	E	E
8500	B	D	E	E	E	E	E
9500	A	C	E	E	E	E	E
10000	A	C	D	E	E	E	E
10500	A	C	D	E	E	E	E
11000	A	B	D	D	E	E	E
11500	A	B	C	D	E	E	E
12000	A	A	C	D	E	E	E
12500	A	A	C	D	D	E	E
13000	A	A	B	B	C	D	E

Table 56. 27.5 - 35 Ton horizontal economizer (O/A) damper static pressure setup

System Design CFM	Return Air Duct Static + Return Air Damper Static (Inches of Water)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	Drive Rod Position						
8000	A	F	G	G	G	G	G
8500	A	F	G	G	G	G	G
9000	A	E	G	G	G	G	G
9500	A	E	F	G	G	G	G
10000	A	D	E	G	G	G	G
11000	A	D	E	F	G	G	G
11500	A	B	E	F	G	G	G
12000	A	A	D	F	G	G	G
12500	A	A	D	E	F	G	G

Table 56. 27.5 - 35 Ton horizontal economizer (O/A) damper static pressure setup (continued)

System Design CFM	Return Air Duct Static + Return Air Damper Static (Inches of Water)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	Drive Rod Position						
13000	A	A	D	E	F	G	G
13500	A	A	C	E	F	F	G
14000	A	A	C	D	E	F	G
14500	A	A	B	D	E	F	F

Table 57. 40 - 50 Ton downflow economizer (O/A) damper static pressure setup

System Design CFM	Return Air Duct Static + Return Air Damper Static (Inches of Water)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	Drive Rod Position						
12000	A	A	C	D	E	E	E
12500	A	A	C	D	D	E	E
13000	A	A	B	C	D	E	E
13500	A	A	B	C	D	D	E
14000	A	A	B	C	C	D	E
14500	A	A	B	B	C	D	D
15000	A	A	A	B	C	D	D
15500	A	A	A	B	C	D	D
16000	A	A	A	B	C	C	D
16500	A	A	A	B	B	C	D
17000	A	A	A	B	B	C	C
17500	A	A	A	A	B	C	C
18000	A	A	A	A	B	C	C
18500	A	A	A	A	B	B	C
19000	A	A	A	A	B	B	C
19500	A	A	A	A	B	B	B
20000	A	A	A	A	A	B	B

Table 58. 40 - 50 Ton horizontal economizer (O/A) damper static pressure setup

System Design CFM	Return Air Duct Static + Return Air Damper Static (Inches of Water)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	Drive Rod Position						
12000	A	B	E	F	G	G	G
12500	A	B	D	E	F	G	G
13000	A	A	D	E	F	G	G
13500	A	A	D	E	F	G	G
14000	A	A	C	E	F	F	G
14500	A	A	C	D	E	F	F
15000	A	A	B	D	E	F	F
15500	A	A	B	D	E	E	F
16000	A	A	A	C	D	E	F
16500	A	A	A	C	D	E	F
17000	A	A	A	B	D	E	E
17500	A	A	A	B	D	E	E
18000	A	A	A	B	C	D	E
18500	A	A	A	A	C	D	E
19000	A	A	A	A	B	D	E
19500	A	A	A	A	B	C	E
20000	A	A	A	A	B	C	D

Models with Ultra-Low Leak Economizers

The installer can adjust the stroke of the direct drive actuator on the O/A damper to compensate for various R/A duct losses. Figure 61, p. 86 and Figure 62, p. 86 illustrate the damper & actuator assembly and Table 59, p. 86 through Table 62, p. 87 list the various O/A actuator limit positions based on the air flow (CFM) and the return duct losses (static pressure) for Downflow and Horizontal units. The actuator stroke limit can be adjusted between 33% and 100% of full stroke. To adjust the O/A damper for the correct pressure drop:

1. Measure the return duct static pressure.
2. Enter the calculated CFM from the previous section “Verifying Proper Air Flow (CFM) - CV or VFD's,” p. 74 to obtain the return air damper pressure drop.
3. Add the measured return duct static pressure and the return air damper pressure drop together to obtain the Total Return Static Pressure. Apply this calculation and the calculated CFM to the appropriate table. See Table 59, p. 86 through Table 62, p. 87.
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. (See Figure 60, p. 86).

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. 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 - same direction as spring return. (See Figure 63, p. 86).

Figure 60. Actuator stroke limit adjustment

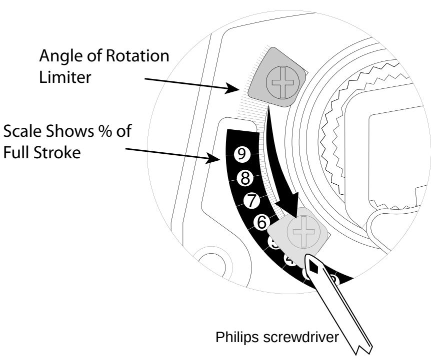


Figure 61. Actuator for OA damper - Downflow

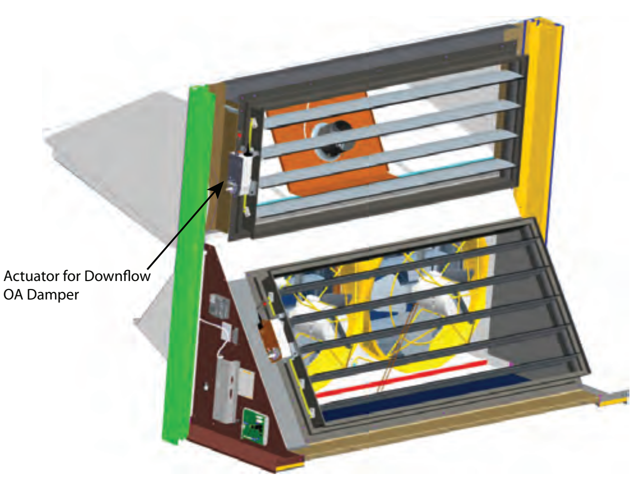


Figure 62. Actuator for OA damper - horizontal

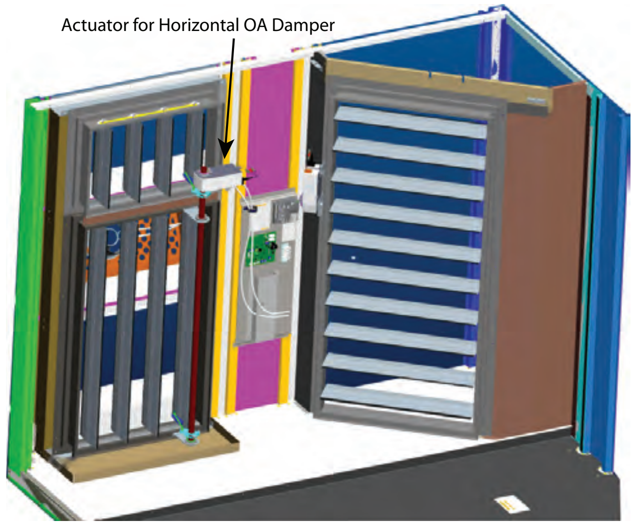


Figure 63. Actuator auto-scaling feature details

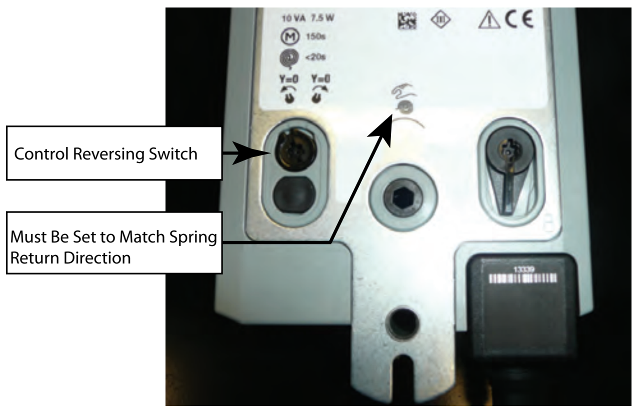


Table 59. 27.5 - 35 Ton downflow economizer (O/A) - ultra-low leak economizer

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
8000	75	55	55	55	55	55	55
8500	75	60	55	55	55	55	55
9500	100	65	55	55	55	55	55
10000	100	65	60	55	55	55	55
10500	100	65	60	60	55	55	55
11000	100	75	65	60	55	55	55
11500	100	75	65	60	55	55	55
12000	100	100	65	60	55	55	55

Table 59. 27.5 - 35 Ton downflow economizer (O/A) - ultra-low leak economizer (continued)

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
12500	100	100	65	60	60	55	55
13000	100	100	75	75	65	60	55

Table 60. 27.5 - 35 Ton horizontal economizer (O/A) - ultra-low-leak economizer

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
8000	100	45	40	40	40	40	40
8500	100	45	40	40	40	40	40
9000	100	50	40	40	40	40	40
9500	100	50	45	40	40	40	40
10000	100	60	50	40	40	40	40
11000	100	60	50	45	40	40	40
11500	100	80	50	45	40	40	40
12000	100	100	60	45	40	40	40
12500	100	100	60	50	45	40	40
13000	100	100	60	50	45	40	40
13500	100	100	70	50	45	45	40
14000	100	100	70	60	50	45	40
14500	100	100	80	60	50	45	45

Table 61. 40 - 50 Ton downflow economizer (O/A) - ultra-low-leak economizer

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
12000	100	100	65	60	55	55	55
12500	100	100	65	60	60	55	55
13000	100	100	75	65	60	55	55
13500	100	100	75	65	60	60	55
14000	100	100	75	65	65	60	55
14500	100	100	75	75	65	60	60

Table 61. 40 - 50 Ton downflow economizer (O/A) - ultra-low-leak economizer (continued)

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
15000	100	100	100	75	65	60	60
15500	100	100	100	75	65	60	60
16000	100	100	100	75	65	65	60
16500	100	100	100	75	75	65	60
17000	100	100	100	75	75	65	65
17500	100	100	100	100	75	65	65
18000	100	100	100	100	75	65	65
18500	100	100	100	100	75	75	65
19000	100	100	100	100	75	75	65
19500	100	100	100	100	75	75	75
20000	100	100	100	100	100	75	75

Table 62. 40 - 50 Ton horizontal economizer (O/A) - ultra-low-leak economizer

System Design CFM	Return Air Duct Static + Return Air Damper Static (in WC)						
	0.2-0	0.4-0	0.6-0	0.8-0	1.0-0	1.2-0	1.4-0
	stroke limit setting % on OA damper actuator						
12000	100	80	50	45	40	40	40
12500	100	80	60	50	45	40	40
13000	100	100	60	50	45	40	40
13500	100	100	60	50	45	40	40
14000	100	100	70	50	45	45	40
14500	100	100	70	60	50	45	45
15000	100	100	80	60	50	45	45
15500	100	100	80	60	50	50	45
16000	100	100	100	70	60	50	45
16500	100	100	100	70	60	50	45
17000	100	100	100	80	60	50	50
17500	100	100	100	80	60	50	50
18000	100	100	100	80	70	60	50
18500	100	100	100	100	70	60	50
19000	100	100	100	100	80	60	50
19500	100	100	100	100	80	70	50
20000	100	100	100	100	80	70	60

Manual Outside Air Damper

Units ordered with the 25% manual outside air option have two slidable dampers. By adjusting one or both, the desired amount of fresh air entering the system can be obtained.

To adjust the outside air damper;

1. Turn the “System” selection switch to the “Off” position and the “Fan” selection switch (if applicable) to the “Auto” position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit's power terminal block or the unit factory mounted disconnect switch.

⚠ 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.

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK HTB1 OR UNIT DISCONNECT SWITCH.

3. Remove the mist eliminator retainer bracket and the mist eliminators from the fresh air hood.
4. Remove the five (5) screws in the top and bottom of each fresh air damper located inside the hood area.
5. Using the Service Test guide in Table 39, p. 68 — Table 44, p. 73, momentarily jump across the test terminals one time for constant volume applications, or three consecutive times for a variable air volume application, to start the Minimum Ventilation Test.
6. With the supply fan “On” and rotating in the proper direction, measure the return duct static pressure.
7. Using Table 63, p. 88, enter the desired amount of fresh air and the return air static pressure reading to obtain the proper damper opening dimension.
8. Loosen the adjustment screws on each side of the damper and slide it downward to the required opening.
9. Tighten the adjustment screws and re-install the mist eliminators and the mist eliminator retainer bracket.
10. Open the main power disconnect or the unit mounted disconnect switch to shut the unit off and to reset the RTRM.
11. Before closing the disconnect switch, ensure that the compressor discharge service valve(s) and suction service valve(s) are backseated.

Table 63. Damper adjustment

Damper Opening (In.)		Return Air Static Pressure - Inches w.c.							
Damper #1	Damper #2	-0.20	-0.40	-0.60	-0.80	-1.00	-1.20	-1.40	-1.60
2	0	430	590	725	840	950	1040	1120	740
4	0	780	1080	1330	1545	1730	1890	2035	2170
6	0	1185	1620	1990	2300	2575	2815	3030	3240
8	0	1530	2110	2600	3025	3390	3705	3985	4240
10	0	1930	2655	3270	3800	4250	4650	5005	5345
10	2	2295	3165	3910	4545	5095	5575	6010	6415
10	4	2660	3650	4510	5255	5905	6480	6995	7470
10	6	3010	4150	5130	5965	6690	7330	7900	8440
10	8	3345	4600	5680	6610	7410	8120	8765	9365
10	10	3690	5125	6350	7395	8295	9075	9775	10420

Starting the Compressor

Optional service valves must be fully opened before startup (suction and discharge line).

Note: *Suction and discharge service valves are standard on high efficiency units and 40-50T standard efficiency constant volume units.*

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.

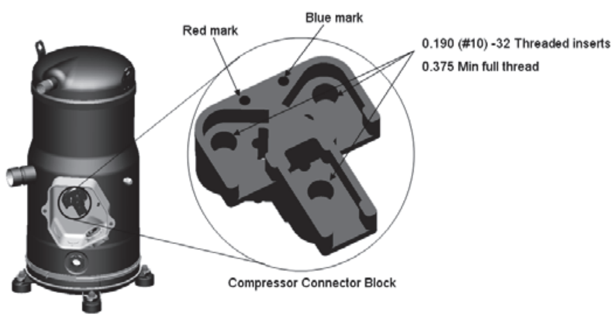
Starting 27.5 to 35 Ton Standard Efficiency Units

Install a set of service gauges onto the suction and discharge service ports. To start the compressor test, close the main power disconnect switch or the unit mounted disconnect switch.

Jump across the "Test terminals" on LTB1 or toggle the test switch three consecutive times if it is a constant volume application, or five times if it is a variable air volume application for two to three seconds per jump. Refer to Table 39, p. 68 - Table 44, p. 73 for the Cooling Test sequence.

Important: *The compressors are protected from reverse rotation caused by improper sequencing of the customer supplied unit power wires by the unit phase monitor. It is imperative to verify correct sequencing of compressor power wires to prevent compressor failure from reverse rotation. Refer to the unit wiring schematic and/or wire color markers vs. the compressor terminal block color markers.*

Figure 64. Compressor terminal block color markers



If a scroll compressor is rotating backwards, it will not pump and a loud rattling sound can be observed. If 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 compressor will likely fail or the motor windings will overheat and cause the motor winding thermostats to open. The opening of the motor winding thermostat will cause a "compressor trip" diagnostic and stop the compressor.

Starting 40 to 50 Ton Standard Efficiency VAV Units

Install a set of service gauges onto the suction and discharge service ports of each circuit. Follow the same procedures as above to start the first stage of compressor operation.

After the compressor and the condenser fans have been operating for approximately 30 minutes, use Figure 73, p. 91 through Figure 98, p. 104 to determine the proper operating pressures for that circuit.

Jump across the "Test Terminals" once again. This will allow the second stage compressors to start. The first stage compressor will shut off providing the 3 minute "On" time has elapsed.

Note: *When the second refrigerant circuit is requested to operate, both compressors of the 50 ton unit will run simultaneously. Verify that the compressors are rotating in the correct direction.*

Observe the operation of the compressor(s) and the system operating pressures. After compressors and condenser fans for the circuit have been operating for approximately 30 minutes, use Figure 73, p. 91 through Figure 98, p. 104 to determine the proper operating pressures. For subcooling guidelines, refer to "Measuring Subcooling," p. 105.

Units with Lead/Lag function disabled, jump across the "Test Terminals" once again. This will allow the third stage of cooling (number one circuit) to start providing the 3 minute "Off" time has been satisfied.

Starting 27.5-50 Tons High Efficiency Units and 40-50 Tons Standard Efficiency Constant Volume Units

Install a set of service gauges onto the suction and discharge service ports of the circuit. Jump across the "Test Terminals" on LTB1 or toggle the test switch three consecutive times if it is a constant volume application, or five times if it is a variable air volume application for two to three seconds per jump in order to get to cooling stage 1.

Jump across the "Test Terminals" two more times for full load cooling. After the compressor and the condenser fans have been operating for approximately 30 minutes, use Figure 73, p. 91 through Figure 98, p. 104 to determine the proper operating pressures for that circuit.

For subcooling guidelines, refer to "Measuring Subcooling," p. 105.

Line Weights

The standard and high efficiency units use line weights to dampen vibration. Do not remove, relocate, or over-torque these weights. The torque specification for the attaching bolts is 6 ft-lbs ± 1.0 ft-lb.

The locations of the line weights are shown in the following figures.

Figure 65. Line weight locations TE, YC, TC*330, 360, & 420 standard efficiency w/o service valves

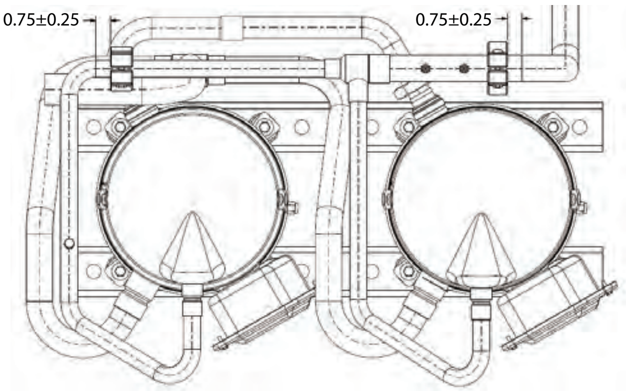


Figure 66. Line weight location TE, YC, TC*330, 360, & 420 standard efficiency with service valves

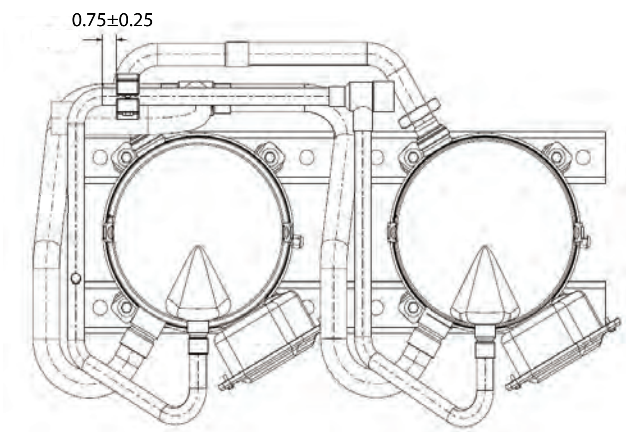


Figure 67. Line weight location TE, YC, TC*400 standard efficiency VAV w/o service valves

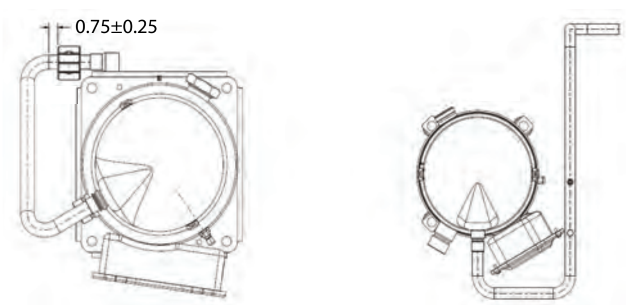


Figure 68. Line weight location TE, YC, TC*400 & 480 standard efficiency VAV with service valves & TE, YC, TC*480 with reheat valve with service valves

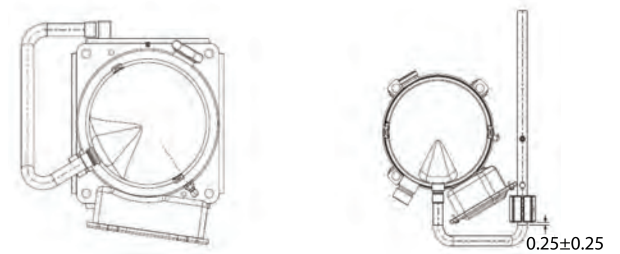


Figure 69. Line weight locations TE, YC, TC*500 & 600 standard efficiency VAV w/o service valves

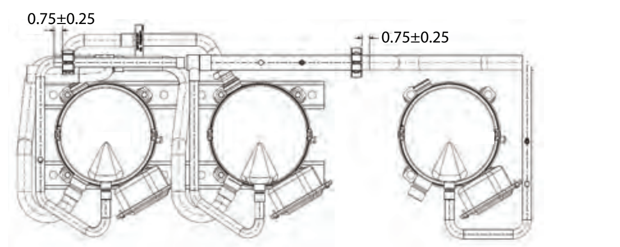


Figure 70. Line weight locations TE, YC, TC*500 & 600 standard efficiency VAV with service valves

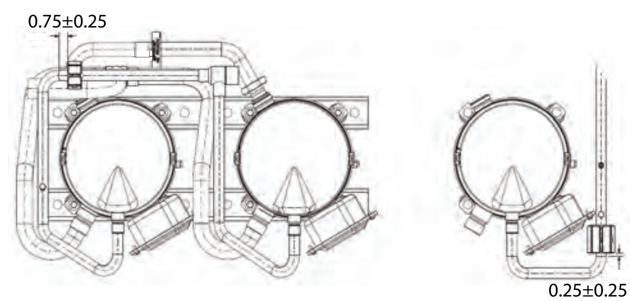


Figure 71. Line weight location TE, YC, TC*600 standard efficiency VAV reheat with service valves

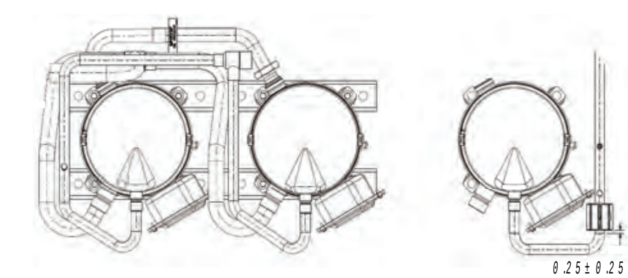
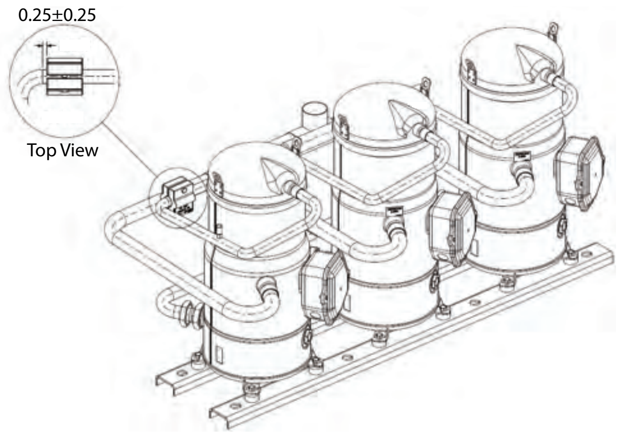


Figure 72. Line weight location TE, YC, TC*275–500 high efficiency and 400, 500 standard efficiency CV



Compressor Oil

Once all of the compressors have been started, verify that the oil level is visible through the sight glass or above the sight glass. Use appropriate lighting (flash light) to verify the presence of oil. A tandem manifold set may have different oil heights, but still must be visible in the sight glass or above the sight glass.

After shutting the compressors off, check the oil's appearance. Discoloration of the oil indicates that an abnormal condition has occurred. If the oil is dark, overheating may have occurred. Potential causes of overheating: compressor is operating at extremely high condensing temperatures; high superheat; a compressor mechanical failure; or, occurrence of a motor burnout. If the oil is black and contains metal flakes, a mechanical failure has occurred. This symptom is often accompanied by a high compressor amperage draw.

Refer to the refrigeration system in the maintenance section for details on testing and replacing oil.

Figure 73. 27.5 Ton operating pressure — standard efficiency (60Hz)

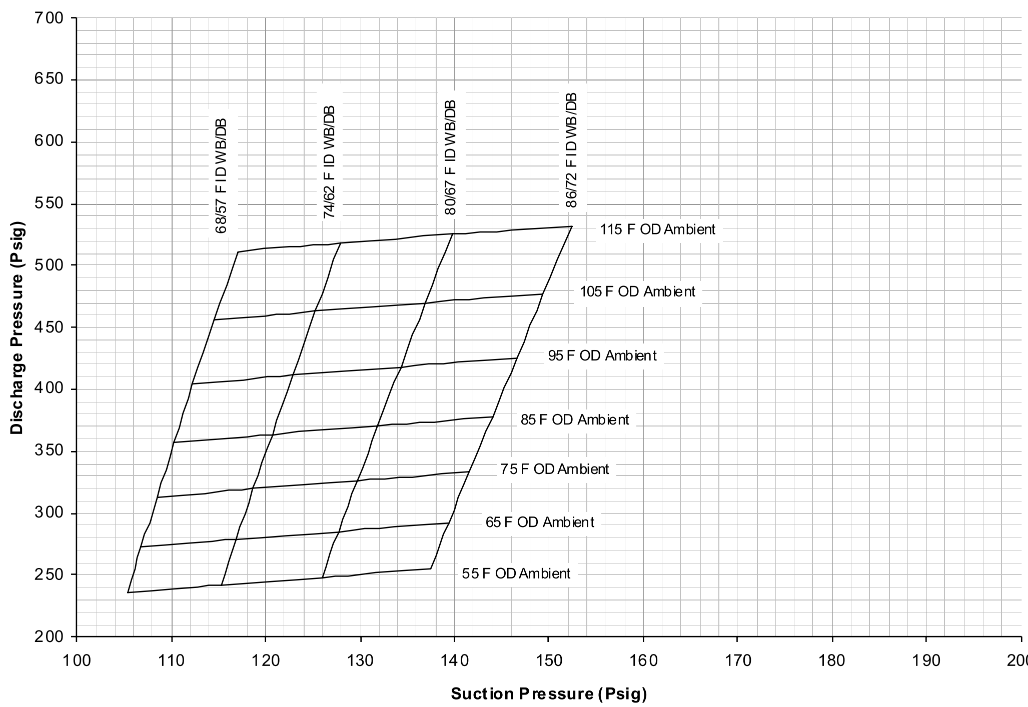


Figure 74. 30 Ton operating pressure — standard efficiency (60 Hz)

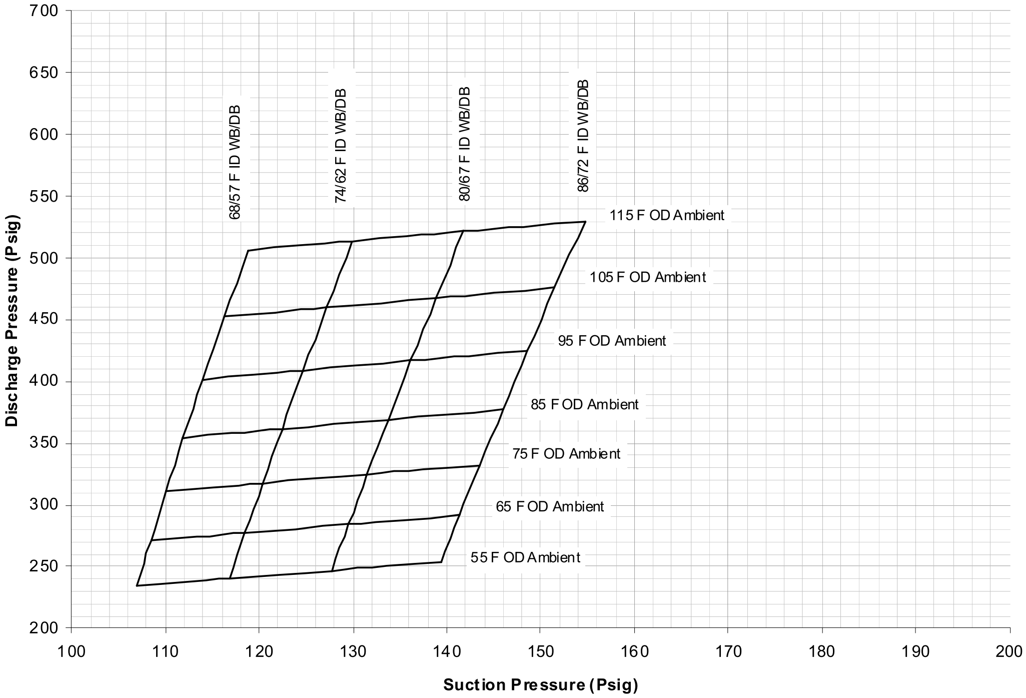


Figure 75. 35 Ton operating pressure — standard efficiency (60 Hz)

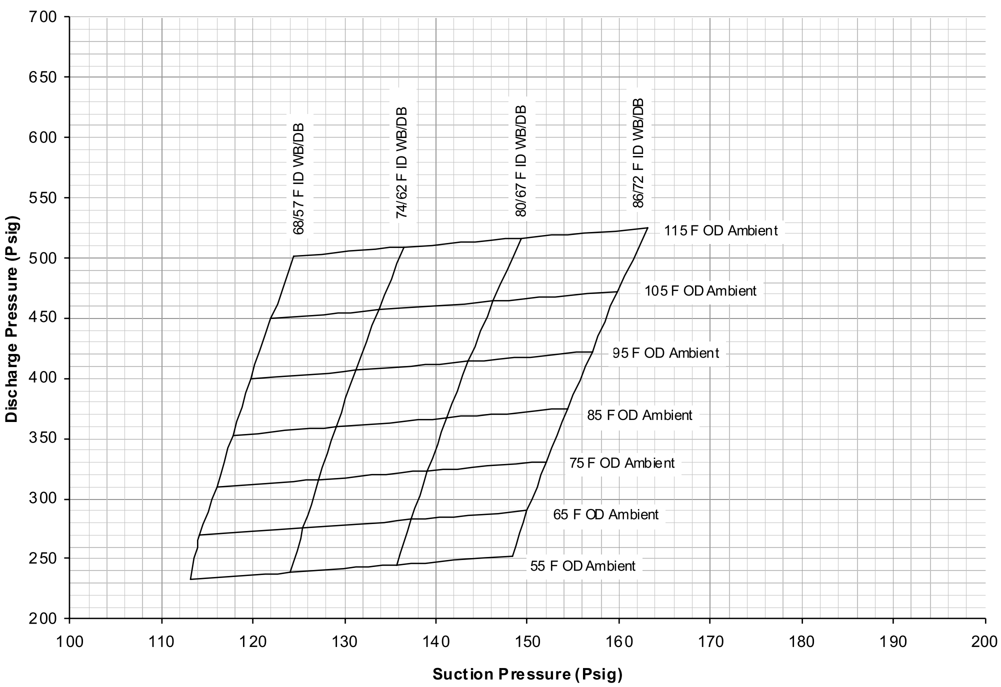


Figure 76. 40 Ton dual circuit operating pressure, Cir #1 — standard efficiency VAV (60 Hz)

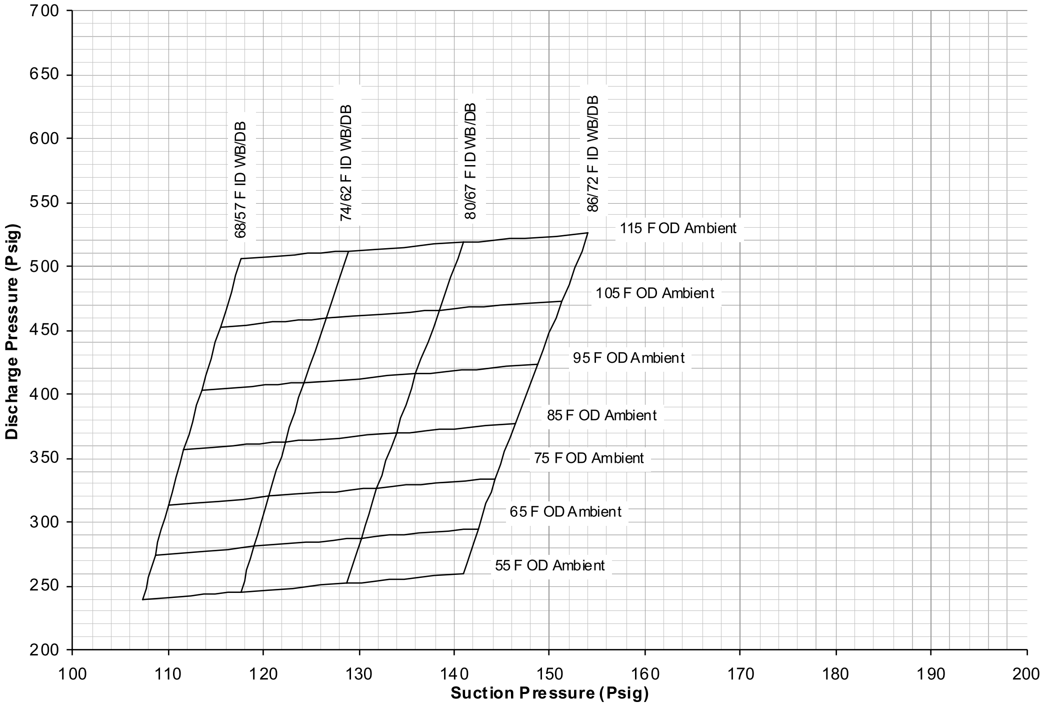


Figure 77. 40 Ton dual circuit operating pressure Cir #2 — standard efficiency VAV (60 Hz)

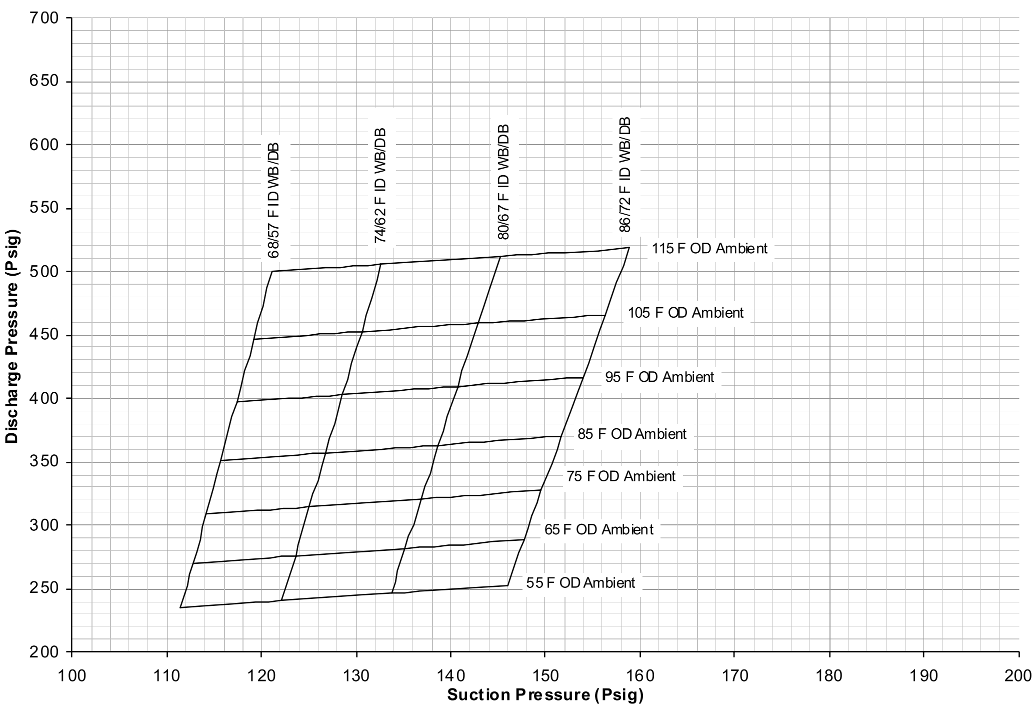


Figure 78. 40 Ton operating pressure — standard efficiency CV (60 Hz)

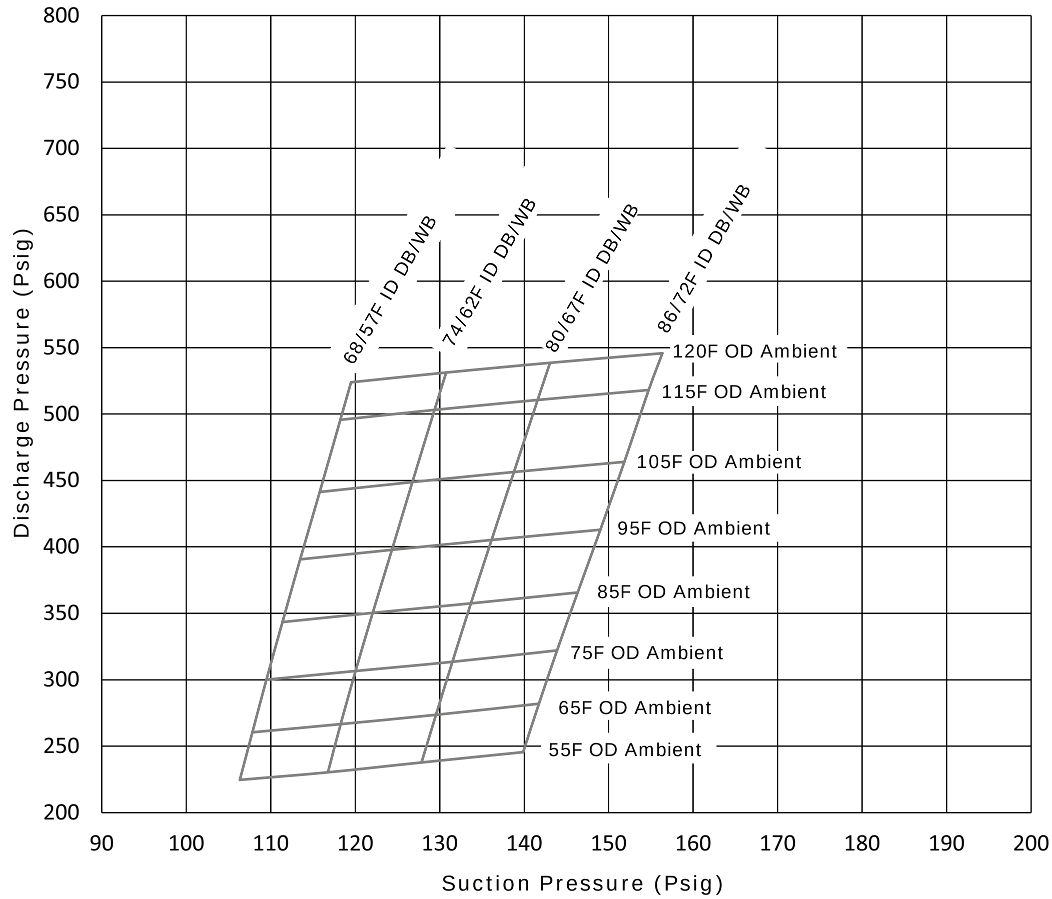


Figure 79. 50 Ton dual circuit operating pressure Cir #1 — standard efficiency VAV (60 Hz)

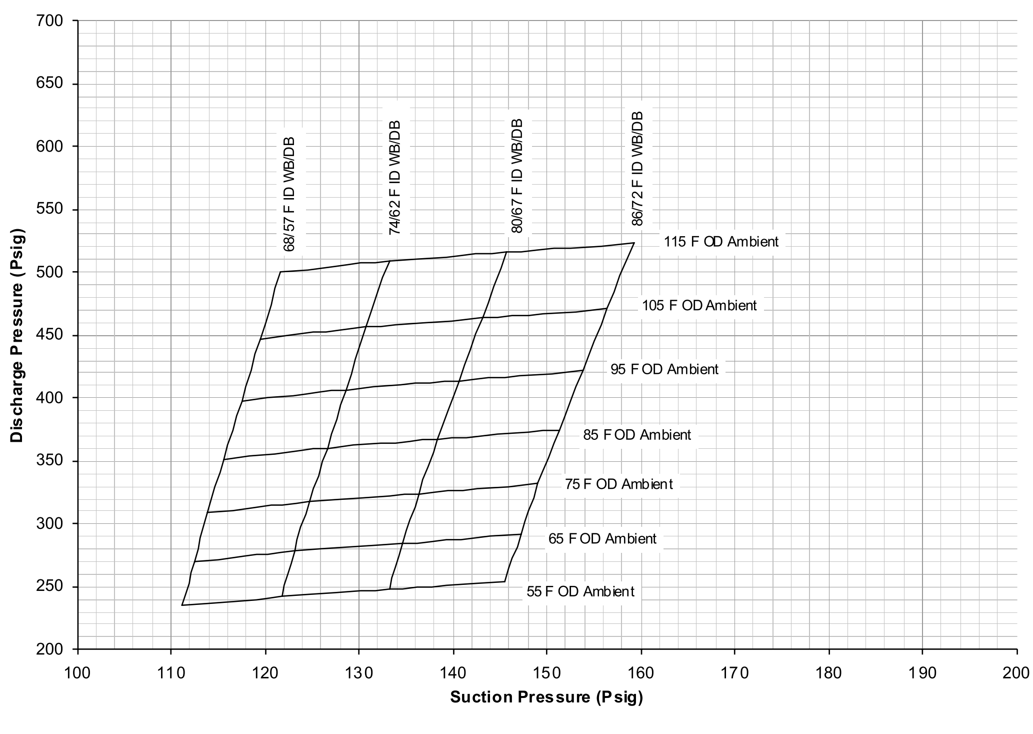


Figure 80. 50 Ton dual circuit operating pressure Cir #2 — standard efficiency VAV (60 Hz)

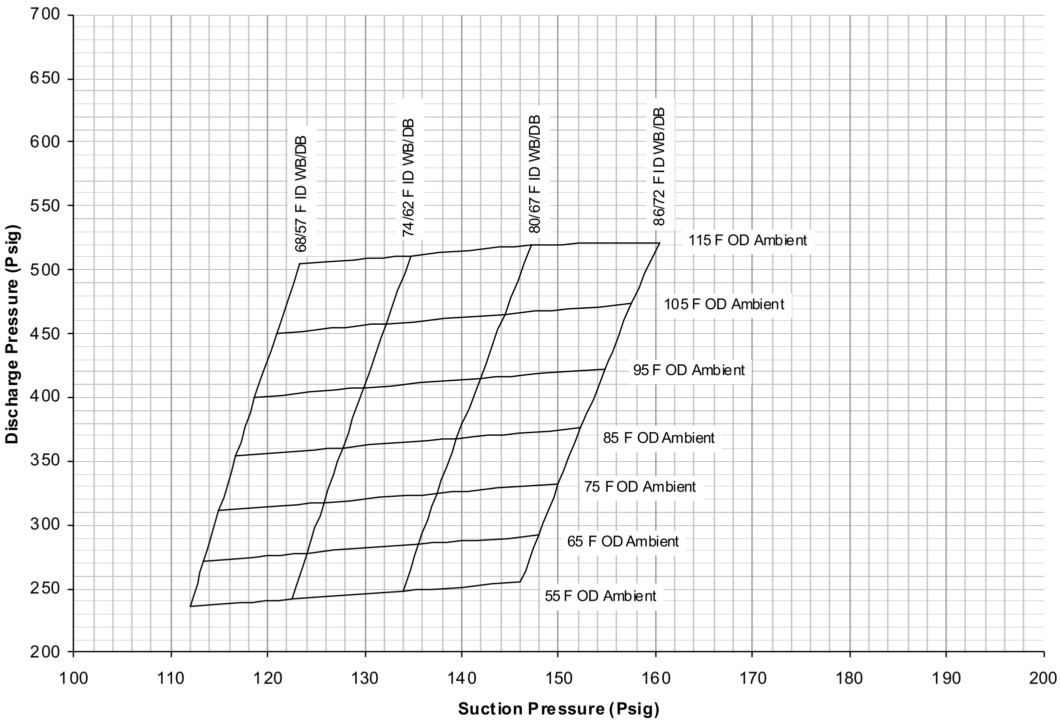


Figure 81. 27.5 Ton operating pressure — high efficiency (60 Hz)

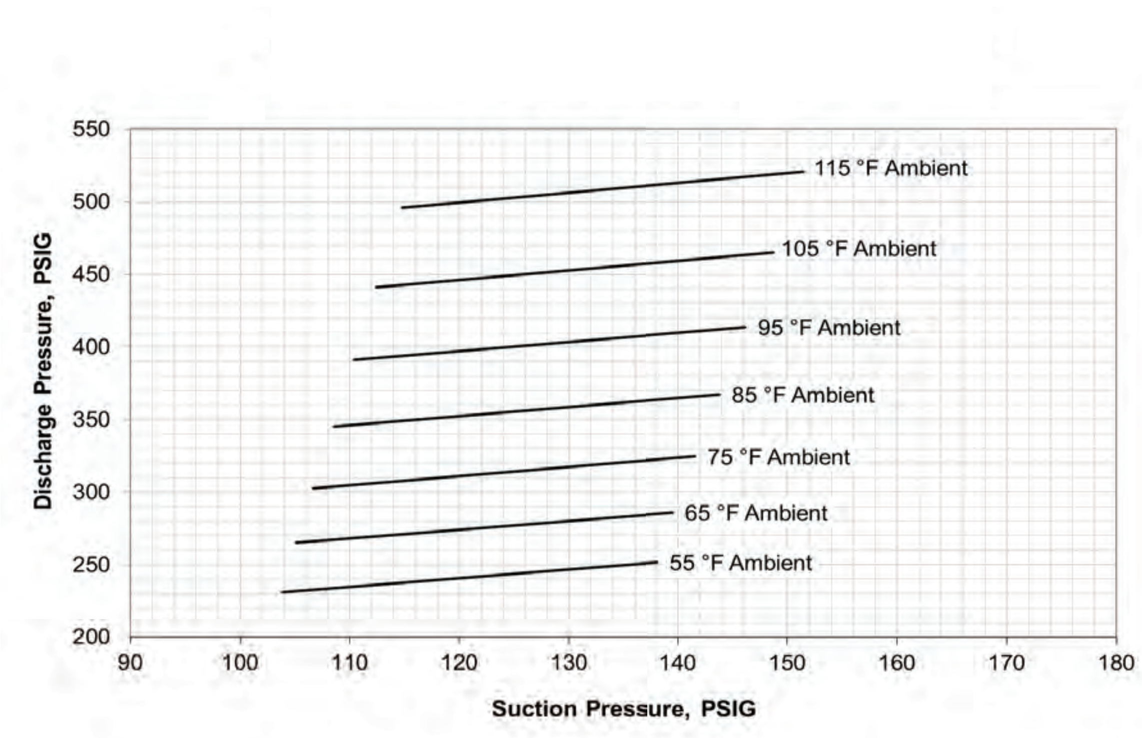


Figure 82. 30 Ton operating pressure — high efficiency (60 Hz)

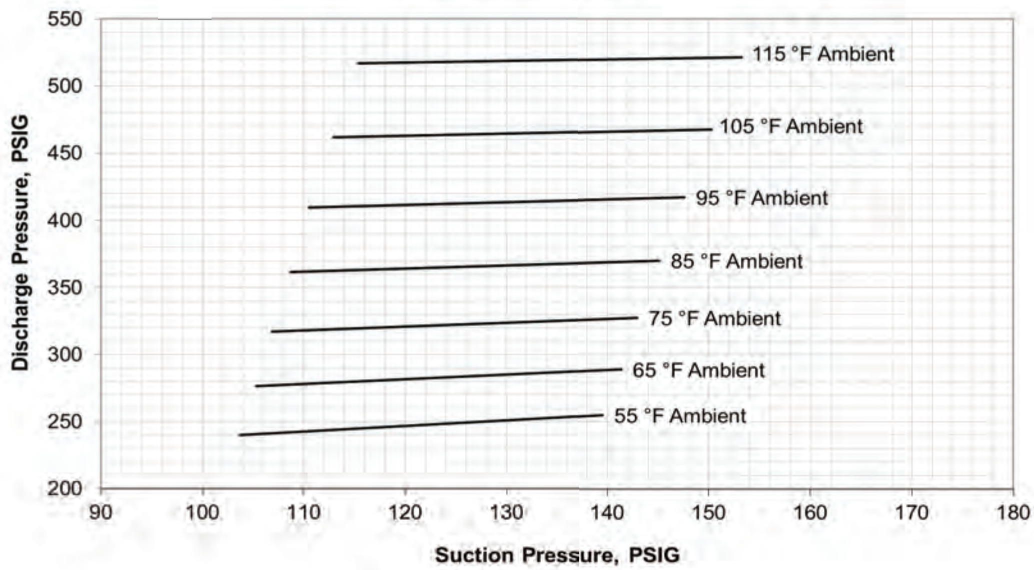


Figure 83. 35 Ton operating pressure — high efficiency (60 Hz)

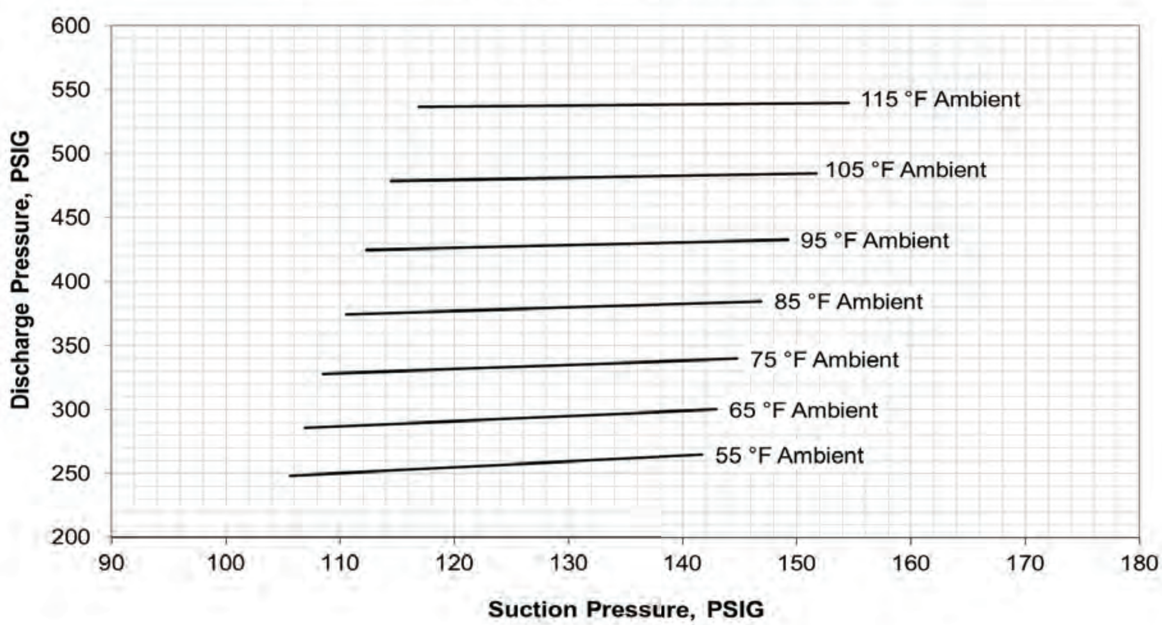


Figure 84. 40 Ton operating pressure — high efficiency (60 Hz)

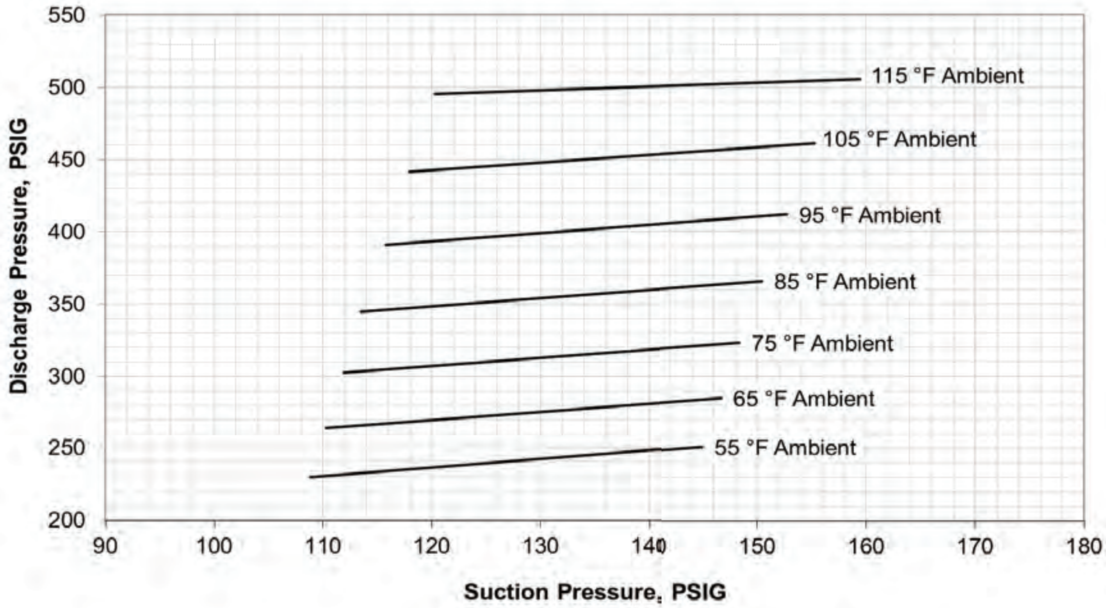


Figure 85. 50 Ton operating pressure — high efficiency and standard efficiency CV (60 Hz)

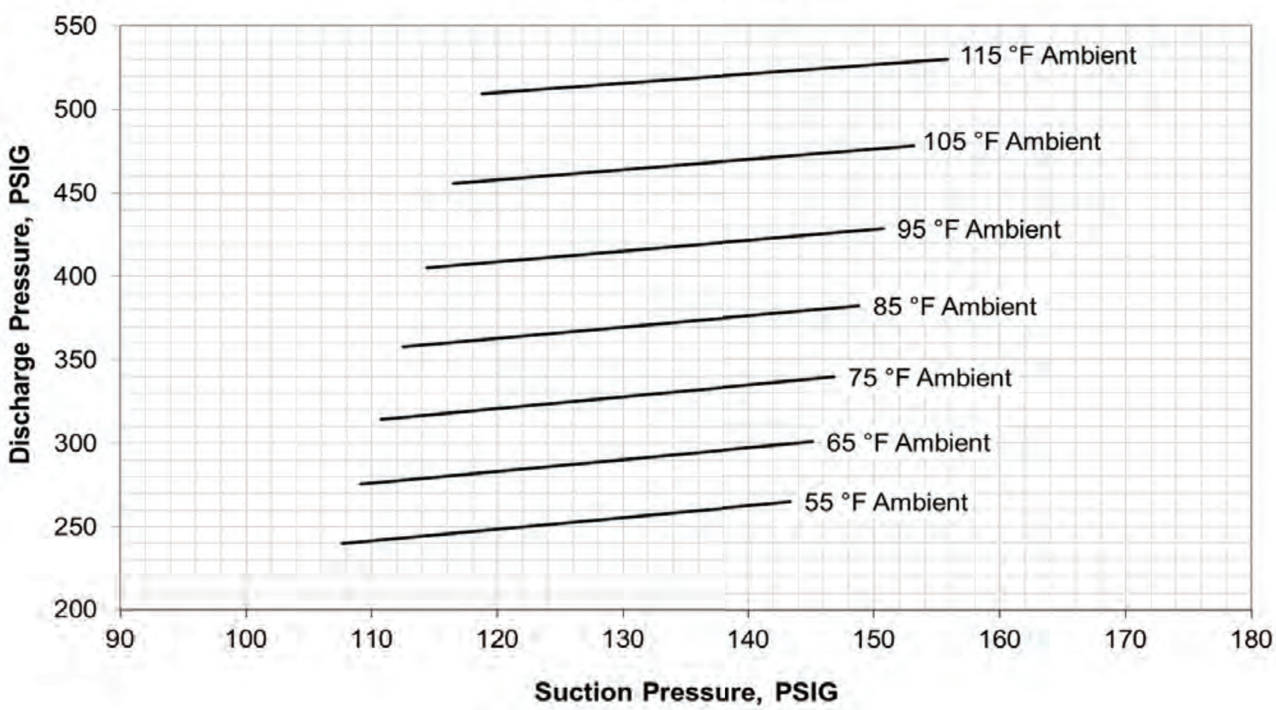


Figure 86. 22.9 Ton operating pressure — standard efficiency (50 Hz)

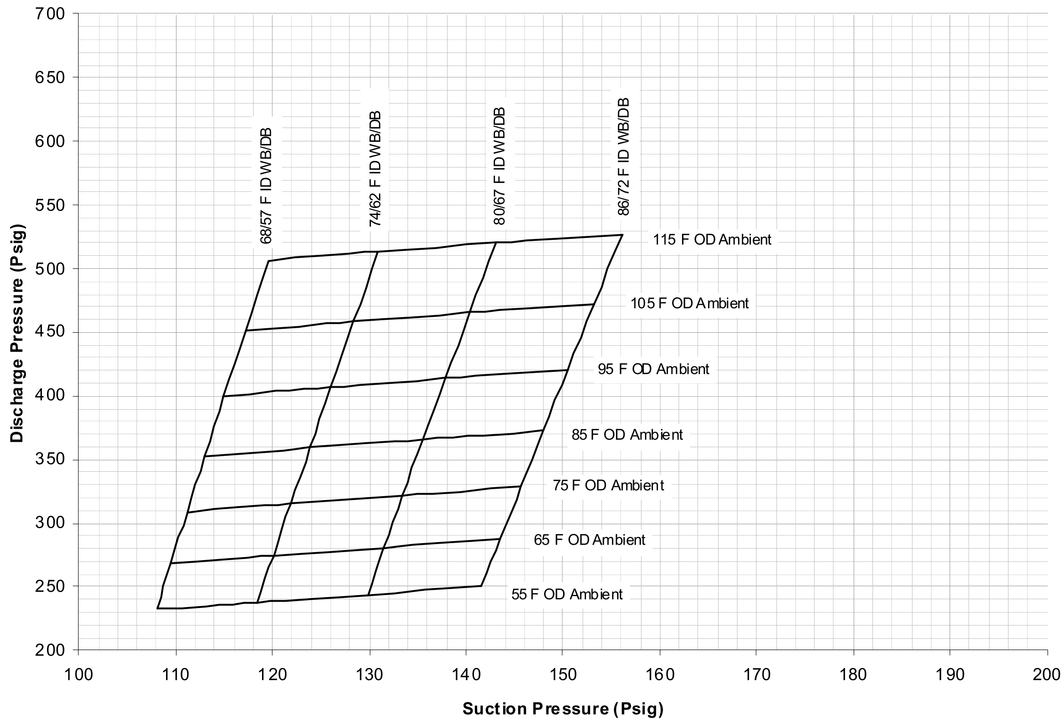


Figure 87. 25.4 Ton operating pressure — standard efficiency (50 Hz)

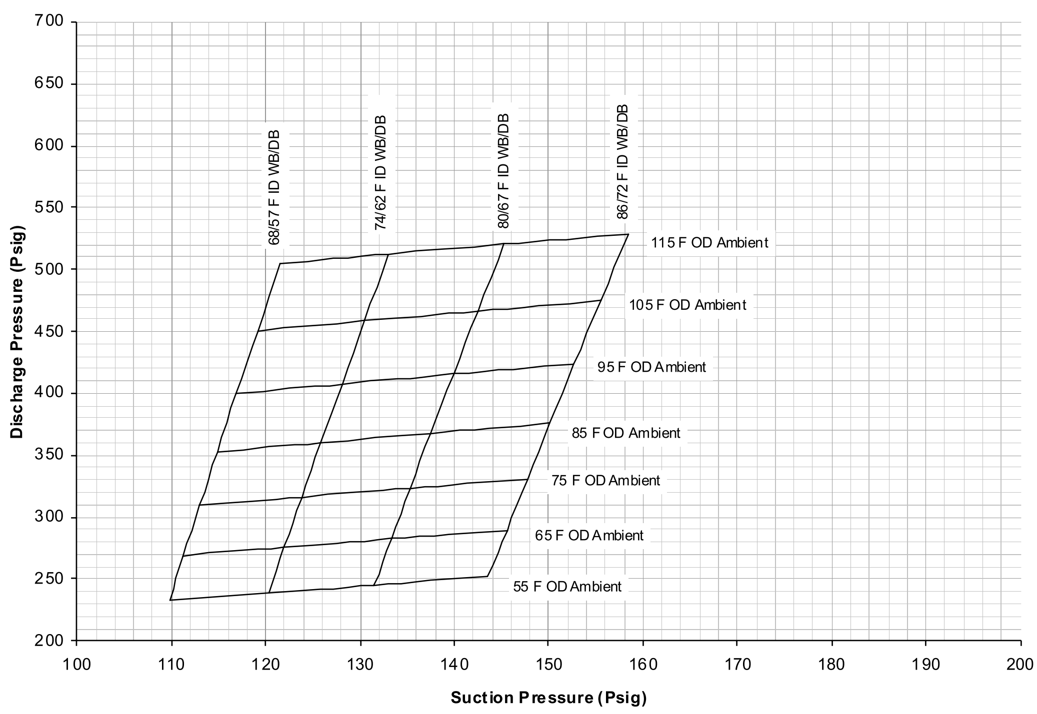


Figure 88. 29.2 Ton operating pressures — standard efficiency (50 Hz)

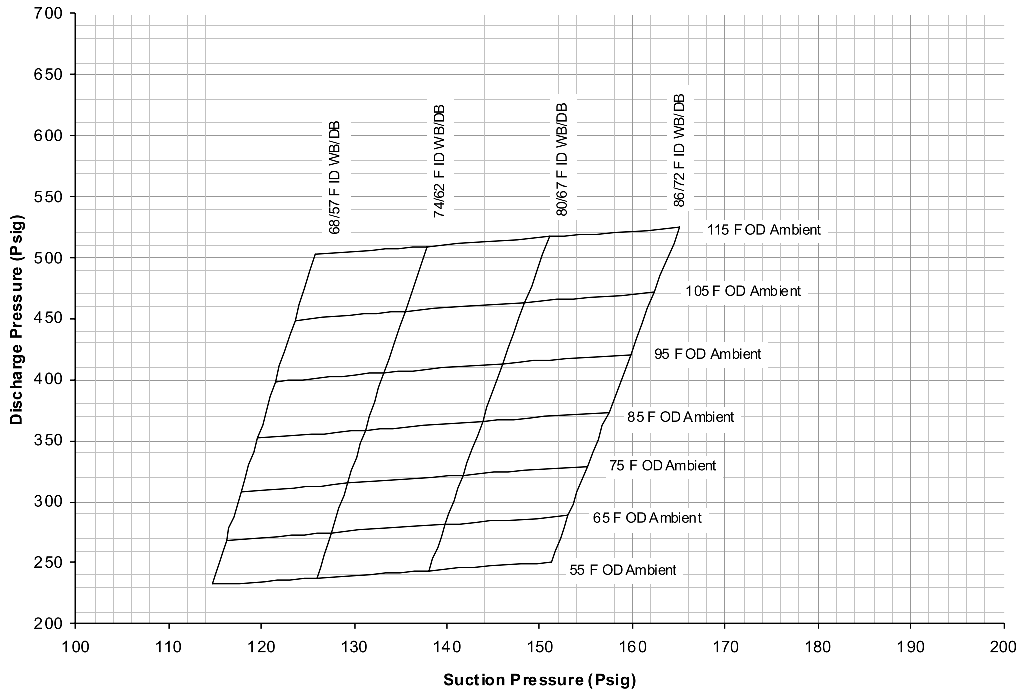


Figure 89. 33.3 Ton operating pressure — standard efficiency CV (50 Hz)

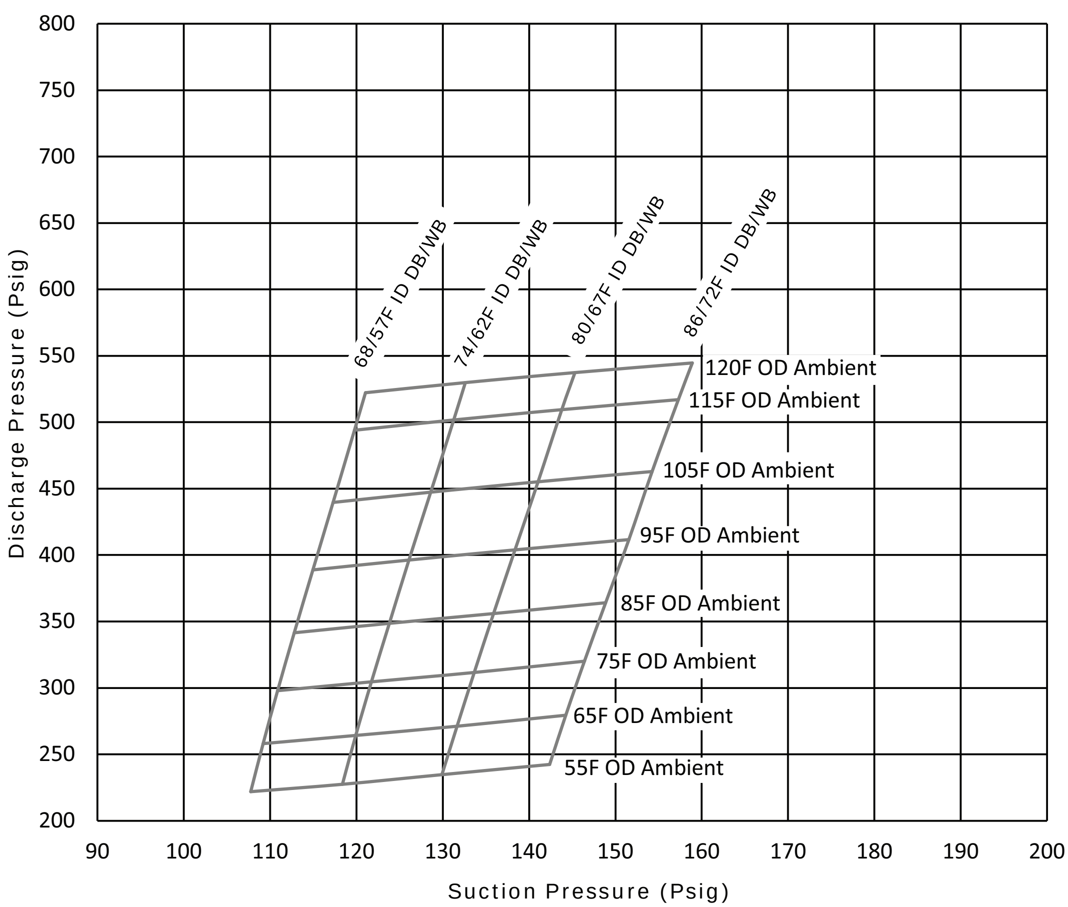


Figure 90. 33.3 Ton dual circuit operating pressure, circuit #1 — standard efficiency VAV (50 Hz)

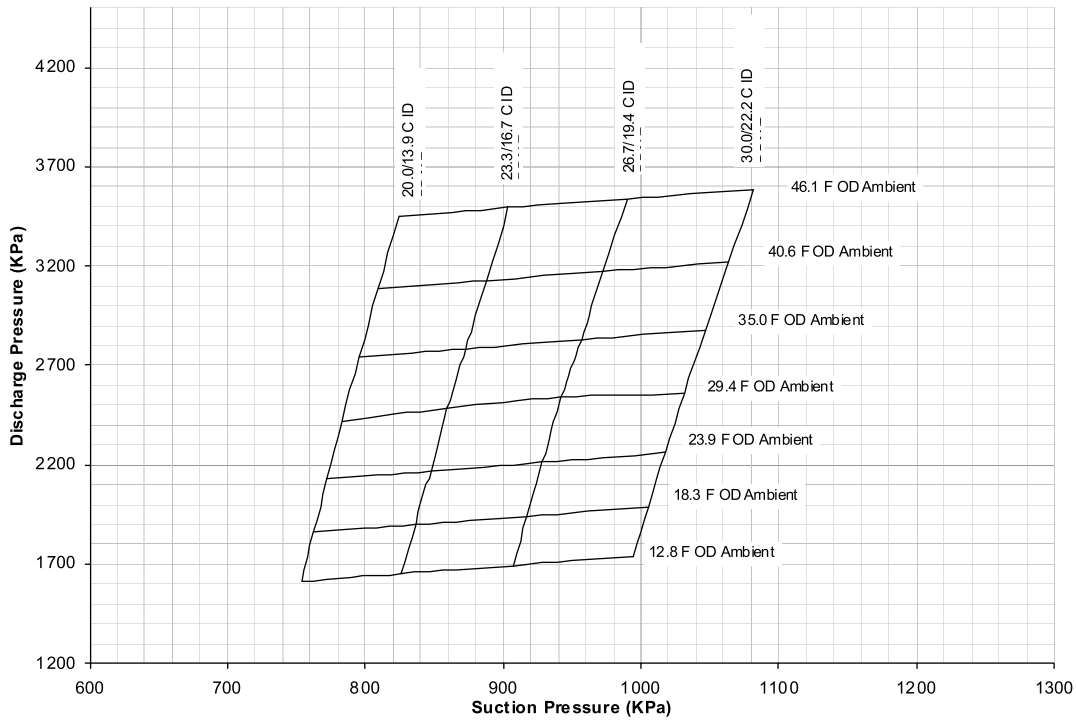


Figure 91. 33.3 Ton dual circuit operating pressure, circuit #2 — standard efficiency VAV (50 Hz)

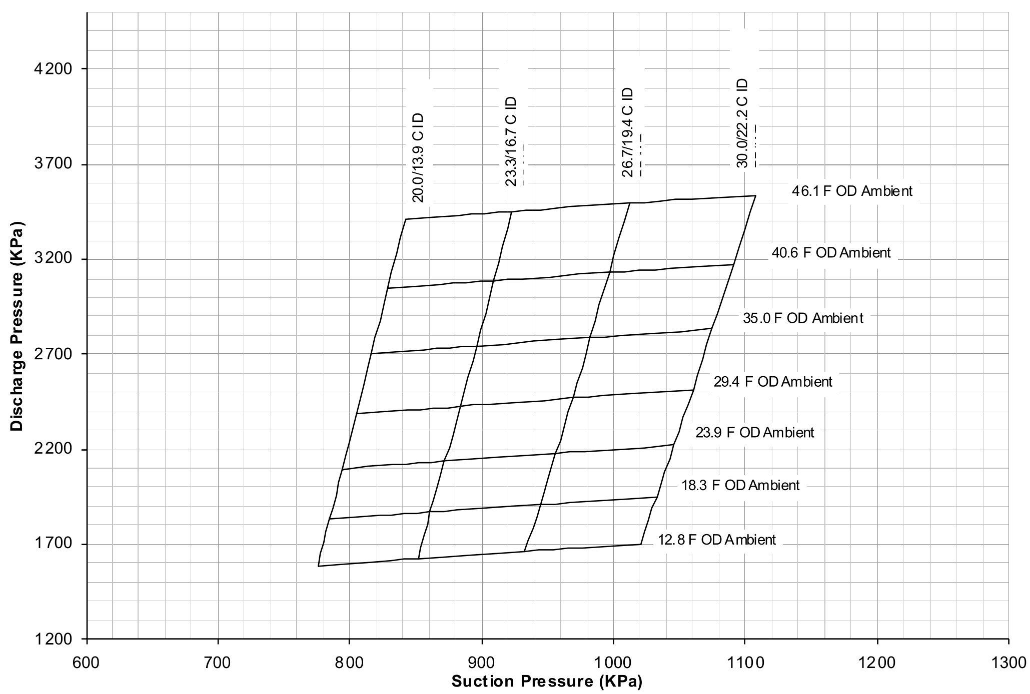


Figure 92. 41.7 Ton dual circuit operating pressure, circuit #1 — standard efficiency VAV (50 Hz)

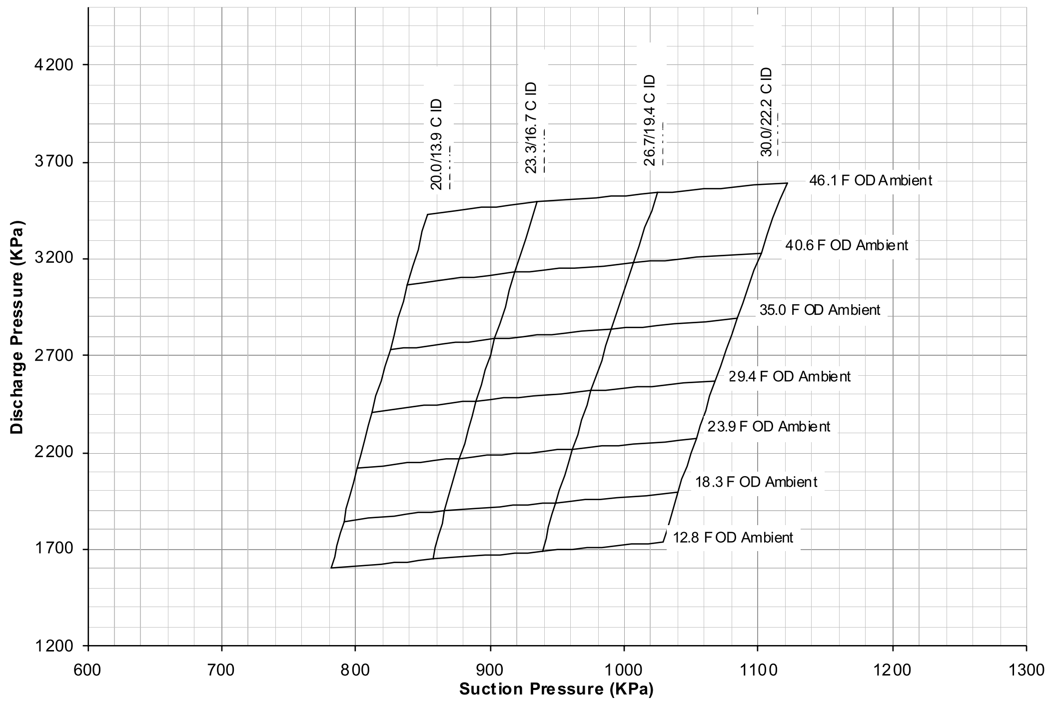


Figure 93. 41.7 Ton dual circuit operating pressure, circuit #2 — standard efficiency VAV (50 Hz)

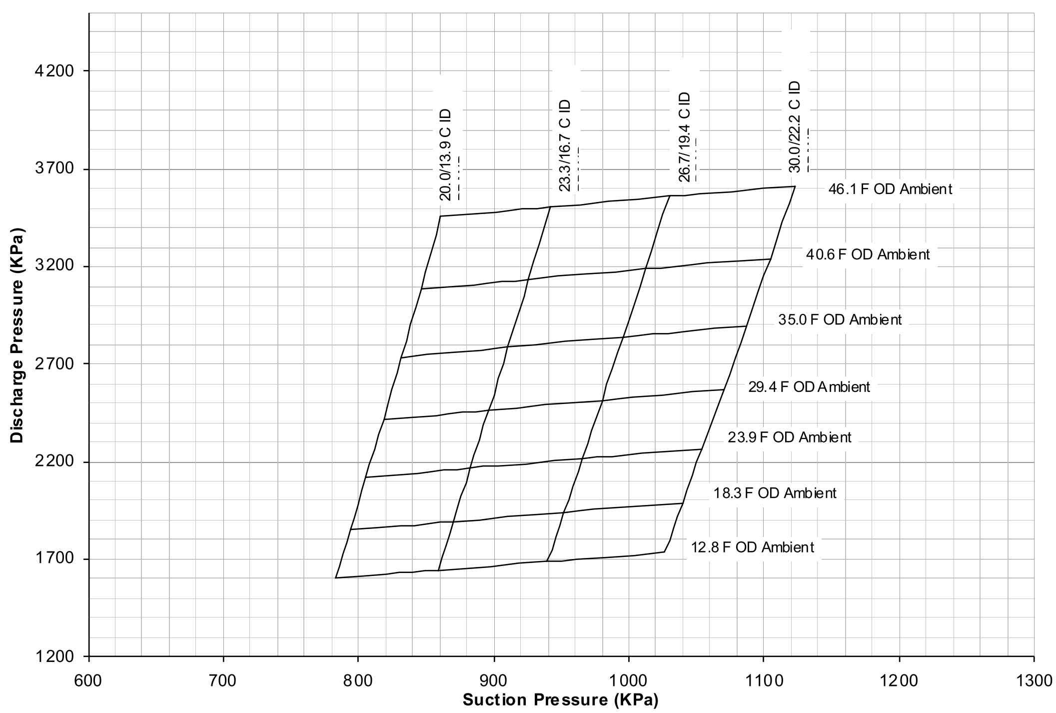


Figure 94. 22.9 Ton operating pressure — high efficiency (50 Hz)

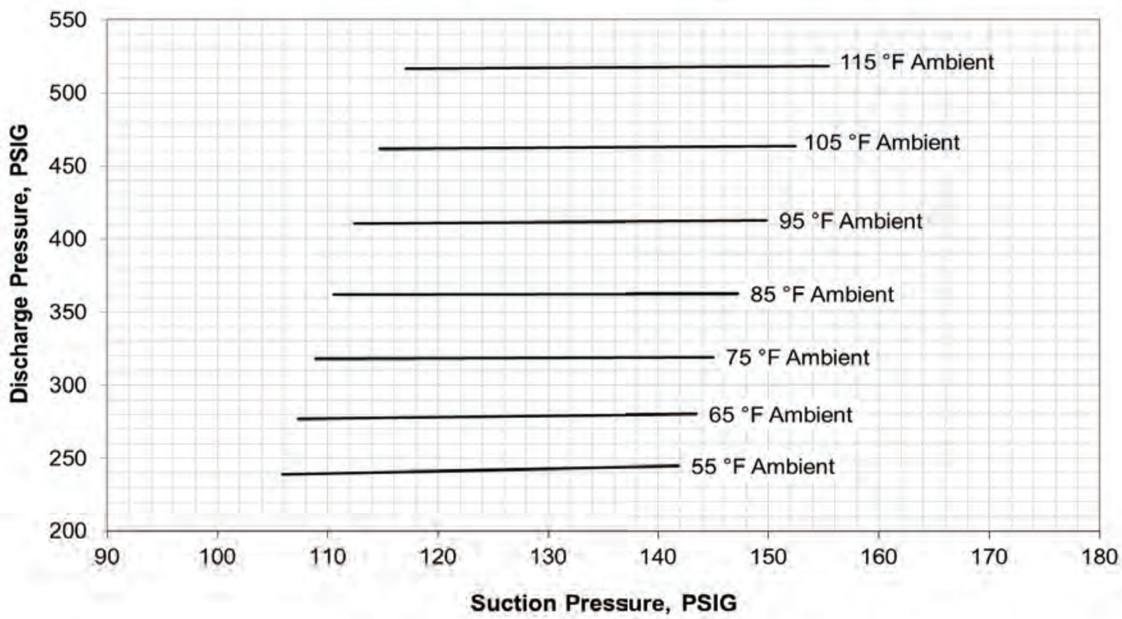


Figure 95. 25.4 Ton operating pressure — high efficiency (50 Hz)

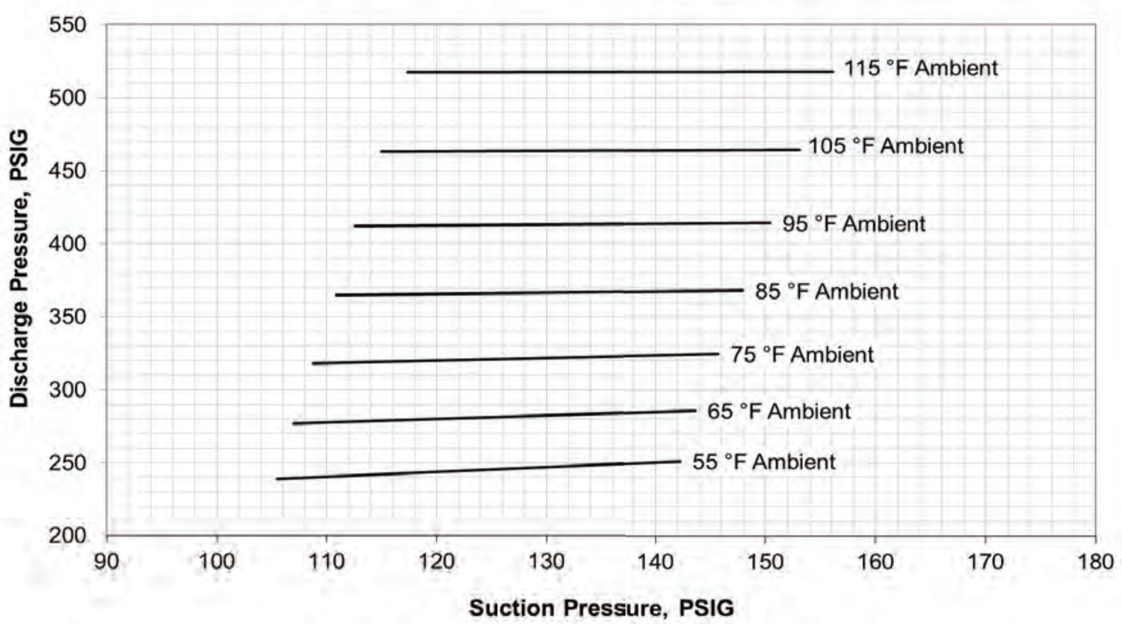


Figure 96. 29.2 Ton operating pressure — high efficiency (50 Hz)

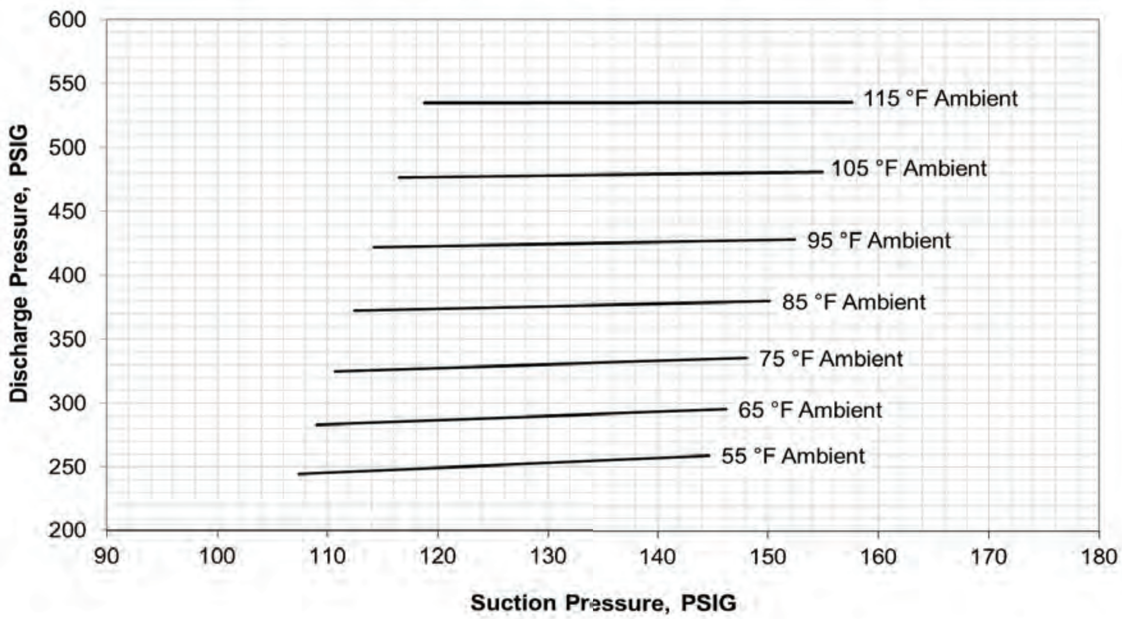


Figure 97. 33.3 Ton operating pressure — high efficiency (50 Hz)

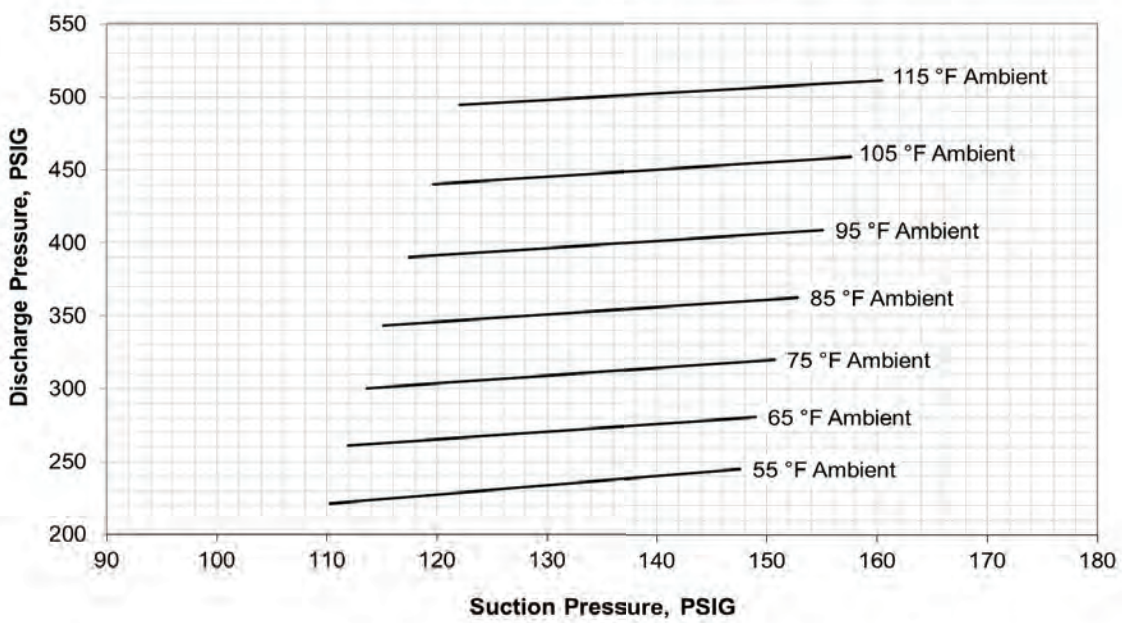
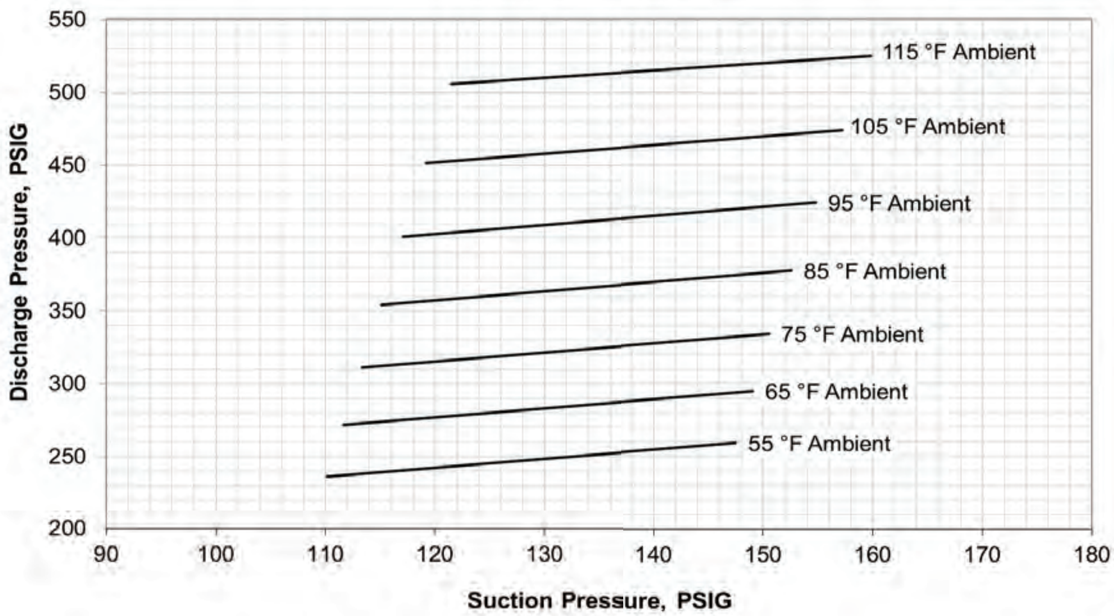


Figure 98. 41.7 Ton operating pressure — high efficiency and standard efficiency CV (50 Hz)



Scroll Compressor Operational Noises

Because the scroll compressor is designed to accommodate liquids (both oil and refrigerant) and solid particles without causing compressor damage, there are some characteristic sounds that differentiate it from those typically associated with a reciprocating compressor. These sounds (which are described below) are characteristic, and do not affect the operation or reliability of the compressor.

At Shutdown

When a Scroll compressor shuts down, the gas within the scroll compressor expands and causes momentary reverse rotation until the discharge check valve closes. This results in a “flutter” type sound.

At Low Ambient Startup

When the compressor starts up under low ambient conditions, the initial flow rate of the compressor is low due to the low condensing pressure. This causes a low differential across the thermal expansion valve that limits its capacity. Under these conditions, it is not unusual to hear the compressor rattle until the suction pressure climbs and the flow rate increases.

During Normal Operation

The scroll compressor emits a higher frequency tone (sound) than a reciprocating compressor.

Compressor Crankcase Heaters

Each compressor is equipped with a crankcase heater. When the compressor is “Off”, the crankcase heater is energized. When the compressor is “On”, the crankcase heater is de-energized. The proper operation of the crankcase heater is important to maintain an elevated compressor oil temperature during the “Off” cycle which reduces the potential for refrigerant to migrate into the compressor oil.

If present during a compressor start, liquid refrigerant could damage compressor bearings due to reduced lubrication and eventually could cause compressor mechanical failures.

Prior to the initial start or when power to the unit has been “Off” for an extended period, allow the crankcase heater to operate a minimum of 8 hours before starting the unit.

Charging by Subcooling

The unit is shipped with a complete refrigerant charge. However, if it becomes necessary to add refrigerant, it should be done so by adding charge to obtain an acceptable subcooling as described below. Refer to the maintenance section for proper refrigerant charging practices.

The outdoor ambient temperature must be between 65° and 105° F and the relative humidity of the air entering the evaporator must be above 40 percent. When the temperatures are outside of these ranges, measuring the operating pressures can be meaningless.

With the unit operating at “Full Circuit Capacity”, acceptable subcooling ranges between 14° F to 22° F.

Measuring Subcooling

⚠ WARNING

R-410A Refrigerant under Higher Pressure than R-22!

Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage.
The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.

1. Measure the liquid line pressure. Using a Refrigerant R-410A pressure/temperature chart, convert the pressure reading into the corresponding saturated temperature.
2. Measure the actual liquid line temperature. 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.

   Note: *Glass thermometers do not have sufficient contact area to give an accurate reading.*
3. Determine the system subcooling by subtracting the actual liquid line temperature (measured in step 2) from the saturated liquid temperature (converted in step 1).

Gas Heat Units

Open the main disconnect switch to shut the unit off and to reset the RTRM.

Follow the Test Guide in Table 39, p. 68 to Table 44, p. 73 to start the unit in the heating mode. Jumping the “Test” terminals several times for two to three seconds will be required.

When starting the unit for the first time or servicing the heaters, it is a good practice to start the heater with the main gas supply turned “Off”.

All heating units have either two stage or modulating heat capabilities. The “High” heat models contain two heat exchangers. In staged units, the heat exchangers operate simultaneously at either the low or high fire state. In modulating units, the modulating furnace fires first and adjusts to the needed capacity. If more heat is required than the modulating can provide, the second bank is fired at full fire and the modulating bank again adjusts to the heating load present.

Check both ignition systems (if applicable) when going through the test procedures.

Once the ignition system and ignitors have been checked, open the main power disconnect switch to reset the RTRM.

⚠ 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.

Turn the main gas supply to the unit “On” and check the gas pressure at the unit's gas train. Refer to “Installation Piping,” p. 40 for the proper gas supply pressure and Figure 35, p. 41 for the location of the gas pressure taps.

Close the main power disconnect switch and start the first stage heating Test again. Wait approximately 60 seconds for the heater to switch to low fire and check the manifold gas pressure. The manifold pressure for a two stage burner must be set at negative 0.2" w.c., +/-0.05" w.c. The manifold pressure on a modulating burner should be set at a positive 0.5" w.c., +/-0.05” w. c. For modulating burners, expect to see the manifold pressure reading fluctuate while the burner is operating, but it should never read negative.

⚠ WARNING

Hot Surface!

Failure to follow instructions below could result in severe burns.
Surface temperatures may exceed 300°F (150°C). To avoid possible skin burns, stay clear of these surfaces. If possible, allow surfaces to cool before servicing. If servicing is necessary while surface temperatures are still elevated, you MUST put on all Personal Protective Equipment (PPE).

Jump the test terminals momentarily to initiate second stage heat operation. The combustion blower motor should go to high speed. The second stage of heat in units with modulating gas will initiate the second heater bank to fire and both banks will operate at high fire. The manifold pressures of the two heater banks in a high heat modulating unit will be different. The pressure setting of the two stage burner will be a negative 0.2" w.c., while the modulating burner will be a positive 0.05" w.c.

Note: *When firing a modulating unit for the first time, a "humming", or resonance sound may be heard. This is an operational sound made by the burner screen as it burns in. This sound is not a concern unless it persists longer than the first few times the unit is fired.*

Electric Heat Units

Start the service test and check the amperage draw for each heating stage. Refer to the heater electrical data in Table 9, p. 29 (60 Hz) and Table 13, p. 31 (50 Hz) for the full load amps of a specific heater size.

Once the operation of the heaters have been checked, open the main power disconnect switch or the unit mounted disconnect switch to shut the unit "Off" and to reset the RTRM.

This concludes the setup and testing for the major components and controls within the unit. Follow the Test guide in Table 39, p. 68 - Table 44, p. 73 to verify that the optional VFD, economizer actuator, and minimum ventilation controls are functioning.

Final Unit Checkout

After completing all of the checkout and startup procedures outlined in the previous sections (i.e., operating the unit in each of its modes through all available stages of cooling and heating), perform these final checks before leaving the unit:

Verify that the RTRM is in the normal operation mode. The LED located on the UCP module is "on" and glowing continuously.

For Variable Air Volume Units

For Constant Volume Units

Verify that the "Mode" selection switch and the "Zone Temperature" setpoints are set and/or programmed at the sensor modules.

For Variable Air Volume Units

The RTAM has input setpoint potentiometers inside the control panel that are set at the factory which will allow the unit to operate and maintain system control. For specific job specifications;

- Verify that the control input potentiometers are set according to the job specifications, i.e.;
  - Outside air reset temperature - _______ Setpoint
  - Reset amount °F. - _______ Setpoint
  - Static pressure - _______ Setpoint
  - Static pressure deadband - ________ Setpoint
  - Discharge air temperature - _______Setpoint
  - Morning warm up temperature - _______ Setpoint
  - Exhaust Fan - _______ Setpoint
- Inspect the unit for misplaced tools, hardware and debris.
- Verify that all unit exterior panels—including the control panel doors—are secured in place.

For Single Zone Variable Air Volume Units

Verify that the "Mode" selection switch and the "Zone Temperature" setpoints are set and/or programmed at the sensor modules.

The RTOM has input setpoint potentiometers inside the control panel that are set at the factory which will allow the unit to operate and maintain system control. For specific job specifications:

- Verify that the control input potentiometers are set according to the job specifications:
  - DA Heat -_____Setpoint
  - DA Cool - Fan SPD - _____Setpoint
  - EXH Fan - _____Setpoint
- Inspect the unit for misplaced tools, hardware and debris.
- Verify that all unit exterior panels—including the control panel doors—are secured in place.

Sequence of Operation

Mechanical Cooling Sequence Of Operation

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

Units Without an Economizer

For 27.5 to 35 Ton units, when mechanical cooling is required, the RTRM energizes the Compressor Contactor (CC1) coil. When the CC1 contacts close, the Compressor CPR1 and Outdoor Fan Motor (ODM1) will start providing the 3 minute “off” time has elapsed. ODM2 and ODM3 cycles off/on based on the outdoor ambient temperature as measured by the Outdoor Air Sensor (OAS). CPR1 cycles off as required providing the 3 minute “on” time has elapsed.

With CPR1 operating for a minimum of 3 minutes. If additional cooling is required, the RTRM energizes the 2nd compressor contactor (CC2) to bring on CPR2. While CPR1 continues to run, CPR2 cycles on/off as needed to meet the cooling requirements.

For 40 Ton constant volume and variable air volume applications, once CPR1 has operated for a minimum of 3 minutes, and additional cooling is required, the RTRM cycles CPR1 off and energizes compressor contactor CC2. If additional cooling is required, the RTRM energizes compressor contactor (CC1) providing CPR1 has been off for a minimum of 3 minutes. This configuration will allow the dual circuit unit to operate with three steps of cooling if CPR1 is the lead compressor.

For 50 Ton constant volume and variable air volume applications, once CPR1 has operated for a minimum of 3 minutes, and additional cooling is required, the RTRM cycles CPR1 off and energizes compressor contactors CC2 and CC3 simultaneously. If additional cooling is required, the RTRM energizes compressor contactor (CC1) providing CPR1 has been off for a minimum of 3 minutes. This configuration allow the dual circuit unit to operate with three steps of cooling if CPR1 is the lead compressor.

If the indoor Fan selection switch is set to the “AUTO” position on constant volume applications, the RTRM energizes the Indoor Fan Contactor (F) coil approximately one second after energizing first stage compressor contactor (CC1). When the cooling cycle is complete and CC1 is de-energized, the RTRM keeps the Fan on for approximately 60 seconds to enhance unit efficiency. On variable air volume applications, the Fan operates continuously.

Economizer Operation Based on Dry Bulb

Standard economizer dry bulb change over has five field selectable temperatures 55, 63, 67, 70, 73°F. Refer to Table 32, p. 59 for the proper potentiometer setting for each temperature selection.

The economizer option allows cooling utilizing outdoor air when the temperature is below the specified dry bulb setpoint (73° ±2°F factory setting). The air is drawn into the unit through modulating dampers. The ECA modulates the economizer dampers from minimum position to full open based on a 1.5°F control point below either the space temperature setpoint for constant volume applications or 1.5°F around the supply air temperature setpoint for variable air volume applications.

If the Mixed Supply Air Sensor (MAS) senses that supply air temperature is too cold, the dampers are held in their current position until the supply air temperature rises, or begin to modulate toward the minimum position if the supply air temperature continues to drop.

The economizer control allows fully integrated cooling operation between the compressor(s) and the economizer when needed to satisfy the cooling setpoint. The RTRM will not allow a compressor to operate until the economizer dampers have been fully open for at least three minutes. The RTRM evaluates the rate of temperature change during this delay and will energize compressor(s) as needed to maintain temperatures within setpoint deadbands.

If a power exhaust option is installed:

- The power exhaust fan(s) comes on based on the position of the of the exhaust fan setpoint potentiometer on the RTOM (ReliaTel Options Module). The setpoint is factory set at 25%. The exhaust fan(s) will come on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.
- The exhaust dampers have provisions to limit the amount of exhaust airflow by limiting the maximum opening of the damper blades. Barometric dampers have physical damper blade stops. These stops (sliding brackets secured with wing-nuts) are present under the rain hood on the non-modulating power exhaust option. There is one stop on each side of each damper. The practical range of blade position control is between 1.5" and 4.0" blade opening. The damper is wide-open at 4.0". The stops on each side of a damper must be in the same position, such that the damper blade connecting member contacts the stops at the same time.

- The modulating power exhaust actuator is a slave to the position of the economizer damper actuator such that the power exhaust dampers proportionally follow or track the fresh air damper position. The proportional offset between the dampers is adjustable. With barometric dampers the offset between the dampers is adjusted under the rain hood by hole position selection of the power exhaust actuator jack shaft on the damper linkage arm. With direct-drive ultra-low-leak exhaust options, the actuator stroke can be adjusted as described in "Economizer (O/A) Dampers," p. 84. The stroke limit can be set between 33% and 100% of full stroke.
- When the Statitrac™ option is selected, the Exhaust Blade Actuator will modulate independently to the economizer in order the relieve positive building pressure. If the space pressure transducer fails, the unit will revert back to fresh air tracking control.

Economizer Operation Based on Reference Enthalpy

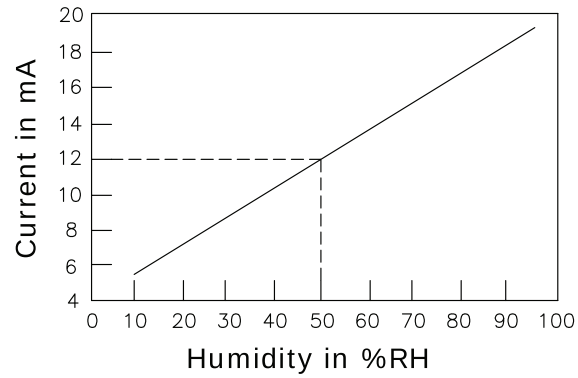
Reference enthalpy is accomplished by using an Outdoor Humidity Sensor (OHS). The reference enthalpy is field selectable to one of five standard enthalpies. Refer to Table 32, p. 59 for the proper potentiometer setting for each enthalpy selection.

If the outdoor air enthalpy is greater than the selected reference enthalpy, the economizer will not operate and the damper will not open past the minimum position setting.

If the outdoor air enthalpy is less than the reference enthalpy, the dampers will modulate to maintain a 45° to 55°F minimum supply air temperature (constant volume or variable air volume applications). The ECA modulates the economizer dampers from minimum position to fully open based on a 1.5°F control point below either the space temperature setpoint for constant volume applications or 1.5° F below the discharge air temperature setpoint for variable air volume applications. With reference enthalpy control, reference enthalpy is not allowed if the outdoor temperature is below 32°F. Below 32°F, dry bulb economizer control is enabled.

If communications between the Outdoor Humidity Sensor (OHS) and the Economizer Actuator Control (ECA) were to fail, the economizer will operate using the dry bulb parameters.

Figure 99. Humidity vs. current input



Economizer Operation Based on Comparative Enthalpy

Comparative enthalpy is accomplished by using an outdoor humidity sensor (OHS), return humidity sensor (RHS), and the return air sensor (RAS).

If the outdoor air enthalpy is greater than the return air enthalpy, the economizer will not operate and the damper will not open past the minimum position setting. The economizer will not operate at outdoor air temperatures above 75°F.

If the outdoor air enthalpy is less than the return air enthalpy, the dampers will modulate to maintain a 45° to 55°F supply air temperature (constant volume or variable air volume applications). The ECA modulates the economizer dampers from minimum position to fully open based on a 1.5°F control point below either the space temperature setpoint for constant volume applications or 1.5°F around the supply air temperature setpoint for variable air volume applications. Refer to Figure 99, p. 108 for the Humidity versus Voltage Input Values.

If either or both the return air humidity sensor (RHS) or the return air sensor (RAS) fails, the economizer will operate using the reference enthalpy setpoint perimeters.

Economizers with Traq

OA Damper Min Position Arbitration

The Economizer Minimum Position will be controlled to maintain outdoor air CFM at a CFM control setpoint. Air Velocity will be measured across the Traq assembly utilizing a pressure transducer and will be calibrated (zeroed) against ambient pressure to correct for changing environmental conditions.

The local Minimum OA CFM Setpoint input (or a calculated Min OA Flow Target Setpoint from the DCV description below) is used unless a valid BAS/Network Minimum OA CFM Setpoint has been selected and received in which case the BAS/Network value is used. The BAS/Network Minimum OA CFM Setpoint, if valid, overrides the DCV CO_2 reset calculation of Min OA Flow Target as well.

The measured OA CFM value from the local sensor input will normally be used for this function. At this time OA CFM value from other sources is not supported.

The algorithm used for this function will be P+I, with integration occurring only when outside the deadband. As long as the measured airflow is within the deadband, the control will be satisfied. When the OA CFM value is above the upper deadband limit the algorithm will decrease the Traq OA Min Damper Position Request allowing less fresh air into the space. When the OA CFM value is below the lower deadband limit the algorithm will increase the Traq OA Damper Min Position Request allowing more fresh air into the space. The OA CFM Deadband will be hard coded to +/- 250 CFM.

Traq with Demand Controlled Ventilation (DCV)

If Demand Controlled Ventilation is enabled, the Minimum OA CFM control point will be modified by high CO_2 concentrations resetting the setpoint between Design and DCV Minimum OA CFM setpoint limits. The Traq airflow control functionality described above will then use the calculated Min OA Flow Target for determining the Traq OA Minimum Position Request.

Modulating Hot Gas Reheat Sequence of Operation

When the relative humidity in the controlled space (as measured by the sensor assigned to space humidity sensing) rises above the space humidity setpoint, compressors and the supply fan will energize to reduce the humidity in the space. All compressors on both refrigerant circuits will be staged up during active hot gas reheat.

A Voyager Commercial Rooftop unit can contain one or two refrigerant circuits. Units with hot gas reheat will have one circuit with an outdoor condenser coil located in the outdoor section for normal head pressure control and a reheat coil located in the indoor air stream section for supply air reheat; both coils are for the same circuit. For 40-50 ton Voyager Commercial units the reheat circuit is circuit# 2. For 27.5-35 ton Voyager Commercial units there is only one circuit.

During hot gas reheat mode, the CLV and RHP will modulate which will allow refrigerant to flow through both the condenser coil and the reheat coil. The RHP will be de-energized when in hot gas reheat mode.

During hot gas reheat mode, the Supply Air Temperature is controlled to the Supply Air Reheat Setpoint by controlling the reheat and cooling modulating valve position. The range for the Supply Air Reheat Setpoint is 65°F to 80°F and the default is 70°F. The Supply Air Reheat Setpoint is adjusted by using a potentiometer on the RTOM.

During cooling operation, the cooling valve (CLV) will be open 100% and the reheat valve (RHV) will be closed which will allow refrigerant to flow through the condenser coil and not the reheat coil. During cooling mode the reheat pump-out solenoid (RHP) will also be energized to allow refrigerant to be removed from the reheat coil.

During cooling or hot gas reheat mode, to ensure proper oil distribution throughout the reheat and cooling condenser circuits, a purge is initiated by a hard coded purge interval timer. After the purge interval timer reaches 60 minutes, the unit performs a purge for a fixed 3-minute time period. During this state the reheat and cooling valve will be driven 50% and the reheat pump-out solenoid is energized.

See Hot Gas Reheat Low Pressure Control section for the reheat low pressure control (RLP) function during active dehumidification.

See Hot Gas Reheat Frost Protection section for the control scheme during active dehumidification.

See the Condenser Fan / Compressor sequence section for Condenser fan staging during active dehumidification.

Sensible Cooling or Heating Control Overrides Hot Gas Reheat Control

For both multi-circuit and single circuit units, any sensible heating request will terminate hot gas reheat control. If heating is active at the time a call for hot gas reheat control is received the heating operation must complete and an additional 5 minutes from the time heat is terminated must elapse before hot gas reheat will be allowed.

Note: *Occupied VAV operation in cooling mode will consider a critical zone temperature and when the sensible cooling requirements of this zone are not being met, the unit will terminate hot gas reheat control.*

Note: *Occupied CV and all unoccupied operation will terminate hot gas reheat if the sensible zone cooling requirements exceeds one-half the available cooling capacity of the unit.*

Gas Heat Sequence Of Operation

When heating is required, the RTRM initiates the heating cycle through the ignition control module (IGN). The IGN normally open contacts close to start the combustion blower motor (CBM) on high speed. Next, the IGN control energizes the hot surface igniter (IP) for 45 seconds. After a preheat period, the gas valve (GV) is energized for approximately 7 seconds. If the burner lights, the gas valve remains energized. If the burner fails to ignite, the ignition module will attempt two retries and then lock out if flame is not proven. The unit will attempt to ignite at 60 minute intervals until the heating call is removed.

An IGN lockout due to flame loss can be reset by:

- Open and close the main power disconnect switch.
- Switch the MODE switch on the zone sensor to “Off” and then to the desired position (VAV units – remove and reapply the mode input).
- Allow the IGN to reset automatically after one hour.

When ignition takes place, the hot surface igniter (IP) is de-energized and functions as the flame sensor.

Two Stage—If, after 60 seconds, the unit requires 1st stage heating only, the IGN will change the combustion blower from high speed to low speed. If additional heating is required and first stage heat has been operating for a minimum of 10 seconds, the IGN inducer relay will change the combustion blower motor (CBM) to high speed, delivering second stage heat capacity.

Modulating—Units with modulating heat will fire the modulating bank first at high fire for 60 seconds. The unit will then modulate the heater to the necessary rate. If the modulating heat bank cannot satisfy the zone needs alone, the second bank will come on and the modulating will find the appropriate operating point.

Constant Volume (CV) Unit Fan Operation

If the fan selection switch is in the “AUTO” position for constant volume units, the RTRM will delay starting the supply fan for 60 seconds to allow the heat exchanger to warm up. When the zone temperature rises above the heating setpoint, the IGN control module will terminate the heat cycle. The supply fan remains energized for an additional 90 seconds.

Variable Air Volume (VAV) Unit Fan Operation (2 Stage and Modulating Gas Heat)

During Unoccupied heating, Morning Warm up, and Daytime Warm up mode, the VFD must be at 100%. Therefore, before the unit can heat, the VHR relay must have been energized for at least 6 minutes to ensure that the VAV boxes have driven to maximum. For example, 6 minutes after a Daytime Warm up mode is initiated, the VFD output will go to 100% and then the heat cycle will begin. The VHR relay is energized during Unoccupied mode, Morning Warm up mode, and Daytime Warm up mode.

Variable Air Volume (VAV) Unit Fan Operation (Modulating Gas Heat Only)

During Changeover Heat (LTB5-1 shorted to LTB5-2), the unit will heat to the Supply Air Heating Setpoint +/- 7°F. The VFD will modulate to maintain the Static Pressure Setpoint.

Ignition Control Module

There is a green LED located on the ignition module. Any time the Ignition module is powered, the LED will be on to provide status of the ignition system.

- Steady OFF - no power/ internal failure
- Steady ON - no diagnostic, no call for heat
- Slow flash rate ¾ second on, ¼ second off - normal call for heat

Error Code Flashes

- One flash - Communication loss between RTRM and IGN
- Two flashes - System lockout; failed to detect or sustain flame (3 tries, lockout after 3rd try)
- Three flashes - Not used
- Four flashes - High limit switch TCO1, TCO2, or TCO3 open (auto reset)
- Five flashes - Flame sensed and gas valve not energized; or flame sensed and no call for heat (auto reset)

The pause between groups of flashes is approximately two seconds.

High Temperature Limit Operation and Location

All of the heater limit controls are automatic reset. The high limit cutouts (TCO1) and/or (TCO3) protect against abnormally high supply air temperature. The fan failure limit (TCO2) protects against abnormally high heat build up due to excessive high limit (TCO1) (TCO3) cycling if the indoor fan motor (IDM) fails. If TCO1, TCO2, or TCO3 open during a heating call, the heat will shut down and the supply fan will be forced to run. The heat will automatically restart should the TCO circuit re-close during an active heating call. While the TCO circuit is open, a heat fail diagnostic will be sent from the IGN to the RTRM.

The TCO1 and TCO3 is located in the bottom right corner of the burner assemblies on both downflow and horizontal units. TCO2 is located on the IDM partition panel; below and to the right of the blower housing on downflow units. On horizontal units, TCO2 is located on the IDM partition panel above the blower housing.

Electric Heat Sequence Of Operation

Constant Volume (CV)

When heat is required and the Fan selection switch is in the “AUTO” position for constant volume applications, the RTRM energizes the Supply Fan approximately one second before energizing the first stage electric heat contactor (AH). A 10 seconds minimum “off” time delay must elapse before the first stage heater is activated. When the heating cycle is completed, the RTRM de-energizes the Fan and the heater contactor (AH) at the same time.

The RTRM cycles the first stage of heat as required to maintain zone temperature. If the first stage cannot satisfy the heating requirement, the RTRM energizes the second stage electric heat contactors (BH) and (CH) providing first stage has been on for at least 10 seconds or the second stage has been off for at least 10 seconds. (CH contactor is used on 54KW and larger heaters.)

The RTRM cycles the second stage electric heat as required to maintain the zone temperature.

Variable Air Volume (VAV)

During Unoccupied heating, Morning Warm up, or Daytime Warm up, the VHR relay will be energized for at least 6 minutes and the VFD output will go to 100%. The heaters will stage on and off to satisfy the zone temperature setpoint.

Variable Air Volume Applications (Single Zone VAV) Sequence of Operation

Occupied Cooling Operation

For normal Cooling operation, available Cooling capacity will be staged or modulated in order to meet the calculated discharge air setpoint between the user selected upper and lower limits. If the current active cooling capacity is controlling the discharge air within the deadband no additional Cooling capacity change will be requested. As the Discharge Air Temperature rises above the deadband the control will request additional capacity as required (additional compressor operation or economizer). As the Discharge Air Temperature falls below the deadband the algorithm will request a reduction in active capacity.

Economizer Cooling

During normal Economizer Cooling, the fan speed will operate at its minimum. However, if the economizer is able to meet the demand alone, due to desirable ambient conditions, the supply fan speed will be allowed to increase above the minimum prior to utilizing mechanical cooling. Note that Economizer Enable/Disable decisions will be made based on the previous sections, however, the economizer control point will now be variable based on the zone cooling demand.

Economizer Enabled at Cooling Start

Once the unit has a request for economizer cooling and the unit has met all Cool mode transition requirements, the Economizer will open beyond minimum position with the Supply Fan Speed at 45% in order to meet the calculated discharge air setpoint value. If the economizer at 100% alone cannot meet the active discharge air setpoint, the Supply Fan Speed will increase to 100% for 3 minutes. Once the 3 minute compressor inhibit delay has expired, compressors will be allowed to energize to meet the space demand. The supply fan speed output will continue to modulate in order to meet the zone cooling requirements.

Once compressors are being utilized for additional cooling capacity, the economizer will be forced to 100% if enabled. As the cooling capacity begins to stage back (less cooling load) the economizer will remain at 100%, if enabled, until all compressors have de-energized.

Economizer Enabled to Disabled

If the economizer is enabled and the unit is actively cooling with the economizer, if the economizer becomes disabled the economizer will be closed to the active minimum position and compressors will be allowed to stage without delay if the minimum off timers have expired and there is a Cooling demand requesting compressor operation. During this transition, the fan will continue to modulate in order to meet the space demand.

Economizer Disabled to Enabled

If compressors are energized for Cooling and the economizer was disabled, but becomes enabled due to desirable ambient conditions, the economizer will be forced to 100% as on traditional VAV units.

Compressor Cooling

Compressor output control and protection schemes will function much like on non-SZ VAV units. Normal compressor HPC and LPC control will remain in effect as well as normal 3-minute minimum on, off, and inter-stage timers. Also, the condenser fans will be controlled as on non-SZ VAV units and compressor staging sequences will be as described in Table 23, p. 46 and Table 24, p. 47 based on unit tonnage configuration and lead/lag status.

Cooling Sequence

If the control determines that there is a need for compressor stages in order to meet the discharge air requirements, once supply fan proving has been made, the unit will begin to stage compressors accordingly. Note that a 5 second delay will be enforced between the command for supply fan output operation and the command for compressor output operation. This delay is enforced to ensure that the supply fan is energized and ramping up to operating speed prior to energizing compressors.

As the zone cooling demand continues to increase, if additional capacity is required, the supply fan output will be modulated above minimum speed in order to meet the zone requirements.

Note: *The supply fan speed will remain at the compressor stage's associated minimum value until the control requires additional capacity to meet the zone demand.*

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

Cooling Stages Minimum Fan Speed

As the unit begins to stage compressors to meet the cooling demand, the following minimum Supply Fan Speeds will be utilized for each corresponding Cooling Stage. Note that the Supply Fan Speed will be allowed to ramp up beyond the minimum speed in order to meet the zone cooling demand.

2-Stage Cooling Units (27.5-35T Units)

The minimum fan speed for units with 2 stages of DX Cooling will be 45% of the unit's full airflow capacity. At Stage 1 of DX Cooling the Fan Speed will be at a minimum of 45% and at Stage 2 of DX Cooling the Fan Speed will be at a minimum of 67%.

3-Stage Cooling Units (40-50T Standard Efficiency VAV Units)

The minimum fan speed for units with 3 stages of DX Cooling will be 45% of the unit's full airflow capacity. At Stage 1 of DX Cooling the Fan Speed will be at a minimum of 45% and at Stages 2 and 3 of DX Cooling the Fan Speed will be at a minimum of 67%.

5-Stage High Efficiency Cooling Units and 40-50T Standard Efficiency CV Units

The minimum fan speed for units with 5 stages of DX Cooling will be 33% of the unit's full airflow capacity. At Stage 1 of DX Cooling the Fan Speed will be at a minimum of 33%.

Add % for other stages 2-5.

Occupied Heating Operation

Occupied Heating operation on units configured with Single Zone VAV control will utilize two separate control methodologies based on heating configurations. For all “Staged” Heating types (Electric and Gas), the unit will utilize 100% full airflow during all active heating periods like traditional Constant Volume units. For Modulating Gas heat units, the unit will have the ability to control the discharge air temperature to the calculated discharge air heating setpoint in order to maintain the Zone Temperature to the Zone Heating setpoint.

Staged Heating Operation

For units configured with Staged Heat once the control determines that there is an active heating capacity request, the unit will energize the Supply Fan and ramp up to full speed. The control methodology during Active Heating on units configured with Staged Heat types will be identical to traditional Constant Volume units; heating stages will be energized/de-energized to meet the Zone Heating demand. Note that all Electric and Gas Heat staging sequences will be identical to as on Constant Volume units.

Modulating Heat Operation with SZVAV Heating

Units configured with Modulating Gas Heat will utilize true Single Zone VAV control in the same manner as during Active Cooling.

Heating Sequence

Once the unit has met all Auto-Changeover requirements and the control determines that there is a space heating demand, the unit will transition into zone heating. Once the Discharge Air Temperature falls below the calculated discharge air temperature setpoint, the unit will initiate the Modulating Heat output request and control the supply fan at minimum speed. At this point, the Modulating Heat output will be controlled to maintain the discharge air temperature requirements and the supply fan speed will be controlled between 58%-100% to meet the zone heating requirements.

As the heating load in the zone decreases the fan speed will decrease down to minimum (58%) and control the modulating heat output as necessary to meet the discharge air heating requirements. As the load in the zone continues to drop the fan speed will be maintained at this minimum airflow and the modulating heat output will be controlled accordingly.

Note: *The gas heat staging sequences will be the same on SZ VAV units as on traditional CV units.*

Unoccupied Cooling and Heating Operation

For SZ VAV units, the unit will control Heating, Cool, and Hot Gas Reheat as during Occupied periods using the normal heating and cooling Single Zone VAV algorithms. In Unoccupied periods the unit will utilize setback setpoints, a 0% Minimum OA Damper position, and Auto fan mode operation as on normal Constant Volume units.

Modulating Hot Gas Reheat Operation

Singe Zone VAV units support modulating hot gas reheat operation. Most functions will be identical to hot gas reheat control on CV and Traditional VAV units.

Entering Hot Gas Reheat

At startup a zone heating or cooling demand will prevent hot gas reheat operation as on a non-Single Zone VAV unit. At this point the unit will perform normal sensible cooling or heating control until the respective setpoint is satisfied.

After startup, the unit will monitor the unit conditions to determine when to enter and leave hot gas reheat mode. As long as the unit is not actively heating or actively cooling with more than half the unit design mechanical cooling capacity for Standard Efficient units and have a call for stage 3 or below for High Efficient units (5 stage units), hot gas reheat mode will be allowed (also the unit has not been disabled due to the override limits described below).

When hot gas reheat mode is entered the unit will:

- Energize the Supply Fan, if not already ON, and ramp the Fan Speed output up to 80% airflow.
- Stage up all compressors with ~2 seconds between stages.
- Command the OA damper to minimum position.
- The Supply Air Reheat setpoint (R130 located on the RTOM) will become the maximum discharge air control setpoint.
- The reheat and cooling valves will be modulated to meet the calculated discharge air setpoint.

Leaving Hot Gas Reheat

On a call to leave hot gas reheat mode the unit will perform the following:

- Mechanical cooling will stage back to 50% (Cool 1) of the available capacity then will be released to normal Single Zone VAV control to meet the space demand.
- The economizer will be released to normal control.
- The Supply Fan output will be released to meet the space load.
- The cooling valve will be driven to 100% and the reheat valve will be driven to 0%.
- The Reheat Pumpout relay will be energized if the reheat circuit is requested or de-energized if the reheat circuit de-energizes.

Typical causes to leave hot gas reheat are:

- Space humidity levels have fallen below the Active Occ/Unocc Dehumidification Setpoint -5% Dehumidification Hysteresis Offset,
- The zone temperature has dropped too close to the Zone Heating Setpoint in any unit mode (Zone Temp. ? ZHSP + 0.5°F).
- The zone temperature rises above the Zone Cooling Setpoint +2°F in any unit mode.
- Entering Evaporator Temperature falls too low or Froststat input becomes active.
- Dehumidification/Reheat becomes disabled.

Hot Gas Reheat Overrides

Sensible cooling or heating control overrides hot gas reheat control. Any heating request will terminate hot gas reheat control. If heating is active at the time a call for hot gas reheat control is received the heating operation must complete and an additional 5 minutes from the time heat is terminated must elapse before hot gas reheat will be allowed. Hot gas reheat will also be disabled if any of the functional disables that apply to CV or traditional VAV have gone active.

Purge Mode (Comfort and Dehumidification)

Purge cycle operation will operate identically to Purge on non-Single Zone VAV Hot Gas Reheat units; if the Reheat Circuit operates in one mode (dehumidification or cooling) for a cumulative 60 minutes the unit will initiate a 3-minute Purge cycle with all compressors energized, the Cooling and Reheat Valves at 50%, and the Reheat Pumpout relay de-energized.

During an active Purge Cycle the Supply Fan Speed will operate at the appropriate speed based on the active compressor step. If a dehumidification purge is initiated, the unit will run at 80%, if performing a cooling purge the supply fan will track based on the appropriate minimum speed for the associated number of compressors energized. After the Purge Cycle is complete, the Supply Fan will be released to normal control based on the Cooling/Dehumidification demand.

Hot Gas Reheat - Humidistat Operation

A humidistat input located on the Options module will be supported as on non-SZ VAV.

Other Hot Gas Reheat Related Topics

The following aspects of Single Zone VAV units configured with Modulating hot gas reheat will operate identically to non-Single Zone VAV units:

- Outdoor Fan Control.
- Low Pressure/High Pressure Cutout input handling.
- Function Enable/Disable Details.

Failure and Overriding Conditions

Certain failure and overriding conditions require special handling of the Supply Fan Speed on units configured with Single Zone VAV. See below for a list of these conditions:

- Supply Fan Proving Failure - If a Supply Fan Proving failure is detected the Supply Fan will be de-energized after 40s of run time and the Fan Speed output will go to 0 Vdc (0%).

- Ventilation Override Mode - If a VOM goes active in which the Supply Fan is commanded ON (Purge, Pressurize, etc.) the Supply Fan will be energized and the Fan Speed output will ramp to 100%.
- Zone Temperature Sensor Failure - If the Active Zone Temperature input goes out of range, the unit will discontinue all Heating, Cooling, and Hot Gas Reheat operation.
- Supply Air Temperature Sensor Failure - If the Supply Air Temperature input goes out of range, the unit will revert back to Full Airflow, Traditional CV control. The unit will call out a Supply Air Temperature Sensor Failure Alarm, the RTRM System LED will flash the 2-blink error code, and the Zone Sensor Heat (Modulating Heat Only) and Cool LEDs will flash.
- Frostat Failure - If the unit has a Froststat Failure occur, all active Heating, Cooling, and Hot Gas Reheat will be de-energized immediately and the Supply Fan will ramp up to 100%.
- Heat Failure (High Temp. Limit Trip) - If a unit configured with Gas Heat has a High Temp. Limit trip the Supply Fan will be requested to remain ON and the Fan Speed output will ramp to full speed.

Low Pressure Control (LPC) Sequence of Operation (ReliaTel Control)

When the LPC is opened for one (1) continuous second, the compressor for that circuit is turned off immediately. The compressor will not be allowed to restart for a minimum of three (3) minutes.

If four consecutive open conditions occur during the first three minutes of operation, the compressor will be locked out, a diagnostic communicated to ICSTM if applicable, and a manual reset will be required to restart the compressor.

High Pressure Control and Temperature Discharge Limit (ReliaTel Control)

The Temperature Discharge Limit (TDL) is located in the Compressor Output circuit and is connected in series with the High Pressure Control (HPC). The RTRM will register an auto reset lockout if either the high pressure control switch or the temperature discharge limit opens during compressor operation. If the compressor output circuit is opened four consecutive times during compressor operation, the RTRM will generate a manual reset lockout.

Maintenance

Fan Belt Adjustment

The supply fan belts must be inspected periodically to assure proper unit operation.

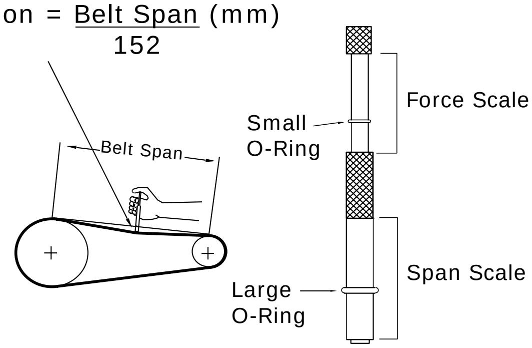
Replacement is necessary if the belts appear frayed or worn. Units with dual belts require a matched set of belts to ensure equal belt length. When installing new belts, do not stretch them over the sheaves; instead, loosen the adjustable motor-mounting base.

Once the new belts are installed, adjust the belt tension using a Browning or Gates tension gauge (or equivalent) illustrated in Figure 100, p. 115.

Figure 100. Typical belt tension gauge

$$\text{Deflection} = \frac{\text{Belt Span (in.)}}{64}$$

$$\text{Deflection} = \frac{\text{Belt Span (mm)}}{152}$$



⚠ 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.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06*-EN.

1. To determine the appropriate belt deflection:
   a. Measure the center-to-center distance, in inches, between the fan sheave and the motor sheave.
   b. Divide the distance measured in Step 1a by 64; the resulting value represents the amount of belt deflection for the proper belt tension.
2. Set the large O-ring on the belt tension gauge at the deflection value determined in Step 1b.
3. Set the small O-ring at zero on the force scale of the gauge.
4. Place the large end of the gauge on the belt at the center of the belt span. Depress the gauge plunger until the large O-ring is even with the of the second belt or even with a straightedge placed across the sheaves.
5. Remove the tension gauge from the belt. Notice that the small O-ring now indicates a value other than zero on the force scale. This value represents the force (in pounds) required to deflect the belt(s) the proper distance when properly adjusted.
6. Compare the force scale reading in step 5 with the appropriate "force" value in Table 64, p. 116. If the force reading is outside of the listed range for the type of belts used, either readjust the belt tension or contact a qualified service representative.

   ***Note:** The actual belt deflection force must not exceed the maximum value shown in Table 64, p. 116 .*
7. Recheck the new belt's tension at least twice during the first 2 to 3 days of operation. Readjust the belt tension as necessary to correct for any stretching that may have occurred. Until the new belts are "run in", the belt tension will decrease rapidly as they stretch.

Table 64. Belt tension measurements and deflection forces

Belts Cross Section	Small P.D Range	Deflection Force (Lbs.)									
		Super Gripbelts		Gripnotch		Steel Cable Gripbelts		358 Gripbelts		358 Gripnotch Belts	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
A	3.0 -3.6	3	4 1/2	3 7/8	5 1/2	3 1/4	4	—	—	—	—
	3.8 - 4.8	3 1/2	5	4 1/2	6 1/4	3 3/4	4 3/4	—	—	—	—
	5.0 - 7.0	4	5 1/2	5	6 7/8	4 1/4	5 1/4	—	—	—	—
B	3.4 - 4.2	4	5 1/2	5 3/4	8	4 1/2	5 1/2	—	—	—	—
	4.4 - 5.6	5 1/8	7 1/8	6 1/2	9 1/8	5 3/4	7 1/4	—	—	—	—
	5.8 - 8.8	6 3/8	8 3/4	7 3/8	10 1/8	7	8 3/4	—	—	—	—
5V	4.4 - 8.7	—	—	—	—	—	—	—	—	10	15
	7.1 - 10.9	—	—	—	—	—	—	10 1/2	15 3/4	12 7/8	18 3/4
	11.8 - 16.0	—	—	—	—	—	—	13	19 1/2	15	22

Table 65. Supply fan sheave and belt

Tons	Mo-tor	RPM	Fan Sheave[a] [b] [c]		Fan Bushing		Motor Sheave [d]		Motor Bushing [e]		Belt
			Brown-ing	SST	Brown-ing	SST	Brown-ing	SST	Brown-ing	SST	
27.5 & 30	7.5 hp	550	BK190 X 1 7/16	BK190-1-7/16			BK62H	BK62H	H 1-3/8	H-1-3/8	BX108 Notched
		600	BK160 X 1 7/16	BK160-1-7/16			BK57H	BK57H	H 1-3/8	H-1-3/8	BX100 Notched
		650	BK160 X 1 7/16	BK160-1-7/16			BK62H	BK62H	H 1-3/8	H-1-3/8	BX103 Notched
27.5 & 30	10 hp [f]	650	BK190 X 1 7/16	BK190-1-7/16			BK75H	BK75H	H 1-3/8	H-1-3/8	BX108 Notched
		700	BK160 X 1 7/16	BK160-1-7/16			BK67H	BK67H	H 1-3/8	H-1-3/8	BX103 Notched
		750	BK160 X 1 7/16	BK160-1-7/16			BK72H	BK72H	H 1-3/8	H-1-3/8	BX103 Notched
35	7.5 hp	600	BK160 X 1 7/16	BK160-1-7/16			BK57H	BK57H	H 1-3/8	H-1-3/8	BX100 Notched
	10 hp	650	BK190 X 1 7/16	BK190-1-7/16			BK75H	BK75H	H 1-3/8	H-1-3/8	BX108 Notched
		700	BK160 X 1 7/16	BK160-1-7/16			BK67H	BK67H	H 1-3/8	H-1-3/8	BX103 Notched
	15 hp [g]	790	BK160 X 1 7/16	BK160-1-7/16			1B5V68	1B68SDS	B 1 5/8	SDS 1 5/8	BX103 Notched
		800	BK160 X 1 7/16	BK160-1-7/16			1B5V70	1B70SDS	B 1 5/8	SDS 1 5/8	BX103 Notched

Table 65. Supply fan sheave and belt (continued)

Tons	Motor	RPM	Fan Sheave[a] [b] [c] Browning	Fan Sheave SST	Fan Bushing Browning	Fan Bushing SST	Motor Sheave [d] Browning	Motor Sheave SST	Motor Bushing [e] Browning	Motor Bushing SST	Belt
40	10 hp	500	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2BK36H	2BK36H	H 1-3/8	H-1-3/8	BX95 Notched
		525	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2BK40H	2BK40H	H 1-3/8	H-1-3/8	BX95 Notched
		575	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2BK45H	2BK45H	H 1-3/8	H-1-3/8	BX95 Notched
	15 hp	625	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2B5V42	2B42SH	P1 1-5/8	SH 1 5/8	BX95 Notched
		675	2B5V136	2B136SK	B 1 11/16	SK 1 11/16	2B5V50	2B50SDS	B 1 5/8	SDS 1 5/8	BX97 Notched
		725	2B5V136	2B136SK	B 1 11/16	SK 1 11/16	2B5V54	2B54SDS	B 1 5/8	SDS 1 5/8	BX97 Notched
50	10 hp	525	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2BK40H	2BK40H	H 1-3/8	H-1-3/8	BX95 Notched
		575	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2BK45H	2BK45H	H 1-3/8	H-1-3/8	BX95 Notched
	15 hp	625	2B5V124	2B124SK	B 1 11/16	SK 1 11/16	2B5V42	2B42SH	P1 1-5/8	SH 1 5/8	BX95Notc-hed
		675	2B5V136	2B136SK	B 1 11/16	SK 1 11/16	2B5V50	2B50SDS	B 1 5/8	SDS 1 5/8	BX97 Notched
	20 hp	725	2B5V136	2B136SK	B 1 11/16	SK 1 11/16	2B5V54	2B54SDS	B 1 5/8	SDS 1 5/8	BX97 Notched

(a) Browning BK160 X 1 7/16 and SST BK160-1-7/16 sheaves are interchangeable.
(b) Browning BK190 X 1 7/16 and SST BK190-1-7/16 sheaves are interchangeable.
(c) All other sheaves & bushings are interchangeable only in sheave/bushing combination sets. Sets do not mix vendors.
(d) Browning and SST sheaves with identical numbers are interchangeable and can be used with each other's bushings.
(e) Browning H 1-3/8 and SST H-1-3/8 bushings are interchangeable and can be used with each other's sheaves.
(f) For YC gas/electric only.
(g) For TC and TE Cooling only and with electric heat units only.

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.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06*-EN.

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 table below for filter information.

Table 66. Filters

Unit Model	Quantity	Filter Dimension (inches)[a]
TC, TE, YC*330 - 420	16	15½ X 19½ X 2 or 4*
TC, TE, YC*480 & 600	17	15½ X 19½ X 2 or 4*

(a) Filter dimensions are actual. Nominal filter size is 16 x 20.

Condensate Overflow Switch

During maintenance, the switch float (black ring) must be checked to ensure free movement up and down.

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.
- ☐ 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 F/A-R/A 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.
- ☐ Verify that all damper linkages move freely; lubricate with white grease, if necessary.
- ☐ Check supply fan motor bearings; repair or replace the motor as necessary.
- ☐ Check the fan shaft bearings for wear. Replace the bearings as necessary.

  Note: *These bearing are considered permanently lubricated for normal operation. For severe dirty applications, if relubrication becomes necessary, use a lithium based grease. See for recommended greases.*

  Important: *The bearings are manufactured using a special synthetic lithium-based grease designed for long life and minimum relube intervals. Over lubrication can be just as harmful as not enough.*

- ☐ Use a hand grease gun to lubricate these bearings; add grease until a light bead appears all around the seal. Do not over lubricate! After greasing the bearings, check the setscrews to ensure that the shaft is held securely. Make sure that all bearing braces are tight.
- ☐ Check the supply fan belt(s). If the belts are frayed or worn, replace them. Refer to the "Fan Belt Adjustment," p. 115 for belt replacement and adjustments.
- ☐ Check the condition of the gasket around the control panel doors. These gaskets must fit correctly and be in good condition to prevent water leakage.
- ☐ Verify that all wire terminal connections are tight.
- ☐ Remove any corrosion present on the exterior surfaces of the unit and repaint these areas.
- ☐ Generally inspect the unit for unusual conditions (e.g., loose access panels, leaking piping connections, etc.)
- ☐ Make sure that all retaining screws are reinstalled in the unit access panels once these checks are complete.
- ☐ With the unit running, check and record the 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 68, p. 121. If the operating pressures indicate a refrigerant shortage, measure the system superheat and system subcooling. For guidelines, refer to "Charging by Subcooling," p. 104.

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.

☐ Check the fan shaft bearings for wear. Replace the bearings as necessary.

Note: *These bearing are considered permanently lubricated for normal operation. For severe dirty applications, if relubrication becomes necessary, use a lithium based grease. See* *Table 67, p. 119* *for recommended greases.*

Important: *The bearings are manufactured using a special synthetic lithium-based grease designed for long life and minimum relube intervals. Over lubrication can be just as harmful as not enough.*

☐ Use a hand grease gun to lubricate these bearings; add grease until a light bead appears all around the seal. Do not over lubricate!

☐ After greasing the bearings, check the setscrews to ensure that the shaft is held securely. Make sure that all bearing braces are tight.

☐ Inspect both the main unit control panel and heat section control box for loose electrical components and terminal connections, as well as damaged wire insulation. Make any necessary repairs.

☐ Gas units only - Check the heat exchanger(s) for any corrosion, cracks, or holes.

☐ Check the combustion air blower for dirt or blockage from animals or insects. Clean as necessary.

Note: *Typically, it is not necessary to clean the gas furnace. However, if cleaning does become necessary, remove the burner plate from the front of the heat exchanger to access the drum. Be sure to replace the existing gaskets with new ones before reinstalling the burner.*

☐ Open the main gas valve and apply power to the unit heating section; then initiate a "Heat" test using the startup procedure described in "Gas Heat Units," p. 105.

⚠ 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.

☐ Verify that the ignition system operates properly.

Table 67. Grease recommendations

Recommended Grease	Recommended Operating Range
Exxon Unirex #2	-20 F to 250 F
Mobil 532	
Mobil SHC #220	
Texaco Premium RB	

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, microchannel condenser, and reheat coils using the instructions outlined below. Be sure to follow these instructions as closely as possible to avoid damaging the coils.

⚠ WARNING

Hazardous Chemicals!

Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin 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.

Important: *DO NOT use any detergents with microchannel condenser coils. Pressurized water or air ONLY.*

For evaporator and reheat coil cleaners, contact the local Trane Parts Center for appropriate detergents.

1. Remove enough panels from the unit to gain safe access to coils.
   a. For the 50 ton unit with the 3rd coil closest to the bulk-head, safe access can be gained by removal of the unit side panels.
   b. For the 40 ton and 50 ton units, access to the 2-row microchannel condenser coils removal of the corner posts will be necessary.

⚠ 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" between the sprayer nozzle and the coil. For microchannel condenser coils, optimum clearance between the sprayer nozzle and the microchannel coil is 1"-3”.
6. Spray the leaving-airflow side of the coil first; then spray the opposite side of the coil. For evaporator and reheat coils, allow the cleaning solution to stand on the coil for five minutes.
7. Rinse both sides of the coil with cool, clean water.
8. Inspect both sides of the coil; if it still appears to be dirty, repeat Steps 6 and 7.
9. Reinstall all of the components and panels removed in Step 1; then restore power to the unit.
10. For evaporator and reheat coils, use a fin comb to straighten any coil fins which were inadvertently bent during the cleaning process.

Microchannel Condenser Coil Repair and Replacement

If microchannel condenser coil repair or replacement is required, refer to General Service Bulletin RT-SVB83*-EN for further details.

Final Process

Record the unit data in the blanks provided.

Table 68. 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					

Fall Restraint

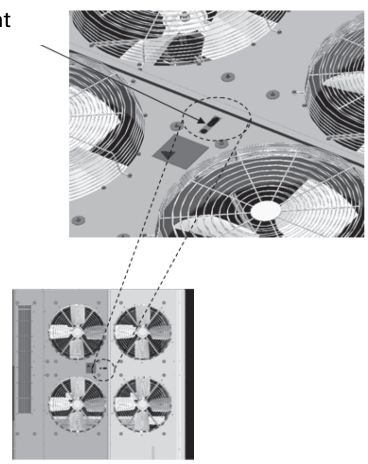
⚠ WARNING

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, for 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 101. Fall restraint



Refrigeration System

⚠ WARNING

R-410A Refrigerant under Higher Pressure than R-22!

Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage.
The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane 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-410A 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-410A 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-410A 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.

Compressor Oil

If a motor burn out is suspected, use an acid test kit to check the condition of the oil. Test results will indicate an acid level has exceeded the limit if a burn out 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 acid.

If a motor burn out has occurred, change the oil in both compressors in a tandem set. This will require that the oil equalizer tube be removed to suck the oil out of the oil sump. A catch pan must be used to catch the oil when the compressor oil equalizer line is loosened.

Note: *Refrigerant oil is detrimental to some roofing materials. Care must be taken to protect the roof from oil leaks or spills.*

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.

Compressor model	Oil amount
CSHD075-161	7.0 pts
CSHD183	7.6 pts
CSHN250	14.2 pts

Compressor Replacements

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 startup procedure of this manual.

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.

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 102. Precision suction restrictor

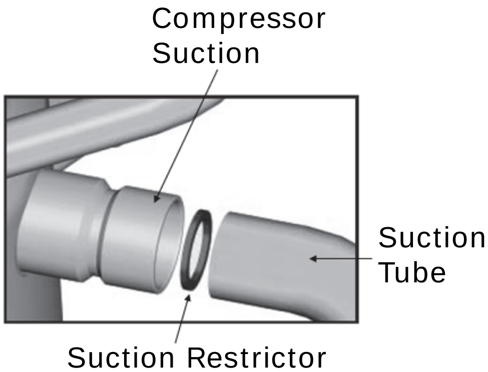


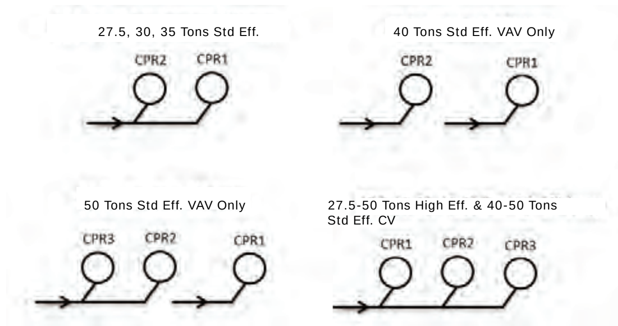
Table 69. Compressor restrictor location

Model	Efficien-cy	Restrictor Location		
		CPR 1	CPR2	CPR 3
TC/TE/YC*275 & 330	Standard		X	
TC/TE/YC*350 & 420	Standard		X	
TC/TE/YC*500 & 600	Standard VAV			X

Table 69. Compressor restrictor location (continued)

Model	Efficien-cy	Restrictor Location		
		CPR 1	CPR2	CPR 3
TC/TE/YC*275 & 330	High	X		
TC/TE/YC*305 & 360	High	X		
TC/TE/YC*500 & 600	High & Std CV	X		

Figure 103. Compressors



Diagnostics

The RTRM has the ability to provide the service personnel with some unit diagnostics and system status information.

Before turning the main power disconnect switch “Off”, follow the steps below to check the Unit Control. All diagnostics and system status information stored in the RTRM will be lost when the main power is turned “Off”.

⚠ 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.

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK HTB1 OR UNIT DISCONNECT SWITCH.

1. Verify that the LED on the RTRM is on. If the LED is on or blinking (2 blinks every 2 seconds). If so, go to step 3.
2. If the LED is not on, verify that 24 Vac is present between RTRM J1-1 and J1-2. If 24 Vac is present, proceed to Step 3. If 24 Vac is not present, check the unit main power supply, check transformer (TNS1) and fuse. If the LED is not on or blinking yet 24Vac is present, the RTRM has failed and must be replaced.
3. If the LED is blinking, a diagnostic is present. If the LED is on, certain diagnostics may still be present. Utilizing “System Status/Diagnostics,” p. 125, check the following system status:

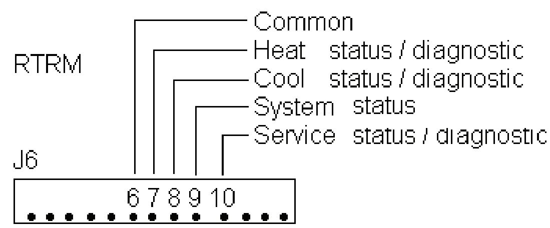
- Service status
- Heating status
- Cooling status

4. If any diagnostic is seen, refer to the appropriate Diagnostics section for CV, SZ VAV, or Traditional VAV units. Once the condition causing the diagnostic is cleared, proceed to the next step.
5. If no diagnostics are present, use one of the TEST mode procedures described in “Test Modes,” p. 66 to start the unit. This procedure will allow you to check all of the RTRM outputs, and all of the external controls (relays, contactors, etc.) that the RTRM outputs energize, for each respective mode. Proceed to the next step.
6. Step the system through all of the available modes and verify operation of all outputs, controls, and modes. If a problem in operation is noted in any mode, you may leave the system in that mode for up to one hour while troubleshooting. Refer to the sequence of operations for each mode to assist in verifying proper operation. Make the necessary repairs and proceed to the next step.
7. If no abnormal operating conditions appear in the test mode, exit the test mode by turning the power “Off” at the main power disconnect switch.
8. Refer to the individual component test procedures if other microelectronic components are suspect.

System Status/Diagnostics

System status and/or diagnostics can be observed at the ZSM, through ICS, or at the unit by using a DC voltmeter. The LED on the RTRM module does not indicate whether diagnostics are present or not. This RTRM LED is an indicator that the RTRM has power, and it pulses during the TEST mode.

Figure 104. Terminal locations



System Status / Diagnostics Checkout Procedure (DC Voltmeter Required)

The method described below to determine unit status or to see if diagnostics are present assumes the Zone Sensor or NSB panel is not within sight or close by or is not being used. If a zone sensor is within sight however, DC readings need not be taken - just look at the LED or display and go to STEP 3.

1. Measure and record DC voltage from J6-6 (common) to each output: J6-7, J6-8, J6-9, and J6-10.
2. Using the data below, determine if each output is ON, OFF, or PULSING.

   All voltages are approximate - this is a sensitive circuit, so the type of voltmeter used, sensor connections etc. may all slightly affect the reading.

   ON = 30Vdc if no NSB or ZSM with LED's is connected, 25 Vdc if NSB panel (BAYSENS119*) is connected, 2Vdc if ZSM w/ LED's (BAYSENS110*, BAYSENS021*) is connected.

   OFF = 0.75 Vdc regardless of ZSM / NSB connection

   PULSING (DIAGNOSTIC PRESENT) = A distinct pulsing from 0.75 Vdc to 30 Vdc will be seen depending on the type of meter used. Some meters may only pulse between 20 and 30 volts DC.

3. Refer to the data in "What Outputs Mean" section to determine course of action.

   What Outputs Mean:

   HEAT J6-7

- On = system is actively heating
- Off = system is not actively heating
- Pulsing = a diagnostic is present (see DIAGNOSTICS section).

  COOL J6-8

- On = system is actively cooling
- Off = system is not actively cooling
- Pulsing = a diagnostic is present (see DIAGNOSTICS section).

  SYSTEM J6-9

- On = RTRM has power
- Off = RTRM does not have power or has failed
- Pulsing = unit is in the TEST mode

  SERVICE J6-10

- On = dirty air filter indication
- Off = normal operation
- Pulsing = a diagnostic is present (see DIAGNOSTICS section).

Note: *Diagnostics for CV/SZ VAV or VAV units are listed separately. The same diagnostic may have a different meaning depending on whether the unit has VAV controls or CV/SZ VAV controls.*

Diagnostics (CV and SZ VAV Units Only)

If only one diagnostic is present, refer to that diagnostic listing below. If more than one diagnostic is present, refer to combination diagnostics such as COOL + HEAT as appropriate. On a BAYSENS119*, the display will show HEAT FAIL or COOL FAIL or SERVICE (or an appropriate combination) if a diagnostic is present. If the unit is using a conventional thermostat, diagnostics are still available by using a DC voltmeter as described above.

HEAT (YC only)

- TCO1, TCO2 or TCO3 has opened.
- IGN Module lockout (see gas heat section for troubleshooting).
- Supply Air Temperature has Failed (SZ VAV Only with Modulating Heat).

COOL

- Zone temp input (RTRM J6-1) is open, shorted, or has failed after the RTRM sensed a valid input.

Note: *Since CV units may use a conventional thermostat, the RTRM will not send a diagnostic if a zone sensor is not attached when power is applied to the unit. Also, the RTRM ignores a zone sensor if it is attached to a powered-up unit. (after a brief time-out). Therefore, always reset power after installing a mechanical ZSM to terminals RTRM J6-1 through J6-5.*

All units configured for SZ VAV will blink the Cool indicator if there is a Zone Temp. input failure because a valid Zone Temperature reading is required for all SZ VAV operation.

- Cooling and heating setpoint inputs are both open, shorted, or failed, but the unit has a valid zone temp input.
- Programmable ZSM (BAYSENS119*) has failed to communicate after successful communication has occurred.
- CC1 or CC2 24 VAC control circuit has opened 3 times during a cooling mode. Check CC1, CC2 coils or any controls in series with the coils (winding thermostat, HPC, circuit breaker auxiliary contacts).
- LPC 1 or LPC 2 has opened during the 3 minute minimum "on" time during 4 consecutive compressor starts. Check LPC 1 circuit by measuring voltage from RTRM J1-8 to chassis ground. Check LPC 2 circuit by measuring voltage from RTRM J3-2 to chassis ground. If 24 VAC is not present, the circuit is open. 24 VAC should be present at these terminals at all times.
- Discharge air sensor (DTS) input is open, shorted, or has failed.

SERVICE

The supply fan proving switch (FFS) has failed to close within 40 seconds after the fan starts or has closed during fan operation.

HEAT + COOL

- The Emergency Stop input (LTB1-5 and LTB1-6) is open. Check this input at the RTRM by measuring voltage from RTRM J1-12 to chassis ground. 24 VAC should be present whenever the Emergency Stop input is closed.
- Outdoor air sensor (OAS) input is open, shorted, or has failed.

HEAT + COOL + SERVICE

- Smoke Detector input active.
- Supply Air Temperature Failure on units with modulating hot gas reheat
- Entering Evaporator Temperature Failure on units with modulating hot gas reheat.
- RTDM Communication Failure on units with modulating hot gas reheat.

Diagnostics (VAV only)

If only one diagnostic is present, refer to that diagnostic. If more than one diagnostic is present, refer to combination diagnostics such as COOL + HEAT as appropriate. On a BAYSENS119*, the display will show HEAT FAIL or COOL FAIL or SERVICE (or an appropriate combination) if a diagnostic is present.

HEAT (YC only)

- TCO1, TCO2, or TCO3 has opened.
- IGN Module lockout (see gas heat section for troubleshooting).

COOL

- Discharge air sensor (DTS) is open, shorted, or has failed.
- Zone temp input (RTRM J6-1) is open, shorted, or failed during an unoccupied mode. If the unit has a default mode input (jumper from RTRM J6-2 to RTRM J6-4, a valid zone temp input is needed for unoccupied heating, MWU and DWU.
- CC1 or CC2 24 VAC control circuit has opened 3 times during a cooling mode. Check CC1, CC2 coils or any controls in series with the coils (winding thermostat, HPC, circuit breaker auxiliary contacts).
- LPC 1 or LPC 2 has opened during the 3 minute minimum "on" time during 4 consecutive compressor starts. Check LPC 1 circuit by measuring voltage from RTRM J1-8 to chassis ground. Check LPC 2 circuit by measuring voltage from RTRM J3-2 to chassis ground. If 24 VAC is not present, the circuit is open. 24 Vac should present at these terminals at all times.

SERVICE

The supply fan proving switch (FFS) has failed to open within 40 seconds after the fan starts or has closed during fan operation.

COOL + SERVICE

Static Pressure Transducer output voltage at RTAM J1-3 is less than 0.25Vdc. The transducer output is open, shorted, or the transducer is reading a negative supply air pressure.

HEAT + COOL

- The Emergency Stop input (TB1-5 and TB1-6) is open. Check this input at the RTRM by measuring voltage from RTRM J1-12 to chassis ground. 24 Vac should be present whenever the Emergency Stop input is closed.
- Outdoor air sensor (OAS) input is open, shorted, or has failed.

HEAT + COOL + SERVICE

- Static Pressure High Duct Static Trip. The static pressure has exceeded 3.5" W.C. three consecutive times.
- Smoke Detector input active.
- Supply Air Temperature Failure on units with modulating hot gas reheat.
- Entering Evaporator Temperature Failure on units with modulating hot gas reheat.
- RTDM Communication Failure on units with modulating hot gas reheat.

Resetting Cooling and Ignition Lockouts

Cooling Failures and Ignition Lockouts are reset in an identical manner. Method 1 explains resetting the system from the space; Method 2 explains resetting the system at the unit.

Note: *Before resetting Cooling Failures and Ignition Lockouts check the Failure Status Diagnostics by the methods previously explained. Diagnostics will be lost when the power to the unit is disconnected.*

Method 1

To reset the system from the space, turn the "Mode" selection switch at the zone sensor to the "Off" position. After approximately 30 seconds, turn the "Mode" selection switch to the desired mode, i.e. Heat, Cool or Auto.

Method 2

To reset the system at the unit, cycle the unit power by turning the disconnect switch "Off" and then "On".

Lockouts can be cleared through the building management system. Refer to the building management system instructions for more information.

Zone Temperature Sensor (ZSM) Service Indicator

The ZSM SERVICE LED is used to indicate a clogged filter, an active Smoke Detector, or a Fan Failure trip.

Clogged Filter Switch

This LED will remain on 2 minutes after the Normally Open switch is closed. The LED will be turned off immediately after resetting the switch (to the Normally Open position), or any time that the IDM is turned off.

If the switch remains closed, and the IDM is turned on, the SERVICE LED will be turned on again after the 2 (±1) minutes.

This LED being turned on will have no other affect on unit operation. It is an indicator only.

Smoke Detector Switch

The LED will flash anytime that the N.O. Smoke Detector input is closed and will be reset anytime that the input is returned to its N.O. state. During an Active Smoke Detector trip the unit will be shut down.

Fan Failure Switch

The LED will flash 40 seconds after the fan is turned "On" if the Fan Proving Switch is not made. This LED will remain flashing until the unit is reset by means explained above. If the "Fan Failure" switch opens for at least 40 seconds during fan operation (indicating a fan failure) the unit will stop.

Condensate Overflow Switch

When the condensate overflow switch is closed, a drain pan overflow condition is indicated and it will shut unit operations down.

RTRM Zone Sensor Module (ZSM) Tests

Note: *These procedures are not for programmable or digital models and are conducted with the Zone Sensor Module electrically removed from the system.*

Table 70. Zone Sensor Module (ZSM) terminal identification (constant volume only)

Terminal #	Terminal I. D.	Terminal #	Terminal I. D.
J6-1	ZTEMP	J6-6	LED COMMON
J6-2	SIGNAL COMMON	J6-7	HEAT LED
J6-3	CSP*	J6-8	COOL LED
J6-4	MODE	J6-9	SYS ON LED
J6-5	HSP	J6-10	SERVICE LED

Test 1: Zone Temperature Thermistor (ZTEMP)

This component is tested by measuring the resistance between terminals 1 and 2 on the Zone Temperature Sensor. The following are some typical indoor temperatures, and corresponding resistive values.

Table 71. Resistance values

Zone or Set Point Temperature	Nominal ZTEMP Resistance	Nominal CSP or HSP Resistance
50° F	19.9 K-Ohms	889 Ohms
55° F	17.47 K-Ohms	812 Ohms
60° F	15.3 K-Ohms	695 Ohms
65° F	13.49 K-Ohms	597 Ohms
70° F	11.9 K-Ohms	500 Ohms
75° F	10.50 K-Ohms	403 Ohms
80° F	9.3 K-Ohms	305 Ohms

Table 71. Resistance values (continued)

Zone or Set Point Temperature	Nominal ZTEMP Resistance	Nominal CSP or HSP Resistance
85° F	8.25 K-Ohms	208 Ohms
90° F	7.3 K-Ohms	110 Ohms

Test 2: Cooling Set Point (CSP) and Heating Set Point (HSP)

The resistance of these potentiometers are measured between the following ZSM terminals. Refer to the chart above for approximate resistances at the given set points.

CSP = Terminals 2 and 3

Range = 100 to 900 Ohms approximate

HSP = Terminals 2 and 5

Range = 100 to 900 Ohms approximate

Test 3: System Mode and Fan Selection

The combined resistance of the Mode selection switch and the Fan selection switch can be measured between terminals 2 and 4 on the ZSM. The possible switch combinations are listed below with their corresponding resistance values.

Table 72. Nominal resistance

VAV System Switch	CV System Switch	CV Fan Switch	Nominal Resistance
OFF	OFF	AUTO	2.3 K-Ohms
	COOL	AUTO	4.9 K-Ohms
AUTO	AUTO	AUTO	7.7 K-Ohms
	OFF	ON	11.0 K-Ohms
	COOL	ON	13.0 K-Ohms
	AUTO	ON	16.0 K-Ohms
	HEAT	AUTO	19.0 K-Ohms
	HEAT	ON	28.0 K-Ohms

Test 4: LED Indicator Tests (SYS ON, HEAT, COOL & SERVICE)

- **Method 1:** Testing the LED using a meter with diode test function. Test both forward and reverse bias. Forward bias should measure a voltage drop of 1.5 to 2.5 volts, depending on your meter. Reverse bias will show an over load, or open circuit indication if LED is functional.
- **Method 2:** Testing the LED with an analog Ohmmeter. Connect Ohmmeter across LED in one direction, then reverse the leads for the opposite direction. The LED should have at least 100 times more resistance in reverse direction, as compared with the forward direction. If high resistance in both

directions, LED is open. If low in both directions, LED is shorted.

- **Method 3:** Testing the LED with an analog Ohmmeter. Connect Ohmmeter across LED in one direction, then reverse the leads for the opposite direction. The LED should have at least 100 times more resistance in reverse direction, as compared with the forward direction. If high resistance in both directions, LED is open. If low in both directions, LED is shorted.

Note: *Measurements should be made from LED common (ZSM terminal 6 to respective LED terminal). Refer to the Zone Sensor Module (ZSM) Terminal Identification table at the beginning of this section.*

Programmable & Digital Zone Sensor Test

Testing serial communication voltage

1. Verify 24 VAC is present between terminals RTRM J6-14 and RTRM J6-11.
2. Disconnect wires from RTRM J6-11 and RTRM J6-12. Measure the voltage between RTRM J6-11 and RTRM J6-12; it should be approximately 32 Vdc.
3. Reconnect wires to terminals RTRM J6-11 and RTRM J6-12. Measure voltage again between RTRM J6-11 and RTRM J6-12, voltage should flash high and low every 0.5 seconds. The voltage on the low end will measure about 19 Vdc, while the voltage on the high end will measure from approximately 24 to 38 Vdc.
4. Verify all modes of operation, by running the unit through all of the steps in “Test Modes,” p. 66.
5. After verifying proper unit operation, exit the test mode. Turn the fan on continuously at the ZSM, by pressing the button with the fan symbol. If the fan comes on and runs continuously, the ZSM is good. If you are not able to turn the fan on, the ZSM is defective.

ReliaTel Refrigeration Module (RTRM)

Default Chart - CV and SZ VAV Units

If the RTRM loses input from the building management system, the RTRM will control in the default mode after approximately 15 minutes. If the RTRM loses the Heating and Cooling Setpoint input from the potentiometers, the RTRM will control in the default mode instantaneously. The temperature sensing thermistor in the Zone Sensor Module for CV applications is the only component required for the “Default Mode” to operate.

Table 73. Constant volume and single zone VAV default operations

Component or Function	Default Operation
Cooling Setpoint (CSP)	74°F
Heating Setpoint (HSP) Economizer	71°F Normal Operation
Economizer Minimum Position	Normal Operation
Mode	Normal operation, or auto if ZSM mode switch has failed
Fan	Normal operation, or continuous if fan mode switch on ZSM has failed
Night Setback Mode	Disabled - Used with Integrated Comfort™ System and Programmable ZSM’s only
Supply Air Tempering	Disabled - Used with Integrated Comfort™ Systems only
DA Cool Setpoint	50ºF (SZ VAV Only)
DA Heat Setpoint	100ºF (SZ VAV Only)

Default Chart - VAV Units

If the RTRM loses input from the building management system, the RTRM will control in the default mode after approximately 15 minutes. For VAV units, a “shorted” mode input is the only input required for the “Default Mode” to operate. If the RTRM loses setpoint inputs from the RTAM due to remote setpoint input failure, the RTRM will use default setpoint inputs as defined in the default chart for VAV units.

Table 74. Variable air volume default operation

Component or Function	Default Operation
Supply Air Cooling Setpoint Failure	55° F
Supply Air Reset Setpoint Failure	Disable Reset
Supply Air Reset Amount	Disable Reset
Supply Air Static	
Setpoint Failure	0.5 IWC
Supply Air Static	
Deadband Failure	0.5 IWC
Morning Warm-Up	
Setpoint Failure	Disable MWU and DWU
Mode Failure “Open	“Unit Mode “Off”
Mode Failure “Shorted	“Unit Mode “Auto”

Economizer Actuator (ECA/ RTEM) Test Procedures

Economizer Fault Detection and Diagnostics

Fault Detection of the Outdoor Air Damper will be evaluated based on the commanded position of the damper actuator compared to the feedback position from the damper actuator. The damper is commanded to a position based on a 2-10 VDC signal. If the damper position is outside of ±10% of the commanded position, a diagnostic is generated.

Note: *Only one diagnostic will be active at any given time.*

Unit Not Economizing When it Should Be

The unit is operating in cooling mode, economizing is enabled and/or mechanical cooling is enabled. If the commanded economizer position is greater than the current economizer feedback position +10% for 5 continuous minutes, a 'Unit Not Economizing When it Should Be' diagnostic is generated.

Unit Economizing When it Should Not Be

The unit is operating in cooling mode, economizing is enabled and/or mechanical cooling is enabled. If the commanded economizer position is less than the current economizer feedback position -10% for 5 continuous minutes, a 'Unit Economizing When it Should Not Be' diagnostic is generated.

Outdoor Air Damper Not Modulating

If the unit is operating in ventilation only mode - not attempting to economize - and the commanded damper position is greater than the current damper feedback position +10% for 5 continuous minutes, a 'Outside Air Damper Not Modulating' diagnostic is generated.

Excessive Outdoor Air

If the unit is operating in ventilation only mode - not attempting to economize - and the commanded damper position is less than the current damper feedback position -10% for 5 continuous minutes, a 'Excessive Outdoor Air' diagnostic is generated.

Mixed Air Temperature Low Limit Diagnostic

In all conditions on all ReliaTel controlled units, if the Mixed Air Temperature falls below 45°F, the 'Mixed Air Temperature Low Limit' diagnostic is active and the economizer actuator will close to the active minimum position. On Title 24 compliant units, ReliaTel will set an Auto-Reset Diagnostic to be used by BAS and TD5 when the Mixed Air Temperature Low Limit is active.

The RTEM will revert to normal operation when the Mixed Air Temperature rises above 48°F. The Diagnostic will be reset when the Mixed Air Temperature Low Limit is inactive.

Verify Economizer Status by Economizer Actuator (ECA/RTEM)

LED indicator:

- OFF: No Power or Failure
- ON: Normal, OK to Economize
- Slow Flash: Normal, Not OK to Economize
- Fast Flash: ¼ Second ON/2 Seconds OFF Communications Failure
- 1 Flash: Actuator Fault
- 2 Flashes: CO2 Sensor out of range
- 3 Flashes: RA Humidity Sensor out of range
- 4 Flashes: RA Temp Sensor out of range
- 6 Flashes: OA Humidity Sensor out of range
- 7 Flashes: OA Temp Sensor out of range
- 8 Flashes: MA Temp Sensor out of range
- 9-11 Flashes: Internal ECA failure

Note: *The Outdoor Air Sensor (OAS) is also used for the economizer operation. It is connected to the RTRM.*

Test 1: Voltage

Disconnect the OAS from the wires in the return air section. Check the voltage at the wires going to the RTRM. The voltage should be 5 (± 0.25) Vdc.

Check the resistance at the wires going to the OAS and measure the temperature at the OAS location. Using the Temperature versus Resistance chart, verify the accuracy of the OAS.

If voltage specified is not present, the ECA has failed.

Test 2: Testing the ECA sensors

1. Testing the Mixed Air Sensor (MAS). Disconnect the cable connected to MAT on the ECA. Using the Thermistor Resistance / Temperature Chart (Table 18, p. 39):
   a. Measure the resistance of the sensor between the connector terminals P23-1 and P23-2.
   b. Measure the temperature at the MAS location. Using the Temperature versus Resistance chart, verify the accuracy of the MAF.

   Replace the sensor if it is out of range.
2. Testing the Return Air Sensor (RAS). Disconnect the cable connected to RAT on the ECA. Using the Thermistor Resistance / Temperature Chart (Table 18, p. 39):
   a. Measure the resistance of the sensor between the connector terminals P10-1 and P10-2.
   b. Measure the temperature at the RAS location.

Using the Temperature versus Resistance chart, verify the accuracy of the RAS.

Replace the sensor if it is out of range.

3. Testing the Humidity Sensors.
   a. Return Humidity Sensor (RHS). Leave the sensor connected to the ECA, and measure the operating current. The normal current range is 4 to 20 mA (milliampere). Replace the sensor if it is out of range.
   b. Outdoor Humidity Sensor (OHS). Leave the sensor connected to the ECA, and measure the operating current. The normal current range is 4 to 20 mA (milliampere). Replace the sensor if it is out of range.

   Note: *Both the RHS and the OHS are polarity sensitive. Verify that the polarity is correct before condemning the sensor. Incorrect wiring will not damage any of the controls, but they will not function if wired incorrectly.*

ReliaTel Air Module (RTAM) Tests

⚠ 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.

Test 1: Testing the Variable Frequency Drive (VFD) Output

1. Using the procedure for VAV applications outlined in “Test Modes,” p. 66, step the unit to the first test (Step 1). Verify that 10 Vdc is present between terminals J4-2 and J4-1.

   Note: *If voltage is incorrect, verify RTAM DIP switch settings.*

2. If voltage to the VFD is not present, verify that the wires are properly connected between the RTRM or COMM (Communications Module) and the RTAM.

   If Step 2 checks out and the voltage is still not present at the VFD output, replace the RTAM.

Test 2: Testing the Static Pressure Transducer (SPT) Input

1. With main power to the unit turned “Off”, disconnect all of the tubing to the Static Pressure Transducer.
2. With the system MODE “Off”, apply power to the unit and measure the voltage between J1-4 and J1-1 on the RTAM. The voltage should be approximately 5 Vdc. If not, check the wiring between the RTRM and the RTAM. If the wiring checks good, replace RTAM.
3. Measure the voltage between J1-3 and J1-1 on the RTAM. The voltage should be approximately 0.25 Vdc. If not, check the wiring between the RTAM and the SPT. If the wiring checks good, replace the SPT.
4. Apply 2.0" w.c. pressure to the HI port on the static pressure transducer (SPT). Measure the voltage between J1-1 and J1-3. The voltage should be 1.75 (± 0.14) Vdc. If not, replace the SPT.

   Note: *The SPT is susceptible to interference from VFD’s. Make sure the SPT is mounted on plastic standoffs and is not touching any sheet metal.*

Test 3: Testing the VAV Setpoint Potentiometers

Turn the main power disconnect switch “OFF”. Check each potentiometer listed in the table below by measuring resistance. These potentiometers are built into the RTAM and are not replaceable.

Static Pressure Setpoint	0-560 ohms (Approximate)	RTAM J7-1,2
Static Pressure Dead band	0-560 ohms (Approximate)	RTAM J7-7,8
Reset Setpoint	0-560 ohms (Approximate)	RTAM J7-11,12
Reset Amount	0-560 ohms (Approximate)	RTAM J7-5,6
Morning Warm-up Setpoint	0-560 ohms (Approximate)	RTAM J7-9,10
Supply Air Cooling Setpoint	0-560 ohms (Approximate)	RTAM J7-3,4
Supply Air Heating Setpoint	0-560 ohms (Approximate)	RTAM J7-13,14

Test 4: Testing the VFD

1. Verify that the keypad in control box is powered. If not, check the power wires to the VFD and the Keypad cable.
2. Using the procedure described in “Test Modes,” p. 66, verify that the fan starts and the speed increases until the SA Pressure reaches the “Setpoint” on VAV Setpoint panel. If the fan does not start, check for “Fault Conditions” on the VFD Keypad.
3. If no “Fault Conditions” exist and the fan started but did not ramp up to speed, verify the “speed reference voltage” output from the RTAM between terminals J4-1 and J4-2.

4. If no "Fault Conditions" exist and the fan did not start, verify that the Fan relay is energized and the VFD "Start Command" is properly wired from the Fan relay, (24 volts on the Logic Input 2 (LI2) terminal). Verify that the jumper between +24V and the LI1 terminal is properly connected.
5. Verify that 115 Vac is present from the transformer on the VFD assembly panel.

   Notes:

   - *Begin troubleshooting by checking for any diagnostics. See System Status/ Diagnostics.*
   - *Always verify the unit is operating in the proper "MODE" when troubleshooting.*

ReliaTel Air Module (RTOM) Tests

Test 1: Testing the Variable Frequency Drive (VFD) Output

1. Using the "Test Modes," p. 66 procedure for SZ VAV applications in the "Startup," p. 42 section, step the unit to the fourth test (Step 4). Verify that 10 Vdc is present between terminals J11-2 and J11-1.
2. If the voltage to the VFD is not present, verify that the wires are properly connected between the RTRM or COMM (Communications Module) and the RTOM.
3. If Step 2 checks out and the voltage is still not present at the VFD output, replace the RTOM.

Test 2: Testing the VFD

1. Verify that the keypad in control box is powered. If not, check the power wires to the VFD and the Keypad cable.
2. Using the "Step Test Mode" procedure described in the "Startup," p. 42 section, step the unit to the fourth test (Step 4). Verify that the fan starts and the speed increases. If the fan does not start, check for "Fault Conditions" on the VFD Keypad.
3. If no "Fault Conditions" exist and the fan started but did not ramp up to speed, verify the "speed reference voltage" output from the RTOM between terminals J11-1 and J11-2.
4. If no "Fault Conditions" exist and the fan did not start, verify that the Fan relay is energized and the VFD "Start Command" is properly wired from the Fan relay, (24 volts on the Logic Input 2 (LI2) terminal). Verify that the jumper between +24V and the LI1 terminal is properly connected.
5. Verify that 115 Vac is present from the transformer on the VFD assembly panel.

   Notes:

   - *Begin troubleshooting by checking for any diagnostics. See System Status/ Diagnostics.*
   - *Always verify the unit is operating in the proper "MODE" when troubleshooting.*

Compressor—Blink Codes

The CSHN*** large commercial compressors come equipped with a compressor protection device capable of detecting phase reversal, phase loss, and phase unbalance. The compressor protection device uses a green and red LED to indicate the compressor status. A solid green LED denotes a fault-free condition; a blinking red LED indicates an identifiable fault condition.

Note: *If the compressor has tripped, the resistance will be 4500 ohms or greater; when reset, it will be less than 2750 ohms.*

The blink code consists of different on / off times of the red LED which is repeated continuously until either the fault is cleared or until power is cycled.

Table 75. Blink codes

Fault	LED on	LED off	LED on	LED off
PTC overheat or PTC reset delay active	short blink	long blink	short blink	long blink
Phase loss	long blink	long blink	long blink	long blink
Incorrect phase sequence	short blink	short blink	short blink	long blink

Troubleshooting

Table 76. Troubleshooting

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
A. Unit will not operate. No Heat, No Cool or No Fan operation.	1. No power to the Unit.	1. Check line voltage at service disconnect.
	2. No power to the RTRM.	2. Check for 24 VAC at RTRM J1-1 to system ground.
	3. Zone Sensor Module (ZSM) is defective or MODE circuit is open. (VAV only)	3. See Zone Sensor Module (ZSM) Test Procedures or short MODE input on VAV units.
	4. RTRM is defective.	4. If 24 VAC is present at the RTRM J1-1 to ground, the LED on the RTRM should be on. If the LED is not lit, replace the RTRM.
	5. Supply Fan Proving (FFS) switch has opened.	5. Check the IDM and belts, replace as necessary.
	6. Emergency Stop input is open.	6. Check the Emergency Stop input.
CV or SZ VAV Units only		
B. Unit will not Heat or Cool, but the Fan switch operates.	1. Zone Sensor Module (ZSM) is defective.	1. Refer to the Zone Sensor Module (ZSM) Test Procedures.
	2. Problem in (ZSM) wiring.	2. Disconnect the ZSM wiring at RTRM and test the wires using the Zone Sensor Test Procedures to locate any wiring problems.
	3. RTRM is defective.	3. Disconnect the ZSM wiring at the RTRM and perform the Zone Sensor Module (ZSM) Test Procedures. If within range, replace RTRM.
CV, SZ VAV or VAV (Unoccupied)		
C. Unit heats and cools, but will not control to set point.	1. Zone Sensor Module (ZSM) is defective.	1. Refer to the Zone Sensor Module (ZSM) Test Procedures.Refer to the Default Chart.
	2. Thermometer on the ZSM out of calibration.	2. Check and calibrate the thermometer.
D. CPR1 will not operate, ODM's will operate.	1. Compressor failure.	1. Test compressor, mechanically and electrically. Replace if necessary.
	2. Wiring, terminal, or mechanical CC1 contactor failure.	2. Check wires, terminals and CC1. Repair or replace if necessary.
	3. LPC1 has tripped	3. Leak check, repair, evacuate and recharge as necessary. Check LPC1 operation.
E. CPR1 operates, ODM's will not operate.	1. ODM has failed.	1. Check ODM's, replace if necessary.
	2. ODM capacitor(s) has failed.	2. Check ODM capacitors, replace if necessary.
	3. Wiring, terminal, or mechanical CC1 or CC2 contactor failure.	3. Check wires, terminals,CC1 and CC2. Repair or replace if necessary.
	4. ODF 20 or 34 relay has failed	4.Check for proper voltage and contact closure. ODF20 and 34 have a 24 VAC holding Coil. If voltage is present, replace relay.
	5. RTRM is defective	5. Locate the P3 connector on the RTRM. Check for 24 VAC at terminal P3-6. If 24 VAC is not present, replace RTRM.
F. CPR1 and ODM1 will not operate.	1. No power to CC1 coil. Possible Cool Failure	1. Check wiring, terminals and applicable controls (CCB1, HPC1, TDL1, WTL1, LPC1)
	2. CC1 coil defective. Cool Failure Indicated.	2. Check CC1 coil. If open or shorted, replace CC1.
	3. CC1 contacts defective.	3. If 24 VAC is present at CC1coil, verify contact closure.
	4. RTRM is defective.	4. If 24 VAC is not present at CC1 coil, reset the Cool Failure by cycling the main power disconnect switch. Verify system MODE is set for cooling operation. If no controls have opened, and CC1 will not close, replace RTRM.
	5. LPC1 has tripped	5. Leak check, repair, evacuate, and recharge as necessary. Check LPC1 operation.

Table 76. Troubleshooting (continued)

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
G. ODM 3 and/or 4 will not cycle.	1. OAS has failed.	1. Perform OAS Resistance/Temperature check. Replace if necessary.
	2. ODM3 and/or 4 capacitor has failed.	2. Check ODM capacitor, replace if necessary.
	3. Wiring, terminal, or CC2 contactor failure.	3. Check wires, terminals, and CC2. Repair or replace if necessary.
	4. ODM3 and/or 4 has failed.	4. Check ODM, replace if necessary.
	5. RTRM is defective.	5. Replace RTRM module
	6. ODF20 has failed.	6. Check for proper voltage and contact closure. ODF20 relay has a 24 VAC holding coil. If voltage is present, replace relay.
H. CPR2 and 3 (if applicable) will not operate.	1. No power to CC2 and/or 3 coil. Cool Failure Possible.	1. Check wiring, terminals and applicable controls (CCB2, CCB3, HPC2, LPC2, WTL2, WTL3, TDL2 & TDL3)
	2. CC2 and/or 3 coil defective. Cool Failure Indicated.	2. Verify integrity of CC2 and/or 3 coil windings. If open or shorted replace CC2 and/or CC3.
	3. CC2 and/or 3 contacts defective.	3. If 24 VAC is present at CC2 and/or 3 coil, replace relay.
	4. RTRM is defective.	4. 24 VAC is not present at CC2 and/or 3 coil. Reset the Cool Failure by cycling the service disconnect. Place the unit into Cool Stage 2 Mode, step 4 for constant Volume or step 6 for variable air volume, to insure CPR2 and 3 Compressor operation. Check input devices in #1 & #2 above, if no controls have opened, and CC2 and/or 3 will not close, replace RTRM.
	5. DLT2 and DLT3 has tripped.	4. Check for leaks, Open wire connections, Lose quick connect terminals, TDL2 and TDL3 resistance check.
I. Indoor motor (IDM) will not operate	1. IDM has failed.	1. Check IDM, replace if necessary.
	2. Wiring, terminal, or contactor failure.	2. Check wiring, terminals and F contactor. Repair or replace wiring, terminals, or fan contactor F.
	3. ZSM is defective.	3. Place unit in test mode. If the fan operates in the test mode, test the ZSM using the appropriate test procedures.
	4. RTRM is defective.	4. Check the RTRM fan output. Locate P2-1 on the RTRM. Measure voltage to ground. If 24 VAC is not present on a call for fan, replace the RTRM.
	5. Supply Fan Proving (FFS) switch has opened.	5. Check FFS and belts, repair or replace if necessary.
J. No Heat (YC's only) CFM will not run, IP warms up, GV is energized	1. CFM has failed.	1. Check CFM, replace if necessary.
	2. CFM capacitor has failed.	2. Disconnect BROWN wires from capacitor, test, and replace if necessary.
	3. Wiring, or terminal failure.	3. Check wiring, and terminals. Repair, or replace if necessary.
	4. TNS3 and/or 4 has failed. (460/575 V units only)	4. Check for 230 VAC at TNS3 and/or 4 secondary, between Y1 and Y2. If 230 VAC is not present, replace TNS3 and/or 4.
	5. Modulating gas is not configured properly.	5. Check RTOM wiring and control board software versions.
K. No Heat (YC's only) CFM runs, GV energizes, IP does not warm up.	1. TNS3 and/or 4 has failed.	1. Check for 115 VAC at TNS3 and/or 4 secondary, between X1 and X2. If 115 VAC is not present, replace TNS3 and/or 4.
	2. Wiring or terminal failure.	2. Check wiring and terminals. Repair or replace if necessary.
	3. IP has failed.	3. With 115 VAC applied to IP, warm up should take place. Cold resistance of IP should be a minimum of 50 Ohms. Nominal current should be 2.5 to 3.0 Amps.
L. No Heat (YC's only) GV does not energize, CFM runs, IP warms up	1. Wiring or terminal failure.	1. Verify presence of 24 VAC between IGN J1-7 terminal to ground, if not present, check wiring and terminals. Repair or replace if necessary.
	2. GV has failed, in two stage units	2. Measure voltage between TH and TR on the gas valve (GV). If 24 VAC is present and the GV will not open, replace the GV.
	3. Pressure switch failure, in mod heat units	3. In mod heat units, verify the pressure switch is wired correctly. If wired correctly, verify operation of pressure switch.

Table 76. Troubleshooting (continued)

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
M. Low Heat Capacity Intermittent Heat. (YC's only) CFM runs in LO or HI speed only, or; may not operate at all in one speed or the other.	CFM has failed.	Check CFM, test LO and HI speed windings.
N. No Heat (YC's only) "Fan" selection switch on the ZSM is in the "AUTO" position and the fan runs continuously.	TCO2 has opened. Heat Failure Indicated.	System Status Failure Diagnostic. Place the unit in the Heating Test Mode, steps 6 & 7 for constant volume or step 8 & 9 for variable air volume and check the complete heating system for failure. Make necessary repairs or adjustments to the unit.
O. No Heat (TE's only) Electric heat will not operate.	1. Heater contactor(s) have failed.	1. Check for 24 VAC at AH, BH,CH, and DH contactor coils. If 24 VAC is present on a call for heat, and the contacts do not close, the contactor has failed.
	2. Heater element temperature limit(s) is open.	2. Check line voltage between the element temperature limit terminals located in heat section. If line voltage is present, the limit is open. Repair heating unit, or replace limit(s) as needed.
	3. Wiring or terminal failure.	3. Check for wiring, or terminal failure in control and power circuit. Repair or replace if necessary.
	4. Heater Element(s) has failed.	4. Check element and circuit integrity. Repair or replace as necessary. Replace open elements.
	5. RTRM is defective.	5. Check RTRM heat outputs. "First stage", locate P2 connector, connected to J2 on the RTRM. Locate wire 65E at terminal P2-9, measure between 65E and ground. If 24 VAC is present, repeat #3 above. If 24 Vac is not present, the RTRM has failed. "Second stage", Locate 67B wire at terminal P2-8, measure between 67B and ground. 24 Vac should be present. If 24 Vac is not present, the RTRM has failed.
P. Evaporator coil freezes up during low ambient operation.	1. System low on refrigerant charge.	1. Leak check, repair, evacuate, and recharge system as necessary.
	2. System low on air flow.	2. Check return air for obstruction or dirty filters. Check fan wheels, motors, and belts.
	3. Outdoor Air Sensor (OAS) has Failed.	3. Check OAS at connector P8 by disconnecting P8 from J8 on the RTRM. Check resistance between P8-1 and P8-2, refer to the Resistance versus Temperature chart. Replace sensor if necessary.
	4. Frostat™ has Failed	4. Check Frostat Switch
Q. Economizer will not operate.	1. Economizer connector not plugged into unit wiring harness.	1. Check connector, and connect if necessary.
	2. Economizer Actuator (ECA) has failed.	2. Verify that 24 VAC is present between ECA terminals 24 VAC and Common. Place the unit in econ test mode; economizer actuator should drive open. In any other unit test mode, economizer actuator should drive to minimum position. If ECA does not drive as specified, replace ECA.
	3. Wiring or terminal failure.	3. Check wiring and terminals. Repair or replace if necessary.
	4. ECA is defective.	4. Perform the ECA Test Procedures discussed previously.
R. Minimum position is at zero, cannot be adjusted. Economizer still modulates.	1. Remote Minimum position potentiometer has failed.	1. With the main power off, check the resistance between terminals P and P1 at the ECA by rotating the remote minimum position potentiometer knob. Resistance should be 50 to 200 Ohms.
	2. Minimum position potentiometer has failed.	2. Rotate the onboard minimum position potentiometer knob. If ECA does not drive to different minimum position, replace ECA.
S. Economizer goes to minimum position, and will not modulate.	1. OAS has failed.	1. Check the OAS at connector P8 by disconnecting P8 from J8 on the RTRM. Check resistance between P8-1 and P8-2, refer to the Resistance versus Temperature Chart. Replace sensor if necessary.
	2. MAS has failed.	2. Check the MAS at connector P23 by disconnecting P23 from MAT on the ECA. "MAT" is marked on the actuator. Check for resistance between P23-1 and P23-2, refer to the Resistance versus Temperature Chart. Replace sensor if necessary.

Table 76. Troubleshooting (continued)

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
T. Economizer modulates, but system does not seem to operate as efficiently as in the past.	1. Comparative enthalpy setup, RAS or RHS failed. System is operating using Reference enthalpy.	1. Check the return air sensor (RAS) at connector P10 by disconnecting P10 from RAT on the ECA. Check for resistance between P10-1 and P10-2, refer to the Resistance versus Temperature Chart. Replace the sensor if necessary. Check the return air humidity sensor (RHS) by measuring the operating current at terminals RAH-1 and RAH-2 on the ECA. Normal operating current is 4 to 20 milliamps mA. Note: The humidity sensors are polarity sensitive, and will not operate if connected backwards.
	2. Reference enthalpy setup, OHS has failed. System is operating using dry bulb control.	2. Check the outside humidity sensor (OHS) by measuring the operating current at terminals OAH-1, and OAH-2 on the ECA. Normal operating current is 4 to 20 milliamps mA.
	3. Comparative enthalpy setup, OHS has failed. System is operating using dry bulb control.	3. Perform #2 above.
U. Power Exhaust will not operate.	1. Exhaust motor has failed.	1. Check the exhaust fan motor, and replace if necessary.
	2. XFR has failed.	2. Check the exhaust fan contactor (XFR). Replace if necessary
	3. ECA has failed.	3. Perform the ECA Test Procedures discussed previously.
	4. XFSP has Failed	4. Perform the Exhaust Fan Setpoint Test Procedures discussed previously.
V. VFD will not operate properly	1. RTAM has Failed	1. Perform the RTAM Test Procedures discussed previously.
	2. VFD has Failure	2. Check the VFD
	3. Setpoint Failure	3. Perform the VFD Setpoint Test Procedures discussed previously.
	4. RTOM has Failed	4. Perform the RTOM Test Procedures discussed previously.
W. Power Exhaust Fan cycles ON/OFF	1. Space Pressure Deadband is too narrow	1. Increase the Space Pressure Deadband.
	2. Space Pressure Setpoint is too high/low	2. Verify Building Pressure with maximum building exhaust enabled. Adjust Space Pressure Setpoint accordingly.

Table 77. Component failure mode

COMPONENT	FAILURE RESPONSE	NORMAL RANGE	DIAGNOSTIC
(OAS) Outdoor Air Sensor	1. Economizer in minimum position. Will not modulate.	-55 to 175F / 680K to 1.2K	Heat and cool failure output at RTRM J6-7 to J6-6 and RTRM J6-8 to J6-6. Heat and cool LED's blink at ZSM. Check at RTRM connector P8, between P8-1 & P8-2.
	2. ODM3 will not cycle off (runs continuously).	-55 to 175F / 680K to 1.2K	Check at RTRM connector P8.
(RAS) Return Air Sensor	Economizer operates using Reference Enthalpy	0 to 209 F / 90K to 7.1K	ECA LED 4 Flashes. Check at ECA connector P1 between P10-1 & P10-2.
(MAS) Supply Air Sensor	Economizer in minimum position, will not modulate.	0 to 209 F / 90K to 7.1K	ECA 8 flashes.
(OHS) Outdoor Humidity Sensor	Uses Dry Bulb operation and economizes if below 60 F DB.	4 to 20 mA / 10 to 90% RH Honeywell C7600A.	ECA 6 flashes. Check at ECA OAH-1 and OAH-2 by measuring current draw.
(RHS) Return Humidity Sensor	Economizer operates using Reference Enthalpy.	4 to 20 mA / 10 to 90% RH Honeywell C7600A.	Check at ECA ECA 3 flashes. RAH-1 and RAH-2 by measuring current draw.
Remote Minimum position Potentiometer	1Economizer modulates but minimum position stays at zero.	Potentiometer range 50 to 200 Ohms.	*NONE* Check resistance at ECA P and P1 50 to 200 Ohms.
Cooling Setpoint (CSP) for CV or SZ VAV ZSM slide potentiometer	Uses HSP and CSP CSP= HSP + 4 F or use RTRM Default Mode.	100 to 900 Ohms Use ZSM Test Procedures.	*NONE* Check at terminals 2 and 3 on ZSM
Heating Setpoint (HSP) for CV or SZ VAV ZSM slide potentiometer	Uses CSP and HSP HSP= CSP - 4 F.	100 to 900 Ohms Use ZSM Test Procedures.	*NONE* Check at terminals 2 and 5 on ZSM.
TDL1, TDL2 or TDL3 (Temperature Discharge Limit)	Comp1, Comp2 or Comp3 will not operate.	Open 230 F +/- 6.5 F, Close 180 F +/- 12.5 F, Normally closed	Cool Failure Output at RTRM J6-8 to J6-6 LED blinks at ZSM.

Table 77. Component failure mode (continued)

COMPONENT	FAILURE RESPONSE	NORMAL RANGE	DIAGNOSTIC
HSP and CSP for CV or SZ VAV are both lost.	Cannot control at ZSM, unit using RTRM Default Mode.	100 to 900 Ohms approx. Use ZSM Test Procedures.	If a sensor is used at RTRM J6-1 and J6-2, Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED Blinks at ZSM. If RTRM senses a zone temp input and then it is lost,
(ZTEMP) Zone Temperature Sensor CV, SZ VAV, or VAV during Unoccupied mode.	No Heating or Cooling ZSM "Fan" selection switch operates IDM during Unoccupied Mode.	-40 TO 150 F, 346K to 2.1K	CV Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED Blinks at ZSM
TC01, TCO2, TC03 High Temp Limit	Heat goes off, IDM runs continuously.	Normally Closed, Open 135 F, Reset 105 F.	Heat Failure Output at RTRM J6-7 to J6-6 "HEAT" LED Blinks at ZSM.
(LPC1) Low Pressure Control	Compressor CPR1 will not operate.	Open 25 PSIG, Close 41 PSIG.	Possible Cool Failure at RTRM J1-8 to Ground, 0 VAC. "COOL" LED Blinks at ZSM.
(LPC2) Low Pressure Control Dual Circuits Only	Compressor CPR2 will not operate.	Open 25 PSIG, Close 41 PSIG.	Possible Cool Failure at RTRM J3-2 to Ground, 0 VAC. "COOL" LED blinks at ZSM.
(CCB1)	Compressor CPR1 will not operate.	Normally Closed. range varies by unit.	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(CCB2 or CCB3) Compressor Overload	Compressor CPR2 or CPR3 will not operate.	Normally Closed. range varies by unit.	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(HPC1) High Pressure Control	Compressor CPR1 will not operate.	Open 650 psig, Close 550 psig	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(HPC2) High Pressure Control	Compressor CPR2 or CPR3 will not operate.	Open 650 psig, Close 550 psig	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(WTL1) Winding Temperature Limit	Compressor CPR1 will not operate.	Normally Closed	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(WTL2 or WTL3) Winding Temperature Limit	Compressor CPR2 or CPR3 will not operate.	Normally Closed	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(CC1) Compressor Contactor 24 VAC coil	Compressor CPR1 will not operate.	Varies by unit	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(CC2 or CC3) Compressor Contactor 24 VAC coil	Compressor CPR2 or CPR3 will not operate.	Varies by unit	Cool Failure Output at RTRM J6-8 to J6-6 "COOL" LED blinks at ZSM.
(CFS) Clogged Filter Switch	This input is for "indication" only and does not effect the normal operation of the unit.	"Normal operation = 0 VAC measured between terminals J5-1 and Ground.	SERVICE LED ON 2-30 Vdc present at RTRM J6-6 and J6-10.
(FFS) Supply Fan Proving Switch	Unit will not operate in any mode.	0.5" W.C. Normally Open	Service Failure Output at RTRM J6-6 to J6-10 "SERVICE" LED blinks at ZSM.
(SPT) Static Pressure Transducer VAV	Fan speed command remains at 0%.	0.25 - 4 Vdc between J8 and J9 on VAV	Heat and Cool Failure Output at RTRM J6-7 to J6-6 & RTRM J6-8 to J6-6 "HEAT" and "COOL" LED's blink at ZSM.
Condensate Overflow Switch	Closed - Unit will not operate	N/A	Check to make sure the float position is not in a tripped condition and verify an "open" between wires connecting to RTOM J6-1, J6-2.
Traq - CFM Setpoint and airflow sensor	1. In the event a required Traq control input is out of range the Traq Minimum Position Request will be disabled and a static value of 10% will be utilized for minimum position at all times. 2. If BAS is in "remote control" and sending a valid OA Minimum Position Setpoint that setpoint will be used for OA Minimum Position, however a diagnostic indication will continue to be set via the BAS and the 2-blink code will be initiated on the RTRM to indicate a problem.	0 to 20000CFM	A diagnostic will be set via BAS communication and the 2-blink code will be initiated on the RTRM to indicate a problem.
Traq - w/DCV loss of CO2 sensor or CO2 setpoint(s)	In the event of the loss of a required control parameter for DCV when paired with Traq control the system will revert to using on the Design Minimum OA CFM Setpoint and continue Traq control functionality without DCV.	0 to 2500	The proper failure code will be set on the RTEM and an indication of the failure will be set via the BAS Communication packet.

Table 77. Component failure mode (continued)

COMPONENT	FAILURE RESPONSE	NORMAL RANGE	DIAGNOSTIC
Traq - RTVM Communications Failure	In the event of the loss communications with the RTVM in a system previously configured for Traq control a static OA Minimum Position value of 10% will be utilized at all times.	N/A	A diagnostic will be set via BAS communication and the 2-blink code will be initiated on the RTRM to indicate a problem.
Traq - RTEM Communications Failure	In the event of the loss communications with the RTEM in a system previously configured for Traq control the RTEM will revert to the Local Design OA Minimum Position potentiometer on the RTEM as a fail safe built into the RTEM. The damper will remain at that position until communications is re-established to the RTEM or the power is disconnected. Traq control will be disabled since it requires transmission of the Traq OA Minimum Position Request to the RTEM via Modbus link.	N/A	The proper diagnostic will be set via BAS communication and the 2-blink code will be initiated on the RTRM to indicate a problem.

Note: *NONE* = No LED indication

TR-200 VFD Programming Parameters

Table 78. Supply and exhaust fan VFD programming parameters for model TR-200

Menu	Parameter	Description	Setting	Description
Load & Motor	1-21	Motor Power	Set Based on Motor Nameplate	Set only for applications using 3hp Hi-Efficiency motors. Set to 2.2 kW/3 hp.
	1-22	Motor Voltage	Set Based on Motor Nameplate	Set only for 200/230v 60hz & 380/415 50hz applications
	1-24	Motor Current	Set Based on Motor Nameplate	Sets the motor FLA
	1-25	Motor RPM	Set Based on Motor Nameplate	Sets the motor RPM
Limits and Warnings	4-18	Current Limit	100% Rated Current	Limits the maximum current to motor

Units shipped with an optional variable frequency drive (VFD) are preset and run tested at the factory. If a problem with a VFD occurs, ensure that the programmed parameters listed in the previous table have been set before replacing the drive.

Note: *Model TR-200—Check to make sure that parameter 1-23 is set to 60 Hz. To check parameter 1-23 press the [Main Menu] button (press [Back] button if the main menu does not display), use the [?] button to scroll down to Load & Motor, press OK, use the [?] button to select 1-2, press OK, and finally use the [?] button until parameter 1-23 is displayed. Parameter 1-23 can then be modified by pressing OK button and using [?] and [?] buttons. When the desired selection has been made, press the OK button.*

Should replacing the a 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. Remove the mode input (RTRM J6-2 and J6-4) or turn the NSB panel to OFF so that the fan will not attempt to start during programming.

⚠ 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.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06*-EN.

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK 1TB1 OR UNIT DISCONNECT SWITCH 1S14.

2. To modify TR-200 parameters:
   a. Press Main Menu button (press [Back] button if the main menu does not display)
   b. Use the [?] and [?] buttons to find the parameter menu group (first part of parameter number)
   c. Press [OK]
   d. Use [?] and [?] buttons to select the correct parameter sub-group (first digit of second part of parameter number)
   e. Press [OK]
   f. Use [?] and [?] buttons to select the specific parameter
   g. Press [OK]
   h. To move to a different digit within a parameter setting, use the [??] buttons (Highlighted area indicates digit selected for change)
   i. Use [?] and [?] buttons to adjust the digit
   j. Press [Cancel] button to disregard change, or press [OK] to accept change and enter the new setting
3. Repeat step two for each menu selection setting in Table 78, p. 138.
4. To reset TR-200 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:
   - *Steps 4 resets the drive to the default factory settings. The program parameters listed in Table 78, p. 138 will need to be verified or changed as described in item 2.*
   - *Some of the parameters listed in the tables are motor specific. Due to various motors and efficiencies available, use only the values stamped on the specific motor nameplate. Do not use the Unit nameplate values.*
   - *A backup copy of the current setup may be saved to the LCP before changing parameters or resetting the drive. See LCP Copy in the VFD Operating Instructions for details.*
5. After verifying that the VFD(s) are operating properly, put the unit into normal operation.

Unit Wiring Diagram Numbers

Table 79. Wiring diagrams - TC/TE units - standard efficiency (excluding 40–50T CV units)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Constant Volume, Variable Air Volume, Single Zone Variable Air Volume	Power	208-575	2313-1261	All Units - Standard Efficiency
	Heat Power and Controls	208-575	2313-1279	All Units - Cooling Only - Standard Efficiency
		208-230	2313-1276	36kw and 54kw Electric Heat
		380-575	2313-1277	36kw and 54kw Electric Heat
			2313-1278	72kw/90kw/108kw Electric Heat
	Refrigeration Controls (RTRM, Sensors)	208-575	2313-1263	27.5-35 ton Units
			2313-1264	40 ton Units
			2313-1265	50 ton Units
Constant Volume	Control Modules	208-575	2313-1267	All Units without Statitrac
			2313-1269	All Units with Statitrac
	Control Box Connection Print	208-230	2313-0779	27.5-35 ton, 36KW-54KW Electric Heat
			2313-0781	40 ton, 54KW Electric Heat
			2313-0783	50 ton, 54KW Electric Heat
			2313-0797	27.5-35 ton, Cooling Only
			2313-0798	40 ton, Cooling Only
			2313-0799	50 ton, Cooling Only
		380-575	2313-0780	27.5-35 ton, 36KW-54KW Electric Heat
			2313-0782	40 ton, 54KW Electric Heat
			2313-0784	50 ton, 54KW Electric Heat
			2313-0785	27.5-35 ton, 72KW-90KW Electric Heat
			2313-0786	40 ton, 72KW-108KW Electric Heat
			2313-0787	50 ton, 72KW-108KW Electric Heat
			2313-0800	27.5-35 ton, Cooling Only
			2313-1201	40 ton, Cooling Only
			2313-1202	50 ton, Cooling Only
	Raceway Devices Connection Print	208-575	2313-1281	27.5-35 ton, 36KW-54KW
			2313-1282	27.5-35 ton, 72KW-90KW
			2313-1283	40 ton, 54KW-72KW
			2313-1284	40 ton, 90KW-108KW
			2313-1285	50 ton, 54KW-72KW
			2313-1286	50 ton, 90KW-108KW

Table 79. Wiring diagrams - TC/TE units - standard efficiency (excluding 40–50T CV units) (continued)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Variable Air Volume	Control Modules	208-575	2313-1268	All Units without Statitrac
			2313-1270	All Units with Statitrac
	Control Box Connection Print	208-230	2313-0788	27.5-35 ton, 36KW-54KW Electric Heat
			2313-0790	40 ton, 54KW Electric Heat
			2313-0792	50 ton, 54KW Electric Heat
			2313-1203	27.5-35 ton, Cooling Only
			2313-1204	40 ton, Cooling Only
			2313-1205	50 ton, Cooling Only
		380-575	2313-0789	27.5-35 ton, 36KW-54KW Electric Heat
			2313-0791	40 ton, 54KW Electric Heat
			2313-0793	50 ton, 54KW Electric Heat
			2313-0794	27.5-35 ton, 72KW-90KW Electric Heat
			2313-0795	40 ton, 72KW-108KW Electric Heat
			2313-0796	50 ton, 72KW-108KW Electric Heat
			2313-1206	27.5-35 ton, Cooling Only
			2313-1207	40 ton, Cooling Only
			2313-1208	50 ton, Cooling Only
	Raceway Devices Connection Print	208-575	2313-1287	27.5-35 ton, 36KW-54KW
			2313-1288	27.5-35 ton, 72KW-90KW
			2313-1289	40 ton, 54KW-72KW
			2313-1290	40 ton, 90KW-108KW
			2313-1291	50 ton, 54KW-72KW
			2313-1292	50 ton, 90KW-108KW

Table 79. Wiring diagrams - TC/TE units - standard efficiency (excluding 40–50T CV units) (continued)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Single Zone Variable Air Volume	Control Modules	208-575	2313-1268	All Units without Statitrac
			2313-1270	All Units with Statitrac
	Control Box Connection Print	208-230	2313-1233	27.5-35 ton, 36KW/54KW Electric Heat
			2313-1235	40 ton, 54KW Electric Heat
			2313-1237	50 ton, 54KW Electric Heat
			2313-1242	27.5-35 ton, Cooling Only
			2313-1243	40 ton, Cooling Only
			2313-1244	50 ton, Cooling Only
		380-575	2313-1234	27.5-35 ton, 36KW/54KW Electric Heat
			2313-1236	40 ton, 54KW Electric Heat
			2313-1238	50 ton, 54KW Electric Heat
			2313-1239	27.5-35 ton, 72KW/90KW Electric Heat
			2313-1240	40 ton, 72KW-108KW Electric Heat
			2313-1241	50 ton, 72KW-108KW Electric Heat
			2313-1245	27.5-35 ton, Cooling Only
			2313-1246	40 ton, Cooling Only
			2313-1247	50 ton, Cooling Only
	Raceway Devices Connection Print	208-575	2313-1305	27.5-35 ton, 36KW/54KW Electric Heat
			2313-1306	27.5-35 ton, 72KW/90KW Electric Heat/ Cooling Only
			2313-1307	40 ton, 54KW/72KW Electric Heat
			2313-1308	40 ton, 90KW/108KW Electric Heat/Cooling Only
			2313-1309	50 ton, 54KW/72KW Electric Heat
			2313-1310	50 ton, 90KW/108KW Electric Heat/Cooling Only

Table 80. Wiring diagrams - YC units - standard efficiency (excluding 40–50T CV units)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Constant Volume, Variable Air Volume, Single Zone Variable Air Volume	Power	208-575	2313-1261	All Units - Standard Efficiency
	Heat Power and Controls	208-575	2313-1272	Low Heat Gas Units
			2313-1273	High Heat Gas Units
			2313-1274	Low Heat Modulating Gas Units
			2313-1275	High Heat Modulating Gas Units
	Refrigeration Controls (RTRM, Sensors)	208-575	2313-1263	27.5-35 ton Units
			2313-1264	40 ton Units
			2313-1265	50 ton Units
Constant Volume	Control Modules	208-575	2313-1267	All Units without Statitrac
			2313-1269	All Units with Statitrac
	Control Box Connection Print	208-230	2313-1209	27.5-35 ton, 2 Stage Gas Heat
			2313-1210	40 ton, 2 Stage Gas Heat
			2313-1211	50 ton, 2 Stage Gas Heat
			2313-1215	27.5-35 ton, Modulating Gas Heat
			2313-1216	40 ton, Modulating Gas Heat
			2313-1217	50 ton, Modulating Gas Heat
		380-575	2313-1212	27.5-35 ton, 2 Stage Gas Heat
			2313-1213	40 ton, 2 Stage Gas Heat
			2313-1214	50 ton, 2 Stage Gas Heat
			2313-1218	27.5-35 ton, Modulating Gas Heat
			2313-1219	40 ton, Modulating Gas Heat
			2313-1220	50 ton, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	2313-1293	27.5-35 ton, 2 Stage Gas Heat
			2313-1294	40 ton, 2 Stage Gas Heat
			2313-1295	50 ton, 2 Stage Gas Heat
			2313-1299	27.5-35 ton, Modulating Gas Heat
			2313-1300	40 ton, Modulating Gas Heat
			2313-1301	50 ton, Modulating Gas Heat

Table 80. Wiring diagrams - YC units - standard efficiency (excluding 40–50T CV units) (continued)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Variable Air Volume	Control Modules	208-575	2313-1268	All Units without Statitrac
			2313-1270	All Units with Statitrac
	Control Box Connection Print	208-230	2313-1221	27.5-35 ton, 2 Stage Gas Heat
			2313-1222	40 ton, 2 Stage Gas Heat
			2313-1223	50 ton, 2 Stage Gas Heat
			2313-1227	27.5-35 ton, Modulating Gas Heat
			2313-1228	40 ton, Modulating Gas Heat
			2313-1229	50 ton, Modulating Gas Heat
		380-575	2313-1224	27.5-35 ton, 2 Stage Gas Heat
			2313-1225	40 ton, 2 Stage Gas Heat
			2313-1226	50 ton, 2 Stage Gas Heat
			2313-1230	27.5-35 ton, Modulating Gas Heat
			2313-1231	40 ton, Modulating Gas Heat
			2313-1232	50 ton, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	2313-1296	27.5-35 ton, 2 Stage Gas Heat
			2313-1297	40 ton, 2 Stage Gas Heat
			2313-1298	50 ton, 2 Stage Gas Heat
			2313-1302	27.5-35 ton, Modulating Gas Heat
			2313-1303	40 ton, Modulating Gas Heat
			2313-1304	50 ton, Modulating Gas Heat
Single Zone Variable Air Volume	Control Modules	208-575	2313-1268	All Units without Statitrac
			2313-1270	All Units with Statitrac
	Control Box Connection Print	208-230	2313-1248	27.5-35 ton, 2 Stage Gas Heat
			2313-1249	40 ton, 2 Stage Gas Heat
			2313-1250	50 ton, 2 Stage Gas Heat
			2313-1254	27.5-35 ton, Modulating Gas Heat
			2313-1255	40 ton, Modulating Gas Heat
			2313-1256	50 ton, Modulating Gas Heat
		380-575	2313-1251	27.5-35 ton, 2 Stage Gas Heat
			2313-1252	40 ton, 2 Stage Gas Heat
			2313-1253	50 ton, 2 Stage Gas Heat
			2313-1257	27.5-35 ton, Modulating Gas Heat
			2313-1258	40 ton, Modulating Gas Heat
			2313-1259	50 ton, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	2313-1311	27.5-35 ton, 2 Stage Gas Heat
			2313-1312	40 ton, 2 Stage Gas Heat
			2313-1313	50 ton, 2 Stage Gas Heat
			2313-1314	27.5-35 ton, Modulating Gas Heat
			2313-1315	40 ton, Modulating Gas Heat
			2313-1316	50 ton, Modulating Gas Heat

Table 81. Wiring diagrams - TC/TE units - high efficiency & 40-50T standard efficiency CV

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Constant Volume, Variable Air Volume, Single Zone Variable Air Volume	Power	208-575	1213-0200	All Units - High Efficiency
	Heat Power and Controls	208-575	1213-0336	All Units - Cooling Only
		208-230	1213-0333	36kw and 54kw Electric Heat
		380-575	1213-0334	36kw and 54kw Electric Heat
			1213-0335	72kw/90kw/108kw Electric Heat
	Refrigeration Controls	208-575	1213-0201	27.5-50 Ton Units
Constant Volume	Control Modules	208-575	1213-0203	All Units without Statitrac
			1213-0205	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0208	27.5-35T, 40T and 50T - Cooling Only
			1213-0227	27.5-35T, 36KW-54KW Electric Heat
			1213-0236	40T and 50T, 54KW Electric Heat
		380-575	1213-0209	27.5-35T, 40T and 50T - Cooling Only
			1213-0228	27.5-35T, 36KW-54KW Electric Heat
			1213-0229	27.5-35T, 72KW-90KW Electric Heat
			1213-0237	40T and 50T, 54KW Electric Heat
			1213-0238	40T and 50T, 72KW-108KW Electric Heat
	Raceway Devices Connection Print	208-575	1213-0292	27.5-35T, 36KW/54KW Electric Heat/Cooling Only
			1213-0293	27.5-35T, 72KW/90KW Electric Heat
			1213-0296	40T and 50T, 54KW/72KW Electric Heat/ Cooling Only
			1213-0297	40T and 50T, 90KW-108KW Electric Heat
Variable Air Volume	Control Modules	208-575	1213-0204	All Units without Statitrac
			1213-0206	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0212	27.5-35T, 40T and 50T - Cooling Only
			1213-0233	27.5-35T, 36KW-54KW Electric Heat
			1213-0242	40T and 50T, 54KW Electric Heat
		380-575	1213-0213	27.5-35T, 40T and 50T - Cooling Only
			1213-0234	27.5-35T, 36KW-54KW Electric Heat
			1213-0235	27.5-35T, 72KW-90KW Electric Heat
			1213-0243	40T and 50T, 54KW Electric Heat
			1213-0244	40T and 50T, 72KW-108KW Electric Heat
	Raceway Devices Connection Print	208-575	1213-0298	27.5-35T, 36KW/54KW Electric Heat/Cooling Only
			1213-0299	72KW/90KW Electric Heat
			1213-0302	40T and 50T, 54KW/72KW Electric Heat/ Cooling Only
			1213-0303	40T and 50T, 90KW-108KW Electric Heat

Table 81. Wiring diagrams - TC/TE units - high efficiency & 40-50T standard efficiency CV (continued)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Single Zone Variable Air Volume	Control Modules	208-575	1213-0204	All Units without Statitrac
			1213-0206	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0210	27.5-35T, 40T and 50T - Cooling Only
			1213-0230	27.5-35T, 36KW-54KW Electric Heat
			1213-0239	40T and 50T, 54KW Electric Heat
		380-575	1213-0211	27.5-35T, 40T and 50T - Cooling Only
			1213-0231	27.5-35T, 36KW-54KW Electric Heat
			1213-0232	27.5-35T, 72KW-90KW Electric Heat
			1213-0240	40T and 50T, 54KW Electric Heat
			1213-0241	40T and 50T, 72KW-108KW Electric Heat
	Raceway Devices Connection Print	208-575	1213-0316	27.5-35T, 36KW/54KW Electric Heat/Cooling Only
			1213-0317	72KW/90KW Electric Heat
			1213-0320	40T and 50T, 54KW/72KW Electric Heat/ Cooling Only
			1213-0321	40T and 50T, 90KW-108KW Electric Heat

Table 82. Wiring diagrams - YC units - high efficiency & 40-50T standard efficiency CV

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Constant Volume, Variable Air Volume, Single Zone Variable Air Volume	Power	208-575	1213-0200	All Units - High Efficiency
	Heat Power and Controls	208-575	1213-0329	Low Heat Gas Units
			1213-0330	High Heat Gas Units
			1213-0331	Low Heat Modulating Gas Units
			1213-0332	High Heat Modulating Gas Units
	Refrigeration Controls	208-575	1213-0201	27.5-50 Ton Units
Constant Volume	Control Modules	208-575	1213-0203	All Units without Statitrac
			1213-0205	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0255	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0257	27.5-35T, 40T and 50T, Modulating Gas Heat
		380-575	1213-0256	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0258	27.5-35T, 40T and 50T, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	1213-0306	27.5-35 TON, 40T and 50T, 2 Stage Gas Heat
			1213-0312	27.5-35T, 40T and 50T, Modulating Gas Heat
Variable Air Volume	Control Modules	208-575	1213-0204	All Units without Statitrac
			1213-0206	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0263	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0265	27.5-35T, 40T and 50T, Modulating Gas Heat
		380-575	1213-0264	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0266	27.5-35T, 40T and 50T, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	1213-0309	27.5-35 TON, 40T and 50T, 2 Stage Gas Heat
			1213-0313	27.5-35T, 40T and 50T, Modulating Gas Heat

Table 82. Wiring diagrams - YC units - high efficiency & 40-50T standard efficiency CV (continued)

Type of Airflow	Schematic Type	Voltage	Diagram Number	Description
Single Zone Variable Air Volume	Control Modules	208-575	1213-0204	All Units without Statitrac
			1213-0206	All Units with Statitrac
	Control Box Connection Print	208-230	1213-0259	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0261	27.5-35T, 40T and 50T, Modulating Gas Heat
		380-575	1213-0260	27.5-35T, 40T and 50T, 2 Stage Gas Heat
			1213-0262	27.5-35T, 40T and 50T, Modulating Gas Heat
	Raceway Devices Connection Print	208-575	1213-0322	27.5-35 TON, 40T and 50T, 2 Stage Gas Heat
			1213-0325	27.5-35T, 40T and 50T, Modulating Gas Heat

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 startup or 18 months from date of shipment, whichever is less, that the Company products covered by this order (1) are free from defects in material and workmanship and (2) have the capacities and ratings set forth in the Company's catalogs and bulletins, provided that no warranty is made against corrosion, erosion or deterioration. The Company's obligations and liabilities under this warranty are limited to furnishing f.o.b. factory or warehouse at Company designated shipping point, freight allowed to Buyer's city (or port of export for shipment outside the conterminous United States) replacement equipment (or at the option of the Company parts therefore) for all Company products not conforming to this warranty and which have been returned to the manufacturer. The Company shall not be obligated to pay for the cost of lost refrigerant. No liability whatever shall attach to the Company until said products have been paid for and then said liability shall be limited to the purchase price of the equipment shown to be defective.

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Manager - Product Service

Trane

Clarksville, Tn 37040-1008

PW-215-2688

*A 10 year limited warranty is provided on optional Full Modulation Gas Heat Exchanger.

*Optional Extended Warranties are available for compressors and heat exchangers of Combination Gas-Electric Air Conditioning Units.

*A 5 year limited warranty is provided for optional “AMCA 1A Ultra Low Leak” airfoil blade economizer assemblies and the “AMCA 1A Ultra Low Leak” economizer actuator.

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