Installation, Operation, and Maintenance

IntelliPak™ II

Commercial Rooftop Air Handlers with CV, VAV, or SZVAV Controls

'F0' and later design sequence

WEHC
WFHC
WLHC
WSHC
WXHC

⚠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.

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Warnings, Cautions and Notices

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

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

Read this manual thoroughly before operating or servicing this unit.

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

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

Responsible Refrigerant Practices!

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

⚠WARNING

Proper Field Wiring and Grounding Required!

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

⚠WARNING

Personal Protective Equipment (PPE) Required!

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

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

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

Overview of Manual

Notes:

- *This document is the customer property and must be retained by the unit owner for use by maintenance personnel.*
- *The procedures discussed in this manual should only be performed by qualified, experienced HVAC technicians.*

This booklet describes proper installation, start-up, operation, and maintenance procedures for Casings A-C rooftop air handlers designed for Constant Volume (CV), Single Zone Variable Air Volume (SZVAV) and Variable Air Volume (VAV) applications. By carefully reviewing the information within this manual and following the instructions, the risk of improper operation and/or component damage will be minimized.

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

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

Table of Contents

Model Number Descriptions

W	E	H	C	A00	4	0	A	0	4	1	1	F	7	0	0	0	1	A	0	0	0	0	A	0	D	0	A	0	0	0	0	0	0	0	0
1	2	3	4	567	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38

DIGIT 1 — UNIT TYPE

W Self-Contained (Packaged Air Handler)

DIGIT 2 — UNIT FUNCTION

E Electric Heat
F Natural Gas Heat
L Hot Water Heat
S Steam Heat
X No Heat

DIGIT 3 — SYSTEM TYPE

H Single Zone

DIGIT 4 — DEVELOPMENT SEQUENCE

C Third

DIGIT 5 — UNIT SIZE

A 16,000 - 31,000 CFM
B 20,000 - 38,000 CFM
C 20,000 - 45,000 CFM

DIGIT 6 — COOLING COIL

0 No Cooling Coil
2 2 Row Chilled Water
4 4 Row Chilled Water
6 6 Row Chilled Water
8 8 Row Chilled Water

DIGIT 7 — CHILLED WATER COIL FIN SERIES

0 No Chilled Water Coil
A Series 80 without Turbulators
B Series 80 with Turbulators
C Series 108 without Turbulators
D Series 108 with Turbulators
E Series 144 without Turbulators
F Series 144 with Turbulators
G Series 168 without Turbulators
H Series 168 with Turbulators

DIGIT 8 — VOLTAGE SELECTION

4 460/60/3 XL
5 575/60/3 XL

DIGIT 9 — HEAT CAPACITY SELECTION

0 No Heat
1 Electric Heat 90 kW
2 Electric Heat 140 kW
3 Electric Heat 265 kW
4 Electric Heat 300 kW
A Low Gas Heat - 2 stage
B Medium Gas Heat - 2 stage
C High Gas Heat - 2 stage
D Low Gas Heat - Modulating
E Medium Gas Heat - Modulating
F High Gas Heat - Modulating

Low Heat Options

H Low Heat - 1.25 in. (32mm) Valve
J Low Heat - 1.5 in. (38mm) Valve
K Low Heat - 2.0 in. (50mm) Valve
L Low Heat - 2.50 in. (64mm) Valve
M Low Heat - 3.0 in. (76mm) Valve

High Heat Options

P High Heat - 1.25 in.(32mm) Valve
Q High Heat - 1.5 in. (38mm) Valve
R High Heat - 2.0 in. (50mm) Valve
T High Heat - 2.50 in. (64mm) Valve
U High Heat - 3.0 in. (76mm) Valve

DIGIT 10 & 11— DESIGN SEQUENCE

AO

DIGIT 12 — UNIT CONFIGURATION SELECTION

4 1 Piece Unit - without Blank Section
5 1 Piece Unit with 4 ft. Blank Section
6 1 Piece Unit with 8 ft. Blank Section

DIGIT 13 — AIRFLOW DIRECTION

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

DIGIT 14 — FAN MOTOR SELECTION

1 Standard Fan
3 Standard Fan w/ TEFC Motor

DIGIT 15 — SUPPLY FAN MOTOR SELECTION

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

DIGIT 16 — SUPPLY FAN RPM SELECTION

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

DIGIT 17 — EXHAUST/RETURN FAN OPTIONS

0 None
1 High CFM Exhaust w/o Statitrac CV Only
2 Low CFM Exhaust w/o Statitrac CV Only
3 High CFM Exhaust w/o VFD w/ Statitrac
4 Low CFM Exhaust w/o VFD w/ Statitrac
5 High CFM Exhaust w/ VFD w/ Bypass w/ Statitrac
6 Low CFM Exhaust w/ VFD w/ Bypass w/ Statitrac
7 High CFM Exhaust w/ VFD w/o Bypass w/ Statitrac
8 Low CFM Exhaust w/ VFD w/o Bypass w/ Statitrac
A Return w/o Statitrac CV Only
C Return w/ VFD w/ Bypass w/ Statitrac
E Return w/ VFD w/o Bypass w/ Statitrac

DIGIT 18 — EXHAUST/RETURN FAN MOTOR SELECTION

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

DIGIT 19 — EXHAUST/RETURN RPM SELECTION

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

DIGIT 20 — SYSTEM CONTROL SELECTION

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

DIGIT 21 — FRESH AIR AND ECONOMIZER OPTIONS/ CONTROLS

A 0 - 25% Motorized Damper
B Econ w/Dry Bulb
C Econ w/Reference Enthalpy
D Econ w/Comparative Enthalpy
E Econ w/Fresh Air Measure /Dry Bulb
F Econ w/ Fresh Air Measure /Ref Enth
G Econ w/Fresh Air Measure /Comp Enth
H Econ w/DCV /Dry Bulb
J Econ w/DCV /Ref Enth
K Econ w/DCV /Comp Enth

DIGIT 22 — DAMPER OPTION

0 Standard
1 Low Leak
2 Ultra Low Leak

DIGIT 23 — PRE COOLING COIL FILTER SELECTION

0 2" High Efficiency Throw Away
1 2" Throw Away Rack / Less Filters
2 90 - 95%, Bag Filters w/ Pre Filters
3 Bag Filter Rack / Less Filters
4 90 - 95%, Cartridge Filters w/ Pre Filters
5 Cartridge Rack / Less Filters
6 90 - 95% Low PD Cartridge w/ Pre Filters
7 Low PD Cartridge Rack / Less Filters

DIGIT 24 — BLANK SECTION APPLICATION OPTIONS

0 None
A 90 - 95% Bag w/Pre Filters
B 90 - 95% Low PD Cartridge w/ Pre Filters
C 90 - 95%, Cartridge Filters w/ Pre Filters
D 90 - 95% Hi Temp Cartridge w/ Pre Filters
E HEPA w/Pre Filters
F Hi Temp HEPA w/Pre Filters

DIGIT 25 — FUTURE DEVELOPMENT

0

DIGIT 26 — UNIT MOUNTED POWER CONNECTION SELECTION

A Terminal Block
B Non Fused Disconnect
C Non Fused Disconnect w/ Pwrd conv outlet
D Circuit Breaker w/ SCWR
E Ckt Brkr w/ SCWR/ Pwrd conv outlet

DIGIT 27 — (FUTURE DEVELOPMENT)

0 None

DIGIT 28 — COIL/DRAIN PAN

D No Drain Pan
E Galvanized Drain Pan

DIGIT 29 — CHILLED WATER COIL VALVE

0 None
A 1.5" Cooling Valve
B 2" Cooling Valve
C 2.5" Cooling Valve
D 3" Cooling Valve

DIGIT 30 — (FUTURE DEVELOPMENT)

0 None

DIGIT 31 — (FUTURE DEVELOPMENT)

0 None

DIGIT 32 — HIGH DUCT TEMPERATURE THERMOSTAT

0 None
1 High Duct Temp Thermostat

DIGIT 33 — REMOTE HUMAN INTERFACE

0 None
1 RHI & IPCB
2 IPCB

DIGIT 34 — MODULE OPTIONS

0 None
A 0-5 Volt GBAS
B 0-10 Volt GBAS
C 0-5 / 0-10 Volt GBAS
F LonTalk Communication Interface (LCI)
D Ventilation Override
G 0-5 Volt GBAS / Ventilation Override
H 0-10 Volt GBAS / Ventilation Override
J 0-5 / 0-10 V GBAS / Ventilation Override
L LCI & Ventilation Override
M BACnet Communication Interface (BCI)
N BCI & Ventilation Override

DIGIT 35 — ZONE SENSOR OPTION

0 None
A Dual Setpoint w/Man/Auto Changeover
B Dual Stpt w/Man/Auto Chgovr & Sys Lights
C Room Sensor w/Timed Override & Cancel
D Room Snsr w/TO & Cancel & Local Stpt Adj
G VAV w/System Lights
L Programmable Night Setback

DIGIT 36 — AGENCY APPROVAL OPTION

0 None
1 cULus

DIGIT 37 — SERVICE ENHANCEMENTS

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

DIGIT 38 — BELT GUARDS/ BURGLAR BARS/MARINE LIGHTS

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

General Information

Unit Nameplate

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

Precautionary Measures

- Avoid breathing fiberglass dust
- Use a NIOSH approved dust/mist respirator
- Avoid contact with the skin or eyes. Wear long-sleeved, loose-fitting clothing, gloves, and eye protection
- Wash clothes separately from other clothing: rinse washer thoroughly
- Operations such as sawing, blowing, tear-out, and spraying may generate fiber concentrations requiring additional respiratory protection. Use the appropriate NIOSH approved respiration in these situations.

First Aid Measures

Eye Contact

– Flush eyes with water to remove dust. If symptoms persist, seek medical attention.

Skin Contact

– Wash affected areas gently with soap and warm water after handling.

Commonly used Acronyms

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

- AHU = Air Handler Unit
- BAS = Building automation systems
- BCI = BACnet Communication Interface module
- CFM = Cubic-feet-per-minute
- CV = Constant volume
- CW = Clockwise
- CCW = Counterclockwise
- E/A = Exhaust air
- ECEM = Exhaust/comparative enthalpy module
- F/A = Fresh air
- GBAS = Generic building automation system
- HGBP = Hot gas bypass
- HI = Human Interface
- HVAC = Heating, ventilation and air conditioning
- I/O = Inputs/outputs
- IOM = Installation/operation/ maintenance manual
- IPC = Interprocessor communications
- IPCB = Interprocessor communications bridge
- LCI-I = LonTalk Communication Interface for IntelliPak
- LH = Left-hand
- MWU = Morning warm-up
- NSB = Night setback
- O/A = Outside air
- psig = Pounds-per-square-inch, gauge pressure
- R/A = Return air
- RH = Right-hand
- RPM = Revolutions-per-minute
- RTM = Rooftop module
- S/A = Supply air
- SZ = Single-zone (unit airflow)
- SZVAV = Single zone variable air volume
- UCM = Unit control modules
- VAV = Variable air volume
- VCM = Ventilation control module
- VOM = Ventilation override module
- w.c. = Water column

Unit Description

Each Trane commercial, single-zone rooftop air handler ships fully assembled from the factory.

An optional roof curb, specifically designed for the W_HC units is available from Trane. The roof curb kit must be field assembled and installed according to the latest edition of the roof curb installation manual.

Trane Commercial Rooftop Air Handlers are controlled by a microelectronic control system that consists of a network of modules and are referred to as Unit Control Modules (UCM). The acronym UCM is used extensively throughout this document when referring to the control system network.

These modules through Proportional/Integral control algorithms perform specific unit functions which provide the best possible comfort level for the customer.

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

Rooftop Module (RTM - Standard on all units)

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

Human Interface Module (HI - standard on all units)

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

Heat Module (used on heating units)

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

Table 1. Resistance input vs. setpoint temperature

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

Table 2. Resistance value vs. system operating mode

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

Ventilation Override Module (VOM - Optional)

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

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

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

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

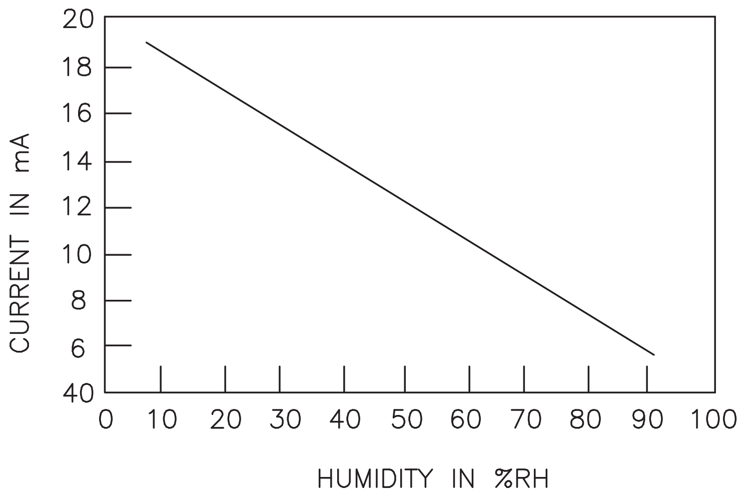
Lontalk/BACnet Communication Interface Module (LCI/BCI - Optional - used on units with Trane ICS™ or 3rd party Building Automation Systems)

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

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

The Exhaust/Comparative Enthalpy module receives information from the return air humidity sensor, the outside air humidity sensor, and the return air temperature sensor to utilize the lowest possible humidity level when considering economizer operation. In addition, it receives space pressure information which is used to maintain the space pressure to within the setpoint controlband. Refer to Figure 1, p. 12 for the Humidity vs. Voltage input values.

Figure 1. Humidity vs. current



Ventilation Control Module (VCM)

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

An optional temperature sensor can be connected to the VCM which enables it to control a field installed fresh air preheater.

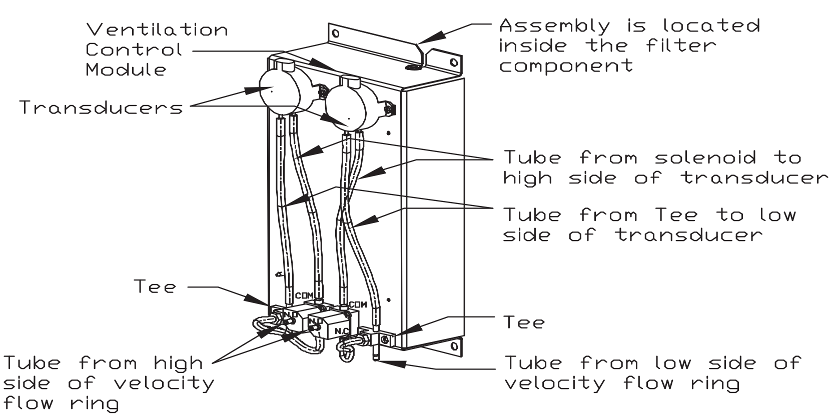
An optional CO_2 sensor can be connected to the VCM to control CO_2 reset. The reset function adjusts the minimum CFM upward as the CO_2 concentrations increase. The maximum effective (reset) setpoint value for fresh air entering the unit is limited to the systems operating CFM. The following table lists the Minimum Outside Air CFM vs. Input Voltage.

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

Unit	Input Volts	CFM
Casings A-Cs	0.5 - 4.5 VDC	0 - 45000

The velocity pressure transducer/solenoid assembly is illustrated below. Refer to the “Units with Traq™ Sensor,” p. 81 section for VCM operation.

Table 4. Velocity pressure transducer/solenoid assembly



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

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

Input Devices and System Functions

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

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

Chilled Water Valve Control

The 0 to 10 VDC output from the heat module doubles as the chilled water controller. The unit has isolating relays to switch between heat and cool.

Supply Air Temperature Sensor

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

Return Air Temperature Sensor

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

Filter Switch

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

Supply and Exhaust Airflow Proving Switches

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

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

Supply and Exhaust Fan Circuit Breakers

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

Outdoor Air Humidity Sensor

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

Return Air Humidity Sensor

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

Space Humidity Sensor

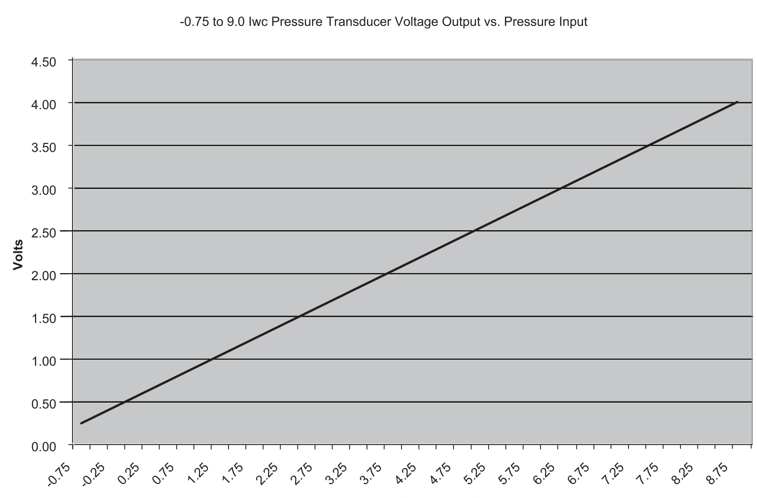
Analog input device used on CV and VAV applications with modulating dehumidification option and/or humidification field installed option. It is used to monitor the humidity level in the space and compared to dehumidification and humidification setpoints to maintain space humidity requirements. It is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

Status/Annunciator Output

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

1. diagnostic and mode status signals to the remote panel (LEDs) and to the Human Interface
2. control of the binary Alarm output on the RTM
3. control of the binary outputs on the GBAS module to inform the customer of the operational status and/or diagnostic conditions

Table 5. Transducer voltage output vs. pressure input w/ multiple sensors



Space Pressure Transducer

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

Morning Warm-Up—Zone Heat

When a system changes from an unoccupied to an occupied mode, or switches from STOPPED to AUTO, or power is applied to a unit with the MWU option, the heater in the unit or external heat will be brought on if the space temperature is below the MWU setpoint. The heat will remain on until the temperature reaches the MWU setpoint. If the unit is VAV, then the VAV box/unocc relay will continue to stay in the unoccupied position and the VFD output will stay at 100% during the MWU mode. When the MWU setpoint is reached and the heat mode is terminated, then the VAV box/unocc relay will switch to the occupied mode and the VFD output will be controlled by the duct static pressure. During Full Capacity MWU the economizer damper is held closed for as long as it takes to reach setpoint. During Cycling Capacity MWU the economizer damper is allowed to go to minimum position after one hour of operation if setpoint has not been reached.

Supply Air Temperature Low Limit

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

Freezestat - Heating

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

1. drive the Hydronic Heat Actuator to the full open position
2. turn the supply fan "Off"
3. closes the outside air damper
4. turns "On" the SERVICE light at the Remote Panel
5. initiates a "Freezestat" diagnostic to the Human Interface

Freezestat - Cooling

A binary input device used on CV and VAV units with Chilled Water. The freezestat is mounted on the upstream side of the cooling coil. If the temperature of the air entering the cooling coil falls to 40 F, the normally closed contacts on the freezestat open signalling the Rooftop Module (RTM) to:

1. drive the Chilled Water Actuator to the full open position
2. turn the supply fan "Off"
3. closes the outside air damper
4. turns "On" the SERVICE light at the Remote Panel
5. initiates a "Freezestat" diagnostic to the Human Interface

Chilled Water Valve Control

The 0 to 10 VDC output from the heat module doubles as the chilled water controller. The unit has isolating relays to switch between heat and cool.

Constant Volume (CV) Units

Zone Temperature—Cooling

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

Zone Temperature—Heating

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

Supply Air Tempering

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

Variable Air Volume (VAV) Units

Occupied Heating—Supply Air Temperature

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

Occupied Cooling—Supply Air Temperature

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

Daytime Warm-up

On VAV units equipped with heat, if the zone temperature falls below the daytime warm-up initiate temperature during the occupied mode, the system will switch to full airflow. During this mode, the VAV box/unocc relay will be energized (this is to signal the VAV boxes to go to 100%). After the VAV box max stroke time has elapsed (factory set at 6 minutes), the VFD output will be set to 100%. The airflow will be at 100% and the heat will be turned on to control to the occupied heating setpoint. When the zone temperature reaches the daytime warm-up termination setpoint, the heat will be turned off, the relay will be de-energized, releasing the VAV boxes, the VFD output will go back to duct static pressure control and the unit will return to discharge air control. If the occ zone heating setpoint is less than the DWU terminate setpoint, the heat will turn off when the occ zone heat setpoint is reached, but it will stay in DWU mode and cycle the heat to maintain setpoint.

Unoccupied Heating—Zone Temperature

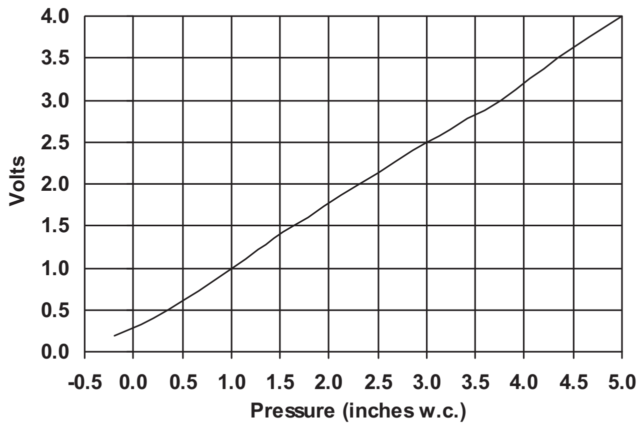
When a VAV unit is equipped with gas, electric, or hydronic heat and is in the unoccupied mode, the zone temperature will be controlled to within the customer specified setpoint deadband. During an unoccupied mode for a VAV unit, the VAV box/unocc relay will be in the unoccupied position and the VFD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

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

Supply Duct Static Pressure Control (Occupied)

The RTM relies on input from the duct pressure transducer when a unit is equipped with a Variable Frequency Drive to position the supply fan speed to maintain the supply duct static pressure to within the static pressure setpoint deadband. Refer to Figure 2, p. 17.

Figure 2. Transducer voltage output vs. pressure input with multiple sensors



Single Zone Variable Air Volume (SZVAV) Only

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

Supply Fan Output Control

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

VFD Control

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

Ventilation Control

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

Space Pressure Control

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

For SZVAV an Exhaust Enable Setpoint must be selected during the 100% Fan Speed Command. Once selected, the difference between the Exhaust Enable Setpoint and Design OA Damper

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

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

Occupied Cooling Operation

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

Default Economizer Operation

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

Unoccupied Mode

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

Occupied Heating Operation

Occupied heating operation has two separate control sequences; staged and modulated. All staged heating types will drive the supply fan to maximum flow and stage heating to control to the Zone Heating Setpoint. For units with Hydronic and Gas heat, modulated SZVAV Heating. On an initial call for heating, the supply fan will drive to the minimum heating airflow. On an additional call for heating, the heat will control in order to meet the calculated discharge air target setpoint. As the load in the zone continues to request heat operation, the supply fan will ramp-up while the control maintains the heating discharge air temperature. Heating can be configured for either the energy saving SZVAV Heating solution as described above, or the traditional, less efficient CV Heating solution.

Compressor (DX) Cooling

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

Cooling Sequence

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

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

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

Space Temperature Averaging

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

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

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

Table 6. Space temperature averaging with multiple sensors

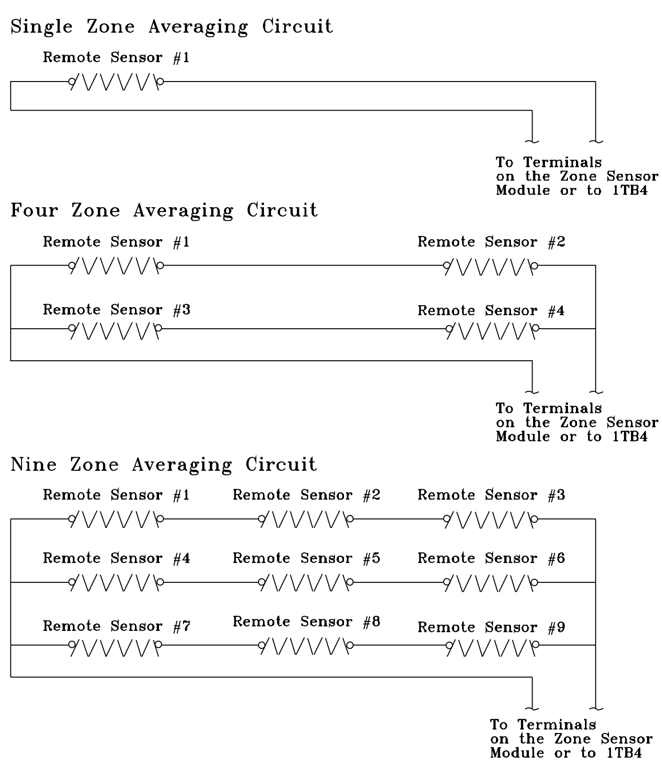
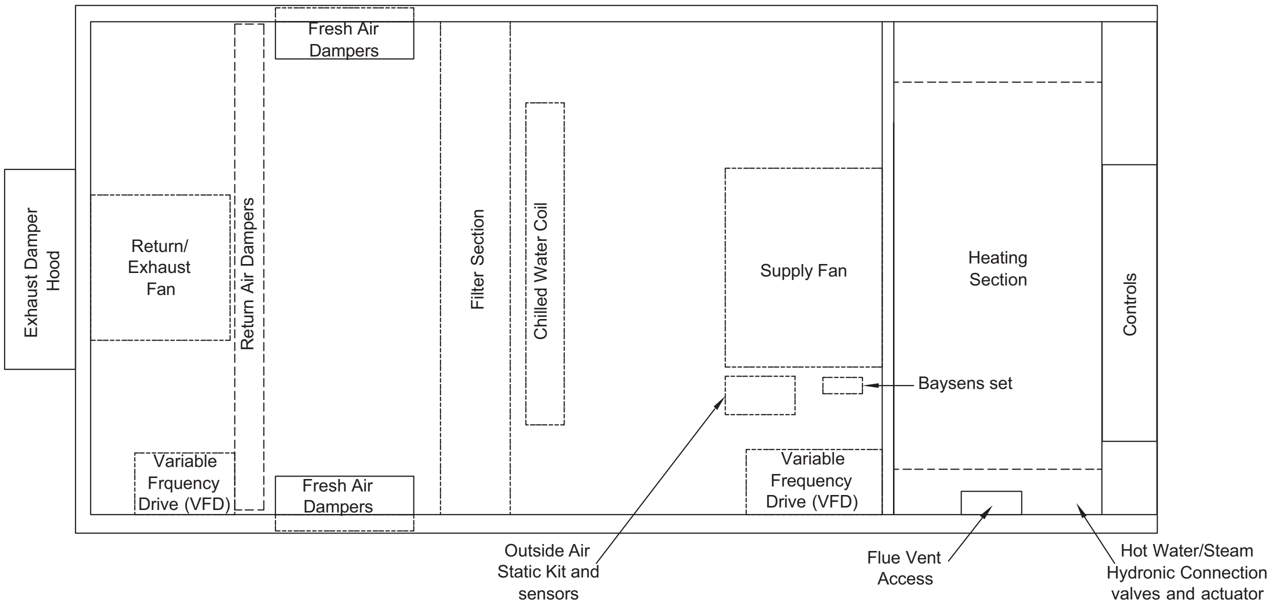


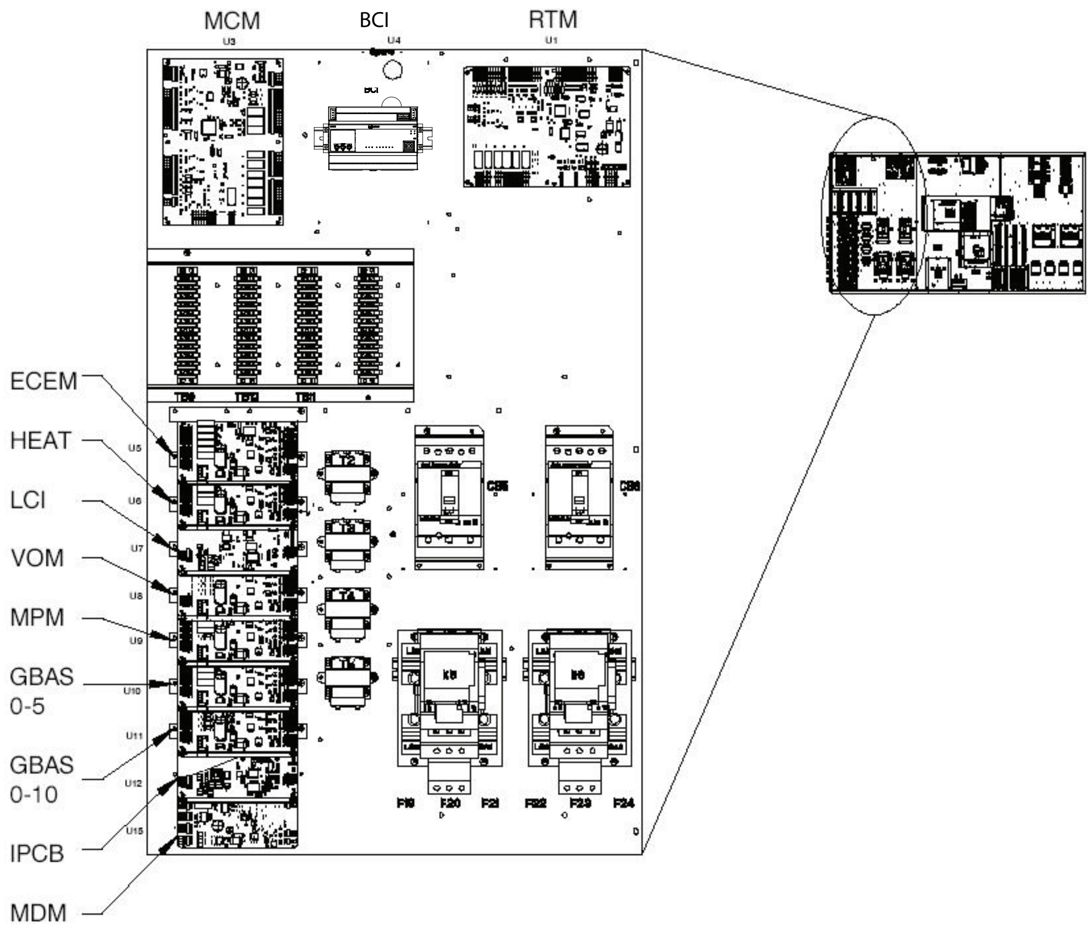
Table 7. Unit component layout and "ship with" locations



Unit Control Modules

Unit control modules are microelectronic circuit boards designed to perform specific unit functions. These modules, through proportional/integral control algorithms, provide the best possible comfort level for the customer. They are mounted in the control panel and are factory wired to their respective internal components. They receive and interpret information from other unit modules, sensors, remote panels, and customer binary contacts to satisfy the applicable request for economizing, mechanical cooling, heating, and ventilation. Figure 3, p. 21 illustrates the typical location of each designated module.

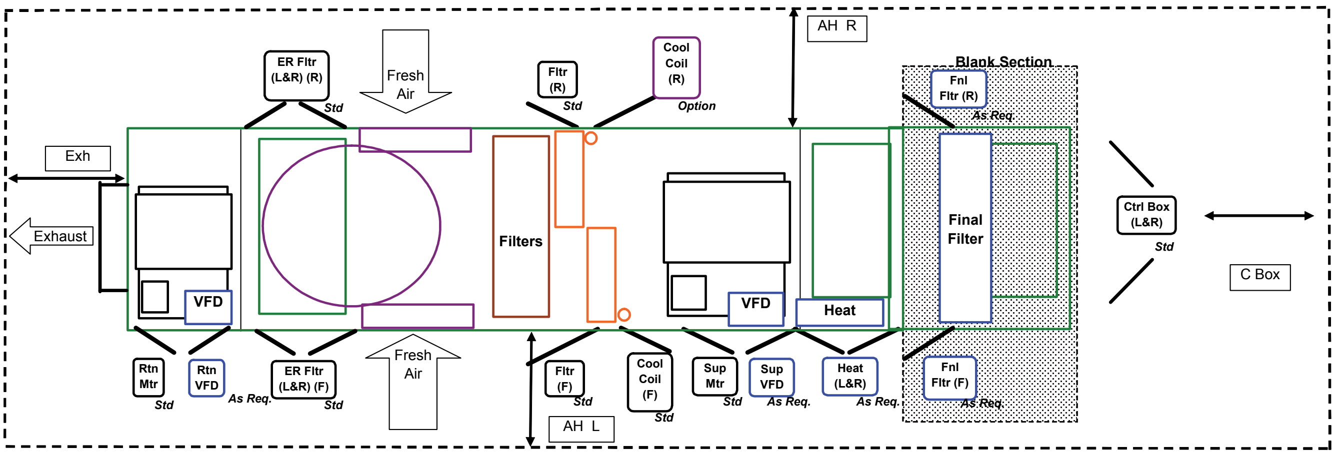
Figure 3. Control module locations



Dimensional Data

Unit Clearance

Figure 4. Minimum required clearance (i)



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

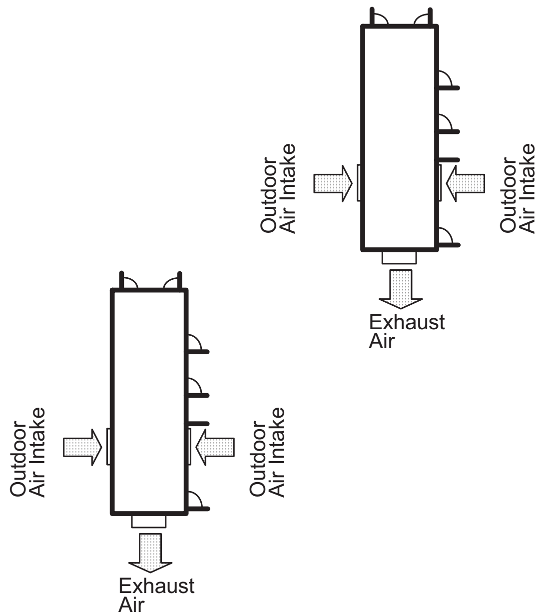
Table 8. Minimum required clearance

		Unit Option Selection (Door Swing Ft. and In.)					
		Standard	VFD		Heat		
Door Location	Availability	A,B,C	Return/ Exhaust	Supply	Electric/ Hot Water/ Steam	Two-side Access	Final Filter
Exhaust Motor	Std	2' 2"	*	*	*	*	*
Exhaust VFD	As Req.	*	2' 2"	*	*	*	*
Filter (Front)	Std	2' 8"	*	*	*	*	*
Filter (Rear)	Option	*	*	*	*	2′ 2"	*
Cooling Coil (Front)	Std	2' 2"	*	*	*	*	*
Cooling Coil (Rear)	Std	2' 8"	*	*	*	*	*
or Cooling Coil (Rear)	Option	*	*	*	*	*	*
Supply Motor	Std	2' 8"	*	*	*	*	*
Supply VFD	As Req.	*	*	2' 2"	*	*	*
Heat (Left & Right)	As Req.	*	*	*	2' 2"	*	*
Final Filter (Front)	As Req.	*	*	*	*	*	2' 2"
Final Filter (Rear)	As Req.	*	*	*	*	*	2' 2"
Control Box (L & R)	Std	3' 2"	*	*	*	*	*

Minimum Required Clearance (Ft.)

AH_L	AH_R	Exh	Control Box
8′	8′	8′	6′

Figure 5. Multiple units placement



Important: *Stagger units to minimize span deflection which deters sound transmission and to maximize proper diffusion of the exhaust air before it reaches the adjacent unit fresh air intake.*

Unit Dimensions

Figure 6. Unit top/front view

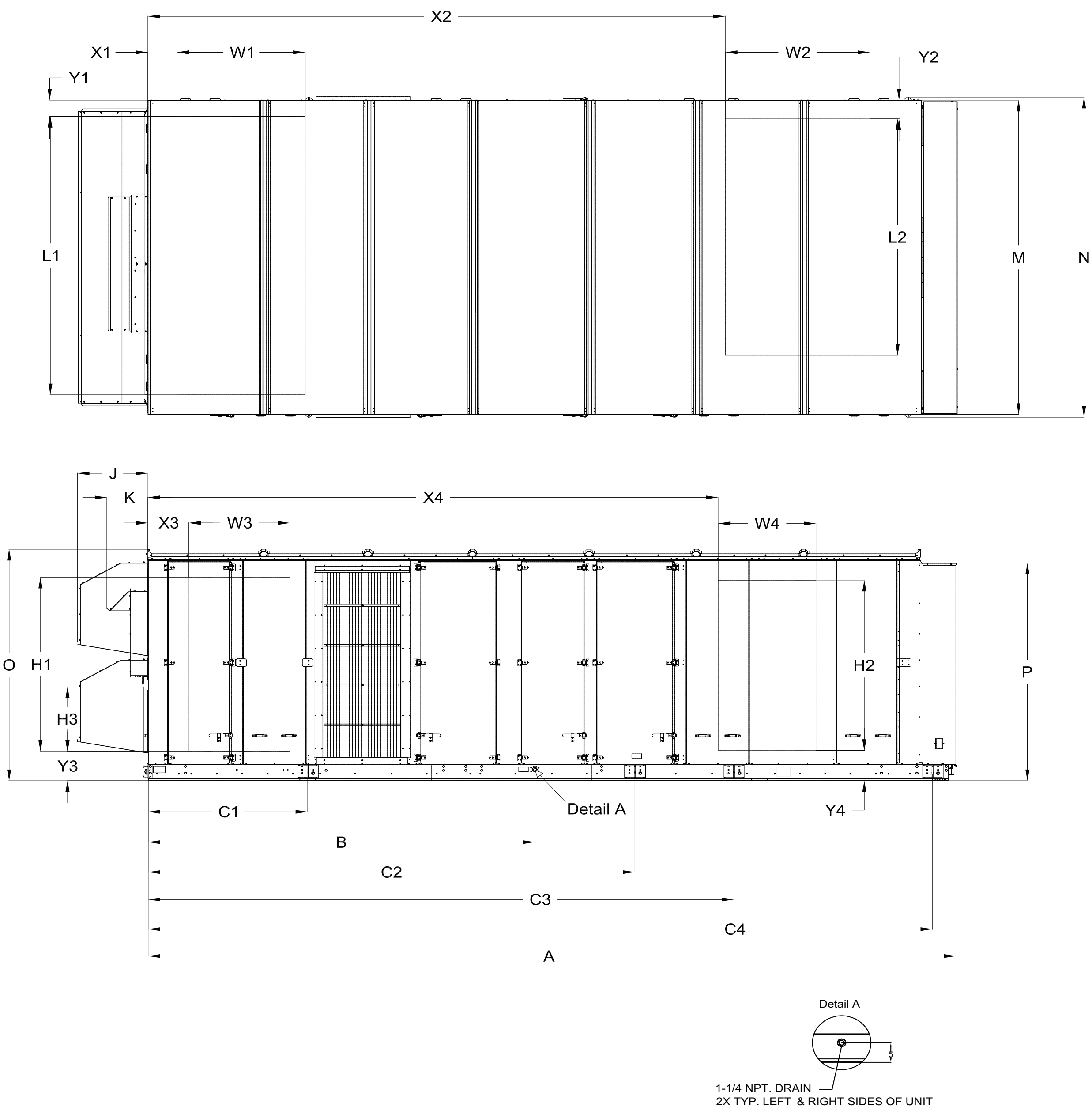


Table 9. Unit dimensions (In.)

ONE-PIECE Dimensions										
			Unit Dimensions		Lifting Lug Locations Air Handler Side				Unit Width	
Casing	Blank Section		A	B	C1	C2	C3	C4	M	N
A, B, C	None		334 2/16	159 15/16	66	252 14/16	n/a	n/a	139 13/16	143 8/16
	4Ft		382 5/16	159 15/16	66	252 14/16	368 6/16	n/a	139 13/16	143 8/16
	8Ft		430 9/16	159 15/16	66	252 14/16	416 10/16	n/a	139 13/16	143 8/16

	Unit Height		Return Fan	Exhaust Fan
Casing	O	P	J	K
A, B, C	103 12/16	97 9/16	29 3/16	17
	103 12/16	97 9/16	29 3/16	17
	103 12/16	97 9/16	29 3/16	17

Table 10. Downflow/horizontal airflow configuration dimensions (in.)

			DOWNFLOW Opening Dimensions							
			Return Opening—with or without Exhaust Fan				Return Opening—with Return Fan			
Casing	Gas Heat	Blank Section	X1	Y1	W1	L1	X1	Y1	W1	L1
A, B, C	No Gas	None	14 13/16	8 14/16	48 3/16	121 15/16	14 13/16	42 14/16	48 3/16	53 14/16
	No Gas	4Ft	14 13/16	8 14/16	48 3/16	121 15/16	14 13/16	42 14/16	48 3/16	53 14/16
	No Gas	8Ft	14 13/16	8 14/16	48 3/16	121 15/16	14 13/16	42 14/16	48 3/16	53 14/16
	Gas	None	14 13/16	8 14/16	48 3/16	121 15/16	14 13/16	42 14/16	48 3/16	53 14/16
	Gas	8Ft	14 13/16	8 14/16	48 3/16	121 15/16	14 13/16	42 14/16	48 3/16	53 14/16

			DOWNFLOW Opening Dimensions			
			Supply Opening			
Casing	Gas Heat	Blank Section	X2	Y2	W2	L2
A, B, C	No Gas	None	256 1/16	13	47 14/16	102 8/16
	No Gas	4Ft	304 4/16	13	47 14/16	102 8/16
	No Gas	8Ft	352 8/16	13	47 14/16	102 8/16
	Gas	None	256 1/16	13	47 14/16	102 8/16
	Gas	8Ft	352 8/16	13	47 14/16	102 8/16

			HORIZONTAL Opening Dimensions							
			Return Side Opening				Return End Opening			
Casing	Gas Heat	Blank Section	X3	Y3	W3	H1	X1	Y3	H3	H1
A, B, C	No Gas	None	9 5/16	10 10/16	54 12/16	84 15/16	6 5/16	8 3/16	35 3/16	127 2/16
	No Gas	4Ft	9 5/16	10 10/16	54 12/16	84 15/16	6 5/16	8 3/16	35 3/16	127 2/16
	No Gas	8Ft	9 5/16	10 10/16	54 12/16	84 15/16	6 5/16	8 3/16	35 3/16	127 2/16
	Gas	None	9 5/16	10 10/16	54 12/16	84 15/16	6 5/16	8 3/16	35 3/16	127 2/16
	Gas	8Ft	9 5/16	10 10/16	54 12/16	84 15/16	6 5/16	8 3/16	35 3/16	127 2/16

Table 10. Downflow/horizontal airflow configuration dimensions (in.)

			HORIZONTAL Opening Dimensions			
			Supply Opening			
Casing	Gas Heat	Blank Section	X4	Y4	W4	H2
A, B, C	No Gas	None	254 12/16	10 10/16	54 12/16	84 15/16
	No Gas	4Ft	302 15/16	10 10/16	54 12/16	84 15/16
	No Gas	8Ft	351 3/16	10 10/16	54 12/16	84 15/16
	Gas	None	254 12/16	10 10/16	54 12/16	66 11/16
	Gas	8Ft	351 3/16	10 10/16	54 12/16	84 15/16

Figure 7. Electrical entry details/bottom view

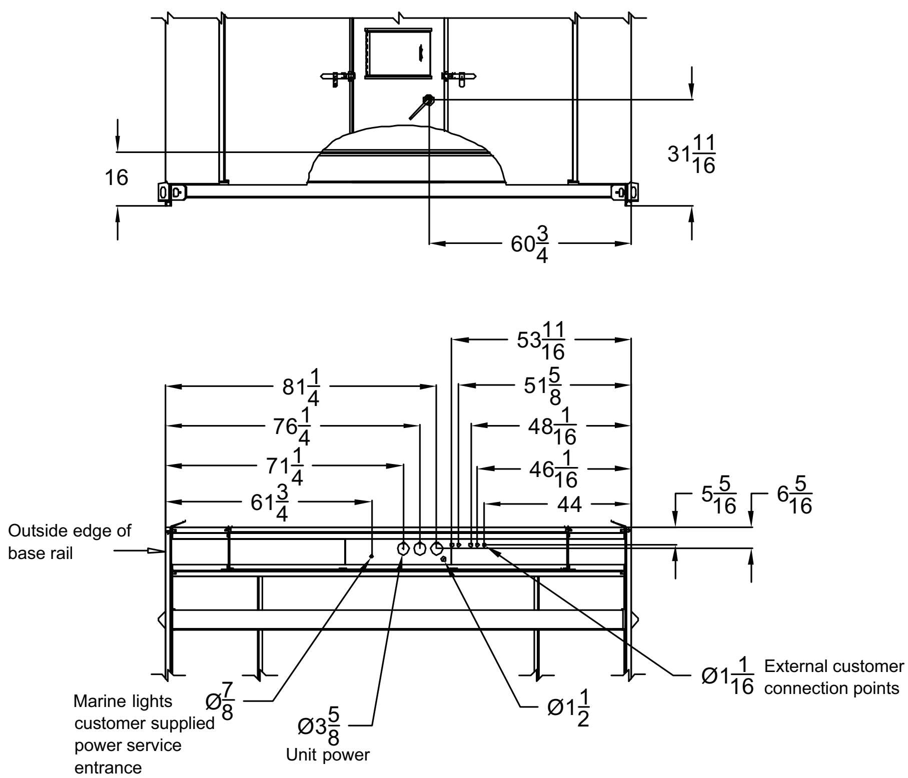
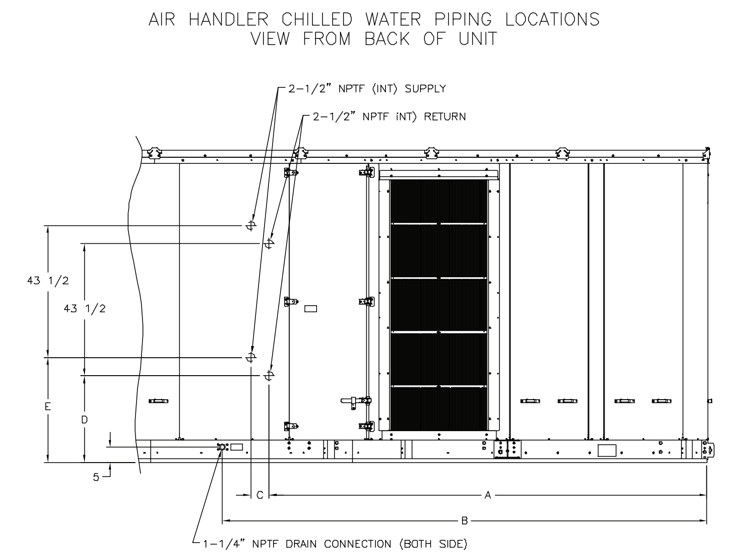
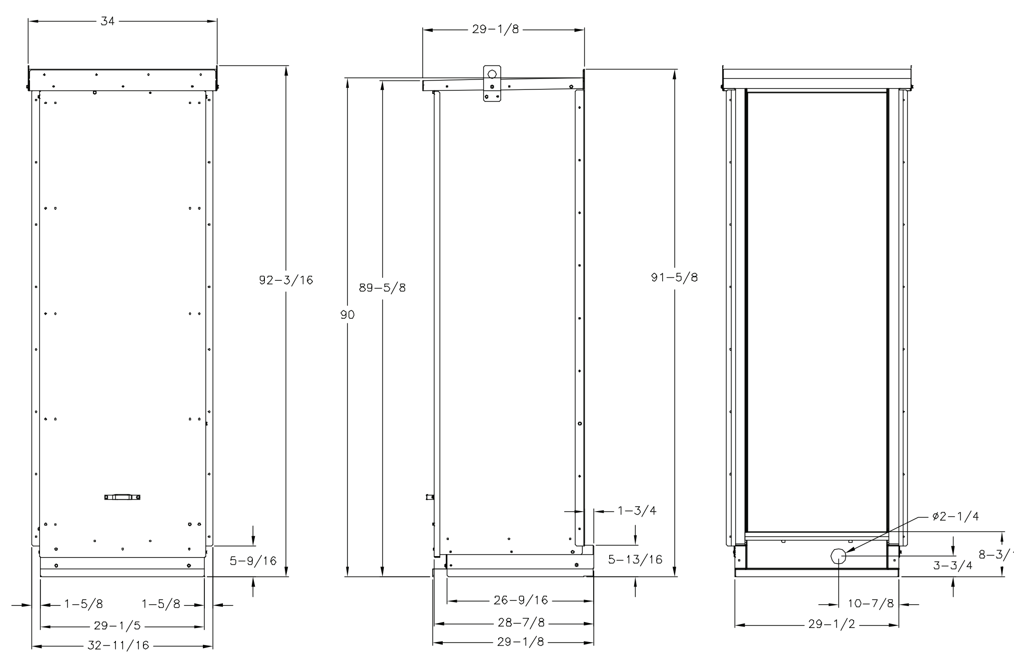


Figure 8. Chilled water piping locations



COIL	A	B	C	D	E
2-ROW	147-7/8	159-3/4	2-3/4	27-7/8	35-3/8
4-ROW	147-7/8	159-3/4	5-3/4	28-5/8	34-5/8
6-ROW	149-1/4	159-3/4	6	28-5/8	34-5/8
8-ROW	149-1/4	159-3/4	9	28-5/8	34-5/8

Figure 9. Piping enclosure



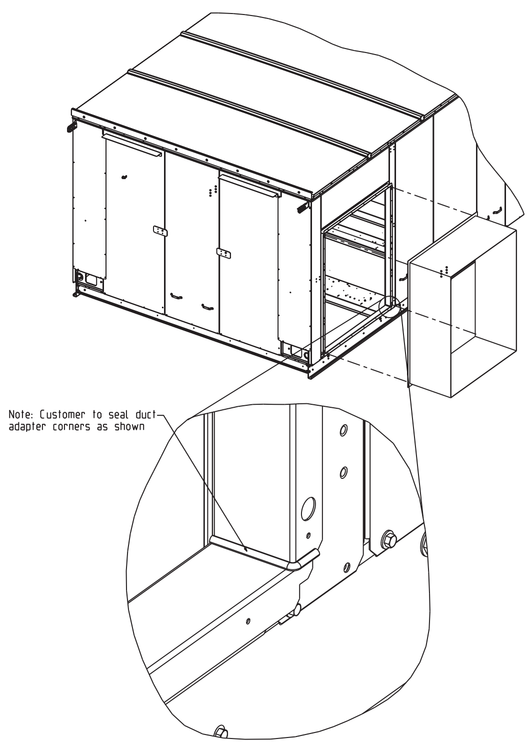
Pre-Installation

General Unit Requirements

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

- Check the unit for shipping damage and material shortage; file a freight claim and notify Trane office.
- Verify that the installation location of the unit will provide the required clearance for proper operation.
- Assemble and install the roof curb. Refer to the current edition of the roof curb installer's guide.
- Install and connect condensate drain lines to each cooling coil drain connection.

Figure 10. Sealed ductwork



- Fabricate and install ductwork; secure ductwork to curb. Seal the corners of duct adapters as shown in Figure 10. Ducting attached to the unit should be self supporting. Do not use the unit to support the weight of the ducting
- Install pitch pocket for power supply through building roof. (If applicable)

Rigging the Unit

- Set the unit onto the curb; check for levelness.
- Ensure unit-to-curb seal is tight and without buckles or cracks.
- Remove the shipping hold-down bolts and shipping channels from the supply and exhaust fans with spring isolators.
- Check all supply and exhaust fan spring isolators for proper adjustment.

Main Electrical Power Requirements

- Verify that the power supply complies with the unit nameplate specifications.
- Inspect all control panel components; tighten any loose connections.
- Connect properly sized and protected power supply wiring to a field-supplied/installed disconnect and unit
- Properly ground the unit.
- All field-installed wiring must comply with NEC and applicable local codes.

Field Installed Control Wiring

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

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

Requirements for Electric Heat Units

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

Requirement for Gas Heat

- Gas supply line properly sized and connected to the unit gas train.
- All gas piping joints properly sealed.
- Drip leg Installed in the gas piping near the unit.
- Gas piping leak checked with a soap solution. If piping connections to the unit are complete, do not pressurize piping in excess of 0.50 psig or 14 inches w.c. to prevent component failure.
- Main supply gas pressure adequate.
- Flue Tubes clear of any obstructions.
- Factory-supplied flue assembly installed on the unit.
- Connect the 3/4" CPVC furnace drain stubout to a proper condensate drain.

Requirements for Hot Water Heat

- Route properly sized water piping through the base of the unit into the heating section.
- Install the factory-supplied, 3-way modulating valve.
- Complete the valve actuator wiring.

Requirements for Steam Heat

- Route properly sized steam piping through the base of the unit into the heating section.
- Install the factory-supplied, 2-way modulating valve
- Complete the valve actuator wiring.
- Install 1/2", 15-degree swing-check vacuum breaker(s) at the top of each coil section. Vent breaker(s) to the atmosphere or merge with return main at discharge side of steam trap.
- Position the steam trap discharge at least 12" below the outlet connection on the coil.
- Use float and thermostatic traps in the system, as required by the application.

Requirements for Chilled Water Cooling

- Install and connect condensate drain lines to each cooling coil drain connection.
- Route properly sized water piping through the back of the unit.
- Install external piping enclosure.
- Install the factory-supplied, 3-way modulating valve.
- Complete the valve actuator wiring.

O/A Pressure Sensor and Tubing Installation (all units with Statitrac)

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

Condensate Drain Connections

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

Due to the size of these units, all condensate drain connections must be connected to the cooling coil drain connections. Refer to Detail A in Figure 6, p. 24 for the location of these drain connections.

A condensate trap must be installed due to the drain connection being on the "negative pressure" side of the fan. Install the P-Traps at the unit using the guidelines in Figure 11.

Figure 11. Condensate trap installation

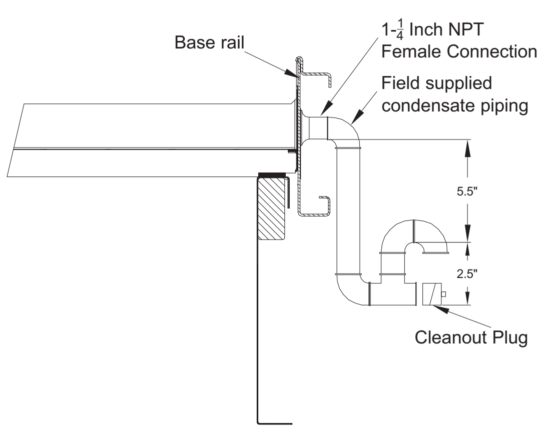
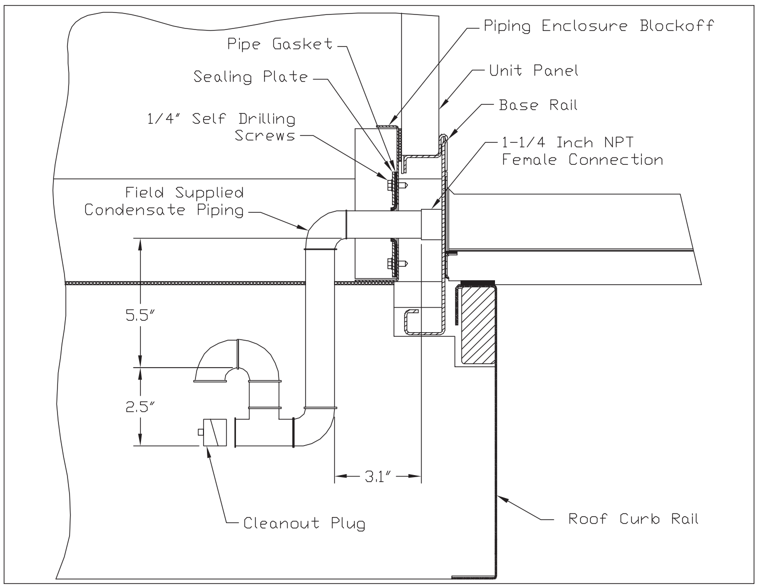


Figure 12. Trap installation inside external piping enclosure



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

For units with an external piping enclosure, the condensate trap must be run through the external piping enclosure on the rear side of the unit. Use Figure 12 as a guideline to install a P-Trap at the back of the unit when an external piping enclosure is mounted around the condensate drain connection.

Units with Gas Furnace

Units equipped with a gas furnace have a 3/4" CPVC drain connection stubbed out through the vertical support in the gas heat section. It is extremely important that the condensate be piped to a proper drain. Refer to the appropriate illustration in Figure 6, p. 24 for the location of the drain connection.

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

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

Removing Supply and Exhaust Fan Shipping Channels

Each supply fan assembly and exhaust fan assembly is equipped with spring isolators. Shipping channels are installed beneath each fan assembly and must be removed. To locate and remove these channels, refer to Figure 13, p. 32 and use the following procedures.

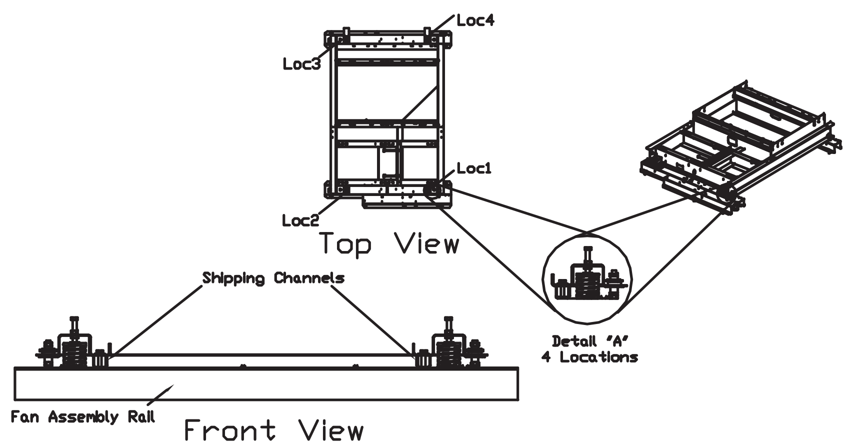
Spring Isolators

Spring isolators for the supply and/or exhaust fan are shipped with the isolator adjusting bolt backed out. Field adjustment is required for proper operation. Figure 13, p. 32 shows isolator locations. To adjust the spring isolators use the following procedure.

1. Remove and discard the shipping tie down bolts but leave the shipping channels in place during the adjustment procedure. See Figure 13, p. 32.

2. Tighten the leveling bolt on each isolator until the fan assembly is approximately 1/4" above each shipping channel.
3. Secure the lock nut on each isolator.
4. Remove the shipping channels and discard.

Figure 13. Removing fan assembly shipping hardware



O/A Sensor and Tubing Installation

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

On VAV systems, a duct pressure transducer and the outside air sensor is used to control the discharge duct static pressure to within a customer-specified parameter.

On CV & VAV units equipped with 100% modulating exhaust w/Stratitrac, a space pressure transducer and the outside air sensor is used to control the exhaust fan and dampers to relieve static pressure, to within a customer-specified parameter, within the controlled space. Refer to Figure 14, p. 33 and the following steps to install the sensor and the pneumatic tubing.

1. Remove the O/A pressure sensor kit located inside the "ship with" item container. The kit contains the following items:
   a. O/A static pressure sensor with slotted mounting bracket
   b. 50 ft. 0.188 in tubing
   c. Mounting hardware
2. Remove the two roof cap screws and install the provided L mounting bracket as shown in the figure.
3. Place the sensor mounting slotted bracket to the L mounting bracket with the slot located to the top.
4. Install the sensor vertically to the slotted bracket and secure it with provided bolt and nut.
5. Connect one end of factory provided tubing to the top port of sensor and pass it through the two slots in the mount and the other end to the port in the base.
6. Secure the tubing with the mounting hardware located in the ship with item container.

Units with Statitrac

1. Open the filter access door, and locate the DSP control devices illustrated in Figure 15. There are three tube connectors mounted on the left of the solenoid and transducers. Connect one end of the field provided1/4" (length 50-100 ft.) or 3/8" (length greater than 100 ft.) O.D. pneumatic tubing for the space pressurization control to the bottom fitting. 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 14. Outside air sensing kit

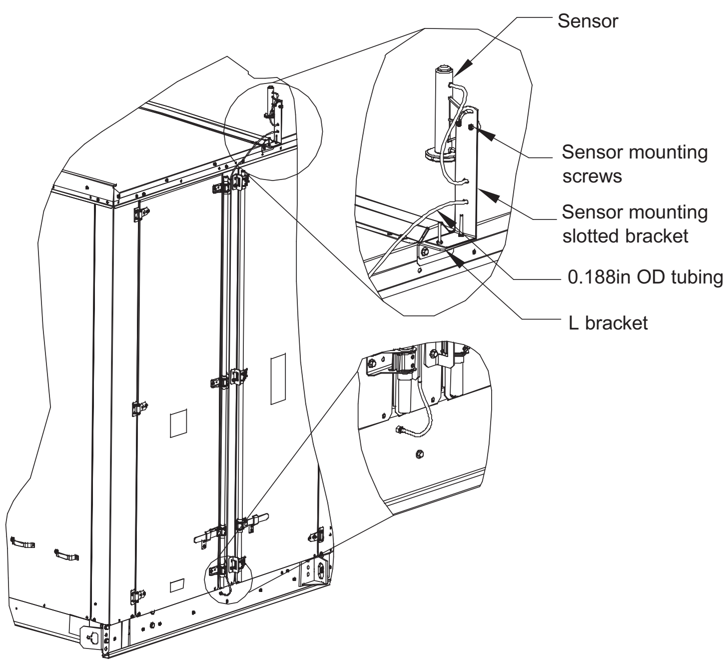
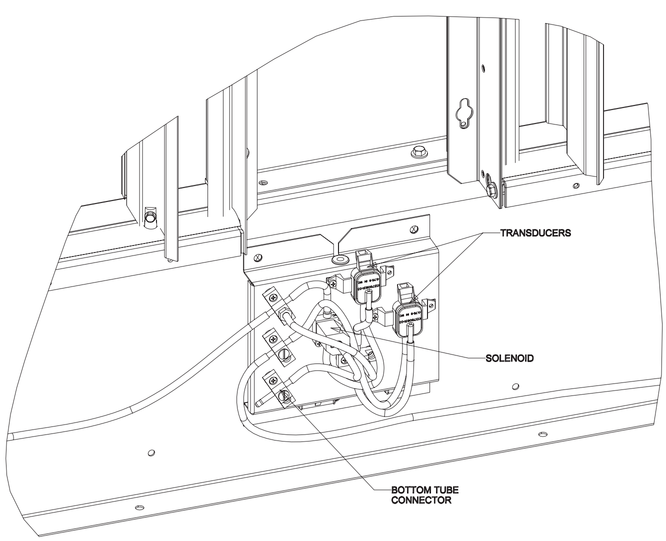


Figure 15. DSP control device



Installation

Unit Weights

Table 11. Approximate operating weights (lbs.)

Nominal Tons	Unit (Minimum)	Roof Curb (Minimum)
A	8580	1066
B	8782	1066
C	8910	1066

Notes:

1. Weights shown include the following features: standard coils, 0-25% Fresh Air, throwaway filters, low cfm supply fan, minimum motor sizes, constant volume, 460 XL, No heat.
2. Weights shown represent approximate operating weights and have a + 5% accuracy. To calculate weight for a specific unit configuration, utilize TOPSS or contact the local Trane sales representative. ACTUAL WEIGHTS ARE STAMPED ON THE UNIT NAMEPLATE.

Table 12. Component weights (lbs.)

	A		B		C	
	Size	Wt (lbs.)	Size	Wt (lbs.)	Size	Wt (lbs.)
Supply Fan Assembly						
Supply Fan & FanBoard Assy.	25"	1226	32"	1419	36"	1530
Belt Guard		116		116		116
Supply VFD (50 HP and below)		233		233		233
Supply VFD (60 thru 75 HP)		284		284		284
Supply-Exh Fan Motor - 15 HP		181		181		181
Supply-Exh Fan Motor - 20 HP		206		206		206
Supply-Exh Fan Motor - 25 HP		358		358		358
Supply-Exh Fan Motor - 30 HP		413		413		413
Supply-Exh Fan Motor - 40 HP		495		495		495
Supply-Exh Fan Motor - 50 HP		604		604		604
Supply-Exh Fan Motor - 60 HP		-		776		776
Supply-Exh Fan Motor - 75 HP		-		-		879
Return/Exhaust Fan Assembly						
Return Fan & Dampers	36"	2284	40"	2333	40"	2333
Exhaust Fan & Dampers - Low CFM	25"	879	25"	879	28"	963
Exhaust Fan & Dampers - Std CFM	-	-	28"	963	32"	1417
Belt Guard		119		119		119
Exhaust VFD (50 HP and below)		244		244		244
Exhaust VFD (60 HP)		295		295		295
Exh Fan Motor - 7.5 HP		160		160		-
Exh Fan Motor - 10 HP		181		181		181
Exh Fan Motor - 15 HP		206		206		206
Exh Fan Motor - 20 HP		206		206		206
Exh Fan Motor - 25 HP		358		358		358
Exh Fan Motor - 30 HP		-		413		413
Exh Fan Motor - 40 HP		-		495		495
Exh Fan Motor - 50 HP		-		604		604
Exh Fan Motor - 60 HP		-		-		776

Table 12. Component weights (lbs.) (continued)

	A		B		C	
	Size	Wt (lbs.)	Size	Wt (lbs.)	Size	Wt (lbs.)
Chilled Water Assy.						
2 Row 5W Chilled Water Coil - 80 FPF		992		992		992
2 Row 5W Chilled Water Coil - 108 FPF		1042		1042		1042
2 Row 5W Chilled Water Coil - 144 FPF		1106		1106		1106
2 Row 5W Chilled Water Coil - 168 FPF		1148		1148		1148
4 Row W Chilled Water Coil - 80 FPF		1523		1523		1523
4 Row W Chilled Water Coil - 108 FPF		1622		1622		1622
4 Row W Chilled Water Coil - 144 FPF		1750		1750		1750
4 Row W Chilled Water Coil - 168 FPF		1835		1835		1835
6 Row WD Chilled Water Coil - 80 FPF		2046		2046		2046
6 Row WD Chilled Water Coil - 108 FPF		2195		2195		2195
6 Row WD Chilled Water Coil - 144 FPF		2387		2387		2387
6 Row WD Chilled Water Coil - 168 FPF		2515		2515		2515
8 Row WD Chilled Water Coil - 80 FPF		2643		2643		2643
8 Row WD Chilled Water Coil - 108 FPF		2842		2842		2842
8 Row WD Chilled Water Coil - 144 FPF		3098		3098		3098
8 Row WD Chilled Water Coil - 168 FPF		3268		3268		3268
External Piping Cabinet						
External Piping Cabinet - Shipping		353		353		353
External Piping Cabinet - Operation		268		268		268
Gas/Electric Heat						
Gas Heat Low	0.85M	690	0.85M	690	0.85M	690
Gas Heat Med	1.1M	840	1.1M	840	1.1M	840
Gas Heat High	1.8M	1150	1.8M	1150	1.8M	1150
Electric Heat		485		485		485
Hydronic Heat						
Steam Heat Low		946		946		946
Steam Heat High		1014		1014		1014
Hot Water Heat Low		1080		1080		1080
Hot Water Heat High		1125		1125		1125
Filters						
Filter Rack - Throwaway Filters		181		181		181
Filter Rack - Bag Filters		395		395		395
Filter Rack - Cartridge Filters		662		662		662
Final Filters - Bag Filters		392		392		392
Final Filters - Cartridge Filters w/ 2" pre-filter		607		607		607
Final Filters - Cartridge Filters w/ 4" pre-filter		638		638		638
Final Filters - High Temp. Cartridge		669		669		669
Final Filters - HEPA		1777		1777		1777
Final Filters - HEPA High Temp.		1839		1839		1839

Table 12. Component weights (lbs.) (continued)

	A		B		C	
	Size	Wt (lbs.)	Size	Wt (lbs.)	Size	Wt (lbs.)
Fresh Air						
0-25% Damper		611		611		611
Econ		759		759		759
Econ w/ Air Measure		715		715		715
Cabinet						
Cabinet		5971		5971		5971
Cabinet - 4' Blank Section		846		846		846
Cabinet - 8' Blank Section		1650		1650		1650
Control Box - Main						
Control Box - Main		454		454		454
Convenience Outlet		36		36		36

Table 13. Roof curb weights

Casing	Blank	Installed Weight	Shipping Weight
A, B, C	None	1066	1334
	4 Ft	1147	1415
	8 Ft	1228	1497

Roof Curb and Ductwork

The roof curb for air handler units consist of two main components; a "full perimeter" enclosure to support the unit air handler section and an add on substructure to support the external piping enclosure when the chilled water option is selected.

Before installing any roof curb, verify;

1. That it is the correct curb for the unit,
2. That it includes the necessary gaskets and hardware
3. That the purposed installation location provides the required clearance for proper operation.

Insure that the curb is level and square. The top surface of the curb must be true to assure an adequate curb-to-unit seal.

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

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

If the unit is elevated, a field constructed catwalk around the unit is strongly recommended to provide easy access for unit maintenance and service.

Recommendations for installing the Supply Air and Return Air ductwork joining the roof curb are included in the curb instruction booklet. Curb ductwork must be fabricated and installed by the installing contractor before the unit is set into place.

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

Pitch Pocket Location

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

The center line dimensions shown in the illustration below indicates the center line of the electrical access hole in the unit base when it is positioned on the curb, ±3/8 inch. The actual diameter of the hole in the roof should be at least 1/2 inch larger than the diameter of the conduit penetrating the roof. This will allow for the clearance variable between the roof curb rail and the unit base rail illustrated in Figure 16.

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

Figure 16. Pitch pocket location

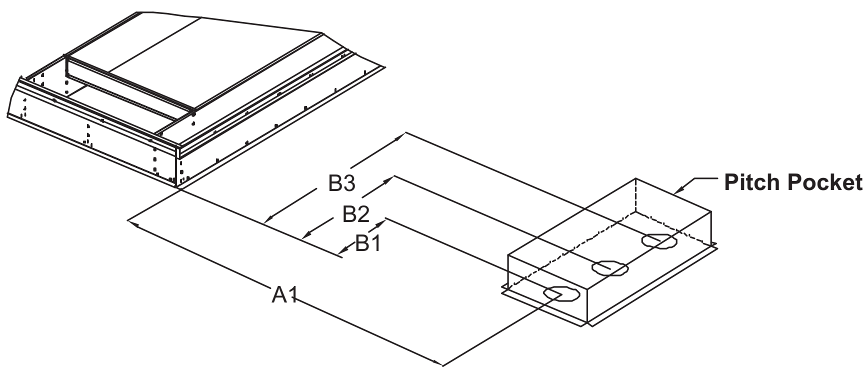


Table 14. Pitch pocket dimensions (in.)

Tonnages	A1	B1	B2	B3
Casings A-C	9.52	68.875	73.875	78.875

If a Trane Curb Accessory Kit is not used

If a Trane Curb Accessory Kit is not used:

1. The ductwork can be attached directly to the unit bottom, around the unit supply and return air openings. Be sure to use flexible duct connections at the unit. The customer is responsible for sealing the bottom of the external piping enclosure when the unit contains the chilled water option.
2. For "built-up" curbs supplied by others, gaskets must be installed around the unit, external piping enclosure curb, and the supply and return air opening perimeters. The customer is responsible for sealing the bottom of the external piping enclosure when the unit contains the chilled water option.
3. Units that come with external piping enclosures must be mounted on a roof curb.

Notes:

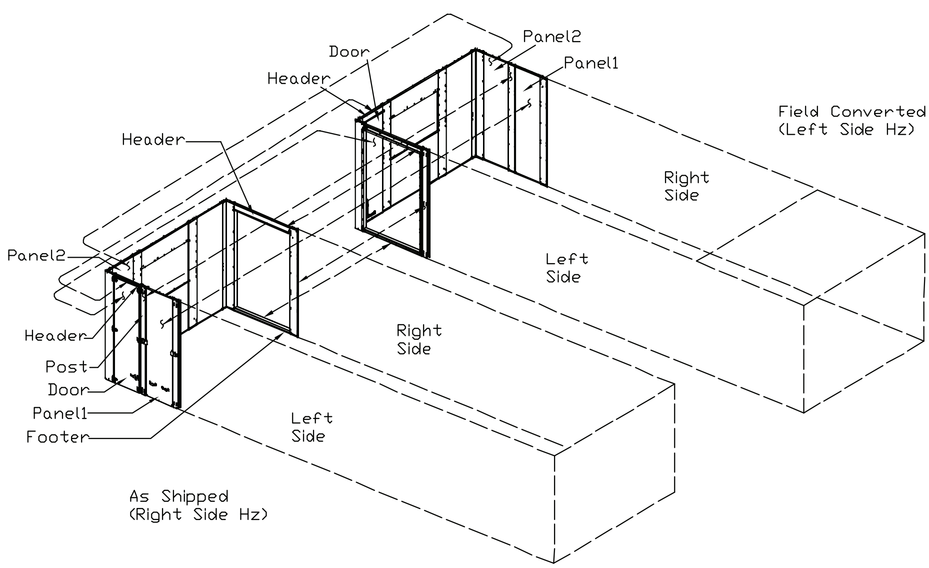
- *If a "built-up" curb is provided by others, keep in mind that external piping enclosure roof curbs must have a notch for the air handler unit base rail.*
- *If a "built-up" curb is provided by others, it should NOT be made of wood.*
- *If this is a REPLACEMENT UNIT keep in mind that the CURRENT DESIGN rooftop air handler units with chilled water require an add-on roof curb for the external piping enclosure.*

Field Converting Horizontal Ductwork from Right to the Left Side

To field convert horizontal ductwork from one side to the other, follow this procedure:

1. Remove the door and door header from the left side.
2. Remove Panel 2.
3. Remove Post and Panel 1.
4. Place door and door header removed from the left side in the empty location on the end wall.
5. Remove the horizontal duct header, footer, and side flange kits and install them at the empty left side.
6. Finally place Panel 2, Post, and Panel 1 at the empty spot on the right horizontal side to complete the field conversion.

Figure 17. Ductwork conversion



Unit Rigging and Placement

⚠WARNING

Heavy Objects!

Do not use cables (chains or slings) except as shown. Each of the cables (chains or slings) used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements may cause equipment or property-only damage. Failure to properly lift unit could result in death or serious injury. See details below.

1. To configure the unit center-of-gravity, utilize TOPPS or contact the local Trane sales office.

2. Attach adequate strength lifting slings to all lifting lugs. The minimum distance between the lifting hook and the top of the unit should be 12 feet. Figure 19, p. 40, Figure 20, p. 40, and Figure 21, p. 41 illustrate the installation of spreader bars to protect the unit and to facilitate a uniform lift. Table 1, p. 10 lists typical approximate minimal unit operating weights. To determine additional component weight, see Table 2, p. 10

⚠WARNING

Improper Unit Lift!

Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level. Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury and possible equipment or property-only damage.

3. Test lift the unit to ensure it is properly rigged and balanced, make any necessary rigging adjustments.
4. Lift the unit and position it over the curb and pedestal. (These units have a continuous base rail around the air handler section which matches the curb.
5. Align the base rail of the unit air handler section with the curb rail while lowering the unit onto the curb. Make sure that the gasket on the curb is not damaged while positioning the unit. (The pedestal simply supports the unit condenser section)

A cross section of the juncture between the unit and the roof curb is shown in Figure 18, p. 39.

Figure 18. Curb cross section

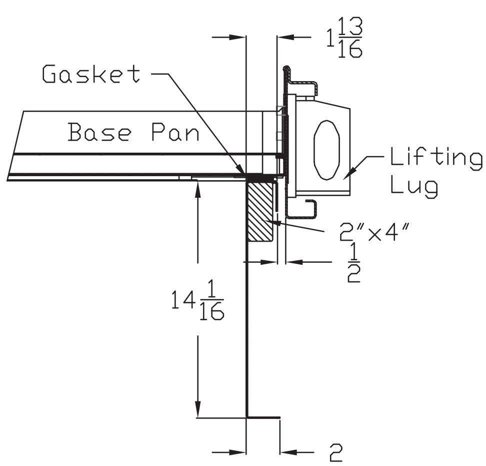
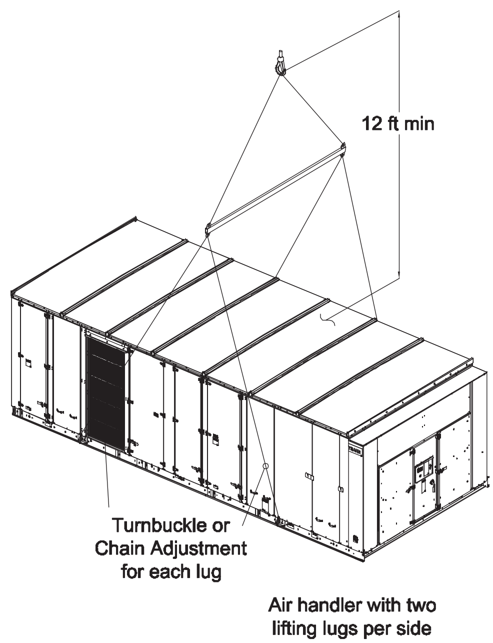
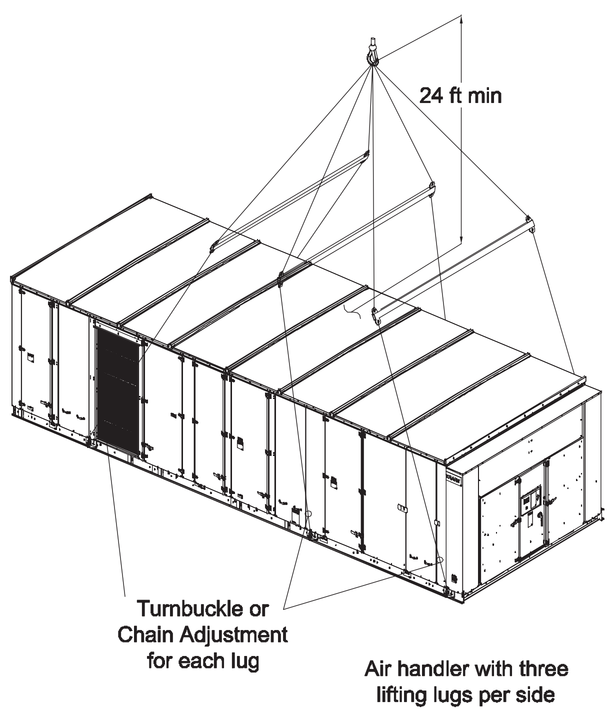


Figure 19. Typical unit rigging—air handler with two lifting lugs per side



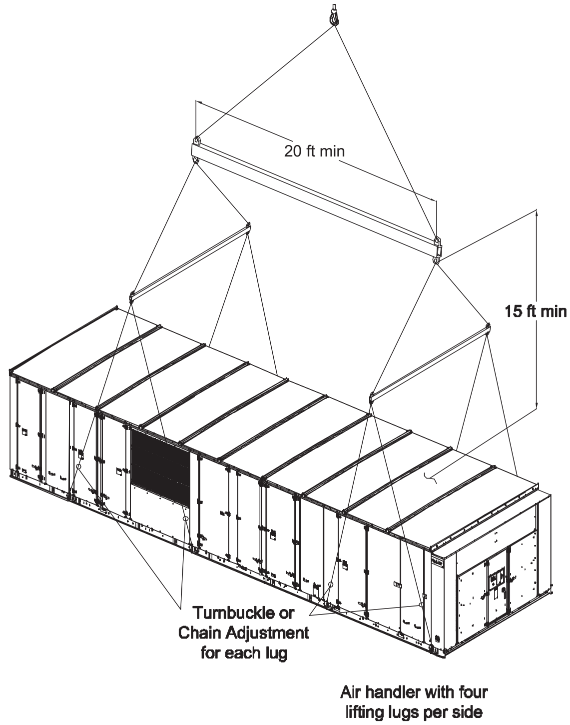
Note: *Turnbuckle or Chain Adjustment required for each lifting point.*

Figure 20. Typical unit rigging—air handler with three lifting lugs per side



Note: *Turnbuckle or Chain Adjustment required for each lifting point.*

Figure 21. Typical unit rigging—air handler with four lifting lugs per side



Lifting the External Piping Enclosure

NOTICE:

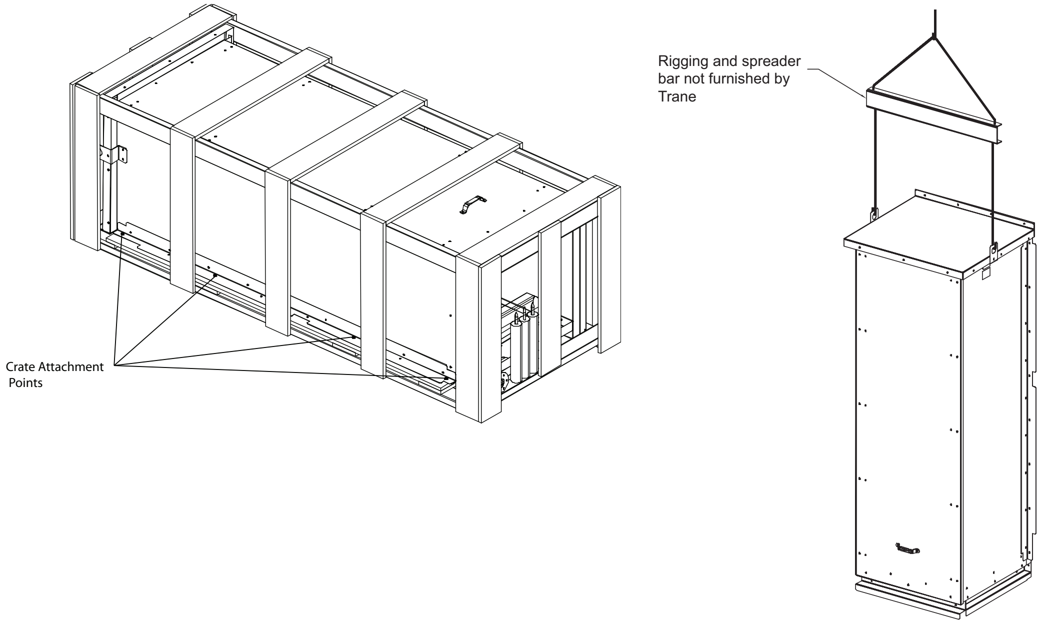
Lifting Damage!

Do not attach the external piping enclosure to the unit prior to lifting the unit. Doing so could damage the air handler or piping enclosure.

1. Detach external piping enclosure from shipping skid as shown in Figure 22.
2. Attach the cables, chains or straps to lifting lugs Figure 23, p. 45.

Note: *Rigging and spreader bars not furnished by Trane.*

Figure 22. External piping enclosure crate



Gas Heat Units

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

⚠WARNING

Hazardous Gases and Flammable Vapors!

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

⚠WARNING

Hazardous Pressures!

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

Access holes are provided on the unit as illustrated in Figure 25, p. 47 to accommodate a side or bottom pipe entry. Following the guidelines listed below will enhance both the installation and operation of the furnace.

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

1. To assure sufficient gas pressure at the unit, use Table 15, p. 44 as a guide to determine the appropriate gas pipe size for the unit heating capacity listed on the unit nameplate.
2. If a gas line already exists, verify that it is sized large enough to handle the additional furnace capacity before connecting to it.
3. Take all branch piping from any main gas line from the top at 90 degrees or at 45 degrees to prevent moisture from being drawn in with the gas.
4. Ensure that all piping connections are adequately coated with joint sealant and properly tightened. Use a piping compound that is resistant to liquid petroleum gases.
5. Provide a drip leg near the unit.
6. Install a pressure regulator at the unit that is adequate to maintain 7" w.c. for natural gas while the furnace is operating at full capacity.

NOTICE:

Gas Valve and Gas Train Damage!

- **Gas pressure in excess of 14" w.c. or 0.5 psig will damage the gas train.**
- **Failure to use a pressure regulating device will result in incorrect gas pressure. This can cause erratic operation due to gas pressure fluctuations as well as damage the gas valve.**
- **Over sizing the regulator will cause irregular pulsating flame patterns, burner rumble, potential flame outages, and possible gas valve damage.**

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

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

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

Connecting the Gas Supply Line to the Furnace Gas train

Follow the steps below to complete the installation between the supply gas line and the furnace. Refer to Figure 23, p. 45, and Figure 24, p. 45 for the appropriate gas train configuration.

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

Table 15. Sizing natural gas pipe mains and branches

	Gas Input (Cubic Feet/Hour)*					
Gas Supply Pipe Run (ft)	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

*Table is based on a specific gravity of 0.60. Use Table 16 for the specific gravity of the local gas supply.

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 850 MBH furnace to a natural gas supply having a rating of 1,000 BTU/Cu.Ft. and a specific gravity of 0.60

Cu.Ft/Hour = Furnace MBH Input
Gas BTU/Cu.Ft. X Multiplier Table 16
Cu.Ft/Hour = 850
This table indicates that a 2" pipe is required.

Table 16. Specific gravity multipliers

Specific Gravity	Multiplier
0.50	1.10
0.55	1.04
0.60	1.00
0.65	0.96

Table 17. Gas heating capacity altitude correction factors

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

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

Figure 23. Two-Stage natural gas train

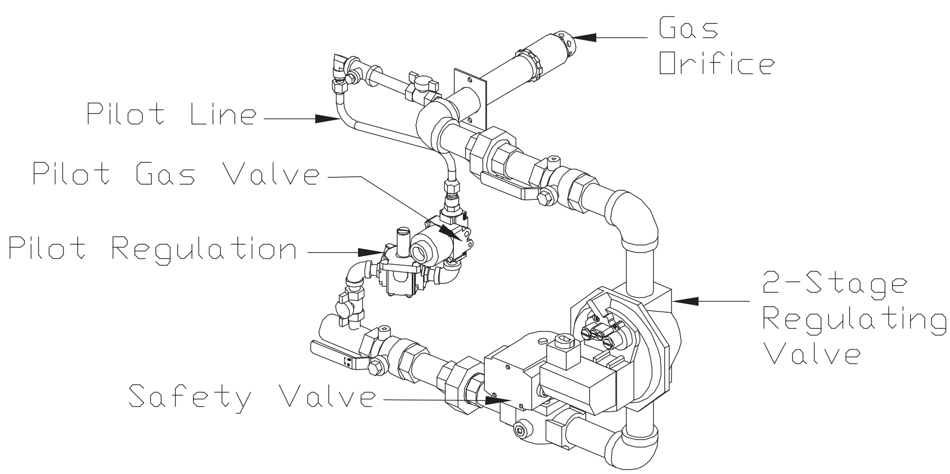


Figure 24. Modulating natural gas train

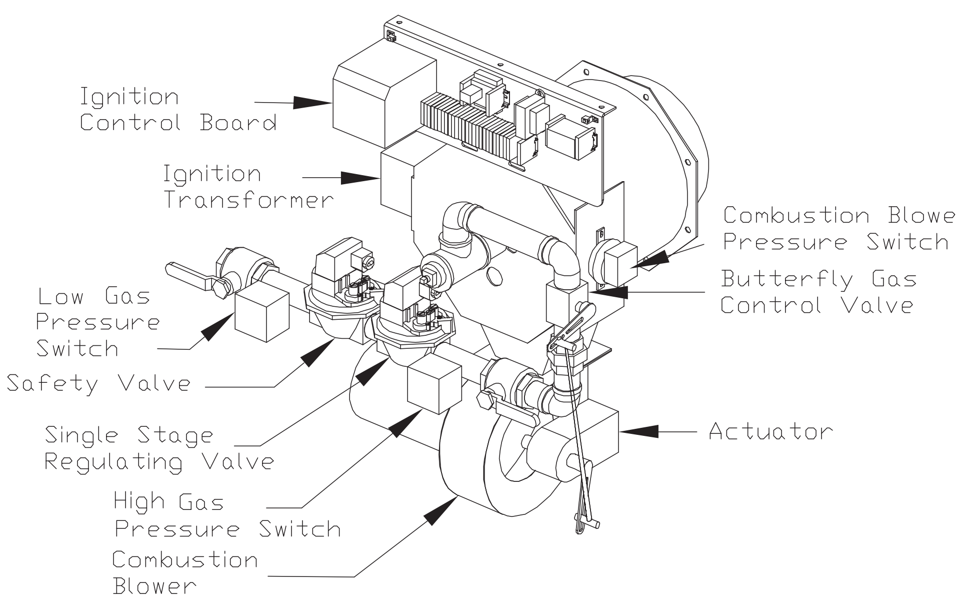
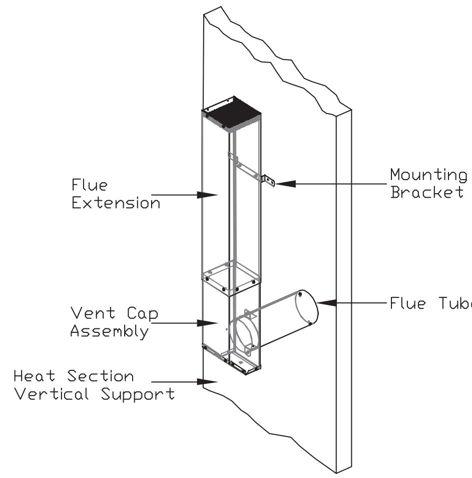


Table 18. Gas heat inlet sizes

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

Flue Assembly Installation

1. Locate the collapsed flue assembly in the compartment above the gas heat controls by removing the panel screws. The assembly is secured by screws up through the roof of the gas controls compartment roof.
2. Separate the pieces of the collapsed assembly.
3. Then assemble the stack as shown in Figure 26.
4. Insert the tube on the flue assembly into the hole located in the vertical support for the heat section.
5. Butt both tube sections together and center the pipe clamp over joint.



6. Using the pre-punch hole in the flue assembly, extension, and the vertical support, install the appropriate number of mounting brackets (Refer to the installation instructions that ship with the flue assembly.)

NOTICE:

Equipment Damage!

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

Figure 25. Gas heat piping penetration locations

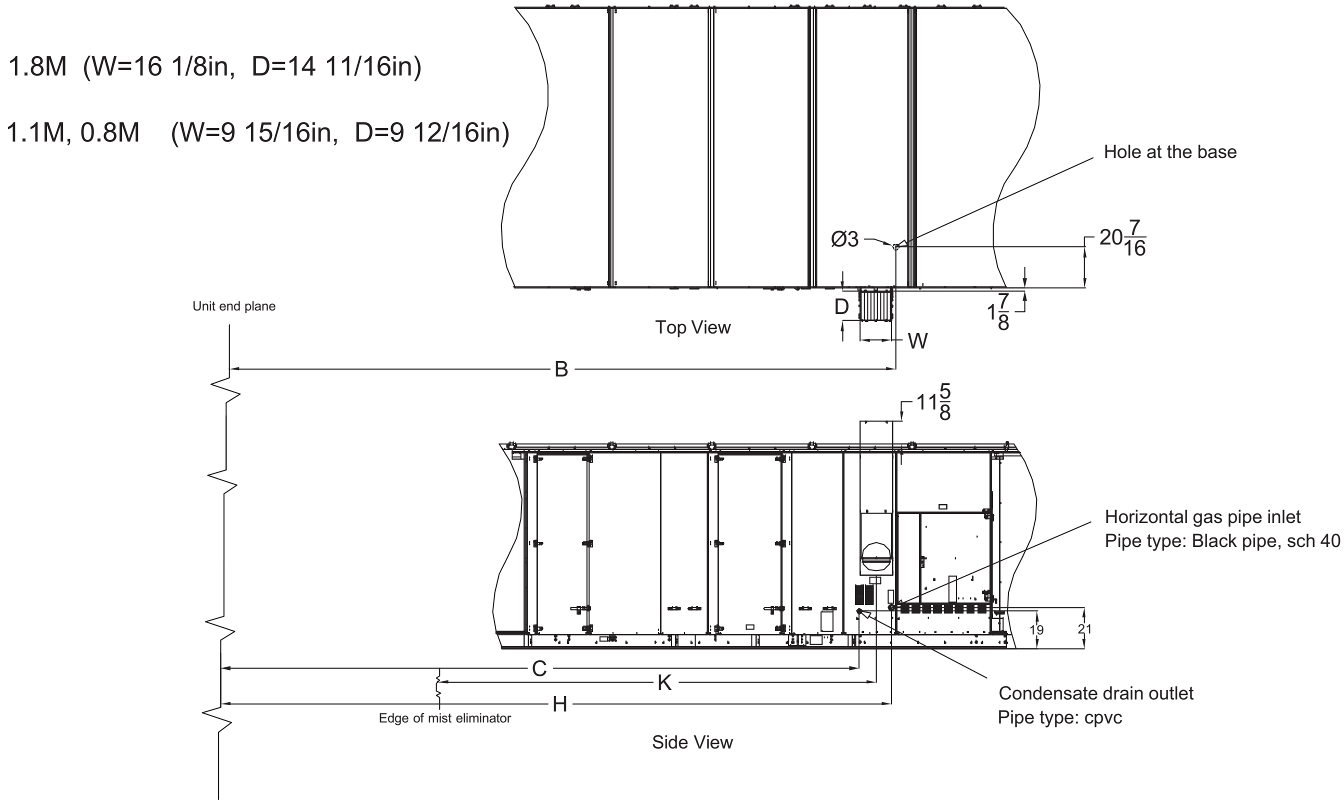


Table 19. Gas heat piping connection locations

Casings	Distance from Mist Eliminator to the Center of Flu			Distance of Condensate Drain Outlet			Distance of Horizontal Gas Pipe Inlet			
	K			C			H			B
A-C	1.8M	1.1M	0.8M	1.8M	1.1M	0.8M	1.8M	1.1M	0.8M	
	160.1	159.9	159.9	254.9	263.6	263.6	266.2	265.3	265.3	274.8

Hot Water Heat Units

Hot water heating coils are factory installed inside the heater section of the unit. Once the unit is set into place, the hot water piping and the factory provided three way modulating valve must be installed. The valve can be installed inside the heat section or near the unit. If the valve is installed in a remote location, use field supplied wiring to extend the control wires from the heater section to the valve. Two access holes are provided in the unit base as illustrated in Figure 26, p. 51.

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

Figure 27, p. 51 illustrates the recommended piping configuration for the hot water coil. Table 20 on page 50 lists the coil connection sizes.

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

1. Support all field-installed piping independently from the heating coil.
2. Use swing joints or flexible connectors adjacent to the heating coil. (These devices will absorb the strains of expansion and contraction).
3. All return lines and fittings must be equal to the diameter of the "outlet" connection on the hot water coil.
4. Install a "Gate" type valve in the supply branch line as close as possible to the hot water main and upstream of any other device or takeoff.
5. Install a "Gate" type valve in the return branch line as close as possible to the return main and down stream of any other device.
6. Install a strainer in the hot water supply branch as shown in Figure 27, p. 51.
7. Install the 3-way valve in an upright position, piped for valve seating against the flow. Ensure that the valve location lends itself to serviceability.
8. The Type "W" hot water coil is self-venting only when the tube water velocity exceeds 1.5 feet per second (fps). If the tube velocity is less than 1.5 feet per second, either:
   a. install an automatic air vent at the top of the return header, using the tapped pipe connection

   or,

   b. vent the coil from the top of the return header down to the return piping. At the vent connection, size the return piping to provide sufficient water velocity.
9. Install a "Globe" type valve in the Bypass line as shown in Figure 27, p. 51.

Steam Heat Units

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

Once the unit is set into place, the steam piping and the factory provided two way modulating valve must be installed. The valve can be installed inside the heater section or near the unit. If the valve is installed in a remote location, use field supplied wiring to extend the control wires from the heater section to the valve. Two access holes are provided in the unit base as illustrated in Figure 26, p. 51.

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

Figure 28, p. 52 illustrates the recommended piping configurations for the steam coil. Table 20, p. 50 lists the coil connection sizes.

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

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

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

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

    a. an atmospheric pressure/gravity condensate return;

    or,

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

    The two steam coils are stacked together and must be piped in a parallel arrangement. The steps listed below should be used in addition to the previous steps. Figure 28, p. 52 illustrates the recommended piping configuration for the steam coils.
13. Install a strainer in each return line before the steam trap.
14. Trap each steam coil separately as described in steps 10 and 11 to prevent condensate backup in one or both coils.
15. In order to prevent condensate backup in the piping header supplying both coil sections, a drain must be installed utilizing a strainer and a steam trap as illustrated in Figure 28, p. 52.

General Coil Piping and Connection Recommendations

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

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

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

NOTICE:

Coil Header Damage!

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

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

NOTICE:

Over Tightening!

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

NOTICE:

Equipment Damage!

Properly seal all penetrations in unit casing. Failure to seal penetrations from inner panel to outer panel may result in unconditioned air entering the module, which could result in equipment damage.

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

NOTICE:

Coil Damage!

Failure to properly protect coils not in use during freezing temperatures could result in coil freeze-up damage.

Note: *If glycol is used in the hot water system, be sure to use a glycol approved for use with commercial heating systems and copper tube coils. Follow the manufacturer's recommendations for water treatment and mix. Failure to do so could affect coil performance or damage the tubes or braze joints.*

Table 20. Hot water and steam coil connection sizes

	Hot Water Coil			Steam Coil		
Casings	Supply	Return	Drain/ Vent	Supply	Return	Vent
A-C	2 ½	2 ½	½	3.0	1 ¼	1 ¼

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

Table 21. Hot water and steam heat connection dimensions

Casings	A	B	Y	Diameter
A-C	276 9/16	290 5/16	18	5

Figure 26. Hot water and steam heat connection locations

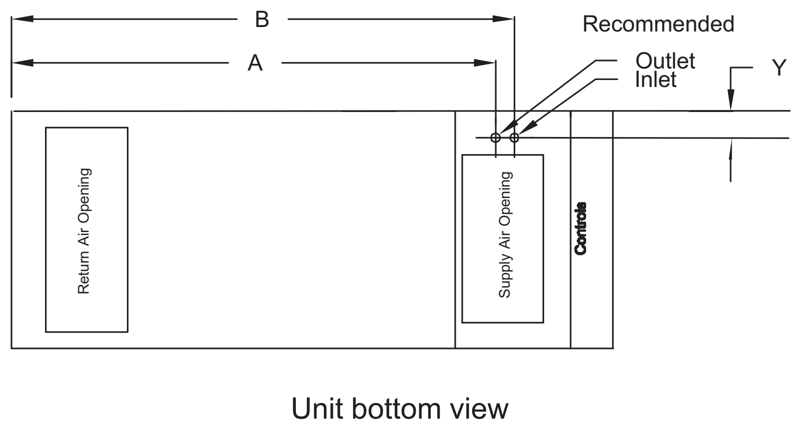


Figure 27. Hot water coil piping

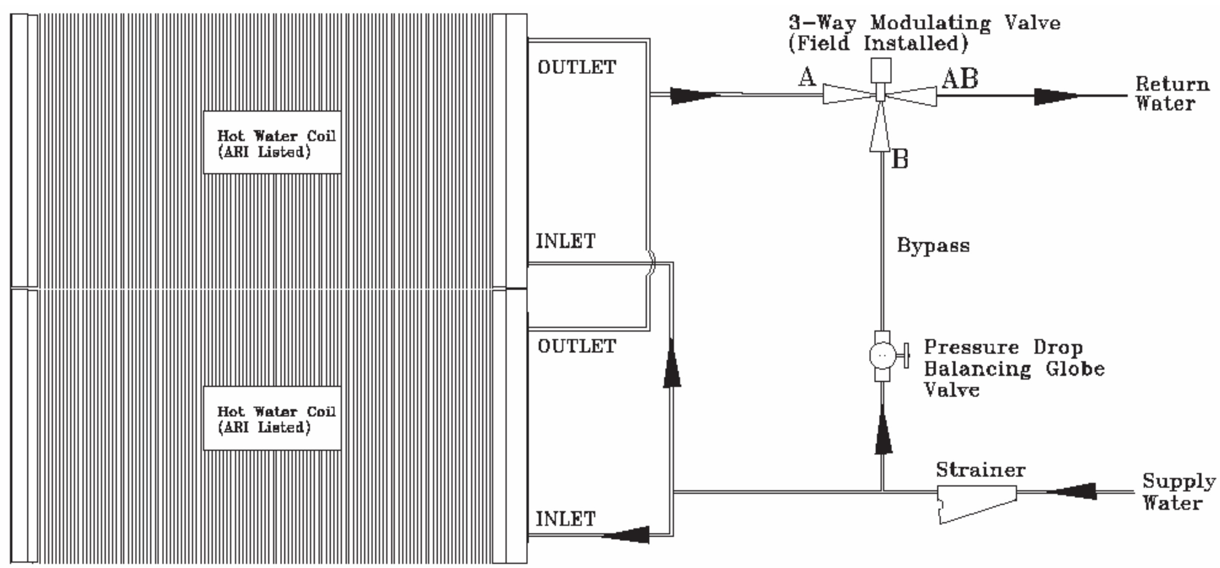
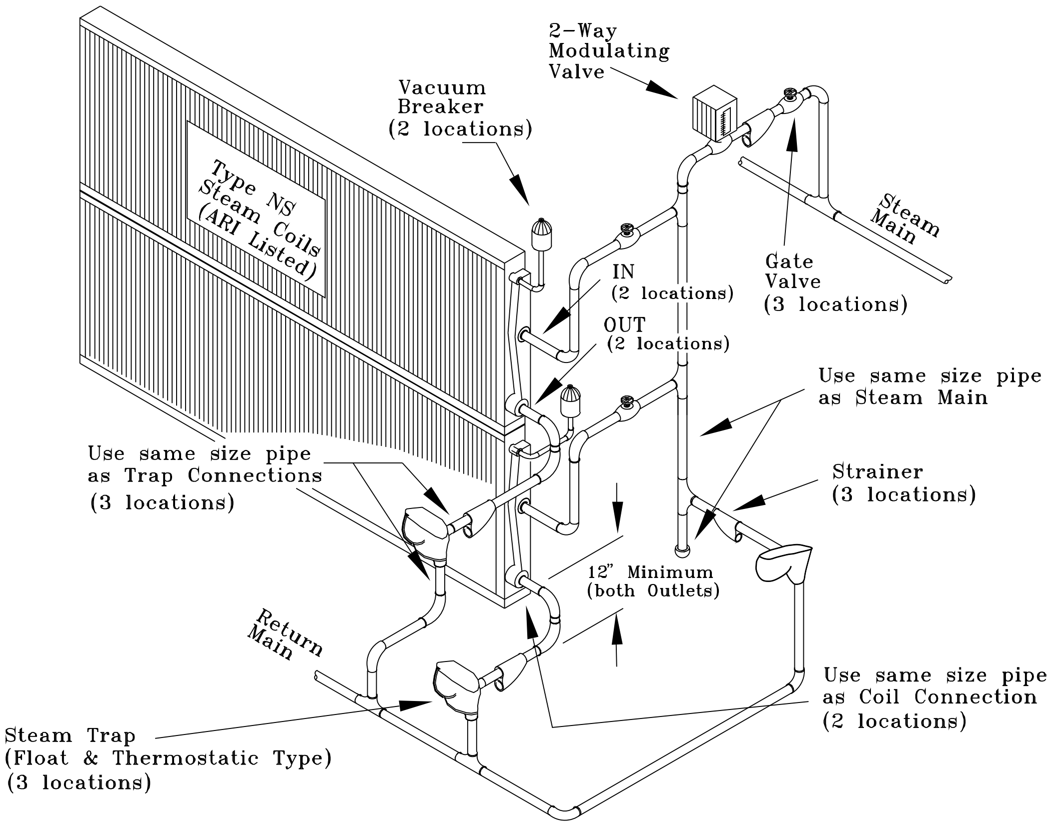


Figure 28. Steam coil piping



Chilled Water Units

Chilled water coils are factory installed inside the cooling section of the unit. Once the unit is set into place, the chilled water piping, external piping enclosure, and appropriate modulating valve (factory provided) must be installed.

Important: *Supply, return, and vent connections, control valve, and actuator must be field installed.*

General Coil Piping Recommendations

1. Support all field-installed piping independently from the cooling coil.
2. When attaching the piping to the coil header, make the connection only tight enough to prevent leaks. Maximum recommended torque is 200 pound-feet.

NOTICE:

Coil Header Damage!

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

NOTICE:

Over Tightening!

Teflon tape or piping compound should not be used for any field connections because its high lubricity may allow connections to be overtightened, resulting in damage to the coil header.

3. Use a short nipple on the coil headers prior to making any welded flange or welded elbow type connections.
4. Use swing joints or flexible connectors adjacent to the cooling coil. (These devices will absorb the strains of expansion and contraction).
5. All return lines and fittings must be equal to the diameter of the "outlet" connection on the chilled water coil. Table 22, p. 54
6. Coils should be installed with field fitted drains and vents to permit winterization of coils not in use and to assist in evacuating air from the chilled water system during start-up. See coil winterization for more details.
7. The Types 5W and W cold water coils are self-venting only when the tube water velocity exceeds 1.5 feet per second (fps). If the tube velocity is less than 1.5 feet per second, either:
   a. install an automatic air vent at the top of the return header, using the tapped pipe connection or,
   b. vent the coil from the top of the return header down to the return piping. At the vent connection, size the return piping to provide sufficient water velocity.
8. The Types WD cold water coils are self-venting only when the tube water velocity exceeds 2.5 feet per second (fps). If the tube velocity is less than 2.5 feet per second, either:
   a. install an automatic air vent at the top of the return header, using the tapped pipe connection or,
   b. vent the coil from the top of the return header down to the return piping. At the vent connection, size the return piping to provide sufficient water velocity.
9. Use the provided piping gasket and sealing ring on the sections of pipe penetrating the unit cabinet. See Figure 29, p. 54 and Figure 30, p. 55.

NOTICE:

Equipment Damage!

Properly seal all penetrations in unit casing. Failure to seal penetrations from inner panel to outer panel may result in unconditioned air entering the module which could result in equipment damage.

10. Seal the piping penetration on both sides of the cabinet wall before piping insulation.
11. Install the 3-way valve in an upright position. Ensure that the valve location lends itself to serviceability and is protected from freezing temperatures.
12. Install the actuator in a location protected from moisture and freezing temperatures. Actuator control wiring is located in the chilled water section of the unit.

Note: *Space inside the piping enclosure limits the ability to house control valves and actuators along with coil supply and return piping.*

Important: *Valve actuators are not waterproof. Failure to protect the valve from moisture may result in the loss of cooling control.*

NOTICE:

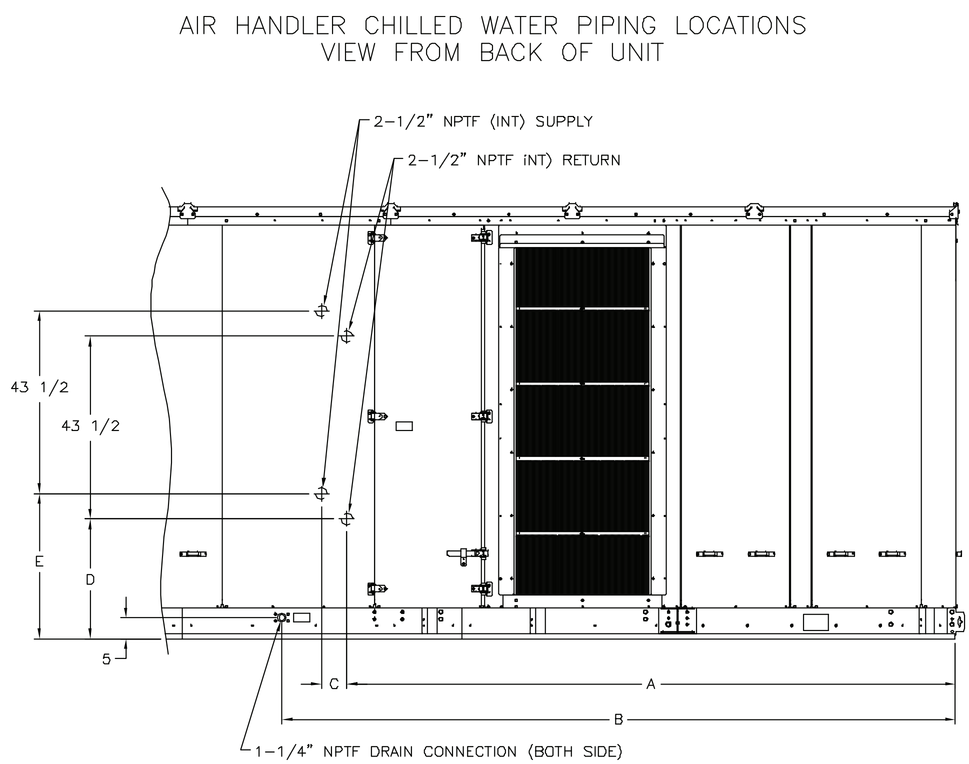
Coil Damage!

Failure to properly protect coils not in use during freezing temperatures could result in coil freeze-up damage.

Table 22. Chilled water connection sizes (in.)

Chilled Water Coil Connection Sizes			
Coil Type	**Supply**	**Return**	**Drain/Vent**
5W	2 1/2	2 1/2	1/2
W	2 1/2	2 1/2	1/2
WD	2 1/2	2 1/2	1/2

Figure 29. Chilled water piping locations



COIL	A	B	C	D	E
2-ROW	147-7/8	159-3/4	2-3/4	27-7/8	35-3/8
4-ROW	147-7/8	159-3/4	5-3/4	28-5/8	34-5/8
6-ROW	149-1/4	159-3/4	6	28-5/8	34-5/8
8-ROW	149-1/4	159-3/4	9	28-5/8	34-5/8

Figure 30. Chilled water piping penetration seal

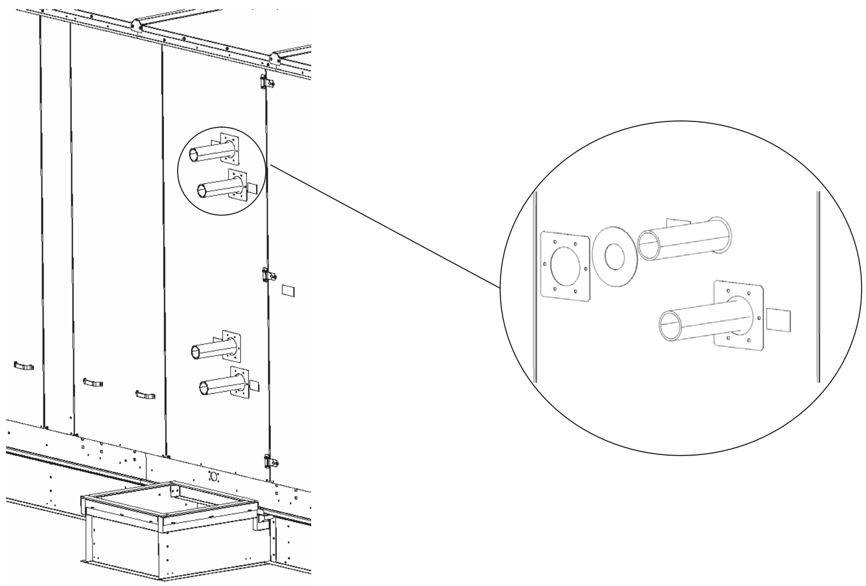
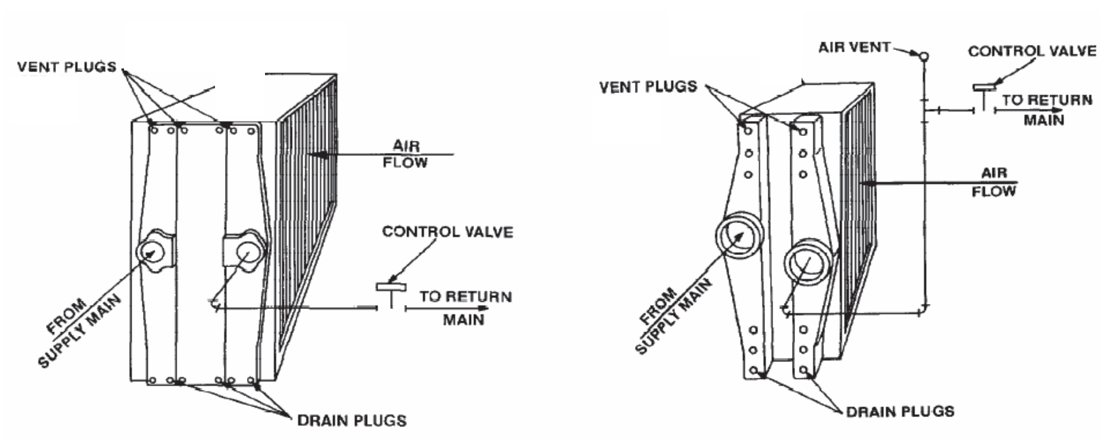


Figure 31. Chilled water piping schematic



Type WD Coils

Type 5W & W Coils

Coil Winterization

When applying air handlers with a chiller water coil and an economizer, the coil should be completely drained for winter operation. If the coil can not be completely drained, the coil should be filled with a glycol mixture that will protect the solution from freezing due to winter ambient temperatures.

NOTICE:

Coil Damage!

Failure to properly protect coils not in use during freezing temperatures could result in coil freeze-up damage.

Important: *If glycol is used in the chilled water system, be sure to use a glycol approved for use with commercial cooling systems and copper tube coils. Follow the manufacturer's recommendations for water treatment and mix. Failure to do so could affect coil performance or damage the tubes or braze joints.*

External Piping Enclosure Installation

Installation of the external piping enclosure requires assembly of the curb and installing the enclosure to both the unit baserail and unit cabinet as described below.

The pipe cabinet should be supported by chains, spreader bar, or other means when installing (see lifting instructions section). Mounting hardware, caulk, piping boot and sealing rings are located inside the piping enclosure skid.

1. Verify that the piping enclosure roof curb was properly installed. See roof curb installation manual for more information.
2. Remove paper backing on butyl tape from back and bottom of external piping enclosure. Figure 32, p. 57
3. Set external piping enclosure on curb. Figure 33, p. 57
4. Ensure enclosure-to-curb seal is tight and without buckles or cracks.
5. Attach external piping enclosure top and side flanges to air handler cabinet panel with #14 drill screws. Figure 33, p. 57

Notes:

- *Use force to compress the gasket between piping enclosure and the main unit cabinet while drilling screws.*
- *Use all holes in the attachment flanges.*

6. Attach the external piping enclosure baserail flanges to air handler unit base rail with #14 drill screws. Figure 33, p. 57
7. Remove external piping enclosure access panel. Figure 34, p. 57

Note: *Only remove outside perimeter bolts to remove access panel.*

8. Attach condensate drain hole blockoff to air handler cabinet panel with #14 drill screws. Figure 35, p. 58
9. Apply caulk around the inside and outside perimeter of the external piping enclosure.
10. Seal condensate drain hole extension with pipe gasket and sealing plate using #14 drill screws. Figure 12, p. 31
11. Re attach access panel to external piping enclosure.

Notes:

- *When locating the access panel, first slide the panel into the roof slot. Next grab the handle and use force to compress roof gasket. Then slide bottom into place over baserail gasket.*
- *Use all access panel bolt holes for reattachment to prevent water leakage.*

Figure 32. External piping enclosure butyl tape backing

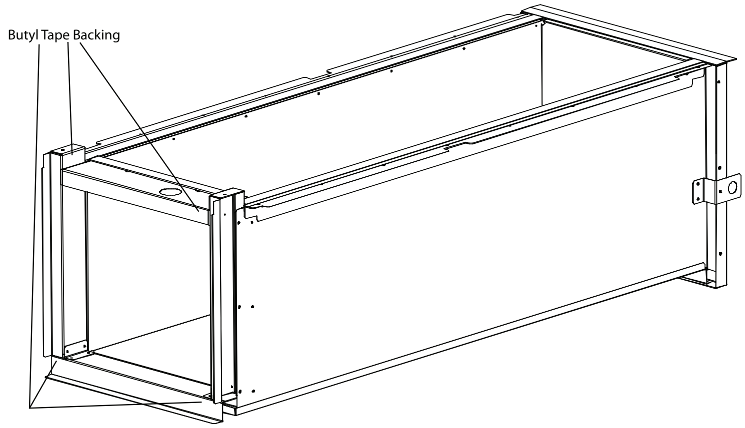


Figure 33. External Piping enclosure installation

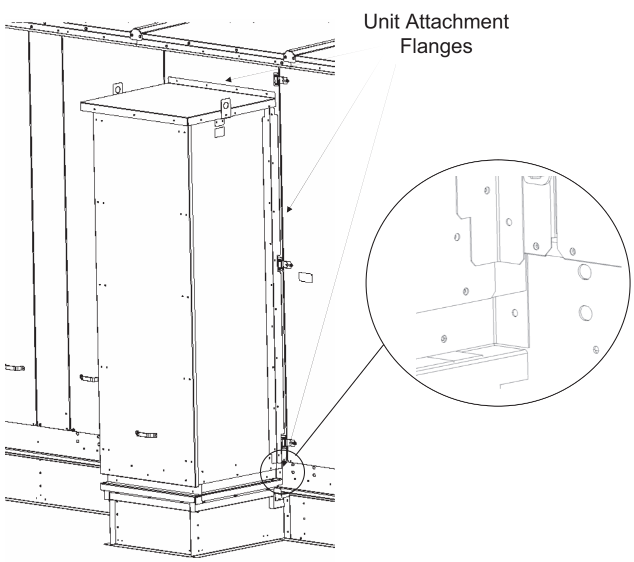


Figure 34. External piping enclosure access panel

Electrical Data

Disconnect Switch w/External Handle

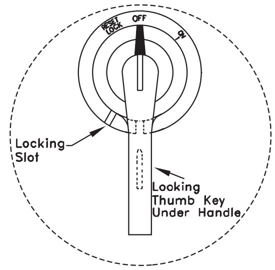
Units come equipped with a factory mounted disconnect switch with an externally mounted handle. This allows the operator to disconnect power from the unit without having to open the control panel door. The handle locations and its three positions are shown below;

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

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

"OPEN COVER/RESET" - Turning the handle to this position releases the handle from the disconnect switch, allowing the control panel door to be opened.

Figure 35. Disconnect switch external handle



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.

An overall layout of the field required power wiring is illustrated beginning with Figure 36, p. 59. To insure that the unit supply power wiring is properly sized and installed, follow these guidelines.

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

⚠WARNING

Live Electrical Components!

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

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

NOTICE:

Use Copper Conductors Only!

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

Electric Heat Units

Electric Heat Units require one power entry as illustrated in Figure 36, p. 59. Use the information provided in Table 23, p. 62 and the "Power Wire Sizing & Protection Device Equations", to determine the appropriate wire size and Maximum Over current Protection for the heaters/unit.

Important: *Each power supply must be protected from short circuit and ground fault conditions. To comply with NEC, protection devices must be sized according to the "Maximum*

Over current Protection" (MOP) or "Recommended Dual Element" (RDE) fuse size data on the unit nameplate.

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

Main Unit Power Wiring

Figure 38, p. 60 lists the field connection wire ranges for both the main power terminal block and the optional main power disconnect switch. The electrical tables beginning with Table 23, p. 62 list the component electrical data. The electrical service must be protected from over current and short circuit conditions in accordance with NEC requirements. Protection devices must be sized according to the electrical data on the nameplate. Refer to the "Power Wire Sizing and Protection Device Equations", for determining;

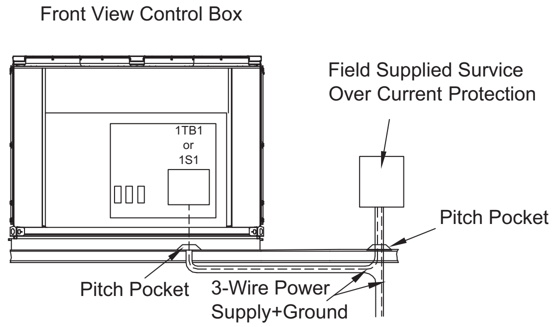
a. the appropriate electrical service wire size based on "Minimum Circuit Ampacity" (MCA),

b. the "Maximum Over current Protection" (MOP) device,

c. the "Recommended Dual Element fuse size" (RDE).

1. Location for the electrical service entrance is illustrated in Figure 6, p. 24. Complete the unit power wiring connections onto either the main terminal block, or the factory mounted non-fused disconnect switch, inside the unit control panel. Refer to the customer connection diagram that shipped with the unit for specific termination points.
2. Provide proper grounding for the unit in accordance with local and national codes.

Figure 36. Typical field power wiring



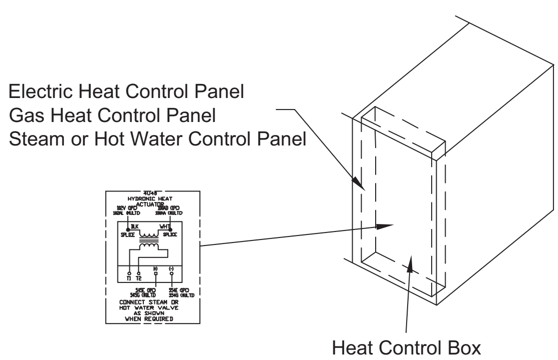


Figure 37. Typical field power wiring

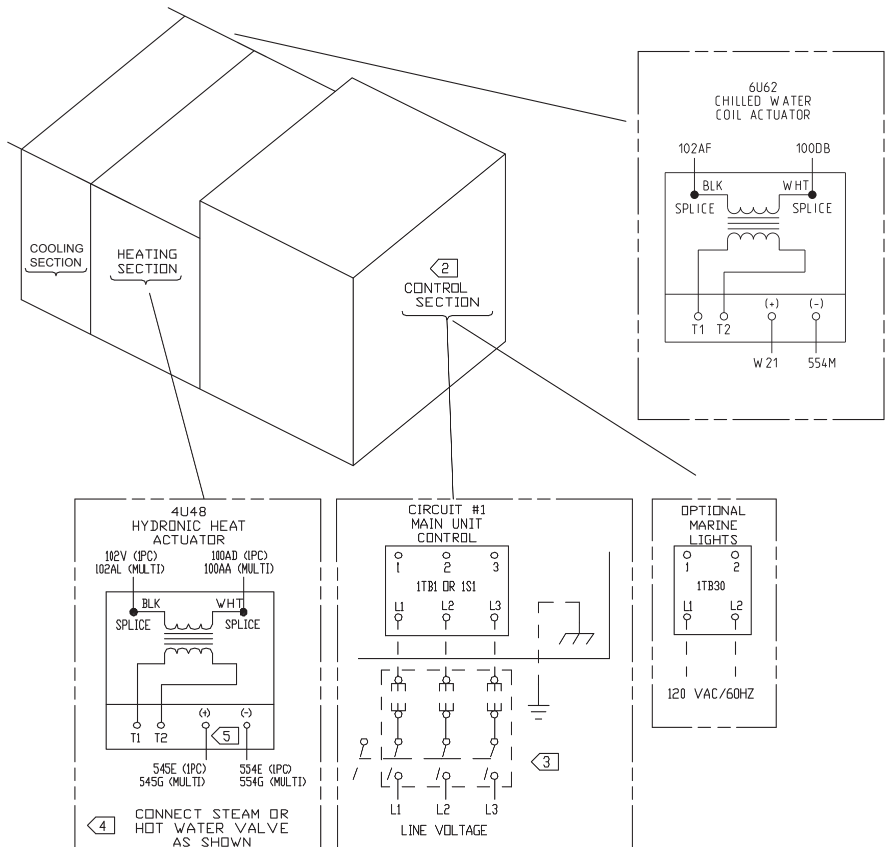


Figure 38. Customer connection wire range

UNITS WITH MAIN POWER
TERMINAL BLOCK (ALL VOLTAGES)

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

UNITS WITH MAIN POWER
DISCONNECT SWITCH (ALL VOLTAGES)

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

Note: *DISCONNECT SWITCH SIZE IS CALCULATED BY SELECTING THE SIZE GREATER THAN OR EQUAL TO 1.15 X (SUM OF UNIT LOADS). SEE UNIT LITERATURE FOR UNIT LOAD VALUES.*

NOTES:

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

2 CUSTOMER CONNECTIONS - MAIN UNIT CONTROLS SECTION

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

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

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

Power Wire Sizing and Protection Devices

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

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

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

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

LOAD2 = SUM OF THE CURRENTS OF ALL REMAINING MOTORS

LOAD3 = CURRENT OF ELECTRIC HEATERS

LOAD4 = ANY OTHER LOAD RATED AT 1 AMP OR MORE

Set 1. Cooling Only Air Handler Units and Cooling with Gas Heat Air Handler Units

MCA = (1.25 x LOAD1) + LOAD2 + LOAD4

MOP = (2.25 x LOAD1) + LOAD2 + LOAD4

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

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

RDE = (1.5 x LOAD1) + LOAD2 + LOAD4

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

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

Set 2. Air Handler Units with Electric Heat

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

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

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

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

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

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

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

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

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

The selection RDE value will be the larger of the cooling mode RDE value or the heating mode RDE value calculated above. Select a fuse rating equal to the RDE value. If the RDE value does not equal a standard fuse size as listed in NEC 240-6, select the next higher standard fuse rating.

Notes:

- *If the selected RDE is greater than the selected MOP value, then select the RDE value to equal the MOP value.*
- *On air handler units, the selected MOP value is stamped in the MOP field on the nameplate.*

Table 23. Electrical service sizing data—motors

Supply Fan Motors		
	460 V	575 V
Motor Horsepower	FLA	FLA
15	18.9	15.1
20	24.7	19.6
25	31.0	24.5
30	36.6	29.2
40	47.6	39
50	60.5	48
60	71.5	57.2
75	90	72
100	115	92
Exhaust/Return Fan Motors		
	460 V	575 V
Motor Horsepower	FLA	FLA
7.5	9.4	8.2
10	12.6	10.1
15	18.9	15.1
20	24.7	19.6
25	31	24.5
30	36.6	29.2
40	47.6	39
50	60.5	48

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

	Voltage	
	460	575
Module kW	FLA	FLA
90	108.3	86.6
140	168.4	134.7
265	318.8	255
300	360.8	288.7

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

Unit Size	Digit 2 Unit Function	Voltages	
		460	575
		FLA	FLA
A, B, C	E, L, S, X	3	3
	F (850 MBH)	4	4
	F (1100 MBH)	4	4
	F (1800 MBH)	4	4

Table 26. Voltage utilization range

Unit Voltage	
460/60/3	414-506
575/60/3	517-633

Table 27. Electrical service sizing data - convenience outlet transformer

Nominal Tons	Voltage	
	460	575
	FLA Add	FLA Add
Casings A-C	3.3	2.6

Controls

⚠WARNING

Hazardous Voltage!

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

⚠WARNING

Proper Field Wiring and Grounding Required!

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

Field Installed Control Wiring

The Rooftop Module (RTM) must have a mode input in order to operate the air handler. The flexibility of having several system modes depends upon the type of sensor and/or remote panel selected to interface with the RTM. An overall layout of the various control options available, with the required number of conductors for each device, is illustrated beginning with Figure 39, p. 73.

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

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

Controls using 24 VAC

Before installing any connecting wiring, refer to Figure 7, p. 26 for the electrical access locations provided on the unit and Table 28, p. 64 for AC conductor sizing guidelines, and;

1. Use copper conductors unless otherwise specified.
2. Ensure that the AC control wiring between the controls and the unit's termination point does not exceed three (3) ohms/conductor for the length of the run.

NOTICE:

Equipment Damage!

Resistance in excess of 3 ohms per conductor could cause component failure due to insufficient AC voltage supply.

Important: *Be sure to check all loads and conductors for grounds, shorts, and miswiring.*

Table 28. AC conductors

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

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

Controls using DC Analog Input/Outputs

Before installing any connecting wiring between the unit and components utilizing a DC analog input\output signal, refer to the appropriate illustration in Figure 7, p. 26 for the electrical access locations provided on the unit and Table 28, p. 64 for conductor sizing guidelines and;

1. Use standard copper conductor thermostat wire unless otherwise specified.
2. Ensure that the wiring between the controls and the unit termination point does not exceed two and a half (2.5) ohms/conductor for the length of the run.

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

Table 29. 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

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

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

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

Constant Volume System Controls

Remote Panel w/o NSB—BAYSENS110*

This electronic sensor features four system switch settings (Heat, Cool, Auto, and Off) and two fan settings (On and Auto) with four system status LED's. It is a manual or automatic changeover control with dual setpoint capability. It can be used with a remote zone sensor BAYSENS077*. Refer to Table 30, p. 71 for the Temperature vs. Resistance coefficient.

Constant Volume Zone Panel -BAYSENS108*

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

Variable Air Volume System Controls

Remote Panel w/o NSB -BAYSENS021*

The remote panel w/o Night setback has a system switch as well as a S/A temperature setpoint indicator, a local sensor, and four LED's. These features allow the operator to control system operation, and monitor unit operating status from a remote location. Use the installation instructions that shipped with the panel to install it, and the unit field wiring diagram to connect it to the unit.

VAV Changeover Contacts

These contacts are connected to the RTM when daytime heating on VAV units with internal or external hydronic heat is required. Daytime (occupied) heating switches the system to a CV type mode of operation. Refer to the unit wiring diagram for the field connection terminals in the unit control panel. The switch must be rated at 12 ma @ 24 VDC minimum.

Constant Volume or Variable Air Volume System Controls

Remote Panel w/ NSB -BAYSENS119*

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

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

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

The DIP switches on the subbase are used to enable or disable applicable functions, i.e.; Morning warm-up, economizer minimum position override during unoccupied status, heat installed, remote zone temperature sensor, 12/24 hour time display, and daytime warm-up. Refer to Table 30, p. 71 for the Temperature vs. Resistance coefficient.

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

Remote Human Interface Module

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

One remote panel is designed to monitor and control up to four units providing each of the units are equipped with an IPCB module. Use the installation instructions that shipped with the module to install it, and the appropriate illustrations beginning with Figure 39, p. 73 to connect it to the unit.

Remote Zone Sensor (BAYSENS073*)

This electronic analog sensor features remote zone sensing and timed override with override cancellation. It is used when the RTM has been programmed as the source for zone temperature control. Refer to Table 30, p. 71 for the Temperature vs. Resistance coefficient.

Remote Zone Sensor (BAYSENS074*)

This electronic analog sensor features single setpoint capability and timed override with override cancellation. It is used with a Trane Integrated Comfort™ system. Refer to Table 30, p. 71 for the Temperature vs. Resistance coefficient.

Remote Zone Sensor (BAYSENS016*)

This bullet type analog Temperature sensor can be used for; outside air (ambient) sensing, return air temperature sensing, supply air temperature sensing, remote temperature sensing (uncovered), morning warm-up temperature sensing, and for VAV zone reset. Wiring procedures vary according to the particular application and equipment involved. When this sensor is wired to a BAYSENS119* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to Table 30, p. 71 for the Temperature vs. Resistance coefficient.

Remote Zone Sensor (BAYSENS077*)

This electronic analog sensor can be used with BAYSENS019*, 020*, or 021* Remote Panels. When this sensor is wired to a BAYSENS019* or BAYSENS020* Remote Panel, wiring must be 18 AWG Shielded Twisted Pair (Belden 8760 or equivalent). Refer to the specific Remote Panel for wiring details.

CO_2 Sensing—Space or Duct

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

Remote Minimum Position Potentiometer (BAYSTAT023*)

The remote minimum position potentiometer is used on units with an economizer. It allows the operator to remotely set the economizer minimum position (which controls the amount of outside air entering the unit). Use the installation instructions that shipped with the potentiometer to install it, and the appropriate illustrations beginning with Figure 39, p. 73 to connect it to the unit.

External Auto/Stop Switch

A field supplied single pole single throw switch may be used to shut down the unit operation. This switch is a binary input wired to the RTM. When opened, the unit shuts down immediately and can be cancelled by closing the switch.

Refer to the appropriate illustrations beginning with Figure 39, p. 73 for the proper connection terminals in the unit control panel. The switch must be rated for 12 ma @ 24 VDC minimum.

Emergency Override

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

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

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

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

Ventilation Override Module (VOM)

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

The user can customize up to five (5) different override sequences for purposes of ventilation override control. If more than one VOM sequence is being requested, the sequence with the highest priority is initiated first. Sequence hierarchy is the sequence “A” (UNIT OFF) is first, with sequence “E” (PURGE with Duct Pressure Control) last.

A ventilation override mode can be initiated by closing any of the five (5) corresponding binary input on the VOM module. A binary output is provided on the VOM module to provide remote indication of an active VOM mode. The Humidification output is deenergized for any VOM sequence. The factory default definitions for each mode are as follows:

1. UNIT OFF sequence “A”

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

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

2. PRESSURIZE sequence “B”

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

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

3. EXHAUST sequence “C”

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

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

4. PURGE sequence “D”

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

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

5. PURGE with duct pressure control sequence “E”

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

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

– Return Fan - On; Exhaust Dampers - Open (if so equipped)
– Return VFD - Max (if so equipped)
– OA Bypass Dampers - Open (if so equipped)
– Exhaust Bypass Dampers - Open (if so equipped)

Temperature vs. Resistance Coefficient

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

Table 30. Temperature vs. resistance

Temperature (°F)	Resistance (in. 1000 Ohms)	Temperature (°F)	Resistance (in. 1000 Ohms)
-40	346.1	71	11.6
-30	241.7	72	11.31
-20	170.1	73	11.03
-10	121.4	74	10.76
-5	103	75	10.5
0	87.56	76	10.25
5	74.65	77	10
10	63.8	78	9.76
15	54.66	79	9.53
20	46.94	80	9.3
25	40.4	85	8.25
30	34.85	90	7.33
35	30.18	100	5.82
40	26.22	105	5.21
45	22.85	110	4.66
50	19.96	120	3.76
55	17.47	130	3.05
60	15.33	140	2.5
65	13.49	150	2.05
66	13.15	160	1.69
67	12.82	170	1.4
68	12.5	180	1.17
69	12.19	190	0.985
70	11.89	200	0.83

Emergency Stop Switch

A normally closed (N.C.) switch wired to the RTM may be used during emergency situations to shut down all unit operations. When opened, an immediate shutdown occurs. An emergency stop diagnostic is entered into the Human Interface and the unit must be manually reset. Refer to the appropriate illustrations in Figure 40, p. 74 and Figure 41, p. 75 for the proper connection terminals in the unit control panel. The switch must be rated for 12 ma @ 24 VDC minimum.

Occupied/Unoccupied Contacts

To provide Night Setback control if a remote panel with NSB was not ordered, a field supplied contact must be installed. This binary input provides the Occupied/Unoccupied status information of the building to the RTM. It can be initiated by a time clock, or a Building Automation System control output. The relay's contacts must be rated for 12 ma @ 24 VDC minimum. Refer to the appropriate illustrations in Figure 40, p. 74 and Figure 41, p. 75 for the proper connection terminals in the unit control panel.

Demand Limit Relay

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

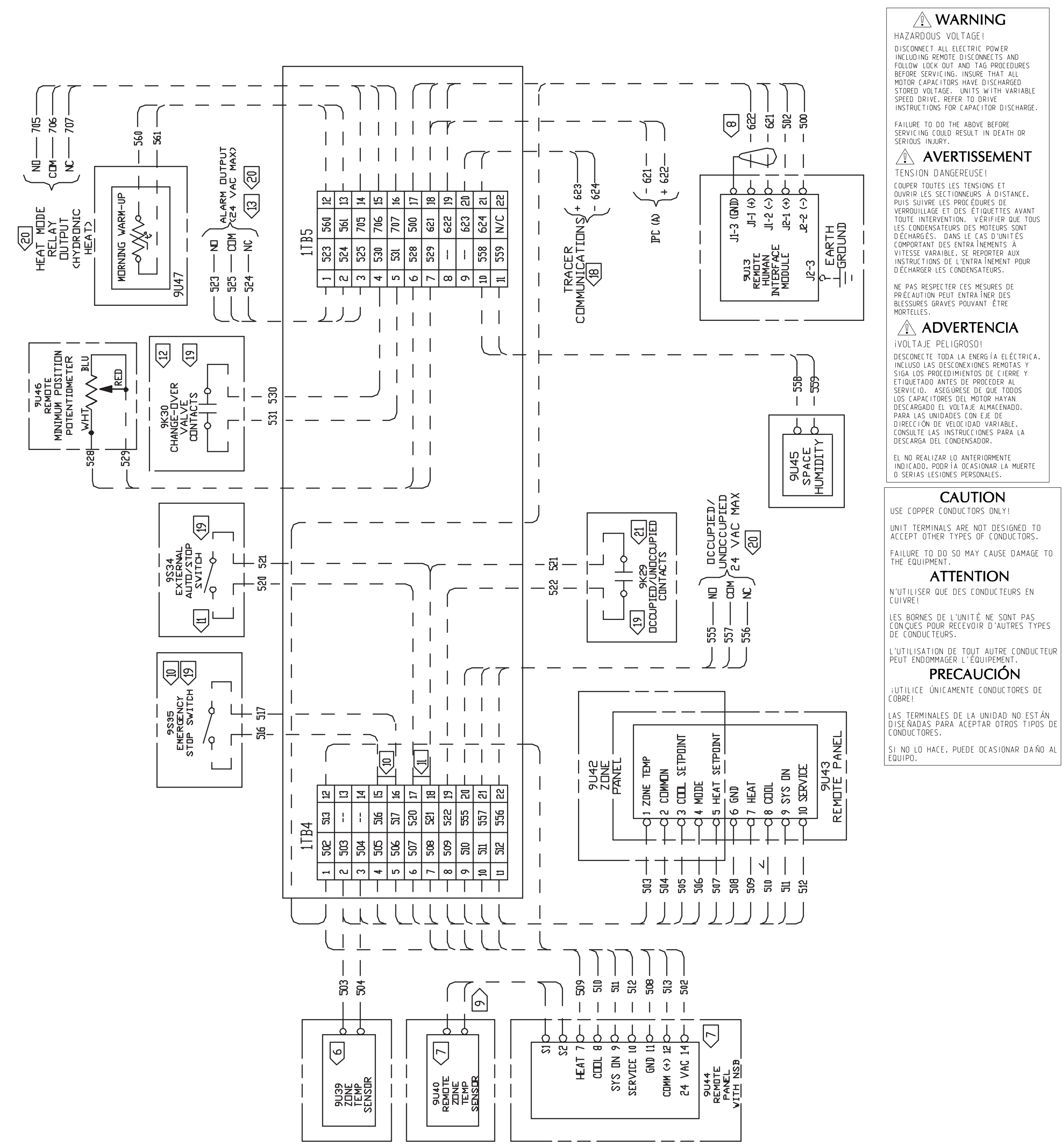
Outside Air Sensor (BAYSENS016*)

This device senses the outdoor air temperature and sends this information in the form of an analog input to the RTM. It's factory installed on units with an economizer, but can be field provided/ installed and used for informational purposes on units without an economizer. Refer to the appropriate illustrations in Figure 40, p. 74 and Figure 41, p. 75 for the proper connection terminals in the unit control panel. Refer to Table 30, p. 71 for Temperature vs. Resistance coefficient.

Generic Building Automation System

The Generic Building Automation System (GBAS) module allows a non-Trane building control system to communicate with the air handler unit and accepts external setpoints in form of analog inputs for cooling, heating, demand limiting, and supply air pressure parameters. Refer to Figure 44, p. 78 & Table 31, p. 79 for the input wiring to the GBAS module and the various desired setpoints with the corresponding DC voltage inputs for both VAV and CV applications.

Figure 39. Typical field wiring diagram for casings A-C CV control options



Notes: See notes Figure 43, p. 77
Source: 2309-3675

Figure 40. Typical ventilation override binary output for casings A-C CV control options

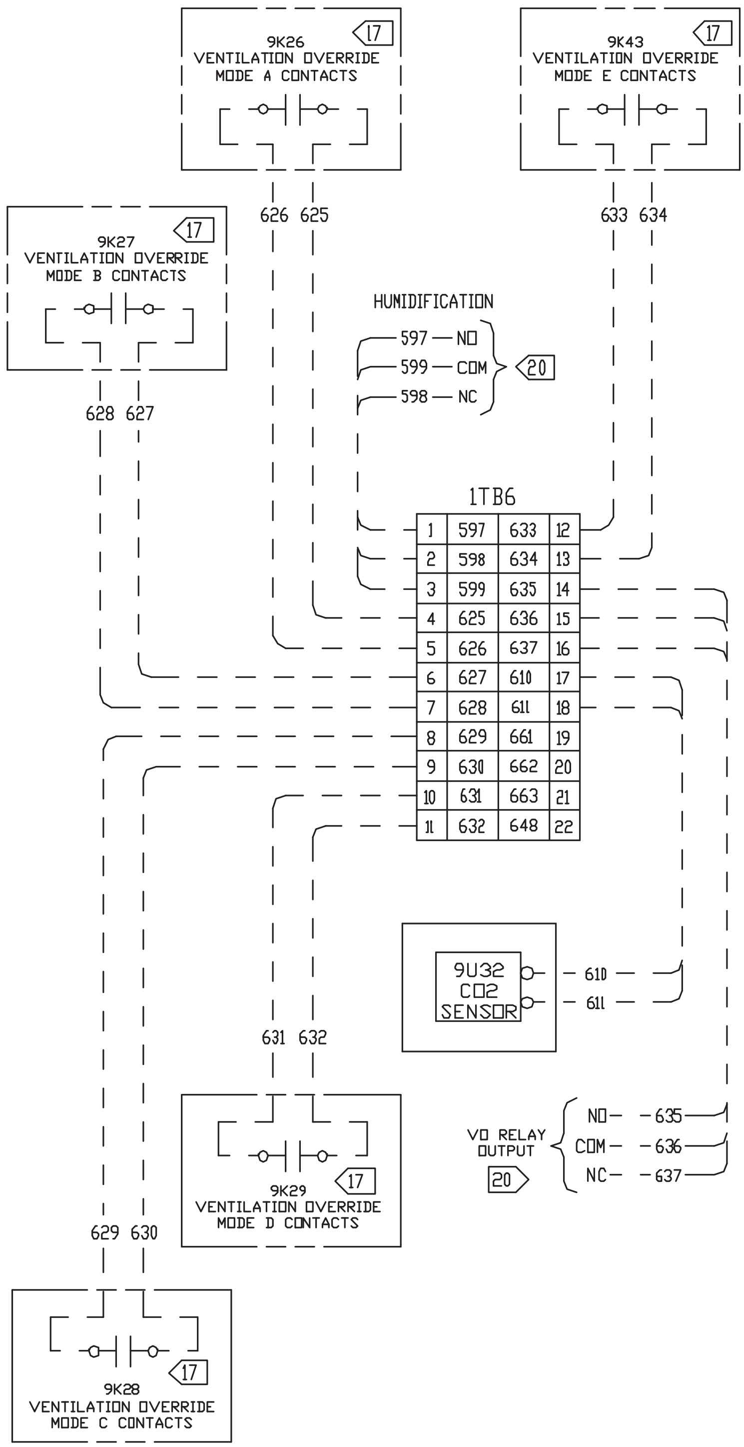
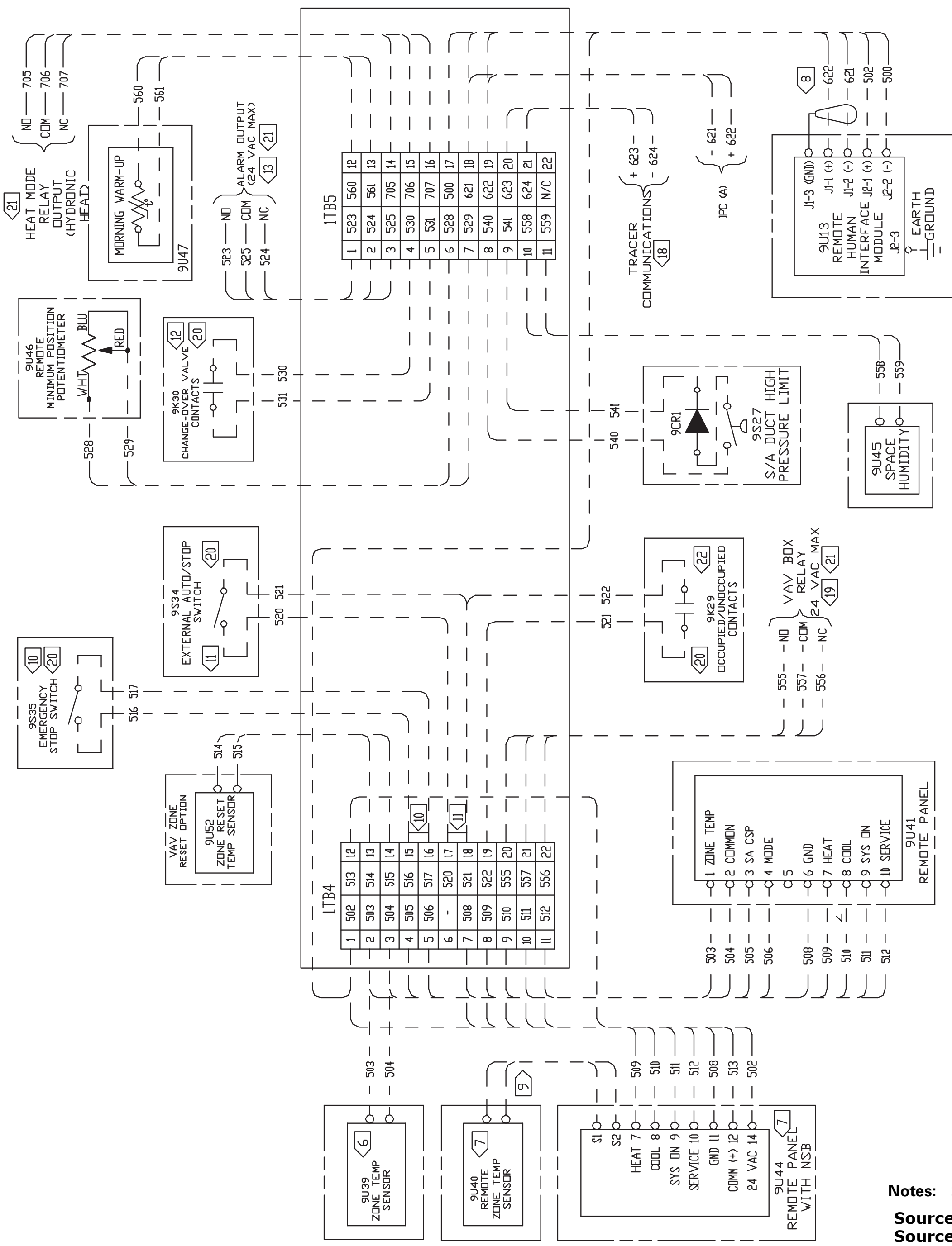


Figure 41. Typical field wiring diagram for casings A-C VAV control options



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Notes: See Figure 43, p. 77

Source: 2309-3676
Source: 2309-3675

Figure 42. Typical ventilation override binary output for casings A-C CV control options

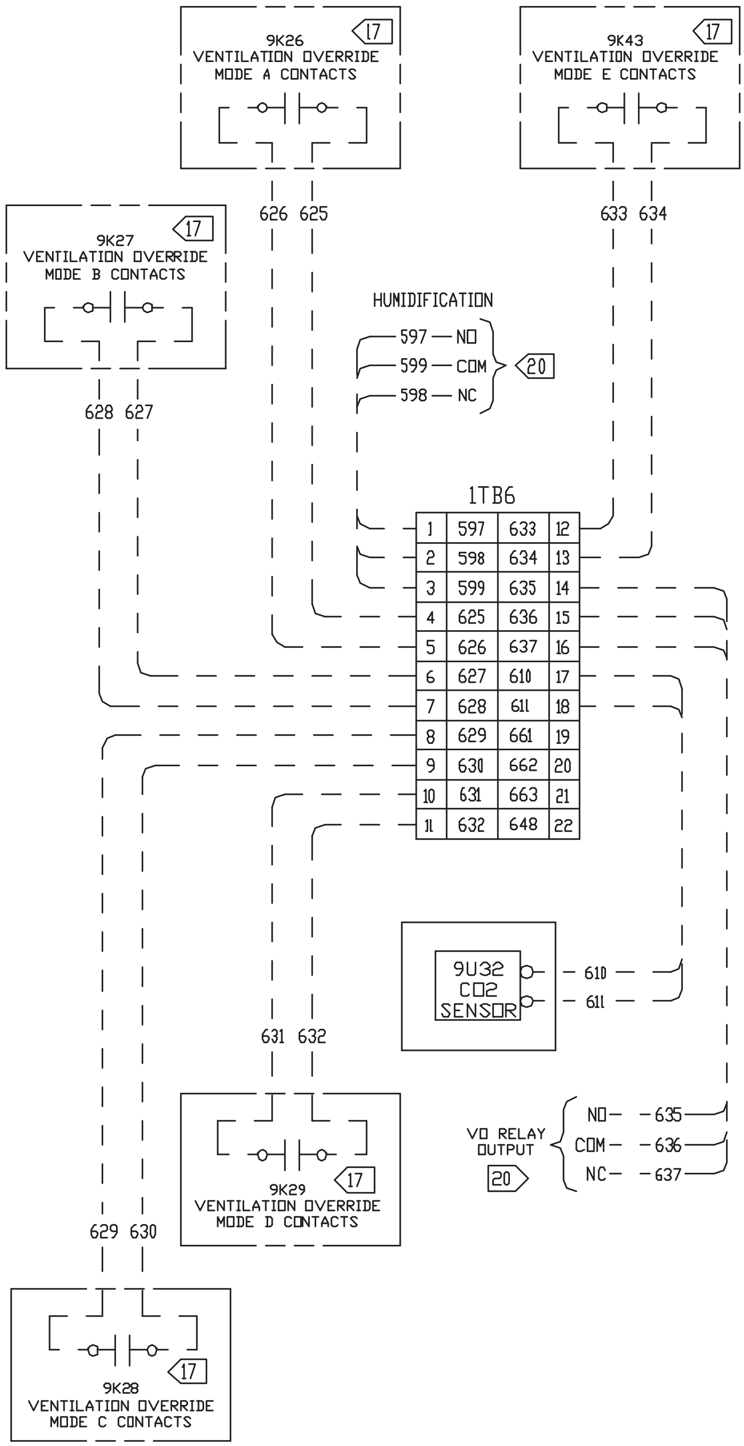
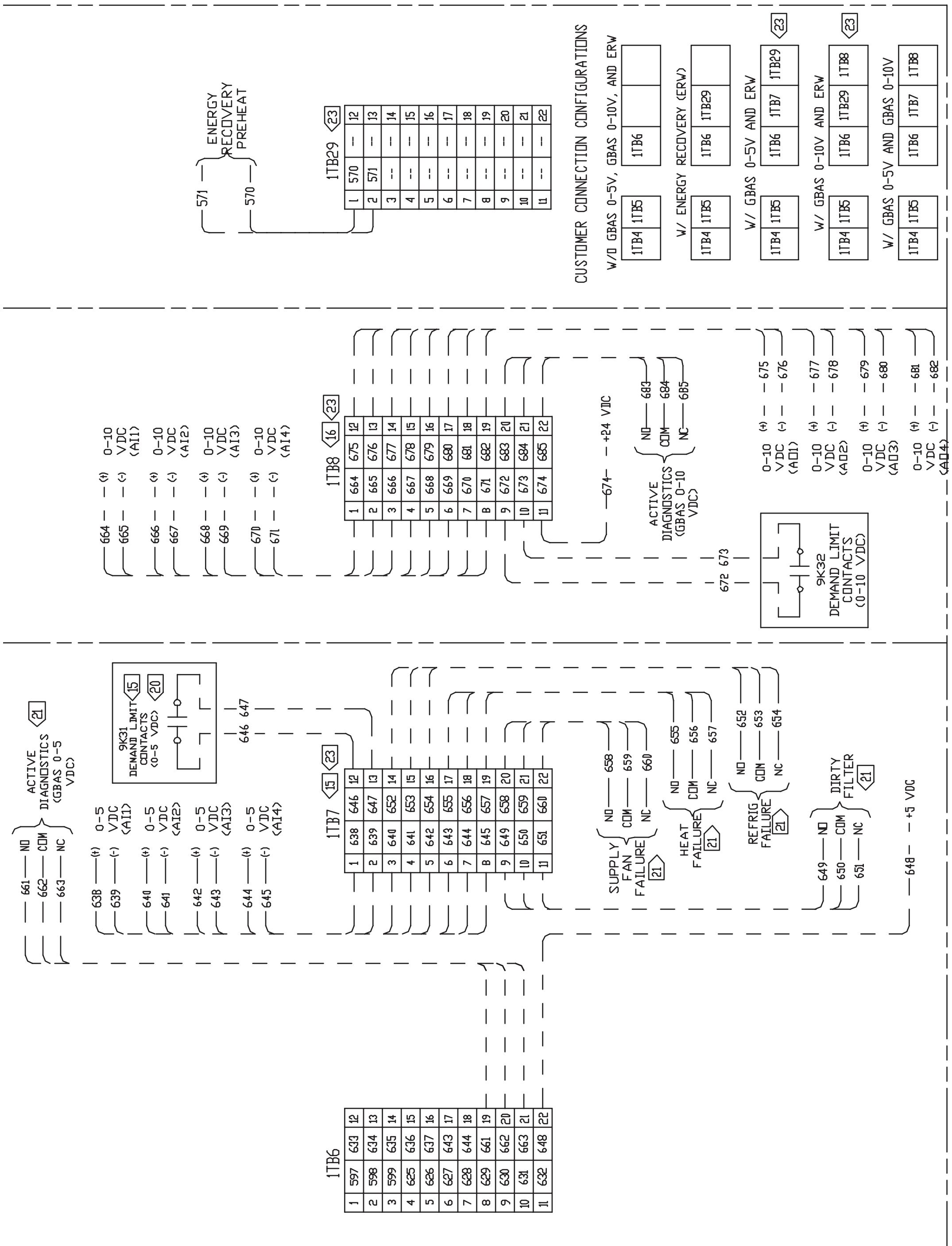


Figure 43. Typical field wiring diagram notes for VAV and CV control options

NOTES:

1. ALL WIRING AND COMPONENTS SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. CUSTOMER CONNECTIONS - MAIN UNIT CONTROLS ARE LOCATED IN THE CONDENSER SECTION FOR 90 THRU 150 TON UNITS.
3. SEE CUSTOMER CONNECTION WIRE RANGE TABLE FOR ACCEPTABLE WIRE SIZES FOR CONNECTION TO MAIN UNIT TERMINAL BLOCK (1TB1) OR DISCONNECT SWITCH (1S1).
4. WIRES TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT VALVE ARE SUPPLIED WITH THE UNIT. WIRE CONNECTIONS TO THE VALVE TO BE MADE BY THE CUSTOMER.
5. WIRES CONNECTING TO THE OPTIONAL STEAM AND/OR HOT WATER HEAT ACTUATOR AT NODES 100, 102, 545 AND 554 WILL BE NUMBERED 100AD, 102V, 545E AND 554E ON 1-PIECE UNITS AND WILL BE NUMBERED 100AA, 102AL, 545G AND 554G ON MULTI-PIECE UNITS.
6. OPTIONAL 9U39 REMOTE ZONE TEMP SENSOR IS USED FOR UNOCCUPIED HEAT/COOL TEMP CONTROL SENSING.
7. WHEN 9U40 REMOTE ZONE TEMP SENSOR IS USED, REMOVE INTERGRAL ZONE TEMP SENSOR ATTACHED TO TERMINALS S1 AND S2 ON 9U44 REMOTE PANEL.
8. WIRE USING SHIELDED TWISTED PAIR CABLE.
9. WIRE USING SHIELDED TWISTED PAIR CABLE. WRAP SHIELDS WITH TAPE TO PREVENT CONTACT WITH GROUND.
10. REMOVE JUMPER (1TB4-15 & 1TB4-16) AND INSTALL HIGH DUCT TEMP T-STAT OR FIELD SUPPLIED DEVICE.
11. REMOVE JUMPER (1TB4-17 & 1TB4-18) WHEN FIELD SUPPLIED EXTERNAL AUTO/STOP SWITCH (9S34) IS INSTALLED.
12. CHANGEOVER (9K30) AVAILABLE ONLY ON HYDRONIC HEAT UNITS OR MODULATING GAS HEAT UNITS.
13. ALARM OUTPUT ACTIVATES ON ANY MAPPED DIAGNOSTIC.
14. OPTIONAL HEAT MODULE AUX. TEMP (9RT17) IS USED FOR MORNING WARM-UP CONTROL ON UNITS WITH HEATING OPTION.
15. TERMINAL BLOCK 1TB7 AND ASSOCIATED WIRING REQUIRED WITH GBAS 0-5V (1U10) OPTION. DEMAND LIMIT RELAY (9K31) TO BE PROVIDED BY CUSTOMER.
16. TERMINAL BLOCK 1TB8 AND ASSOCIATED WIRING REQUIRED WITH GBAS 0-10V (1U11) OPTION.
17. VENTILATION OVERRIDE MODE CONTACTS (5K90 - 5K94) RATED 12 MA TO BE PROVIDED BY CUSTOMER.
18. WIRE NODES 623 & 624 REQUIRED WITH BAS/NETWORK COMM MODULE (1U7) OPTION.
19. FIELD CONNECTIONS TO DRIVE VAV BOXES FULL OPEN DURING NIGHT SETBACK MODE.
20. CONTACTS RATED 12 MA @ 24 VDC MINIMUM.
21. CONNECT TO 24VAC CLASS 2 CIRCUITS ONLY.
22. FIELD SUPPLIED AND INSTALLED OCCUPIED/UNOCCUPIED CONTACTS (9K29) FOR USE ON UNITS WITHOUT REMOTE PANEL WITH NIGHT SETBACK (9U44).
23. 1TB29 NOT AVAILABLE WHEN BOTH 0-5V GBAS AND 0-10V GBAS ARE INSTALLED. IF A SINGLE GBAS IS INSTALLED, 1TB29 WILL OCCUPY THE POSITION WHERE THE TERMINAL BLOCK SUPPORTING THE SECOND GBAS WOULD BE PLACED.

Figure 44. Typical GBAS analog input wiring diagram for casings A-C CV and VAV control options



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Notes: See Figure 43, p. 77

Table 31. GBAS voltage vs. setpoint

Setpoint	GBAS 0-5vdc	GBAS 0-10vdc	Valid Range
Occ Zone Cooling Setpoint(CV only)	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 90°F
Unocc Zone Cooling Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 90°F
Occ Zone Heating Setpoint(CV only)	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 90°F
Unocc Zone Heating Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 90°F
SA Cooling Setpoint (VAV only)	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 180°F
SA Heating Setpoint (VAV only)	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 180°F
Space Static Pressure Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	-0.20 to 0.30 IWC
SA Static Pressure Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	0.7 to 5.1 IWC
Min OA Flow Setpoint [1]	0.5 to 4.5vdc	0.5 to 9.5vdc	0 to Unit Max Flow
MWU Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 90°F
Econ Dry Bulb Enable Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	50 to 140°F
SA_Reheat_Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 180°F
Minimum Position Setpoint [2]	0.5 to 4.5vdc	0.5 to 9.5vdc	0 to 100%
Occ Dehumidification Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 65%
Unocc Dehumidification Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 65%
Occ Humidification Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 65%
Unocc Humidification Setpoint	0.5 to 4.5vdc	0.5 to 9.5vdc	40 to 65%

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

Sequence of Operation

Cooling Sequence of Operation

Time delays are built into the controls to increase reliability and performance.

SZVAV Cooling Sequence of Operation

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

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

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

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

Cooling Stages Minimum Fan Speed

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

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

Units without an Economizer

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

When a cooling request is sent to the RTM from a zone temperature sensor, the RTM evaluates the operating condition of the system using the supply air temperature input and the outdoor temperature input. before sending the request to the MCM.

Units with an Economizer

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

When a cooling request is sent to the RTM from the zone temperature sensor, the RTM evaluates the operating condition of the system using the supply air temperature input and the outdoor temperature input before sending the request to the MCM for mechanical cooling.

Units with Traq™ Sensor

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

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

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

If the CO_2 concentration is less than the DCV Minimum CO_2 Setpoint the OA damper will be closed to the DCV Minimum OA Damper Setpoint (w/o Traqs) or until the DCV Minimum OA Flow Setpoint is met (w/ Traqs). If the CO_2 concentration is between the Design Minimum CO_2 Setpoint and the DCV Minimum CO_2 Setpoint the OA damper will be modulated proportionally between the Design Minimum OA Damper Setpoint and the DCV Minimum OA Damper Setpoint (w/ Traqs) and between the Design Minimum OA Flow Setpoint and the DCV Minimum OA Flow Setpoint (w/o Traqs).

Units Equipped with 100% Modulating Exhaust

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

Gas Heating Sequence of Operation

Standard Two Stage Gas Furnace

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

Honeywell Ignition System

(850 & 1100 MBH Two Stage Natural Gas)

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

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

The system will operate in the low heat mode until an additional call for heat is established by closing the contacts on the Heat Module.

The sequencing time delay relay will energize the combustion blower motor relay which switches the combustion blower motor to high speed and energizes the 2nd stage solenoid on the gas valve after approximately 60 seconds.

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

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

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

(1800 MBH Two Stage Natural Gas)

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

The supply airflow switch and the combustion air switch closes. Power is applied through the high limit cutout to the Honeywell ignition control board. The ignition control board begins the pre-purge timing cycle with the damper in the light off position and the low fire start interlock is closed

At the end of the pre-purge cycle, the ignition transformer and the pilot solenoid valve are energized. This starts a 10-second trial for pilot ignition.

When the pilot flame is established and sensed by the flame sensing rod, the stage 1 of the main gas valve will begin. The gas butterfly control valve is in the low fire setting by the linkage arm connection between the combustion air actuator and the butterfly valve.

The system will operate in the low heat mode until there is an additional call for heat established by closing the contacts on the Heat Module.

If the flame rod does not detect a pilot flame within the 10 second trial for ignition period, the ignition control board will lockout. The combustion blower motor will continue to operate as long as a heating demand exists and the system switch is "On".

Once locked out on flame failure, the IC board will not reactivate the ignition/combustion control circuit until it is reset manually. To do this, press the reset button on the front of the IC board case.

A set of relay contacts is available for external use for heat fail (Information Only).

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

Modulating Gas Sequence of Operation

The control system for air handler units is wired to ensure that the heating and cooling do not occur simultaneously. Refer to the modulating heat wiring diagram that shipped with the unit while reviewing the following sequence of operation. As you review the sequence of operation, keep the following in mind:

1. The furnace will not light unless the manual gas valves are open and the control circuit switch is closed.
2. The control systems are wired to ensure that heating and cooling cannot occur simultaneously.
3. The unit supply fans must run continuously so airflow switch will stay closed.
4. Modulating Gas heat is available during both occupied and unoccupied operation.

When there is a call for heat, the heat module energizes the combustion blower which causes the combustion air flow switch to close. The ignition control board will energize providing that the indoor air flow switch, high limit, and low and high pressure gas switches are closed.

The Low Pressure Gas Switch must be closed, indicating the required minimum gas pressure is present. The High Pressure Gas Switch must be closed, indicating the manifold pressure is not set too high. The ignition control board then causes the combustion air actuator to drive the inlet air damper to the fully open position for a 30 second pre-purge. The pre-purge time does not begin until the purge interlock switches are made.

After the pre-purge, the combustion air actuator drives the inlet air damper and the gas butterfly control valve to a nearly closed position for light off. When the Low fire interlock switch on is closed the ignition transformer is energized, the igniter begins to spark and the main valve and auxiliary gas valve open.

This begins a 10-second trial for ignition period during which the flame rod must detect the flame. If does not detect a flame at the end of the period, it will shut down and lock out the ignition/ combustion circuit.

Once the light off flame has been established, the heat module will drive the combustion air actuator to a firing rate based on a 2-10 VDC signal. The gas butterfly control valve will respond through the connecting linkage.

The heater will continue to run until the call for heat is removed or a limit opens. Following the completion of the call for heat, there is a 15-second post-purge.

Flame Failure

In the event that (IC) board loses the "proof-of-flame" input signal during furnace operation, it will lock out and the must be manually reset (Combustion blower motor continues to run as long as a heating requirement exists and control circuit switch is ON.)

Once locked out on flame failure, the (IC) board will not reactivate the ignition/combustion control circuit until it is reset manually. To do this, press the reset button on the front of the (IC) board case.

A set of relay contacts is available for external use for heat fail (Information Only).

Note: *The modulating gas heaters are factory adjusted for the proper air/gas ratio at minimum and nameplate rated firing MBH for most areas in the country.*

Electric Heat Sequence of Operation

The control system for air handler units is wired to ensure that heating and cooling do not occur simultaneously. Refer to electric heat wiring diagrams that shipped with the unit while reviewing the following sequence of operation. As you review the sequence of operations, remember these points:

1. The high limit switch will trip if exposed to a temperature greater than the trip point, and will reset automatically once the temperature falls below the reset point.
2. The linear high limit switch is encased in a capillary that extends across the unit supply air opening. The limit will trip if any 6” span of the capillary exceeds the trip point.
3. Electric heat will only energize if both of the high limit safety controls are closed.

CV Electric Heat

CV electric heat operation is done with discrete stages of electric heat. Stages 2 and 3 will not energize unless Stage 1 is already operating and unable to satisfy the heating load. The heat will be staged to control to the Zone Temperature Heating Setpoint.

VAV Occupied Electric Heat

VAV occupied electric heating operation is done with discrete stages (steps) of electric heat. The heat staging is dependent on unit tonnage and heater selection. The heat will be staged to control to the Supply Air Heating Setpoint.

Demand Control Ventilation Sequence of Operation

Sequence of Operation without TRAQs

If the space CO_2 level is greater than or equal to the Design Minimum CO_2 Setpoint, the outdoor air damper will open to the Design Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space CO_2 level is less than or equal to the DCV Minimum CO_2 Setpoint, the outdoor air damper will close to the DCV Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space CO_2 level is greater than the DCV Minimum CO_2 Setpoint and less than the Design Minimum CO_2 Setpoint, the outdoor air damper position is modulated proportionally to the space CO_2 level relative to a target position between the DCV Minimum CO_2 Setpoint and the Design Minimum CO_2 Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

Sequence of Operation with TRAQs

If the space CO_2 level is greater than or equal to the Design Minimum CO_2 Setpoint, the outdoor air damper will open to the Design Minimum Outdoor Air Flow Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space CO_2 level is less than or equal to the DCV Minimum CO_2 Setpoint, the outdoor air damper will close to the DCV Minimum Outdoor Air Flow Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the space CO_2 level is greater than the DCV Minimum CO_2 Setpoint and less than the Design Minimum CO_2 Setpoint, the outdoor air damper position is modulated proportionally to the space CO_2 level relative to a target position between the DCV Minimum CO_2 Setpoint and the Design Minimum CO_2 Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

Return Fan Sequence of Operation

Whenever the Supply Fan is turned ON, the return fan will be turned ON. The speed of the return fan will control to the Return Air Plenum Pressure Target. The target is calculated internal to the control and will be between the Minimum Return Air Plenum Pressure Setpoint and the Maximum Return Air Plenum Pressure Setpoint depending on unit operation conditions. A Return Air Pressure High Limit will be set at 3.5 IWC. If the pressure inside the return plenum exceeds the limit the unit will shut down.

Wet Heat Sequence of Operation

Electrical circuitry for units with steam or hot water heat is limited to the connections associated with the modulating valve actuator and the freezestat. Like the furnaces described earlier, steam and hot water heat control systems are wired to ensure that simultaneous heating and cooling do not occur. The supply fan will cycle "On" and "Off" with each call for heat during both an occupied and unoccupied period.

Whenever there is a call for heat, **the relay on the heat module** energizes. This allows a modulated voltage signal to be sent to the "Wet" heat actuator. The value of this signal regulates the flow of steam or hot water through the coil by positioning the valve stem at some point between fully closed (6 VDC) and fully open (8.5 VDC).

Freeze Protection

A freezestat is mounted inside the heat section of hot water and steam heat units to prevent the "wet" heat coil from freezing during the "Off" cycle.

If the temperature of the air leaving the heating coils falls to 40 F, the freezestat normally open contacts close, completing the heat fail circuit on the UCM. When this occurs:

1. The supply fan is turned "Off".
2. "Wet" heat actuator fully opens to allow hot water or steam to pass through the heating coil and prevent freeze-up.
3. A "Heat Fail" diagnostic is displayed on the Human Interface LCD screen.

For heating control settings and time delay specifications, refer to Table 38, p. 113. Use the following checklist, in conjunction with the "General Unit Requirement" checklist", to ensure that the unit is properly installed and ready for operation. Be sure to complete all of the procedures described in this section before starting the unit for the first time.

- Turn the field supplied disconnect switch, located upstream of the air handler unit, to the "Off" position.

⚠WARNING

Hazardous Voltage!

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

- Turn the 115 volt control circuit switch 1S1 to the "Off" position. It is located in the secondary of the 1T1 transformer.
- Turn the 24 volt control circuit switch 1S70 to the "Off" position. It is located in the secondary of the 1T2 & 1T3 transformers.
- Turn the "System" selection switch (at the Remote Panel) to the "Off" position and the "Fan" selection switch (if Applicable) to the "Auto" or "Off" position.
- Check all electrical connections for tightness and "point of termination" accuracy.

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

Standard unit with or without HGBP-+45 F

- Check the supply fan belts for proper tension and the fan bearings for sufficient lubrication. If the belts require adjustment, or if the bearings need lubricating, refer to the Service/ Maintenance section of this manual for instructions.
- Inspect the interior of the unit for tools and debris. Install all panels in preparation for starting the unit.

Table 32. Service test guide component operation

COMPONENT BEING TESTED	COMPONENT CONFIGURATION								Occ Unocc Relay
	Supply Fan	Exhaust Fan	Heat Stages			Econo Damper	Exhaust Damper	VFD Output	
			1	2	3				
SUPPLY FAN	ON	OFF	OFF	OFF	OFF	Closed	Closed	100%	Unocc
EXHAUST FAN	OFF	ON	OFF	OFF	OFF	Closed	Closed	100%	Default
CHILLED WATER	OFF	OFF	100% Select			Closed	Closed	0%	Default
GAS HEAT (Full Capacity)	ON	OFF	ON	ON	N/A	Closed	Closed	100%	Unocc
STAGE 1	ON	OFF	ON	OFF	N/A	Closed	Closed	100%	Unocc
STAGE 2	ON	OFF	OFF	ON	N/A	Closed	Closed	100%	Unocc
FULL MODULATING	ON	OFF	10% - 90%			Closed	Closed	100%	Unocc
ELECTRIC HEAT	ON	OFF	ON	ON	ON	Closed	Closed	100%	Unocc
Stage 1	ON	OFF	ON	OFF	OFF	Closed	Closed	100%	Unocc
Stage 2	ON	OFF	OFF	ON	OFF	Closed	Closed	100%	Unocc
Stage 3	ON	OFF	OFF	OFF	ON	Closed	Closed	100%	Unocc
HYDRONIC HEAT	OFF	OFF	100% Select			Closed	Closed	0%	Default
FRESH AIR DAMPERS	OFF	OFF	100% Select			100% Open	Closed	0%	Default
EXHAUST DAMPERS	OFF	OFF	100% Select			100%	100% Open	0%	Default

Verifying Proper Fan Rotation

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position and the "Fan" selection switch for constant volume units is in the "Auto" position. (VAV units do not utilize a "Fan" selection input.)
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block 1TB1 or the unit mounted disconnect switch 1S14.
3. Turn the 115 volt control circuit switch 1S1 and the 24 volt control circuit switch 1S70 to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 32, p. 86 to program the unit Fans for operation by scrolling through the displays. All Fans can be programmed to be "On", if desired. Verify proper fan rotation for VFDs with bypass.
6. Once the configuration for the Fans is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

⚠WARNING

Rotating Components!

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

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fans will begin to operate.
8. Check the supply fan and the exhaust fans (if equipped) for proper rotation. The direction of rotation is indicated by an arrow on the fan housings.

If all of the fans are rotating backwards

1. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.
2. Open the field supplied disconnect switch upstream of the air handler unit. Lock the disconnect switch in the open position while working at the unit.

⚠WARNING

Hazardous Voltage!

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

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

Note: *Interchanging "Load" side power wires at the fan contactors will only affect the individual fan rotation. Ensure that the voltage phase sequence at the main terminal block or the factory mounted disconnect switch is ABC as outlined in the "Electrical Phasing" section.*

If some of the fans are rotating backwards

1. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.
2. Open the field supplied disconnect switch upstream of the air handler unit. Lock the disconnect switch in the open position while working at the unit.
3. Interchange any two of the fan motor leads at the contactor for each fan that is rotating backwards.

System Airflow Measurements

Constant Volume Systems

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position and the "Fan" selection switch for constant volume units is in the "Auto" position. (VAV units do not utilize a "Fan" selection input.)
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

⚠WARNING

Hazardous Voltage!

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

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

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 32, p. 86 to program the Supply Fan for operation by scrolling through the displays.
6. Once the configuration for the Fan is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the **+** key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

⚠WARNING

Live Electrical Components!

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

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fans will begin to operate.
8. With the system in the SERVICE MODE and the supply fan rotating in the proper direction, measure the amperage at the supply fan contactors. If the amperage exceeds the motor nameplate value, the static pressure is less than design and the airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);
   a. Measure the actual fan RPM
   b. Calculate the Theoretical BHP

   Actual Motor Amps X Motor HP

   Motor Nameplate Amps

   c. Plot this data onto the appropriate Fan Performance Curve beginning with Figure 12, p. 31. Where the two points intersect, read straight down to the CFM line.

Use this data to assist in calculating a new fan drive if the CFM is not at design specifications.

An alternate method with less accuracy is to measure the static pressure drop across the chilled water coil. This can be accomplished by;

   d. drilling a small hole through the unit casing on each side of the coil.

Note: *Coil damage can occur if care is not taken when drilling holes in this area.*

   e. Measure the difference between the pressures at both locations.

f. Plot this value onto the appropriate pressure drop curve beginning with Figure 39, p. 73. Use the data in Table 22, p. 54
(Component Static Pressure Drops) to assist in calculating a new fan drive if the CFM is not at design specifications.

g. Plug the holes after the proper CFM has been established.

9. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

Variable Air Volume Systems

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

⚠WARNING

Hazardous Voltage!

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

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

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate Programming Manual for VAV applications for the SERVICE TEST screens and programming instructions.

   Use Table 32, p. 86 to program the following system components for operation by scrolling through the displays:

   Supply Fan,

   Variable Frequency Drive (100% Output, if applicable),

   RTM Occ/Unocc Output (Unoccupied)
5. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the **+** key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

⚠WARNING

Live Electrical Components!

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

6. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
7. With the VFD at 100% and the supply fan operating at full airflow capability, measure the amperage at the supply fan contactors. If the amperage exceeds the motor nameplate value,

the static pressure is less than design and the airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);

a. Measure the actual fan RPM

b. Calculate the Theoretical BHP

Actual Motor Amps X Motor HP

Motor Nameplate Amps

c. Plot this data onto the appropriate Fan Performance Curve beginning with Figure 39, p. 73. Where the two points intersect, read straight down to the CFM line.

Use this data to assist in calculating a new fan drive if the CFM is not at design specifications.

An alternate method with less accuracy is to measure the static pressure drop across the chilled water coil. This can be accomplished by:

d. drilling a small hole through the unit casing on each side of the coil.

Note: *Coil damage can occur if care is not taken when drilling holes in this area.*

e. Measure the difference between the pressures at both locations.

f. Plot this value onto the appropriate pressure drop curve beginning with Figure 39, p. 73. Use the data in Table 23, p. 62 (Component Static Pressure Drops) to assist in calculating a new fan drive if the CFM is not at design specifications.

g. Plug the holes after the proper CFM has been established. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

8. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

Exhaust Airflow Measurement (Optional)

1. Close the disconnect switch or circuit protector switch that provides the supply power to the unit's terminal block or the unit mounted disconnect switch.

⚠WARNING

Hazardous Voltage!

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

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

2. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
3. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
4. Use Table 32, p. 86 to program the following system components for operation by scrolling through the displays:

   Exhaust Fan,

   Exhaust Dampers (100% Open, if applicable),

   Fresh Air dampers (100% Open),

Variable Frequency Drive (100%, if applicable),

RTM Occ/Unocc Output (Default)

5. Once the configuration for the components is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

WARNING

Live Electrical Components!

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

6. Press the TEST START key to start the test. Remember that the delay designated in step 5 must elapse before the fans will begin to operate.
7. With the exhaust dampers open and the exhaust fan operating at full airflow capability, measure the amperage at the exhaust fan contactor. If the amperage exceeds the motor nameplate value, the static pressure is less than design and airflow is too high. If the amperage is below the motor nameplate value, static pressure may be too high and CFM may be too low. To determine the actual CFM (± 5%);
   a. Measure the actual fan RPM
   b. Calculate the Theoretical BHP

   Actual Motor Amps X Motor HP

   Motor Nameplate Amps

Use appropriate figures beginning with Figure 45, p. 93 to calculate a new fan drive if the CFM is not at design specifications.

8. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.

Traq™ Sensor Airflow Measurement (Optional with all units equipped with an economizer)

1. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
2. Use Table 32, p. 86 to program the following system components for Economizer operation by scrolling through the displays;

   Supply Fan (On)

   Fresh Air dampers (Selected% Open)

   Variable Frequency Drive (100% Output, if applicable)

   RTM Occ/Unocc Output (Unoccupied)

   Outside Air CFM Setpoint

   Outside Air Pre-Heater Operation (if applicable)

3. Once the configuration for the components is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test

is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

4. Press the TEST START key to start the test. Remember that the delay designated in step 3 must elapse before the fans will begin to operate.
5. With the unit operating in the "TEST MODE", the amount of outside air flowing through the traq sensor can be viewed by switching to the "STATUS MENU" screen "OA CFM.
6. Scroll to the "ECONOMIZER ENABLE/ECONOMIZER POSITION" screen by pressing the "NEXT" key and read the corresponding damper opening percentage (%).
7. Press the STOP key at the Human Interface Module in the unit control panel to stop the unit operation.

Performance Data

Supply Fan (with or without Variable Frequency Drive)

Figure 45. Supply fan performance STANDARD CFM — casing A, 25"

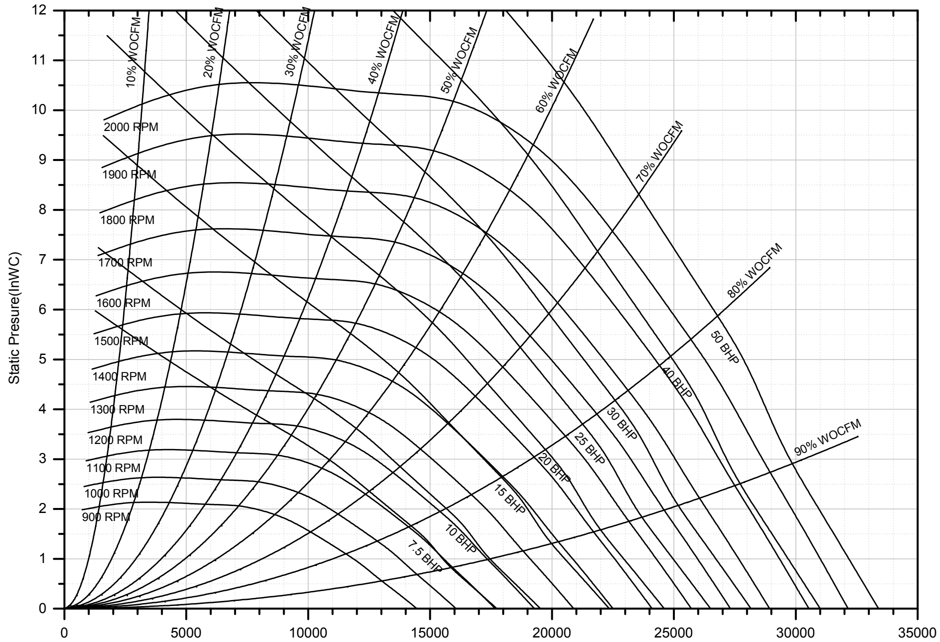


Figure 46. Supply fan performance STANDARD CFM — casing B, 32"

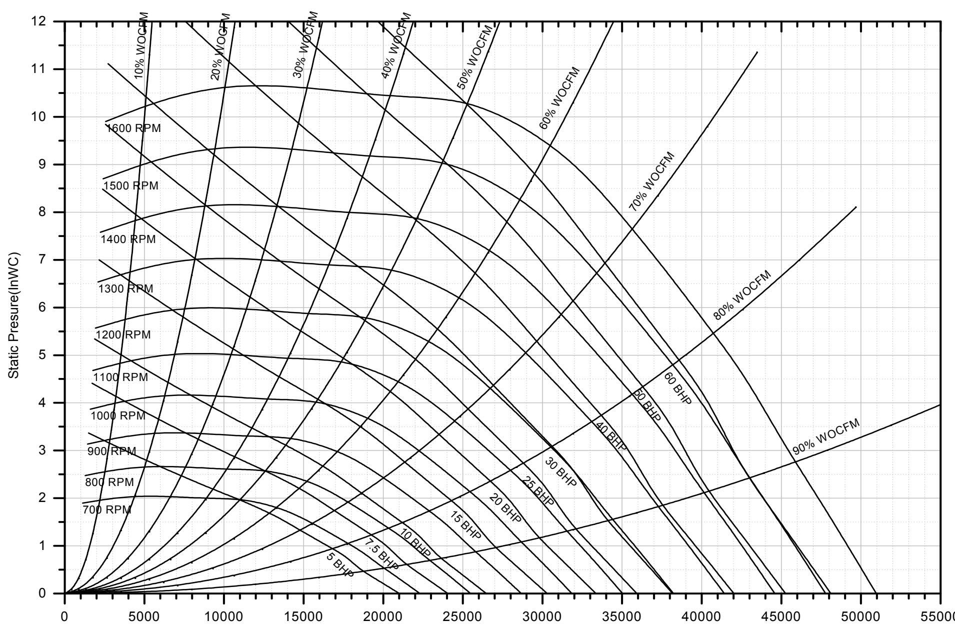
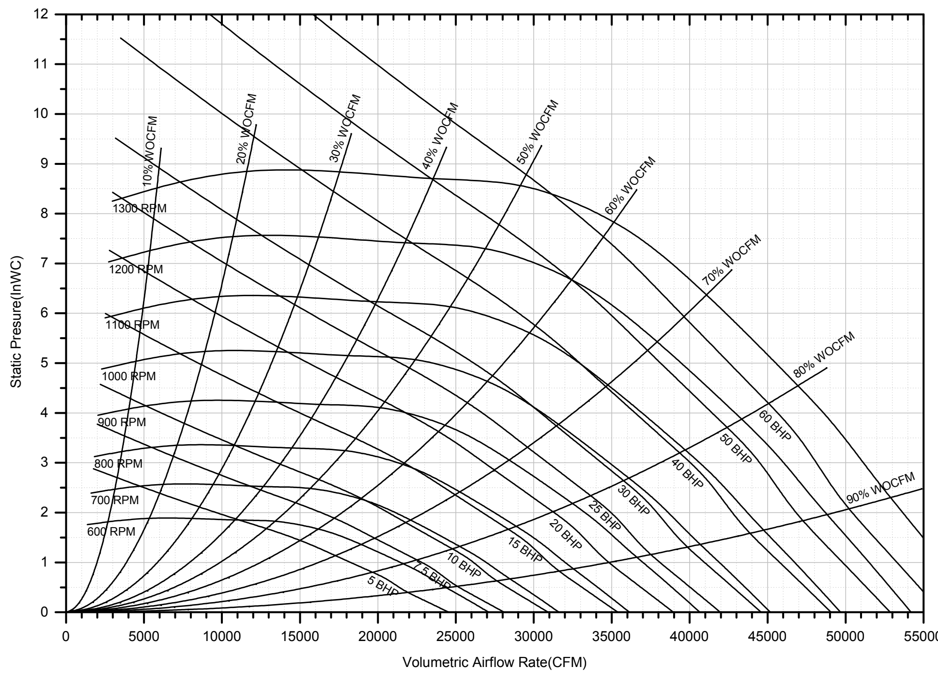


Figure 47. Supply fan performance STANDARD CFM — casing C, 36”



Exhaust Fan

Figure 48. Exhaust fan performance STANDARD CFM—casing A; LOW CFM—casing B

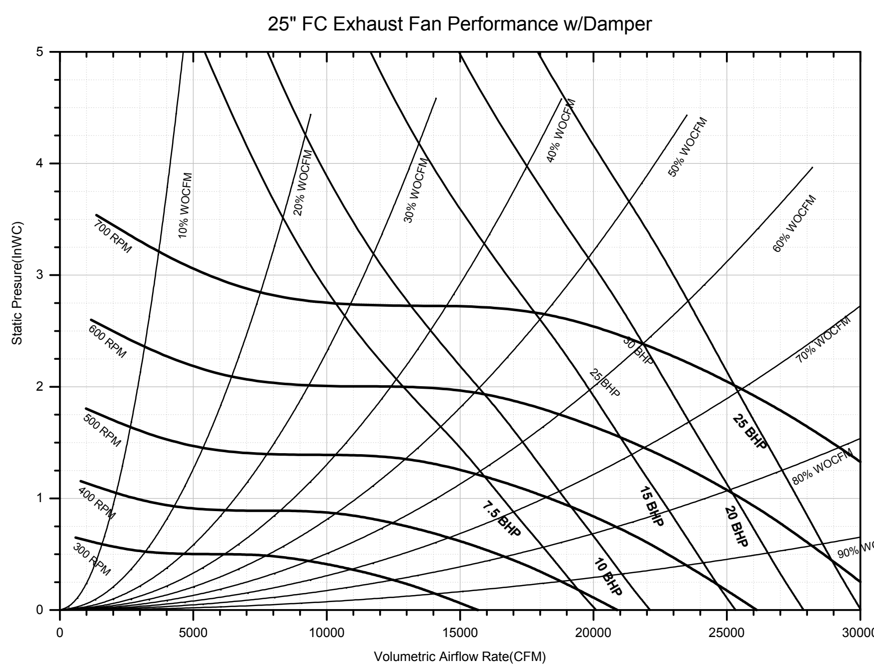


Figure 49. Exhaust fan performance STANDARD CFM—casing B; LOW CFM—casing C

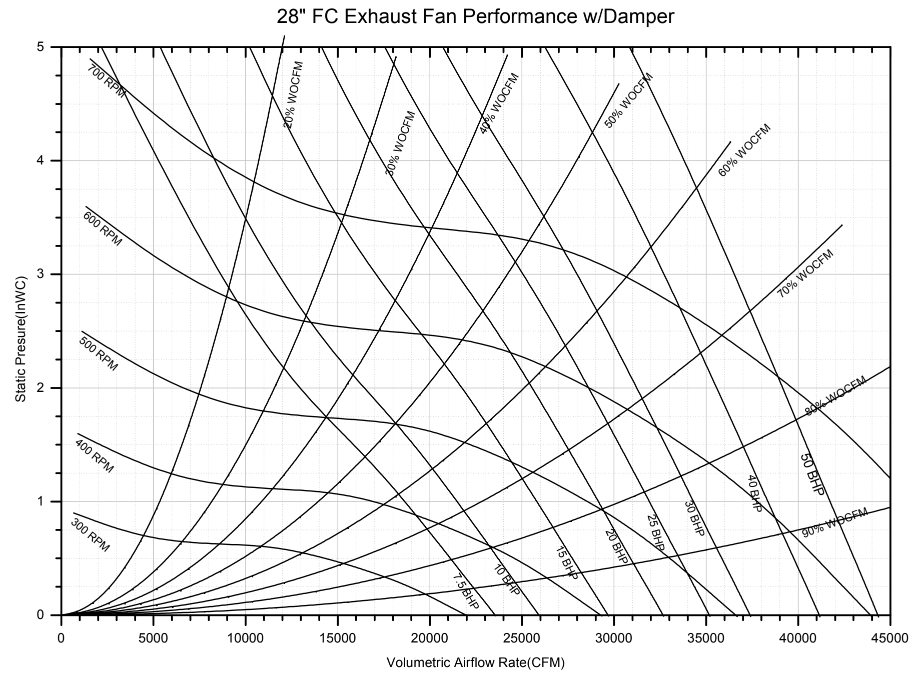
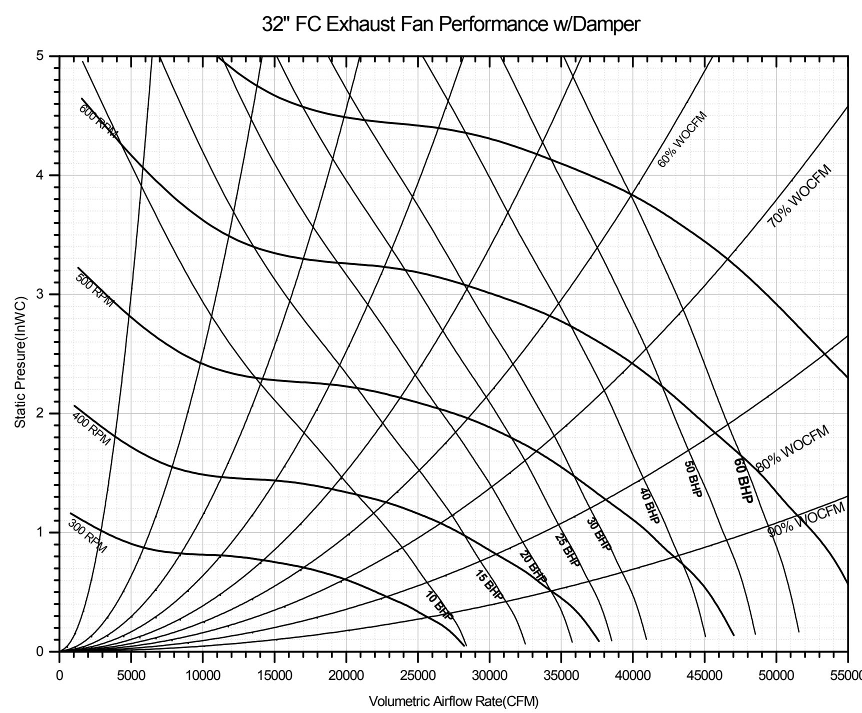


Figure 50. Exhaust fan performance standard CFM—casing C



Return Fan

Figure 51. Return fan performance STANDARD CFM—casing A

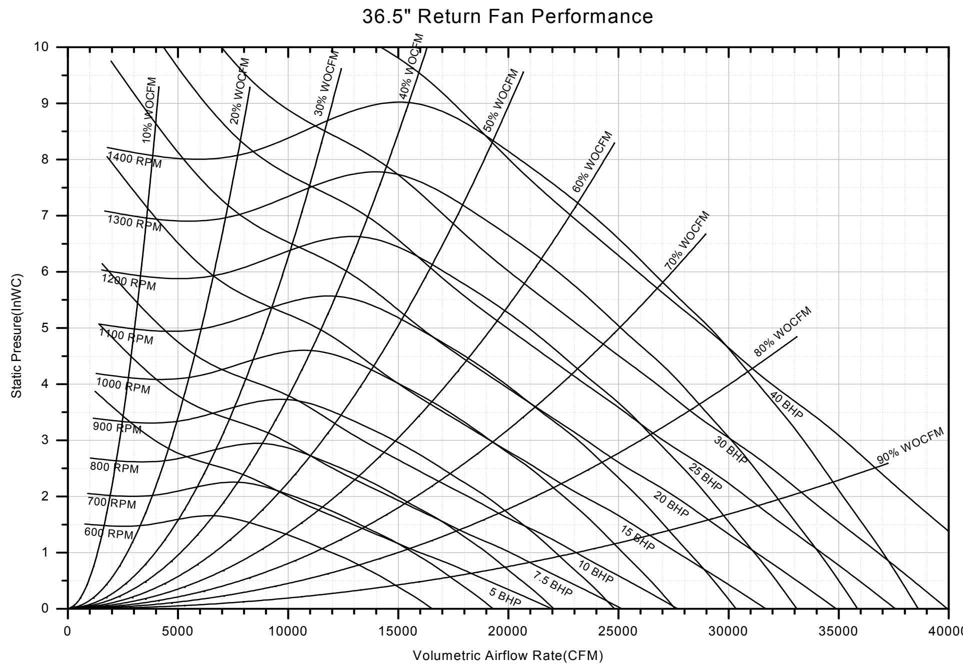
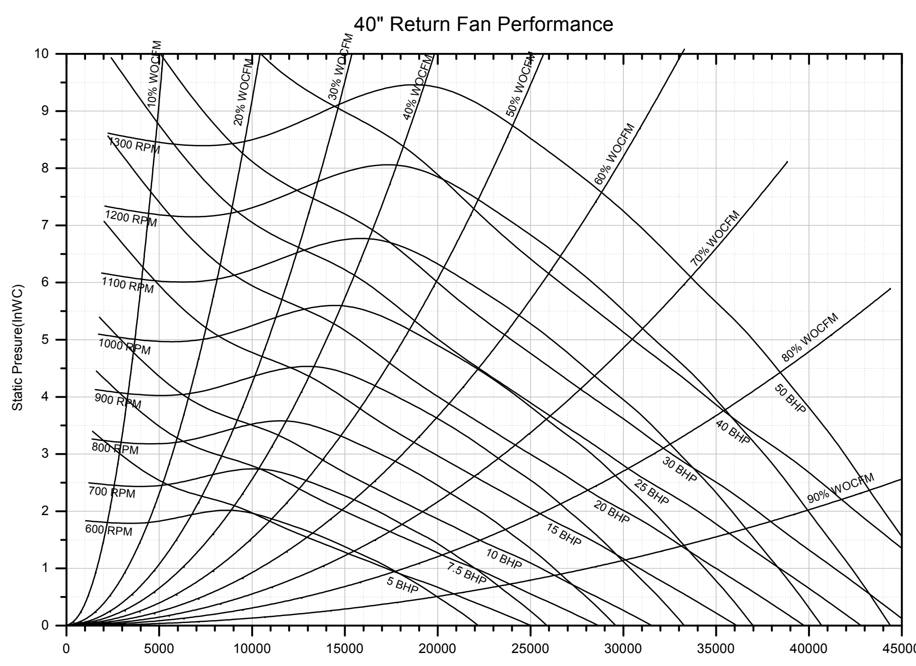


Figure 52. Return fan performance standard CFM—casing B and C



Component Static Pressure Drops

Table 33. Chilled water coil airside pressure drop (in H_2O)

Casing	CFM	Chilled Water Coil Airside Pressure Drop (in H_2O) 2 row 80 fpf	2 row 108 fpf	2 row 144 fpf	2 row 168 fpf	4 row 80 fpf	4 row 108 fpf	4 row 144 fpf	4 row 168 fpf	6 row 80 fpf	6 row 108 fpf	6 row 144 fpf	6 row 168 fpf	8 row 80 fpf	8 row 108 fpf	8 row 144 fpf	8 row 168 fpf
A, B, C	16000	0.03	0.06	0.09	0.12	0.09	0.13	0.19	0.25	0.13	0.19	0.29	0.36	0.18	0.27	0.39	0.49
	20000	0.06	0.09	0.13	0.16	0.13	0.19	0.27	0.34	0.20	0.28	0.40	0.50	0.27	0.38	0.54	0.68
	23000	0.07	0.11	0.16	0.19	0.17	0.24	0.33	0.41	0.25	0.35	0.49	0.61	0.34	0.48	0.67	0.83
	28000	0.10	0.15	0.21	0.26	0.24	0.33	0.44	0.54	0.35	0.49	0.66	0.81	0.48	0.67	0.89	1.10
	33000	0.14	0.19	0.26	0.32	0.31	0.43	0.57	0.69	0.46	0.64	0.85	1.03	0.63	0.87	1.14	1.39
	38000	0.18	0.24	0.33	-	0.40	0.54	0.70	-	0.59	0.80	1.04	-	0.81	1.09	1.41	-
	43000	0.22	0.29	-	-	0.49	0.65	-	-	0.73	0.98	-	-	0.99	1.34	-	-
	45000	0.23	0.31	-	-	0.53	0.70	-	-	0.78	1.05	-	-	1.07	1.44	-	-

Table 34. Component static pressure drops (in. H_2O)

Casing	CFM	Electric Heating (Horiz.) All kW's (i)	Gas Heating Low Heat DF	Gas Heating Low Heat Hz	Gas Heating Medium Heat DF	Gas Heating Medium Heat Hz	Gas Heating High Heat DF	Gas Heating High Heat Hz	Hydronic Heating Coil Data Hot Water Coil High	Hot Water Coil Low	Steam Coil High	Steam Coil Low	Return Damper	Econo Damper (wide open in H_2O)	Traq Damper (wide open in H_2O)
A, B, C	16000	0.01	0.01	0.10	0.01	0.12	0.01	0.14	0.13	0.08	0.12	0.08	0.06	0.11	0.19
	20000	0.02	0.01	0.16	0.01	0.19	0.01	0.22	0.17	0.11	0.16	0.11	0.09	0.15	0.26
	23000	0.03	0.01	0.21	0.01	0.26	0.01	0.30	0.23	0.15	0.22	0.16	0.13	0.23	0.38
	28000	0.04	0.02	0.31	0.02	0.38	0.02	0.44	0.32	0.21	0.31	0.22	0.20	0.34	0.57
	33000	0.06	0.02	0.42	0.02	0.53	0.02	0.61	0.42	0.28	0.41	0.30	0.28	0.47	0.79
	38000	0.07	0.03	0.56	0.03	0.70	0.03	0.81	0.53	0.36	0.52	0.39	0.38	0.63	1.05
	43000	0.10	0.04	0.72	0.04	0.89	0.04	1.03	0.65	0.45	0.65	0.49	0.49	0.81	1.34
	45000	0.10	0.04	0.79	0.04	0.98	0.04	1.13	0.71	0.49	0.70	0.53	0.53	0.89	1.47

(i) There is no pressure drop with Electric Heat DF configuration

Performance Data

Table 35. Component static pressure drops (in. H_2O)

Casing	CFM	Standard Filter Section (Cooling Coil)				Final Filter Section (Cooling Coil)					
		Std 2" High Eff Throw Away Filters	90-95% Low PD Cartridge Filters w/ 2" Prefilter	90-95% Cartridge Filters w/ 2" Prefilter(i)	90-95% Bag Filters w/ 2" Prefilter (i)	90-95% Std Temp Low PD Cartridge Filters w/ 4" Prefilter (i)	90-95% Std Temp Bag Filters w/ 2" Prefilter (i)	90-95% Std Temp Cartridge Filters w/ 2" Prefilter (i)	90-95% Hi Temp Cartridge Filters w/ 2" Hi Temp Prefilter (i)	90-95% Hi Temp HEPA w/ 2" Hi Temp Prefilter (ii)	90-95% Std Temp HEPA Filters w/ 2" Hi Temp Prefilter (ii)
A, B, C	16000	0.08	0.24	0.27	0.34	0.23	0.36	0.29	0.35	0.54	0.48
	20000	0.11	0.29	0.32	0.39	0.29	0.42	0.34	0.42	0.66	0.58
	23000	0.11	0.29	0.32	0.39	0.29	0.42	0.34	0.42	0.66	0.58
	28000	0.18	0.49	0.49	0.56	0.51	0.61	0.54	0.68	1.01	0.88
	33000	0.23	0.61	0.61	0.67	0.65	0.73	0.69	0.86	1.22	1.06
	38000	0.28	0.74	0.76	0.78	0.81	0.86	0.86	1.06	-	-
	43000	0.33	0.89	0.92	0.91	0.98	1.00	1.05	1.30	-	-
	45000	0.36	0.95	0.99	0.96	1.05	1.06	1.13	1.40	-	-

(i) Case A, B, C Max CFM 45,000
(ii) Case A, B, C Max CFM 37,000

Unit Start-up

Storage and Operating Temperature Limits

Storage: -40°F to 150°F

Operation: -40°F to 125°F

Economizer Damper Adjustment

Exhaust Air Dampers

Verify that the exhaust dampers (if equipped) close tightly when the unit is off. Adjust the damper linkage as necessary to ensure proper closure. An access panel is provided under each damper assembly.

Fresh Air & Return Air Damper Operation

The fresh air and return air damper linkage is accessible from the filter section of the unit. The damper linkage connecting the fresh air dampers to the return air dampers is preset from the factory in the number 1 position. Refer to Figure 53, p. 101 for the appropriate linkage position for the unit and operating airflow (CFM).

⚠WARNING

No Step Surface!

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

Note: *Bridging between the unit main supports may consist of multiple 2 by 12 boards or sheet metal grating.*

Arbitrarily adjusting the fresh air dampers to open fully when the return air dampers are closed or; failing to maintain the return air pressure drop with the fresh air dampers when the return air dampers are closed, can overload the supply fan motor and cause building pressurization control problems due to improper CFM being delivered to the space.

The fresh air/return air damper linkage is connected to a crank arm with a series of holes that allows the installer or operator to modify the amount of fresh air damper travel in order to match the return static pressure. Refer to Table 36, p. 103 for the equivalent return air duct losses that correspond to each of the holes illustrated in Figure 53, p. 101.

To Adjust the Fresh Air Damper Travel

1. Drill a 1/4" hole through the unit casing up stream of the return air dampers. Use a location that will produce an accurate reading with the least amount of turbulence. Several locations may be necessary, and average the reading.

⚠WARNING

Hazardous Voltage!

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

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

2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.

4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the applicable programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 32, p. 86 to program the following system components for operation by scrolling through the displays;

   Supply Fan (On)

   Variable Frequency Drive (100% Output, if applicable)

   RTM Occ/Unocc Output (Unoccupied)

   Fresh Air Dampers (Closed)
6. Once the configuration for the components is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

⚠WARNING

Rotating Components!

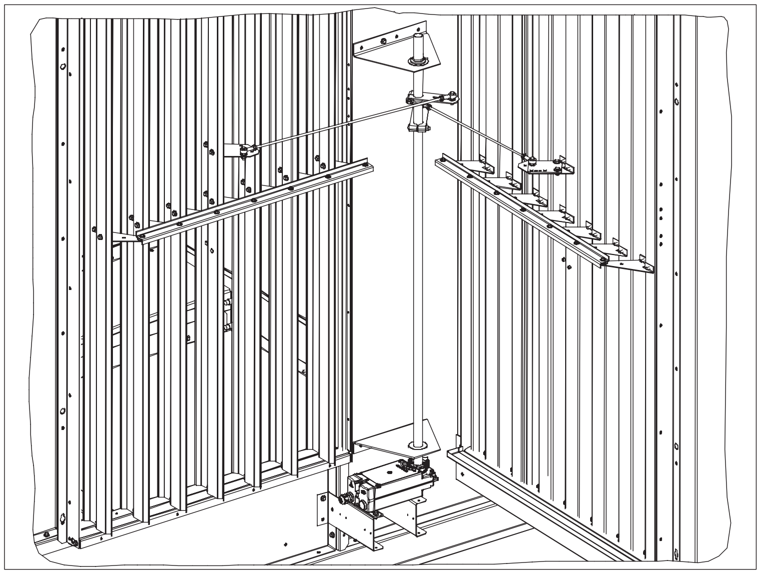
The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in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

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
8. With the fresh air dampers fully closed and the supply fan operating at 100% airflow requirements, measure the return static pressure at the location determined in step 1.
9. Press the STOP key at the Human Interface Module in the unit control panel to stop the fan operation.
10. Open the field supplied main power disconnect switch upstream of the air handler unit. Lock the disconnect switch in the "Open" position while working on the dampers.
11. Compare the static pressure reading to the static pressure ranges and linkage positions in Table 36, p. 103 for the unit size and operating CFM.

To relocate the fresh air/return air connecting rod to balance the fresh air damper pressure drop against the return static pressure, use the following steps. If no adjustment is necessary, proceed to step 17.

12. Remove the drive rod and swivel from the crank arm(s). If only one hole requires changing, loosen only that end.
13. Manually open the return air dampers to the full open position.
14. Manually close the fresh air dampers.
15. Reattach the drive rod and swivel to the appropriate hole(s). The length of the drive rod may need to be adjusted to align with the new hole(s) location. If so, loosen the lock nut on the drive rod against the swivel. Turn the swivel "in" or "out" to shorten or lengthen the rod as necessary. For some holes, both ends of the rod may need to be adjusted.
16. Tighten the lock nut against the swivel(s).
17. Plug the holes after the proper CFM has been established.

Figure 53. Fresh air and return air damper assembly



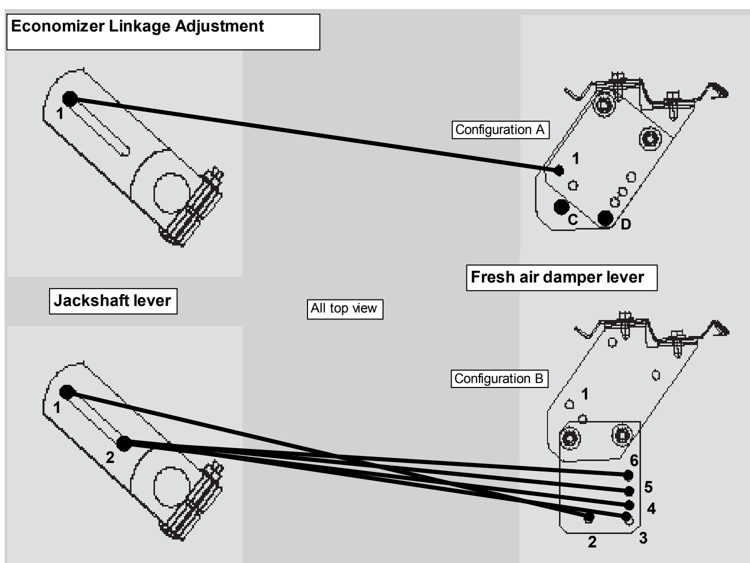


Figure 54. Fresh air and return air economizer assembly (w/Traq™ dampers)

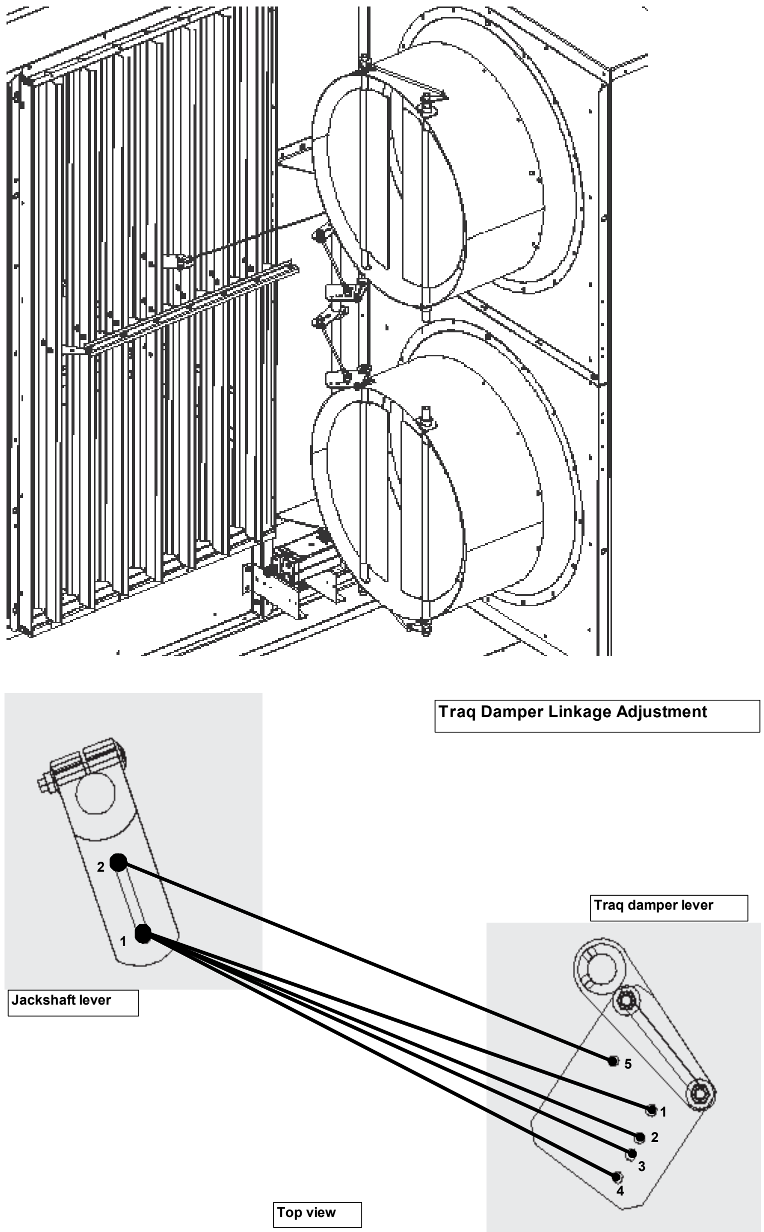


Table 36. (Economizer) Fresh air damper travel adjustment/pressure drop (*inches H_2O*).

	Damper Position					
Linkage Set-up	**1**	**2**	**3**	**4**	**5**	**6**
Jackshaft rod end location	**1**	**1**	**2**	**2**	**2**	**2**
Damper lever configuration	**A**	**B**	**B**	**B**	**B**	**B**
Damper lever rod end location	**1**	**2**	**3**	**4**	**5**	**6**
w/Economizer (includes mist eliminator)						
CFM	**Pressure Drop (*inches h2O*)**					
45000	0.74	1.71	—	—	—	—
43000	0.67	1.56	2.95	—	—	—
38000	0.52	1.22	2.31	2.89	—	—
33000	0.39	0.92	1.74	2.18	2.59	—
28000	0.28	0.66	1.25	1.57	1.87	2.27
23000	0.19	0.45	0.85	1.06	1.26	1.53
20000	0.14	0.34	0.64	0.80	0.95	1.16
16000	0.09	0.22	0.41	0.52	0.61	0.74
Linkage Set-up	**1**	**2**	**3**	**4**	**5**	
Jackshaft rod end location	**1**	**1**	**1**	**2**	**1**	
Damper lever rod end location	**1**	**2**	**3**	**5**	**4**	
w/Traq™ Damper (includes mist eliminator)						
CFM	**Pressure Drop (*inches h2O*)**					
45000	1.23	1.70	2.46	—	—	
43000	1.12	1.54	2.24	2.87	—	
38000	0.86	1.18	1.72	2.23	2.93	
33000	0.64	0.86	1.27	1.66	2.21	
28000	0.46	0.59	0.89	1.17	1.58	
23000	0.31	0.37	0.57	0.76	1.04	
20000	0.25	0.26	0.40	0.55	0.76	
16000	0.18	0.15	0.22	0.31	0.45	

Chilled Water Cooling Startup (Constant Volume & Variable Air Volume Systems)

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.
3. Check piping and valve for leaks. Open or close the valves to check operation. Drain lines should be open.
4. Remove all foreign material from the drain pan and check drain pan opening and condensate line for obstructions.

⚠WARNING

Hazardous Voltage!

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

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

5. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.
6. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
7. Use Table 32, p. 86 to program the following system components for operation by scrolling through the Human Interface displays;
8. Chilled Water Cooling
9. Supply Fan (On)
10. Variable Frequency Drive (100%Output, if applicable)
11. RTM Occ/Unocc Output (Unoccupied)
12. Chilled Water Actuator (100%Open)
13. Open the main chilled water valve supplying the coils.
14. Once the configuration for the appropriate cooling system is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.
15. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
16. Once the system has started, verify that the cooling system is operating properly by using appropriate service technics; i.e. amperage readings, delta tees, etc.
17. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

Electric, Steam and Hot Water Start-Up (Constant Volume & Variable Air Volume Systems)

1. Ensure that the "System" selection switch at the remote panel is in the "Off" position.
2. Close the disconnect switch or circuit protector switch that provides the supply power to the unit terminal block or the unit mounted disconnect switch.

⚠WARNING

Hazardous Voltage!

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

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

3. Turn the 115 volt control circuit switch and the 24 volt control circuit switch to the "On" position.

4. Open the Human Interface access door, located in the unit control panel, and press the SERVICE MODE key to display the first service screen. Refer to the latest edition of the appropriate programming manual for CV or VAV applications for the SERVICE TEST screens and programming instructions.
5. Use Table 32, p. 86 to program the following system components for operation by scrolling through the Human Interface displays;

Electric Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Heat Stages 1 & 2 (On)

Steam or Hot Water Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Hydronic Heat Actuator (100% Open)

Open the main steam or hot water valve supplying the air handler heating coils.

6. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the “Start test in __Sec.” screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

⚠WARNING

Rotating Components!

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

7. Press the TEST START key to start the test. Remember that the delay designated in step 6 must elapse before the fan will begin to operate.
8. Once the system has started, verify that the electric heat or the hydronic heat system is operating properly by using appropriate service technics; i.e. amperage readings, delta tees, etc.
9. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

Gas Furnace Start-Up (Constant Volume and Variable Air Volume Systems)

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

Since the proper manifold gas pressure for a particular installation will vary due to the specific BTU content of the local gas supply, adjust the burner based on carbon dioxide and oxygen levels.

The volume of air supplied by the combustion blower determines the amount of oxygen available for combustion, while the manifold gas pressure establishes fuel input. By measuring the percentage of carbon dioxide produced as a by-product of combustion, the operator can estimate the amount of oxygen used and modify the air volume or the gas pressure to obtain the proper air/fuel ratio.

Arriving at the correct air/fuel mixture for a furnace results in rated burner output, limited production of carbon monoxide, and a steady flame that minimizes nuisance shutdowns.

⚠WARNING

Hazardous Gases and Flammable Vapors!

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

⚠WARNING

Hazardous Pressures!

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

Two Stage Gas Furnace

Figure 55. Flue gas carbon dioxide and oxygen measurements

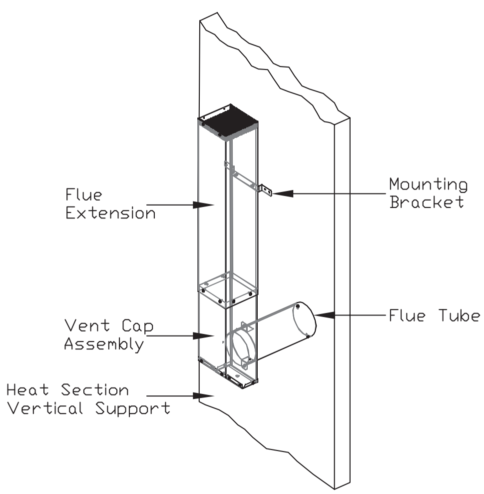


Figure 56. High/low pressure regulator

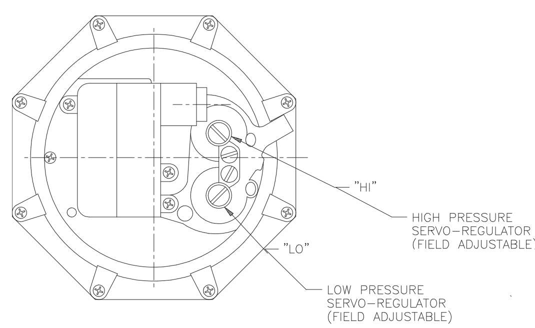


Figure 57. Natural gas combustion curve (ratio of oxygen to carbon dioxide in percent)

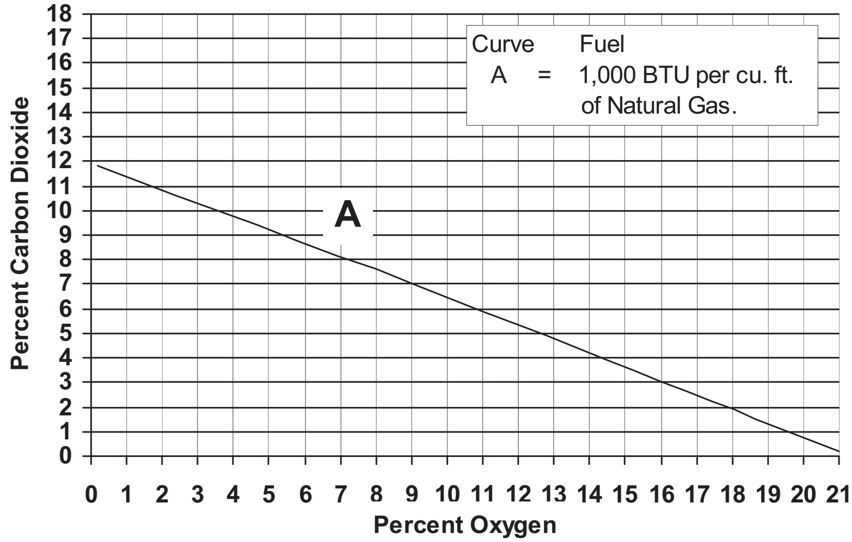


Table 37. Recommended manifold pressures and CO_2 levels during furnace operation

2-STAGE						MODULATING					
MBH	FIRING RATES	% CO2 NAT GAS	MANIF PRESS "W.C.	% CO2 PROPANE	MANIF PRESS " W.C.	MBH	FIRING RATE	% CO2 NAT GAS	MANIF PRESS " W.C.	% CO2 PROPANE	MANIF PRESS "W.C.
850	100%	8.0-9.0	3.0-3.5	9.0-10.0	3.0-3.5	850	100%	8.0-9.0	3.0- 3.5	7.8-8.4	1.7-2.2
510	60%	5.0 -7.0	0.8-0.95	5.0-7.0	1.5-3.0	85	10%	5.0 -7.0	0.8- 0.9.5	2.0-3.0	.1-.2
1100	100%	8.0-9.0	3.0-3.3	9.0-10.0	3.0-3.3	1100	100%	7.0-9.0	.8-.9	8.5-9.5	.5-.75
550	50%	5.0 -7.0	0.8-0.95	5.0-7.0	0.8-0.95	55	5%	1.5-3.0	.05-1.0	1.5-2.5	.02-.04
1800	100%	7.0- 8.0	1.5- 1.8	N/A	N/A	1800	100%	7.0-9.0	1.5- 1.8	N/A	N/A
900	50%	5.0- 7.0	0.5- 0.7	N/A	N/A	90	5%	1.5-3.0	.05-1.0	N/A	N/A

High-Fire Adjustment

1. Use Table 32, p. 86 to program the following system components for operation by scrolling through the Human Interface displays;

Gas Heat

Supply Fan (On)

Return Fan (On, if supplied)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

Heat Stages 1 & 2 (On)

Turn the 115 volt control circuit switch 4S24 located in the heater control panel to the "On" position.

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

2. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.

3. Press the TEST START key to start the test. Remember that the delay designated in step 2 must elapse before the system will begin to operate.
4. Once the system has started, check the appearance of the flame through the sight glass provided on the front of the heat exchanger. In appearance, a normal flame has a clearly defined shape, and is primarily (75%) blue in color with an orange tip.
5. Check the manifold gas pressure by using the manifold pressure port on the gas valve. Refer to Table 37, p. 107 for the required manifold pressure for high-fire operation. If it needs adjusting, remove the cap covering the high-fire adjustment screw on the gas valve. Refer to Figure 56, p. 106 for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.
6. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 55, p. 106. Take several samples to assure that an accurate reading is obtained. Refer to Figure 57, p. 107 for the proper carbon dioxide levels. A carbon dioxide level exceeding the listed range indicates incomplete combustion due to inadequate air or excessive gas.

Combustion Air Adjustment (O_2)

1. Use an oxygen analyzer and measure the percentage of oxygen in the flue gas. Take several samples to assure an accurate reading. Compare the measured oxygen level to the combustion curve in Figure 57, p. 107. The oxygen content of the flue gas should be 4% to 5%. If the oxygen level is outside this range, adjust the combustion air damper to increase or decrease the amount of air entering the combustion chamber. Refer to Figure 59, p. 109 for the location of the combustion air damper.
2. Recheck the oxygen and carbon dioxide levels after each adjustment. After completing the high-fire checkout and adjustment procedure, the low-fire setting may require adjusting.

Low-Fire Adjustment (850 & 1100 MBH only)

1. Use the TEST initiation procedures outlined in the previous section to operate the furnace in the low-fire state (1st Stage).
2. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 57, p. 107, Inset A. Take several samples to assure that an accurate reading is obtained. Refer to Table 37, p. 107 for the proper carbon dioxide levels. If the measured carbon dioxide level is within the listed values, no adjustment is necessary. A carbon dioxide level exceeding the listed range indicates incomplete combustion due to inadequate air or excessive gas.
3. Check the manifold gas pressure by using the manifold pressure port on the gas valve. Refer to Table 37, p. 107 for the required manifold pressure during low-fire operation. If it needs adjusting, remove the cap covering the low-fire adjustment screw on the gas valve. Refer to Figure 56, p. 106 for the adjustment screw location. Turn the screw clockwise to increase the gas pressure or counterclockwise to decrease the gas pressure.

Note: *Do not adjust the combustion air damper while the furnace is operating at low-fire.*

4. Check the carbon dioxide levels after each adjustment.
5. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

Full Modulating Gas Furnace

Figure 58. Modulating gas regulator

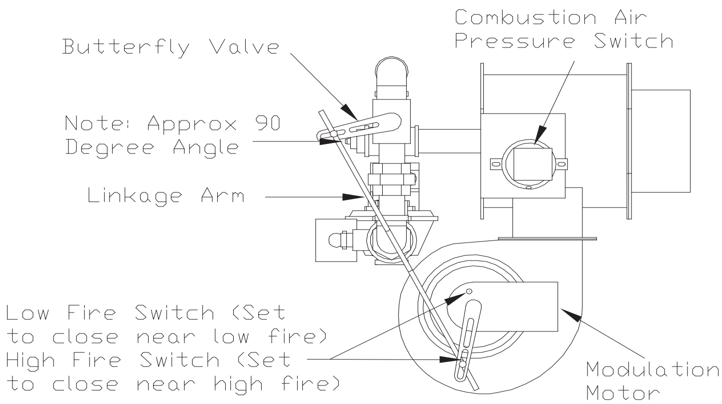
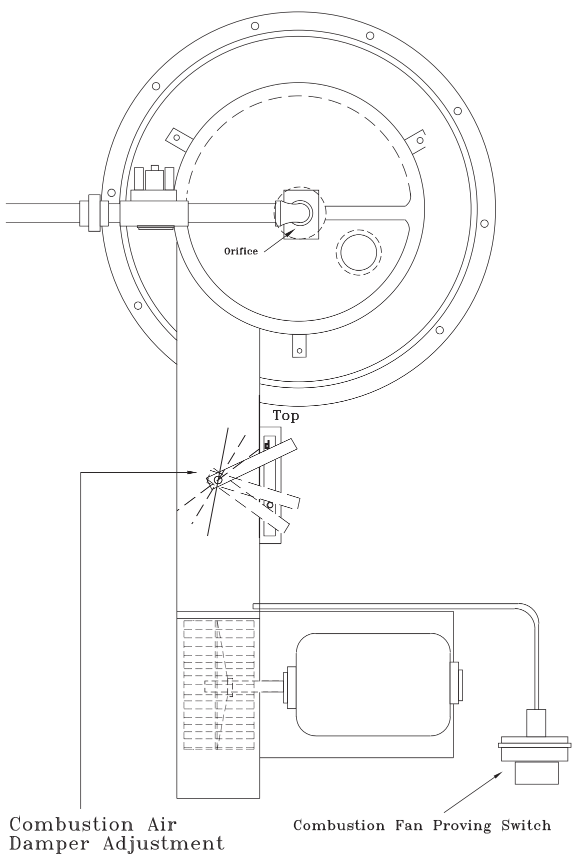


Figure 59. 850-1100 MBH



Full Modulating gas heaters are available for the 850, 1100 and 1800 MBH heater sizes.

- The firing rate of the 850 MBH modulating heater can vary from 10% to 100% of the 850 MBH.
- The firing rate of the 1100 and 1800 MBH can vary from 5% to 100% of it's nameplate value.

Heat Exchanger

The heat exchanger drum, tubes and front and rear headers are constructed from stainless steel alloys.

Unit Control

The unit is controlled by a supply air temperature sensor located in the supply air stream for VAV units. CV units have two sensors, one located in the supply air stream and the zone sensor. The temperature sensor signal is sent to the Heat module of the IntelliPak II Unit Control. The control signal from the Heat Module signal is directly proportional 0-10 VDC. The higher the voltage signal, the lower the call for heat.

The 0-10 VDC signal controls the air damper actuator which is mounted on the end of the air damper shaft. As the actuator rotates clockwise, more combustion air passes through the combustion air blower. In turn, the gas butterfly valve opens more through a directly connected linkage, resulting in a higher rate of firing.

1. Use Table 32, p. 86 to program the following system components for operation by scrolling through the Human Interface displays;

Gas Heat

Supply Fan (On)

Variable Frequency Drive (100% Output, if applicable)

RTM Occ/Unocc Output (Unoccupied)

High Fire (90%)

Turn the 115 volt control circuit switch 4S24 located in the heater control panel to the "On" position.

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

2. Once the configuration for the appropriate heating system is complete, press the NEXT key until the LCD displays the "Start test in __Sec." screen. Press the + key to designate the delay before the test is to start. This service test will begin after the TEST START key is pressed and the delay designated in this step has elapsed. Press the ENTER key to confirm this choice.
3. Press the TEST START key to start the test. Remember that the delay designated in step 2 must elapse before the system will begin to operate.

⚠WARNING

Rotating Components!

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

4. Once the system has started, check the appearance of the flame through the sight glass provided on the front of the heat exchanger. In appearance, a normal flame has a clearly defined shape, and is primarily (75%) blue in color with an orange tip.
5. Check the inlet gas pressure at the modulating gas valve. The inlet pressure should be 6" to 8" w.c.
6. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. Refer to the illustration in Figure 55, p. 106. Take several samples to assure that an accurate reading is obtained. The $C0_2$ level should fall in the ranges shown in the Guide Values Table 37, p. 107

Note: *The burner capacity is controlled by the movement of the air damper. This has been preset at the factory and normally does not need field adjustment. The combustion quality (air/gas) is controlled by the setup of the air damper and butterfly valve linkage relationship.*

7. Use Table 32, p. 86 to program the minimum (5%) firing rate. Allow the system to operate for approximately 10 minutes.
8. Use a carbon dioxide analyzer and measure the percentage of carbon dioxide in the flue gas. If the measured carbon dioxide level is in the ranges shown in the Guide Values Table 37, p. 107, no adjustment is necessary.

Note: *It is normal for the low fire CO_2 to be lower than the high fire.*

9. If the measured carbon dioxide level is below the recommended values for low heat, return the burner to 90% fire rate and repeat step 6, to achieve optimum combustion.
10. Program the burner for 100% operation and recheck the CO_2 or O_2 value.
11. Check the flue gas values at several intermediate output levels. If corrections are necessary;
    - Adjust butterfly linkage
12. Press the STOP key at the Human Interface Module in the unit control panel to stop the system operation.

Final Unit Checkout

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

- Close the disconnect switch or circuit protector switch that provides the supply power to the unit's terminal block or the unit mounted disconnect switch.

⚠WARNING

Hazardous Voltage!

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

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

- Turn the 115 volt control circuit switch "Off".
- Turn the 24 volt control circuit switch to the "On" position.
- At the Human Interface Module, press the "SETUP" key. The LCD screen will display various preset "parameters of operation" based on the unit type, size, and the installed options. Compare the factory preset information to the specified application requirements. If adjustments are required, follow the step-by-step instructions provided in the appropriate programming manual for CV or VAV applications.
- Program the Night Setback (NSB) panel (if applicable) for proper unoccupied operation. Refer to the programming instructions for the specific panel.
- Verify that the Remote panel "System" selection switch, "Fan" selection switch, and "Zone Temperature" settings for constant volume systems are correct.
- Verify that the Remote panel "System" selection switch and the "Supply Air Temperature" settings for variable air volume systems are correct.
- Inspect the unit for misplaced tools, hardware, and debris.
- Turn the 115 volt control circuit switch "On".
- Press the "AUTO" key at the Human Interface Module to begin system operation. The system will start automatically once the dampers modulate and a request for either heating or cooling has been given.
- Verify that all exterior panels including the control panel doors are secured in place.

Table 38. Control settings and time delays

Control Description	Elec. Designation	Contacts Open	Contacts Closed
Combustion Airflow Switch (Gas Heat Only)	4S25	see note 1	0.1 - 0.25" wc rise in press diff
Supply Airflow Switch (Gas Heat Only)	4S38	0.03 - 0.12" wc	0.15 + 0.05" wc rise in press diff
Freezestat (Hydronic Heat Only)	4S12	(N.O.) Auto Reset	40°F
Gas Heat Units			
Prepurge Timer: Honeywell	4U18	internal timing function	2 Stage 850/1100 MBH 60—seconds/ All other configurations—30 seconds
Sequencing Time Delay Relay	4DL6	N.C. - timed to close	60 seconds ± 20%

Note: The combustion airflow switch (4S25) differential is 0.02" - 0.08" wc.

Table 39. Gas heat—high limit

Unit Size	Fan Size (in)	Config.	Contacts Open	Contacts Closed
Casings A-C	**1800 MBH High Limit**			
	25	DF	240	200
	25	HZ	220	180
	32	DF & HZ	240	200
	36	DF & HZ	240	200
	36	HZ	240	310
	1100 MBH High Limit			
	25	DF & HZ	220	180
	32	DF	240	200
	32	HZ	200	160
	36	DF & HZ	220	180
	850 MBH High Limit			
	25 &36	DF & HZ	240	200

Table 40. Electric heat—selection limits

Size	Indoor Fan Option	Electric Heat Option	Supply Discharge	Linear Limit Open Temp.	Fan Fail Limit Open Temp.
A	25	262.5 kW	Downflow	215°F	155°F
			Hz (right)	235°F	155°F
		90 kW	Downflow	150°F	175°F
			Hz (right)	150°F	175°F
B	32	300 kW	Downflow	205°F	185°F
			Hz (right)	185°F	185°F
		262.5 kW	Downflow	225°F	185°F
			Hz (right)	205°F	185°F
		140 kW	Downflow	150°F	185°F
			Hz (right)	150°F	185°F
		90 kW	Downflow	150°F	175°F
			Hz (right)	150°F	175°F
C	36	262.5 kW	Downflow	195°F	155°F
			Hz (right)	195°F	155°F
		90 kW	Downflow	150°F	175°F
			Hz (right)	150°F	175°F

Table 41. Unit internal & VFD fuse replacement

CONTROL POWER FUSES			
TRANSFORMER PRIMARY	TRANSFORMER SIZE	460V	575V
PROTECTION FUSE	1.00 kVA	3.5A	2.5A
1F3 & 1F4	1.50 kVA	5A	4A
TYPE FLQ	2.00 kVA	6A	5A
TRANSFORMER SECONDARY	TRANSFORMER SIZE	460V	575V
PROTECTION FUSE	1.00 kVA	15A	15A
1F1	1.50 kVA	20A	20A
TYPE S	2.00 kVA	20A	20A
CONTROL WIRING PROTECTION FUSE 1F7 & 1F8 TYPE MTH	FUSE SIZE	460V	575V
		6A	6A
VFD PROTECTION FUSES*			
SUPPLY FAN VFD FUSES 1F19, 1F20, 1F21 & OPTIONAL EXHAUST / RETURN FAN VFD FUSES 1F22, 1F23, 1F24 CLASS T	MOTOR HP	460V	575V
	7.5	35A	25A
	10	45A	35A
	15	60A	50A
	20	90A	70A
	25	100A	80A
	30	125A	90A
	40	150A	125A
	50	200A	175A
	60	225A	200A
	75	300A	225A

Table 41. Unit internal & VFD fuse replacement (continued)

MISCELLANEOUS FUSES			
OPTIONAL CONVENIENCE OUTLET FUSES		460V	575V
1F25 & 1F26 TIME DELAY TYPE FUSE	FUSE SIZE	5A	4A
OPTIONAL MARINE LIGHTS FUSES		460V	575V
1F27 & 1F28	FUSE SIZE	15A	15A

*SEE FUSE REPLACEMENT TABLE ON VFD PANEL FOR VFD POWER FUSES (F40, F41, F42).

Table 42. Filter data (all dimensions in inches)

	Casing A	Casing B	Casing C
Standard 2" High Efficiency Throwaway Filters			
Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
Face area (Ft^2)	80	80	80
90-95% Bag Filters w/Prefilters			
Number/Size	21 - 20X24X19 5 - 12X24X19	21 - 20X24X19 5 - 12X24X19	21 - 20X24X19 5 - 12X24X19
Face area (Ft^2)	80	80	80
Prefilters Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
90-95% Cartridge Filters w/Prefilters			
Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
Face area (Ft^2)	80	80	80
Prefilters Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
90-95% Low Pressure Drop Cartridge Filters w/Prefilters			
Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
Face area (Ft^2)	80	80	80
Prefilters Number/Size	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2	21 - 20X24X2 5 - 12X24X2
Final Filters			
90-95% Low Pressure Drop Cartridge Filters w/Prefilters(1)			
Number/Size	15 - 24X24X12 7 - 12X24X12	15 - 24X24X12 7 - 12X24X12	15 - 24X24X12 7 - 12X24X12
Face area (Ft^2)	74	74	74
Prefilters Number/Size	15 - 24X24X4 7 - 12X24X4	15 - 24X24X4 7 - 12X24X4	15 - 24X24X4 7 - 12X24X4
90-95% Bag Filters w/Prefilters(2)			
Number/Size	15 - 24X24X19 7 - 12X24X19	15 - 24X24X19 7 - 12X24X19	15 - 24X24X19 7 - 12X24X19
Face area (Ft^2)	74	74	74
Prefilters Number/Size	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2
Final Filters			
90-95% Cartridge Filters(2)			
Number/Size	15 - 24X24X12 7 - 12X24X12	15 - 24X24X12 7 - 12X24X12	15 - 24X24X12 7 - 12X24X12
Face area (Ft^2)	74	74	74
Prefilters Number/Size	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2

Table 42. Filter data (all dimensions in inches) (continued)

	Casing A	Casing B	Casing C
90-95% High Temp Cartridge Filters(3) Number/Size Face area (Ft^2)	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74
Prefilters Number/Size	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2
HEPA Filters(2) **w/Prefilters** Number/Size Face area (Ft^2)	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74
Prefilters Number/Size	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2
Final Filters			
High Temp HEPA Cartridge Filters w/Prefilters(3) Number/Size Face area (Ft^2)	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74	15 - 24X24X12 7 - 12X24X12 74
Prefilters Number/Size	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2	15 - 24X24X2 7 - 12X24X2

(1) High Airflow Applications of Cooling only/Steam and Hot Water Units require 4" High Efficiency Throw Away Prefilters with the 90-95% Low PD Cartridge Filter Option.
(2) Standard Airflow Applications of Cooling only/Steam and Hot Water Units include 2" High Efficiency Throw Away Prefilters with the 90-95% Bag and HEPA Filter Options.
(3) Gas/Electric Units require 2" High Efficiency High Temperature Rated Throwaway Prefilters with High Temperature Rated 90-95% Cartridge and HEPA filter options.

Table 43. Grease recommendation

Recommended Grease for Fan Bearings	Recommended Operating Range
Exxon Unirex #2	
Mobil 532	-20°F to 250°F
Mobil SHC #220	
Texaco Premium RB	

Fan Belt Adjustment

The supply fan belts and optional exhaust fan belts must be inspected periodically to assure proper unit operation.

Replacement is necessary if the belts appear frayed or worn. Units with dual belts require a matched set of belts to ensure equal belt length.

When removing or installing the new belts, do not stretch them over the sheaves. Loosen the belts using the belt tension adjustment bolts on the motor mounting base.

Once the new belts are installed, using a Browning or Gates tension gauge (or equivalent), see Figure 61, p. 117, adjust the belt tension as follows:

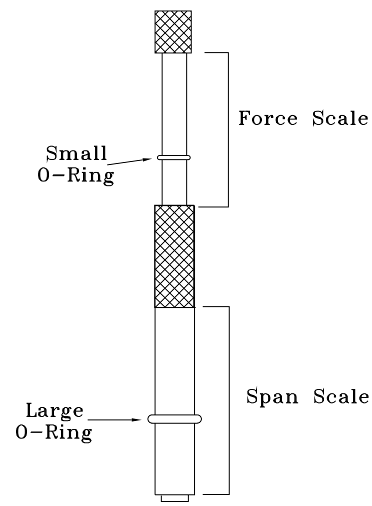
⚠WARNING

Hazardous Voltage!

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

1. To determine the appropriate belt deflection:
   a. Measure the center-to-center shaft distance (in inches) between the fan and motor sheaves.
   b. Divide the distance measured in Step 1a by 64; the resulting value represents the amount of belt deflection that corresponds to the proper belt tension.
2. Set the large O-ring on the belt tension gauge at the deflection value determined in Step 1b.
3. Set the small O-ring at zero on the force scale of the gauge plunger.
4. Place the large end of the gauge at the center of the belt span; then depress the gauge plunger until the large O-ring is even with the top of the next belt—-or even with a straightedge placed across the fan and motor sheaves. Refer to Figure 61, p. 117.
5. Remove the belt tension gauge. The small O-ring now indicates a number other than zero on the plunger's force scale. This number represents the force (in pounds) required to give the needed deflection.

Figure 60. Tension gauge



6. Compare the "force" scale reading (Step 5) with the appropriate "force" value listed in Table 44, p. 118. If the "force" reading is outside the range, readjust the belt tension.

Note: *Actual belt deflection "force" must not exceed the maximum "force" value shown in Table 44, p. 118.*

7. Recheck the belt tension at least twice during the first 2 to 3 days of operation. Belt tension will decrease rapidly until the new belts are "run in".

Figure 61. Belt tension

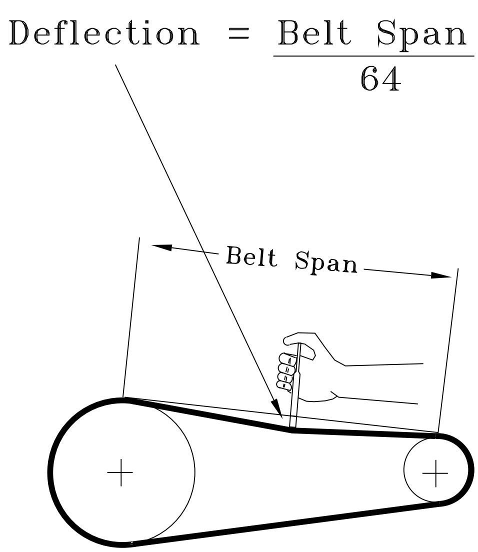


Table 44. Belt tension measurement and deflection ranges

Belt Cross Section	Smallest Sheave Diameter Range (In.)	RPM Range	Belt Deflection Force (Lbs.)			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
			Min.	Max.	Min.	Max.
A, AX	3.0-3.6	1000-2500	3.7	5.5	4.1	6.1
	3.8-4.8	1000-2500	4.5	6.8	5.0	7.4
	5.0-7.0	1000-2500	5.4	8.0	5.7	8.4
B, BX	3.4 – 4.2	860-2500	--	--	4.9	7.2
	4.4 – 5.6	860-2500	5.3	7.9	7.1	10.5
	5.8 – 8.6	860-2500	6.3	9.4	8.5	12.6
3V, 3VX	2.2 - 2.4	1000-2500	--	--	3.3	4.9
	2.65 - 3.65	1000-2500	3.6	5.1	4.2	6.2
	4.12 - 6.90	1000-2500	4.9	7.3	5.3	7.9
5V, 5VX	4.4 – 6.7	500-1749 1750-3000	--	--	10.2 8.8	15.2 13.2
	7.1 –10.9	500-1740	12.7	18.9	14.8	22.1
	11.8-16.0	500-1740	15.5	23.4	17.1	25.5

Table 45. Supply and exhaust fan VFD programming

Menu	Parameter	Description	Setting	Description
Load & Motor	1-21	Motor Power	Set Based on Motor Nameplate	Set only for application using 3hp hi- Efficiency motors. Set to 2.2 kW/3 hp
	1-22	Motor Voltage	Set Based on Motor Nameplate	Set only for 380/415 50 Hz applications
	1-24	Motor Current	Set Based on Motor Nameplate	Sets the motor FLA
	1-25	Motor Speed	Set Based on Motor Nameplate	Sets the motor RPM

Note: These parameters are motor specific and the actual motor nameplate rating must be used. Do not use the unit name.

⚠WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

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

VFD Programming Parameters

Units shipped with an optional variable frequency drive (VFD) are preset and run tested at the factory. If a problem with a VFD occurs, ensure that the programmed parameters listed in Table 45, p. 118 have been set before replacing the drive.

Note: *Check to make sure that parameter 1-23 is set to 60 Hz. To check parameter 1-23 press the [Main Menu] button (press [Back] button if the main menu does not display), use the [▼] button to scroll down to Load & Motor, press OK, use the [▼] button to select 1-2, press OK, and finally use the [▼] button until parameter 1-23 is displayed. Parameter 1-23 can then be modified by pressing OK button and using [▲] and [▼] buttons. When the desired selection has been made, press the OK button.*

Should replacing the VFD become necessary, the replacement is not configured with all of Trane's operating parameters. The VFD must be programmed before attempting to operate the unit.

To verify and/or program a VFD, use the following steps:

1. At the unit, turn the 115 volt control circuit switch to the "Off" position.
2. Turn the 24 volt control circuit switch to the "Off' position.

⚠WARNING

Hazardous Voltage!

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

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

3. To modify parameters:
   a. Press Main Menu button (press [Back] button if the main menu does not display)
   b. Use the [▲] and [▼] buttons to find the parameter menu group (first part of parameter number)
   c. Press [OK]
   d. Use the [▲] and [▼] buttons to select the correct parameter sub-group (first digit of second part of parameter number)
   e. Press [OK]
   f. Use the [▲] and [▼] buttons to select the specific parameter
   g. Press [OK]
   h. To move to a different digit within a parameter setting, use the [► ◄] buttons (Highlighted area indicates digit selected for change)
   i. Use the [▲] and [▼] buttons to adjust the digit
   j. Press [Cancel] button to disregard change, or press [OK] to accept change and enter the new setting
4. Repeat step (3) for each menu selection setting in Table 45, p. 118.
5. To reset all programming parameters back to the factory defaults:
   a. Go to parameter 14-22 Operation Mode
   b. Press [OK]
   c. Select "Initialization"
   d. Press [OK]
   e. Cut off the mains supply and wait until the display turns off.

f. Reconnect the mains supply - the frequency converter is now reset.

g. Ensure parameter 14-22 Operation Mode has reverted back to "Normal Operation".

Notes:

- *Item 5 resets the drive to the default factory settings. The program parameters listed in* Table 45, p. 118 *will need to be verified or changed as described in Item 3 and 4.*
- *Some of the parameters listed in the Table are motor specific. Due to various motors and efficiencies available, use only the values stamped on the specific motor nameplate. Do not use the Unit nameplate values.*
- *A backup copy of the current setup may be saved to the LCP before changing parameters or resetting the drive. See LCP Copy in the VFD Operating Instructions for details.*

6. Follow the startup procedures for supply fan in the "Variable Air Volume System" section or the "Exhaust Airflow Measurement" startup procedures for the exhaust fan.
7. After verifying that the VFD(s) are operating properly, press the STOP key at the Human Interface Module to stop the unit operation.
8. Follow the applicable steps in the "Final Unit Checkout" section to return the unit to its normal operating mode.

If a problem with a VFD occurs, ensure that the programmed parameters listed for supply and exhaust VFD Table 45, p. 118 have been set before replacing the drive.

Monthly Maintenance

⚠WARNING

Hazardous Voltage!

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

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 42, p. 115 for filter information.

Cooling Season

⚠WARNING

Hazardous Voltage!

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

- Check the unit drain pans and condensate piping to ensure that there are no blockages.
- Inspect the chilled water 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.
- Manually rotate the condenser fans to ensure free movement and check motor bearings for wear. Verify that all of the fan mounting hardware is tight.
- Inspect the F/A-R/A damper hinges and pins to ensure that all moving parts are securely mounted. Keep the blades clean as necessary.

- Verify that all damper linkages move freely; lubricate with white grease, if necessary.
- Check supply fan motor bearings; repair or replace the motor as necessary.
- Check the fan shaft bearings for wear. Replace the bearings as necessary.
- Lubricate the supply fan shaft bearings with a lithium based grease. Refer to Table 43, p. 116 for recommended greases.

Important: *The bearings are manufactured using a special synthetic lithium based grease designed for long life and minimum lube intervals. Over lubrication can be just as harmful as not enough.*

Use a hand grease gun to lubricate these bearings; add grease until a light bead appears all around the seal. Do not over lubricate!

After greasing the bearings, check the setscrews to ensure that the shaft is held securely to the bearings and fan wheels. Make sure that all bearing supports are tight.

- Check the supply fan belt(s). If the belts are frayed or worn, replace them. Refer to the "Fan Belt Adjustment" section for belt replacement and adjustments.
- Check the condition of the gasket around the control panel doors. These gaskets must fit correctly and be in good condition to prevent water leakage.
- Verify that all wire terminal connections are tight.
- Remove any corrosion present on the exterior surfaces of the unit and repaint these areas.
- Generally inspect the unit for unusual conditions (e.g., loose access panels, leaking piping connections, etc.)
- Make sure that all retaining screws are reinstalled in the unit access panels once these checks are complete.
- With the unit running, check and record the:
  - ambient temperature;
  - compressor oil level (each circuit);
  - compressor suction and discharge pressures (each circuit);
  - superheat and subcooling (each circuit);

  Record this data on an “operator’s maintenance log” like the one shown in Table 46, p. 124.

Heating Season

⚠WARNING

Hazardous Voltage!

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

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.
- Lubricate the supply fan shaft bearings with a lithium based grease. Refer to Table 43, p. 116 for recommended greases.

Important: *The bearings are manufactured using a special synthetic lithium based grease designed for long life and minimum lube intervals. Too much lubrication in a bearing can be just as harmful as not enough.*

Use a hand grease gun to lubricate the bearings; add grease until a light bead appears all around the seal. Do not over lubricate! After greasing the bearings, check the setscrews to ensure that the shaft is held securely. Make sure that all bearing braces are tight.

- Inspect both the main unit control panel and heat section control box for loose electrical components and terminal connections, as well as damaged wire insulation. Make any necessary repairs.
- Gas Heat Units only - Check the heat exchanger for any corrosion, cracks, or holes.
- Check the combustion air blower for dirt. Clean as necessary.

Note: *Typically, it is not necessary to clean the gas furnace. However, if cleaning does become necessary, remove the burner inspection plate from the rear of the heat exchanger to access the drum. Be sure to replace the existing gaskets with new ones before reinstalling the inspection plate.*

- Open the main gas valve and apply power to the unit heating section; then initiate a "Heat" test using the start-up procedure described in "Gas Furnace Start-Up".

⚠WARNING

Hazardous Gases and Flammable Vapors!

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

⚠WARNING

Hazardous Pressures!

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

- Verify that the ignition system operates properly.

Coil Cleaning

Regular coil maintenance, including annual cleaning enhances the unit operating efficiency by minimizing:

- water carryover;
- fan brake horsepower; and,
- static pressure losses

At least once each year—or more often if the unit is located in a “dirty” environment—clean the chilled water coils using the instructions outlined below. Follow these instructions as closely as possible to avoid damaging the coils.

NOTICE:

Damaging Coil Cleaners!

Coil cleaners can damage roofs, surrounding buildings, vehicles, etc. Cleaning substances should be checked to ensure that they will not cause damage to surroundings. Coils and roof (if applicable) should be rinsed thoroughly. Do not spray coil cleaners in windy conditions.

Chilled Water Coils

To clean coils, use a soft brush and a sprayer (either a garden pump-up type or a high-pressure sprayer). A high-quality detergent is also required; suggested brands include “SPREX A.C.,” “OAKITE 161,” “OAKITE 166” and “COILOX.” If the detergent selected is strongly alkaline (pH value exceeds 8.5), add an inhibitor.

1. Remove the access panels on both sides of the unit and the filters.

⚠WARNING

No Step Surface!

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

Note: *Bridging between the unit's main supports may consist of multiple 2 by 12 boards or sheet metal grating.*

2. Straighten any bent coil fins with a fin comb.
3. 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.
4. Pour the cleaning solution into the sprayer. If a high-pressure sprayer is used:
   a. Do not allow the sprayer pressure to exceed 600 psi. The minimum spray nozzle angle is 15 degrees.
   b. Spray the solution perpendicular (at 90 degrees) to the coil face.
   c. Maintain a minimum clearance of 6" between the sprayer nozzle and the coil.
5. Spray the leaving-airflow side of the coil first; then spray the opposite side of the coil. Allow the cleaning solution to stand on the coil for five minutes.
6. Rinse both sides of the coil with cool, clean water.
7. Inspect both sides of the coil; if it still appears to be dirty, repeat Steps 7 and 8.
8. Reinstall all of the components and panels removed in Step 2; then restore power to the unit.

Steam or Hot Water Coils

To clean a steam or hot water coil, use a soft brush, a steam-cleaning machine, and water.

1. Verify that switches 1S1 and 1S70 are turned "OFF", and that the main unit disconnect is locked open.
2. Remove enough panels and components from the unit to gain sufficient access to the coil.
3. Straighten any bent coil fins with a fin comb.
4. Remove loose dirt and debris from both sides of the coil with a soft brush.
5. Use the steam-cleaning machine to clean the leaving-air side of the coil first; start at the top of the coil and work downward; then clean the entering-air side of the coil, starting at the top of the coil and working downward.
6. Check both sides of the coil; if it still appears dirty, repeat Step 5.
7. Reinstall all of the components and panels removed in Step 2; then restore power to the unit.

Final Process

For future reference, it may be helpful to record the unit data in the blanks provided.

Table 46. Unit data log

Complete Unit Model Number:	
Unit Serial Number:	
Unit "DL" Number ("design special" units only):	
Wiring Diagram Numbers (from unit control panel): **-schematic(s)**	
-connections	
Network ID (LCI/BCI):	

Wiring Diagrams

Note: *Trane Wiring Diagrams are available via Trane e-Library or through the local Trane Sales Office.*

Table 47. Unit wiring diagrams

Diagram No.	Description
2309-3625	SCHEMATIC-CONTROLS-RTM-STD 90-150 TON
2309-3626	SCHEMATIC-CONTROLS-RTM-W/SUP 90-150 TON
2309-3627	SCHEMATIC-CONTROLS-RTM-W/EXH/RTN 90-150 TON
2309-3628	SCHEMATIC-CONTROLS-RTM-W/SUP & EXH/RTN 90-150 TON
2309-3637	SCHEMATIC-CONTROLS-HEAT-ELEC/HYDRONIC HEAT- 90-150 TON
2309-3638	SCHEMATIC-CONTROLS-HEAT-2-STG-MOD GAS HEAT- 90-150 TON
2309-3645	SCHEMATIC-LHI-ECEM-VCM-MPM-W/O EXH OR RTN VFD
2309-3646	SCHEMATIC-LHI-ECEM-VCM-MPM-W/ RTN VFD
2309-3647	SCHEMATIC-LHI-ECEM-VCM-MPM-W/ EXH VFD
2309-3651	SCHEMATIC-VOM-LCI/BCI-IPCB-GBAS 0-5V-GBAS 0-10V- 90-150 TON
2309-3652	NOTES AND SPECS
2309-3653	SCHEMATIC-ELEC-HEAT-90KW
2309-3654	SCHEMATIC-ELEC-HEAT-140KW
2309-3655	SCHEMATIC-ELEC-HEAT-265KW
2309-3656	SCHEMATIC-ELEC-HEAT-300KW
2309-3661	CONNECTION-ELEC-HEAT-90KW
2309-3662	CONNECTION-ELEC-HEAT-140KW
2309-3663	CONNECTION-ELEC-HEAT-265KW
2309-3664	CONNECTION-ELEC-HEAT-300KW
2309-3669	SCHEMATIC/CONNECTION-2 STG-NATURAL-GAS-HEAT < 1800 MBH - 90-118 TON LOW-MED - 120-162 TON LOW
2309-3670	SCHEMATIC/CONNECTION-2 STG-NATURAL-GAS-HEAT-1800/2500 MBH- 90-118 TON HIGH - 120-162 TON MED-HIGH
2309-3671	PRINT SCHEMATIC/CONNECTION-MODULATING-NATURAL-GAS-HEAT
2309-3672	SCHEMATIC/CONNECTION-2 STG-NATURAL-GAS-HEAT < 1800 MBH-2 PC- 90-118 TON LOW-MED - 120-162 TON LOW
2309-3673	SCHEMATIC/CONNECTION-2 STG-NATURAL-GAS-HEAT-1800/2500 MBH-2 PC- 90-118 TON HIGH - 120-162 TON MED-HIGH
2309-3674	PRINT SCHEMATIC/CONNECTION-MODULATING-NATURAL-GAS-HEAT-2 PC
2309-3685	SCHEMATIC-CONTROLS-COOLING-ONLY- 90-150 TON
2309-3708	CONNECTION, COMMON CONTROL MODULES - W/O RETURN VFD
2309-3709	CONNECTION, COMMON CONTROL MODULES - W/ RETURN VFD
2309-3730	SCHEMATIC/CONNECTION-MODULATING-NATURAL-GAS-HEAT
2313-0863	Schematic, Power - Standard Air Handler
2309-0864	Schematic, Power - w/Supply VFD Air Handler
2309-0865	Schematic, Power - w/ Exhaust/Return VFD Air Handler
2309-0866	Schematic, Power - w/Sup & Exh/Rtn VFD Air Handler
2309-3736	Connection, Control Box - Standard Air Handler
2309-3737	Connection, Control Box - w/Supply VFD Air Handler
2309-3738	Connection, Control Box - w/Exh/Rtn VFD Air Handler
2309-3739	Connection, Control Box - w/Sup & Exh/Rtn VFD Air Handler
2309-3740	Connection, Raceway Devices - Air Handler Standard
2309-3741	Connection, Raceway Devices - Air Handler w/Supply VFD

Table 47. Unit wiring diagrams

Diagram No.	Description
2309-3742	Connection, Raceway Devices - Air Handler w/ Exh/Rtn VFD
2309-3743	Connection, Raceway Devices - Air Handler w/Sup & Exh/Rtn VFD
2309-3789	Connection, Raceway Devices - Condenser Zone (Air Handler)
2309-3901	SCHEMATIC/CONNECTION-SUP-VFD-W/O-BYPASS
2309-3902	SCHEMATIC/CONNECTION-SUP-VFD-W/ BYPASS
2309-3905	SCHEMATIC/CONNECTION-EXH-RTN-VFD-W/O-BYPASS
2309-3906	SCHEMATIC/CONNECTION-EXH-RTN-VFD-W/ BYPASS

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Warranty and Liability Clause

Commercial Equipment Rated 20 Tons and Larger and Related Accessories

PRODUCTS COVERED - This warranty* is extended by Trane Inc. and applies only to commercial equipment rated 20 Tons and larger and related accessories.

The Company warrants for a period of 12 months from initial start-up or 18 months from date of shipment, whichever is less, that the Company products covered by this order (1) are free from defects in material and workmanship and (2) have the capacities and ratings set forth in the Company's catalogs and bulletins, provided that no warranty is made against corrosion, erosion or deterioration. The Company's obligations and liabilities under this warranty are limited to furnishing f.o.b. factory or warehouse at Company designated shipping point, freight allowed to Buyer's city (or port of export for shipment outside the conterminous United States) replacement equipment (or at the option of the Company parts therefore) for all Company products not conforming to this warranty and which have been returned to the manufacturer. The Company shall not be obligated to pay for the cost of lost refrigerant. No liability whatever shall attach to the Company until said products have been paid for and then said liability shall be limited to the purchase price of the equipment shown to be defective.

The Company makes certain further warranty protection available on an optional extra-cost basis. Any further warranty must be in writing, signed by an officer of the Company.

The warranty and liability set forth herein are in lieu of all other warranties and liabilities, whether in contract or in negligence, express or implied, in law or in fact, including implied warranties of merchantability and fitness for particular use. In no event shall the Company be liable for any incidental or consequential damages.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Manager - Product Service

Trane

Clarksville, Tn 37040-1008

PW-215-2688

*A 10 year limited warranty is provided on optional Full Modulation Gas Heat Exchanger.

*Optional Extended Warranties are available for compressors and heat exchangers of Combination Gas-Electric Air Conditioning Units.

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