REZNOR®

Revision: PREEVA-IOM (05-26) REV-A

Supersedes: I-PDH,SDH,PEH,SHH,PXH (03-18) PN211408R23
I-RDH REH RHH RXH (04-18) PN215210R19
O-PREEVA (1-16) PN234661 R10

AIR HANDLER INSTALLATION, OPERATION, AND MAINTENANCE

DISCONTINUED INDOOR MODELS PDH, PEH, PXH, SDH, AND SHH
DISCONTINUED OUTDOOR MODELS RDH, REH, RHH, AND RXH



⚠ DANGER ⚠

FIRE OR EXPLOSION HAZARD

- **Failure to follow safety warnings exactly could result in serious injury, death, or property damage.**
- **Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damage.**
- **Installation and service must be performed by a qualified installer, service agency, or the gas supplier.**
- **Be sure to read and understand the installation, operation, and service instructions in this manual.**
- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

WHAT TO DO IF YOU SMELL GAS

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Leave the building immediately.**
- **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

DO NOT DESTROY. PLEASE READ CAREFULLY. KEEP IN A SAFE PLACE FOR FUTURE REFERENCE.

Installation / Operation

Applies to: **Air Handler Model PDH, Model SDH, Model PEH, Model PXH, and Model SHH**



PREEVA® Model SDH with an Optional Cooling Coil Module

- **PREEVA® MODEL PDH - Indoor, Gas-Fired, Power Vented, Heating/Makeup Air (Cooling Optional)**
- **PREEVA® MODEL SDH - Indoor, Gas-Fired, Separated-Combustion, Power Vented, Heating/Makeup Air (Cooling Optional)**
- **PREEVA® MODEL PEH - Indoor, Electric Heat, Heating/Makeup Air (Cooling Optional)**
- **PREEVA® MODEL PXH - Indoor, Makeup Air (blower only) (Cooling Optional) (Hot Water Heat Optional)**
- **PREEVA® High-Efficiency MODEL SHH - Indoor, Gas-Fired, Separated-Combustion, Power Vented, Heating (Cooling Optional)**

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1.0 General

1.1 Application

The information in this manual applies to all PREEVA® Indoor Models including the high efficiency Model SHH. Each model has unique features. Please read carefully to be sure of what applies to the model being installed.

1.2 Hazard Labels and Notices

There are warning labels on the unit and throughout this manual. For your safety, read the definitions below and comply with all boxes labeled **CAUTION, WARNING**, and **DANGER** during installation, operation, maintenance, and service of this heater.

Definitions of Hazard Intensity Levels in this Manual

HAZARD INTENSITY LEVELS

1. **DANGER: Failure to comply will result in severe personal injury or death and/or property damage.**
2. **WARNING: Failure to comply could result in severe personal injury or death and/or property damage.**
3. **CAUTION: Failure to comply could result in minor personal injury and/or property damage.**

WARNING

Installation should be done by a qualified agency in accordance with these instructions. The qualified service agency installing this unit heater is responsible for the installation.

WARNING:

These appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances. See Hazard Levels, page 2.

WARNING - Models PDH, SDH, SHH:

Should overheating occur, or the gas supply fail to shut off, shut off the manual gas valve to the appliance before shutting off the electrical supply.

WARNING:

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and replace any control that has been under water.

1.3 General Installation Information

Models PDH, SDH, and SHH are listed by ETL Testing Agency as conforming to ANSI Standards and certified to CSA Standards. Models PEH and PXH are listed by ETL as conforming to UL and CSA standards. All models are designed for commercial/industrial use.

The type of gas, the firing rate, and the electrical characteristics are on the unit rating plate. Check the rating plate to determine if the unit is appropriate for the intended installation.

If the venting manual (listed in Paragraph 1.3.1 below) for Model PDH, SDH, or SHH is missing, contact your distributor or Factory Representative before continuing installation.

If the order includes a digital control option and the control manual is missing (see Paragraph 1.3.2 below), contact your distributor or Factory Representative before beginning installation.

If your order includes a field-installed optional energy recovery module, a separate instruction sheet is included with the field-installed option.

1.3.1 Venting Manual - applies to Models PDH, SDH, and SHH

IMPORTANT: BOTH this manual AND the correct venting manual are REQUIRED for installation of a Model PDH, SDH, or SHH heater. If the venting manual is missing, contact your distributor Factory Representative before continuing installation.

Installation of gas-fired Models PDH, SDH, and SHH require **both** this manual **AND** the appropriate venting manual. Look for the “matching label” and verify that the venting manual is appropriate for the system being installed.

Venting Manual by Model - applies to Models PDH, SDH, and SHH

Model Series	Venting Instruction Manual (Form P/N)	Look for matching label on the venting manual and on the heater near the venter outlet.	
PDH	PN 211409		Label with a Red Square
SDH	PN 211410		Label with a Green Circle
SHH	PN 257037		

1.3.2 Control Manuals - applies to ALL Models with Digital Controls

Installation of any unit with an optional digital control also requires a control instruction manual. Orders with control Option DG1, DG2, DG5, or DG6 using a Model FX05 digital controller require **PN 254027**. Orders with control

1.3 General Installation Information (cont'd)

Option D12B, D12C, D12D, D12E, D12F, or D12G using a Model FX06 digital controller require **Form PN 235267**. The control manual is shipped in the literature bag with this installation manual. **NOTE**: If the unit has special controls and additional information is needed, contact your distributor or the factory. Control options are identified on the unit wiring diagram.

1.3.3 Separated-Combustion Models SDH and SHH

Models SDH and SHH are designed and manufactured in accordance with the ANSI definition of separated combustion. That definition reads, "Separated Combustion System Appliance: A system consisting of an appliance and a vent cap supplied by the manufacturer, and (1) combustion air connections between the appliance and the outside atmosphere, and (2) flue gas connections between the appliance and vent cap, of a type(s) specified by the manufacturer but supplied by the installer, constructed so that, when installed in accordance with the manufacturer's instructions, air for combustion is obtained from the outside atmosphere and flue gases are discharged to the outside atmosphere."

Model SDH and SHH separated-combustion units are designed to separate air for combustion and flue products from the environment of the building in which the unit is installed. Separated-combustion appliances are recommended for use in dust laden and some corrosive fume environments or in buildings with negative pressure (up to .15" w.c.). As the definition states, all separated-combustion equipment must be equipped with both combustion air and exhaust piping to the outdoors.

1.4 Warranty

Refer to the limited warranty information on the Warranty Form in the "Literature Bag".

Warranty is void if ...

a. Heaters are used in atmospheres containing flammable vapors or atmospheres containing chlorinated or halogenated hydrocarbons or any contaminant (silicone, aluminum oxide, etc.) that adheres to the spark ignition flame sensing probe.
b. Wiring is not in accordance with the diagram furnished with the system.
c. Unit is installed without proper clearance to combustible materials or without proper ventilation and air for combustion.
d. Air throughput is not adjusted within the range specified on the rating plate.
e. Product is not installed in accordance with these instructions and/or local codes.

1.5 Installation Codes

Gas-fired Models PDH, SDH, and SHH

All units must be installed in accordance with local building codes. In the absence of local codes, in the United States, Model PDH, SDH, and SHH units must be installed in accordance with the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition). A Canadian installation must be in accordance with the CSA B149.1 Natural Gas and Propane Installation Code. Both codes are available from CSA Information Services, 1-800-463-6727. All packaged systems must be installed in compliance with the National Electric Code ANSI/NFPA No. 70 (latest edition) or in the Canada, the Canadian Electrical Code Part I-C.S.A. Standard C22.1. Local authorities having jurisdiction should be consulted before installation is made to verify local codes and installation procedure requirements.

Special Installations (Aircraft Hangars/Garages) - In the United States, installation in an aircraft hangar should be in accordance with NFPA No. 409 (latest edition), Standard for Aircraft Hangars; in parking structures in accordance with NFPA No. 88A (latest edition); and in repair garages in accordance with NFPA 88B (latest edition). In Canada, installations in aircraft hangars, parking garages, and repair garages should be in accordance with the requirements of the enforcing authorities and with CSA B149.1 codes.

Commercial Makeup Air Installations - Gas-fired Models PDH, SDH, and SHH are certified by ANSI Z83 family of standards governing the safe usage of heating equipment in the industrial/commercial marketplace. This includes using the heaters in makeup air applications to supply corridor pressurization in commercial buildings such as office structures and apartment complexes. This product may be used for all makeup air applications except one or two family dwellings.

All Installations - Clearances from the heater and vent to combustible construction or material in storage must conform with the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition) pertaining to gas-burning devices, and such material must not attain a temperature over 160°F by continued operation of the heater.

California Warning Label - If a unit is being installed in the state of California, the installer **MUST** attach a warning label on the outside of the access door. The California Warning label is shipped in the literature bag along with this manual, the warranty form, and any other paperwork that applies.

Select a location on the heater access panel. Be sure the surface is clean and dry and adhere the label.

Massachusetts Requirement - If a gas-fired heater is being installed in the Commonwealth of Massachusetts, it must be installed by a licensed plumber or licensed gas fitter.

2.0 Location

Location must be in agreement with clearances in Paragraph 4.1, venting requirements in the appropriate venting manual, dimensions in Paragraph 4.2, weights and structural support in Paragraph 5.1, and combustion air requirements for Model PDH in Paragraph 6.3.

CAUTION: Do not locate the heater where it may be exposed to water spray, rain, or dripping water.

CAUTION: When installing a unit that includes a cooling module in a location such as an attic that can experience high dewpoint conditions, a field-supplied drain pan should be installed under the entire unit for water management control. High dewpoint conditions have the potential to form condensation on the exterior of the unit.

CAUTION - Model SHH: Model SHH heaters should not be used in an application where the heated space temperature is below 50°F. The combination of low space and combustion air temperatures may result in condensate freezing in the secondary heat exchanger and/or the condensate drain.

Hazards of Chlorine - The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine found usually in the form of freon or degreaser vapors, when exposed to flame will precipitate from the compound, and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid which readily attacks all metals including 300 grade stainless steel. Care should be taken to separate these vapors from the combustion process. This may be done by wise location of the combustion air terminal (Model SDH or SHH) with regard to exhausters or prevailing wind directions. Chlorine is heavier than air. Keep these facts in mind when determining installation location of the heater in relation to building exhaust systems.

3.0 Receiving, Moving, Uncrating, and Preparing for Installation

The indoor models in this manual are shipped completely assembled. The heavy gauge base of the unit has forklift openings in both sides. (**NOTE:** If system has more than two optional modules, check for labels identifying which side to lift.) To move a unit, use a forklift with forks that have a minimum length of 24" (610mm).

Immediately upon uncrating, check the gas specifications and/or electrical characteristics of the unit to verify that they agree with the gas and/or electric supply at the installation site.

Check for any damage that may have been incurred during shipment. If damage is found, document the damage with the transporting agency and immediately contact your distributor. If you are a Distributor, follow the FOB freight policy procedures.

3.0 Receiving, Moving, Uncrating, and Preparing for Installation (cont'd)

Shipped-Separate or Shipped-Loose Items

Some control options have parts either shipped loose with the heater, shipped separately, or mounted on a shipped-separate remote console (if ordered). If your unit is equipped with any of the control or air inlet options in **TABLE 1A**, be sure these parts are available at the job site. NOTE: Other optional field-installed controls or sensors may also be required for some control options.

TABLE 1A - Shipped-Separate or Shipped-Loose Components of Factory-Installed Options

Option	Shipped Loose with the Heater & Shipped Separate Components
AG3, AG60	On/Off Control Switch, **P/N 39732;** Discharge Air Sensor Holder, **P/N 115850**; Discharge Air Sensor Holder Bracket, **P/N 213612**
AG8	On/Off Control Switch, **P/N 29054;** Discharge Air Sensor, **P/N 48041**
AG9	On/Off Control Switch, **P/N 29054;** Discharge Air Sensor, **P/N 48041**; Remote Temperature Selector, **P/N 48042**
AG9H	On/Off Control Switch, **P/N 29054;** Discharge Air Sensor, **P/N 194261**; Mixing Tube, **P/N 90323**; Remote Temperature Selector, **P/N 194258**
AG15, AG61	On/Off Control Switch, **P/N 39732**; Remote Ductstat Temperature Selector, **P/N 115848**; Stage Adder Module(s), **P/N 115849;** Discharge Air Sensor Holder, **P/N 115850**; Discharge Air Sensor Holder Bracket, **P/N 213612**
AG16, AG62	On/Off Control Switch, **P/N 39732**; Remote Temperature Selector, **P/N 115848**; Stage Adder Module(s), **P/N 115849**; Digital Temperature Display, **P/N 115852;** Discharge Air Sensor Holder, **P/N 11585**0; Discharge Air Sensor Holder Bracket, **P/N 213612**
DG1, DG2	Room Command Module, **P/N 211423**
DG5, DG6	Room Command Module, **P/N 211424;** Discharge Air Sensor Holder, **P/N 115850**; Discharge Air Sensor Holder Bracket, **P/N 213612**
D12B, D12C, D12D, D12E, D12F, D12G	Discharge Air Sensor Holder, **P/N 115850**; Discharge Air Sensor Holder Bracket, **P/N 213612)**
GE10	Potentiometer, **P/N 16110**
GE15	Pressure Null Switch, **P/N 88052**
GE21	Enthalpy Sensor and Parts to install, **P/N 220686**
GE22	Two Enthalpy Sensors and Parts to install, (2) **P/N 220686**
AU7L, AU7R	Duct Humidity/Temperature Sensor, **P/N 206081**; Mounting Bracket, **P/N 207499 (NOTE:** These parts will be factory installed if the system includes a mixing box, Option MXB1.)

NOTE: Instructions for installing the vent/ combustion air kit are in the vent manual in the literature bag.

<u>Models SDH and SHH</u> - Shipped-Separate Combustion Air Inlet/Vent Terminal Kit

A vent/combustion air terminal kit (Option CC2 or CC6) is **required** for all Model SDH and Model SHH installations. Be sure that the correct venting/combustion air terminal kit is at the installation site. Optional kits are unique for each Model; compare P/N's with **TABLE 1B**.

TABLE 1B - Combustion Air Inlet/Vent Terminal Kits

Model	Option	Sizes	Kit P/N
SDH	CC6	75-125	**211762**
		150-400A	**211763**
	CC2	75-125	**205895**
		150-400A	**205896**
SHH	CC6	All	**221247**
	CC2	All	**221248**

Other Field-Installed Accessories

If your unit was ordered with Option UV2, UVC lights in the cooling coil module, the bulbs and a box of parts are shipped in the blower compartment for field installation. Being careful not to touch the bulbs, verify the components with the instruction sheet included with the parts.

Before beginning installation, be sure that all shipped-separate options ordered are available at the site. In addition to the vent/combustion air kit, field-installed, shipped-separate options could include an energy recovery unit, a downturn nozzle, VFD, a thermostat or other wall-mounted control, a remote console, a disconnect switch, fill and drain kit, water hammer arrestor, firestat, a vent cap, and/or a smoke detector.

Storage and Startup

If this system is going to be stored, take precautions to prevent condensate formation inside the electrical compartments and motors. To prevent damage to the unit, do not store sitting on the ground.

After the system has been moved to its installation site, remove all of the shipping brackets and check all of the fans for free movement. See the check lists in Paragraph 9.0 before starting the unit and completing the Startup Form.

4.0 Dimensions and Clearances

4.1 Clearances

For safety and convenience, provide clearances as shown in **TABLE 2** and **TABLE 3**. Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. Minimum clearances are also listed on the heater rating plate.

TABLE 2 - Minimum Clearance from Combustibles - applies to <u>All Sizes</u>

Minimum Clearances from Combustible Material										
	Control Side	Opposite Control Side	Front	Rear	Top	Bottom	Gas-Fired Models			
							Vent Connector at Unit		Vent Pipe	
inches	20	6	48	18	6	0	PDH/SDH - 18	SHH - 6	PDH/SDH - 6	SHH - 0
mm	508	152	1219	457	152	0	PDH/SDH - 457	SHH - 152	PDH/SDH -152	SHH - 0

TABLE 3 - Service Clearances

Recommended Service Clearances by Model and Size													
Model and Size				Control Side						Side Opposite Controls		Top	
				Control Side (Basic)		Control Side with Mixing Box		Control Side with Cooling Coil*					
SDH and PDH	PEH	SHH	PXH	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
75, 100	10A, 20A, 40A	N/A	000A	30	762	30	762	42	1067	6	152	18	457
125, 150	15B, 30B, 60B	N/A	000B	34	864	34	864	52	1321	6	152	18	457
175, 200, 225	N/A	130, 180	000C	30	762	30	762	42	1067	6	152	24	610
250, 300	30D, 60D, 90D, 120D	260	000D	42	1067	42	1067	58	1473	6	152	24	610
350, 400A	40E, 80E, 120E	350	000E	52	1321	52	1321	66	1676	6	152	24	610

* Clearance is required to remove slide out drain pan.

4.0 Dimensions and Clearances (cont'd)

4.2 Configurations and Dimensions

FIGURE 1 Factory-assembled Configurations Depending on Option Selection and KEY to Dimensions A, C, and E

Option ECC3 or ECC2 Evaporative Cooling Module	Option MXB1 Mixing Box with Variety of Inlet Air Options	Optional On/Off Damper	Option AU Cooling Coil Module with a DX or Chilled Water Coil with or without Reheat	Blower and Heat Section (SDH, PDH, SHH, or PEH); Blower only (PXH - "no heat" model only; for PXH with optional hot water heat module, see page 40.) Air Flow →	Use this column to determine which length measurements apply to the system.
ECC	MXB1	AR8	AU 5, 6, or 7	BASIC	KEY to Dimension Codes A, C, and E in **TABLE 4 and FIGURE 2**
--	--	--	--	Basic	A, C, E
--	--	AR8	--	Basic	A, C + 10" (254mm), E
--	MXB1	--	--	Basic	A1, C1, E1
ECCx	--	--	--	Basic	A1, C1, E1
--	--	--	AU 5 or 6 w/o Reheat	Basic	A2, C2, E2
--	--	AR8	AU 5 or 6 w/o Reheat	Basic	A2, C2 + 10" (254mm), E2
--	--	--	AU 7 with Reheat	Basic	A3, C3, E3
--	--	AR8	AU 7 with Reheat	Basic	A3, C3 + 10" (254mm), E3
ECCx	MXB1	--	--	Basic	A4, C4, E4
--	MXB1	--	AU 5 or 6 w/o Reheat	Basic	A5, C5, E5
--	MXB1	--	AU 7 with Reheat	Basic	A6, C6, E6
ECCx	--	--	AU 5 or 6 w/o Reheat	Basic	A5, C5, E5
ECCx	--	--	AU 7 with Reheat	Basic	A6, C6, E6
ECCx	MXB1	--	AU 5 or 6 w/o Reheat	Basic	A7, C7, E7
ECCx	MXB1	--	AU 7 with Reheat	Basic	A8, C8, E8

TABLE 4 - Dimensions

Important NOTES:

1) Dimensions **A**, **C**, and **E** change with selection of factory-installed modules; see Key above.

2) Suspension Point Dimensions **U**, **V**, and **W** apply ONLY to systems with a cooling coil cabinet (AU) and/or a mixing box (MXB). A system with one module (AU or MXB) has two intermediate side hangers; a system with two modules (MXB and AU) has four intermediate side hangers. The basic unit and the basic unit with an evaporative cooling module (ECC) do not require intermediate side suspension points.

3) Dimension **W1** applies to both a mixing box (MXB) and a coil cabinet without reheat (AU5 or AU6); **W2** applies to a mixing box (MXB) and a coil cabinet with reheat (AU7).

4) PXH dimensions are for "no heat" model only. Dimensions for PXH with hot water heat are in Paragraph 6.7.5.

Dimensions - inches (±1/8)

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified											
				A	A1	A2	A3	A4	A5	A6	A7	A8	B	C	C1
75, 100	10A, 20A, 40A	N/A	000A	56-5/8	87-11/16	84-7/16	109-1/2	118-3/4	115-15/32	140-7/8	146-1/2	171-9/16	32-5/8	54-3/4	85-13/16
125, 150	15B, 30B, 60B	N/A	000B	56-5/8	87-11/16	84-7/16	109-1/2	118-3/4	115-15/32	140-7/8	146-1/2	171-9/16	42-5/8	54-3/4	85-13/16
175, 200, 225	N/A	130, 180	000C	PDH/SDH/ PEH /PXH 72-5/16 SHH 82-5/16	PDH/SDH/ PEH/PXH 103-5/8 SHH 113-5/8	PDH/SDH/ PEH/PXH 100-1/8 SHH 110-1/8	PDH/SDH/PEH/ PXH 125-3/16 SHH 135-3/16	PDH/SDH/ PEH/PXH 134-7/16 SHH 144-7/16	PDH/SDH/ PEH/PXH 131-3/16 SHH 141-3/16	PDH/SDH/ PEH/PXH 156-1/4 SHH 166-1/4	PDH/SDH/ PEH/PXH 162-1/4 SHH 172-1/4	PDH/SDH/ PEH/PXH 187-5/16 SHH 197-5/16	32-5/8	PDH/SDH/ PEH/PXH 70-7/16 SHH 80-7/16	PDH/SDH/ PEH/PXH 101-1/2 SHH 111-1/2
250, 300	30D, 60D, 90D, 120D	260	000D										48-7/8		
350, 400A	40E, 80E, 120E	350	000E										56-7/8		

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified											
				C2	C3	C4	C5	C6	C7	C8	D - SDH/SHH	E	E1	E2	E3
75, 100	10A, 20A, 40A	N/A	000A	82-9/16	107-5/8	116-7/8	113-5/8	138-11/16	144-11/16	169-3/4	4	59-5/8	90-21/32	87-13/32	112-15/32
125, 150	15B, 30B, 60B	N/A	000B	82-9/16	107-5/8	116-7/8	113-5/8	138-11/16	144-11/16	169-3/4	4	59-5/8	90-21/32	87-13/32	112-15/32
175, 200, 225	N/A	130, 180	000C	PDH/SDH/ PEH/PXH 98-7/32 SHH 108-7/32	PDH/SDH/ PEH/PXH 123-9/32 SHH 133-9/32	PDH/SDH/ PEH/PXH 132-9/16 SHH 142-9/16	PDH/SDH/PEH/ PXH 129-19/64 SHH 139-19/64	PDH/SDH/ PEH/PXH 154-23/64 SHH 164-23/64	PDH/SDH/ PEH/PXH 160-11/32 SHH 170-11/32	PDH/SDH/ PEH/PXH 185-13/32 SHH 195-13/32	5	PDH/SDH/ PEH/PXH 75-5/16 SHH 85-5/16	PDH/SDH/ PEH/PXH 106-3/8 SHH 116-3/8	PDH/SDH/ PEH/PXH 103-7/64 SHH 113-7/64	PDH/SDH/ PEH/PXH 128-11/64 SHH 138-11/64
250, 300	30D, 60D, 90D, 120D	260	000D								5				
350, 400A	40E, 80E, 120E	350	000E								5				

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified											
				E4	E5	E6	E7	E8	F - PDH/ SDH/SHH	G - PDH/ SDH/SHH	H - SDH/SHH	J - PDH/ SDH/SHH	K*	M	N
75, 100	10A, 20A, 40A	N/A	000A	121-23/32	118-15/32	143-17/32	149-17/32	174-19/32	20-25/32	17-7/8	3-5/8	16-51/64	33-3/4	24-11/16	34-15/32
125, 150	15B, 30B, 60B	N/A	000B	121-23/32	118-15/32	143-17/32	149-17/32	174-19/32	20-25/32	17-7/8	3-5/8	16-51/64	43-3/4	34-11/16	34-15/32
175, 200, 225	N/A	130, 180	000C	PDH/SDH/ PEH/PXH 137-7/16 SHH 147-7/16	PDH/SDH/ PEH/PXH 134-11/64 SHH 144-11/64	PDH/SDH/ PEH/PXH 162-1/2 SHH 172-1/2	PDH/SDH/PEH/ PXH 165-1/4 SHH 175-1/4	PDH/SDH/ PEH/PXH 190-5/16 SHH 200-5/16	PDH/SDH 32-1/32 SHH 42-15/16	PDH/SDH 24-3/4 SHH 35-5/8	4	PDH/SDH 17-7/32 SHH 17-7/16	33-3/4	24-11/16	43-23/32
250, 300	30D, 60D, 90D, 120D	260	000D								4		50	40-15/16	43-23/32
350, 400A	40E, 80E, 120E	350	000E								4		58	48-15/16	43-23/32

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified									
				P	Q	R	S	T	U	V	W1	W2	X-PEH
75, 100	10A, 20A, 40A	N/A	000A	27-11/32	17-23/32	5-3/64	13-13/16	2-27/32	35-3/4	55-15/32	83-1/4	108-5/16	21-11/16
125, 150	15B, 30B, 60B	N/A	000B	27-11/32	27-23/32	5-3/64	13-13/16	2-27/32	45-3/4	55-15/32	83-1/4	108-5/16	21-11/16
175, 200, 225	N/A	130, 180	000C	36-9/16	20-29/32	2	23	2-59/64	35-3/4	71-5/32	98-61/64	PDH/SDH/ PEH/PXH 124-1/64 SHH 134-1/64	N/A
250, 300	30D, 60D, 90D, 120D	260	000D	36-9/16	28-13/16	10-5/16	23	2-59/64	52	71-5/32	98-61/64		29-3/8
350, 400A	40E, 80E, 120E	350	000E	36-9/16	38-15/32	8-41/64	23	2-59/64	60	71-5/32	98-61/64		29-3/8

* Model SHH - See **FIGURE 2**, Front View, for additional width from factory-installed flue connection.

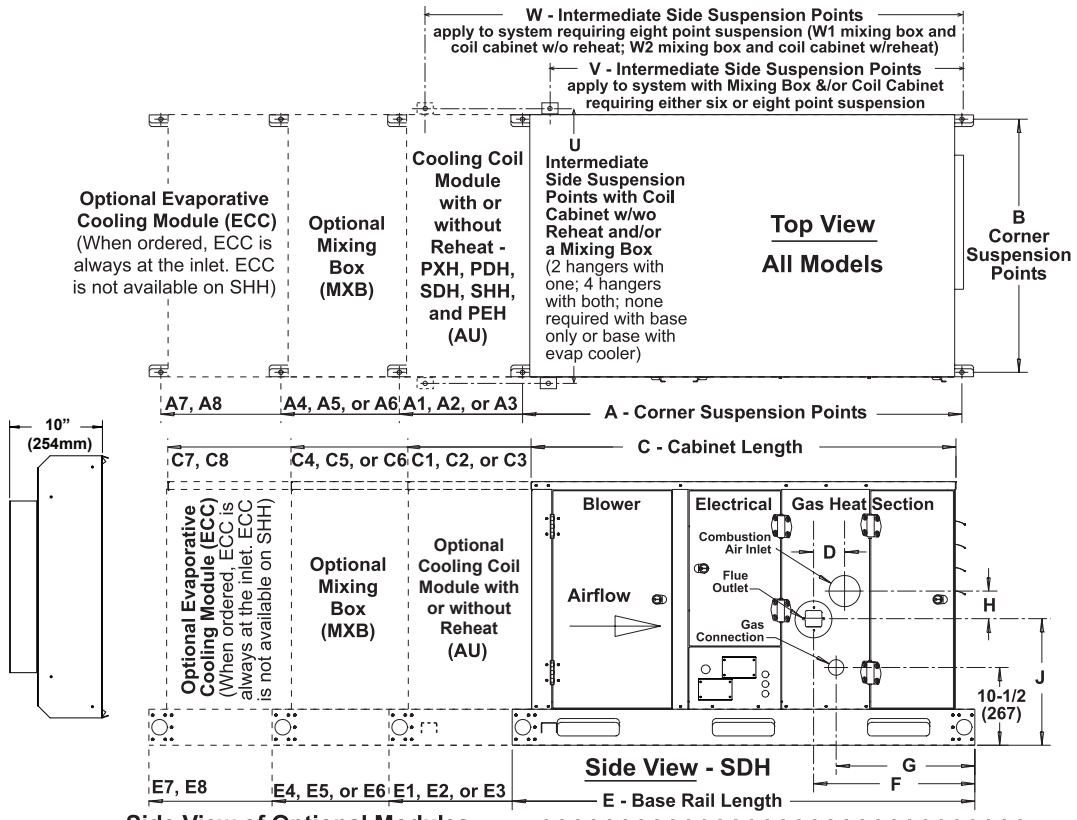
Dimensions - mm (±3)

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified																				
				A	A1	A2	A3	A4	A5	A6	A7	A8	B	C	C1	C2	C3	C4	C5	C6	C7	C8	D-SDH/ SHH	E	E1	E2
75, 100	10A, 20A, 40A	N/A	000A	1438	2227	2144	2781	3016	2933	3578	3722	4359	829	1391	2180	2097	2734	2969	2886	3523	3675	4312	102	1514	2303	2220
125, 150	15B, 30B, 60B	N/A	000B	1438	2227	2144	2781	3016	2933	3578	3722	4359	1083	1391	2180	2097	2734	2969	2886	3523	3675	4312	102	1514	2303	2220
175, 200, 225	N/A	130, 180	000C	PDH/ SDH/ PEH/ PXH 1837 SHH 2091	PDH/ SDH/ PEH/ PXH 2626 SHH 2880	PDH/ SDH/ PEH/ PXH 2543 SHH 2797	PDH/ SDH/ PEH/ PXH 3180 SHH 3434	PDH/ SDH/ PEH/ PXH 3415 SHH 3669	PDH/ SDH/ PEH/ PXH 3332 SHH 3586	PDH/SDH/ PEH/PXH 3969 SHH 4223	PDH/SDH/ PEH/PXH 4121 SHH 4375	PDH/SDH/ PEH/PXH 4758 SHH 5012	829	PDH/ SDH/ PEH/ PXH 1789 SHH 2043	PDH/ SDH/ PEH/ PXH 2578 SHH 2832	PDH/ SDH/ PEH/ PXH 2495 SHH 2749	PDH/ SDH/ PEH/ PXH 313 SHH N/A	PDH/ SDH/ PEH/ PXH 3367 SHH N/A	PDH/ SDH/ PEH/ PXH 3284 SHH 3538	PDH/ SDH/ PEH/ PXH 3921 SHH N/A	PDH/ SDH/ PEH/ PXH 4073 SHH N/A	PDH/ SDH/ PEH/ PXH 4711 SHH N/A	127	PDH/ SDH/ PEH/PXH 1913 SHH 2167	PDH/ SDH/ PEH/PXH 2702 SHH 2956	PDH/ SDH/ PEH/ PXH 2619 SHH 2873
250, 300	30D, 60D, 90D, 120D	260	000D										1241										127			
350, 400A	40E, 80E, 120E	350	000E										1445										127			

PDH or SDH	PEH	SHH	PXH	Dimensions (See FIGURES 1 and 2) - apply to all Models unless specified																				
				E3	E4	E5	E6	E7	E8	F PDH/SDH/SHH	G PDH/SDH/SHH	H-SDH/ SHH	J-PDH/SDH/ SHH	K*	M	N	P	Q	R	S	T	U	V	W1	W2	X - PEH
75, 100	10A, 20A, 40A	N/A	000A	2856	3092	3009	3646	3798	4435	528	454	92	427	857	627	876	695	450	128	351	72	908	1409	2115	2751	551
125, 150	15B, 30B, 60B	N/A	000B	2856	3092	3009	3646	3798	4435	528	454	92	427	1111	881	876	695	704	128	351	72	1162	1409	2115	2751	551
175, 200, 225	N/A	130, 180	000C	PDH/ SDH/ PEH/ PXH 3256 SHH 3510	PDH/ SDH/ PEH/ PXH 3491 SHH 3745	PDH/ SDH/ PEH/ PXH 3009 SHH 3263	PDH/ SDH/ PEH/ PXH 4128 SHH 4382	PDH/ SDH/ PEH/ PXH 4197 SHH 4451	PDH/ SDH/ PEH/ PXH 4834 SHH 5098	PDH/SDH 814 SHH 1091	PDH/SDH 629 SHH 905	102	PDH/SDH 437 SHH 443	857	627	1111	928	531	51	584	74	908	1807	2513	PDH/ SDH/ PEH/PXH 3150 SHH 3404	N/A
250, 300	30D, 60D, 90D, 120D	260	000D									102		1270	1040	1111	928	732	262	584	74	1321	1807	2513		746
350, 400A	40E, 80E, 120E	350	000E									102		1473	1243	1111	928	977	219	584	74	1524	1807	2513		746

* Model SHH - See **FIGURE 2**, Front View, for additional width from factory-installed flue connection

FIGURE 2 - Dimensions inches (mm)

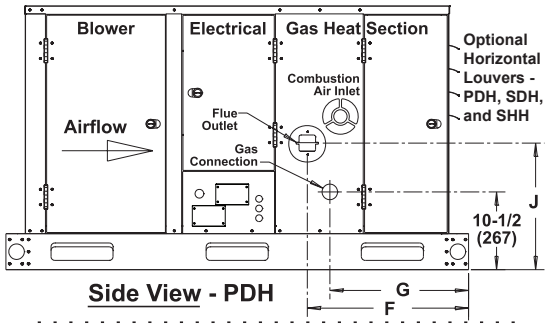


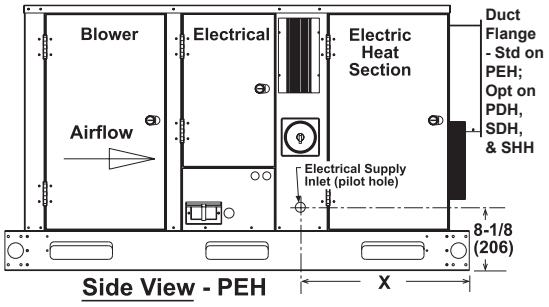
Side View of Option AR8 On/Off Damper with Duct Flange (no mixing box)
[adds 10 inches (254mm) to all "C" dimensions]

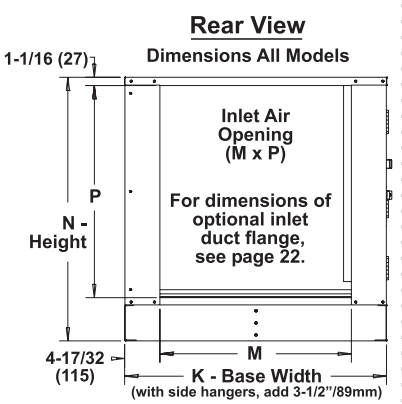
Side View of Optional Modules

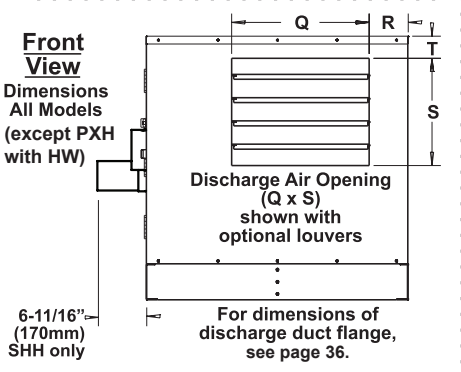
NOTE: Side view of "no heat" Model PXH is not illustrated but includes the blower section and the heat section cabinets less the heating components. Dimensions here apply to "no heat" PXH only. For PXH with hot water heat, see page 40.

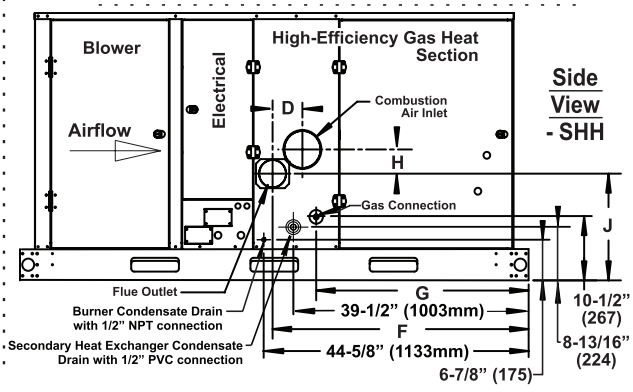
See Table 4 for dimensions.











Option Dimensions and Inlet (Rear) View with Options

- Inlet Duct Flange, page 22
- On/off Inlet Damper with Duct Flange, page 23
- Mixing Box, page 24
- Evaporative Cooling Module, page 29
- Cooling Coil Cabinet, pages 34 and 35
- Outlet Duct Flange option for PDH, SDH, SHH, (std on PEH), page 36
- Optional Outlet Nozzles for PDH, SDH, SHH, and PXH (without heat), page 40
- Hot Water Heat Module for PXH, page 41, including Optional Discharge Duct Flange, Louvers, and Nozzles

5.0 Suspension and Mounting

5.1 Weights

Before installing, check the support structure to be sure that it has sufficient load-bearing capacity to support the weight of unit during installation and operation. Suspension or mounting is the responsibility of the installer.

TABLE 5 - Weights (lbs and kg) of Basic System and Factory-Installed Optional Modules

* Cooling coil cabinet module weight is estimated for heaviest coil. If more accurate information is needed, check with your distributor or Factory Representative who either has the specific information in the order specifications or has software to generate the information.

Model PDH and Model SDH (gas-fired heat)			75	100	125	150	175	200	225	250	300	350	400A
Model PEH (electric heat)			10A, 20A, 40A		15B, 30B, 60B		N/A			30D, 60D, 90D, 120D		40E, 80E, 120E	
Model SHH (high efficiency gas-fired heat)			N/A				130	180	---	260	--	350	--
Model PXH (no heat)			000A		000B		000C			000D		000E	
Approximate Net Weights - lbs (does not include motor weight)													
Basic Gas Heat & Blower Section (PDH or SDH)			323	331	413	421	478	492	492	615	629	721	732
Basic Electric Heat & Blower Section (PEH)			296		368		N/A			523		594	
Basic High Efficiency Gas Heat & Blwr Sctn (SHH)			N/A				538	544	--	729	--	889	--
Blower Section (PXH)			245		307		333			431		483	
Approximate Weights (lbs) of factory-attached options (add to weight listed above)													
Option AR8, on/off damper (no mixing box)			34		45		56			73		85	
Option MXB1 Mixing Box Module w/o Dampers	2 inlets, single wall		119		132		134			159		174	
	2 inlets, double wall		146		165		166			199		216	
	1 inlet, single wall		115		127		130			154		169	
	1 inlet, double wall		146		166		166			201		219	
Cooling Coil Module with heaviest coil weight*	DX coil without reheat pump	4 row coil	214		252		256			329		365	
		6 row coil	235		280		284			373		418	
	DX coil with reheat pump	4 row coil	331		382		394			494		547	
		6 row coil	352		410		422			538		600	
	Chilled water (filled)	4 row coil	301		363		373			497		559	
		6 row coil	351		431		441			604		686	
Evaporative Cooling Module	with dry media	12" media	120		141		136			172		190	
	with wet media & 3" of water	12" media	262		263		218			279		272	
Hot Water Heat Module - for PXH with HW2 only (does not include water wt)		w/4 row, 14 fpi coil	145		175		177			236		263	
Approximate Net Weights - kg (does not include motor weight)													
Basic Gas Heat & Blower Section (PDH or SDH)			147	150	187	191	217	223	223	279	285	327	332
Basic Electric Heat & Blower Section (PEH)			134		167		N/A			237		269	
Basic High Efficiency Gas Heat & Blwr Sctn (SHH)			N/A				244	247	--	331	--	403	--
Blower Section (PXH)			111		139		151			195		219	
Approximate Weights (kg) of factory-attached options (add to weight listed above)													
Option AR8, on/off damper (no mixing box)			15		20		25			33		39	
Option MXB1 Mixing Box Module w/o Dampers	2 inlets, single wall		54		60		61			72		79	
	2 inlets, double wall		66		75		75			90		95	
	1 inlet, single wall		52		58		59			70		77	
	1 inlet, double wall		66		75		75			91		99	
Cooling Coil Module with heaviest coil weight*	DX coil without reheat pump	4 row coil	97		114		116			149		166	
		6 row coil	107		127		129			169		190	
	DX coil with reheat pump	4 row coil	150		173		179			224		248	
		6 row coil	160		186		191			244		272	
	Chilled water (filled)	4 row coil	137		165		169			225		254	
		6 row coil	159		195		200			274		311	
Evaporative Cooling Module	with dry media	12" media	54		64		62			78		86	
	with wet media & 76mm of water	12" media	119		119		99			127		123	
Hot Water Heat Module - for PXH with HW2 only (does not include water weight)		w/4 row, 14 fpi coil	66		79		80			107		119	

TABLE 6 - Corner Weights of Heat Module and Blower Section only for Models Listed

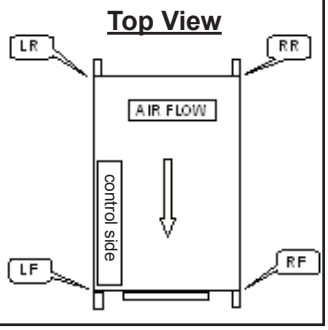
PDH/SDH	75	100	125	150	175	200	225	250	300	350	400A
Corner (FIGURE 3)	**Approximate Corner Weights (lbs) - Heat Section & Blower only**										
LR	70	70	92	92	80	80	80	124	124	158	158
RR	63	63	87	87	74	74	74	110	110	155	155
RF	92	96	113	117	156	163	163	180	187	198	202
LF	98	102	121	125	168	175	175	201	208	210	217
Corner (FIGURE 3)	**Approximate Corner Weights (kg) - Heat Section & Blower only**										
LR	32	32	42	42	36	36	36	56	56	72	72
RR	29	29	39	39	34	34	34	50	50	70	70
RF	42	44	51	53	71	74	74	82	85	90	92
LF	44	46	55	57	76	79	79	91	94	95	98

PEH	10A, 20A, 40A		15B, 30B, 60B		30D, 60D, 90D, 120D		40E, 80E, 120E	
Approx Wt of Each Corner	lbs	kg	lbs	kg	lbs	kg	lbs	kg
	74	34	92	42	131	59	149	68

SHH	130	180	260	350
Corner (FIG 3)	Approx Wt (lbs) - Heat Section & Blower only			
LR	81	82	127	188
RR	87	88	144	192
RF	193	193	241	264
LF	180	180	217	245
Corner (FIG 3)	Approx Wt (kg) - Heat Section & Blower only			
LR	37	37	58	85
RR	39	40	65	87
RF	88	88	109	120
LF	82	82	98	120

Important NOTES: If controls are on the right side, switch left and right side weights. Weights do not include the blower motor or any optional modules.

FIGURE 3 - Corner Weight Locations



5.2 Lifting and Suspension

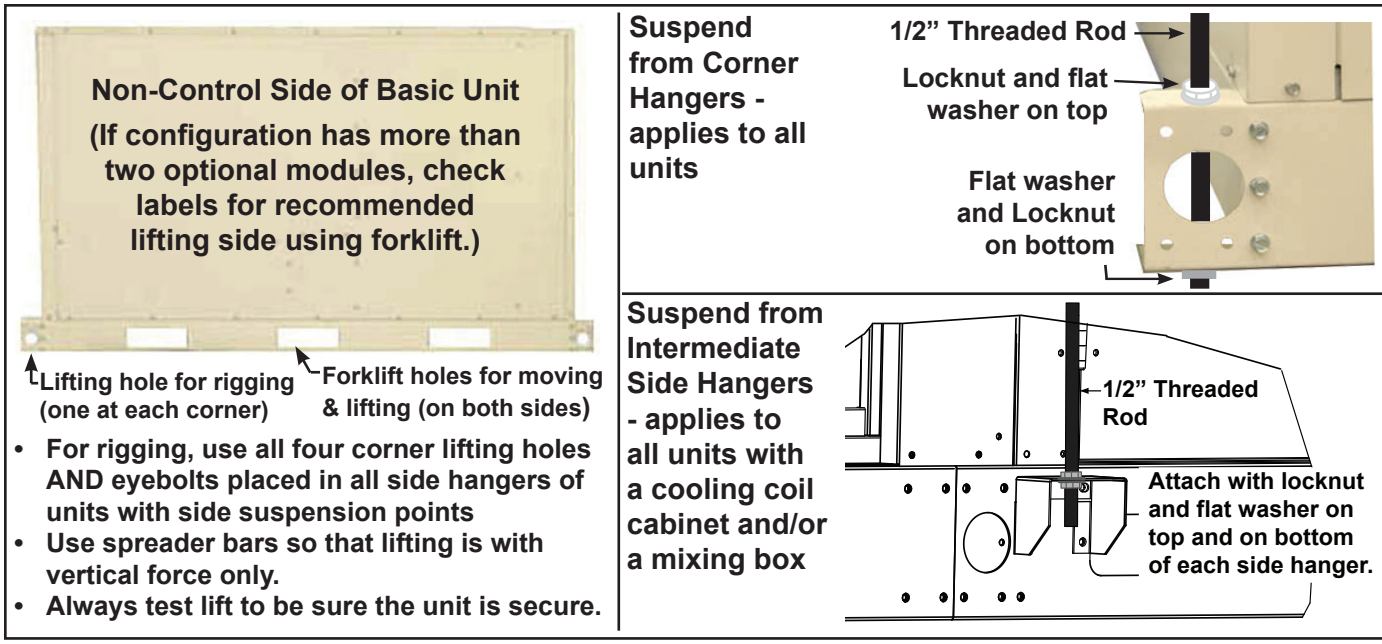
The heavy gauge base of the unit has forklift openings in both sides. See **FIGURE 4**. Use these openings to move and lift the unit. (**NOTE:** If system has more than two optional modules, check for labels identifying which side to lift.) Braces underneath are spaced to accommodate a minimum fork length of 24" (610mm).

In addition, the base of all units has a lifting hole at each corner. Systems with a mixing box and/or a cooling cabinet have additional side suspension points. When lifting, lift from all of the suspension points on the unit (4, 6, or 8). Use spreader bars to lift the unit straight up with vertical force only.

FIGURE 4 - Heavy Gauge Base has Forklift Holes and Lifting Holes plus Holes for Attaching 1/2" Threaded Rod for Suspension

Whichever method is used, test lift the unit to be sure that it is secure. Then lift slowly following safe procedures. Lifting and suspension are the responsibility of the installer.

Depending on the type and number of optional modules, each unit has either four, six, or eight point suspension. See **TABLE 7 A, B, or C** and **FIGURE 2**, page 9. Extend 1/2" threaded hanger rod through both top and bottom of the base at each corner suspension point. Secure with flat washers and locknuts (See **FIGURE 4**, top right). When six or eight point suspension is required, attach 1/2" threaded rod to each side hanger bracket using a locknut and a flat washer on both the top and bottom of the hanger bracket (See **FIGURE 4**, bottom right).



- **For rigging, use all four corner lifting holes AND eyebolts placed in all side hangers of units with side suspension points**
- **Use spreader bars so that lifting is with vertical force only.**
- **Always test lift to be sure the unit is secure.**

TABLE 7A - Suspension Point Dimensions - PDH, SDH, PEH, and PXH without hot water heat

Configuration	Suspension Points (qty)	PDH/SDH 75, 100 / PEH 10A, 20A, 40A / PXH 000A (no heat only)				PDH/SDH 125, 150 / PEH 15B, 30B, 60B / PXH 000B (no heat only)				PDH/SDH 175, 200, 225 / PEH N/A / PXH 000C (no heat only)				PDH/SDH 250, 300 / PEH 30D, 60D, 90D, 120D / PXH 000D (no heat only)				PDH/SDH 350, 400A / PEH 40E, 80E, 120E / PXH 000E (no heat only)			
		Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width
Dimensions (inches)																					
Blower/furnace (PDH/SDH/PEH) or blower only (PXH)	4	56-5/8	N/A		N/A	56-5/8	N/A		N/A	72-5/16	N/A		N/A	72-5/16	N/A		N/A	72-5/16	N/A		N/A
with Evap Cooler (ECC)	4	87-11/16	N/A		N/A	87-11/16	N/A		N/A	103-5/8	N/A		N/A	103-5/8	N/A		N/A	103-5/8	N/A		N/A
with Mixing Box (MXB)	6	87-11/16	53-31/32			87-11/16	53-31/32			103-5/8	69-21/32			103-5/8	69-21/32			103-5/8	69-21/32		
with Coil Cabinet (AU 5 or 6)	6	84-7/16	53-31/32			84-7/16	53-31/32			100-1/8	69-21/32			100-1/8	69-21/32			100-1/8	69-21/32		
with Coil Cab (AU7)	6	109-1/2	53-31/32			109-1/2	53-31/32			125-3/16	69-21/32			125-3/16	69-21/32			125-3/16	69-21/32		
with ECC & MXB	6	118-3/4	53-31/32			118-3/4	53-31/32			134-7/16	69-21/32			134-7/16	69-21/32			134-7/16	69-21/32		
with ECC & AU5 or AU6	6	115-15/32	53-31/32			115-15/32	53-31/32			131-3/16	69-21/32			131-3/16	69-21/32			131-3/16	69-21/32		
with ECC & AU7	6	140-7/8	53-31/32	32-5/8		140-7/8	53-31/32	42-5/8		156-1/4	69-21/32	32-5/8		156-1/4	69-21/32	48-7/8		156-1/4	69-21/32	56-7/8	
with MXB **&** AU5 or AU6	8	115-15/32	53-31/32			115-15/32	53-31/32			131-3/16	69-21/32			131-3/16	69-21/32			131-3/16	69-21/32		
			81-25/32		35-3/4		81-25/32		45-3/4		97-1/2		35-3/4		97-1/2		52		97-1/2		60
with MXB **&** AU7	8	140-7/8	53-31/32			140-7/8	53-31/32			156-1/4	69-21/32			156-1/4	69-21/32			156-1/4	69-21/32		
			106-25/32				106-25/32				122-1/2				122-1/2				122-1/2		
with ECC, MXB, & AU5 or AU6	8	146-1/2	53-31/32			146-1/2	53-31/32			162-1/4	69-21/32			162-1/4	69-21/32			162-1/4	69-21/32		
			81-25/32				81-25/32				97-1/2				97-1/2				97-1/2		
with ECC, MXB, & AU7	8	171-9/16	53-31/32			171-9/16	53-31/32			187-5/16	69-21/32			187-5/16	69-21/32			187-5/16	69-21/32		
			106-25/32				106-25/32				122-1/2				122-1/2				122-1/2		
Dimensions (mm)																					
Blower/furnace (PDH/SDH/PEH) or blower only (PXH)	4	1438	N/A		N/A	1438	N/A		N/A	1837	N/A		N/A	1837	N/A		N/A	1837	N/A		N/A
with Evap Cooler (ECC)	4	2227	N/A		N/A	2227	N/A		N/A	2632	N/A		N/A	2632	N/A		N/A	2632	N/A		N/A
with Mixing Box (MXB)	6	2227	1371			2227	1371			2632	1769			2632	1769			2632	1769		
with Coil Cabinet (AU 5 or 6)	6	2145	1371			2145	1371			2543	1769			2543	1769			2543	1769		
with Coil Cab (AU7)	6	2781	1371			2781	1371			3180	1769			3180	1769			3180	1769		
with ECC & MXB	6	3016	1371			3016	1371			3415	1769			3415	1769			3415	1769		
with ECC & AU5 or AU6	6	2933	1371			2933	1371			3332	1769			3332	1769			3332	1769		
with ECC & AU7	6	3578	1371	829		3578	1371	1083		3969	1769	829		3969	1769	1241		3969	1769	1445	
with MXB **&** AU5 or AU6	8	2933	1371			2933	1371			3332	1769			3332	1769			3332	1769		
			2077		908		2077		1162		2477		908		2477		1321		2477		1524
with MXB **&** AU7	8	3578	1371			3578	1371			3969	1769			3969	1769			3969	1769		
			2712				2712				3112				3112				3112		
with ECC, MXB, & AU5 or AU6	8	3721	1371			3721	1371			4121	1769			4121	1769			4121	1769		
			2077				2077				2477				2477				2477		
with ECC, MXB, & AU7	8	4358	1371			4358	1371			4758	1769			4758	1769			4758	1769		
			2712				2712				3112				3112				3112		

5.0 Suspension and Mounting (cont'd)

5.2 Lifting and Suspension (cont'd)

Option Key:
ECC = Evaporative Cooling Module
MXB = Mixing Box Module
AU5 = DX Cooling Coil Module
AU6 = Chilled Water Cooling Coil Module
AU7 = DX Cooling Coil Module with Reheat Pump
HW = Hot Water Heat Coil

TABLE 7B - Suspension Point Dimensions - SHH	Suspension Points (qty)	SHH 130, 180				SHH 260				SHH 350			
Configuration		Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width
Dimensions (inches)													
Basic (blower/furnace)	4	82-5/16	N/A	32-5/8	N/A	82-5/16	N/A	48-7/8	N/A	82-5/16	N/A	56-7/8	N/A
with Mixing Box (MXB)	6	113-3/8	79-21/32		35-3/4	113-3/8	79-21/32		52	113-3/8	79-21/32		60
with Coil Cabinet (AU 5 or 6)	6	110-5/8	79-21/32			110-5/8	79-21/32			110-5/8	79-21/32		
w/Coil Cabinet w/reheat (AU7)	6	135-3/16	79-21/32			135-3/16	79-21/32			135-3/16	79-21/32		
with MXB & AU5 or AU6	8	141-3/16	79-21/32			141-3/16	79-21/32			141-3/16	79-21/32		
			107-1/2				107-1/2				107-1/2		
with MXB & AU7	8	166-1/4	79-21/32			166-1/4	79-21/32			166-1/4	79-21/32		
			132-1/2				132-1/2				132-1/2		
Dimensions (mm)													
Basic (blower/furnace)	4	2091	N/A	829	N/A	2091	N/A	1241	N/A	2091	N/A	1445	N/A
with Mixing Box (MXB)	6	2886	2023		908	2886	2023		1321	2886	2023		1524
with Coil Cabinet (AU 5 or 6)	6	2810	2023			2810	2023			2810	2023		
w/Coil Cabinet w/reheat (AU7)	6	3434	2023			3434	2023			3434	2023		
with MXB & AU5 or AU6	8	3586	2023			3586	2023			3586	2023		
			2731				2731				2731		
with MXB & AU7	8	4223	2023			4223	2023			4223	2023		
			3366				3366				3366		

TABLE 7C - Suspension Point Dimensions - PXH with hot water heat module (HW)	Suspension Points (qty)	PXH 000A with HW2				PXH 000B with HW2				PXH 000C with HW2				PXH 000D with HW2				PXH 000E with HW2			
Configuration		Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width	Corner to Corner Hanger Point Length	Discharge Corner Hanger Point To Intermediate Side Hanger Points	Corner to Corner Hanger Point Width	Intermediate Side Hanger Point Width
Dimensions (inches)																					
PXH with HW2, hot water heat module	4	73-3/16	N/A	32-5/8	N/A	73-3/16	N/A	42-5/8	N/A	88-7/8	N/A	32-5/8	N/A	88-7/8	N/A	48-7/8	N/A	88-7/8	N/A	56-7/8	N/A
with Evap Cooler (ECC)	4	104-1/4	N/A		N/A	104-1/4	N/A		N/A	120-3/16	N/A		N/A	120-3/16	N/A		N/A	120-3/16	N/A		N/A
with Mixing Box (MXB)	6	104-1/4	70-17/32		N/A	104-1/4	70-17/32		45-3/4	120-3/16	86-7/32		35-3/4	120-3/16	86-7/32		52	120-3/16	86-7/32		60
with Coil Cabinet (AU 5 or 6)	6	101	70-17/32		35-3/4	101	70-17/32			116-11/16	86-7/32			116-11/16	86-7/32			116-11/16	86-7/32		
with Coil Cab (AU7)	6	126-1/16	70-17/32			126-1/16	70-17/32			141-3/4	86-7/32			141-3/4	86-7/32			141-3/4	86-7/32		
with ECC & MXB	6	132-5/16	70-17/32			132-5/16	70-17/32			151	86-7/32			151	86-7/32			151	86-7/32		
with ECC & AU5 or AU6	6	132-1/16	70-17/32			132-1/16	70-17/32			147-3/4	86-7/32			147-3/4	86-7/32			147-3/4	86-7/32		
with ECC & AU7	6	157-7/16	70-17/32			157-7/16	70-17/32			172-13/16	86-7/32			172-13/16	86-7/32			172-13/16	86-7/32		
with MXB ***&*** AU5 or AU6	6	132-1/16	98-11/32			132-1/16	98-11/32			147-3/4	114-1/16			147-3/4	114-1/16			147-3/4	114-1/16		
with MXB ***&*** AU7	6	157-7/16	123-11/32			157-7/16	123-11/32			172-13/16	139-1/16			172-13/16	139-1/16			172-13/16	139-1/16		
with ECC, MXB, & AU5 or AU6	6	163-1/16	98-11/32			163-1/16	98-11/32			178-13/16	114-1/16			178-13/16	114-1/16			178-13/16	114-1/16		
with ECC, MXB, & AU7	6	188-1/8	123-11/32			188-1/8	123-11/32			203-7/8	139-1/16			203-7/8	139-1/16			203-7/8	139-1/16		
Dimensions (mm)																					
PXH with HW2, hot water heat module	4	1859	N/A	829	N/A	1859	N/A	1083	N/A	2257	N/A	829	N/A	2257	N/A	1241	N/A	2257	N/A	1445	N/A
with Evap Cooler (ECC)	4	2648	N/A		N/A	2648	N/A		N/A	3053	N/A		N/A	3053	N/A		N/A	3053	N/A		N/A
with Mixing Box (MXB)	6	2648	1791		908	2648	1791		1162	3053	2190		908	3053	2190		1321	3053	2190		1524
with Coil Cabinet (AU 5 or 6)	6	2565	1791			2565	1791			2964	2190			2964	2190			2964	2190		
with Coil Cab (AU7)	6	3202	1791			3202	1791			3600	2190			3600	2190			3600	2190		
with ECC & MXB	6	3361	1791			3361	1791			3835	2190			3835	2190			3835	2190		
with ECC & AU5 or AU6	6	3354	1791			3354	1791			3753	2190			3753	2190			3753	2190		
with ECC & AU7	6	3999	1791			3999	1791			4389	2190			4389	2190			4389	2190		
with MXB ***&*** AU5 or AU6	6	3354	2498			3354	2498			3753	2897			3753	2897			3753	2897		
with MXB ***&*** AU7	6	3999	3133			3999	3133			4389	3532			4389	3532			4389	3532		
with ECC, MXB, & AU5 or AU6	6	4142	2498			4142	2498			4542	2897			4542	2897			4542	2897		
with ECC, MXB, & AU7	6	4778	3133			4778	3133			5178	3532			5178	3532			5178	3532		

5.3 Mounting

Unit may be set directly on a non-combustible floor or slab. (See **CAUTION** below.) Be sure to comply with clearances in Paragraph 4.1.

WARNING

Whether suspended or mounted, unit must be supported level for proper operation. Do not place or add additional weight to a suspended unit. See Hazard Levels, page 2.

CAUTION: If installing a high efficiency Model SHH and/or the system has an optional cooling coil module; there must be enough height to install a condensate drain trap. See requirements in Paragraph 6.6.3. NOTE: If a gravity condensate drain system is not possible, a field-provided condensate pump may be installed. Follow the pump manufacturer's instructions.

6.0 Mechanical

6.1 Gas Heat Section Piping and Pressure - Models PDH, SDH, and SHH

NOTE: Gas conversion kits are available for changing SDH and PDH units with a 1-stage or 2-stage gas control option (AG1, AG2, AG3, AG15, AG16, D12F) from natural gas to propane or propane to natural gas. Conversion kits are not available for a heater with modulating burner control. Contact your distributor, representative, or the factory for information.

6.1.1 Gas Heat Section Gas Supply and Connections

WARNING:

This appliance is equipped for a maximum gas supply pressure of 1/2 psi, 3.5 kPa, or 14 inches water column. **NOTE:** Supply pressures higher than 1/2 psi require installation of an additional service regulator external to the unit.

Pressure Testing Supply Piping

Test Pressure Above 1/2 PSI: Disconnect the heater and manual valve from the gas supply which is to be pressure tested. Cap or plug the supply line.

Test Pressure Below 1/2 PSI: Before testing, close the manual valve on the heater.

All piping must be in accordance with requirements outlined in the National Fuel Gas Code NFPA 54/ANSI Z223.1 (latest edition) or CSA B149.1 (latest edition) Natural Gas and Propane Installation Code. Gas supply piping installation should conform with good practice and with local codes.

These units for use with natural gas are orificed for gas having a heating value of 1000 (±50) BTU per cubic ft. If the gas at the installation does not meet this specification, consult the factory for proper orifice.

Pipe joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or any other chemical constituents of the gas being supplied.

Install a ground joint union and manual shutoff valve upstream of the unit control system. The 1/8" plugged tapping in the shutoff valve provides connection for supply line pressure test gauge. The National Fuel Gas Code requires the installation of a trap with a minimum 3" (76mm) drip leg. Local codes may require a longer drip leg, typically 6" (152mm). See **FIGURE 5.**

WARNING

All components of a gas supply system must be leak tested prior to placing the equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. See Hazard Levels, page 2.

TABLE 8 - Sizing Gas Supply Lines

Capacity of Piping - Cubic Feet per Hour based on 0.3" w.c. Pressure Drop
Specific Gravity for Natural Gas -- 0.6 (Natural Gas -- 1000 BTU/Cubic Ft)
Specific Gravity for Propane Gas -- 1.6 (Propane Gas -- 2550 BTU/Cubic Ft)

Length of Pipe	Diameter of Pipe											
	1/2"		3/4"		1"		1-1/4"		1-1/2"		2"	
	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane
20'	92	56	190	116	350	214	730	445	1100	671	2100	1281
30'	73	45	152	93	285	174	590	360	890	543	1650	1007
40'	63	38	130	79	245	149	500	305	760	464	1450	885
50'	56	34	115	70	215	131	440	268	670	409	1270	775
60'	50	31	105	64	195	119	400	244	610	372	1105	674
70'	46	28	96	59	180	110	370	226	560	342	1050	641
80'	43	26	90	55	170	104	350	214	530	323	990	604
90'	40	24	84	51	160	98	320	195	490	299	930	567
100'	38	23	79	48	150	92	305	186	460	281	870	531
125'	34	21	72	44	130	79	275	168	410	250	780	476
150'	31	19	64	39	120	73	250	153	380	232	710	433
175'	28	17	59	36	110	67	225	137	350	214	650	397
200'	26	16	55	34	100	61	210	128	320	195	610	372

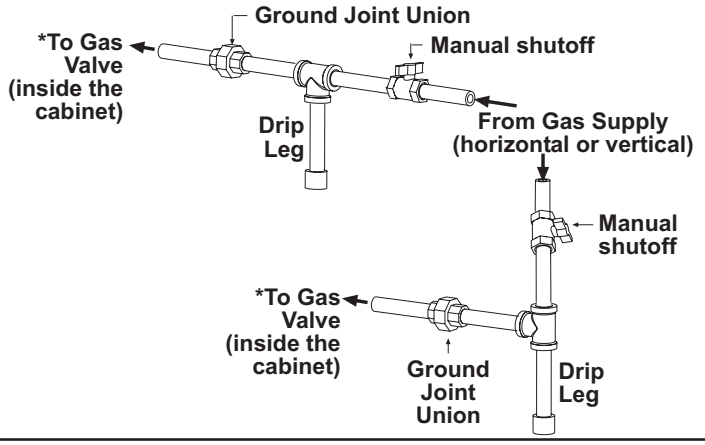
Note: When sizing supply lines, consider possibilities of future expansion and increased requirements.
Refer to National Fuel Gas Code for additional information on line sizing.

TABLE 9 - Gas Connection Sizes

PDH and SDH	**75, 100, 125, 150, 175, 200**	**225, 250, 300, 350, 400A**
SHH	**130, 180**	**260, 350**
Natural Gas	**1/2"**	**3/4"**
Propane	**1/2"**	**3/4"**

NOTE: These are not supply line sizes.

FIGURE 5 - Gas Connection



*See gas connection location on dimension drawing, **FIGURE 2**, page 9.

6.0 Mechanical (cont'd)

6.1 Gas Heat Section Piping and Pressure - Models PDH, SDH, and SHH (cont'd)

NOTE: If unsure of the Gas Control Option Code (AG1, AG2, AG3, AG8, AG9, AG9H, AG15, AG16, AG40, AG58, AG60, AG61, AG62, DG1, DG2, DG5, DG6, D12B, D12C, D12F, or D12G), check the wiring diagram on the heater. All option codes affected by electrical power are listed on the bottom of the wiring diagram after the unit Model and Size.

6.1.2 Checking Gas Pressure

Inlet Pressure (applies to all gas controls)

Before attempting to measure or adjust valve outlet gas pressure, the inlet (supply) pressure must be within the specified range both when the heater is in operation and on standby. Incorrect inlet (supply) pressure could cause excessive outlet gas pressure immediately or at some future time. If natural gas inlet (supply) pressure is too high, install a regulator in the supply line before it reaches the heater. If natural gas supply pressure is too low, contact your gas supplier.

Inlet pressure to the valve for natural gas must be a minimum of 5" w.c. or as noted on the rating plate and a maximum of 14" w.c. Inlet supply pressure to the valve for propane gas must be a minimum of 11" w.c. and a maximum of 14" w.c.

Manifold Pressure at the Burner Orifice

Measuring manifold gas pressure cannot be done until the heater is in operation. It is included in the "Check After Startup" steps, Paragraph 9.3. The procedure required depends on the type of gas control option:

- **Single and Two Stage Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F - Follow INSTRUCTIONS beginning below.**
- **Electronic Modulation (2:1 turndown) Options.AG8, AG9, AG9H - Follow instructions on page 15.**
- **Electronic Modulation (4:1 turndown) Options AG40, DG2, DG6, D12B - Follow instructions on page 15.**
- **Electronic Modulation (8:1 turndown) Options AG58, D12G - Follow instructions on page 16.**

All gas pressure measurements should be done with a manometer (fluid-filled gauge) rather than a spring type gauge due to the difficulty of maintaining calibration. Use a water column manometer readable to the nearest tenth of an inch.

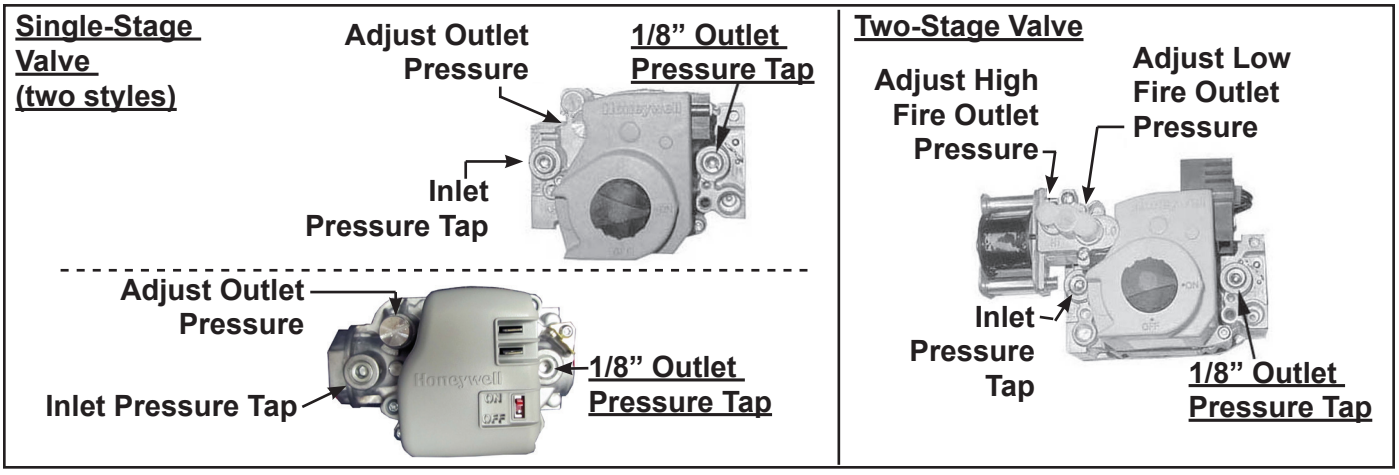
INSTRUCTIONS for single-stage and two-stage gas control options (Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F)

The outlet pressure is regulated by the combination gas valve. The combination valve outlet pressure should be as shown in **TABLE 10**, page 17, (for the model size, gas type, gas control option, and altitude of the installation) or as noted on the rating plate.

1) Gas Valve Pressure Tap Locations

Locate the 1/8" outlet pressure tap on the single or two-stage valve (See **FIGURE 6**). With the manual valve turned off to prevent flow to the gas valve, connect a manometer to the 1/8" pipe outlet pressure tap in the valve. Both high-fire and low-fire outlet pressure can be checked at this pressure tap.

FIGURE 6 - Top Views of Valves Showing Outlet Pressure Tap and Adjustment Locations



2) Measure Outlet Pressure and Adjust (if needed)

Open the manual valve and operate the heater.

Using the manometer connected to the valve, measure the outlet pressure of the single-stage gas valve or high fire on a two-stage valve. To measure low-stage pressure on units equipped with a two-stage valve (Options AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, and D12F), disconnect the wire from the "HI" terminal on the valve. Measure gas pressure with the manometer attached to the valve. Re-connect the wire.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

Normally, when operating at the altitude indicated on the rating plate, adjustments to the factory settings should not be necessary. If adjustment is required, remove the cap from the adjustment screw on the single or two-stage valve. Adjust pressure setting by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure. If an adjustment is made, turn up the thermostat. Cycle the burner once or twice to properly seat the adjustment spring in the valve. Re-check the pressure. When the outlet pressure is right for the installation, remove the manometer and replace the cap. Check for a leak at the pressure tap fitting.

WARNING

Valve outlet gas pressure must never exceed the value listed in TABLE 10 (or as shown on the rating plate).

INSTRUCTIONS for ELECTRONIC MODULATION Gas Control Options AG8, AG9, AG9H, AG40, DG2, DG6, and D12B

1) Gas Valve and Manifold Pressure Tap Locations

The manifold includes a single-stage valve and a modulating valve (**FIGURE 7**). Locate the 1/8" outlet pressure tap on the **single-stage valve** (See **FIGURE 6**). To check high fire outlet pressure, connect a manometer to the 1/8" pipe outlet pressure tap in the single-stage valve.

Modulating Valve in Options AG8, AG9, AG9H,AG40, DG2, DG6, and D12B -- DO NOT adjust.



To ensure an accurate high fire reading at the single-stage valve, a minimum signal of 20VDC must be present at the modulating valve.

FIGURE 7 - Top View of Modulating Valve in AG40, DG2, DG6, and D12B

To check low-fire (bypass pressure), locate the 1/4" NPT pressure tap behind the orifice adapter as shown in **FIGURE 8**. Connect a manometer to the 1/4" pressure tap.

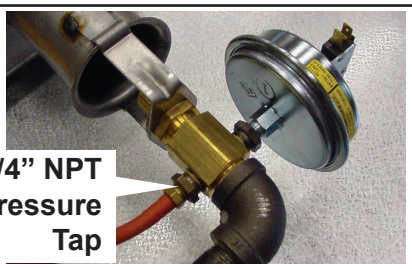


FIGURE 8 - Pressure Tap Location for Measuring Low Fire Outlet (Bypass) Pressure -- Electronic Modulation Gas Control Options AG8, AG9, AG9H, AG40, DG2, DG6, and D12B

WARNING: Measure low-fire pressure at this location only for units with electronic modulation gas control Option AG8, AG9, AG9H,AG40, DG2, DG6, or D12B).

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

2) Measure High Fire Pressure and Adjust (if needed)

Open the manual valve and operate the heater.

Using the manometer connected to the single-stage valve, measure the outlet pressure. To ensure an accurate high-fire gas pressure reading at the single-stage valve, a minimum 20VDC signal MUST be present at the modulating gas valve.

Normally, when operating at the altitude indicated on the rating plate, adjustments to the factory settings should not be necessary. If adjustment is required, remove the cap from the adjustment screw on the single-stage valve. Adjust pressure setting by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure. If an adjustment is made, turn up the thermostat. Cycle the burner once or twice to properly seat the adjustment spring in the valve. Re-check the pressure. When the outlet pressure is right for the installation, remove the manometer and replace the cap. Check for a leak at the pressure tap fitting.

WARNING

Valve outlet gas pressure must never exceed the value listed in TABLE 10, page 17, (or as shown on the rating plate).

3) Measure Low Fire (Bypass) Pressure

To measure low-fire (bypass pressure) on electronic modulation gas control Options AG8, AG9, AG9H, AG40, DG2, DG6, and D12B, disconnect one of the wire leads to the modulating valve. Measure the pressure with the manometer attached to the pressure tap just behind the orifice adapter (**FIGURE 8**). Re-connect the wire.

DO NOT attempt to adjust the bypass (low-fire) pressure. If bypass pressure is incorrect (see **TABLE 10, page 17**), contact the factory.

6.0 Mechanical (cont'd)

6.1 Gas Heat Section Piping and Pressure - Models PDH, SDH, and SHH (cont'd)

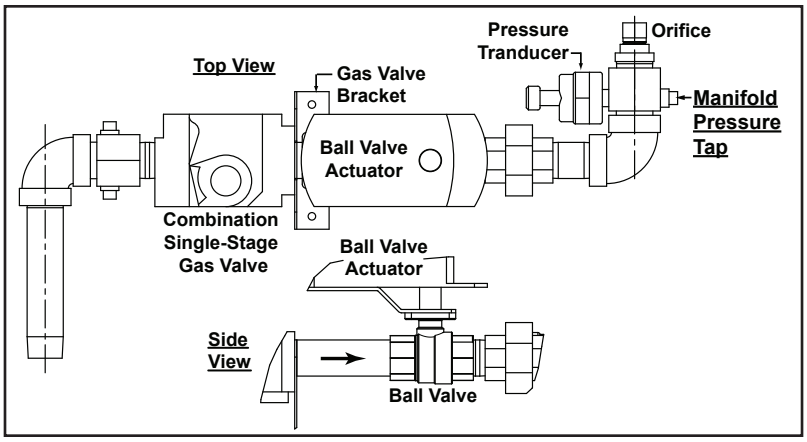
FIGURE 9 - Gas Manifold with Gas Control Options AG58 and D12G

INSTRUCTIONS for ELECTRONIC MODULATION Gas Control Options AG58 and D12G)

1) Measure the Manifold Pressure

Turn the manual valve in the gas line off.

Locate the manifold pressure tap; see **FIGURE 9**. Remove the bushing and connect a manometer to the 1/8" pressure tap.



Turn on the manual gas valve. Operate the unit with a call for heat. Verify that the actuator has fully opened the ball valve (highest fire). The ball valve is fully open when the dash marks on the actuator are aligned with the gas piping. With the burner at highest fire, measure the manifold pressure. The manifold pressure should be 3.4" w.c. for natural gas or 10" w.c. for propane.

2) Adjust Pressure at the Single-Stage Valve (if needed)

Turn the manual gas valve off. On the single-stage gas valve (see **FIGURE 6, page 14**), locate the 1/8" output pressure tap and attach a manometer.

Turn on the manual gas valve. Operate the unit with a call for heat. Check the outlet pressure of the valve with the burner at full fire. Pressure should be 3.5" w.c for natural gas or 10" w.c. for propane. **If adjustment is necessary,** remove the cap from the adjustment screw. Set pressures to correct setting by turning the regulator screws IN (clockwise) to increase pressure. Turn regulator screws OUT (counterclockwise) to decrease pressure.

After an adjustment is made, cycle the heat section. Re-check the outlet pressure of the valve and the manifold pressure. When pressure is correct for highest fire, remove the manometers and replace the caps. Check for a leak at the pressure tap fittings.

3) Lowest fire manifold pressure is regulated by the ball valve actuator in response to signals from the ignition control board. The ball valve was set at the factory and should not need to be checked at startup. For future reference, instructions for checking lowest fire pressure are in the operation/maintenance/service manual (**Form O-PREEVA & SHH**) included in the literature bag.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

6.1.3 High Altitude Operation - Gas-Fired Model PDH, SDH, or SHH being installed above 2000 ft (610M)

(Adjustment does NOT apply to Model SHH with Gas Control Option AG58 or D12G -- see NOTE on the right.)

NOTE: Modulating gas control Options AG58 and D12G **DO NOT** require a gas pressure adjustment derate for high altitude. The patented control system works on a principle of safe, continuous gas and combustion air monitoring and adjustment. As the mass flow through the combustion system changes, due to the lower oxygen level at high altitude, the control system senses the change, automatically reducing the firing rate of the burner.

High Altitude Operation

If the heater is being installed at an elevation above 2000 ft (610M), check the rating plate to verify that the heater is factory-equipped for the elevation at the installation site. **If the elevation on the rating plate matches the elevation of the installation site, field adjustment for high altitude is not required.**

If the rating plate does not match the elevation of the installation site, high altitude adjustment will need to be done as part of the startup procedure. (High altitude adjustment can only be done while the unit is operating.) During startup, follow the instructions in this section to adjust the valve outlet pressure.

FIGURE 10 - High Altitude (>6000ft/ 1830M) Pressure Switch Requirement

NOTE: If elevation is above 6000 ft (1830M) and the following conditions apply, installation of a high altitude pressure switch is required. When a replacement switch is needed, contact your distributor for the switch and follow the instructions below to install the high altitude pressure switch before starting the heater.

- ☐ Model is SDH or PDH
- ☐ Elevation on the rating plate is not above 6000 ft (1830M)
- ☐ Unit has a single or two-stage gas control (Option AG1, AG2, AG3, AG15, AG16, AG60, AG61, DG1, DG5, or D12C).
  NOTE: If equipped with a two-stage control with a two-speed venter (Options AG8, AG9, AG9H, AG60, AG61, DG1, DG5, and D12C), there are two pressure switches. Only the high speed pressure switch needs to be changed.

Pressure Switch



PDH or SDH Size installed above 6000 ft (1830M)	Switch P/N	Label Color	Setting
75, 100	197031	Purple	0.35" w.c.
125	197032	Pink	0.45" w.c.
150	197029	Lt Blue	0.60" w.c.
175, 200, 225, 250, 300, 350, 400A	201160	Brown	1.05" w.c.

Instructions for changing pressure switch:

1. If the unit is installed, turn off the gas and the power.
2. In the control compartment, locate the pressure switch that needs to be replaced. (**NOTE**: If there are two pressure switches, the high speed switch to be replaced is toward the top of the unit.)
3. Mark and disconnect the two wires attached to the pressure switch.
4. Mark and disconnect the sensing tube(s) from the pressure switch.
5. Locate the two screws holding the switch mounting bracket. Remove the pressure switch. Save the screws.
6. Using the same screws, install the high altitude pressure switch. Attach the sensing tube(s) and wires.
7. If the unit is installed, turn on the power and the gas.

Derate by Valve Outlet Pressure Adjustment if needed for High Altitude Operation

If the elevation on the rating plate does not match the elevation of the installation site, follow these instructions to adjust the valve.

Instructions for High Altitude Derate - Models PDH, SDH, and SHH

1. Refer to **TABLE 10**, and determine the required valve outlet pressure(s) for the elevation where the heater will be operating. If unsure of the elevation, contact the local gas supplier. If unsure of the type of gas control, check the option list on the unit wiring diagram.

TABLE 10 - Valve Outlet Pressure Settings by Elevation for Models PDH, SDH, and SHH

(Does NOT apply to Option AG58 or D12G -- see NOTE on page 16.)

Outlet Pressure Settings (inches w.c.) by Altitude for Installation in the UNITED STATES

Altitude		Full Rate Outlet Pressure (Single-Stage & 2-Stage High Fire) - Applies to Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F		Full Rate Outlet Pressure with Electronic Modulation - Applies to Options AG40, DG2, DG6, and D12B (measured at the outlet of the single-stage valve when there is a minimum of a 20VDC signal at the electronic modulating valve) NOTE: Options do not apply to SHH.				2-Stage Low-Fire Outlet Pressure - Applies to Options AG2, AG3, AG15, AG16, D12F		2-Stage Low-Fire Outlet Pressure with Venter Motor Controller - Applies to Options AG60, AG61, AG62, DG1, DG5, D12C		Factory-Set Bypass Pressure with Electronic Modulation - Applies to Options AG40, DG2, DG6, D12B		Electronic Modulation Low-Fire Manifold Pressure - Applies to Options AG8, AG9, AG9H	
FEET	METERS	Natural Gas	Propane	Natural Gas (by Size) 75, 100, 125, 175, 200, 225, 250	Natural Gas (by Size) 150, 300, 350	Natural Gas (by Size) 400A	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
0 - 2000	0 - 610	3.5	10.0	3.8	4.0	4.3	10.0	1.8	5.0	0.4	1.8	0.3	1.8	0.9	2.5
2001 - 3000	611 - 915	3.1	8.8	3.4	3.5	3.8	8.8	1.6	4.4	0.4	1.5	0.3	1.8	0.8	2.2
3001 - 4000	916 - 1220	3.0	8.5	3.2	3.4	3.6	8.5	1.5	4.2	0.3	1.4	0.3	1.8	0.8	2.1
4001 - 5000	1221 - 1525	2.8	8.1	3.1	3.2	3.5	8.1	1.5	4.1	0.3	1.4	0.3	1.8	0.7	2.0
5001 - 6000	1526 - 1830	2.7	7.7	2.9	3.1	3.3	7.7	1.4	3.9	0.3	1.3	0.3	1.8	0.7	1.9
6001 - 7000	1831 - 2135	2.6	7.4	2.8	3.0	3.2	7.4	1.3	3.7	0.3	1.3	0.3	1.8	0.7	1.8
7001 - 8000	2136 - 2440	2.5	7.1	2.7	2.8	3.0	7.1	1.3	3.5	0.3	1.2	0.3	1.8	0.6	1.8
8001 - 9000	2441 - 2745	2.4	6.7	2.6	2.7	2.9	6.7	1.2	3.4	0.3	1.1	0.3	1.8	0.6	1.7

Outlet Pressure Settings (inches w.c.) by Altitude for Installation in CANADA

Altitude		Full Rate Outlet Pressure (Single-Stage & 2-Stage High Fire) - Applies to Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F		Full Rate Outlet Pressure with Electronic Modulation - Applies to Options AG40, DG2, DG6, and D12B (measured at the outlet of the single-stage valve when there is a minimum of a 20VDC signal at the electronic modulating valve) NOTE: Options do not apply to SHH.				2-Stage Low-Fire Outlet Pressure - Applies to Options AG2, AG3, AG15, AG16 , D12F		2-Stage Low-Fire Outlet Pressure with Venter Motor Controller - Applies to Options AG60, AG61, AG62, DG1, DG5, D12C		Factory-Set Bypass Pressure with Electronic Modulation - Applies to Options AG40, DG2, DG6, D12B		Electronic Modulation Low-Fire Manifold Pressure - Applies to Options AG8, AG9, AG9H	
FEET	METERS	Natural Gas	Propane	Natural Gas (by Size) 75, 100, 125, 175, 200, 225, 250	Natural Gas (by Size) 150, 300, 350	Natural Gas (by Size) 400A	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
0 - 2000	0 - 610	3.5	10.0	3.8	4.0	4.3	10.0	1.8	5.0	0.4	1.8	0.3	1.8	0.9	2.5
2001 - 4500	611 - 1373	2.8	8.1	3.1	3.2	3.5	8.1	1.5	4.1	0.3	1.4	0.3	1.8	0.7	2.0

2. Locate the 1/8" outlet pressure tap on the valve (**FIGURE 6**). Turn the knob or switch on the top of the valve to "OFF". Connect a manometer to the 1/8" outlet pressure tap in the valve. Use a water column manometer that is readable to the nearest tenth of an inch. When making the adjustment, turn the adjustment screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease.

6.0 Mechanical (cont'd)

6.1 Gas Heat Section Piping and Pressure - Models PDH, SDH, and SHH (cont'd)

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

Instructions for High Altitude Derate (cont'd)

3. **Single-Stage and Two-Stage High Fire Adjustment** - Turn the knob or switch on the top of the valve to "ON". Remove the cap from the pressure adjusting screw and adjust the outlet pressure to the full rate pressure selected from **TABLE 10**.

   Two Stage Low Fire - Disconnect the wire from the "HI" terminal on the gas valve and check low fire pressure. To adjust, turn the low pressure regulator screw to achieve the "2-Stage Low Fire" pressure listed **for the applicable gas control (TABLE 10)**. Re-connect the wire to the gas valve.

   Electronic Modulation Options AG40, DG2, DG6, and D12B - The electronic modulation valve itself has no high fire adjustment. The only adjustment on the modulation valve is the low-pressure bypass setting which is factory set and does not require field adjustment for high altitude operation.

   However, if the elevation on the rating plate does not match the elevation of the installation, a full rate adjustment is required at the outlet of the combination valve. To make the full rate adjustment, adjust the outlet pressure of the combination gas valve when the modulating valve is fully open (there must be a minimum of a 20 VDC signal at the electronic modulating valve to ensure that it is fully open). Set the outlet pressure of the combination valve to the pressure shown in **TABLE 10**.
4. Turn up the thermostat. (**NOTE**: On Model SDH and SHH, depress and hold the door safety switch.) Cycle the burner once or twice to properly seat the adjustment spring in the valve.

   Re-check the pressure(s). When the outlet pressure(s) is right for the installation, remove the manometer and replace the cap. Check for leak at the pressure tap fitting.
5. With the heater operating, determine that the inlet (supply) pressure to the heater for natural gas is between 5 inches w.c. **(or as noted on the rating plate)** and 14 inches w.c. and for propane between 11 and 14 inches w.c. Take this reading as close as possible to the heater. (Heaters are equipped with a gas valve that has an inlet pressure tap.) If the inlet (supply) pressure is not within the specified range, the inlet (supply) pressure must be corrected and Steps 3 and 4 repeated.
6. Find the High Altitude Adjustment label in the literature bag that contained these instructions. Using a permanent marker, fill-in the appropriate information from **TABLE 11A or 11B**. Affix the label to a clean, dry, and conspicuous location on the outside of the heater access panel.

High Altitude Capacity Changes

The input and/or the capacity of the heater changes with altitude.

TABLE 11A lists inputs and capacities at altitudes from sea level to 9,000 ft (2745M) for Models PDH and SDH installed in the U.S. and to 4,500 ft (1373M) for Canadian installations.

TABLE 11B lists inputs and capacities for Model SHH.

TABLE 11A - BTUH Inputs and Capacities by Altitude for Models PDH and SDH

ALTITUDE		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, DG2, DG6, D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, DG2, DG6, D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, DG2, DG6, D12B)	
						Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane
Feet	**Meters**	**Size 75**								**Size 100**								**Size 125**							
0-2000	0-610	75,000	60,750	52,500	37,500	24,750	30,000	18,750	30,000	100,000	81,000	70,000	50,000	33,000	40,000	25,000	40,000	125,000	101,250	87,500	62,500	41,250	50,000	31,250	50,000
2001-3000	611-915	70,500	57,105	49,350	35,250	23,265	28,200	17,625	28,200	94,000	76,140	65,800	47,000	31,020	37,600	23,500	37,600	117,500	95,175	82,250	58,750	38,775	47,000	29,375	47,000
3001-4000	916-1220	69,000	55,890	48,300	34,500	22,770	27,600	17,250	27,600	92,000	74,520	64,400	46,000	30,360	36,800	23,000	36,800	115,000	93,150	80,500	57,500	37,950	46,000	28,750	46,000
4001-5000	1221-1525	67,500	54,675	47,250	33,750	22,275	27,000	16,875	27,000	90,000	72,900	63,000	45,000	29,700	36,000	22,500	36,000	112,500	91,125	78,750	56,250	37,125	45,000	28,125	45,000
5001-6000	1526-1830	66,000	53,460	46,200	33,000	21,780	26,400	16,500	26,400	88,000	71,280	61,600	44,000	29,040	35,200	22,000	35,200	110,000	89,100	77,000	55,000	36,300	44,000	27,500	44,000
6001-7000	1831-2135	64,500	52,245	45,150	32,250	21,285	25,800	16,125	25,800	86,000	69,660	60,200	43,000	28,380	34,400	21,500	34,400	107,500	87,075	75,250	53,750	35,475	43,000	26,875	43,000
7001-8000	2136-2440	63,000	51,030	44,100	31,500	20,790	25,200	15,750	25,200	84,000	68,040	58,800	42,000	27,720	33,600	21,000	33,600	105,000	85,050	73,500	52,500	34,650	42,000	26,250	42,000
8001-9000	2441-2745	61,500	49,815	43,050	30,750	20,295	24,600	15,375	24,600	82,000	66,420	57,400	41,000	27,060	32,800	20,500	32,800	102,500	83,025	71,750	51,250	33,825	41,000	25,625	41,000
Feet	**Meters**	**Size 150**								**Size 175**								**Size 200**							
0-2000	0-610	150,000	121,500	105,000	75,000	49,500	60,000	37,500	60,000	175,000	141,750	122,500	87,500	57,750	70,000	43,750	70,000	200,000	162,000	140,000	100,000	66,000	80,000	50,000	80,000
2001-3000	611-915	141,000	114,210	98,700	70,500	46,530	56,400	35,250	56,400	164,500	133,245	115,150	82,250	54,285	65,800	41,125	65,800	188,000	152,280	131,600	94,000	62,040	75,200	47,000	75,200
3001-4000	916-1220	138,000	111,780	96,600	69,000	45,540	55,200	34,500	55,200	161,000	130,410	112,700	80,500	53,130	64,400	40,250	64,400	184,000	149,040	128,800	92,000	60,720	73,600	46,000	73,600
4001-5000	1221-1525	135,000	109,350	94,500	67,500	44,550	54,000	33,750	54,000	157,500	127,575	110,250	78,750	51,975	63,000	39,375	63,000	180,000	145,800	126,000	90,000	59,400	72,000	45,000	72,000
5001-6000	1526-1830	132,000	106,920	92,400	66,000	43,560	52,800	33,000	52,800	154,000	124,740	107,800	77,000	50,820	61,600	38,500	61,600	176,000	142,560	123,200	88,000	58,080	70,400	44,000	70,400
6001-7000	1831-2135	129,000	104,490	90,300	64,500	42,570	51,600	32,250	51,600	150,500	121,905	105,350	75,250	49,665	60,200	37,625	60,200	172,000	139,320	120,400	86,000	56,760	68,800	43,000	68,800
7001-8000	2136-2440	126,000	102,060	88,200	63,000	41,580	50,400	31,500	50,400	147,000	119,070	102,900	73,500	48,510	58,800	36,750	58,800	168,000	136,080	117,600	84,000	55,440	67,200	42,000	67,200
8001-9000	2441-2745	123,000	99,630	86,100	61,500	40,590	49,200	30,750	49,200	143,500	116,235	100,450	71,750	47,355	57,400	35,875	57,400	164,000	132,840	114,800	82,000	54,120	65,600	41,000	65,600

BTUH Inputs and Capacities by Altitude in the UNITED STATES for Model PDH and Model SDH

ALTITUDE		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, DG2, DG6, D12B)	
						Natural	Propane	Natural	Propane
Feet	**Meters**	**Size 225**							
0-2000	0-610	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000
2001-3000	611-915	211,500	171,315	148,050	105,750	69,795	84,600	52,875	84,600
3001-4000	916-1220	207,000	167,670	144,900	103,500	68,310	82,800	51,750	82,800
4001-5000	1221-1525	202,500	164,025	141,750	101,250	66,825	81,000	50,625	81,000
5001-6000	1526-1830	198,000	160,380	138,600	99,000	65,340	79,200	49,500	79,200
6001-7000	1831-2135	193,500	156,735	135,450	96,750	63,855	77,400	48,375	77,400
7001-8000	2136-2440	189,000	153,090	132,300	94,500	62,370	75,600	47,250	75,600
8001-9000	2441-2745	184,500	149,445	129,150	92,250	60,885	73,800	46,125	73,800
Feet	**Meters**	**Size 250**							
0-2000	0-610	250,000	202,500	175,000	125,000	82,500	100,000	62,500	100,000
2001-3000	611-915	235,000	190,350	164,500	117,500	77,550	94,000	58,750	94,000
3001-4000	916-1220	230,000	186,300	161,000	115,000	75,900	92,000	57,500	92,000
4001-5000	1221-1525	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000
5001-6000	1526-1830	220,000	178,200	154,000	110,000	72,600	88,000	55,000	88,000
6001-7000	1831-2135	215,000	174,150	150,500	107,500	70,950	86,000	53,750	86,000
7001-8000	2136-2440	210,000	170,100	147,000	105,000	69,300	84,000	52,500	84,000
8001-9000	2441-2745	205,000	166,050	143,500	102,500	67,650	82,000	51,250	82,000
Feet	**Meters**	**Size 300**							
0-2000	0-610	300,000	243,000	210,000	150,000	99,000	120,000	75,000	120,000
2001-3000	611-915	282,000	228,420	197,400	141,000	93,060	112,800	70,500	112,800
3001-4000	916-1220	276,000	223,560	193,200	138,000	91,080	110,400	69,000	110,400
4001-5000	1221-1525	270,000	218,700	189,000	135,000	89,100	108,000	67,500	108,000
5001-6000	1526-1830	264,000	213,840	184,800	132,000	87,120	105,600	66,000	105,600
6001-7000	1831-2135	258,000	208,980	180,600	129,000	85,140	103,200	64,500	103,200
7001-8000	2136-2440	252,000	204,120	176,400	126,000	83,160	100,800	63,000	100,800
8001-9000	2441-2745	246,000	199,260	172,200	123,000	81,180	98,400	61,500	98,400
Feet	**Meters**	**Size 350**							
0-2000	0-610	350,000	283,500	245,000	175,000	115,500	140,000	87,500	140,000
2001-3000	611-915	329,000	266,490	230,300	164,500	108,570	131,600	82,250	131,600
3001-4000	916-1220	322,000	260,820	225,400	161,000	106,260	128,800	80,500	128,800
4001-5000	1221-1525	315,000	255,150	220,500	157,500	103,950	126,000	78,750	126,000
5001-6000	1526-1830	308,000	249,480	215,600	154,000	101,640	123,200	77,000	123,200
6001-7000	1831-2135	301,000	243,810	210,700	150,500	99,330	120,400	75,250	120,400
7001-8000	2136-2440	294,000	238,140	205,800	147,000	97,020	117,600	73,500	117,600
8001-9000	2441-2745	287,000	232,470	200,900	143,500	94,710	114,800	71,750	114,800
Feet	**Meters**	**Size 400A**							
0-2000	0-610	400,000	324,000	280,000	200,000	132,000	160,000	100,000	160,000
2001-3000	611-915	376,000	304,560	263,200	188,000	124,080	150,400	94,000	150,400
3001-4000	916-1220	368,000	298,080	257,600	184,000	121,440	147,200	92,000	147,200
4001-5000	1221-1525	360,000	291,600	252,000	180,000	118,800	144,000	90,000	144,000
5001-6000	1526-1830	352,000	285,120	246,400	176,000	116,160	140,800	88,000	140,800
6001-7000	1831-2135	344,000	278,640	240,800	172,000	113,520	137,600	86,000	137,600
7001-8000	2136-2440	336,000	272,160	235,200	168,000	110,880	134,400	84,000	134,400
8001-9000	2441-2745	328,000	265,680	229,600	164,000	108,240	131,200	82,000	131,200

BTUH Inputs and Capacities by Altitude in CANADA for Model PDH and Model SDH

ALTITUDE		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, DG2, DG6, D12B)	
						Natural	Propane	Natural	Propane
Feet	**Meters**	**Size 75**							
0-2000	0-610	75,000	60,750	52,500	37,500	24,750	30,000	18,750	30,000
2001-3000	611-915	67,500	54,675	47,250	33,750	22,275	27,000	16,875	27,000
Feet	**Meters**	**Size 150**							
0-2000	0-610	150,000	121,500	105,000	75,000	49,500	60,000	37,500	60,000
2001-4500	611-1373	135,000	109,350	94,500	67,500	44,550	54,000	33,750	54,000
Feet	**Meters**	**Size 225**							
0-2000	0-610	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000
2001-4500	611-1373	202,500	164,025	141,750	101,250	66,825	81,000	50,625	81,000
Feet	**Meters**	**Size 350**							
0-2000	0-610	350,000	283,500	245,000	175,000	115,500	140,000	87,500	140,000
2001-4500	611-1373	315,000	255,150	220,500	157,500	103,950	126,000	78,750	126,000
Feet	**Meters**	**Size 100**							
0-2000	0-610	100,000	81,000	70,000	50,000	33,000	40,000	25,000	40,000
2001-3000	611-915	90,000	72,900	63,000	45,000	29,700	36,000	22,500	36,000
Feet	**Meters**	**Size 175**							
0-2000	0-610	175,000	141,750	122,500	87,500	57,750	70,000	43,750	70,000
2001-4500	611-1373	157,500	127,575	110,250	78,750	51,975	63,000	39,375	63,000
Feet	**Meters**	**Size 250**							
0-2000	0-610	250,000	202,500	175,000	125,000	82,500	100,000	62,500	100,000
2001-4500	611-1373	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000
Feet	**Meters**	**Size 400A**							
0-2000	0-610	400,000	324,000	280,000	200,000	132,000	160,000	100,000	160,000
2001-4500	611-1373	360,000	291,600	252,000	180,000	118,800	144,000	90,000	144,000
Feet	**Meters**	**Size 125**							
0-2000	0-610	125,000	101,250	87,500	62,500	41,250	50,000	31,250	50,000
2001-3000	611-915	112,500	91,125	78,750	56,250	37,125	45,000	28,125	45,000
Feet	**Meters**	**Size 200**							
0-2000	0-610	200,000	162,000	140,000	100,000	66,000	80,000	50,000	80,000
2001-4500	611-1373	180,000	145,800	126,000	90,000	59,400	72,000	45,000	72,000
Feet	**Meters**	**Size 300**							
0-2000	0-610	300,000	243,000	210,000	150,000	99,000	120,000	75,000	120,000
2001-4500	611-1373	270,000	218,700	189,000	135,000	89,100	108,000	67,500	108,000

TABLE 11B - BTUH Inputs and Capacities by Altitude for Model SHH with Control Option AG1, AG2, AG3, AG15, AG16, or D12F

(Does NOT apply to AG58 or D12G; see NOTE on page 16.)

BTUH Inputs and Capacities by Altitude in the UNITED STATES for Model SHH

ALTITUDE		SHH130		SHH 180		SHH 260		SHH 350	
Feet	Meters	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)
0 - 2000	0 - 610	131000	120520	175000	159,250	260,000	236,600	345,000	313,950
2001 - 3000	611 - 915	123140	113289	164500	149,695	244,400	222,404	324,300	295,113
3001 - 4000	916 - 1220	120520	110878	161000	146,510	239,200	217,672	317,400	288,834
4001- 5000	1221 - 1525	117900	108468	157500	143,325	234,000	212,940	310,500	282,555
5001 - 6000	1526 - 1830	115280	106058	154000	140,140	228,800	208,208	303,600	276,276
6001 - 7000	1831 - 2135	112660	103647	150500	136,955	223,600	203,476	296,700	269,997
7001 - 8000	2136 - 2440	110040	101237	147000	133,770	218,400	198,744	289,800	263,718
8001 - 9000	2441 - 2745	107420	98826	143500	130,585	213,200	194,012	282,900	257,439
9001 - 10000	2746 - 3045	104800	96416	140000	127,400	208,000	189,280	276,000	251,160

BTUH Inputs and Capacities by Altitude in CANADA for Model SHH

ALTITUDE		SHH130		SHH 180		SHH 260		SHH 350	
Feet	Meters	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)
0 - 2000	0 - 610	131000	120520	175000	159,250	260,000	236,600	345,000	313,950
2001 - 4500	611 - 1373	117900	108468	157500	143,325	234,000	212,940	310,500	282,555

6.1.4 Optional Gas Pressure Safety Switches

If the manifold is equipped with optional high and/or low gas pressure switches, the switches protect against an upstream gas control malfunction that would cause an increase or decrease in the regulated gas pressure.

The low gas pressure switch is an automatic reset switch that is factory set to activate if the gas pressure is 50% of the minimum as stated on the unit rating plate.

The high gas pressure switch is a manually reset switch that is set to activate if the gas pressure is 125% of the outlet pressure stated on the rating plate.

6.2 Gas Heat Section Condensate Drain(s)

A Model SHH heat section has a condensate drain connection on the secondary heat exchanger and on the primary heat exchanger / burner condensate drain connection. Models PDH and SDH have a burner condensate drain connection if ordered with Option CS2.

Follow the requirements in this section that apply to the installation. Connect all required drain lines and install traps as illustrated. Fill traps with water. Empty the condensate drains into a sanitary drain system. Drains may be joined downstream from the traps. Periodic cleaning of the condensate drain pans, traps, and piping is required. If a drain has a cleanout opening, be sure to close the opening after cleaning.

6.2 Gas Heat Section Condensate Drain(s) (cont'd)

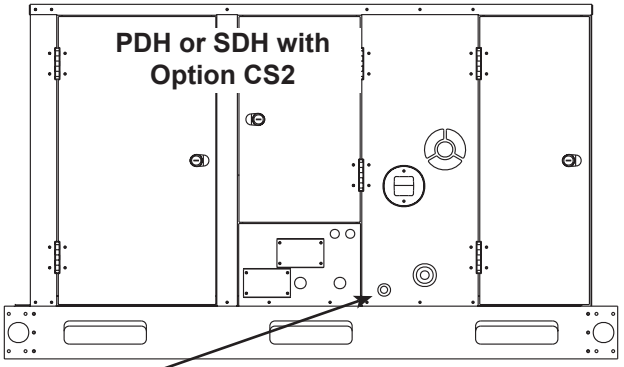
CAUTION: Apply general plumbing practices if pipe insulation or heat tapes are required to prevent freezing of the condensate drain system.

6.2.1 Heat Section Condensate Drain - Models PDH and SDH with Option CS2, and all SHH Models

A Model SDH and PDH heat section with Option CS2 is equipped with a condensate drain with a 1/2" NPT connection. See location in **FIGURE 11**. Models PDH and SDH require a heat section condensate drain when one or more of the three situations listed below exists:

- A cooling coil is installed upstream of the heat section.
- The temperature rise for a makeup air unit is equal to or less than 60°F.
- The space temperature to be maintained by the indoor heating unit installed in the space is 45°F or less.

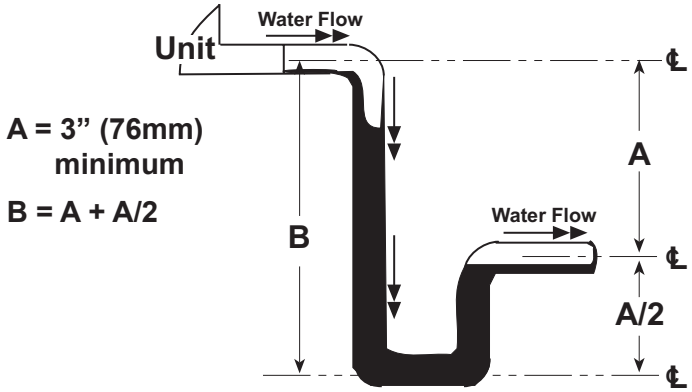
FIGURE 11 - Location of the Primary Heat Exchanger / Burner Condensate Drain Connection and Trap Requirements on Models SDH and PDH with Option CS2, and all SHH Models.



1/2" NPT connection for installer to connect a condensate drain line.

Put a trap in the line as shown on the right and empty it into a sanitary drain system.

Minimum Trap Dimensions for Primary Heat Exchanger / Burner Condensate Drain -- Option CS2 on Models PDH and SDH (and all Model SHH; see 6.2.2 below.)



NOTE: If the system includes a cooling coil cabinet, the cooling coil cabinet also requires a condensate drain. See Paragraph 6.6.3.

6.2.2 Secondary Heat Exchanger, Burner, and Vent Condensate Drains - Model SHH

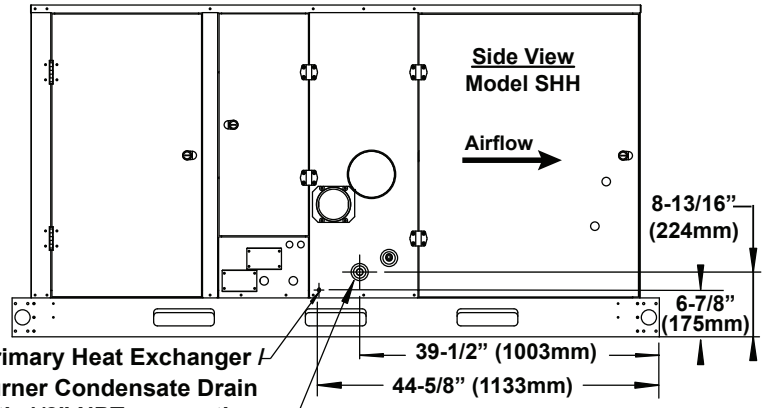
During operation of the high-efficiency Model SHH unit, condensate is both produced in the heater and collected from the venting system. Therefore, the installation requires a condensate drain with a trap from the secondary heat exchanger, primary heat exchanger, (**FIGURE 12**) and the vent pipe. **NOTE:** Instructions for installing the drain in the vent pipe are in the venting manual (Form I-SHH-V, P/N 257037).

In addition, a third condensate line is required at the primary heat exchanger / burner condensate drain (**FIGURE 12**). When installing the burner condensate drain, comply with the trap requirements in **FIGURE 11**. For safe performance of the heater, each condensate drain must include a trap and each trap must be filled with water. Drains may be joined downstream of the traps. All condensate drains must empty into a sanitary drain system.

Check codes to be certain that this is permitted. (Condensate from the heater has a PH of 6. Actual PH may vary depending on fuel and combustion air constituents.) Model SHH Sizes 130 and 180 will produce approximately one gallon (4 liters) of condensate per hour. Sizes 260 and 350 will produce approximately two gallons (8 liters) of condensate per hour.

A condensate disposal system that relies on gravity should be satisfactory for most suspended installations since these heaters are normally several feet above the floor. If a gravity system is not possible with the installation, a condensate pump may be installed. There are a number of commercially available pumps made for this purpose. If using a condensate pump, follow the pump manufacturer's installation recommendations.

FIGURE 12 - Location of Condensate Drain Connections on a Model SHH heat section



Primary Heat Exchanger / Burner Condensate Drain with 1/2" NPT connection on all Model SHH heaters -- All Model SHH units require a condensate drain with a trap as illustrated in **Figure 11**

Secondary Heat Exchanger Condensate Drain with 1/2" PVC connection on all Model SHH units - All Model SHH units require a condensate drain with a trap as illustrated in **FIGURE 13.**

NOTES: See Vent Manual, Form I-SHH-V, for detailed information on installing the vent pipe condensate drain.

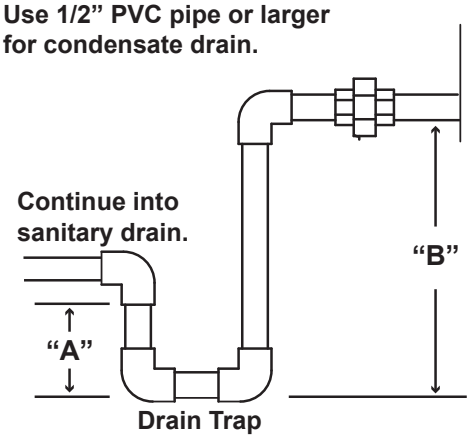
If the system includes a cooling coil cabinet, the cooling coil cabinet also requires a condensate drain. See Paragraph 6.6.3

FIGURE 13 - Secondary Heat Exchanger Drain Trap - Model SHH

Minimum Dimensions for Secondary Heat Exchanger Condensate Drain Trap Required on all Model SHH Heaters

"A" = 3 inches (76mm) minimum

"B" = "A" plus at least 5 inches (127mm)



Condensate Drain Traps

NOTES:

If the system has a cooling coil, the cooling coil cabinet will also require a condensate drain; see Paragraph 6.6.3 for requirements.

A Model SHH has a condensate drain on the vent pipe; see Form I-SHH-V for details.

A condensate drain trap is required for **each** condensate drain line.

- **FIGURE 11** illustrates the trap in the drain attached to the primary heat exchanger / burner and lists the minimum required leg dimensions for that trap.
- **FIGURE 13** illustrates the secondary heat exchanger drain trap and lists the required length difference for the trap legs.

The most important part of fabricating and assembling the traps is the length of the individual legs of the traps. If the difference in the lengths of the legs of the traps is not as illustrated, it could prevent proper drainage of the condensate and possibly permit vent gas to enter the building. (The length difference is also what provides a "water seal" that prevents leakage of vent gas into the sanitary drain.) The two traps may be drained into a common pipe that is connected to the sanitary drain.

The orientation of the piping is not critical and may be arranged to suit the installation. Unions are recommended to permit maintenance of the drains and to facilitate service of the heater. A union is shown in both of the traps and a third union is recommended in the drain pipe. If pipe insulation or heat tapes are required to prevent freezing, use should be in accordance with generally accepted plumbing practices.

6.3 Combustion Air Requirements - Model PDH

NOTE: For both Model SDH and SHH, combustion air must be ducted from outside through the vent/ combustion air terminal kit shipped with the unit. See the Venting Manual, Form I-SDH-V or Form I-SHH-V, for combustion air requirements.

A Model PDH heater must be supplied with the air that enters into the combustion process and is then vented to the outdoors. Combustion air enters through the combustion air opening on the side of the unit and comes from the equipment location. Sufficient air must enter the equipment location to replace that exhausted through the heater vent system. In the past, the infiltration of outside air assumed in heat loss calculations (one air change per hour) was assumed to be sufficient. However, current construction methods using more insulation, vapor barriers, tighter fitting and gasketed doors and windows, weather-stripping, and/or mechanical exhaust fans may require the introduction of outside air through wall openings or ducts.

The requirements for combustion and ventilation air depend upon whether the unit is located in a confined or unconfined space. An "unconfined space" is defined as a space whose volume is not less than 50 cubic feet per 1000 BTUH of the installed appliance. **Under ALL conditions,** enough air must be provided to ensure there will not be a negative pressure condition within the equipment room or space.

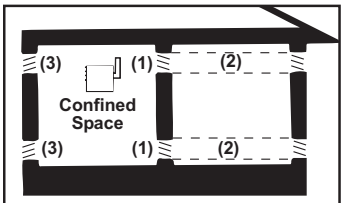
6.0 Mechanical (cont'd)

6.3 Combustion Air Requirements (cont'd) - Model PDH

WARNING

Model PDH power-vented heaters are designed to take combustion air from the space in which the unit is installed and are not designed for connection to outside combustion air intake ducts. Connecting outside air ducts voids the warranty and could cause hazardous operation. See Hazard Levels, page 2.

FIGURE 14 - Definition of Confined Space and Required Openings for Combustion Air



Confined Space: A space whose volume is less than 50 cubic feet per 1000 BTUH of the installed appliance input rating.

Combustion Air Requirements for a Heater Located in a Confined Space

Do not install a PDH unit in a confined space without providing wall openings leading to and from the space. Provide openings near the floor and ceiling for ventilation and air for combustion as shown in **FIGURE 14**, depending on the combustion air source as noted in Items 1, 2, and 3 below.

Add total BTUH of all appliances in the confined space and divide by figures below for square inch free area size of each (top and bottom) opening.

1. **Air from inside the building** -- openings 1 square inch free area per 1000 BTUH. Never less than 100 square inches free area for each opening. See **(1)** in **FIGURE 14.**
2. **Air from outside through duct** -- openings 1 square inch free area per 2000 BTUH. See **(2)** in **FIGURE 14.**
3. **Air direct from outside** -- openings 1 square inch free area per 4000 BTUH. See **(3)** in **FIGURE 14.**

NOTE: For further details on supplying combustion air to a confined space, see the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition).

6.4 Unit Inlet Air (Supply Air)

Depending on the Model and how the unit was ordered, the blower can have a variety of factory-installed inlets. The cabinet end can be full open with or without a screen; the cabinet end can have a duct flange for attaching inlet air ductwork; or the cabinet end can have a two-position damper with duct flange. If filters were ordered, the inlet will have a filter rack with filters.

Or, the unit can have an attached combination of modules including a mixing box with either one or two inlets with duct flanges and a variety of controls, a cooling coil module, and/or an evaporative cooling module.

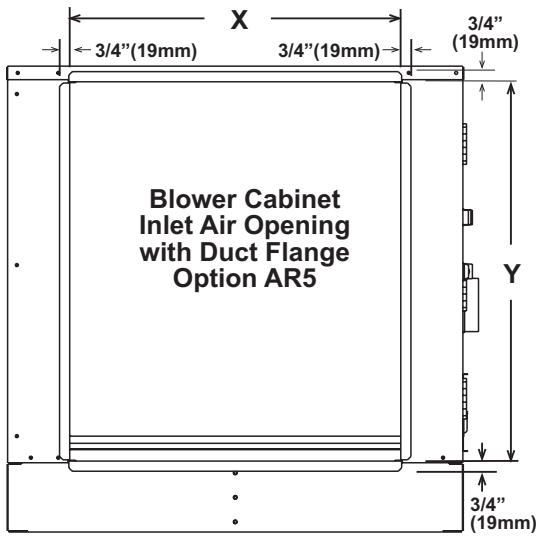
6.4.1 Optional Inlet Duct Flange (factory installed), Option AR5

Dimensions for attaching ductwork are shown in **TABLE 12**. The optional duct flange is 1-1/2" (38mm) long with a 3/4" (19mm) wide flange on all sides. The inlet air duct should be attached and sealed. Ductwork must have a free area equal to the duct connection.

FIGURE 15 - Optional Inlet Air Duct Flange on the Blower Cabinet, Option AR5

TABLE 12 - Dimensions of Optional Inlet Air Duct Flange

PDH/SDH	PEH	SHH	PXH		X	Y
75/100	10A/ 20A/ 40A	N/A	000A	inches	24-1/2	25-1/16
				mm	622	636
125/150	15B/30B/ 60B	N/A	000B	inches	34-1/2	25-1/16
				mm	876	636
175/200/ 225	N/A	130/180	000C	inches	24-1/2	37-5/16
				mm	622	948
250/ 300	30D/ 60D/ 90D/120D	260	000D	inches	40-3/4	37-5/16
				mm	1035	948
350/400A	40E/80E/ 120E	350	000E	inches	48-3/4	37-5/16
				mm	1238	948



6.4.2 Optional Two-Position Damper with Duct Flange (factory installed), Option AR8

The illustration in **FIGURE 16** shows the two-position damper attached directly to the blower cabinet. If ordered with a cooling coil module, the damper will be attached to the inlet air end of the cooling coil module. The damper adds 10" (254mm) to the length as shown in **FIGURE 2 on page 9.** Weight added is in **TABLE 5**, page 10.

The 7/8" duct flange is part of the damper frame. The inlet air duct should be attached and sealed. Dimensions for attaching ductwork are shown in **TABLE 13**. Ductwork must have a free area equal to the duct connection.

FIGURE 16 - Optional Inlet Air Two-Position (on/off) Damper with Duct Flange (factory installed), Option AR8



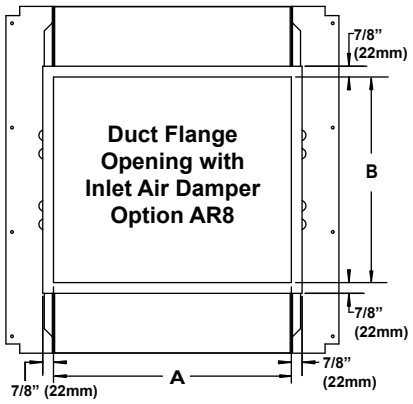


TABLE 13 - Opening Dimensions of Duct Flange on Optional Inlet Air Damper

PDH/SDH	PEH	SHH	PXH		A	B
75/100	10A/ 20A/40A	N/A	000A	inches	19-3/8	16-3/4
				mm	492	425
125/150	15B/30B/ 60B	N/A	000B	inches	24-7/8	16-3/4
				mm	632	425
175/200/ 225	N/A	130/ 180	000C	inches	21-1/4	25-3/4
				mm	540	654
250/ 300	30D/60D/ 90D/120D	260	000D	inches	34-1/4	18-1/4
				mm	870	464
350/400A	40E/80E/ 120E	350	000E	inches	38-5/8	21-1/4
				mm	981	540

6.4.3 Optional Filter Rack and Filters

Filter rack and filters are factory-installed optional equipment. Depending on which option was ordered, filters may be 1" or 2" disposable, 1", 2", or 4" pleated disposable, or 1" or 2" permanent. If the system does not have an optional cooling coil module, the vertical filter rack is located in the entering air side of the blower cabinet. If the system has an optional draw-through cooling coil module, the filter rack is located in the entering air side of the cooling coil module.

TABLE 14 - Filter Quantity and Sizes
(Quantity and width and height dimensions apply to all types and thickness of filters.)

PDH/SDH Sizes	75/100	125/150	175/200/225	250/300	350/400A
PEH Sizes	10A/20A/40A	15B/30B/60B	N/A	30D/60D/90D/120D	40E/80E/120E
SHH Sizes	N/A	N/A	130/180	260	350
PXH Size	000A	000B	000C	000D	000E
Filters - (Qty) Width x Height in inches	(2) 16 x 25	(2) 20 x 25	(2) 16 x 16; (2) 16 x 20	(3) 16 x 16; (3) 16 x 20	(1) 16 x 16; (2) 20 x 25; (3) 16 x 20

TABLE 15 - Pressure Drops for Clean Factory-Installed Filters by Type and Size ("w.c.)

Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
PDH/SDH 75, 100; PEH 10A, 20A, 40A; PXH 000A	569	0.0	0.0	0.0	0.0
	1000	.1	0.0	.1	0.0
	1500	.1	0.0	.1	.1
	1898	.1	.1	.2	.1
PDH/SDH 125, 150; PEH 15B, 30B, 60B; PXH 000B	949	0.0	0.0	0.0	0.0
	1250	.1	0.0	.1	0.0
	1500	.1	0.0	.1	0.0
	2000	.1	0.0	.1	.1
	2500	.1	.1	.2	.1
	2847	.2	.1	.2	.1

Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
PDH/SDH 175, 200, 225; SHH 130, 180; PXH 000C	1329	.1	0.0	.1	0.0
	1650	.1	0.0	.1	0.0
	2000	.1	0.0	.1	.1
	2500	.1	.1	.1	.1
	3000	.1	.1	.2	.1
	3500	.2	.1	.2	.2
	4000	.2	.1	.3	.2
	4271	.2	.1	.3	.2
PDH/SDH 250, 300; PEH 30D, 60D, 90D, 120D; SHH 260; PXH 000D	1898	.1	0.0	.1	0.0
	2050	.1	0.0	.1	0.0
	2500	.1	0.0	.1	0.0
	3000	.1	0.0	.1	.1
	3500	.1	0.0	.1	.1
	4000	.1	.1	.1	.1
	4500	.1	.1	.2	.1
	5000	.2	.1	.2	.1
	5500	.2	.1	.2	.2
	5694	.2	.1	.3	.2

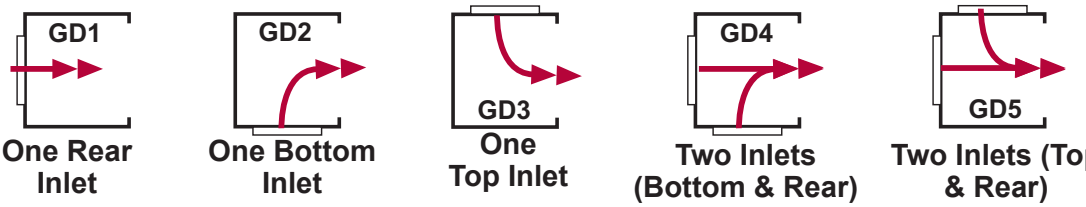
Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
PDH/SDH 350, 400A; PEH 40E, 80E, 120E; SHH 350; PXH 000E	2657	.1	0.0	.1	0.0
	3300	.1	0.0	.1	0.0
	3500	.1	0.0	.1	.1
	4000	.1	0.0	.1	.1
	4500	.1	.1	.1	.1
	5000	.1	.1	.2	.1
	5500	.2	.1	.2	.1
	6000	.2	.1	.2	.1
	6500	.2	.1	.2	.2
	7000	.2	.1	.3	.2
	7400	.2	.1	.3	.2
	7593	.3	.1	.3	.2

6.4.4 Optional Mixing Box (factory installed) - Models PDH, SDH, PEH, SHH, PXH

6.4.4.1 Mixing Box Configurations

If the installation includes an Option MXB1 mixing box, it is factory installed in one of the configurations illustrated in **FIGURE 17**. The configuration and damper control (GE Option, Paragraph 6.4.4.3) was determined when the unit was ordered.

FIGURE 17 - Option MXB1 Mixing Box Configurations



6.4.4.2 Mixing Box Dimensions

All mixing box inlet air openings have a duct flange. (See dimensions in **FIGURE 18 and TABLE 16**.) All inlet air ducts should be attached and sealed. A return air duct must have a free area equal to the return duct connection.

FIGURE 18 - Mixing Box Dimensions (TABLE 16)

Duct flange connections are the same size for all mixing box configurations - D x 18-3/8" (467mm) opening with 3/4" (19mm) flanges.

Top and bottom openings are symmetrical.

* Centerline of opening is at 1/2 of 18-3/8" = 9-3/16" (1/2 of 467mm = 233.5)

** Centerline of opening is at 1/2 of D. Dimension E applies to location of opening for all configurations.

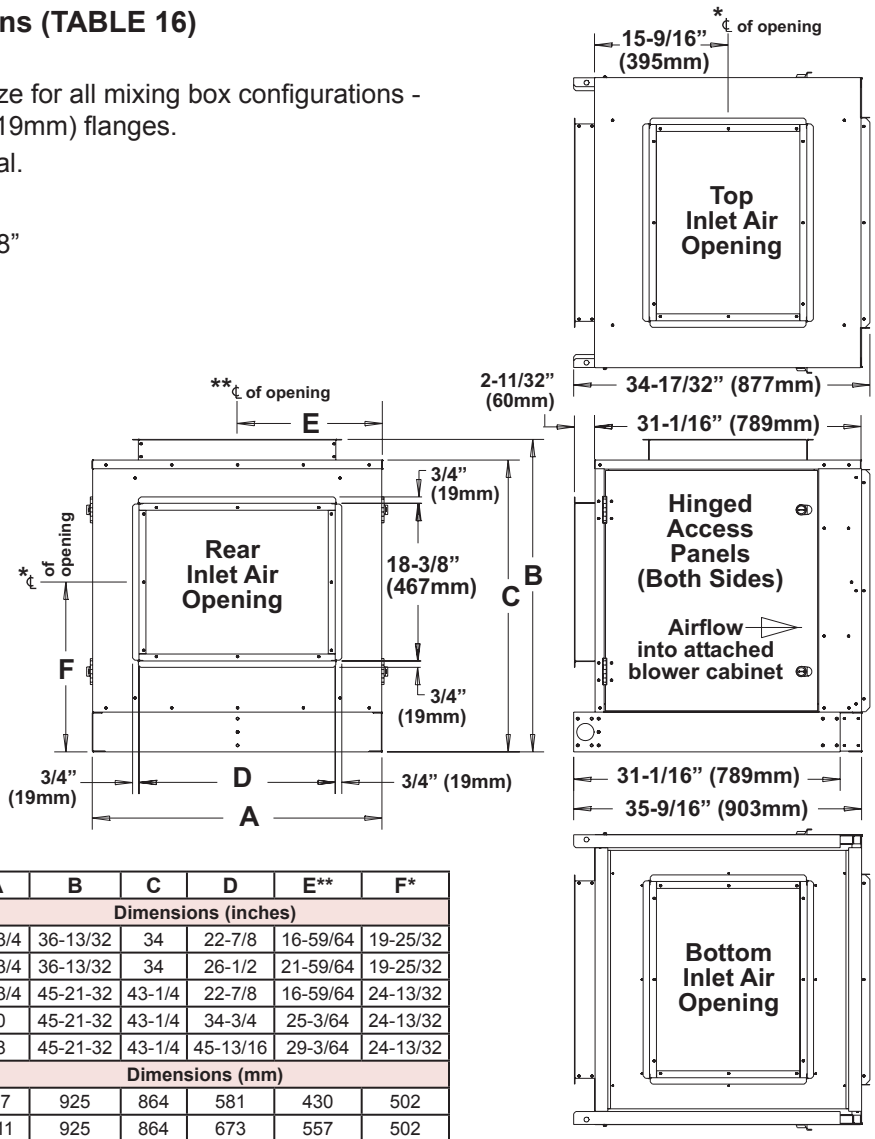


TABLE 16 - Option MXB1 Mixing Box Dimensions in FIGURE 18

Model and Size				A	B	C	D	E**	F*
PDH/SDH	PEH	SHH	PXH	Dimensions (inches)					
75/100	10A/20A/40A	N/A	000A	33-3/4	36-13/32	34	22-7/8	16-59/64	19-25/32
125/150	15B/30B/60B	N/A	000B	43-3/4	36-13/32	34	26-1/2	21-59/64	19-25/32
175/200/ 225	N/A	130/180	000C	33-3/4	45-21-32	43-1/4	22-7/8	16-59/64	24-13/32
250/300	30D/60D/90D/120D	260	000D	50	45-21-32	43-1/4	34-3/4	25-3/64	24-13/32
350/400A	40E/80E/120E	350	000E	58	45-21-32	43-1/4	45-13/16	29-3/64	24-13/32
PDH/SDH	PEH	SHH	PXH	Dimensions (mm)					
75/100	10A/20A/40A	N/A	000A	857	925	864	581	430	502
125/150	15B/30B/60B	N/A	000B	1111	925	864	673	557	502
175/200/ 225	N/A	130/180	000C	857	1160	1099	581	430	620
250/300	30D/60D/90D/120D	260	000D	1270	1160	1099	883	636	620
350/400A	40E/80E/120E	350	000E	1473	1160	1099	1164	738	620

6.4.4.3 Mixing Box Damper and Control Options

(**NOTE**: Electrical damper control GE options are listed on the unit wiring diagram.)

Mixing box options vary by model. Depending on the control option ordered (identified on the wiring diagram), the mixing box may or may not have dampers. Depending on the configuration and controls, dampers may be outside air only or outside and return air with manual or motorized control. Damper motor may be 2-position, 3-position, or modulating and may be controlled by unit operation, unit operation and a damper position dial (potentiometer), discharge temperature, mixed inlet air temperature, building pressure, or a building automation system.

Dampers always close on shutdown.

TABLE 17 - Air Inlet and Damper Controls by Mixing Box Option

Mixing Box Configuration (FIGURE 17)	Air Inlet Control Option	Dampers	Damper Motor Function (damper position)	Damper Controlled by
Option GD1, GD2, or GD3	GE3	Outside Air only	2-position (open/closed)	Unit operation.
	GE4		3-position (2 open/closed)	Unit operation with damper "stop" set by unit-mounted adjustable damper dial (potentiometer).
Option GD4 or GD5	NONE	No factory-installed dampers or controls		
	GE5	Outside and Return Air	None	Damper controlled by a manual quadrant.
	GE6		2-position (outside air open/return air open)	System control (switch or field-supplied time clock).
	*GE7			Return air temperature provides warm-up or cool-down by delaying opening of outside air damper.
	GE8		3-position (2 mixed/return air only)	Unit operation with damper "stop" set by unit-mounted adjustable damper dial (potentiometer).
	GE10		Modulates outside air and return air dampers to provide mixture of outside and return air in response to control	Unit operation with damper "stop" set from a remote adjustable damper dial (potentiometer). Requires installation of shipped-separate potentiometer; follow manufacturer's instructions.
	GE11			Discharge air temperature.
	GE12			Discharge air temperature with unit-mounted adjustable damper dial (potentiometer) set to always provide a minimum amount of outside air.
	*GE13		Modulates outside air and return air dampers to provide mixture of outside and return air in response to control	Discharge air temperature plus return air temperature setting to provide warm-up or cool-down by delaying opening of outside air damper.
	*GE14			Discharge air temperature plus return air temperature providing warm-up or cool-down by delaying opening of outside air damper and with unit-mounted adjustable damper dial (potentiometer) set to always provide a minimum amount of outside air after delay.
	GE15			Building pressure. Requires installation of shipped-separate pressure null switch. See page 26 and follow manufacturer's instructions.
	GE16			DDC control from field-supplied automated building system.
	GE21			Applies to PREEVA with cooling operation; outside air damper is controlled by enthalpy (heat content in a lb of air) using an economizer logic module. On a call for low stage cooling if the enthalpy of outdoor air becomes low, the outdoor air damper opens to reduce the cooling load in the building. As enthalpy of outdoor air increases, the outdoor air damper closes to a preset minimum condition. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. The economizer is automatically locked out during heating and holds the outdoor air damper at the minimum position or closed setting. The enthalpy sensor is shipped loose for field installation in the outside air duct. See instructions starting on page 27.
	GE22			Applies to PREEVA with cooling. In cooling mode, both outside air and return air dampers are modulated by enthalpy (heat content in a lb of air) using an economizer logic module. On a call for low cooling if the outdoor air enthalpy is lower than the return air enthalpy, the outdoor air damper proportions open. If the outdoor air enthalpy is higher than the return air enthalpy, the outdoor air damper closes to minimum position. If outdoor air enthalpy and return air enthalpy are equal, the outdoor air damper proportions open. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. The economizer is automatically locked out during heating and holds the outdoor air damper at the minimum position or closed setting. Two enthalpy sensors are shipped loose for field installation, one in the return air duct and one in the outside air duct. See instructions starting on page 27.

*GE7 provides ASHRAE Cycle I; GE14 provides ASHRAE Cycle II; GE13 provides ASHRAE Cycle III

Adjust the Damper Linkage

When a mixing box has both an outside air and a return air damper, both dampers are closed for shipping. The linkage for the return air damper must be adjusted prior to use. Follow instructions to adjust damper linkage.

1) Open the door on the side of the mixing box.
2) Loosen the setscrew on the return air damper rod at the damper arm.
3) Manually open the return air damper. While the damper blades are opening, the damper rod and arm assembly will automatically move to the correct position.
4) Tighten the setscrew. Close the door.

6.0 Mechanical (cont'd)

6.4 Unit Inlet Air (Supply Air) (cont'd)

6.4.4 Optional Mixing Box (factory installed) (cont'd)

6.4.4.3 Mixing Box Damper and Control Options (cont'd)

Pressure Null Switch (Field installed to control Outside Air Dampers in Option GE15) - PDH, SDH, SHH, PEH, PXH

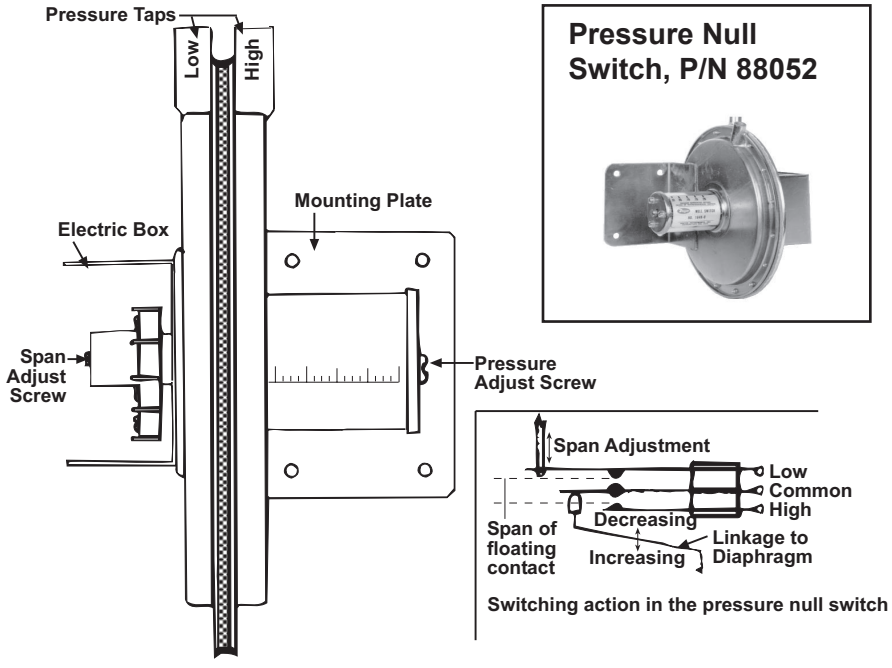
The pressure null switch used in Option GE15 is a Dwyer #1640-0 with a range of .01-.20" w.c. It is shipped separately for field installation. Refer to the following paragraphs and the manufacturer's installation instructions included with the switch.

Description and Application - The pressure null switch is a diaphragm operated differential pressure switch used in makeup air applications to control building pressure. It maintains a selected positive or negative pressure setpoint by changing the amount of outside air being introduced to the building through the modulating outside air dampers. As more pressure is required in the building, the pressure null switch activates the damper motor driving the outside air damper towards the full open position and the recirculated air damper towards the closed position. Conversely, as less pressure is required, the switch drives the dampers in the opposite direction.

Pressure Null Switch Installation Instructions

1. Select an indoor location free from excessive vibration where oil or water will not drip onto the switch and where ambient temperature will be within a range of -30°F (dry air) to 110°F.
2. Mount the switch securely with the diaphragm in a vertical plane to ensure proper operation.
3. Connect the pressure taps on the top of the switch to sources of air pressure differential. Metal tubing with 1/4" O.D. is recommended, but any tubing system which will not unduly restrict the air flow may be used. To maintain a positive building pressure, vent the low pressure tap to the outdoors and allow the high pressure tap to monitor building pressure. To maintain a negative building pressure, reverse the functions of the high and low pressure taps. In either case, be sure that the outdoor vent is protected from the wind and screened from insects.
4. Adjustment of the Switch - The "HIGH" actuation point of the null switch is indicated on a calibrated scale secured to the transparent range screw enclosure. Building pressure is set by turning the adjustment screw. The "Low" actuation point is set by adjusting the span of the null by turning the span adjustment screw. The span range is .01 to .03" w.c.
5. See the wiring diagram included with the furnace to make electrical connections.

FIGURE 19 - Pressure Null Switch (used with Inlet Air Option GE15)



Pressure Null Switch, P/N 88052

IMPORTANT: To eliminate shipping damage to the switch contacts, the manufacturer reduced the span adjustment to zero before shipping. The span should be adjusted prior to using the switch. (If the switch has been installed, disconnect the vent tube so that the null switch is in a neutral position.) Remove the electrical box cover and while observing the contacts, turn the span adjustment screw slowly in a clockwise direction. Continue turning the adjustment screw until you are able to see gaps between the common and both the low and high contacts. A minimum gap provides the greatest sensitivity. The wider the gap the lower the sensitivity.

Enthalpy Sensor(s) - Field installed to control dampers in economizer Options GE21 and GE22) - PDH, SDH, PEH, PXH, SHH

Option GE21 requires installation of one sensor; Option GE22 requires installation of two sensors. A system with Option GE21 includes one field-installed parts bag. A system with Option GE22 includes two field-installed parts bags. Locate the parts bag(s) shipped inside the unit.

TABLE 18 - Components in each Parts Bag, P/N 220686 (GE21 requires one parts bag; GE22 requires two.)

Qty	Component Description	P/N
1	Enthalpy Sensor, Honeywell #C7400A1004	**196290**
1	Blue Wire Assy, 18 ga x 72" with terminals	**220621**
1	Purple Wire Assy, 18 ga x 72" with terminals	**220620**
2	Screws, #6 x 3/4" long	**110650**
2	5/8" Strain Relief, Heyco #SR6N-4	**100392**
4	Stick-on Wire Retainers, Fastex #8511-29-00	**142678**
2	Plastic Wire Ties	**20913**

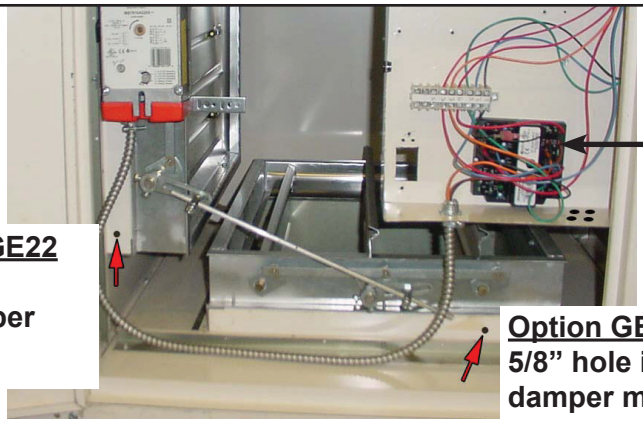
Enthalpy Control Sensor Installation Instructions

1. **Turn off the power. Turn off the gas** (Models PDH, SDH, SHH)**.**
2. **Install the <u>Outside Air</u> Enthalpy Sensor - <u>Options GE21 and GE22</u>**

a) **<u>Attach the Sensor in the Outside Air Ductwork</u>**
Position the sensor on the inside of the outside air ductwork. The sensor may be mounted in any orientation but must be located so that it is exposed to freely circulating air and must be protected from rain, snow, and direct sunlight. Position the sensor in a central location and attach with the two screws provided.

b) **<u>Wire the Sensor</u>**
Connect the two wires to the sensor as shown on the wiring diagram. Drill a 5/8" hole in the outside air damper mounting frame as illustrated in **FIGURE 20A**. Insert the strain relief bushing. Bring the wires through the opening and route them to the bottom of the electrical box. Use the stick-on wire holders to prevent the wires from interfering with the damper operation. Insert a strain relief bushing in a hole in the bottom of the electrical box and route the wires through. Make connections at the economizer logic module as shown on the wiring diagram.

FIGURE 20A - Mixing Box with Optional Economizer Logic Module



Installation of Option GE21 is complete. Refer to **FIGURES 20B and 20C** to set the economizer logic module.

If installing a return air sensor (Option GE22), continue to Step 3 (below).

3. **Install the <u>Return Air</u> Enthalpy Sensor in the Return Air Duct - <u>Option GE22</u>**

a) **<u>Attach the Sensor</u>**
Position the sensor on the inside of the return air duct. The sensor may be mounted in any orientation but must be located so that it is exposed to freely circulating air. Position the sensor in a central location on the side of the duct and attach with the two screws provided.

b) **<u>Wire the Sensor</u>**
Connect the two wires to the sensor as shown on the wiring diagram. Drill a 5/8" hole in the return air damper mounting frame as illustrated in **FIGURE 20A**. Insert the strain relief bushing. Bring the wires through the opening and route them to the bottom of the electrical box. Use the stick-on wire holders and the wire ties to prevent the wires from interfering with damper operation. Insert a strain relief bushing in a hole in the bottom of the electrical box and route the wires through. Make connections at the economizer logic module as shown on the wiring diagram.

Installation of Option GE22 is complete. Refer to **FIGURES 20B and 20C** to set the economizer logic module.

6.4.4 Optional Mixing Box) (cont'd)

6.4.4.3 Mixing Box Damper and Control Options (cont'd)

Operating Sequence with Economizer Option

Turn on the power and, if applicable, the gas.

On a call for low stage cooling:

1. The blower motor is energized.

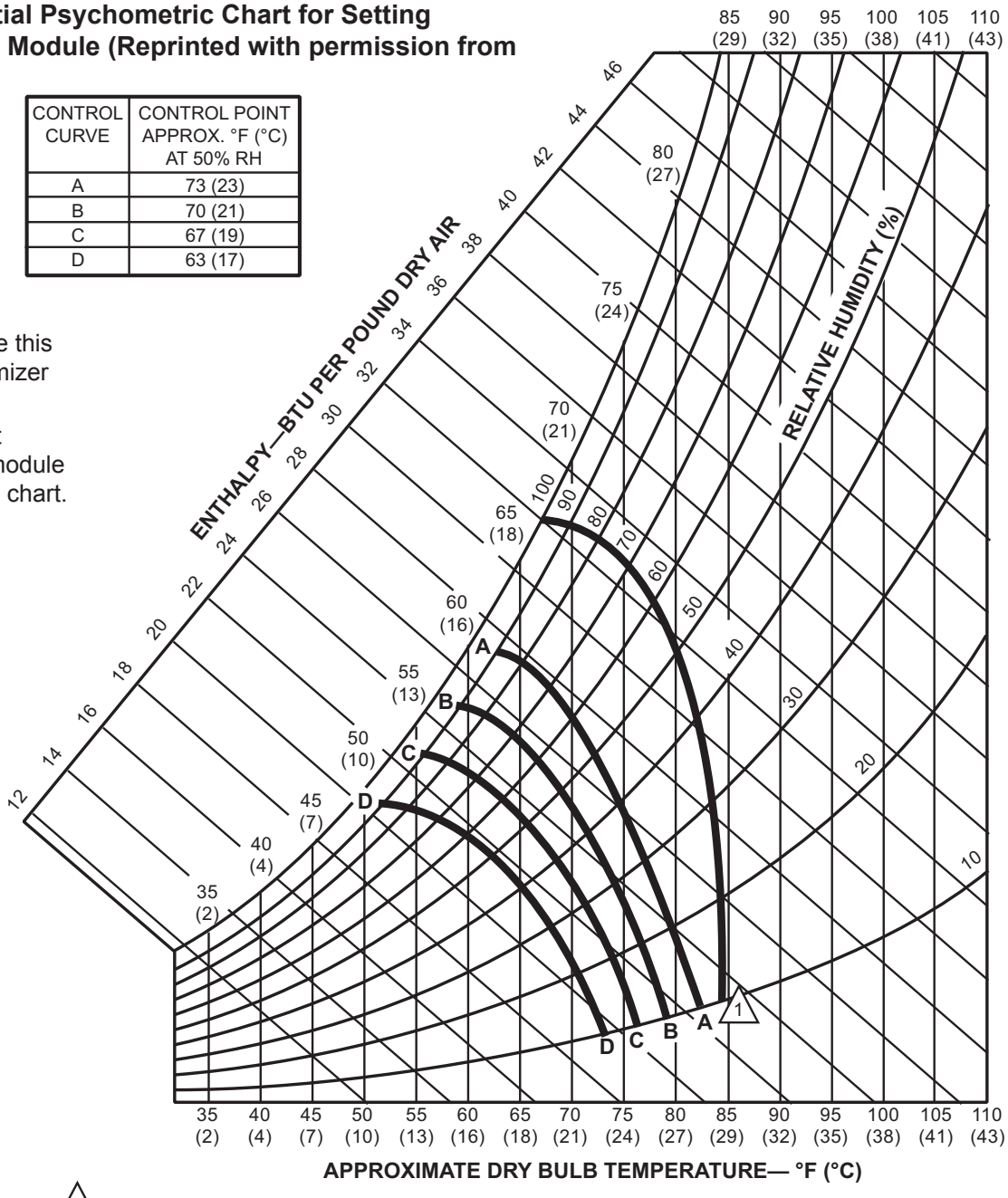
2. With the outdoor enthalpy lower than the return air enthalpy:
   a) The stage 1 and 2 cool circuits are locked out.
   b) Dampers are positioned by the economizer and mixed air sensor.

3. With outdoor air enthalpy higher than the return air enthalpy:
   a) The stage 1 cool circuit is energized.
   b) Dampers are positioned for minimum outside air.
   c) On a call for high stage cooling, the stage 2 and 3 circuits are staged appropriately

FIGURE 20B - Partial Psychometric Chart for Setting Economizer Logic Module (Reprinted with permission from Honeywell)

CONTROL CURVE	CONTROL POINT APPROX. °F (°C) AT 50% RH
A	73 (23)
B	70 (21)
C	67 (19)
D	63 (17)

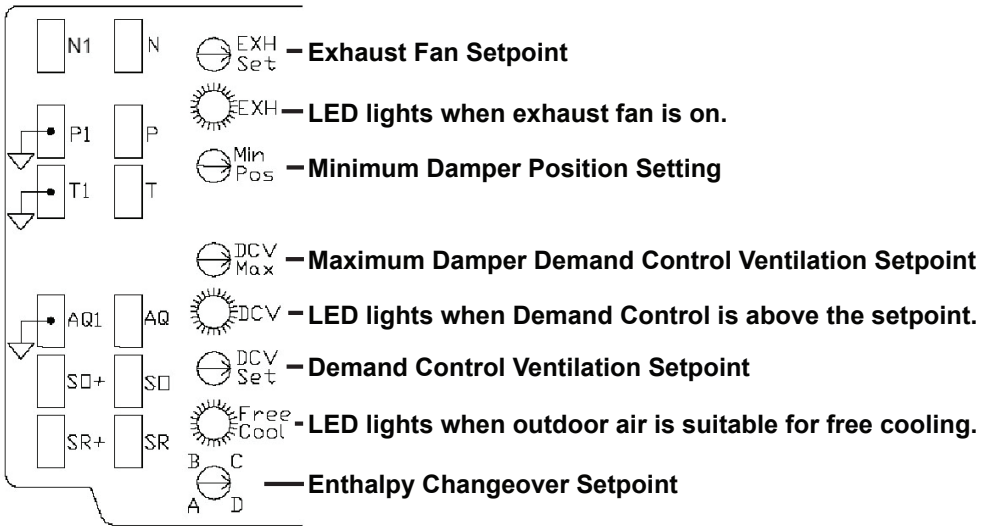
- **Option GE21** - Use this chart to set economizer logic module.
- **Option GE22** - Set economizer logic module to "D" as shown on chart.



1 HIGH LIMIT CURVE FOR W7210D, W7212, W7213, W7214, W7340B.

M11160C

FIGURE 20C - Economizer Logic Module Setpoint and LED Locations



6.5 Optional Evaporative Cooling Module (factory installed) - Models PDH, SDH, SHH, PEH, and PXH

The evaporative cooling module is factory installed as the “entering air” cabinet on the system base. The evaporative cooling module must be connected to a water supply and to a drain.

Depending on how it was ordered, the cooler has either a recirculating float and pump water control system (Option ECD2) or an AquaSaver microprocessor timed water control system (Option ECD1). All coolers are equipped with 12” cellulose or glass fiber media and may have optional 1” or 2” aluminium pre-filters.

NOTE: See **TABLE 5**, page 10, for evaporative cooling module weights.

FIGURE 21 - Evaporative Cooling Module Dimensions and Water Connection Locations

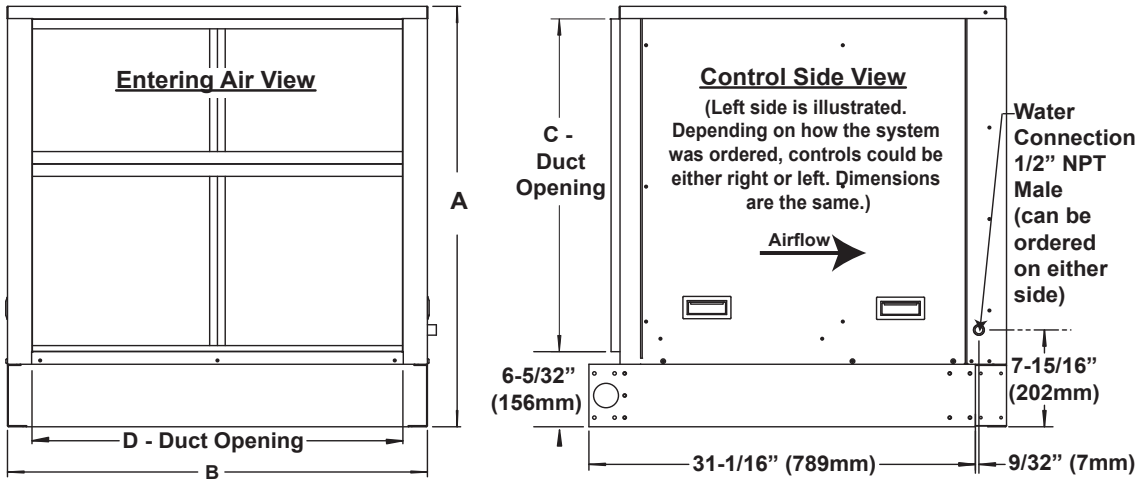
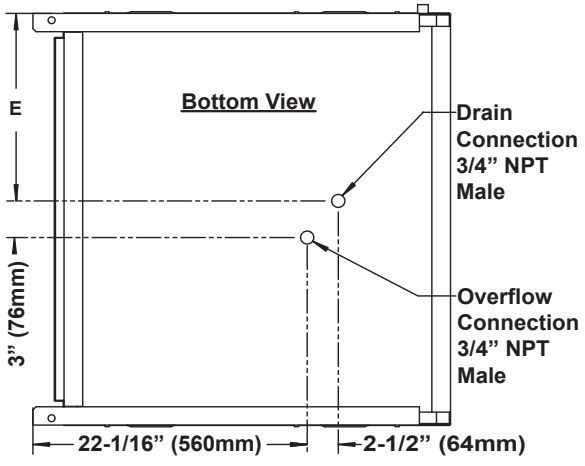


TABLE 19 - Evaporative Cooling Module Dimensions

PDH/SDH	SHH	PEH	PXH	A	B	C	D	E
Dimensions (inches)								
75/100	N/A	10A/20A/40A	000A	34-1/2	33-3/4	27-9/32	29-13/16	15-3/8
125/150	N/A	15B/30B/60B	000B	34-1/2	43-3/4	27-9/32	39-13/16	20-3/8
175/200/225	130/180	N/A	000C	43-3/4	33-3/4	36-17/32	29-13/16	15-3/8
250/300	260	30D/60D/90D/ 120D	000D	43-3/4	50	36-17/32	46-1/16	23-1/2
350/400A	350	40E/80E/120E	000E	43-3/4	58	36-17/32	54-1/16	27-1/2
Dimensions (mm)								
75/100	N/A	10A/20A/40A	000A	876	857	693	757	391
125/150	N/A	15B/30B/60B	000B	876	1111	693	1011	518
175/200/225	130/180	N/A	000C	1111	857	928	757	391
250/300	260	30D/60D/90D/ 120D	000D	1111	1270	928	1170	597
350/400A	350	40E/80E/120E	000E	1111	1473	928	1373	699



6.0 Mechanical (cont'd)

6.5 Optional Evaporative Cooling Module (factory installed) - Models PDH, SDH, PEH, PXH (cont'd)

6.5.1 Supply and Drain Water Connections

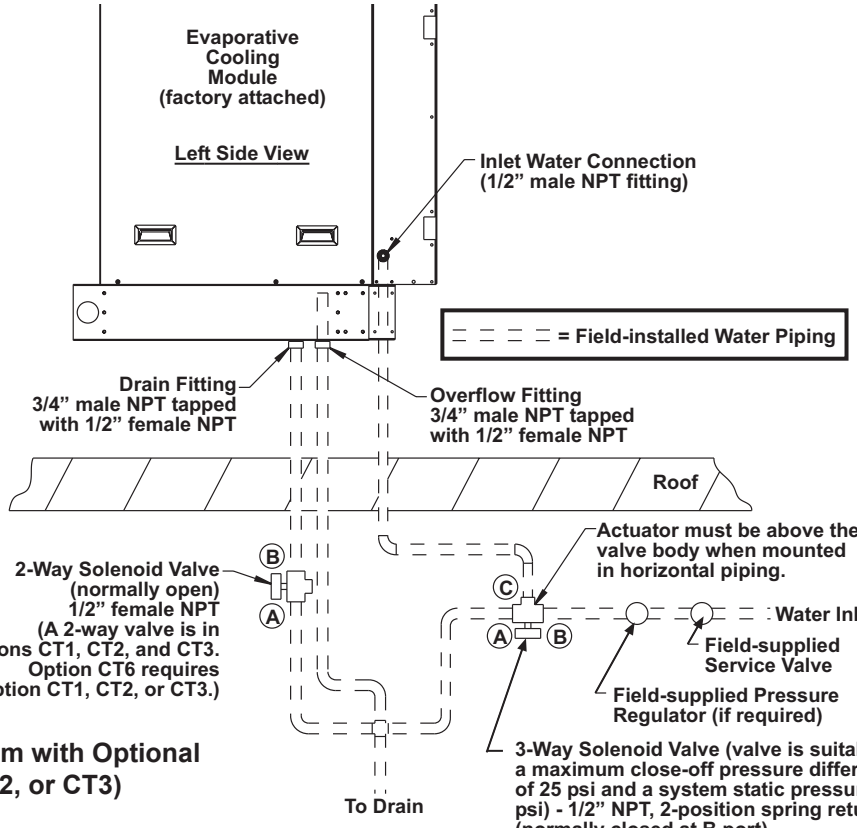
Water Supply - Connect the water supply to the 1/2" NPT male connection on the control side of the evaporative cooling module. See location in **FIGURE 21**. Install a manual water shutoff valve upstream of the cooling module inlet at a convenient non-freezing location. If necessary, install a bleed line between the manual valve and the cooling module to allow drainage of the line between the shutoff valve and the cooling module.

Fill and Drain Kits (field installed) - If the module has a pump and float water control system and is ordered with a fill and drain kit (Option CT1, CT2, or CT3), refer to the illustration in **FIGURE 22** to install the automatic fill and drain valves. Refer to the system wiring diagram to make wiring connections.

Freeze Protection - If a freeze protection option was ordered, the fill valve will not operate at subfreezing temperature. **NOTE:** On an evaporative cooling module with a recirculating pump and float water control system, freeze protection is only available if an optional fill and drain kit is field installed. See **Sequence of Operation Section** in **FIGURE 22**.

FIGURE 22 - Field-installed Fill and Drain Valves for Pump and Float System (Option CT1, CT2, or CT3) **and**

Freeze Protection Kits (Option CT5 for AquaSaver and Option CT6 for Pump and Float System)



Sequence of Operation with Optional Fill and Drain and/or Freeze Protection Kits

Applies to: Float and Pump System with Optional Fill and Drain Kit (Option CT1, CT2, or CT3)

1) Call for cooling.
2) 2-way valve is energized and closes **B** to **A**.
3) 3-way valve is energized opening **B** to **C** and closing **A** to **C**.
4) During no call for cooling, valves return to normal state.

Applies to: AquaSaver Timed Water System with Optional Freeze Protection (Option CT5)

1) Call for cooling.
2) 3-way valve is energized and closes **B** to **A**.
3) If outside air temperature drops below freeze protection controller setting, 3-way valve is de-energized and AquaSaver 24V solenoid valve remains energized for eight minutes to allow complete system water drainage.
4) During no call for cooling, 3-way valve returns to normal state.

Applies to: Float and Pump System with Optional Fill and Drain Kit (Option CT1, CT2, or CT3) and Freeze Protection (Option CT6)

1) Call for cooling.
2) 2-way valve is energized and closes **B** to **A**.
3) 3-way valve is energized opening **B** to **C** and closing **A** to **C**.
4) If outside air temperature drops below freeze protection controller setting, valves return to normal state.
5) During no call for cooling, valves return to normal state.

CAUTION: Water reservoir must be drained and pump motor turned off when outside temperature falls below 32°F (0°C). Pump must never be operated without water in the reservoir. See Hazard Levels,page 2.

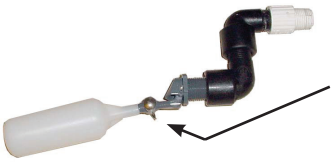
Overflow and Drain - **All cooling modules** are equipped with an overflow and drain fitting. The fittings are in the cabinet bottom and come complete with a lock nut and a sealing gasket. Check these fittings for tightness before installing the overflow and drain piping. The drain and overflow fitting will accommodate 3/4" NPT fittings and are also tapped with a 1/2" female pipe thread for iron pipe.

Bleed Off - **If the module has a recirculating pump and float water control system**, it has a bleed off hose. The bleed off hose is attached to a tee in the fill line and must drain into the overflow drain. Make sure that the end of the bleed off line extends into the overflow drain. Adequate bleed off is important to maintaining an efficiently operating system by lessening the concentration of undesirable minerals in the water being circulated through the cooling module. Minerals buildup because evaporation only releases "pure water vapor" causing the concentration of contaminants in the water to increase as the evaporation process continues. The minerals accumulate on the media, in the water lines, on the pump, and in the reservoir.

Water Hammer Arrestor - **If the cooling module is equipped with an AquaSaver timed metering system**, the operation of the solenoid valve in the water line is controlled by the timer. Due to various water pressures and installation conditions, the water supply line may bang abruptly when the solenoid valve closes. This banging can be minimized by installing an optional water hammer arrestor (Option ECB1) in the supply line. When installing an optional water hammer arrestor, select an indoor location (above 32°F), either horizontal or vertical, in line with and as close to the solenoid valve as possible. Follow the manufacturer's instructions to install and maintain the water hammer arrestor.

Recirculating Float and Pump Control System - Turn on the water supply and check for good flow. When the float valve (**FIGURE 23**) shuts off the water supply, measure the water depth. The depth of the water should be approximately 3" (76mm). If necessary, adjust the position of the float valve with the wing nut to obtain the proper water level.

FIGURE 23 - Float Valve, P/N 216553



1/2" MPT Water Supply Connection

Adjust the float valve position with the wing nut to maintain approximately 3" (76mm) of water in the reservoir.

6.5.2 Adjusting Water Flow Over Pads

Proper water flow over the evaporative cooling media is critical to extend the life and maintain the efficiency of the pads. To adjust the flow, read the warnings and follow the instructions that apply.

WARNING

Adjust ball valve only when the power is disconnected from the system. Failure to do so can cause electrical shock, personal injury, or death.

CAUTION: Do not flood the media pads with extreme quantities of water for long periods as this will cause premature breakdown of the media. An even flow from top to bottom of the media with the least amount of water is all that is required to assure maximum efficiency and media life span. More water does not provide more evaporation or more cooling.

FIGURE 24 - Remove side door and locate ball valve (illustration below is from the rear). Both water flow control systems have a ball valve in the water line.



Adjusting Water Flow with a Float and Pump Control System - Using the ball valve, located in the length of hose running from the pump to the distribution line inlet (See **FIGURE 24**), adjust the valve handle to allow the flow to completely dampen the media pads from top to bottom.

6.0 Mechanical (cont'd)

6.5 Optional Evaporative Cooling Module (factory installed) - Models PDH, SDH, PEH, PXH (cont'd)

6.5.2 Adjusting Water Flow Over Pads (cont'd)

Operate the unit watching the water flow. After 15 minutes with the blower in operation, the water should have completely dampened the pads but should not be flowing off the entering side of the media. If water is flowing off the entering side of the media, turn the system off, disconnect the power, and reduce the entering water flow.

Adjusting Water Flow with a Timed Metering Control System - NOTE: Water flow and pad wetting time should be adjusted at maximum airflow and wet bulb depression to assure complete wetting of the media at the extreme operating conditions.

In addition to adjusting water flow, the timing of the water on/off cycle can be adjusted. Adjustments are correct when **1)** the water rises from the holes in the sprinkler pipe consistently along the entire pipe length, **2)** the media pads wet evenly after a few "ON" cycles (no dry spots or dry streaks), and **3)** a slight amount of excess water collects at the drain at the completion of the "ON" cycle.

1) AquaSaver Water Flow Adjustment - Using the ball valve illustrated in **FIGURE 24**, adjust the water flow so that the water rises above the distribution pipe as illustrated in **FIGURE 25**.

2) AquaSaver Timer Adjustment - At any given temperature, the media pads should completely wet from top to bottom during the ON cycle. The microprocessor has three preset timing settings based on media size. The appropriate setting is selected by changing the position of the suitcase jumper at J2 on the microprocessor. Remove the cover and check the setting (See **FIGURE 26**).

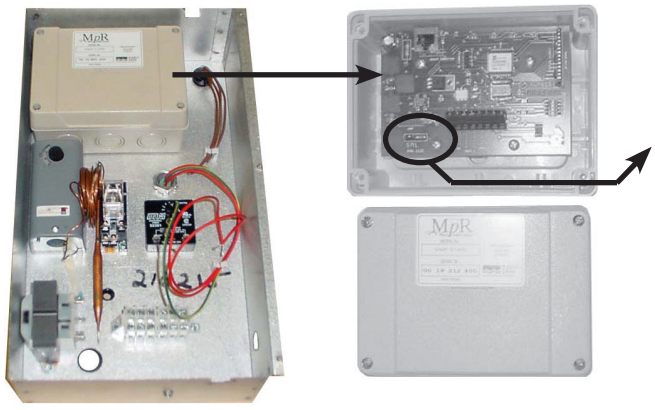
FIGURE 25 - Timed Water System - Use the ball valve in FIGURE 24 to adjust the rise from the distribution (sprinkler) pipe in the evaporative cooling module.

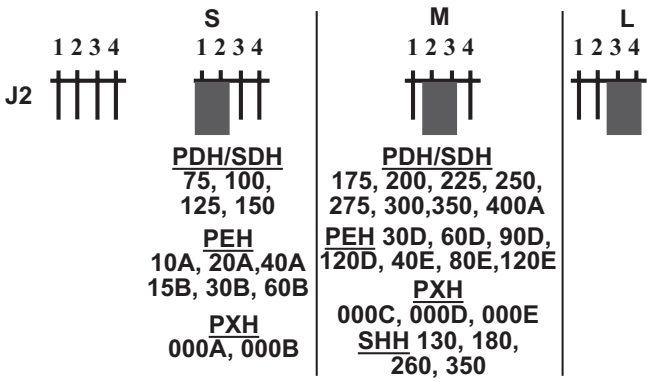


PVC Sprinkler Pipe

PDH/SDH Size	SHH Size	PEH Size	PXH Size	A = Water rise from PVC Sprinkler Pipe
75, 100, 125, 150		10A, 20A, 40A, 15B, 30B, 60B	000A, 000B	1/8" to 1/2" 3 to 13mm)
175, 200, 225, 250, 350, 400A	130, 180, 260, 350	30D, 60D, 90D, 120D, 40E, 80E, 120E	000C, 000D, 000E	1/4" to 1/2" (6 to 13mm)

FIGURE 26 - AquaSaver Microprocessor Control, P/N 205044, in the Junction Box





If the jumper is at the appropriate location, replace the cover. If the jumper needs to be moved, move it to the appropriate setting. The setting will go into effect when the power is restored. Check the "ON" timing; the media pads should be wet from top to bottom during the ON cycle.

If the preset timing is not suitable for the application, follow the instructions supplied with the microprocessor to change the calibration of the "ON" and/or "OFF" cycle.

All Evaporative Cooler Modules - Check the reservoir for water leaks. If any small leaks are present, drain the reservoir. Dry and apply a waterproof silicone sealer around corners and welds.

6.6 Cooling Module - Option AU on PDH, SDH, PEH, SHH, and PXH

6.6.1 General

The draw-through cooling coil module is factory assembled to the entering air side of the system blower cabinet. Depending on which options were ordered, it will house either a single, dual, or 1/3-2/3 circuit DX cooling coil or a chilled water coil with 1/4, 1/2, 3/4, or full circuiting. Depending on the option, the module can include a reheat circuit which is factory charged with R410A refrigerant.

The DX coil will accommodate the refrigerant specified on the order, either R410A, R134a, or R407c. Verify that the correct refrigerant was specified. If the coil was ordered for the incorrect refrigerant, contact your distributor or the factory for revised capacity ratings and appropriate distributor nozzle(s). Distributor nozzles may be changed in the field by a qualified technician.

If being installed with a matching Model MASA condensing unit, the coil must be charged with R410A refrigerant. Follow the instructions in the condensing unit installation manual (Form I-COND) to connect the piping and charge the system.

Condensing related controls such as thermal expansion valves and hot gas bypass may have been ordered factory installed for R410A refrigerant only. All such controls for other refrigerants must be field supplied.

This split air-conditioning system requires a matching MASA or field-supplied condensing coil. Follow the instructions provided by the condensing coil manufacturer to make the piping connections and charge the system. If equipped with a multi-circuit coil, before making connections, blow dry nitrogen into the circuit to determine which distributor goes with which suction line. (See connection dimensions in **FIGURE 27A or 27B**.)

The coil module drain trough has an exterior 1” NPT connection. Connect the drain into a sanitary drain system. The condensate trough and drain require periodic cleaning and are listed in the maintenance schedule (See Form O-PREEVA). The slide out drain pan can be removed for cleaning. The service clearance for the control side of the cooling module must be maintained; see **TABLE 3**, page 7.

Both sides of the cooling coil module have removable door panels for routine coil inspection and cleaning.

Cooling control depends on which system control was ordered. If digital heating/cooling controls (Option DG1, DG2, DG5, DG6, D12B, D12C, D12D, D12E, D12F, D12G) were ordered, see Paragraph 8.3 and the control instruction form for information. If the cooling module was ordered with an optional reheat section (Option AU7L or AU7R), the reheat circuit is factory charged with R410A refrigerant.

CAUTION: When installing a unit that includes a cooling module in a location such as an attic that can experience high dewpoint conditions, a field-supplied drain pan should be installed under the entire unit for water management control. High dewpoint conditions have the potential to form condensation on the exterior of the unit. See condensate drain requirements in Paragraph 6.6.3.

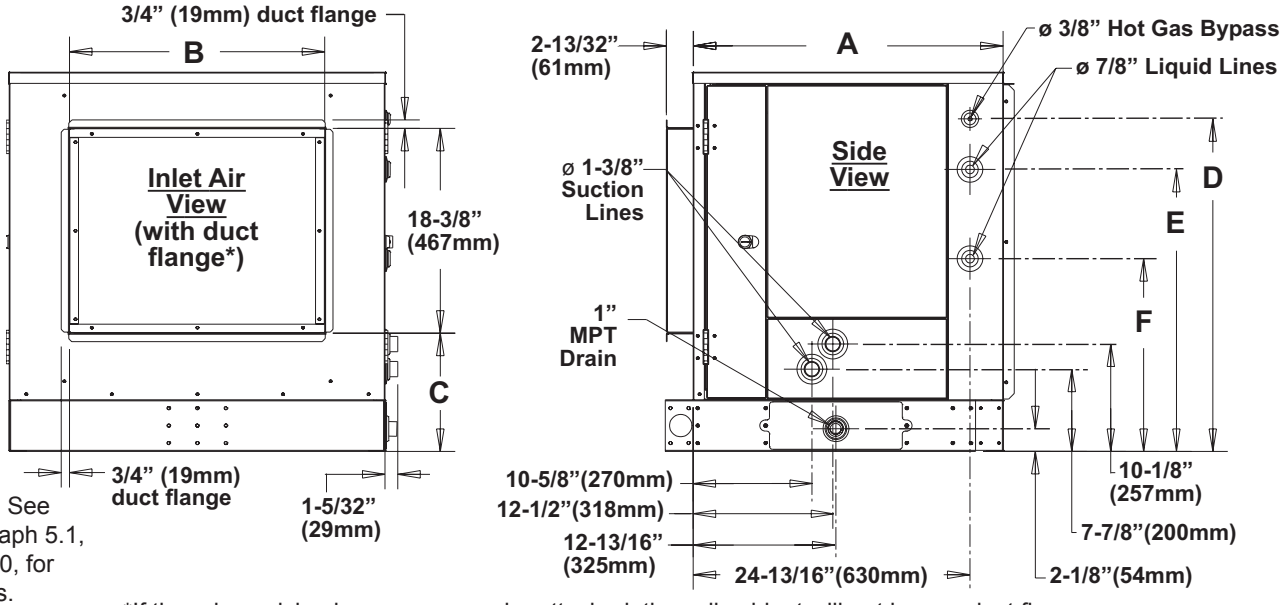
DANGER

The reheat circuit contains R410A high pressure refrigerant. Hazards exist that could result in personal injury or death. Installation, maintenance, and service should only be performed by an HVAC technician qualified in R410A refrigerant and using proper tools and equipment. DO NOT USE service equipment or tools designed for R22 refrigerant.

IMPORTANT: *Do not release refrigerant to the atmosphere!* If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified HVAC technician.

6.6.2 Cooling Coil Module Dimensions

FIGURE 27A - DX Cooling Coil Module Dimensions (without reheat)



NOTE: See Paragraph 5.1, page 10, for weights.

*If there is a mixing box or evap cooler attached, the coil cabinet will not have a duct flange.

TABLE 20A - DX Cooling Coil Module Dimensions

Model PDH or SDH	Model PEH	Model SHH	Model PXH	A	B	C	D	E	F	A	B	C	D	E	F
				Dimensions (inches)						Dimensions (mm)					
75/100	10A/20A/40A	N/A	000A	27-3/4	22-7/8	11-1/8	30-1/4	25-9/32	17-9/32	705	581	283	768	642	439
125/50	15B/30B/60B	N/A	000B	27-3/4	26-1/2	11-1/8	30-1/4	25-9/32	17-9/32	705	673	283	768	642	439
175/200/225	N/A	130/180	000C	27-3/4	22-7/8	11-1/8	30-1/4	25-9/32	17-9/32	705	581	283	768	642	439
250/300	30D/60D/90D/120D	260	000D	27-3/4	34-3/4	15-7/32	35	29-29/32	21-29/32	705	883	387	889	760	556
350/400A	40E/80E/120E	350	000E	27-3/4	45-3/4	15-7/32	35	29-29/32	21-29/32	705	1162	387	889	760	556

FIGURE 27B - DX Cooling Coil Module Dimensions with Reheat Circuit

*If there is no mixing box or evap cooler attached, the inlet air opening would have an optional duct flange as shown in **FIGURE 27A.**

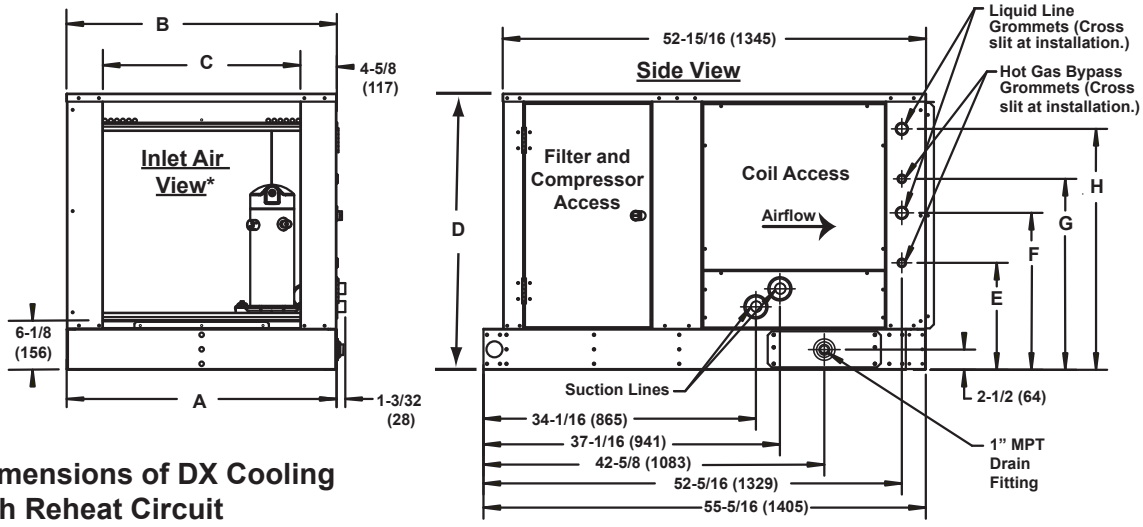


TABLE 20B - Dimensions of DX Cooling Coil Module with Reheat Circuit

Model PDH or SDH	Model SHH	Model PEH	Model PXH	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
				Dimensions (inches)								Dimensions (mm)							
75/100	N/A	10A/20A/40A	000A	33-3/4	33-13/16	24-23/32	34-17/32	13-3/8	19-5/8	23-7/8	30-1/8	857	859	628	877	340	498	606	765
125/150	N/A	15B/30B/60B	000B	43-3/4	43-13/16	34-23/32	34-17/32	13-3/8	19-5/8	23-7/8	30-1/8	1111	1113	882	877	340	498	606	765
175/200/225	130/180	N/A	000C	33-3/4	33-13/16	24-23/32	43-7/8	15-3/8	21-5/8	27-7/8	34-1/8	857	859	628	1114	391	549	708	867
250/300	260	30D/60D/90D/120D	000D	50	50-5/32	40-15/16	43-7/8	15-3/8	21-5/8	27-7/8	34-1/8	1270	1274	1040	1114	391	549	708	867
350/400A	350	40E/80E/120E	000E	58	58-5/32	48-15/16	43-7/8	15-3/8	21-5/8	27-7/8	34-1/8	1473	1503	1243	1114	391	549	708	867

FIGURE 28 - Chilled Water Cooling Coil Module Dimensions (no reheat)

*If there is a mixing box, the coil cabinet will not have a duct flange and this end of the coil cabinet will be attached to the mixing box.

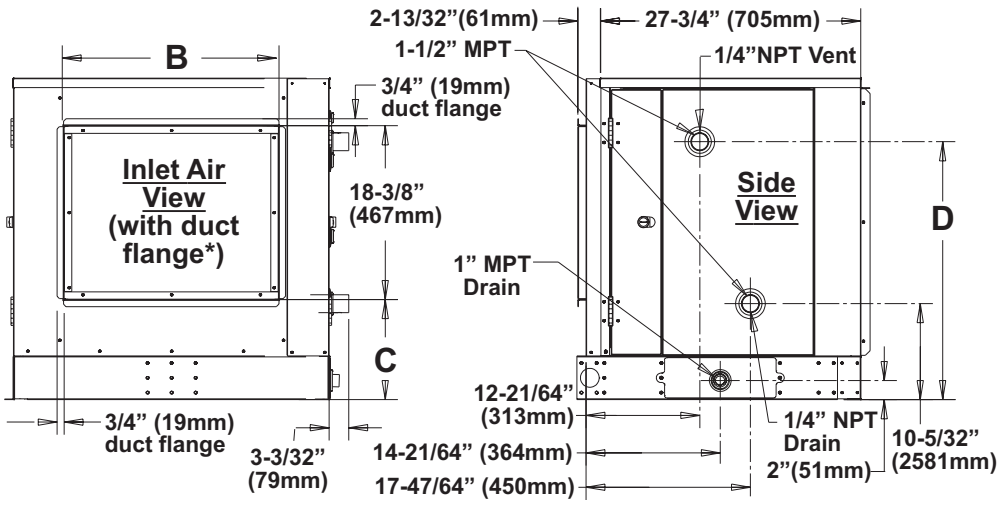


TABLE 21 - Chilled Water Cooling Coil Module Dimensions

Model PDH or SDH	Model PEH	Model SHH	Model PXH	B	C	D	B	C	D
				Dimensions (inches)			Dimensions (mm)		
75, 100	10A/20A/40A	N/A	000A	22-7/8	10-19/32	27-9/32	581	269	693
125, 150	15B/30B/60B	N/A	000B	26-1/2	10-19/32	27-9/32	673	269	693
175, 200, 225	N/A	130, 180	000C	22-7/8	10-19/32	37-9/32	581	269	947
250, 300	30D/60D/90D/120D	260	000D	34-3/4	15-7/32	37-9/32	883	387	947
350, 400A	40E/80E/120E	350	000E	45-3/4	15-7/32	37-9/32	1162	387	947

NOTE: See Paragraph 5.1, page 10, for weights.

6.6.3 Cooling Module Condensate Drain

A removable drain pan with a 1" MPT drain connection is located below the coil cabinet (See **FIGURE 27A or B or FIGURE 28**). When connecting the drain line, provide a means of disconnecting the line at or near the cabinet connection to allow the drain pan to be removed for cleaning.

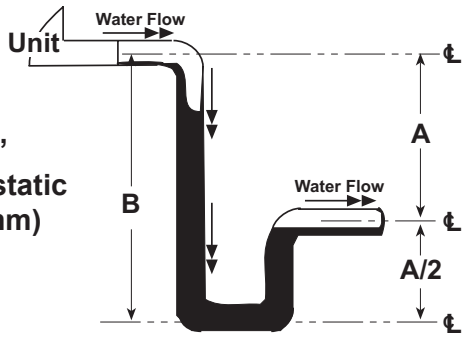
Ensure the system is level and **install a trap in the drain** (see **FIGURE 29A**). Pitch the drain line at least 1/2" (13mm) for every 10 feet (3M) of horizontal run. Drain lines must not interfere with drain pan or access panels. An obstruction in the drain or a poorly designed drain can cause the condensate pan to over flow which could result in unit or building damage.

If the installation or local code requires, run drain into a waste water system.

FIGURE 29A - Condensate Drain Trap Dimensions

A = 1" (25mm) for each 1" (25mm) of maximum static pressure *plus* 1" (25mm)

B = A + A/2



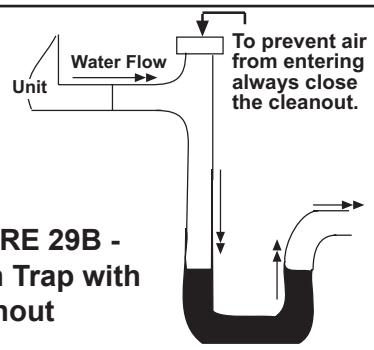


FIGURE 29B - Drain Trap with Cleanout

Drain Trap

The design of the drain trap is important. Since the condensate drain pan is on the blower inlet side, there is a negative pressure at the drain relative to the ambient. The trap height must account for this static pressure difference. Maximum negative static can be determined by reading the negative pressure at the blower inlet and adding .2" w.c. to allow for dirty filters.

If dimension "B" is not tall enough, the water seal will not hold and air will be drawn through the drain pipe into the system. If the outlet leg of the trap is too tall, water will back up into the drain pan. As condensate forms during normal operation, the water level in the trap rises until there is a constant outflow. **FIGURE 29A** illustrates the appropriate dimensions for trapping a negative pressure system.

Improper trap design accounts for some condensate drainage system failures, but incorrect use and maintenance of condensate drain traps can also cause problems.

6.0 Mechanical (cont'd)

6.6 Cooling Module - Option AU on PDH, SDH, PEH, SHH, and PXH (cont'd)

Drain Trap (cont'd)

The combination of airborne particles and moisture in the air handler can result in algae formation in the drain pan and traps. The traps must be cleaned regularly to avoid blockage that can slow or stop water flow, resulting in backup into the system.

If the drains have a cleanout opening (**FIGURE 29B**), be sure to close the opening after cleaning.

Condensate Drain Use

Seasonal Usage - At the beginning of the cooling season, inspect and clean the entire cooling coil cabinet including the condensate drain pan. Thoroughly clean dirt, algae, grease, and other contaminants. Inspect condensate drain pans, traps, and piping; fill traps with water to ensure proper operation.

Year Round Usage - Climates or applications with cooling requirements year round require more frequent inspections of the cooling coil cabinet and condensate drains.

6.6.4 Ultra-Violet Light, Option UV2

If the cooling module was ordered with an optional ultra-violet light, the fixture is factory installed but the bulb and other components are shipped in the blower compartment for field installation. Follow the instructions on the option installation form shipped in the parts bag. Option UV2 ultra-violet light requires its own power supply and disconnect switch.

CAUTION: Do not touch bulb glass without gloves. Oil from fingerprints will permanently etch bulb and weaken structure. Clean bulb after handling.

WARNING

Do not use UVC lights for service lighting. Never expose eyes or skin to ultra-violet light from any source.

6.7 Unit Discharge

Model PEH units require attachment of an outlet duct. They are equipped with a factory-attached discharge duct flange as shown in **FIGURE 30.**

Model SDH, PDH, PXH, and SHH units may have ductwork or may discharge directly into the space. Depending on which option was ordered, the discharge opening is equipped with either an attached duct flange, factory-installed horizontal louvers, factory-attached horizontal and vertical louvers, or is an opening designed for field installation of an optional nozzle (Paragraph 6.7.4). If an outlet option is not selected, see dimensions in **FIGURE 2**, page 9.

6.7.1 Louvers, Option AX2 or AX3 - PDH, SDH, SHH

Factory-installed horizontal louvers (Option AX2) are spring mounted in the discharge opening and do not have a frame. If there are factory-installed horizontal and vertical louvers (Option AX3), the frame adds approximately 4" (102mm) to the length of the cabinet. Adjust louvers for desired discharge airflow.

CAUTION: To avoid getting burned, wear gloves if adjusting louvers during heat operation.

6.7.2 Discharge Duct Flange (factory installed), Std on PEH; Option AX4 on PDH, SDH, SHH, or PXH (without hot water heat)

Dimensions for attaching ductwork are shown in **TABLE 22**. The discharge duct flange is 4" (102mm) long with a 3/4" (19mm) wide flange on all sides. See requirements and recommendations below for sizing and attaching ductwork.

FIGURE 30 - Dimensions of Discharge Duct Flange (factory installed)

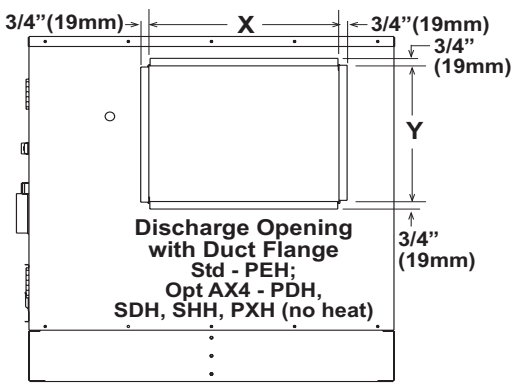


TABLE 22 - Dimensions of Discharge Duct Flange

PDH/SDH	PEH	SHH	PXH (no heat)		X	Y
75, 100	10A, 20A, 40A	N/A	000A	inches	17-9/16	13-9/16
				mm	446	345
125, 150	15B, 30B, 60B	N/A	000B	inches	27-9/16	13-9/16
				mm	700	345
175, 200, 225	N/A	130, 180	000C	inches	20-3/4	22-13/16
				mm	527	580
250, 300	30D, 60D, 90D, 120D	260	000D	inches	28-5/8	22-13/16
				mm	727	580
350, 400A	40E, 80E, 120E	350	000E	inches	38-5/16	22-13/16
				mm	973	580

CAUTION: Joint where supply air duct attaches to the furnace must be sealed securely to prevent air leakage. Leakage can cause poor combustion, shorten heat exchanger life, and cause poor performance. See Hazard levels, page 2.

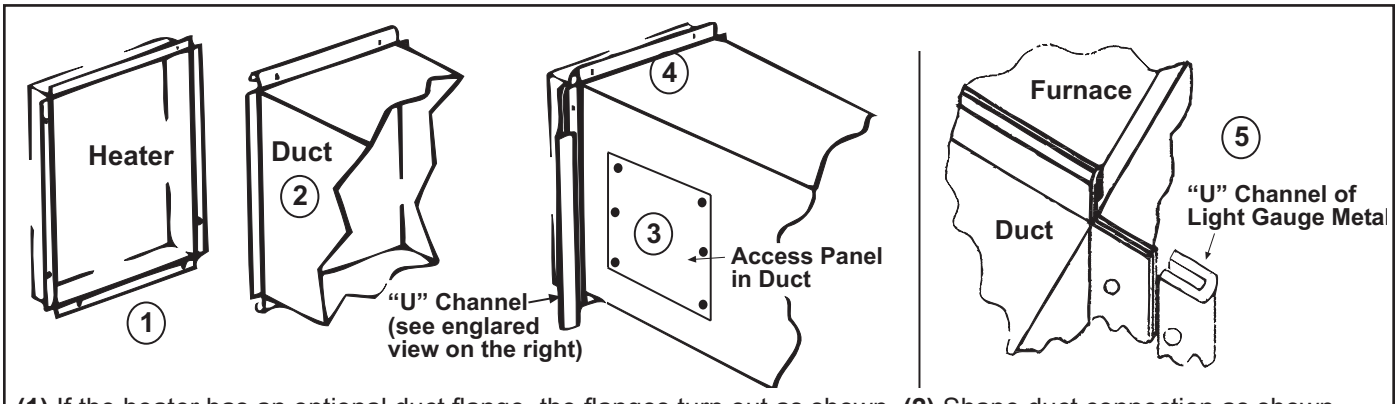
Requirements and Recommendations for Connecting and Installing Discharge Ductwork - All Models

- **Type of Ductwork** - The type of duct installation to be used depends in part on the type of construction of the roof (whether wood joist, steelbar joist, steel truss, pre-cast concrete) and the ceiling (whether hung, flush, etc.).
- **Ductwork Material** - Rectangular duct should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B & S gauge aluminum.
- **Ductwork Structure -** All duct sections 24 inches (610mm) or wider, and over 48 inches (1219mm) in length, should be cross broken on top and bottom and should have standing seams or angle-iron braces. Joints should be S and drive strip, or locked.
- **Through Masonry Walls** - No warm air duct should come in contact with masonry walls. Insulate around all air ducts through masonry walls with not less than 1/2" (1" is recommended) of insulation.
- **Through Unheated Space** - Insulate all exposed warm air ducts passing through an unheated space with at least 1/2" (1" is recommended) of insulation.
- **Duct Supports** - Suspend all ducts securely from adjacent buildings members. Do not support ducts from unit duct connections.
- **Duct Sizing** - Proper sizing of the supply air ductwork is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air Conditioning Contractors Association (www.acca.org), 2800 Shirlington Road, Suite 300, Arlington, VA 22206. A manual covering duct sizing in detail may be purchased directly from them.

CAUTION: An external duct system static pressure not within the limits shown on the rating plate, or improper motor pulley or belt adjustment, may overload the motor. See Hazard Levels, page 2.

- **Removable Panel** (See **FIGURE 31**.) - The ductwork should have a removable access panel. This opening must be accessible when the furnace is in service and should be large enough to view smoke or reflected light, to detect the presence of leaks in the heating equipment, and to check for hot spots on the heat exchanger due to poor air distribution or lack of sufficient air (cfm). The cover for the opening must be attached in such a manner as to prevent leakage.
- **Horizontal Discharge Duct Length** - A minimum horizontal duct run of 24" (610mm) is recommended before turns or branches are made in the duct system to reduce losses at the furnace outlet.

FIGURE 31 - Connecting Discharge Ductwork



(1) If the heater has an optional duct flange, the flanges turn out as shown. **(2)** Shape duct connection as shown with "U" on top and bottom and "L" on sides. **(3)** Provide for sealed access panel in the ductwork. This opening must be accessible when the furnace is in service and should be large enough to view smoke or reflected light, to detect the presence of leaks in the heating equipment, and to check for hot spots on the heat exchanger due to poor air distribution or lack of sufficient air (cfm). The cover for the opening must be attached in such a manner as to prevent leakage. **(4)** Slide "U" channels over top and bottom flanges on the heater. **(5)** Form field-supplied "U" channels over side connections to seal. Drill and lock with sheetmetal screws.

6.0 Mechanical (cont'd)

6.7 Unit Discharge (cont'd)

6.7.3 Discharge Air Sensor for Makeup Air Application

FIGURE 32A
Discharge Air Sensor Holder - P/N 115850
(used in Makeup Air Installations)



Secure sensor in clip. Position holder so that it shields sensor from direct airflow.

FIGURE 32B
Discharge Air Sensor - for P/N's see chart on page 6
(used in Electronic Modulation Options AG8, AG9 & AG9H)



(P/N 48041 shown)

TABLE 23 - Digital Control Signal Wire Gauge and Length

Instructions for Installing Discharge Air Sensor <u>in</u> the <u>Ductwork</u>

6.7.2 Discharge Duct (cont'd)

- **Discharge Air Horizontal Connection** (See **FIGURE 31**.) - The seal between the heater and the duct must be mechanical. Duct connection should be made with "U" type flanges on the top and bottom of the connecting duct. Slide the duct over the flanges of the heater giving an airtight fit. Provide "U" type channels for the side flanges to ensure tight joints. Fasten "U" channels with sheetmetal screws.

All gas or electric control options for makeup air (except AG40) include a discharge air sensor that requires field installation in the discharge duct. (Sensor is field-supplied with Option AG 40.)

Options AG3, AG15, AG16, AG58, AG60, AG61 and AG62 are analog controls. Options AG3 and AG60 have a unit mounted ductstat with a capillary sensor that will fit in the holder in **FIGURE 32A**. Options AG8, AG9, AG9H require field installation of the sensor in the discharge duckwork that include a sensor & mixing tube as shown in **FIGURE 32B**. Options AG16, AG58, AG60, AG61 and AG62 include sensors that require duct mounting using the holder in **FIGURE 32A** and field wiring. Follow the instructions below to attach the holder and the sensor.

Sensors in Options DG5, DG6, D12B, D12C, D12D, D12E, D12F, and D12G are digital and require duct mounting using the holder in **FIGURE 32A** and field wiring. Digital control inputs are low-current, resistance-based signals. For optimum temperature control performance, the analog and digital inputs (zone sensors, discharge air sensors, etc.) that are connected to the main digital controller should be routed to the unit in one of the following manners:

- In separate conduits, isolated from 24 VAC controls and line voltage power to the unit, ***<u>OR</u>***
- If the main controller sensor wires are to be run in the same conduit as the 24 VAC control wiring, the sensor wiring must be completed using shielded cable and bundled separately from the 24 VAC control wiring. The shield must be drained at the unit and taped on the opposite end.

See **TABLE 23** for wire gauge and length requirements of digital control signal wiring.

(**NOTE:** Sensor wire supplied with the FX05 digital controller is 22AWG. There is no sensor wire supplied with the FX06 controller; it must be field supplied.)

	Wire Gauge	Maximum Sensor Wire Length (Digital Control)	
Maximum Sensor Wire Length for less than 1°F Signal Error	AWG	Feet	Meters
	14	800	244
	16	500	152
	18	310	94
	20	200	61
	22	124	38

1. Installation requires the discharge air sensor holder including the box cover.
2. Determine a location in the ductwork to install the sensor. If installing Options AG3 or AG60 with a capillary sensor, determine the location based on the length of the capillary tubing.

   If installing wiring to the sensor, select a location a sufficient distance from the outlet to provide a good mixture of discharge air temperature. According to the latest edition of AMCA Standard 201, in straight ducts, the air is typically well mixed a minimum of five equivalent duct diameters from the discharge of the unit with equivalent duct diameter defined as equal to the square root of 4AB/3.14. "A" and "B" are the duct cross-sectional dimensions.

   <u>Example</u>: **Supply ductwork cross-sectional dimension is 24" x 12" (610mm x 305mm).**

   $5 \times \sqrt{\frac{4 \times 12 \times 24}{3.14}} = 96"$ $\quad 5 \times \sqrt{\frac{4 \times 305 \times 610}{3.14}} = 2435mm$

   Solution: Locate the sensor a minimum of 96" (2435mm) from the outlet of the unit.

   NOTE: If the length of the discharge duct is less than 8 ft (2.4M), a mixing vane is recommended for mixing the discharge air.

TABLE 24 - Sensor Data for Johnson A99 Series Temperature Sensors used in digital controls - Resistance VS Temperature

°F	°C	Ohms
-40	-40	613
-31	-35	640
-22	-30	668
-13	-25	697
-4	-20	727
5	-15	758
14	-10	789
23	-5	822
32	-0	855
41	5	889
50	10	924
59	15	960
68	20	997
77	25	1035
86	30	1074
59	35	1113
104	40	1153
113	45	1195
122	50	1237
131	50	1279
140	60	1323
149	65	1368
158	70	1413
167	75	1459
176	80	1506
185	85	1554
194	90	1602
203	95	1652
212	100	1702
221	105	1753
230	110	1804
239	115	1856
248	120	1908

Do not mount the sensor in the ductwork after a split in the supply as that will cause loss of control in the duct that does not house the sensor.

3. The position of the sensor holder is important. The holder will extend 9-3/16" (233mm) into the ductwork.

   In horizontal ductwork, locate the sensor assembly in the top, middle of the duct with the sensor probe extending vertically down into the center of the airstream.

   In vertical ductwork, locate the sensor assembly in the middle of the side of the duct that corresponds with the top middle of the discharge outlet.

   Turn the holder so that the element will be shielded from direct airflow and will sense the air temperature as it flows through the holes in the holder.

   At the selected location in the ductwork, mark the diamond-shaped hole required for the sensor holder. Cut the hole no larger than required, approximately 1" x 1" (25mm x 25mm).

4. The procedure for installing the sensor and attaching the holder depends on whether the sensor is a capillary or an electrical sensor. Follow the instructions that apply.

   Capillary Sensor (Options AG3 and AG60) - Locate the sensor capillary and run it out through the hole in the discharge panel of the heater. Determine where the sensor capillary should enter the box and remove the knockout. Put the capillary through the hole and secure the bulb to the clip in the holder. Slide the holder into the ductwork. Using four field-supplied No. 6 sheetmetal screws, attach the box portion of the holder to the ductwork. Attach the box cover.

   Sensor with Mixing Tube (Options AG8, AG9 and AG9H) - Slide the mixing tube into the ductwork & attach the sensor. Connect wires as shown in wire diagram.

   Sensor with Wire (Options AG15, AG16, AG58, AG61, AG62, DG5, DG6, D12B, D12C, D12D, D12E, D12F, and D12G and field-supplied sensor for Option AG40) - Push the element into the clip in the holder. Determine where the sensor wire should enter the box and remove the knockout. Slide the holder into the ductwork. Using four field-supplied No. 6 sheetmetal screws, attach the box portion of the holder to the ductwork. Attach a field-supplied cable connector to the box, connect the sensor wire, and attach the box cover.

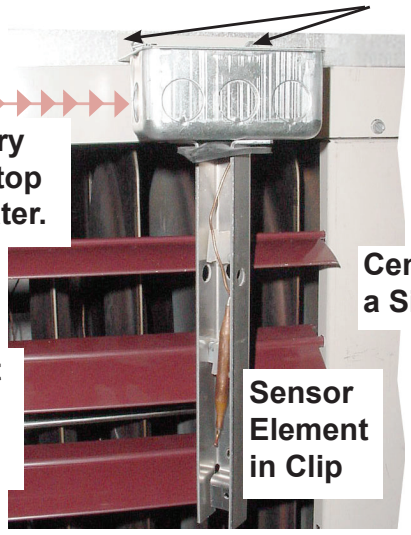
   If sensor is digital, follow the wiring instructions above.

   To test the accuracy of the sensor, measure the ohms. Refer to **TABLE 24** (left) to find the corresponding temperature.

Instructions for Installing Discharge Air Sensor Holder on the Unit - applies only to Models PDH, SDH, PXH, and SHH without ductwork

1. Installation requires the discharge air sensor holder (**FIGURE 32A**) and the bracket in **FIGURE 33**. (If attached, remove box cover; it will not be used.)

FIGURE 33 - Discharge Air Sensor Holder, P/N 115850, and Bracket, P/N 213612



2. Select a location for the box on the front near the center of the heater. Orientation of the sensor holder is important. Position the box so that the element will be sensing the air temperature as it flows through the holes in the holder.

6.0 Mechanical (cont'd)

6.7 Unit Discharge (cont'd)

6.7.3 Discharge Air Sensor for Makeup Air Application (cont'd)

3. The procedure for installing the sensor and attaching the holder depends on whether the sensor is a capillary or an electrical sensor. Follow the instructions that apply.

Capillary Sensor (Option AG2, AG3, and AG60) - Locate the sensor capillary and run it out through the hole in the discharge panel of the heater. Remove the knockout on the end of the box. Put the capillary through the hole and secure the bulb to the clip in the holder. Attach the bracket to the box. Attach the bracket to the front of the heater (**FIGURE 33**).

Sensor with Wire (Options AG15, AG16, AG58, AG61, AG62, DG5, DG6, D12B, D12C, D12F, and D12G) - Push the element into the clip in the holder. Determine where the sensor wire should go through the box and remove the knockout at that location. Attach a field-supplied cable connector to the box. Connect the sensor wire. Attach the bracket to the box. Attach the bracket to the front of the heater.

6.7.4 Optional Discharge Nozzles with Horizontal Louvers - Models PDH, SDH, & SHH

Follow the illustrated instructions shipped with the option package to install the nozzle options. Depending on which option was ordered, the nozzle will have the downturn range shown in **FIGURE 34,** with or without vertical louvers. **NOTES**: Discharge nozzle options do not apply to electric heat Model PEH or to "no heat" Model PXH. See Paragraph 6.7.5 for optional nozzles for Model PXH with hot water heat.

FIGURE 34 - Field-Installed Optional Nozzles

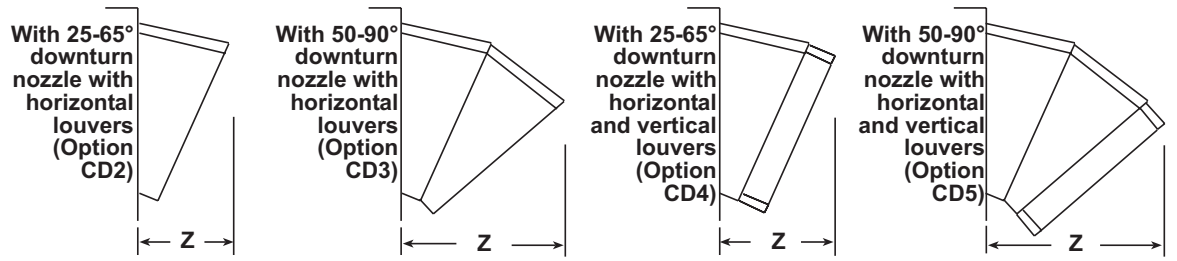


TABLE 25 - Additional Length of Optional Discharge Nozzles, Dimension Z (inches & mm)

PDH/SDH Sizes	SHH Size	PXH (no heat)	Option	CD2	CD3	CD4	CD5
75, 100, 125, 150	N/A	000A, 000B	inches	9	15-11/16	12-1/2	17-3/4
			mm	229	398	318	481
175, 200, 225, 250, 300, 350, 400A	130, 180, 260, 350	000C, 000D, 000E	inches	13-9/16	23-5/8	17-1/8	25-11/16
			mm	345	600	435	652

6.7.5 Hot Water Heat Module, Option HW2 - PXH only

Dimensions

The optional hot water heat module is factory-installed on the unit base at the discharge end of a Model PXH. The module was either ordered with a factory-installed coil or the coil is field-supplied for installation at the job site.

The cabinet height and width are the same as the PXH; see Paragraph 4.2. See **FIGURE 35A** for length and connection dimensions. Add the length of the module to the PXH length in Paragraph 4.2.

FIGURE 35A - Dimensions of Hot Water Heat Module, Option HW2 - inches (mm)

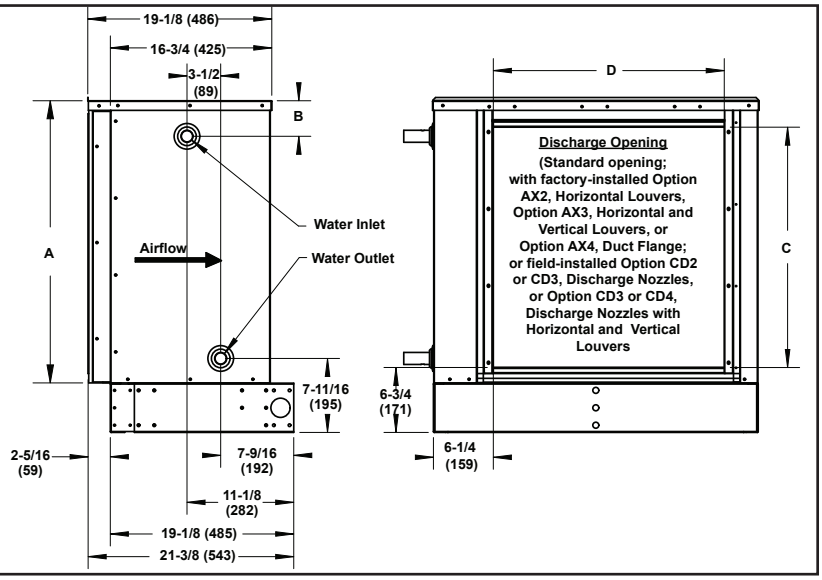


TABLE 26A - Dimensions

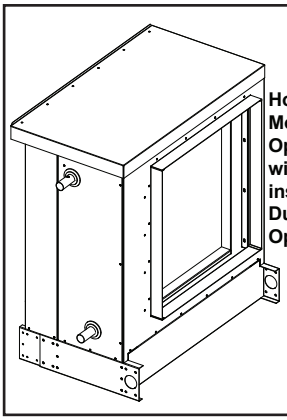
PXH with HW2		A	B	C	D
000A	inches	29-3/8	3-3/4	25	24
	mm	746	95	635	610
000B	inches	29-3/8	3-3/4	25	34
	mm	746	95	635	864
000C	inches	35-9/16	2-15/16	35	24
	mm	903	75	889	610
000D	inches	35-9/16	2-15/16	35	40-1/4
	mm	903	75	889	1022
000E	inches	35-9/16	2-15/16	35	48-1/4
	mm	903	75	889	1226

Hot Water Module Discharge Options

Depending on how it was ordered, the hot water module can have a standard opening without duct flange for adding field-installed optional 30° or 60° discharge nozzle with or without vertical louvers (Options CD2, CD3, CD4, or CD5). Or, the hot water module discharge could have a factory-installed duct flange (Option AX4), horizontal louvers (Option AX2), or horizontal and vertical louvers (Option AX3).

Outlet Duct Flange, Option AX4 - Optional duct flange is factory-installed. See dimensions in **FIGURE 35B**. See duct connection requirements in Paragraph 6.7.2.

FIGURE 35B - Option AX4, Discharge Duct Flange on Model PXH <u>with</u> Optional Hot Water Heat Module (Option HW2)



Hot Water Module, Option HW2, with factory-installed Duct Flange, Option AX4

TABLE 26B - Dimensions of Discharge Duct Flange on Model PXH <u>with</u> an Optional Hot Water Heat Module

PXH with Option HW2		H	W
000A	inches	23-3/4	23-15/16
	mm	603	608
000B	inches	23-3/4	33-15/16
	mm	603	862
000C	inches	33-3/4	23-15/16
	mm	857	608
000D	inches	33-3/4	39-15/16
	mm	857	1014
000E	inches	33-3/4	47-15/16
	mm	857	1218

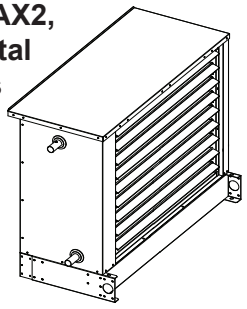
Horizontal or Horizontal and Vertical Louvers, Options AX2 and AX3 - Factory-installed horizontal louvers (Option AX2) are spring mounted in the discharge opening and do not have a frame. If there are factory-installed horizontal and vertical louvers (Option AX3), the frame adds approximately 4" (102mm) to the length of the hot water module.

Adjust louvers for desired discharge airflow. (See **FIGURE 35C**.)

FIGURE 35C - Optional Factory-Installed Horizontal or Horizontal and Vertical Louvers on a Hot Water Heat Module

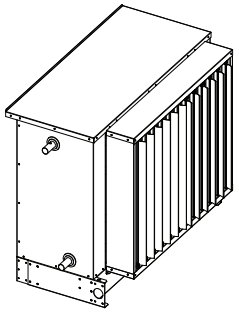
CAUTION: To avoid getting burned, wear gloves if adjusting louvers during heat operation.

Option AX2, Horizontal Louvers



Option AX3, Horizontal and Vertical Louvers

Vertical Louver frame extends 4" (102mm) beyond the cabinet.



Downturn Nozzles, Options CD2, CD3, CD4, and CD5 - Downturn nozzle options are shipped separately for field installation. See the illustrations in **FIGURES 35D and 35E** and follow the instructions shipped with the option package. **NOTE:** The downturn nozzles in **FIGURE 35D** apply to a PXH with a hot water module. For all other models, see **FIGURE 34** on page 40.

FIGURE 35D - Option CD2, 25-65° Nozzle with Louvers and Option CD4, 25-65° Nozzle with Horizontal and Vertical Louvers on a Model PXH <u>with</u> a hot water module

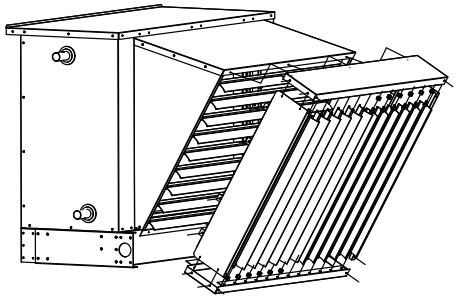
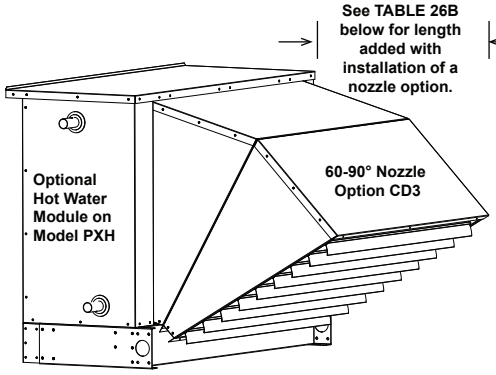


FIGURE 35E - Option CD3, 60-90° Nozzle has Two Nozzle Sections.



If Option CD5 was ordered, package will have CD3 nozzle plus vertical louvers as shown in FIGURE 35D.

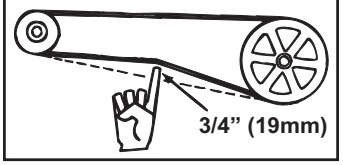
TABLE 26B - <u>Approximate length added to the Hot Water Module Discharge</u>

Nozzle Option		CD2	CD3	CD4	CD5
PXH 000A or 000B with Hot Water Heat Module (Option HW2)	inches	9	15-11/16	12-1/2	17-3/4
	mm	229	398	318	481
PXH 000C, 000D, & 000E with Hot Water Heat Module (Option HW2)	inches	13-9/16	23-5/8	17-1/8	25-11/16
	mm	345	600	435	652

6.0 Mechanical (cont'd)

6.8 Blowers, Belts, and Drives

FIGURE 36 - Check Belt Tension



6.8.1 Belts and Belt Tension

Check belt tension. Proper belt tension is important to the long life of the belt and motor. A loose belt will cause wear and slippage. Too much tension will cause excessive motor and blower bearing wear. Adjust the belt tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (19mm). (See **FIGURE 36**.) After correct tension is achieved, re-tighten the locknut on the adjustment screw. Be sure that the belt is aligned in pulleys.

Linked Belts - If the belt needs tightening, the recommended method of tightening the belt length is to count the number of links and remove one link for every 24. (A link is made up of two joining sections of belt. For easier removal of links, turn the belt inside out. But be sure to turn it back before installing. If belt is removed or replaced, be sure to align directional arrows on the belt to the proper drive rotation.) After the first 24 hours of running at full load and at regular maintenance inspections, check the tension of the belt. Be sure that the belt is aligned in the pulleys.

Solid Belts - Adjust the belt tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (19mm). (See **FIGURE 36**.) After correct tension is achieved, re-tighten the locknut on the adjustment screw. Be sure that the belt is aligned in the pulleys.

6.8.2 Adjusting Blower Speed

The blower speed may be adjusted to achieve the desired outlet temperature, as long as the adjustment is within the temperature rise and the static pressure limits shown on the furnace rating plate. Motors are factory set between maximum and minimum blower speeds.

If the duct resistance is low, the blower may deliver too high an air volume. If the resistance is very low, the blower may deliver excess air to overload the motor, causing the overload protector to cycle the motor. Reducing the blower speed will correct these conditions. If ductwork is added to an installation, it may be necessary to increase the blower speed. Decreasing blower speed will increase outlet temperature; increasing blower speed will decrease outlet temperature.

At final adjustment, amperes should not exceed motor nameplate amp rating. The installation must be adjusted to obtain a temperature rise within the range specified on the furnace rating plate.

The belt drive on these units is equipped with an adjustable pulley which permits adjustment of the blower speed. Follow these instructions to adjust the blower speed.

1. Turn off the gas (SDH/PDH/SHH) and the electric power (all models).
2. Loosen belt tension and remove the belt.
3. Loosen the set screw on the side of the pulley away from the motor.
4. **To increase the blower speed, decreasing outlet temperature**, turn the adjustable half of the pulley inward. **To decrease the blower speed, increasing the outlet temperature**, turn the adjustable half of the pulley outward. One turn of the pulley will change the speed 8-10%.
5. Tighten the set screw on the flat portion of the pulley shaft.
6. Replace the belt and adjust the belt tension. Adjust tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4". (See **FIGURE 36**.) Re-tighten the lock nut on the adjusting screw. Be sure that the belts are aligned in the pulley grooves properly and are not angled from pulley to pulley.
7. Turn on the power (PDH/SDH/PEH/SHH) and the gas (PDH/SDH/SHH). Set the control to call for heat.
8. Check the motor amps with an ammeter. The maximum motor amp rating on the motor nameplate must not be exceeded.

When service is complete, check for proper operation.

6.8.3 Blower Rotation

Rotation may be changed on single-phase motors by re-wiring in the motor terminal box. Three-phase motors may be reversed by interchanging two wires on the 3-phase supply connections.

6.8.4 Optional Variable Frequency Drive (VFD)

If ordered with a VFD, it may be either factory or field installed. If field-installed, follow the manufacturer's instructions and refer to the wiring diagram on the unit. Minimum ambient temperature for a VFD is 18°F. Maximum distance from the unit is 50 feet.

When an optional VFD is ordered, the motor operates on two speeds as determined by the electrical frequency. High speed is used for cooling and low speed for heating.

60 hertz is the maximum high speed. Maximum speed for low speed heating is the frequency that will provide the maximum temperature rise of the heater.

Maximum allowable temperature rise for a Model SDH or PDH is 70°F with an aluminized heat exchanger or 100°F with a stainless steel heat exchanger. (**NOTE**: If equipped with modulating gas control Option AG40, AG58, DG2, DG6, D12B, or D12G and a stainless steel heat exchanger, maximum temperature rise of is 120°F.)

Maximum temperature rise for Model SHH is 100°F (Model SHH built prior to 4/13 has a temperature rise of 70°F.).

Follow the VFD controller manufacturer's instructions that are packaged with the heater (in the owner's envelope) to program the VFD settings. The formula for motor speed is N=120xf/p where N is speed; f is frequency; and p is number of poles (3600 RPM motor has 2 poles; an 1800 RPM motor has 4 poles).

Example: 1800 RPM motor on 60Hz; N = 120 x 60/4 = 1800
1800 is synchronous speed; assume 2% slip. Motor will run between 1750 and 1790 RPM at full load depending on design.
Run the same motor at 45Hz (120 x 45/4 = 1350). 1350 RPM less 2% slip equals about 1300 RPM.

7.0 Electrical Supply and Wiring

7.1 General

All electrical wiring and connections including electrical grounding MUST be completed in accordance with local, state and national codes and regulations and with the National Electric Code (ANSI/NFPA 70) or in Canada the Canadian Electrical Code Part 1 C.S.A. C.22.1.

7.2 Supply Wiring

NOTE: If the system has an optional convenience outlet or UVC light, both of those options require a separate 115 volt power supply.

Check the rating plate on the heater for the supply voltage and the current requirements. A separate line voltage supply with fused disconnect switch should be run directly from the main electrical panel to the unit, making connections in the electrical compartment. Supply wiring enters the cabinet on the control side below the electrical compartment door (PDH/SDH/SHH/PXH), on the control post (PEH), or in line directly below through the base (PDH/SDH/PEH/SHH/PXH). Before turning on the power, check and tighten all electrical terminals. **Seal all electrical entrance openings with field-supplied bushings.**

TABLE 28A - Supply Wiring Size - Models PDH, SDH, PXH, and SHH

Field-Supplied THHN, THWN or THWN-2 Wiring and Conduit Minimum Size - PDH, SDH, PXH, SHH							
Voltage/Phase	115/1		208-230/1	208-230/3		460/3	575/3
Motor HP's	1/4 - 1/2	1	1 - 1-1/2	1/4 - 3	5	1/4 - 5	1/2 - 5
Wire Gauge	14	12	14	14	12	14	14
BX Cable	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"

TABLE 28B - Supply Wiring Size - Model PEH

Field-Supplied THHN, THWN or THWN-2 Wiring and Conduit Minimum Size for Model PEH								
Voltage/Phase	208/1				230/1			
KW	10	15	20	30	10	15	20	30
Ampacity	74	96	119	164	78	104	130	182
75°C Wire Gauge	#4	#3	#1	#2/0	#4	#2	#1	#3/0
Conduit Trade Size	1	1	1-1/4	1-1/2	1	1	1-1/4	2
Voltage/Phase	208/3							
KW	20	30	40	60	80	90	120	
Ampacity	66	92	118	142	184	205	267	
75°C Wire Gauge	#4	#3	#1	#1/0	#3/0	#4/0	300kcmil	
Conduit Trade Size	1	1-1/4	1-1/2	1-1/2	2	2	2-1/2	
Voltage/Phase	230/3							
KW	20	30	40	60	80	90	120	
Ampacity	74	104	134	161	209	233	305	
75°C Wire Gauge	#4	#2	#1/0	#2/0	#4/0	250kcmil	350kcmil	
Conduit Trade Size	1	1-1/4	1-1/2	2	2	2-1/2	3	
Voltage/Phase	460/3							
KW	20	30	40	60	80	90	120	
Ampacity	37	52	67	81	105	117	153	
75°C Wire Gauge	#8	#6	#4	#4	#2	#1	#2/0	
Conduit Trade Size	3/4	3/4	1	1	1-1/4	1-1/2	2	
Voltage/Phase	575/3							
KW	20	30	40	60	80	90	120	
Ampacity	31	44	56	67	88	98	128	
75°C Wire Gauge	#10	#8	#6	#4	#3	#3	#1	
Conduit Trade Size	1/2	3/4	3/4	1	1-1/4	1-1/4	1-1/2	

7.0 Electrical Supply and Wiring (cont'd)

7.2 Supply Wiring (cont'd)

NOTE: These requirements and procedures would also apply to compressors on the condensing unit.

The electric supply to the unit must meet stringent requirements for the system to operate properly. Voltage supply should be within ±10% or as stated on the rating plate. Maximum imbalance on a 3-phase system is 2%. Follow instructions below to check.

CAUTION: If this unit is allowed to operate on an electric supply that is not within the specified tolerances, the product warranty shall be void. See Hazard Levels, page 2.

If the power supply is not within these tolerances, contact the power company prior to operating the system.

Check Voltage Supply - See voltage use range on the rating plate. Measure (and record) each supply leg voltage at all line disconnect switches. Readings must fall within the allowable range.

Check Voltage Imbalance (applies to units with optional reheat compressor) - In a 3-phase system, excessive voltage imbalance between phases will cause compressor motor to overheat and eventually fail. Maximum allowable imbalance is 2%. To determine voltage imbalance, use recorded voltage measurements taken above in the following formula.

Key:	V1, V2, V3 = line voltages as measured VA (average) = $\frac{(V1 + V2 + V3)}{3}$ VD = line voltage (V1, V2, or V3) that deviates farthest from average (VA)
Formula:	% Line Voltage Imbalance = $\frac{[100 \times (VA - VD)]}{VA}$

Reheat Compressor Wiring (applies to units with optional reheat compressor) - A 3-phase scroll compressor must be phased correctly or compressor will operate in reverse. **Since there is a chance of unknowingly connecting the power in such a way as to cause compressor rotation in reverse, it is important to check this on startup.**

CAUTION Be sure to connect pressure gauges to the suction and discharge lines before startup so that compressor rotation can be checked immediately. Scroll compressors will be destroyed if operated in the wrong direction. See Hazard Levels, page 2.

Before initial startup, connect refrigerant pressure gauges to the compressor suction and discharge lines. At startup, observe the gauges. **If the suction pressure rises and discharge pressure drops, the compressor is operating in reverse and should be shut down. (**After several minutes of operation in reverse, the compressor's internal protector will trip. If a compressor is repeatedly allowed to restart and run in reverse, the compressor will be permanently damaged.) **Turn off the power and switch the 3-phase line voltage wiring connections before restarting the unit.**

Blower Motor Wiring - Check rotation of the blower. If rotation is not correct, three-phase motor may be reversed by interchanging two wires on the 3-phase supply connection.

7.2.2 Supply Wiring Options

Disconnect Switch - A disconnect switch is available as optional equipment or may be supplied locally. When installing the disconnect switch, be careful that the conduit and switch housing are clear of all service doors. Allow at least four feet (1.2M) of service room between the disconnect switch and any service panels. When providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size 1.25 times the maximum total input amps.

DANGER

To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open. See Hazard Levels, page 2.

WARNING - applies to Models PDH, SDH, and SHH:
If you turn off the power supply, turn off the gas.

Optional On/Off Switch, Option BA6 - The unit my be equipped with a cabinet-mounted non-fusible, lockable, service on/off switch. The switch is conveniently located on the control side of the unit.

Optional Phase Loss or Low/High Voltage Protection, Opt BF15 or BF14 - A 3-phase system may be equipped with an optional phase loss protection device. Option BF15 is an auto-reset control that shuts down the unit on phase loss or phase reversal. Option BF14 performs the same function but will also shut down the unit on high or low voltage condition.

7.3 Wiring Diagram and Unit Wiring Requirements

Each unit has a custom wiring diagram in the control compartment. All optional electrical components ordered with the unit are shown on the wiring diagram. Codes for options ordered are listed across the bottom of the diagram. To identify option codes, see list in the **APPENDIX** on page 68.

Keep the wiring diagram and all manuals for future reference.

CAUTION: If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for sensor lead wires which must be 150°C. See Hazard Levels, page 2.

7.4 Control Wiring

7.4.1 Control Wiring Requirements

The heater is equipped with a low voltage (24V) control circuit. A wiring diagram is in the high voltage electrical compartment.

Control wiring connected to a thermostat, a switch, a discharge air sensor, a remote temperature selector or sensor, an amplifier, or the valve must not be run close to or inside conduit with power or ignition wires.

TABLE 29 - 24V Control Wiring Gauge and Length Requirements

24V Field Control Wiring Length/Gauge		
Total Wire Length	Distance from Unit to Control	Minimum Recommended Wire Gauge
150ft (46M)	75ft (23M)	18
250ft (76M)	125ft (38M)	16
350ft (107M)	175ft (53M)	14

TABLE 30 - Digital Control Sensor Wire

Maximum Sensor Wire Length for less than 1°F Signal Error		
Wire Gauge	Maximum Sensor Wire Length (Digital Control)	
AWG	Feet	Meters
14	800	244
16	500	152
18	310	94
20	200	61
22	124	38

Digital Control Signal Wiring Recommendations and Requirements

For optimum temperature control performance, the manufacturer recommends that the analog and digital inputs (zone sensors, discharge air sensors, etc.) connected to the main controller (used in heating/cooling control DG and D12 Options) be routed to the unit in one of the following manners:

1) In separate conduits, isolated from 24 VAC controls and line voltage power to the unit, ***OR***

2) If the digital sensor wires are to be run in the same conduit as the 24 VAC control wiring, the sensor wiring must be completed using shielded cable and bundled separately from the 24 VAC control wiring. The shield must be drained at the unit and taped on the opposite end.

See **TABLE 30** for digital control sensor wire gauge and length requirements.

7.4.2 Analog or Digital Controls

Type of control varies with option selection (identified on the unit wiring diagram). Control may be analog or digital depending on the control option selected. Option AG3, AG15, AG16, AG58, AG60, AG61, and AG62 controls are analog; Option DG1, DG2, DG5, DG6, D12B, D12C, D12D, D12E, D12F, and D12G controls are digital. Option AG40 is designed for digital control from a field-supplied source. Optional controls are identified on the wiring diagram supplied with the heater.

7.0 Electrical Supply and Wiring (cont'd)

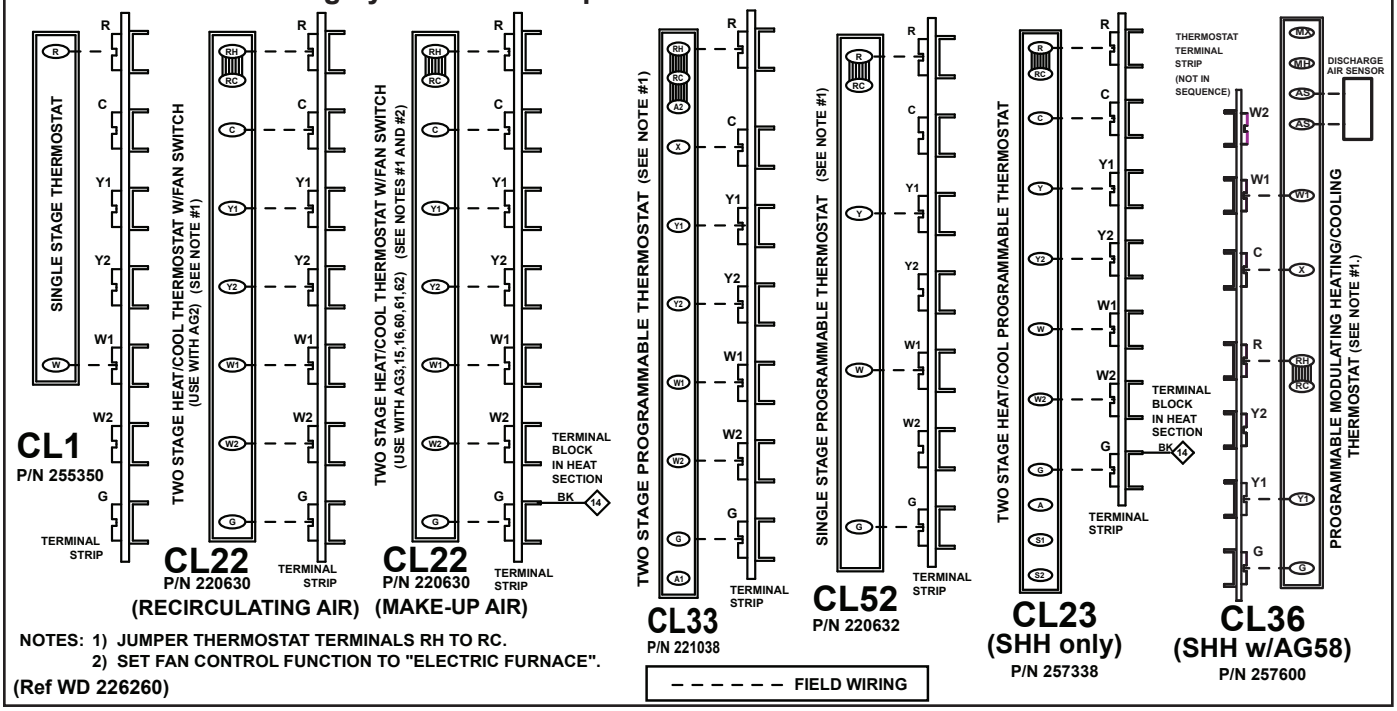
7.4 Control Wiring (cont'd)

7.4.2 Analog or Digital Controls (cont'd)

Analog Control System Requires an Optional or Field-Supplied Thermostat

If using an analog control system, use either an optional or a field-provided low-voltage (24V) thermostat. (A thermostat is not supplied.) Install the thermostat according to the manufacturer's instructions. Depending on the control system option, select either a single-stage or two-stage thermostat.

FIGURE 37 - 24V Wiring by Thermostat Option Code



Digital Control Systems have a Programmable Unit-Mounted Control and a Room Command Module

If using a digital control system, the unit is factory equipped with a programmable controller.

Digital control Options DG1, DG2, DG5, and DG6 also include a room command module. The type of room command module depends on whether the control system has a discharge or a room temperature controlled setpoint. A room command module with an adjustable room temperature setpoint (45°F - 95°F) included with Option DG1 and DG2 control systems is illustrated in **FIGURE 38**. A room command module with a discharge air setpoint included with Option DG5 and DG6 control systems is in **FIGURE 39**. The discharge air setpoint can be adjusted ±6°. Discharge temperature controls may also have an optional room-mounted override sensor.

IMPORTANT: The digital controller inputs are low-current, resistance-based signals. See special wiring recommendations above for digital sensor wiring.

Digital control Options D12B, D12C, D12D, D12E, D12F, and D12G do not include a room command module. The space temperature sensor module with adjustable setpoint control and room override illustrated in **FIGURE 40** is available as an option.

FIGURE 38 - Room Command Module, P/N 211423, Sensing Space Temperature for Digital Controls, Option DG1 and DG2

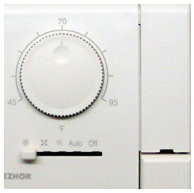


FIGURE 39 - Room Command Module, P/N 211424, Sensing Discharge Temperature for Digital Controls, Option DG5 and DG6



FIGURE 40 - Room Command Module, Option CL67, P/N 260599, Sensing Discharge Temperature for Digital Controls, Options D12B, D12C, D12D, D12E, D12F, D12G



If ordered with an optional expansion card, a digital control system will provide weekday and weekend scheduling of start/stop operation or interface to a field-supplied Johnson N2 or Lonmark building automation system.

7.5 Electrical Operating Components

7.5.1 High Temperature Limit Control - PDH, SDH, SHH

Units are equipped with a temperature activated auto reset capillary-type limit control. The control is factory set and is non-adjustable. If the setpoint is reached, the limit control will interrupt the electric supply to the gas valve. This safety device provides protection in the case of motor failure or lack of airflow due to a restriction at the inlet or outlet.

CAUTION: The auto reset limit control will continue to shut down the heater until the cause is corrected. Never bypass the limit control; hazardous conditions could result. See Hazard Intensity Levels, page 2.

7.5.2 Reverse Airflow Limit Control - PDH, SDH, and SHH

Units are equipped with a temperature activated auto reset reverse airflow limit control. The control is factory set and is non-adjustable. If the setpoint is reached, the limit control will interrupt the electric supply to the gas valve. This safety device provides protection in the case of motor failure or lack of airflow due to a restriction at the outlet.

7.5.3 Combustion Air Pressure Switch (Air Proving Switch) - PDH, SDH, and SHH

The combustion air proving switch is a pressure switch that monitors air pressure to ensure that proper combustion airflow is available. On Model PDH, the switch is a single pole/normally open device which closes when a negative pressure is sensed in the venter housing. On separated-combustion Models SDH and SHH, the switch senses the differential pressure between the negative pressure in the venter housing and the pressure in the cabinet.

On startup when the heater is cold, the sensing pressure is at the most negative level, and as the heater and flue system warm up, the sensing pressure becomes less negative. After the system has reached equilibrium (about 20 minutes), the sensing pressure levels off.

If a restriction or excessive flue length or turns cause the sensing pressure to be outside the switch setpoint, the pressure switch will function to shutoff the main burner. The main burner will remain off until the system has cooled and/or the flue system resistance is reduced.

TABLE 31 lists the switch setpoints for sea level operating conditions by model and size. The high speed settings apply to all units. The low speed settings apply only to units with a two-speed venter (units with Gas Control Option AG8, AG9, AG9H, AG40, AG60, AG61, AG62, DG1, DG2, DG5, DG6, D12B, D12C). Models equipped with two-speed venter motor operation have two combustion air proving switches. When the venter is operated at high speed, the “high speed” combustion air proving switch monitors the combustion airflow to ensure adequate airflow for safe and efficient operation. During low speed venter operation, when fuel gas input rate is reduced, a second “low speed” combustion air proving switch monitors the combustion airflow to ensure adequate airflow for safe and efficient operation.

NOTE: Above 6000 ft (1830 M) elevation, a high altitude pressure switch may be required. See Paragraph 6.1.3.

TABLE 31 - Pressure Switch Settings

P/N’s & Settings for Model PDH

PDH Size	High Speed (applies to all gas controls)		Low Speed (applies only to units with gas controls using a 2-speed venter) *	
	Switch P/N	Setting (" w.c.)	Switch P/N	Setting (" w.c.)
75	**197030**	0.40	**205442**	0.20
100	**197030**	0.40	**205444**	0.30
125	**196388**	0.50	**205444**	0.30
150	**197028**	0.65	**205444**	0.30
175	**201158**	1.10	**197030**	0.40
200	**201158**	1.10	**197030**	0.40
225	**201158**	1.10	**197030**	0.40
250	**201158**	1.10	**197030**	0.40
300	**201158**	1.10	**197030**	0.40
350	**201158**	1.10	**197030**	0.40
400A	**201158**	1.10	**197030**	0.40

P/N’s & Settings for Model SDH

SDH Size	High Speed (applies to all gas controls)		Low Speed (applies only to units with gas controls using a 2-speed venter) *	
	Switch P/N	Setting (" w.c.)	Switch P/N	Setting (" w.c.)
75	**197030**	0.40	**205442**	0.20
100	**197030**	0.40	**205444**	0.30
125	**196388**	0.50	**205444**	0.30
150	**197028**	0.65	**205444**	0.30
175	**201158**	1.10	**197030**	0.40
200	**201158**	1.10	**197030**	0.40
225	**201158**	1.10	**197030**	0.40
250	**201158**	1.10	**197030**	0.40
300	**201158**	1.10	**197030**	0.40
350	**201158**	1.10	**197030**	0.40
400A	**201158**	1.10	**197030**	0.40

P/N’s & Settings for Model SHH

SHH Size	High Speed			
	Applies to SHH with Options AG1, AG2, AG3, AG15, AG16, & D12F		**Applies to SHH** with Option AG58 & D12G	
	Switch P/N	Setting (" w.c.)	Switch P/N	Setting (" w.c.)
130	**201161**	1.30	**201160**	1.05
180	**201161**	1.30	**201160**	1.05
260	**201159**	1.40	**201160**	1.05
350	**221228**	2.30	**221160**	1.05

* Gas Control Options AG8, AG9, AG9H, AG40, AG60, AG61, AG62, DG1, DG2, DG5, DG6, D12B, and D12C.

DANGER

Models PDH, SDH, and SHH require proper venting flow. NEVER bypass combustion air proving switch(es) or attempt to operate the unit without the venter running and the proper flow in the vent system. Hazardous conditions could result. See Hazard Levels, page 2.

7.0 Electrical Supply and Wiring (cont'd)

7.5 Electrical Operating Components (cont'd)

7.5.4 Blower Motor (PDH, SDH, PXH, SHH, PEH) and Venter Motor (PDH, SDH, SHH)

Use an ammeter to check blower motor amps. Amps may be adjusted downward by reducing blower RPM or by increasing duct system static pressure (Paragraph 6.7.2).

TABLE 32 lists full load amps of open-type blower motors by HP and voltage. This chart can be used for sizing line wiring but should not be interpreted as the exact motor amps. See the motor rating plate for exact motor specifications. Do not exceed amp rating on the motor nameplate.

Venter motor amps for a 115 volt or 575 volt unit are 1.5 amps; venter motor amps for a 208, 230, or 460 volt unit are .8 amps.

TABLE 32 - FLA of Single Speed, Open Dripproof, Blower Motor

Full Load Amps - Blower Motor (Open) (Single Speed- Average Values)									
HP	**1/4**	**1/3**	**1/2**	**3/4**	**1**	**1-1/2**	**2**	**3**	**5**
115V 1PH	4.6	6.0	8.8	11.0	13.0	15.0	24.6	N/A	N/A
208V 1PH	2.3	3.0	5.1	5.5	7.5	7.8	12.3	13.7	25.5
230V 1PH	2.3	3.0	4.4	5.4	6.5	7.5	12.3	12.4	23.0
208V 3PH	1.1	1.9	2.5	2.9	4.0	5.6	7.0	9.0	13.4
230V 3PH	1.4	1.6	3.0	2.6	3.7	5.0	6.6	8.6	13.2
460V 3PH	0.75	0.8	1.5	1.3	2.0	2.8	3.5	4.3	6.6
575V 3PH	N/A	N/A	0.9	1.0	1.4	2.0	2.6	3.6	5.4

7.5.5 Door Switch, Model SDH and SHH

All Model SDH and SHH heaters are equipped with a door switch which prevents the heater from operating when the heat section door panel is open. The door is equipped with a tubular core gasket that fully seals to provide added protection from building air entering the combustion zone of the heater.

7.5.6 Condensate Drain Pressure Switch, Model SHH

All Model SHH heaters are equipped with a condensate drain pressure switch. If the secondary heat exchanger condensate drain is blocked causing the sensing pressure to be outside the switch setpoint, the pressure switch will function to shutoff the gas valve. The burner will remain off until the problem is corrected.

7.5.7 Vent Temperature Limit Switch, Model SHH

All Model SHH heaters are equipped with a temperature activated, manually reset switch to limit the temperature of the vent gases to below 145°F. The switch is attached to the side of the combustion air venter housing. If the setpoint is reached, the switch will interrupt the electric supply to the gas valve. If the vent temperature switch is activated, identify and correct the cause before resetting the switch. Refer to the Maintenance Section in Form O-PREEVA for information on probable causes and instructions on resetting the switch.

DANGER

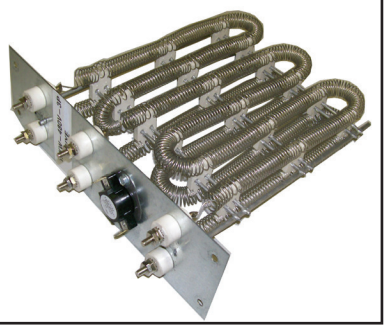
If the manual vent temperature switch activates, identify and correct the cause before resetting the switch. Never bypass the vent temperature switch; hazardous conditions could result. See Hazard Intensity Levels, page 2.

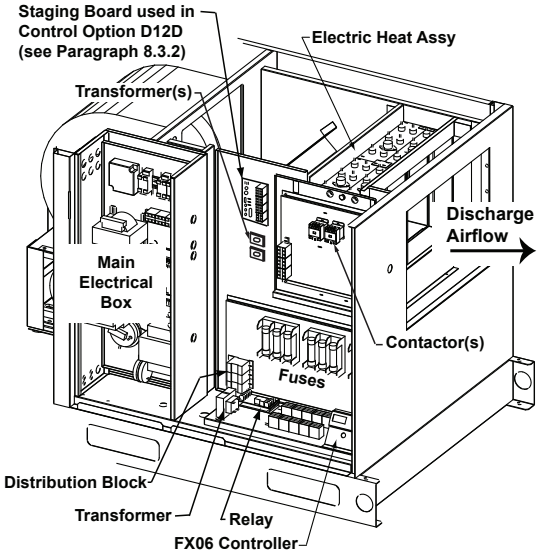
7.5.8 Electric Heating Elements - PEH

Electric heating modules in Model PEH are made up of two to six 5kw or three to twelve 10 kW heating elements depending on size and voltage of the unit. The elements are bracketed together to make up the electric heat section assembly.

FIGURE 41 - Electric Heat Section - Model PEH

Example of one of the Electric Heating Elements in the Electric Heat Assembly





The electric heat section has either heating only analog controls (Option EG1 or EG2) or digital heating/cooing controls (Option D12E or D12D). With Option EG1, operation of the heating elements is controlled by a single stage thermostat. With Option EG2, the heat section provides two-stages of heat in response to a two-stage thermostat. Digital control is either two stage (Option D12E) or modulating (Option D12D). See Paragraph 8.3.2 and the control instruction form (CP-PREEVA-D12) for control information.

7.6 Other Optional Electrical Components

Optional electrical components ordered with the unit are on the wiring diagram. For a list of wiring diagram option codes and descriptions, see **APPENDIX,** page 68.

7.6.1 Reheat Module (Option AU7L or AU7R) Compressor - Models PDH, SDH, SHH, PEH, PXH



Compressor - Reheat circuit is charged with R410A Refrigerant.

The compressor in the optional reheat module is a high efficiency hermetic scroll type that is factory charged with R410A refrigerant. The compressor has a low pressure cutoff (LPCO) switch for protection against damage due to a loss of charge. This protection prevents short cycling on the internal overload (IOL) which can pump the oil out of the compressor. The compressor also has a manual reset high pressure cutout (HPCO).

NOTE: See Operation/Maintenance Form O-PREEVA (in the Literature Bag), for additional information on compressor maintenance and R410A refrigerant.

TABLE 33 - Reheat Module Compressor

Compressor Model	ARI Tonnage	208/240 V 1 PH		208/240 V 3 PH		460 V3 PH		575 V3 PH	
		RLA	LRA	RLA	LRA	RLA	LRA	RLA	LRA
ZP29K5	2.4	14.1	77.0	9.0	71.0	5.6	38.0	3.8	36.5
ZP57K3	4.8	30.1	158.0	20.5	155.0	9.6	75.0	7.6	54.0

DANGER

The reheat circuit contains R410A high pressure refrigerant. Hazards exist that could result in personal injury or death. Installation, maintenance, and service should only be performed by an HVAC technician qualified in R410A refrigerant and using proper tools and equipment. DO NOT USE service equipment or tools designed for R22 refrigerant.

IMPORTANT: *Do not release refrigerant to the atmosphere!* If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified HVAC technician.

7.6.2 Remote Console for Controls



If the system includes an optional control console, it is shipped separately for field installation. A selection of remote consoles is available with a variety of combinations of factory-mounted controls. All consoles include burner and blower indicator lights and may include a dirty filter indicator light (see below); a cooling on indicator light; an on/off switch; a summer/winter/off control switch; a heat/vent/cool system switch; and/or a potentiometer for damper control. The thermostat or room command module may also be mounted on the console. Depending on the console selected, it may be 10-3/4” (273mm) or 15-3/4” (400mm) in length. All consoles are 7-5/8” (194mm) high and 2-5/8” (67mm) deep. Consoles may be flush or recess mounted. If recessing (not using the mount ring) subtract 7/8” (22mm) from the height and width.

Wire the 24V controls on the remote console according to the wiring diagram. Refer to **TABLE 29** on page 45 for minimum control wire gauge by length.

Dirty Filter Switch - If there is a dirty filter indicator light on the console, there is a dirty filter switch in the electrical compartment. After the unit is started, before continuous operation, the dirty filter switch must be set.

Instructions for Setting Dirty Filter Switch (See FIGURE 42.) - With clean filters in place; all doors closed (except electrical compartment); and the blower opening, increase the pressure setting by adjusting the setscrew on the switch clockwise until the

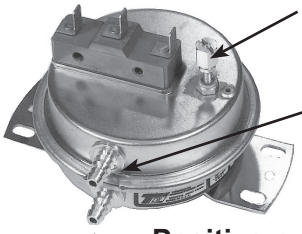
7.0 Electrical Supply and Wiring (cont'd)

7.6 Other Optional Electrical Components (cont'd)

7.6.2 Remote Console for Controls (cont'd)

filter light is energized or the screw is bottomed out. At that point, adjust the setscrew three full turns counter clockwise or until the screw is top ended. At that setpoint, the filter light will be activated at approximately 50% filter blockage.

FIGURE 42 - Dirty Filter Switch, P/N 105507 (must be set prior to continuous operation)



Set screw (on front of switch) must be manually adjusted after the system is in operation.

Negative pressure connection is toward the "front or top" of the switch (senses blower side of filters)

Positive pressure connection is toward the "back or bottom" of the switch (senses air inlet side of filters)

7.6.3 Convenience Outlet, Option BC2 - PDH, SDH, PEH, SHH, PXH

If the unit is equipped with a convenience outlet, it will have an externally accessible, weatherproof 115 volt, duplex, ground fault outlet on the control side of the cabinet. **A separate 115 volt power supply is required.**

7.6.4 Firestat, Option BD4 or BD5 - PDH, SDH, PEH, SHH, PXH



Option BD4 (factory-installed) or Option BD5 (field-installed) 200°F firestat is **P/N 42782**. Firestat Option BD4 is factory installed in the mixing box to sense the temperature of the return air. Firestat Option BD5 is shipped separately for field installation in the discharge ductwork.

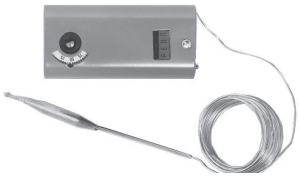
The firestat will shutdown the unit if temperature setpoint is reached. Comply with local building codes.

7.6.5 Discharge Temperature Low Limit (Freezestat), Option BE2 - PDH, SDH, SHH, PEH, PXH



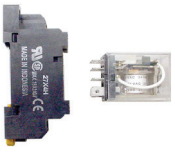
Limit control, **P/N 211480**, is factory installed to monitor the temperature of the discharge air. Setpoint of automatic reset control is adjustable. (**NOTE**: Not needed with digital controls; standard function of the digital controller.)

7.6.6 High Ambient Limit Control (burner cutoff), Option BN2 - PDH, SDH, SHH, PEH, PXH



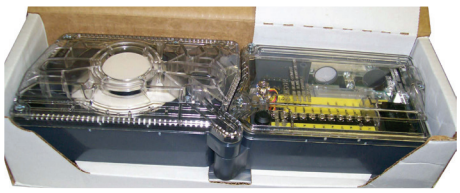
The high ambient limit control monitors the temperature of the outside air and activates to shutoff the heat if the setpoint is reached. The control has an adjustable setpoint and resets automatically. **P/N is 126170**.

7.6.7 Exhaust Fan Interlock Relay, Option BG9 - PDH, SDH, SHH, PXH, PEH



A DPDT plug-in relay is installed for coordination of unit operation with the operation of the building exhaust fan. Plug-in relay **P/N is 211411; socket P/N is 211415.**

7.6.8 Smoke Detector, Option SA1 - PDH, SDH, PEH, SHH, PXH



This photoelectric smoke detector is shipped separately to be installed in the discharge ductwork. Follow installation instructions supplied with the control and the wiring on the unit wiring diagram. Comply with local building codes.

P/N of the device is 159553.

8.0 Controls and Operation

8.1 Gas Controls - apply to Models PDH, SDH, and SHH

All gas-fired furnaces are equipped with a 24-volt combination valve which includes the automatic electric on-off valve the pressure regulator, the safety pilot valve, and the manual shutoff valve. Valve on/off function is controlled by the room thermostat or digital controller.

WARNING

The operating valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting the unit to ensure positive closure. See Hazard Levels, page 2.

8.2 Analog Controls for Heating or Heating/Makeup Air

8.2.1 Single-Stage Operation - Recirculated Heating Only (Option AG1 applies to Models PDH, SDH, and SHH; Option EG1 applies to Model PEH)

The single-stage gas valve on Model PDH, SDH, or SHH allows for single-stage control from a single-stage, 24-volt thermostat. On Model PEH, the heating elements are controlled by a single-stage, 24-volt thermostat. The thermostat is either provided as an option or field supplied. Follow the thermostat manufacturer's instructions for installation. Make wire connections according to the wiring diagram.

8.2.2 Two-Stage Operation - Recirculated Heating Only (Option AG2 applies to Models PDH, SDH, and SHH; Option EG2 applies to Model PEH)

On gas-fired Models PDH, SDH, and SHH, a two-stage combination gas control valve provides for low fire (70%) or high fire (100%) operation controlled by a two-stage thermostat. First stage (low fire) is factory set. Both high and low stages are controlled by a Servo regulator, maintaining constant gas input under wide variations in gas supply pressure. See instructions packed with the unit for specific gas valve specifications, wiring, and operating instructions.

On electric heat Model PEH, staging of heat from the heating elements is controlled by the two-stage thermostat.

A two-stage thermostat is supplied as an option or may be field supplied. Follow the manufacturer's instructions and the wiring diagram.

8.2.3 Two-Stage Operation - Makeup Air Heating Only Application (Option AG3, AG15, or AG16) - applies to Models PDH, SDH, and SHH

Two-stage makeup air units are equipped with a two-stage gas valve, but instead of control from a two-stage room thermostat, the outlet air temperature is monitored and controlled by a two-stage ductstat. When the discharge air temperature drops to the setpoint, factory-set low fire is energized. If low fire (70%) cannot satisfy the ductstat setting, high fire (100%) is energized.

A makeup air application is usually adjusted to discharge an outlet air temperature between 65°F and 75°F. In all applications, the allowable temperature rise of the furnace in the installation dictates the limits of the ductstat temperature setting.

Depending on the option selected, the factory-installed sensor is either field-connected by capillary tubing to the unit-mounted ductstat (**FIGURE 43**) or electrically connected to a remote electronic temperature selector (**FIGURE 44**). The remote temperature selector with stage adder is available with or without a display module.

FIGURE 43 - Unit-mounted Ductstat, P/N 211481, in Options AG3 and AG60

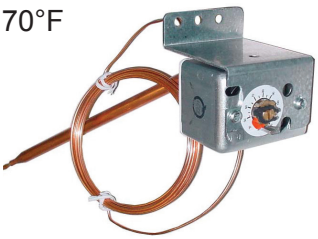


FIGURE 44 - Remote Temperature Selector, Stage-Adder Module, and Optional Display Module for Ductstat Control in Two-Stage Makeup Air Control Options (Option AG15, AG16, AG61, and AG62)



(A) Temperature Selector, P/N 115848;

(B) Stage Adder, P/N 115849;

(C) Display Module, P/N 115852

Optional Unit-Mounted Ductstat with Capillary Tubing (Option AG3) - The control illustrated in **FIGURE 43** has an adjustable range from 50° to 120°F with a fixed differential of 2-1/2°F. Due to different CFM settings and outside air temperatures, the average downstream outlet temperature may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired average outlet air temperature.

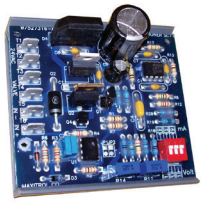
Optional Ductstat with Electronic Remote Setpoint Module (Options AG15 and AG16) - The factory-installed sensing probe must be field-wired to a remote temperature selector. The temperature selector has an operating range to 120°F. Follow the wiring

8.0 Controls and Operation (cont'd)

8.2 Analog Controls for Heating or Heating/Makeup Air (cont'd)

8.2.4 Constant Discharge Air Temperature with Maintained Thermal Efficiency - Makeup Air Heating Only Application (Options AG60, AG61, & AG62) - applies to Models PDH and SDH

FIGURE 46A - Maxitrol Signal Conditioner, P/N 134170, used in Options AG40, DG2, and DG6



8.2.5 Modulation Gas Control with Field-Supplied Digital Control (applies to Models PDH and SDH)

8.2.6 Optional Electronic Modulation

FIGURE 46B - Amplifier in Options AG8, AG9 and AG9H

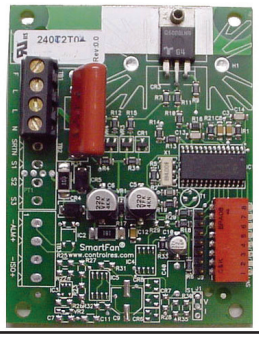


8.2.3 Two-Stage Operation - Makeup Air Heating Only Application (Option AG3, AG15, or AG16) (cont'd)

diagram with the unit and the manufacturer's instructions for wiring and installation. **CAUTION:** Be sure heat/cool selector switch is set at "Heat" position. There will be one module for selecting temperature and one-stage adder module. The optional digital display module is only in Option AG16. See **FIGURE 44**.

Two-Speed Venter System in Options AG60, AG61, and AG62 - A proprietary electronically controlled venter system provides the correct quantity of combustion air to maintain an overall average of 81% thermal efficiency through a range of gas inputs from 100 to 33 percent for natural gas and through a gas input range of 100 to 40 percent for propane gas. The venter's low speed operation is controlled by an electronic board (**FIGURE 45**) and a two-stage ductstat (either **FIGURE 43 or 44**).

FIGURE 45 - Venter Speed Control Board in Control Options AG8, AG9, AG9H, AG40, AG60, AG61, AG62, DG1, DG2, DG5, DG6, D12B, D12C



The proprietary electronically controlled venter system always operates at high speed during pre-purge and post-purge periods. Speed selection occurs after there is a call for burner ignition.

Optional Unit-Mounted Ductstat with Capillary Tubing (Option AG60) - Uses the unit-mounted control illustrated in **FIGURE 43** with an adjustable range from 0° to 120°F. Due to different CFM settings and outside air temperatures, the average downstream outlet temperature will be constant but may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired outlet air temperature.

Optional Ductstat with Electronic Remote Setpoint Module (Options AG61 and AG62) - The factory-installed sensing probe must be field-wired to the 0-120°F remote temperature selector illustrated in **FIGURE 44**.

The remote modules are shipped separately for field installation. Follow the wiring diagram with the unit and the manufacturer's instructions for wiring and installation. **CAUTION:** Be sure heat/cool selector switch is set at "Heat" position. There will be one module for selecting temperature and one-stage adder module.

The optional digital display module is used only in Option AG62. See **FIGURE 44**.

Optional Modulation Gas Control with Field-Supplied Controller (Option AG40) - With this control, the modulation gas heating system is identical to digital Options DG2 and DG6 on page 53. The programmable digital controller is not supplied. The unit is equipped with a Maxitrol signal conditioner (**FIGURE 46A**) that accepts an input signal of either 4-20 milliamps or 0-10 volts from a field-supplied controller and converts it to the 0-20 volt DC current required to control the modulating valve. Temperature selection or building management is controlled by customer-supplied software.

Electronic Modulation between 50% and 100% Firing Rate (Options AG8, AG9 & AG9H) Depending on the heat requirements as established by the thermistor sensor, the burner modulates between 100% and 50% firing. The thermistor is a resistor that is temperature sensitive in that as the surrounding temperature changes, the Ohms resistance changes through the thermistor. This change is monitored by the solid state control center (amplifier) which furnishes varying DC current to the modulating valve to adjust the gas input.

Each modulating valve is basically a regulator with electrical means of raising and lowering the discharge pressure. When no DC current is fed to this device, it functions as a gas pressure regulator, supplying 3.5" w.c. pressure to the main operating valve.

Refer to the wiring diagram supplied with the furnace for proper wiring connections. Electronic modulation control systems for makeup air applications controlled by a field-installed duct sensor (See Paragraph 6.7.3) and temperature selector (55-90°F) are identified as either Option AG8 or Option AG9 & AG9H. The temperature selector setting for Option AG8 is on the amplifier; Option AG9 & AG9H has a remote temperature selector. Both systems are available with an override thermostat.

8.3 Digital Controls for Heating/ Cooling, Makeup Air and Dehumidification

8.3.1 Optional Digital Heating/Cooling/Makeup Air Controls, Options DG1, DG2, DG5, DG6 - PDH and SDH; PXH

Application NOTES: Options DG 1, 2, 5, and 6 do not apply to units with reheat pump (dehumidification) Option AU7L or AU7R. Models SDH, PDH, and PXH with Option AU7 require D12B or D12C; see Paragraph 8.3.2. Options DG 1, 2, 5, and 6 do not apply to Model PEH or Model SHH; Model PXH is not a heating unit.

Digital control systems (Options DG1, DG2, DG5, and DG6) have a unit-mounted, factory-wired, 24 volt, DDC programmable controller (**FIGURE 47**); a venter speed control board (**FIGURE 45**); and a room command module (either **FIGURE 48A or 48B**). Options DG2 and DG6 with modulating gas heat have a Maxitrol conditioner (**FIGURE 46A)**.

The four DG control sequences include a wall-mounted Fan/Heat/Cool/Auto Switch.

Option DG1 - Room control with 2-stage gas heating and 3-stage cooling control. The wall mount interface allows the user to adjust the space setpoint from 45°F to 95°F and select the unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

Option DG2 - Room control with 4:1 modulated gas heat and 3-stage cooling control. The wall mount interface allows the user to adjust the space setpoint from 45°F to 95°F and select the unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

Option DG5 - Room control with 2-stage gas heating and 3-stage cooling control. The wall mount interface allows the user to adjust the discharge air temperature ± 6°F from the factory-mounted controller setpoint and select unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

Option DG6 - Room control with 4:1 modulated gas heat and 3-stage cooling control. The wall mount interface allows the user to adjust the discharge air temperature ± 6°F from the factory-mounted controller setpoint and select unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

FIGURE 47 - Programmable Digital Controller, Johnson Controls FX05 used in all DG Options



Reference: For explanation on the settings and functions of the FX05 programmable control, see the instruction form in the Literature Bag (Form CP-PREEVA-DG with FX05).

The heating and cooling equipment will cycle to maintain the active heating discharge or space temperature setpoint, based upon the unit mode and time of day schedule.

Unit Control Points - DG1, DG2, DG5, DG6	
Analog Inputs	**Digital Inputs**
1) Space Temperature/Discharge Air Temperature	1) Dirty Filter
2) Space Temperature Setpoint (45-90°F) or (± 6°F Warmer/Cooler)	2) Temporarily Unoccupied Override
3) Outdoor Air Temperature	3) Occupied/Unoccupied
4) Mode Slider - Heat, Cool, Auto, Fan, Off	4) Air Proving/Phase Loss
	5) Boost Mode
Digital Outputs	**Analog Outputs**
1) Fan	1) Modulating Gas Valve
2) Heat Stage 1	
3) Heat Stage 2	
4) Cool Stage 1	
5) Cool Stage 2	
6) Cool Stage 3	

Two-Speed Venter System in Options DG1, DG2, DG5, DG6 (also applies to modulation Option AG40 with field-supplied control)

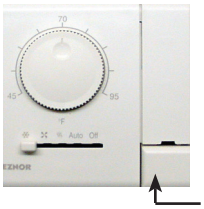
A proprietary electronically controlled venter system provides the correct quantity of combustion air to maintain an overall average of 81% thermal efficiency through a range of gas inputs from 100 to 25 percent for natural gas and through a gas input range of 100 to 40 percent for propane gas. The venter's low speed operation is controlled by an electronic board (**FIGURE 45**) and a gas pressure switch that senses outlet gas pressure. The venter is operated at a reduced voltage when the outlet gas pressure is below 1.7 inches w.c. for natural gas units and for propane units when the outlet gas pressure is below 5.0 inches w.c.

8.0 Controls and Operation (cont'd)

8.3 Digital Controls for Heating/ Cooling, Makeup Air and Dehumidification (cont'd)

8.3.1 Optional Digital Heating/Cooling/ Makeup Air Controls, Options DG1, DG2, DG5, DG6 - PDH and SDH; PXH (cont'd)

FIGURE 48A - Room Command Module, P/N 211423, in Option DG1 and Option DG2



Provides on-off and heat/vent/cool mode selection; room temperature selection; and has a push button for unoccupied override.

FIGURE 48B - Room Command Module, P/N 211424, in Option DG5 and Option DG6



Provides on-off and heat/vent/cool mode selection; adjusts discharge air temperature ±6°; and has a push button for unoccupied override.

The proprietary electronically controlled venter system always operates at high speed during prepurge, postpurge, and the ignition periods. Speed selection occurs after flame is proven.

Sequence of Operation

Options DG1 and DG2 are space temperature control. Options DG5 and DG6 are discharge air temperature control. With all four options, a wall-mounted sensor and setpoint dial controls the functionality. With discharge air temperature control (DG5 and DG6), the wall sensor is disabled and a discharge sensor is used to control the temperature. The wall unit shown in **FIGURE 48A** is used with Options DG1 and DG2; it has a 45°F to 95°F adjustment dial to set the desired space temperature. The wall unit shown in **FIGURE 48B** is used with Options DG5 and DG6; it has a ±6°F warmer/ cooler adjustment dial for the discharge air temperature setpoint. Both wall units have a mode slider and an unoccupied mode override button. The slider selects the functionality of the unit: Cool Only, Heat Only, Fan Only, Auto Mode, Off.

The dial value will be the working heating or cooling setpoint depending on the mode. In the **auto mode,** the dial is the midpoint value between the cooling and heating setpoint. Example: (variable DB = 2°F default) If the dial is set to 72°F, the cooling and heating setpoints for unit operation are 70°F and 74°F respectively.

Mode Slider Functions

Cool Only - The unit will allow only the cooling to function. There is an adjustable parameter "OC" outdoor ambient temperature lockout setting below which mechanical cooling will not be allowed to operate.

Heat Only - The unit will allow only the heating to function. There is an adjustable parameter "OH" outdoor ambient temperature setting above which heating will not be allowed to operate.

Fan Only - The unit will allow only the fan to run. The fan will run only in occupied mode if the external contact is closed (Binary input #3). If the contact is open, the fan will not run.

Auto Only - The unit will be allowed to provide heating and cooling, providing the outdoor ambient conditions are met. The heating setpoint and cooling setpoint are controlled by "HSP" and "CSP" settings and the setpoint dial (warmer/cooler adjust or the Setpoint dial setting), and the value of DB.

Off - The unit will shut down all functionality – neither heating, cooling nor fan will be allowed to operate.

NOTE: Hold the Enter key on the controller for 15 seconds to access the variable screens. (SUO should appear.) Use the down arrow to go to SSI. Press the enter button. If the value is ON, the sensor with the setpoint overlay is active. If the value is OFF, the sensor with the warmer/cooler adjust should be used. Use the up/down arrows to toggle between ON/OFF and press the enter button to save. This setting can also be changed in CommPro (nciWallStatSelect). See the control instruction manual for more information.

Fan Operation

When the slide in not in the OFF position and the unit is in the Occupied Mode based upon the input, the fan will run continuously. In the Unoccupied Mode, the fan will only run on a call for heating or cooling. The fan will be off if the slide is in the OFF mode. Upon a call for the fan to run, if the air proving switch does not make after 180 seconds, the unit shuts down. Turn the unit FX-05 controller OFF then ON, or press the UP and Down arrows simultaneously for 5 seconds, to reset the alarm condition. When the unit is locked out, heating and cooling functions will be disabled. Control will display a flashing "AP".

If cooling or heating operations are energized and fan proof is lost for three seconds, the cooling or heating functions will be shut down, fan will be de-energized, and "AP" will flash on the display.

In the unoccupied mode, when the slider switch is moved to the OFF position, or the call for heating or cooling ends, the fan will run for an additional 30 seconds before shutting off. This fan delay time is adjustable using variable "Fod".

Occupied Mode

Unit will control to the Occupied Setpoints.

Cooling or Heating Slider Mode & Dial Setpoint (Options DG1 and DG2): The dial setting is the working heating or cooling setpoint.

Auto Slider Mode & Dial Setpoint (Options DG1 and DG2): The dial setting is the midpoint for the working heating and cooling setpoint. The actual setpoint is adjusted by a value of "db" (deadband) which has a default value of 2°F.

The cooling setpoint = dial setting + db = 72°F + 2°F = 74°F

The heating setpoint = dial setting + db = 72°F - 2°F = 70°F

Auto, Cooling, or Heating Slider Mode, & Warmer/Cooler Dial (Options DG5 and DG6): The value HSP or CSP in the controller becomes the active heating and cooling setpoint basis. The warmer/cooler adjusts the setpoint by ±6°F.

"HSP," default 68°F

"CSP," default 72°F

The cooling setpoint = dial setting + CSP = +6°F + 72°F = 78°F

The cooling setpoint = dial setting + CSP = -6°F + 72°F = 66°F

The heating setpoint = dial setting + HSP = +6°F + 68°F = 74°F

The heating setpoint = dial setting + HSP = -6°F + 68°F = 62°F

Note: When variable SSI = ON, Room Command Module with setpoint scale should be used (DG1 or DG2). When SSI = OFF, Room Command Module with warmer/cooler scale should be used (DG5 or DG6).

Unoccupied Mode

Unit will control to the Unoccupied Temperature Setpoints.

The unoccupied setpoints are the working Heating Setpoint minus the value of "UoU" which has a default of 10°F and the working Cooling Setpoint plus the value of "UoU".

Auto Slider Mode & Dial Setpoint (Options DG1 and DG2):

The cooling setpoint = dial setting + db + UoU = 72°F + 2°F + 10°F = 84°F

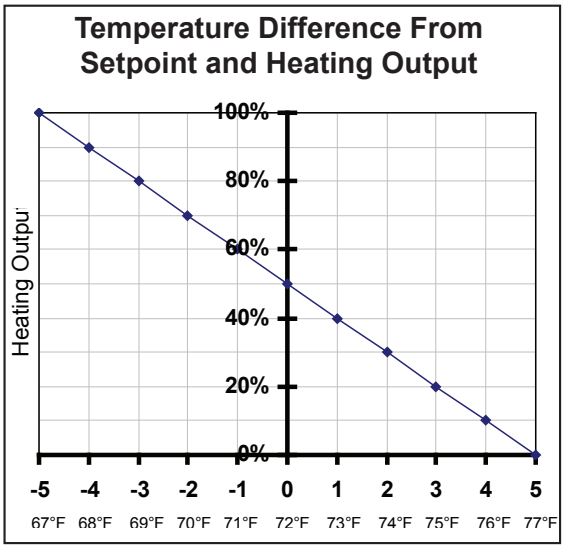
Boost Mode: Unit will add an adjustable amount BOU (nciBoostModeOffset) (default 5°F) to the working heating setpoint and subtract from the working cooling setpoint. Boost Mode will only operate in Heating Only or Cooling Only modes. Boost is not available in Auto Mode.

Example: Cooling Slider Mode & Dial Setpoint:

The cooling setpoint = dial setting + BOU = 72°F - 5°F = 67°F

Heating Operation

The unit will initiate heating if the temperature sensed at the space sensor or discharge falls below the "HSP" setpoint by the value of the heating proportional band, "HPB" (Default value 5°F). When it does, full heating turns on (high fire). The analog output will modulate to 100% full fire for 180 seconds to ensure proper burner ignition. With modulating control (Option DG2 or DG6), the gas valve will then modulate to a position, linearly with the proportional band, "HPB". For staged control (Option DG1 or DG5), the unit will switch to low fire when the heating output required from the proportional band is less than the SSO (5% default) for 30 seconds. The unit switches back to high fire if the gas signal calls for 90% capacity or "SHH" value. Heating will completely turn off when the space or discharge air temperature is above HSP + deadband "HDB."



Example: Heating will enable when

Temperature < *WHSP* – *HSP* – *HDB* < *72*°F – *5*°F – *0*°F < *67*°F

So, when the space temperature drops below 67°F, the signal to the gas valve is 100% and the burner ignites. After the 180 seconds, if the temperature is 72°F, the signal to the gas valve will be 50%.

Heating is disabled when the ambient temperature is above the lockout value "oH" (default 62°F).

8.0 Controls and Operation (cont'd)

8.3 Digital Controls for Heating/ Cooling, Makeup Air and Dehumidification (cont'd)

8.3.1 Optional Digital Heating/Cooling/ Makeup Air Controls, Options DG1, DG2, DG5, DG6 - PDH and SDH; PXH (cont'd)

Cooling Operation

The unit will initiate cooling if the temperature sensed at the space sensor (discharge air sensor) climbs above the WCSP into the Cooling proportional band, CPB. The cooling stages are based on C1, C2 and C3 value.

Example: If the working cooling setpoint (WCSP) is 72°F, stage 1 cooling turns on when space temp (discharge air temp) increases to 73°F (10% of the 10°F CPB). Stage 2 turns on when space temp increases to 76°F (40% of the 10°F CPB). Stage 3 turns on when the space temperature increases to 81°F (90% of the 10°F CPB).

As the space temperature moves back towards WCSP, stage 3 turns off at 40% call for cooling, stage 2 turns off at 10% call for cooling, and stage 1 turns off at 5% cooling call. There is a non-adjustable minimum 240 second interstage time delay. In addition, cooling ambient temperature lockout values prevent individual stages from being enabled until the outside air temperature is above oC, oC2, and oC3 values.

Compressor inter-stage delay time and compressor minimum on time are controlled by the nciClgStgTime which is defaulted at 240 seconds. This means that if stage 1 has just begun, stage 2 cannot start for 240 seconds. Once stage 1 has begun, it must run for 240 seconds before it will be turned off.

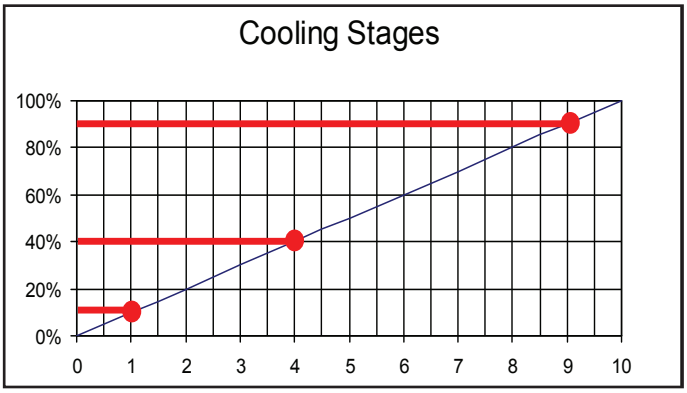




FIGURE 49 - FX06 Programmable Controller in D12B, D12C, D12D, D12E, D12F, and D12G

Reference: For explanation on the settings and functions of the FX06 programmable control, see the instruction form in the Literature Bag (Form CP-PREEVA-D12 B/C/D/E/F/G). If equipped with a special control such as FX07, contact your distributor or the factory for additional information.

8.3.2 Optional Digital Heating/Cooling/Dehumidification (Reheat) Controls, Options D12B, D12C, D12D, D12E, D12F, D12G - applies to SDH, PDH, SHH, PEH, or PXH - required with all dehumidification, Option AU7

The programmable controller (**FIGURE 49**) used with these options has a built-in time clock card for energy savings and better management of the specific application. If equipped with the optional serial communication card, the controller is compatible with either the LON or N2open BAS protocol.

If your unit was ordered with either Option D12B, D12C, D12D, D12E, D12F, or D12G, refer to Form CP-PREEVA-D12 B/C/D/E/F/G in the Literature Bag, for more detailed information.

The microprocessor unit (Model FX06) in control Options D12B, D12C, D12D, D12E, D12F, or D12G is custom programmed for the following:

- Custom 3-step control sequence of cooling and dehumidification (reheat)
- Modulation or 2-stage gas heat control
- SCR control or two stage electric heat
- Fully integrated outdoor ambient lockouts based on outdoor dry bulb/ dewpoint or enthalpy
- Alarm and equipment shutdown features
- Service/Commissioning Test Mode
- Integrated timer functions for cooling and heating

There are four buttons that can be used for adjusting setpoints, viewing unit status, and enabling unit test or shutdown modes. The controller display will indicate unit status (on, off, or alarm), discharge air temperature, outdoor air temperature, dewpoint,

and enthalpy. When equipped with a wall-mounted sensor (Option CL67), space temperature will be displayed.

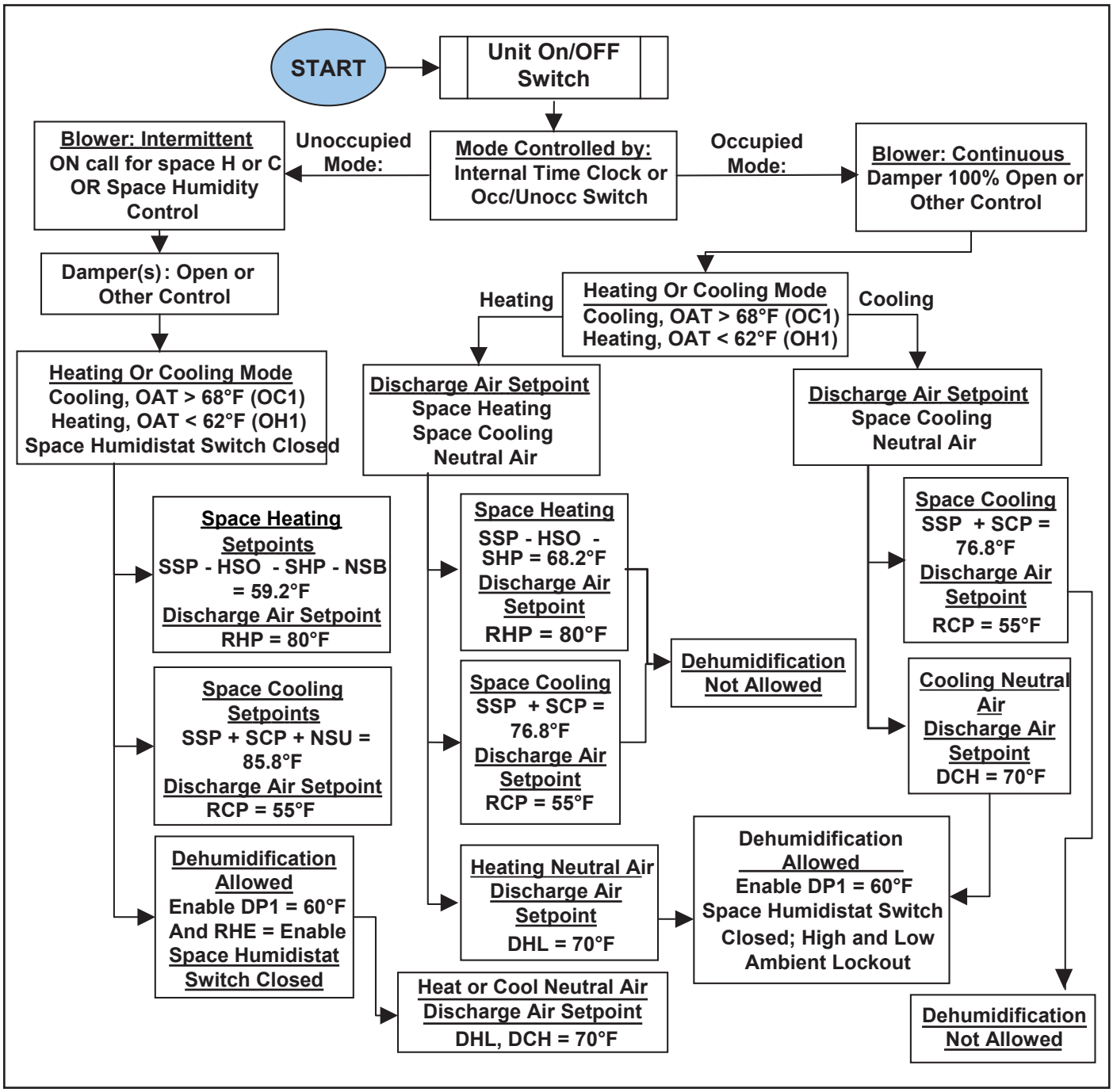
When the unit is called to operate, the main blower will run continuously in occupied mode and intermittently in unoccupied mode. The unit operates based on the four **Discharge Air Temperature Setpoints** listed below:

1. Standard (Neutral) Heating Discharge Air Temperature Setpoint
2. Space Heating Discharge Air Temperature Setpoint
3. Standard (Neutral) Cooling Discharge Air Temperature Setpoint
4. Space Cooling Discharge Air Temperature Setpoint

The heating and cooling equipment will cycle to maintain the active discharge air temperature setpoint for occupied and unoccupied modes. Heating and cooling may be locked out of operation based upon outdoor air temperature and enthalpy conditions.

If equipped with reheat, the control will also activate the dehumidification circuit to maintain a neutral discharge air temperature setpoint and related dewpoint based upon outdoor air and space conditions.

Sequence of Operation with Default FX06 Settings



8.0 Controls and Operation (cont'd)

8.3 Digital Controls or Heating/ Cooling, Makeup Air and Dehumidification (cont'd)

8.3.2 Optional Digital Heating/Cooling/ Dehumidification (Reheat) Controls, Options D12B, D12C, D12D, D12E, D12F, D12G - applies to SDH, PDH, SHH, PEH, or PXH - required with all dehumidification, Option AU7 (cont'd)

Digital (FX06) Control Applications by Option Code

Option D12B - applies to PDH and SDH; PXH (no heat) - Control is factory programmed for electronic modulation gas heating, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

Option D12C - applies to PDH and SDH; PXH (no heat) - Control can be factory programmed for two-stage gas heating, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional

Option D12E - applies to PEH - Control is factory programmed with neutral air control for 2-stage electric heat, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional. **NOTE**: Option D12D is not recommended for makeup air applications.

Option D12D - applies to PEH - Control is factory programmed with recirculating control for electric heat with SCR modulation, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

Option D12F - applies to SHH - Control is factory programmed for 2-stage recirculated heating / 3-stage cooling control. Heating is controlled by space temperature. Cooling is also controlled by space temperature except when equipped with a mixing box with economizer control (either Option GE21 or GE22). Option D12F provides time schedule control and allows for the addition of expansion cards to provide N2 or LON automated building control. (**NOTE**: Makeup air application was not available on Model SHH until 4/13 (Serial No. Date Code BMD).

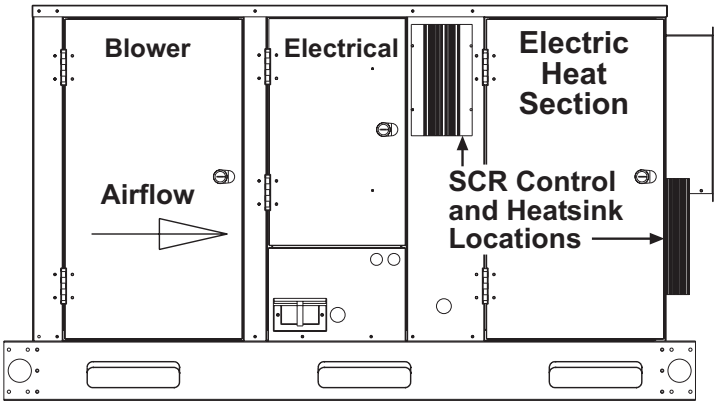
Option D12G - applies to SHH - Control is factory programmed for electronic deep modulation (8:1 turndown) gas heating and with 3-stage cooling control. Space reset control is optional. (**NOTE**: Makeup air application was not available on Model SHH until 4/13/Serial No. Date Code BMD.)

Electric Heat Model PEH with Option D12D - Additional Modulation Controls

Model PEH units with Option D12D have additional controls to provide electric heat modulation. Depending on their size (amp draw), Model PEH units with Option D12D are equipped with one or two SCR power controllers (See **FIGURE 50**).

To provide comfort level heating in response to the system controller, the SCR controllers cause modulation of specified heating elements while other elements are turned on and off or staged. Depending on size, staging is controlled either by the FX06 controller or an additional staging module.

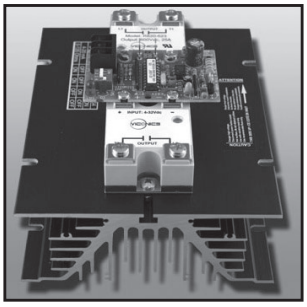
FIGURE 50 - Locations of the SCR Power Controls with Heatsinks on Model PEH w/ith Modulating Heat Control Option D12D



WARNING

The heatsink on the SCR power controllers is HOT to the touch.

SCR Power Control and Heatsink in Option D12D (one or two required depending on amps)



DANGER

High voltages are present on the terminals of the SCR power controller(s).

Relative Humidity Sensor

Options D12B, D12C, D12D, D12E, and D12G include an outside air relative humidity transmitter. Depending on whether the unit includes a mixing box, the sensor is either factory-mounted in the mixing box or shipped separately for field installation in the inlet duct. The sensor sequences compressor operation based on outdoor dewpoint. It is recommended for humid and temperate climates.

8.3.3 Optional Space Mounted Accessories for D12 Control Options

FIGURE 51 - Optional Space Mounted Accessories with Option D12 Digital Controls



Option CL67, **P/N 260599**, Space Temperature Sensor, has adjustable setpoint control and unoccupied override. Follow the instructions included with the sensor and the wiring diagram to install.



Option CL47, Room Dehumidistat, is shipped separately for field installation. The relative humidity inputs control reheat operation. Follow the instructions included with the control and the wiring diagram to install. **NOTE**: Applicable with reheat (Option AU7 or AU8) only. Not available with Option D12F.

Option RB2A, **P/N 223125**, Remote User Interface, provides access to all of the same functions that are accessible from the FX06 controller except Test Mode.

Display Lights	
Symbol and 01 - 08	
Unit ON/OFF	Alarm
Comp #1 ON	Reheat ON
Comp #1 ON	Not Used
Stg #1 Heat ON	Not Used
Stg #1 Heat ON	Not Used



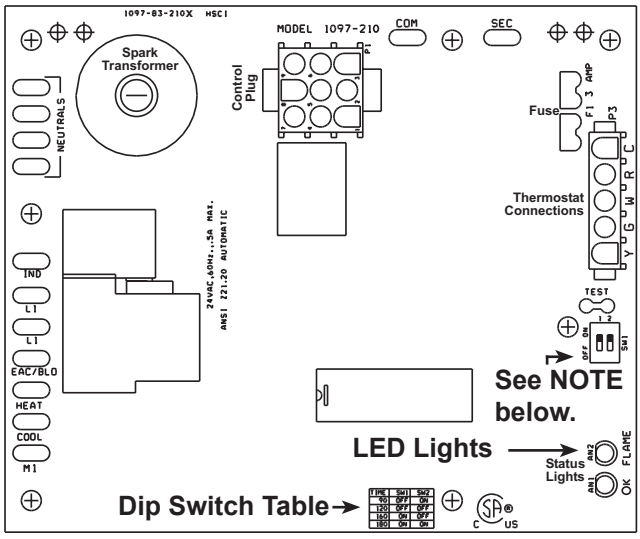
8.4 Ignition System - Models PDH, SDH, and SHH

The gas-fired furnace is equipped with a direct spark integrated control module (circuit board). The module monitors the safety devices and controls the operation of the venter motor and the gas valve between heat cycles. The module in Paragraph 8.4.1 is used on all of the gas fired models. Depending on control option selected, Model SHH uses either the control board in Paragraph 8.4.1 or 8.4.2.

8.4.1 Ignition Control Module used in all gas control options EXCEPT Option AG58 and D12G

IMPORTANT: When using a multimeter to troubleshoot the 24 volt circuit of a unit with this ignition controller, place the meter's test leads into the 5 and 9 pin connectors located on the ignition control. Do not remove connectors or terminals from the electrical components. Doing so can result in misinterpreted readings due to the ignition control board's fault mode monitoring circuits.

FIGURE 52 – Ignition Control Module (circuit board)



Control Status - Green LED Codes

Steady ON... Normal Operation, No call for heat
Fast Flash.... Normal Operation, Call for heat
1 Flash..... System Lockout, Failed to detect or sustain flame
2 Flashes..... Pressure switch did not close within 30 seconds of venter motor
3 Flashes..... High limit switch open
4 Flashes..... Pressure switch is closed before venter motor is energized
Steady OFF . Blown Fuse, No Power, or Defective Board

Flame Status - Yellow LED Codes

Steady ON... Flame is sensed
Slow Flash... Weak flame (current below 1.0 microamps ±50%)
Fast Flash.... Undesired Flame (valve open and no call for heat)

NOTE: Set "blower off" dip switch setting to 45 seconds for makeup air application. Refer to the table on the module for the appropriate settings.

8.0 Controls and Operation (cont'd)

8.4 Ignition System - Models PDH, SDH, and SHH (cont'd)

NOTE: Abnormal Heat Cycle Functions and Ignition System Fault Models for this ignition controller are explained in the Operation/ Maintenance/Service Manual, Form O-PREEVA & SHH

Normal Heat Cycle Operating Sequence with Controller in FIGURE 52.

1) Call for Heat - The heating/cooling system controller calls for heat. The ignition system circuit board checks to see that the limit switch is closed and the pressure switch is open. If the limit switch is open, the circuit board responds as defined in the "Abnormal Heat Cycle, Limit Switch Operation". If the pressure switch is closed, the circuit board will do four flashes on the green LED and wait indefinitely for the pressure switch to open. If the pressure switch is open, the circuit board proceeds to prepurge.

2) Prepurge - The circuit board energizes the venter motor and waits for the pressure switch to close. If the pressure switch does not close within 30 seconds of the venter motor energizing, the circuit board will do two flashes on the green LED. The circuit board will leave the venter motor energized indefinitely as long as the call for heat remains and the pressure switch is open.

When the pressure switch is proven closed, the circuit board begins the prepurge time. If flame is present any time while in prepurge, the prepurge time is restarted. If flame is present long enough to cause lockout, the circuit board responds as defined in "Fault Modes, Undesired Flame".

The ignition system circuit board runs the venter motor for a 20 second prepurge time, then proceeds to the ignition trial period.

3) Ignition Trial Period - The ignition system circuit board energizes the spark and main gas valve. The venter remains energized. If flame is sensed during the first 16 seconds, the spark is de-energized. If flame has not been sensed during the first 16 seconds, the control de-energizes the spark output and keeps the gas valve energized for an additional one second flame proving period. If flame is not present after the flame proving period, the control de-energizes the gas valve and proceeds with ignition re-tries as specified in "Abnormal Heat Cycle, Ignition Retry". If flame is present, the circuit board proceeds to steady heat.

4) Steady Heat - Circuit board inputs are continuously monitored to ensure limit and pressure switches are closed, flame is established (sensor on both burner sections), and the system controller call for heat remains. When the call for heat is removed, the ignition system circuit board de-energizes the gas valve and begins postpurge timing.

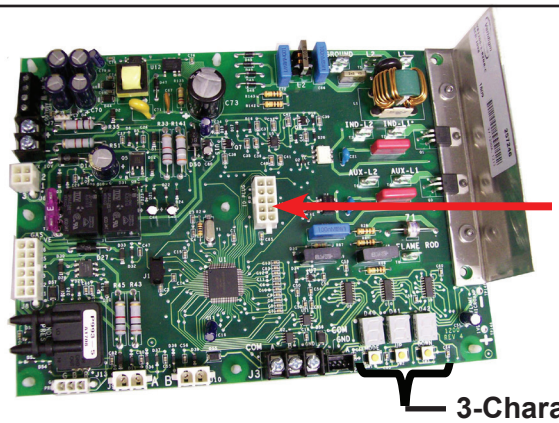
5) Post Purge - The venter motor output remains on for a 45 second postpurge period after the system controller is satisfied.

8.4.2 Ignition Control Module used in Deep Modulation Control Options AG58 and D12G - Model SHH only

IMPORTANT: The control module is **P/N 260252 for all sizes of Model SHH** heat sections. However, the ID plug on each board is unique for each size and type of gas. A replacement board will require either a new ID plug or reuse of the ID plug from the board being replaced.

Integrated Control Module for Gas Control Options AG58 and D12G - The control module is located in the control compartment with an additional board to control spark that is attached to the removable shield on the end of the burner. Except for the replaceable parts shown, do not attempt to disassemble either board. Each heating season, check the lead wires for insulation deterioration and good connections. If replacement is required, these boards must be replaced with identical parts.

FIGURE 53 - Integrated Control Module (Circuit Board), P/N 260252, for Deep Modulation Options AG58 and D12G

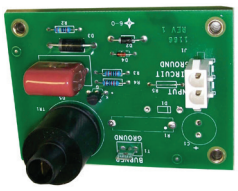


The control has a built-in, self-diagnostic capability. The control continuously monitors its own operation and the operation of the heat section including direct spark ignition, safety and modulating valves, and venter motor speed. The 3-digit display on the control indicates the current system state, warnings, failures, and test modes.

NOTE: Operating and Lockout Error Codes displayed on the ignition controller 3-character display (**FIGURE 53**) are listed in Troubleshooting Paragraph in the Operation/Maintenance/ Service Manual, Form O-PREEVA.

LED 3-Character Display (displayed on power up)	
Display Info (example only)	Description
SHH	Furnace series or model name
350	Heat Section Size
nAt or LP	Fuel type
1.01	Software version

FIGURE 54 - Spark Ignition Board, P/N 257975, is located on the removable shield at the end of the burner.



CAUTION: Due to high voltage on the spark wire and electrode, do not touch when energized. See Hazard Levels, page 2.

8.4.3 Ignitor Location

Proper location of the ignitor to the burner is shown in **FIGURE 55A**. Ignitor spark gap is shown in **FIGURE 55B**. The ignitor is the same for all gas control options.

FIGURE 55A - Ignitor Location

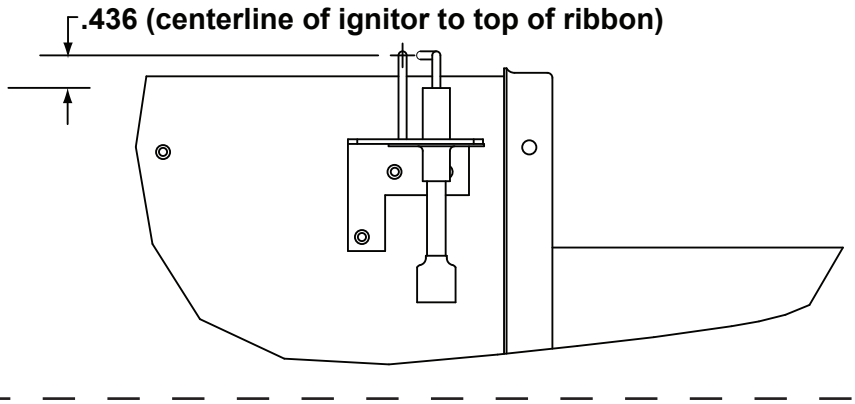
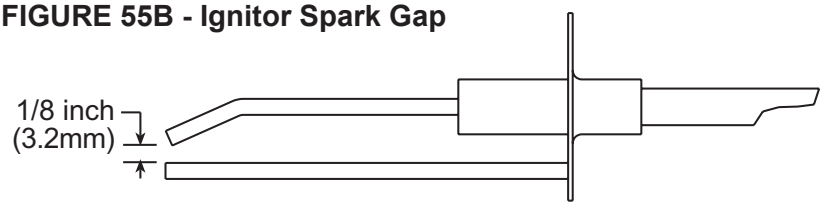


FIGURE 55B - Ignitor Spark Gap



9.0 Commissioning and Startup

9.1 General

Assumptions: All connections are made; actual startup is imminent. Site is clean; all excess supplies, scraps, and debris have been removed. Clean filters are in place. Doors are open for checks.

DANGER

To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open when doing checks prior to startup. See Hazard Levels, page 2.

9.2 Checklist Prior to Startup

9.2.1 All Systems Check List Prior to Startup:

- ☐ Check clearances. All clearances must be as illustrated in Paragraph 4.1.
- ☐ Verify the electrical supply matches voltage rating of the unit. (Refer to the rating plate.)
- ☐ Check the wiring for loose connections or damaged wire. Tighten connections. Replace damaged wiring. (See Paragraph 7.0 or the wiring diagram for replacement wiring requirements.)
- ☐ Check all field wiring against the wiring diagram. Be sure all field-installed controls are in place. Be sure that wire gauges are as required for the electrical load. All field wiring must be in compliance with the National Electric Code and local regulations.
- ☐ Check that fuses or circuit breakers are in place and sized correctly.
- ☐ Be certain optional manual reset controls (firestat and high gas pressure switch) are reset.
- ☐ If any changes are required to factory settings, be sure they have been made. (Refer to control instructions shipped with the unit.)
- ☐ **IMPORTANT - Before applying power, check blower pulley, blower wheel, and motor pulley to be sure they are secure to the shafts. Check blower and pulleys for free movement.**
  Check belt tension and alignment. See Paragraph 6.8.
- ☐ Verify the removal of all shipping supports.
- ☐ Check discharge duct connections. See Paragraph 6.7.2.
- ☐ Verify all condensate drain traps are filled with clean water.

9.2.2 Gas Heat (SDH, PDH, and SHH) Checklist Prior to Startup:

- ☐ Check gas piping for leaks and proper supply gas pressure (6.0" w.c. minimum/14.0” w.c. maximum). Bleed gas lines of trapped air.
  a) Turn manual shutoff valve to off position.
  b) Turn gas supply on.
  c) Observe gas meter for movement, or
  d) Attach pressure gauge readable to 0.1" w.c. and after turning gas on for ten seconds, turn gas supply off. No change in pressure should occur over a three-minute period.
  e) If either c) or d) above indicate a leak, locate leak by brushing a soapy solution on all fittings. Bubbles will appear at the leak. Repair and repeat tests.
- ☐ **MODELS PDH, SDH, and SHH** - Check venting. See Venting Manual. Be sure that both flue discharge and combustion air openings are free of obstructions.
- ☐ If installed in California, verify that California Warning Label is displayed. See Paragraph 1.3.
- ☐ Verify that the condensate drain(s) are connected and properly trapped. See Paragraph 6.2 and the Model SHH venting manual, Form I-SHH-V.

9.2.3 Mixing Box Damper (if equipped) Check:

- ☐ If the installation has a mixing box with two dampers, adjust damper linkage. See Paragraph 6.4.4.1.

9.2.4 Cooling Checklist Prior to Startup (PXH, PDH, SDH, SHH, and PEH with cooling module):

☐ Verify that the condensate drain(s) are connected and properly trapped. See Paragraph 6.2 and 6.6.3.

☐ Verify that the refrigerant circuits are charged with the appropriate refrigerant and leak tested according to the condensing unit instructions.

9.3 Startup Checklist and Warnings

CAUTION: If equipped with a cooling module with reheat, the crankcase heater must be allowed to warm up for at least 24 hours prior to startup. Disable cooling controls before turning on power to warm up crankcase heaters. See Hazard Levels, page 2.

☐ Close and latch the doors.

IMPORTANT: If equipped with digital controls, when turning on the main controller for the first time, be sure to push and hold the Function Key for five seconds. This should cause the first LED to light. If the LED light is lit, the controller will remain on and allow for remote control even after a power outage. If the LED light is not lit, it will be necessary to restart the controller at the unit after a power outage.

☐ Read and follow the preparation instructions below on power supply voltage phasing. When ready, turn on the power. Turn on the gas.

Power Supply Voltage Phasing

Because it is possible to unknowingly connect 3-phase power in such a way as to cause the blower and, if there is an optional reheat compressor, the scroll compressor to rotate in reverse. It is very important to check this on startup.

Blower Rotation - Check rotation on startup. If blower rotation is not correct, reverse by interchanging two wires on the 3-phase supply connection to the blower motor.

Check Reheat Compressor (if equipped) - Connect refrigerant pressure gauges to the suction and discharge lines of the compressor and an electric meter to the power supply.

CAUTION: Be sure to connect pressure gauges to the suction and discharge lines before system startup so that compressor rotation can be checked immediately. A scroll compressor will be destroyed if allowed to operate in the wrong direction. See Hazard Levels, page 2.

Adjust the controller so that a call for reheat exists. Immediately at startup, observe the gauges. If the suction pressure rises and discharge pressure drops, the compressor is operating in reverse and must be shut down. Turn off the power and switch the 3-phase line voltage wiring connections before restarting the unit.

(Important NOTE: If allowed to operate for several minutes in reverse, the compressor's internal protector will trip. If a compressor is repeatedly allowed to restart and run in reverse, the compressor will be permanently damaged.)

☐ Check heat section operation.

WARNINGS

For your safety, read before operating. If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or death.

- **Models SDH, PDH, SHH - This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner manually.**

9.0 Commissioning and Startup (cont'd)

9.3 Startup Checklist and Warnings (cont'd)

- **Before operating, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.**

WHAT TO DO IF YOU SMELL GAS

- **Do not try to start any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call your fire department.**

- **PDH, SDH, and SHH - Use only your hand to turn the gas control ON/OFF knob on the gas valve. Never use tools. If the valve ON/OFF knob will not turn by hand, do not try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.**
- **PDH, SDH, and SHH - Should overheating occur, or the gas supply fail to shut off, turn off the manual gas valve to the appliance before shutting off the electrical supply.**
- **All Models - Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.**

☐ Adjust the control so that a call for heat exists. Observe for complete sequencing.

Operating Instructions and Heating Sequence of Operation - PDH/SDH/SHH

1. Set thermostat at lowest setting.
2. Turn off all electric power to the appliance.
3. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner manually. Open the door and locate the gas control (ON/OFF) knob on the gas valve.
4. Turn the gas control knob clockwise to "OFF".
5. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. **If you smell gas, STOP!** and follow the steps in the **WARNINGS** printed above or on the Operating Label on the heater. If you do not smell gas, proceed to the next step.
6. Turn the gas control knob counterclockwise to "ON".
7. Close and latch access door.
8. Turn on the electric power to the heater.
9. Set thermostat or other control to the desired setting.

NOTE: If the appliance does not operate, follow the instructions "To Turn Off Gas to Appliance" printed below (and on the Operating Label on the heater) and call your service technician.

10. Control calls for heat, energizing the venter motor.
11. Venter pressure switch closes, firing the unit.
12. Burner flame is sensed and in 30 seconds after the gas valve is energized, the blower motor is energized.
13. If the flame is extinguished during the main burner operation, the integrated control system closes the main valve and must be reset by interrupting power to the control circuit. (See lighting instructions on the heater.).

TO TURN OFF GAS TO THE APPLIANCE

1) Set thermostat to lowest setting
2) If service is to be performed, turn off all electric power to the appliance.
3) Open the access door.
4) Turn the gas control knob clockwise to "OFF". Do not force.
5) Close and latch the door.

DANGER:

Incomplete Combustion: The gas burner in Model PDH, SDH, and SHH gas-fired equipment is designed to provide safe, complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion which produces carbon monoxide, a poisonous gas that can cause death.

Improper Venting: Safe operation of indirect-fired gas burning equipment requires a properly operating vent system which vents all flue products to the outside atmosphere. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

On separated combustion Model SDH and SHH heaters, install either the horizontal or vertical combustion air/vent system illustrated in the heater venting manual, using the concentric adapter supplied. For all gas-fired heater installations, always comply with the combustion air requirements in the installation codes and instructions. Model PDH units installed in a confined space must be supplied with air for combustion as required by Code and in the heater installation manual. Combustion air at the burner should be regulated only by manufacturer-provided equipment. NEVER RESTRICT OR OTHERWISE ALTER THE SUPPLY OF COMBUSTION AIR TO ANY HEATER. MAINTAIN THE VENT OR VENT/COMBUSTION AIR SYSTEM IN STRUCTURALLY SOUND AND PROPER OPERATING CONDITION.

Operating and Heating Sequence - Electric Heat Model PEH

Turn on power to the unit.

- Outside air dampers open.
- Damper end switch closes energizing the blower motor.
- Unit is controlled by FX06 controller (with sensors in outside and discharge air.)
- Temperature control staging is based on sensor setpoints and inputs.

Electric Heating Sequence:

1) On a call for heat from the FX06 controller, the blower energizes.
2) Supply air switch closes and the first stage of electric heat is energized.
3) Subsequent staging is controlled by the FX06 controller (Option D12E) or by the FX06 controller with modulation control from the SCR power controller (Option D12D).

☐ **Vent System Testing Procedure - Model PDH**

1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code, NFPA54/ANSI Z223.1 (latest edition) or CAN/CSA B149.1 Natural Gas and Propane Codes, and the Model PDH venting manual (Form I-PDH-V). Determine that there is no blockage or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.
3. In so far as practical, close all building doors and windows and all doors between the space where the heater is and other spaces of the building. Turn

9.0 Commissioning and Startup (cont'd)

9.3 Startup Checklist and Warnings (cont'd)

on exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4. Light the heater following the lighting instructions. Adjust the control for continued operation. Verify that combustion products are venting properly. After determining that the heater vents properly, return doors, windows, exhaust fans, and fireplace dampers to their previous conditions. If improper venting is observed, the venting system must be corrected.

☐ **Models PDH, SDH, and SHH** - With the unit in operation, measure valve outlet gas pressure. If operated at high altitude, adjust outlet gas pressure for altitude if required. See information and instructions in Paragraph 6.1.2 and 6.1.3.

☐ **Models PDH, SDH, and SHH** - Turn the unit off and on, pausing two minutes between each cycle. Observe for smooth ignition. On two-stage or modulating burner systems, manipulate temperature adjustment slowly up and down to see if control is sequencing or modulating properly.

☐ If the system is equipped with an optional dirty filter switch, set the switch. Follow the instructions in Paragraph 7.6.2.

☐ If the system is equipped with a reheat pump, follow the instructions below to check the refrigerant subcooling and superheat.

Instructions for Checking and Adjusting the Subcooling of an Isolated Circuit

Acceptable subcooling readings range from 14° to 18°F (7.8° to 10°C).

Measure and record temperature and pressure of the liquid line at the condenser coil outlet.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 69,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Chart (STEP 2) _____°F (°C) - _____°F (°C) = _____°F (°C) degrees of Subcooling

Instructions for Checking and Adjusting the Superheat of an Isolated Circuit

Superheat should be in the 8° to 12°F (4.5° to 6.7°C) range.

Measure and record temperature (insulate probe from surrounding air temperature) and pressure in the suction line at the compressor inlet.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 69,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Table (STEP 2) _____°F (°C) - _____°F (°C) = _____°F (°C) degrees of Superheat

☐ **REMINDER: Keep all product literature.** Place "Literature Bag" containing Limited Warranty, this booklet, the venting manual, and any optional information including the digital control instructions in an accessible location near the heater. Follow the instructions on the envelope.

☐ **IMPORTANT:** After at least 8 hours but no longer than a week of operation, recheck the blower wheel, all set screws, blower pulley, motor pulley, and belt tension. Make any required adjustments. (See Paragraph 6.8.)

APPENDIX

STARTUP FORM

Fill out the applicable sections and keep for future reference.

Job Name:		**Contractor Contact:**	
Street Address		**Contractor Phone:**	
City, State, Zip		**Model #**	
Date:		**Serial #**	
Contractor:		**Tag:**	

Start-Up Checklist

NOTE: See Paragraph 9.0 for a complete list.

General Checks	Reference
NOTE: Checks may not apply depending on option selection.	
□ Inspect unit for damage.	Paragraph 3.0
□ Verify shipping brackets are removed.	
□ Check fuses/breakers for correct sizing. (Check rating plate for electrical requirements.)	
□ Check clearances.	Paragraph 4.1
□ Check condensate connections. Fill traps.	Paragraphs 6.2 & 6.6
□ Verify air filters are installed.	
□ Inspect dampers.	
□ Tighten all screws on pulleys and fans.	Paragraph 6.8
□ Check and tighten all electrical terminals.	
□ Seal electrical entrances.	
□ Check optional dirty filter switch.	Paragraph 7.6.2
□ Check for manual resets (firestat, high gas pressure switch)	
□ Verify all copper tubing is isolated and does not rub.	
□ Verify crankcase heater (reheat compressor) is energized 24 hrs before startup.	

Blower Assembly				
□ Fan alignment	Motor HP: _____ Name Plate Amps: _____			
□ Belt tension	Motor Make/Amps:	L1	L2	L3
□ VAV controls	_____	_____	_____	_____

Gas Heating Section	□ LP	□ Natural Gas
□ Leak test gas piping		
□ Purge air from lines		
□ Check Inlet Gas Pressure	Maximum:	14” w.c. for both natural gas and LP
Actual Gas Inlet Pressure: _____	Minimum:	As listed on the unit rating plate
□ Check Manifold Pressure (As listed on the rating plate.)		
Actual Manifold Gas Pressure:_____		

Electric Heating Section		
Heater Number and Amps:		
1		
2		
3		
4		
5		
6		

Reheat Compressor Data						
Outdoor Air Conditions:				Dry Bulb: _____		Wet Bulb: _____
Circuit	**L1**	**L2**	**L3**	**Name Plate RLA**	**Head Pressure PSIG**	**Suction Pressure PSIG**
Reheat						

APPENDIX (cont'd)

Wiring Diagram Option Identification

The Option Codes for these electrical options are shown on the wiring diagram. Only options ordered with be listed on the custom wiring diagram.

Option Code	Brief Description
AG1	Analog Heating Control - 1-Stage
AG2	Analog Heating Control - 2-Stage
AG3	Analog Heating/Makeup Air - 2-Stage unit-mounted ductstat
AG15	Analog Heating/Makeup Air - 2-Stage remote ductstat w/dial
AG16	Analog Heating/Makeup Air - same as AG15 with display
AG40	Analog Heating/Makeup Air - converts to digital for field supplied BMS
AG58	Analog Heating/Makeup Air - electronic modulation 8:1 turndown (SHH)
AG60	Analog Heating/Makeup Air - same as AG3 plus 33% low fire
AG61	Analog Heating/Makeup Air - same as AG15 plus 33% low fire
AG62	Analog Heating/Makeup Air - same as AG61 with display
AK1	115/1 Supply Voltage
AK2	208/1 Supply Voltage
AK3	230/1 Supply Voltage
AK5	208/3 Supply Voltage
AK6	230/3 Supply Voltage
AK7	460/3 Supply Voltage
AK8	575/3 Supply Voltage
AN2	Contactor, IEC
AN10	Motor Starter with Overloads
AR8	On/Off Inlet Air Damper with Duct Flanges
AU7	Cooling Coil Cabinet with DX Coil and Reheat Pump
AUR1	Modulating Reheat
BA6	Disconnect Switch - Flush-mounted, lockable, non-fusible
BB8	Wiring for Energy Recovery Module
BC2	Convenience Outlet (requires separate power supply)
BD4	Firestat, 200°F
BD5	Firestat, 200°F (field installed)
BE2	Low Limit, Discharge Temperature
BE4	Evaporator Frostat for Coils
BF14	Phase Loss/Low Voltage Protection - with AK5, AK6, AK7 only
BF15	Phase Loss/Phase Reversal Protection - 3 phase only
BG7__	Plugin DPDT Relay - Specified operation
BG9	Plugin DPDT Relay - Exhaust Fan Interlock
BHB1	Time Clock Card - with DG 1, 2, 5, 6
BHB2	N2 Card - with DG 1, 2, 5, 6 and D12 B, C, D, E
BHB3	LonMark Card - with DG 1, 2, 5, 6 and D12 B, C, D, E
BN2	Limit Control - High Ambient (burner cutoff)
BP4	Gas Pressure Safety Switches, High and Low
CL1	Thermostat - 1-stage heat, 24V, 40-80°F
CL22	Thermostat - 24v non programmable, 1 or 2-stage
CL23	Thermostat - 24v, 2-stg heat/cool, touch screen, programmable
CL33	Thermostat - 2-stage heat/cool, 24V, programmable
CL36	Thermostat - Modulating Heat/cool with 3-stage cooling
CL52	Thermostat - 1-stage heat/cool, 24V, 45-88°F, programmable 5/2 day
CL67	Space Temperature Sensor/Override - with D12 B, C, D, E
CN1__	3-Position Switch - specified operation
CN3__	2-Position Switch - specified operation
CP__	Disconnect Switch (field installed)
CT1	Evap Cooler Fill & Drain Kit - 120/1 with AK1, AK7, AK8
CT2	Evap Cooler Fill & Drain Kit - 208/1 with AK2, AK5
CT3	Evap Cooler Fill & Drain Kit - 240/1 with AK3, AK6
CT5	Evap Cooler Freeze Protection - AquaSaver controls
CT6	Evap Cooler Freeze Protection - with CT 1, 2, or 3

Option Code	Brief Description
D12B	Digital Control w/FX06 - Neutral Air/Discharge Air Temp Control (applies to PDH or SDH with or without reheat)
D12C	Digital Control w/FX06 - Space Temp Cntrl w/Discharge Air Reset (applies to SDH or PDH with or without reheat)
D12D	Digital Control w/FX06 - Neutral Air/Discharge Air Temp Control (applies to PEH with SCR (modulating) heating control and 3-stage cooling with or without reheat)
D12E	Digital Control w/FX06 - Recirculating Air Temp Control (applies to PEH with 2-stage heating and 3-stage cooling with or without reheat) (not recommended for makeup air)
D12F	Digital Control w/FX06 - Space Temperature, 2-stage heating / 3-stage cooling (applies to SHH)
D12G	Digital Control w/FX06 - Gas-fired electronic modulation with 8:1 turndown; 3-stage cooling; with or without reheat; discharge air temperature control (applies to SHH)
DG1	Digital Control w/FX05 - Space Temperature, 2-stg heating/3-stg cooling (applies to PDH or SDH without reheat)
DG2	Digital Control w/FX05 - Space Temperature elec mod htg/3-stg clng (applies to PDH or SDH without reheat)
DG5	Digital Control w/FX05 - Discharge Air Temperature, 2-stg htg/3-stg clng (applies to PDH or SDH without reheat)
DG6	Digital Control w/FX05 - Discharge Air Temperature elec mod htg/3 stg clng (applies to PDH or SDH without reheat)
ECD1	Evap Cooler AquaSaver meter water flow system
ECD2	Evap Cooler Recirculating Pump Control
EG1	Analog Heating Control - 1 Stage thermostat (PEH)
EG2	Analog Heating Control - 2 Stage thermostat (PEH)
GE3	Damper Control - Outside air, 2-position motor
GE5	Damper Control - Outside air, 3-position motor
GE6	Damper Control - Outside & Return, 2-position motor
GE7	Damper Control - Outside & Return, 2-position mtr w/warm up
GE8	Damper Control - Outside & Return, 3-position, unit potentiometer
GE10	Damper Control - Outside & Return, 3-position, remote potentiometer
GE11	Damper Control - Outside & Return, modulating, mixed air
GE12	Damper Control - Outside & Return, modulating, mixed air w/min
GE13	Damper Control - Outside & Return, modulating, mixed air w/warm up
GE14	Damper Control - Outside & Return, mod, mixed air w/min & warm up
GE15	Damper Control - Outside & Return, modulating, building pressure
GE16	Damper Control - Outside & Return, modulating, BMS control
GE21	Damper Control - Outside & Return, modulating, enthalpy
GE22	Damper Cntrl - Outside & Return, modulating, dual reference enthalpy
RB2A	Remote Display - Control Options D12B-G
RC__	Remote Console - lights, switches, optional sensors
SA1	Duct Photoelectric Smoke Detector
T4 XX	Thermal Expansion Valve (R410A only)
UV2	Germicidal Lamp
VFD1	Variable Frequency Drive
VFD2	Variable Frequency Drive (requires field installation)
VFD3	Variable Freuency Drive (supplied by others)

Pressure/ Temperature Chart for Checking Superheat & Subcooling

NOTE: Information in this chart was taken from the Temperature Pressure Chart printed in Form IC-2-04 by the Sporlan Valve Company, Washington, MO 63090

Pressure/Temperature Chart for Checking Superheat & Subcooling					
Saturation Temperature		Pressure (psig) by Refrigerant			
(°F)	(°C)	R22	R410A	R407C	R134a
0	-17.8	24.0	48.2	18.9	6.5
5	-15.0	28.3	55.0	22.8	9.1
10	-12.2	32.8	62.3	27.1	12.0
15	-9.4	37.8	70.2	31.8	15.1
20	-6.7	43.1	78.7	36.9	18.4
25	-3.9	48.8	87.8	42.4	22.1
30	-1.1	54.9	97.5	48.4	26.1
35	1.7	61.5	107.9	54.8	30.4
40	4.4	68.6	118.9	61.7	35.0
45	7.2	76.1	130.7	69.1	40.0
50	10.0	84.1	143.3	77.1	45.4
55	12.8	92.6	156.6	106.0	51.2
60	15.6	101.6	170.7	116.2	57.4
65	18.3	111.3	185.7	127.0	64.0
70	21.1	121.5	201.5	138.5	71.1
75	23.9	132.2	218.2	150.6	78.6
80	26.7	143.7	235.9	163.5	86.7
85	29.4	155.7	254.6	177.0	95.2
90	32.2	168.4	274.3	191.3	104.3
95	35.0	181.9	295.0	206.4	113.9
100	37.8	196.0	316.9	222.3	124.1
105	40.6	210.8	339.9	239.0	134.9
110	43.3	226.4	364.1	256.5	146.3
115	46.1	242.8	389.6	274.9	158.4
120	48.9	260.0	416.4	294.2	171.1
125	51.7	278.1	444.5	314.5	184.5
130	54.4	297.0	474.0	335.7	198.7
135	57.2	316.7	505.0	357.8	213.5
140	60.0	337.4	537.6	380.9	229.2
145	62.8	359.1	571.7	405.1	245.6
150	65.6	381.7	607.6	430.3	262.8
155	68.3	405.4	645.2	456.6	281.0

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Installation / Operation

Applies to: **PREEVA® Outdoor Air Handler Model RDH, Model REH, Model RHH, and Model RXH**



Outdoor, Gas-Fired, Power Vented, PREEVA® Model RDH
(shown with field-installed inlet air hood, Option AS2)

- **PREEVA® MODEL RDH - Outdoor, Gas-Fired Heat, Power Vented, Heating/ Makeup Air (Cooling Optional)**
- **PREEVA® MODEL REH - Outdoor, Electric Heat, Heating/Makeup Air (Cooling Optional)**
- **PREEVA® MODEL RHH - Outdoor, High Efficiency Gas-Fired Heat, Power Vented, Heating/Makeup Air (Cooling Optional)**
- **PREEVA® MODEL RXH - Outdoor, Makeup Air (blower only) (Cooling Optional) (Hot Water Heat Optional)**

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1.0 General

1.1 Application

The information in this manual applies to PREEVA® Outdoor Model RDH, Model REH, Model RHH, and Model RXH. Each model has unique features. Please read carefully to be sure of what applies to the model being installed.

1.2 Hazard Labels and Notices

There are warning labels on the unit and throughout this manual. For your safety, read the definitions below and comply with all boxes labeled **CAUTION, WARNING**, and **DANGER** during installation, operation, maintenance.

Definitions of Hazard Intensity Levels in this Manual

HAZARD INTENSITY LEVELS

1. **DANGER: Failure to comply will result in severe personal injury or death and/or property damage.**
2. **WARNING: Failure to comply could result in severe personal injury or death and/or property damage.**
3. **CAUTION: Failure to comply could result in minor personal injury and/or property damage.**

WARNING

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and replace any gas control that has been under water.

WARNING—Models RDH and RHH:

Should overheating occur, or the gas supply fail to shut off, shut off the manual gas valve to the appliance before shutting off the electrical supply.

WARNING

Model RDH and Model RHH gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances (see Hazard Levels, page 2).

1.3 General Installation Information

Model RDH and Model RHH are listed by ETL Testing Agency as conforming to ANSI Standards and certified to CSA Standards. Models REH and RXH are listed by ETL Testing Agency as conforming to CSA and UL Standards. All models are designed for commercial/industrial use.

The type of gas, the firing rate, and the electrical characteristics are on the unit rating plate. Check the rating plate to determine if the unit is appropriate for the intended installation.

WARNING

Installation of this system should be done by a qualified agency in accordance with the instructions in this manual and in compliance with all codes and requirements of authorities having jurisdiction.

Control Manual: An installation of Model RDH, REH, RHH, or RXH with a digital controller requires a control instruction manual. The manual is shipped in the literature bag with this booklet.

- Orders with control Option DG1 or DG5 require **PN 254027**
- Orders with control Option D12B, D12C, D12D, D12E, or D12G require **PN 235267**

  NOTE: All systems with reheat Option AU7 have an Option D12 digital control.

1.4 Warranty

Refer to the limited warranty information on the Warranty Form in the “Literature Bag”.

Warranty is void if ...

a. Heaters are used in atmospheres containing flammable vapors or atmospheres containing chlorinated or halogenated hydrocarbons or any contaminant (silicone, aluminum oxide, etc.) that adheres to the spark ignition flame sensing probe.
b. Wiring is not in accordance with the diagram furnished with the heater.
c. Unit is installed without proper clearance to combustible materials or without proper ventilation and air for combustion.
d. Air throughput is not adjusted within the range specified on the rating plate.
e. Product is not installed in accordance with these instructions or local codes.

1.5 Installation Codes

All installations must be in accordance with local building codes.

Gas-Fired Models RDH and RHH: In the absence of local codes, in the United States the unit must be installed in accordance with the National Fuel Gas Code NFPA54/ ANSI Z223.1 (latest edition). A Canadian installation must be in accordance with the CSA B149.1 Natural Gas and Propane Installation Code. Both codes are available from CSA Information Services, 1-800-463-6727. Local authorities having jurisdiction should be consulted before installation is made to verify local codes and installation procedure requirements.

Commercial Makeup Air Installations: These gas-fired products are certified by ANSI Z83 family of standards governing the safe usage of heating equipment in the industrial/commercial marketplace. This includes using the heaters in makeup air applications to supply corridor pressurization in commercial buildings such as office structures and apartment complexes.

This product may be used for all makeup air applications except one or two family dwellings.

All Installations: Clearances from the heater and vent to combustible construction or material in storage must conform with the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition) pertaining to gas-burning devices, and such material must not attain a temperature over 160°F by continued operation of the heater.

1.0 General (cont'd)

1.5 Installation Codes (cont'd)

Model RDH: If local code requires 4-ft (1.2M) vertical clearance between the flue outlet and the fresh air intake of the heating system or the building, install a vertical vent with an optional vent cap. (If the vent cap has not been ordered, contact your distributor). See Paragraph 6.3 for specific installation requirements.

California Warning Label: If a Model RDH or RHH gas-fired heater is being installed in the state of California, the installer MUST attach a warning label on the outside of the access door. The California Warning label is shipped in the literature bag along with this manual, the warranty form, and any other paperwork that applies.

Select a location on the heater access panel. Be sure the surface is clean and dry and affix the label.

Massachusetts Requirement: If a Model RDH or RHH gas-fired heater is being installed in the Commonwealth of Massachusetts, it must be installed by a licensed plumber or licensed gas fitter.

2.0 Location

Most of the outdoor units are designed to be set on a slab, on a roof curb, or on rails (**NOTE**: Model RHH is designed for curb mount only.) All units must be level. When selecting the location, check the following.

- Installation location must comply with local codes.
- Refer to the weights in Paragraph 5.1. Structure must support the weight.
- Comply with required clearances in Paragraph 4.1.
- Position the unit so that the outside air inlet will not be facing into the prevailing wind.
- Refer to the paragraph below on the hazards of chlorine.

Hazards of Chlorine (Models RDH and RHH): The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine found usually in the form of freon or degreaser vapors, when exposed to flame will precipitate from the compound, and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid which readily attacks all metals including 300 grade stainless steel. Care should be taken to separate these vapors from the combustion process. This may be done by wise location with regard to exhausters or prevailing wind directions. Chlorine is heavier than air. Keep these facts in mind when determining installation location of the heater in relation to building exhaust systems.

3.0 Receiving, Uncrating, and Preparing for Installation

Model RDH, REH, RHH, and RXH units are shipped completely assembled. The heavy gauge unit base has a lifting hole at each corner. Use spreader bars when lifting to prevent chains or cables from damaging the cabinet.

Immediately upon receiving, check for any damage that may have been incurred during shipment. If damage is found, document the damage with the transporting agency and immediately contact your factory distributor. If you are an authorized Distributor, follow the FOB freight policy procedures.

Check the gas specifications and electrical characteristics of the unit to verify that they agree with the gas and/or electric supply at the installation site.

Review this booklet and become familiar with the installation requirements. Before beginning, make preparation for necessary supplies, tools, and manpower.

Field-Installed Parts: If installing a high efficiency Model RHH, components for field installation of a freeze-resistant condensate drain and trap are shipped separately.

	PN	Description
Required Parts Shipped Separately for Model RHH	**271064**	Condensate Drain Trap
	205037	1/2" Schedule 40 Tee
	105944	1/2" Schedule 40 Female Adapter
	105948	1/2 × 1/2" Nylon Hose Barb
	271183	36" length of pipe insulation (for insulating the drain hose)
	271184	36" length of pipe insulation (for insulating the 1/2" PVC drain)

Shipped-Loose or Shipped-Separate Optional Parts: Some control options have parts either shipped loose with the heater, shipped separately, or mounted on a shipped-separate remote console (if ordered). If your unit is equipped with any of the gas or air inlet control options in the table below, be sure these parts are available at the job site.

TABLE 1- Shipped-Separate or Shipped-Loose Components for Factory-Installed Options

Factory-Installed Option	Option Parts Requiring Installation (parts are either shipped loose with the heater or shipped separately)
AG3, AG60	On/Off Control Switch, **PN 39732;** Discharge Air Sensor Holder, **PN 115850;** Discharge Air Sensor Holder Bracket, **PN 213612**
AG8	On/Off Control Switch, **PN 29054**; Sensor, **PN 48041**; Mixing Tube, **PN 90323**
AG9	On/Off Control Switch, **PN 29054**; Sensor, **PN 48041**; Mixing Tube, **PN 90323;** Remote Temperature Selector, **PN 48042**
AG9H	On/Off Control Switch, **PN 29054**; Sensor, **PN 194261**; Mixing Tube, **PN 90323;** Remote Temperature Selector, **PN 194258**
AG15, AG61	On/Off Control Switch, **PN 39732**; Remote Ductstat Temperature Selector, **PN 115848**; Stage Adder Module(s), **PN 115849;** Discharge Air Sensor Holder, **PN 115850;** Discharge Air Sensor Holder Bracket, **PN 213612**
AG16, AG62	On/Off Control Switch, **PN 39732**; Remote Temperature Selector, **PN 115848**; Stage Adder Module(s), **PN 115849**; Digital Temperature Display, **PN 115852;** Discharge Air Sensor Holder, **PN 115850;** Discharge Air Sensor Holder Bracket, **PN 213612**
DG1	Room Command Module, **PN 211423**
DG5	Room Command Module, **PN 211424;** Discharge Air Sensor Holder, **PN 115850;** Discharge Air Sensor Holder Bracket, **PN 213612**
AG58, D12B, D12C, D12D, D12E, D12G	Discharge Air Sensor Holder, **PN 115850;** Discharge Air Sensor Holder Bracket, **PN 213612**
GE10	Potentiometer, **PN 16110**
GE15	Pressure Null Switch, **PN 88052**
GE21	Enthalpy Sensor and Parts to install, **PN 220686**
GE22	Two Enthalpy Sensors and Parts to install, (2) **PN 220686**
AU7L, AU7R	Duct Humidity/Temperature Sensor, **PN 206081**; Mounting Bracket, **PN 207499** **NOTE:** These will be factory installed if mixing box, Option MXB1, is ordered.

Field-Installed Accessories: If your unit was ordered with Option UV2, UVC lights in the cooling coil module, the bulbs and a box of parts are shipped in the blower compartment for field installation. Being careful not to touch the bulbs, verify the components with the instruction sheet included with the parts.

Before beginning installation, be sure that all shipped-separate options ordered are available at the site. Field-installed, shipped-separate options could include a roof curb, an outside air hood, a vent cap, an energy recovery unit, a VFD, a thermostat or other wall-mounted control, a remote console, a disconnect switch, a fill and drain or freeze protection kit, a water hammer arrestor, a firestat, and/or a smoke detector.

Storage and Startup: If this unit is going to be stored, take precautions to prevent condensate formation inside the electrical compartments and motors. To prevent damage to the unit, do not store sitting on the ground.

After the system has been moved to its installation site, remove all of the shipping brackets and check the blower for free movement. See the check lists in Paragraph 9.0 before starting the unit and completing the Startup Form.

4.0 Clearances and Dimensions

4.1 Clearances

For safety and convenience, provide clearances as shown in the following table. Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. Minimum clearances are also listed on the heater rating plate.

TABLE 2A - Minimum Clearances from Combustible Material

Minimum Clearances to Combustibles—ALL Sizes of Models RDH, REH, RHH						
UOM	**Control Side**	**Side Opposite Controls**	**Front**	**Rear**	**Top**	**Bottom**
inches	20	6	48	18	6	0
mm	508	152	1219	457	152	0

TABLE 2B - Recommended Service Clearances

Recommended Service Clearances by Model and Size													
Model and Size				Control Side						Side Opposite Controls		Top	
RDH	REH	RHH	RXH	Control Side (Basic)		Control Side with Mixing Box		Control Side with Cooling Coil*					
				inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
75/100	10A/20A/30A	—	000A	30	762	30	762	42	1067	6	152	18	457
125/150	15B/30B/60B	—	000B	34	864	34	864	52	1321	6	152	18	457
175/200/225	N/A	130/180	000C	30	762	30	762	42	1067	6	152	24	610
250/300	30D/60D/90D/120D	260	000D	42	1067	42	1067	58	1473	6	152	24	610
350/400A	40E/80E/120E	350	000E	52	1321	52	1321	66	1676	6	152	24	610

*Clearance is **required** for sliding out drain pan.

4.0 Clearances & Dimensions (cont'd)

4.2 Configurations and Dimensions

FIGURE 1 - Model RDH/REH/RHH/RXH Factory-assembled Configurations Depending on Option Selection and KEY to Dimensions A and C

NOTE: Dimensions A and C change with selection of factory-installed modules.

4.2.1 Model RDH, REH, RHH, or RXH (no heat only) with Horizontal Discharge

*Option AS2 Field-installed Outside Air Hood	*Field-installed hood (Option AS2) does not add length to the base of the system. The hood does add 42" (1066mm) to length of cabinet of RDH 75-150, REH 10A-60B, & RXH A&B; and 40-1/2" (1029mm) to length of cabinet of RDH 175-400A, RHH 130, 180, 260 & 350, REH 30D-120E, and RXH C-E. The evaporative cooling module, the mixing box, the coil cabinet, and the downturn plenum are mounted on the system base. (The evaporative cooling module is outside the curb cap.)

Option ECC3 or ECC2 Evaporative Cooling Module	Option MXB1 Mixing Box with Variety of Inlet Air Options	Option AU Cooling Coil Module with a DX Coil with or without a Reheat Pump or a Chilled Water Coil	Blower and Heat Section (RDH, RHH, & REH); Blower only (RXH "no heat" only; for RXH with optional hot water heat, see page 39) Airflow →	With Horizontal Discharge
ECC	MXB1	AU	BASIC	KEY to Dimension Codes A and C in FIGURE 2 & TABLE 3.
—	—	—	Basic	A, C
—	MXB1	—	Basic	A1, C1
ECCx	—	—	Basic	A1, C
—	—	AU 5 or 6 w/o Reheat	Basic	A1, C1
—	—	AU 7 with Reheat	Basic	A2, C2
ECCx	MXB1	—	Basic	A3, C1
—	MXB1	AU 5 or 6 w/o Reheat	Basic	A3, C3
—	MXB1	AU 7 with Reheat	Basic	A4 C4
ECCx	—	AU 5 or 6 w/o Reheat	Basic	A3, C1
ECCx	—	AU 7 with Reheat	Basic	A4, C2
ECCx	MXB1	AU 5 or 6 w/o Reheat	Basic	A5, C3
ECCx	MXB1	AU 7 with Reheat	Basic	A6, C4

TABLE 3 - Dimensions (inches and mm) of Model RDH, REH, RHH, or RXH (no heat only) with Horizontal Discharge (without an optional downturn plenum)

Dimensions (inches ±1/8)

RDH	REH	RHH	RXH	A	A1	A2	A3	A4	A5	A6	B	C	C1	C2	C3	C4
75/100	10A/20A/40A	—	000A	60-13/16	88-9/16	113-9/16	116-5/16	141-5/16	144-1/16	169-1/16	33-3/4	53-9/16	81-5/16	106-5/16	109-1/16	134-1/16
125/150	15B/30B/60B	—	000B	60-13/16	88-9/16	113-9/16	116-5/16	141-5/16	144-1/16	169-1/16	43-3/4	53-9/16	81-5/16	106-5/16	109-1/16	134-1/16
175/200/225	N/A	130/180	000C	RDH/ REH/RXH 76-1/2 RHH 86-1/2	RDH/ REH/RXH 104-1/4 RHH 114-1/4	RDH/ REH/RXH 129-1/4 RHH 139-1/4	RDH/ REH/RXH 132 RHH 142	RDH/REH/ RXH 157 RHH 167	RDH/REH/ RXH 159-3/4 RHH 169-3/4	RDH/REH/ RXH 184-3/4 RHH 194-3/4	33-3/4	RDH/ REH/RXH 69-1/4 RHH 79-1/4	RDH/REH/ RXH 97 RHH 107	RDH/REH/ RXH 122 RHH 132	RDH/ REH/RXH 124-3/4 RHH 134-3/4	RDH/ REH/RXH 149-3/4 RHH 159-3/4
250/300	30D/60D/90D/ 120D	260	000D								50					
350/400A	40E/80E/120E	350	000E								58					

RDH	REH	RHH	RXH	D	E	F	G	H	J	K	L	M	N	P-RDH	R-RDH	X-REH
75/100	10A/20A/40A	—	000A	31-9/16	30-7/16	22-7/8	18-3/8	27	24	17-9/16	13-9/16	13-13/16	25-15/16	28-9/16	19	21-11/16
125/150	15B/30B/60B	—	000B	41-9/16	30-7/16	26-1/2	18-3/8	37	24	27-9/16	13-9/16	18-13/16	25-15/16	28-9/16	19	21-11/16
175/200/225	N/A	130/180	000C	31-9/16	39-11/16	22-7/8	18-3/8	27	33-1/4	20-3/4	22-13/16	12-5/16	30-9/16	37-13/16	26-3/4	N/A
250/300	30D/60D/90D/ 120D	260	000D	47-13/16	39-11/16	34-3/4	18-3/8	43-1/4	33-1/4	28-5/8	22-13/16	24-7/16	30-9/16	37-13/16	26-3/4	29-3/8
350/400A	40E/80E/120E	350	000E	55-13/16	39-11/16	45-13/16	18-3/8	51-1/4	33-1/4	38-5/16	22-13/16	27-13/16	30-9/16	37-13/16	26-3/4	29-3/8

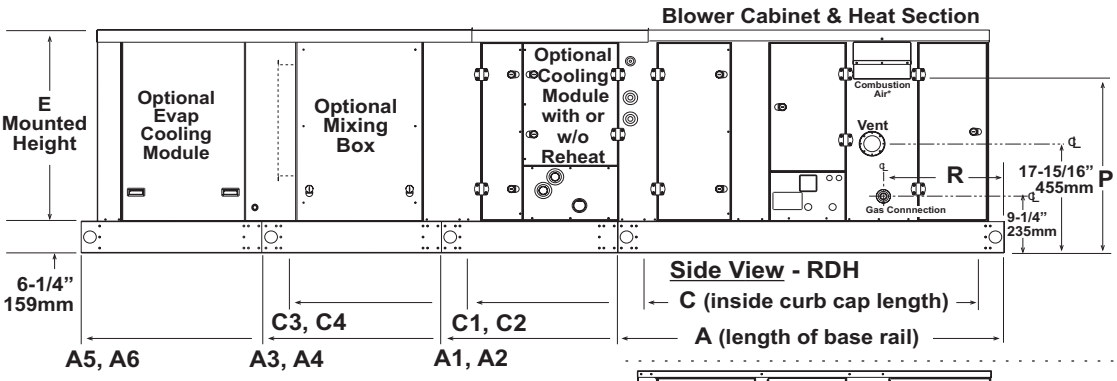
Dimensions (mm ±3)

RDH	REH	RHH	RXH	A	A1	A2	A3	A4	A5	A6	B	C	C1	C2	C3	C4
75/100	10A/20A/40A	—	000A	1545	2250	2885	2954	3589	3659	4294	857	1361	2065	2700	2770	3405
125/150	15B/30B/60B	—	000B	1545	2250	2885	2954	3589	3659	4294	1111	1361	2065	2700	2770	3405
175/200/225	N/A	130/180	000C	RDH/ REH/RXH 1943 RHH 2197	RDH/ REH/RXH 2648 RHH 2902	RDH/ REH/RXH 3283 RHH 3537	RDH/ REH/RXH 3353 RHH 33791	RDH/ REH/RXH 3988 RHH 4242	RDH/ REH/RXH 4058 RHH 4312	RDH/ REH/RXH 4693 RHH 4947	857	RDH/ REH/RXH 1759 RHH 2013	RDH/ REH/RXH 2464 RHH 2329	RDH/ REH/RXH 3099 RHH 3353	RDH/ REH/RXH 3169 RHH 3423	RDH/ REH/RXH 3804 RHH 4058
250/300	30D/60D/90D /120D	260	000D								1270					
350/400A	40E/80E/120E	350	000E								1473					

RDH	REH	RHH	RXH	D	E	F	G	H	J	K	L	M	N	P-RDH	R-RDH	X-REH
75/100	10A/20A/40A	—	000A	802	773	581	467	686	610	446	344	351	659	725	483	551
125/150	15B/30B/60B	—	000B	1056	773	673	467	940	610	700	344	478	659	725	483	551
175/200/225	N/A	130/180	000C	802	1008	581	467	686	845	527	580	313	777	960	679	N/A
250/300	30D/60D/90D/ 120D	260	000D	1214	1008	883	467	1099	845	728	580	621	777	960	679	746
350/400A	40E/80E/120E	350	000E	1418	1008	1164	467	1302	845	973	580	706	777	960	679	746

FIGURE 2 - Dimensions—Models RDH, REH, RHH, and RXH (no heat model only) with Horizontal Discharge (no Downturn Plenum)

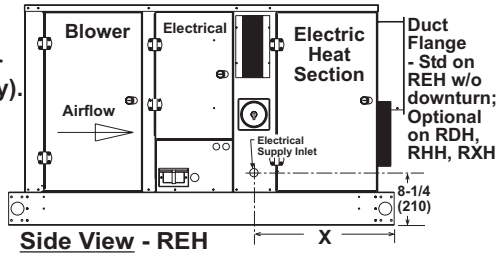
NOTE: An optional evaporative cooling module (Option ECC) is always first and extends beyond the roof curb. It has no affect on inside curb length, Dimension **C**.



Side View of Optional Modules

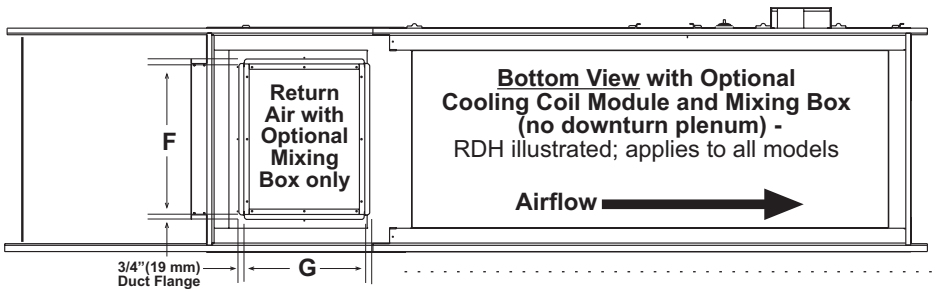
Side View Dimensions A, C, and E are the same for Models RDH, REH, RXH (subject to option availability). Model RHH side dimensions are longer.

NOTE: Side view of "no heat" Model RXH is not illustrated but includes the blower section and the heat section cabinets less the heating components. Dimensions here apply to "no heat" RXH only. For RXH with hot water heat, see page 38.



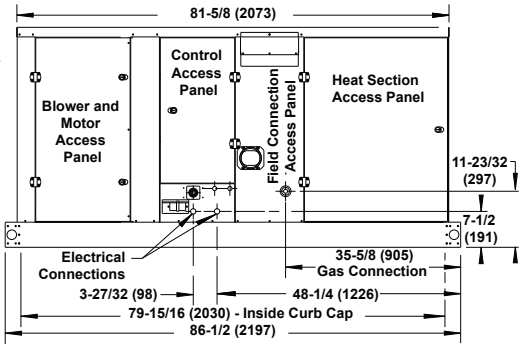
Dimensions Specific to each Module:

- Mixing Box (MXB), **FIGURE 22**, page 27.
- Evaporative Cooling Module (ECC), **FIGURE 25**, page 32.
- Chilled Water Cooling Coil Cabinet (AU6), **FIGURE 31**, page 35.
- DX Cooling Coil Cabinet (AU5), **FIGURE 32A**, page 36.
- DX Cooling Coil Cabinet w/Reheat (AU7), **FIGURE 32B**, page 36.
- Hot Water Heat Module for RXH, **FIGURE 36A** page 39.
- RDH Gas Heat, **FIGURE 2** top of page & **FIGURES 14A&B**, page 22.
- REH Electric Heat, **Side View** above.
- RHH High Efficiency Model, **Side View** center right and **FIGURE 15**, page 23, for heat section drain connection location.

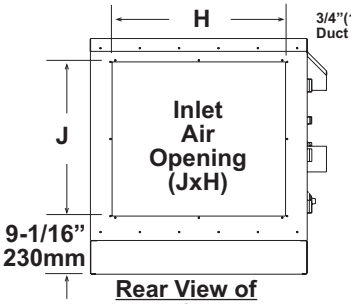


Side View - High Efficiency Model RHH

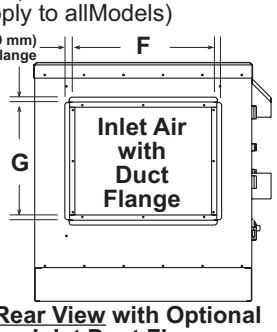
NOTE: Model RHH must be mounted on a roof curb. The area within the curb under the unit must be open.



Rear Views -(RDH shown; dimensionsapply to allModels)



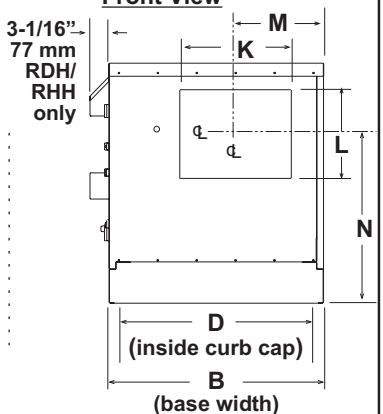
Rear View of Basic Cabinet
(If basic unit only, optional outside air hood is installed here; see page 25.)



Rear View with Optional Inlet Duct Flange

Rear View with Optional Evap Cooler, see page 32.

Front View



Other Dimensions:

- All Configurations **with** a Downturn Plenum (Option AQ), **FIGURE 4**, page 9.
- Outside Air Hood (Option AS2), **FIGURE 19A**, page 25.

FIGURE 3 - Models RDH, REH, RHH, and RXH (No Heat Only)—Factory-Assembled Configurations Depending on Option Selection and KEY to Dimensions A, C, and K

4.2.2 Model RDH, REH, RHH, or RXH (no heat) with Vertical Discharge

*Option AS2 Field-installed Outside Air Hood	*Field-installed hood (Option AS2) does not add length to the base of the system. The hood does add 42" (1066mm) to length of cabinet of RDH 75-150, REH 10A-60B, & RXH A&B; and 40-1/2" (1029mm) to length of cabinet of RDH 175-400A, REH 30D-120E, RHH 130, 180, 260 & 350, and RXH C-E. The evaporative cooling module, the mixing box, the coil cabinet, and the downturn plenum are mounted on the system base. (The evaporative cooling module is outside the curb cap.)			
Option ECC3 or ECC2 Evaporative Cooling Module	**Option MXB1 Mixing Box with Variety of Inlet Air Options**	**Option AU Cooling Coil Module with a DX Coil with or without a Reheat Pump or a Chilled Water Coil**	**Blower and Heat Section (RDH, REH, & RHH); Blower only (RXH "no heat" only; for RXH with optional hot water heat, see page 39)** **Airflow →**	**Vertical Discharge with Downturn Plenum Option AQxx ↓**
ECC	**MXB1**	**AU**	**BASIC**	KEY to Dimension Codes A, C, & K in **FIGURE 4** and **TABLE 4.**
—	—	—	**Basic**	**A, C**
—	**MXB1**	—	**Basic**	**A1, C1, K**
ECCx	—	—	**Basic**	**A1, C**
—	—	**AU 5 or 6 w/o Reheat**	**Basic**	**A1, C1**
—	—	**AU 7 with Reheat**	**Basic**	**A2, C2**
ECCx	**MXB1**	—	**Basic**	**A3, C1, K**
—	**MXB1**	**AU 5 or 6 w/o Reheat**	**Basic**	**A3, C3, K1**
—	**MXB1**	**AU 7 with Reheat**	**Basic**	**A4, C4, K2**
ECCx	—	**AU 5 or 6 w/o Reheat**	**Basic**	**A3, C1**
ECCx	—	**AU 7 with Reheat**	**Basic**	**A4, C2**
ECCx	**MXB1**	**AU 5 or 6 w/o Reheat**	**Basic**	**A5, C3, K1**
ECCx	**MXB1**	**AU 7 with Reheat**	**Basic**	**A6, C4, K2**

TABLE 4 - Dimensions (inches and mm) of Model RDH, REH, RHH, or RXH (no heat only) with a Downturn Plenum

Dimensions (inches ±1/8)

RDH	REH	RHH	RXH	A	A1	A2	A3	A4	A5	A6	B	C	C1	C2	C3	C4
75/100	10A/20A/40A	—	000A	88-9/16	116-5/16	141-5/16	144-1/16	169-1/16	172-1/8	197-1/8	33-3/4	81-5/16	109-1/16	134-1/16	136-13/16	161-13/16
125/150	15B/30B/60B	—	000B	88-9/16	116-5/16	141-5/16	144-1/16	169-1/16	172-1/8	197-1/8	43-3/4	81-5/16	109-1/16	134-1/16	136-13/16	161-13/16
175/200/225	N/A	130/180	000C	RDH/REH/ RXH 104-1/4 RHH 114-1/4	RDH/REH/ RXH 132 RHH 142	RDH/REH/ RXH 157 RHH 167	RDH/REH/ RXH 159-3/4 RHH 169-3/4	RDH/REH/ RXH 184-3/4 RHH 194-3/4	RDH/ REH/RXH 187-1/2 RHH 197-1/2	RDH/ REH/RXH 212-1/2 RHH 222-1/2	33-3/4	RDH/ REH/RXH 97 RHH 107	RDH/REH/ RXH 124-3/4 RHH 134-3/4	RDH/REH/ RXH 149-3/4 RHH 159-3/4	RDH/REH/ RXH 152-1/2 RHH 162-1/2	RDH/REH/ RXH 177-1/2 RHH 187-1/2
250/300	30D/60D/90D /120D	260	000D								50					
350/400A	40E/80E/120E	350	000E								58					

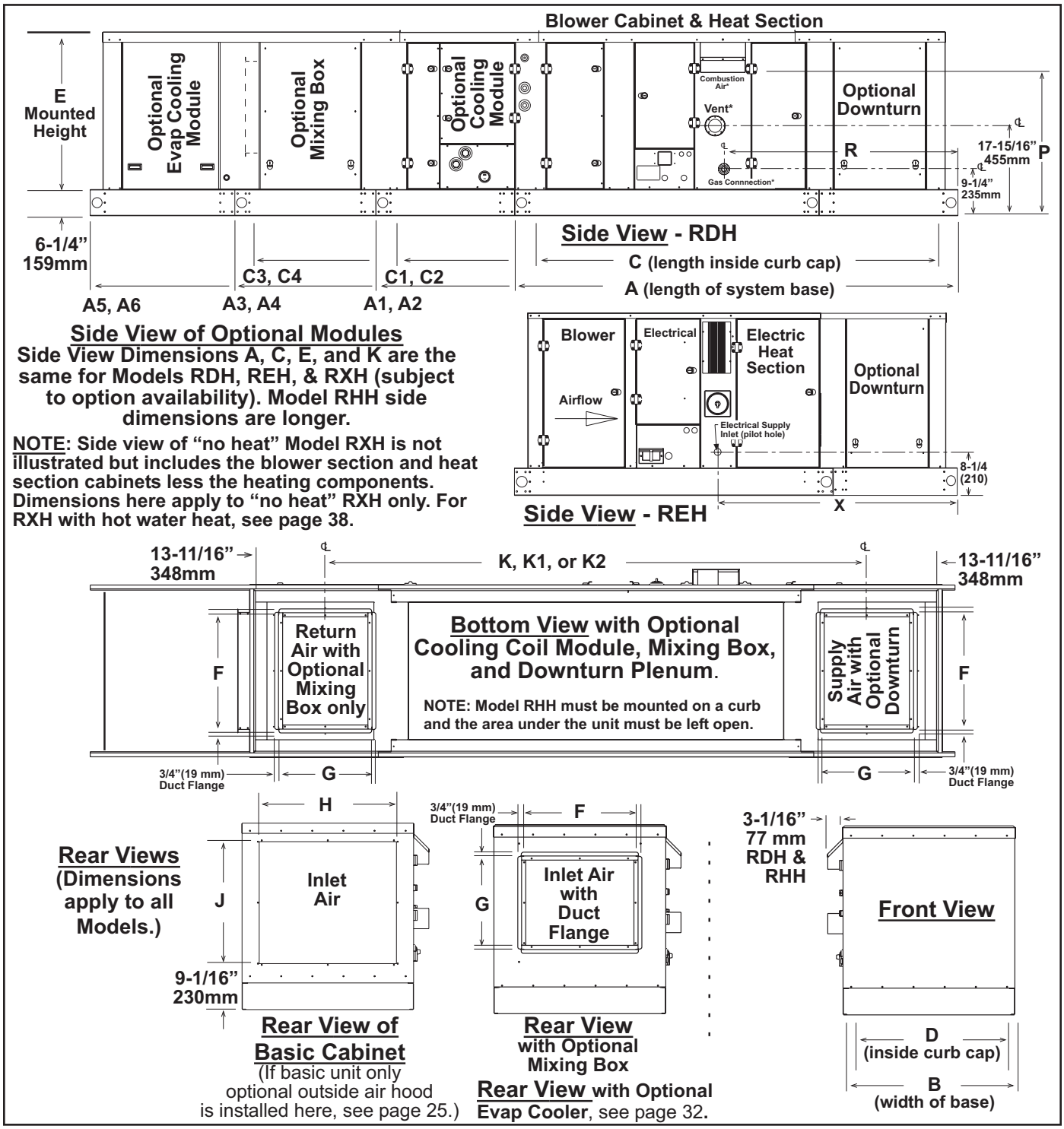
RDH	REH	RHH	RXH	D	E	F	G	H	J	K	K1	K2	P-RDH	R-RDH	X-REH
75/100	10A/20A/40A	—	000A	31-9/16	30-7/16	22-7/8	18-3/8	27	24	81-5/8	109-3/8	134-3/8	28-9/16	46-3/4	49-7/16
125/150	15B/30B/60B	—	000B	41-9/16	30-7/16	26-1/2	18-3/8	37	24	81-5/8	109-3/8	134-3/8	28-9/16	46-3/4	49-7/16
175/200/225	N/A	130/180	000C	31-9/16	39-11/16	22-7/8	18-3/8	27	33-1/4	RDH/ REH/RXH 97-3/8 RHH 107-3/8	RDH/ REH/RXH 125-1/8 RHH 135-1/8	RDH/ REH/RXH 150-1/8 RHH 160-1/8	37-13/16	54-1/2	N/A
250/300	30D/60D/90D /120D	260	000D	47-13/16	39-11/16	34-3/4	18-3/8	43-1/4	33-1/4				37-13/16	54-1/2	57-1/8
350/400A	40E/80E/120E	350	000E	55-13/16	39-11/16	45-13/16	18-3/8	51-1/4	33-1/4				37-13/16	54-1/2	57-1/8

Dimensions (mm ±3)

RDH	REH	RHH	RXH	A	A1	A2	A3	A4	A5	A6	B	C	C1	C2	C3	C4
75/100	10A/20A/40A	—	000A	2250	2954	3589	3659	4294	4372	5007	857	2065	2770	3405	3475	4110
125/150	15B/30B/60B	—	000B	2250	2954	3589	3659	494	4372	5007	1111	2065	2770	3405	3475	4110
175/200/225	N/A	130/180	000C	RDH/REH/ RXH 2648 RHH 2902	RDH/REH/ RXH 3353 RHH 3607	RDH/ REH/RXH 3988 RHH 4242	RDH/REH/ RXH 4058 RHH 4312	RDH/REH/ RXH 4693 RHH 4947	RDH/ REH/RXH 4763 RHH 5017	RDH/ REH/RXH 5398 RHH 5652	857	RDH/ REH/RXH 2464 RHH 2718	RDH/REH/ RXH 3169 RHH 3423	RDH/ REH/RXH 3804 RHH 4058	RDH/REH/ RXH 3874 RHH 4128	RDH/REH/ RXH 4509 RHH 4763
250/300	30D/60D/90D /120D	260	000D								1270					
350/400A	40E/80E/120E	350	000E								1473					

RDH	REH	RHH	RXH	D	E	F	G	H	J	K	K1	K2	P-RDH	R-RDH	X-REH
75/100	10A/20A/40A	—	000A	802	773	581	467	686	610	2073	2778	3413	725	1187	1255
125/150	15B/30B/60B	—	000B	1056	773	673	467	940	610	2073	2778	3413	725	1187	1255
175/200/225	N/A	130/180	000C	802	1008	581	467	686	845	RDH/ REH/ RXH 2473 RHH 2727	RDH/ REH/RXH 3432 RHH	RDH/ REH/RXH 3813 RHH 4067	960	1384	N/A
250/300	30D/60D/90D /120D	260	000D	1214	1008	883	467	1099	845				960	1384	1451
350/400A	40E/80E/120E	350	000E	1418	1008	1164	467	1302	845				960	1384	1451

FIGURE 4 - Dimensions—Model RDH, REH, RHH and RXH (no heat only) with a Downturn Plenum (bottom discharge)



NOTE: An optional evaporative cooling module (Option ECC) is always first and extends beyond the roof curb. It has no affect on inside curb length Dimension **C or K**.

Dimensions Specific to each Module:

- Mixing Box (MXB), **FIGURE 22**, page 27.
- Evaporative Cooling Module (ECC), **FIGURE 25**, page 32.
- Chilled Water Cooling Coil Cabinet (AU6), **FIGURE 31**, page 35.
- DX Cooling Coil Cabinet (AU5), **FIGURE 32A**, page 36.
- DX Cooling Coil Cabinet with Reheat (AU7), **FIGURE 32B**, page 36.
- Hot Water Heat Module for RXH, page 39, **FIGURE 36A**.

Other Dimensions:

- All Configurations with Horizontal Discharge (no downturn plenum), **FIGURE 2**, page 7.
- Outside Air Hood (Option AS2), **FIGURE 19A**, page 25.

RDH Gas Heat, **FIGURE 4** above and **FIGURES 14A&B**, page 22.

REH Electric Heat, **SIDE VIEW** in **FIGURE 4** above .

RHH High Efficiency Model, **FIGURE 2,** page 7, but with length dimensions from TABLE 4 that include 27-1/2" (699) added for downturn plenum. See **FIGURE 15**, page 23, for heat section drain connection location.

5.0 Mounting and Lifting

5.1 Weights

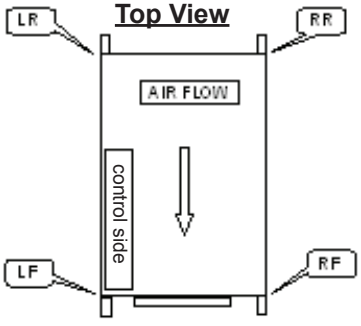
Before installing, check the supporting structure to be sure that it has sufficient load-bearing capacity to support the weight of the unit during installation and operation. Lifting and mounting are the responsibility of the installer.

TABLE 5 - Weights (lb and kg) of Basic System, Outside Air Hood and Factory-Installed Optional Modules

Model RDH (gas-fired heat)			75	100	125	150	175	200	225	250	300	350	400A
Model REH (electric heat)			10A, 20A, 40A		15B, 30B, 60B		N/A			30D, 60D, 90D, 120D		40E, 80E, 120E	
Model RHH (high efficiency gas-fired heat)			—		—		130 / 180			260		350	
Model RXH (no heat)			000A		000B		000C			000D		000E	
Approximate Net Weights—lb (does not include motor weight)													
Basic Gas Heat & Blower Section (Model RDH)			355	364	454	463	526	552	552	677	692	793	805
Basic Electric Heat & Blower Section (Model REH)			364		462		N/A			692		804	
High Efficiency Gas Heat & Blower Section (RHH)			—		—		539 / 544			729		889	
Blower Section, no heat (Model RXH)			278		348		393			494		556	
Option AS2 Outside Air Hood (field-installed)			70		76		76			87		96	
Approximate Weights of Factory-Attached Modules—lb (add to weight of basic unit above)													
Optional Downturn Plenum			120		124		130			140		150	
Option AR8, On/Off Damper (no mixing box)			34		45		56			73		85	
Option MXB1 Mixing Box			146		166		166			201		219	
Cooling Coil Module with heaviest coil weight*	DX coil (without reheat pump)	4 row coil	214		252		256			329		365	
		6 row coil	235		280		284			373		418	
	DX coil (with reheat pump)	4 row coil	331		382		394			494		547	
		6 row coil	352		410		422			538		600	
	Chilled water (filled) (no reheat pump)	4 row coil	301		363		373			497		559	
		6 row coil	351		431		441			604		686	
Evaporative Cooling Module	with Dry Media	12" media	120		141		136			172		190	
	with Wet Media & 3" of Water (full sump)		262		263		218			279		272	
Hot Water Heat Module for RXH with HW2 only (does not include water weight)		with 4 row, 14 fpi coil	145		175		177			236		263	
Approximate Net Weights—kg (does not include motor weight)													
Basic Gas Heat & Blower Section (Model RDH)			161	165	206	210	239	250	250	307	314	360	365
Basic Electric Heat & Blower Section (Model REH)			165		210		N/A			314		365	
High Efficiency Gas Heat & Blower Section (RHH)			—		—		244 / 247			331		403	
Blower Section, no heat (Model RXH)			126		158		178			224		252	
Option AS2 Outside Air Hood (field-installed)			32		34		34			39		44	
Approximate Weights (kg) of factory-attached modules (add to wt of basic unit above)													
Optional Downturn Plenum			54		56		56			63		68	
Option AR8, On/Off Damper (no mixing box)			15		20		25			33		39	
Option MXB1 Mixing Box			66		75		75			91		99	
Cooling Coil Module with heaviest coil weight*	DX coil (without reheat pump)	4 row coil	97		114		116			149		166	
		6 row coil	107		127		129			169		190	
	DX coil (with reheat pump)	4 row coil	150		173		179			224		248	
		6 row coil	160		186		191			244		272	
	Chilled water (filled) (no reheat pump)	4 row coil	137		165		169			225		254	
		6 row coil	159		195		200			274		311	
Evaporative Cooling Module	with Dry Media	305mm media	54		64		62			78		86	
	with Wet Media & 76mm of Water (full)		119		119		99			127		123	
Hot Water Heat Module for RXH with HW2 only (does not include water weight)		with 4 row, 14 fpi coil	66		79		80			107		119	

* Cooling coil cabinet module weight is estimated for heaviest coil. If more accurate information is needed, check with your distributor or Factory Representative who either has the specific information in the order specifications or has software to generate the information.

FIGURE 5 - Corner Weight Locations



NOTES: If controls are on the right side, switch left and right side weights. Weights do not include the blower motor or any optional modules. For additional corner weights contact your distributor.

TABLE 6 - Approximate Corner Weights (lb & kg) of Basic Heat Module and Blower Section

RDH	75	100	125	150	175	200	225	250	300	350	400A
Approximate Corner Weights (lb)—Basic Heater & Blower only											
LR	77	79	98	100	114	117	120	147	150	172	174
RR	69	71	89	90	103	106	108	132	135	155	157
RF	101	104	129	132	150	154	157	193	197	226	229
LF	108	110	138	140	160	164	167	205	210	241	244
Approximate Corner Weights (kg)—Basic Heater & Blower only											
LR	35	36	45	46	52	53	54	67	68	78	79
RR	31	32	40	41	47	48	49	60	61	70	71
RF	46	47	59	60	68	70	71	87	89	102	104
LF	49	50	62	64	72	74	76	93	95	109	111

REH	10A, 20A, 40A		15B, 30B, 60B		30D, 60D, 90D, 120D		40E, 80E, 120E	
Approx Wt of Each Corner	lb	kg	lb	kg	lb	kg	lb	kg
	74	34	92	42	131	59	149	68

5.2 Mounting

Model RHH is designed to be mounted on a roof curb.

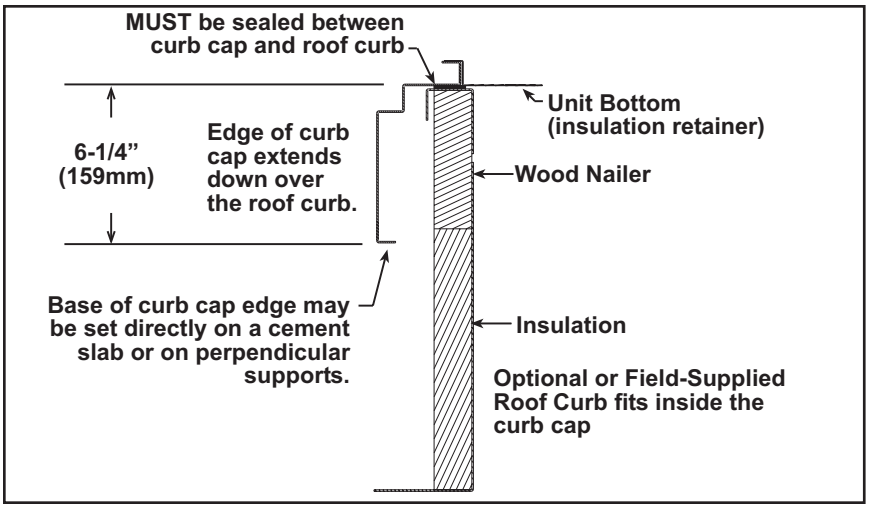
Model RDH, REH, and RXH outdoor systems are designed to be mounted on a roof or a cement slab. The system may be set directly on a slab without any additional support. When installed on a roof, either a manufacturer-designed roof curb, a manufacturer-designed roof curb adapter (required if replacing a Model RGB or RPB), a field-supplied roof curb, or other field-supplied support is required.

NOTE: A roof curb is recommended with a downturn plenum and/or bottom return air to provide a weatherproof installation.

5.2.1 Curb Cap Base

The system is equipped with a load-bearing curb cap which forms the integral part of the unit. The curb cap has bolted seams and is designed so that it may be set directly on a cement slab, on perpendicular supports, or over a roof curb.

FIGURE 6 - Curb Cap Base



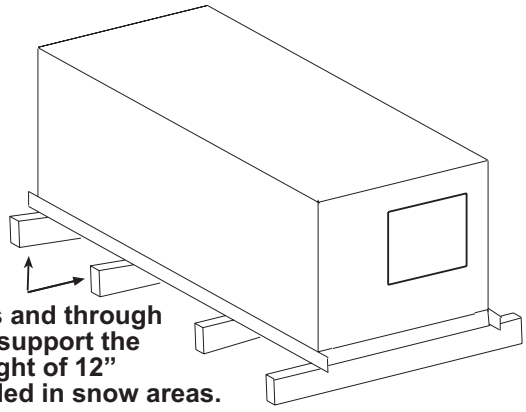
NOTE: The curb cap on Models RDH, REH, RHH, and RXH will not fit on the same roof curb as a Model RGB/RPB. Contact your distributor about the availability of a curb adapter.

5.2.2 Mounting Without a Curb (does not apply to Model RHH)

Prior to installation, be sure that the method of support is in agreement with all local building codes and is suited to the climate. If considering an installation without a roof curb in snow areas, it is recommended that the support under the system be at least 12" (305mm) higher than the roof surface. **IMPORTANT NOTE:** If setting cross supports on the roof surface and not decking, be sure to have sufficient tread material under the supports to adequately spread the load and prevent “sinking” into the roofing material.

The field supplied, weather resistant, cross-support structure must be secure and adequate for the weight of the system (Refer to weights in Paragraph 5.1). See width dimensions in Paragraph 4.2.

FIGURE 7 - Mounting a Unit on Cross Supports



5.2.3 Mounting on a Roof Curb (see FIGURES 8 and 9, pages 12 and 14 and follow the instructions for the model being installed)

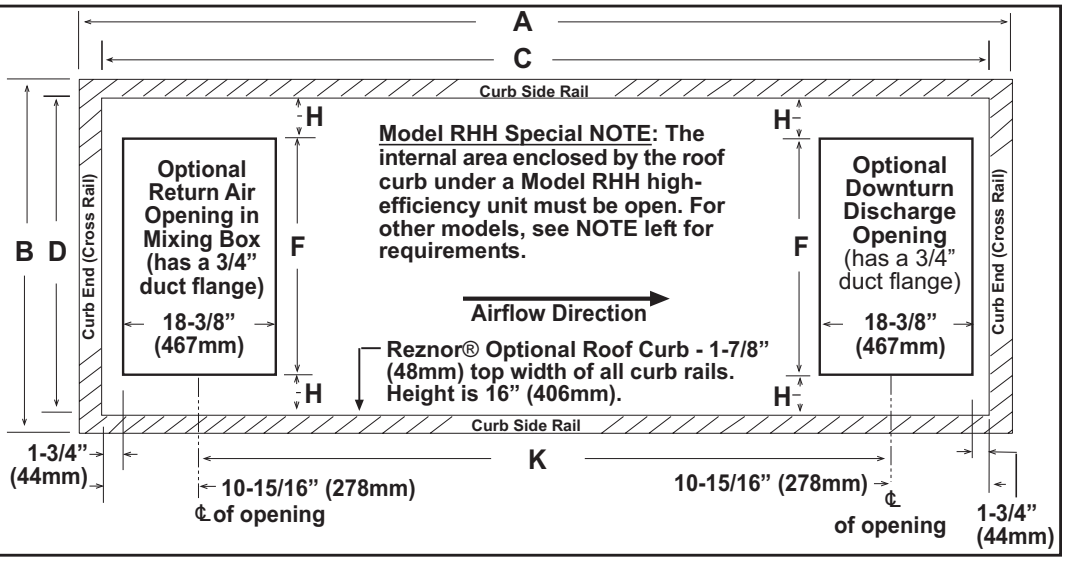
NOTE: If installing a Model RDH or REH unit to replace a Model RGB or RPB, install a curb adapter on the already installed roof curb. Follow the instructions provided with the adapter. Seal the top of the adapter before setting the new unit.

The Option CJ curb for a Model RDH, REH, RHH, and RXH unit is a 16" high, fully enclosed, insulated roof curb. If the application is sound sensitive, consider installing a field-supplied vibration isolation curb or specialty sound attenuation curb. Whether using the optional roof curb available with the system or a field-supplied curb, the curb must be secure, square, and level.

The top surface of the roof curb must be caulked with 1/4" × 1-1/4" sealant tape or two 1/4" beads of suitable sealant. The unit must be sealed to the curb to minimize sound transmission, prevent air leakage, and to prevent water leakage into the curb area due to wind blown rain and capillary action.

FIGURE 8 - Dimensions of Optional Roof Curbs

IMPORTANT Note—Models RDH, REH, and RXH with Hot Water Heat: The area enclosed by the roof curb must comply with clearance to combustible materials. If roof is constructed of combustible materials, the area within the curb must be either ventilated, left open, or covered with **non-combustible** material which has an "R" value of at least 5.0. If the area within the curb is left open, higher radiated sound levels may result.



NOTE: If your installation includes an optional energy recovery module, a separate field-supplied roof curb is required for the energy recovery module.

TABLE 7A - Dimensions and Weights of Optional Roof Curbs for Model RDH, Model REH, and Model RXH without a hot water heat module (for a Model RXH with a hot water heat module, see **TABLE 8A**)

Configuration*	Option Code	RDH Size	REH Size	**RXH Size	Inches (±1/8)				mm (±3)				Weight	
					A	B	C	D	A	B	C	D	lb	kg
Basic Unit ONLY (blower and heat section) with horizontal discharge	CJ8A	75/100	10A/20A/40A	000A	51-13/16	29-13/16	48-1/16	26-1/16	1,316	757	1,221	662	90	41
		125/150	15B/30B/60B	000B	51-13/16	39-13/16	48-1/16	36-1/16	1,316	1,011	1,221	916	101	46
		175/200/225	N/A	000C	67-1/2	29-13/16	63-3/4	26-1/16	1,715	757	1,619	662	107	49
		250/300	30D/60D/90D/120D	000D	67-1/2	46-1/16	63-3/4	42-5/16	1,715	1,170	1,619	1,075	125	57
		350/400A	40E/80E/120E	000E	67-1/2	54-1/16	63-3/4	50-5/16	1,715	1,373	1,619	1,278	134	61
Basic unit PLUS 1: Either Downturn Discharge Plenum (AQ5 or AQ8); OR Mixing Box (MXB1) with horizontal discharge; OR Cooling Coil Cabinet without Reheat (AU5 or AU6) with horizontal discharge	CJ8B	75/100	10A/20A/40A	000A	79-9/16	29-13/16	75-13/16	26-1/16	2,021	757	1,926	662	120	54
		125/150	15B/30B/60B	000B	79-9/16	39-13/16	75-13/16	36-1/16	2,021	1,011	1,926	916	131	59
		175/200/225	N/A	000C	95-1/4	29-13/16	91-1/2	26-1/16	2,419	757	2,324	662	138	63
		250/300	30D/60D/90D/120D	000D	95-1/4	46-1/16	91-1/2	42-5/16	2,419	1,170	2,324	1,075	155	70
		350/400A	40E/80E/120E	000E	95-1/4	54-1/16	91-1/2	50-5/16	2,419	1,373	2,324	1,278	164	74
Basic unit PLUS 2: Down Discharge (AQ 5 or 8) AND Mixing Box OR Cooling Coil Cabinet without Reheat (AU 5 or 6); OR Mixing Box AND Cooling Coil Cabinet without Reheat (AU 5 or 6) with horizontal discharge	CJ8C	75/100	10A/20A/40A	000A	107-5/16	29-13/16	103-9/16	26-1/16	2726	757	2631	662	151	68
		125/150	15B/30B/60B	000B	107-5/16	39-13/16	103-9/16	36-1/16	2726	1011	2631	916	162	73
		175/200/225	N/A	000C	123	29-13/16	119-1/4	26-1/16	3124	757	3029	662	168	76
		250/300	30D/60D/90D/120D	000D	123	46-1/16	119-1/4	42-5/16	3124	1170	3029	1075	186	84
		350/400A	40E/80E/120E	000E	123	54-1/16	119-1/4	50-5/16	3124	1373	3029	1278	195	88
Basic unit PLUS 3: Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1) AND Cooling Coil Cabinet without Reheat (AU5 or AU6)	CJ8D	75/100	10A/20A/40A	000A	135-1/16	29-13/16	131-5/16	26-1/16	3431	757	3335	662	181	82
		125/150	15B/30B/60B	000B	135-1/16	39-13/16	131-5/16	36-1/16	3431	1011	3335	916	192	87
		175/200/225	N/A	000C	150-3/4	29-13/16	147	26-1/16	3829	757	3734	662	199	90
		250/300	30D/60D/90D/120D	000D	150-3/4	46-1/16	147	42-5/16	3829	1170	3734	1075	216	98
		350/400A	40E/80E/120E	000E	150-3/4	54-1/16	147	50-5/16	3829	1373	3734	1278	225	102
Basic unit PLUS 1: Cooling Coil Cabinet with Reheat (AU7) with horizontal discharge	CJ8E	75/100	10A/20A/40A	000A	104-9/16	29-13/16	100-13/16	26-1/16	2656	757	2561	662	149	68
		125/150	15B/30B/60B	000B	104-9/16	39-13/16	100-13/16	36-1/16	2656	1011	2561	916	160	73
		175/200/225	N/A	000C	120-1/4	29-13/16	116-1/2	26-1/16	3054	757	2959	662	167	76
		250/300	30D/60D/90D/120D	000D	120-1/4	46-1/16	116-1/2	42-5/16	3054	1170	2959	1075	184	83
		350/400A	40E/80E/120E	000E	120-1/4	54-1/16	116-1/2	50-5/16	3054	1373	2959	1278	193	88
Basic unit PLUS 2: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) OR Mixing Box (MXB1) with horizontal discharge	CJ8F	75/100	10A/20A/40A	000A	132-5/16	29-13/16	128-9/16	26-1/16	3361	757	3266	662	180	82
		125/150	15B/30B/60B	000B	132-5/16	39-13/16	128-9/16	36-1/16	3361	1011	3266	916	191	87
		175/200/225	N/A	000C	148	29-13/16	144-1/4	26-1/16	3759	757	3664	662	197	89
		250/300	30D/60D/90D/120D	000D	148	46-1/16	144-1/4	42-5/16	3759	1170	3664	1075	215	98
		350/400A	40E/80E/120E	000E	148	54-1/16	144-1/4	50-5/16	3759	1373	3664	1278	224	102
Basic unit PLUS 3: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1)	CJ8G	75/100	10A/20A/40A	000A	160-1/16	29-13/16	156-5/16	26-1/16	4066	757	3970	662	210	95
		125/150	15B/30B/60B	000B	160-1/16	39-13/16	156-5/16	36-1/16	4066	1011	3970	916	221	100
		175/200/225	N/A	000C	175-3/4	29-13/16	172	26-1/16	4464	757	4369	662	228	103
		250/300	30D/60D/90D/120D	000D	175-3/4	46-1/16	172	42-5/16	4464	1170	4369	1075	245	111
		350/400A	40E/80E/120E	000E	175-3/4	54-1/16	172	50-5/16	4464	1373	4369	1278	254	115

* See Configurations in Paragraph 4.2. **NOTE:** If there is an evaporative cooling module, the base of the unit under the evaporative cooling module extends beyond the end of the roof curb. An evaporative cooling module does not affect the length of the roof curb.

** Model RXH in Tables 7A and 7B apply to “no heat” model only. For roof curb for Model RXH with optional hot water heat module, see Tables 8A and 8B

TABLE 7B - Dimensions for Locations of Bottom Duct Openings as shown in FIGURE 8 for Models in TABLE 7A

NOTE: Duct openings should be 1" larger than the duct size for installation clearance.

Model and Size			Dimensions (inches ±1/8)					Dimensions (mm ±3)				
RDH	REH	RXH	F	H	K (with mixing box and down discharge)			F	H	K (with mixing box and down discharge)		
		No hot water heat module	With mixing box and/or down discharge		No cooling coil module	With a cooling coil module		With mixing box and/ or down discharge		No cooling coil module	With a cooling coil module	
						No reheat	With reheat				No reheat	With reheat
75/100	10A/20A/40A	000A	22-7/8	1-9/16	81-5/8	109-3/8	134-3/8	581	40	2073	2778	3413
125/150	15B/30B/60B	000B	26-1/2	4-3/4	81-5/8	109-3/8	134-3/8	673	121	2073	2778	3413
175/200/225	N/A	000C	22-7/8	1-9/16	97-3/8	125-1/8	150-1/8	581	40	2473	3178	3813
250/300	30D/60D/90D/ 120D	000D	34-3/4	3-3/4	97-3/8	125-1/8	150-1/8	883	96	2473	3178	3813
350/400A	40E/80E/120E	000E	45-13/16	2-1/4	97-3/8	125-1/8	150-1/8	1164	57	2473	3178	3813

TABLE 8A - Dimensions and Weights of Optional Roof Curbs for Model RXH with Optional Hot Water Heat Module (Option HW2)

Configuration*	Option Code	RXH with Optional Hot Water Heat Module	Inches (±1/8)				mm (±3)				Weight	
			A	B	C	D	A	B	C	D	lb	kg
Model RXH with Optional Hot Water Heat Module (HW2) and horizontal discharge	CJ8H	000A	68-5/8	29-13/16	64-7/8	26-1/16	1743	757	1648	662	115	52
		000B	68-5/8	39-13/16	64-7/8	36-1/16	1743	1,011	1648	916	127	58
		000C	84-3/8	29-13/16	80-5/8	26-1/16	2143	757	2048	662	134	61
		000D	84-3/8	46-1/16	80-5/8	42-5/16	2143	1,170	2048	1,075	153	69
		000E	84-3/8	54-1/16	80-5/8	50-5/16	2143	1,373	2048	1,278	153	69
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 1: Either Downturn Discharge Plenum (AQ5 or AQ8); OR Mixing Box (MXB1) with horizontal discharge; OR Cooling Coil Cabinet without Reheat (AU5 or AU6) with horizontal discharge	CJ8J	000A	96-3/8	29-13/16	92-5/8	26-1/16	2448	757	2353	662	148	67
		000B	96-3/8	39-13/16	92-5/8	36-1/16	2448	1,011	2353	916	160	73
		000C	112-1/8	29-13/16	108-3/8	26-1/16	2848	757	2753	662	167	76
		000D	112-1/8	46-1/16	108-3/8	42-5/16	2848	1,170	2753	1,075	167	76
		000E	112-1/8	54-1/16	108-3/8	50-5/16	2848	1,373	2753	1,278	167	76
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 2: Down Discharge (AQ 5 or AQ8) AND Mixing Box OR Cooling Coil Cabinet without Reheat (AU 5 or 6); OR Mixing Box AND Cooling Coil Cabinet without Reheat (AU 5 or 6) with horizontal discharge	CJ8K	000A	124-1/8	29-13/16	120-3/8	26-1/16	3153	757	3058	662	189	86
		000B	124-1/8	39-13/16	120-3/8	36-1/16	3153	1011	3058	916	201	91
		000C	139-7/8	29-13/16	136-1/8	26-1/16	3553	757	3458	662	208	94
		000D	139-7/8	46-1/16	136-1/8	42-5/16	3553	1170	3458	1075	227	103
		000E	139-7/8	54-1/16	136-1/8	50-5/16	3553	1373	3458	1278	237	108
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 3: Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1) AND Cooling Coil Cabinet without Reheat (AU5 or AU6)	CJ8L	000A	151-3/4	29-13/16	148	26-1/16	3854	757	3759	662	185	84
		000B	151-3/4	39-13/16	148	36-1/16	3854	1011	3759	916	197	89
		000C	167-3/8	29-13/16	163-5/8	26-1/16	4251	757	4156	662	204	93
		000D	167-3/8	46-1/16	163-5/8	42-5/16	4251	1170	4156	1075	224	102
		000E	167-3/8	54-1/16	163-5/8	50-5/16	4251	1373	4156	1278	234	106
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 1: Cooling Coil Cabinet with Reheat (AU7) with horizontal discharge	CJ8M	000A	121-1/4	29-13/16	117-1/2	26-1/16	3080	757	2985	662	222	101
		000B	121-1/4	39-13/16	117-1/2	36-1/16	3080	1011	2985	916	234	106
		000C	136-7/8	29-13/16	133-1/8	26-1/16	3477	757	3381	662	241	109
		000D	136-7/8	46-1/16	133-1/8	42-5/16	3477	1170	3381	1075	261	118
		000E	136-7/8	54-1/16	133-1/8	50-5/16	3477	1373	3381	1278	271	123
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 2: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) OR Mixing Box (MXB1) with horizontal discharge	CJ8N	000A	148-7/8	29-13/16	145-1/8	26-1/16	3781	757	3686	662	219	99
		000B	148-7/8	39-13/16	145-1/8	36-1/16	3781	1011	3686	916	231	105
		000C	164-5/8	29-13/16	160-7/8	26-1/16	4181	757	4086	662	238	108
		000D	164-5/8	46-1/16	160-7/8	42-5/16	4181	1170	4086	1075	258	117
		000E	164-5/8	54-1/16	160-7/8	50-5/16	4181	1373	4086	1278	267	121
Model RXH with Optional Hot Water Heat Module (HW2) PLUS 3: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1)	CJ8P	000A	176-3/4	29-13/16	173	26-1/16	4489	757	4394	662	252	114
		000B	176-3/4	39-13/16	173	36-1/16	4489	1011	4394	916	265	120
		000C	192-3/8	29-13/16	188-5/8	26-1/16	4886	757	4791	662	271	123
		000D	192-3/8	46-1/16	188-5/8	42-5/16	4886	1170	4791	1075	291	132
		000E	192-3/8	54-1/16	188-5/8	50-5/16	4886	1373	4791	1278	301	137

* See Configurations in Paragraph 4.2. **NOTE:** If there is an evaporative cooling module, the base of the unit under the evaporative cooling module extends beyond the end of the roof curb. An evaporative cooling module does not affect the length of the roof curb.

TABLE 8B - Dimensions for Locations of Bottom Duct Openings as shown in FIGURE 8 for Models in TABLE 8A

NOTE: Duct openings should be 1" larger than the duct size for installation clearance.

Model RXH	Dimensions (inches ±1/8)					Dimensions (mm ±3)				
	F	H	K (with mixing box & downturn)			F	H	K (with mixing box & downturn)		
With hot water heat module	With mixing box and/or down discharge		No cooling coil module	With cooling coil module		With mixing box and/or down discharge		No cooling coil module	With cooling coil module	
				No reheat	With reheat				No reheat	With reheat
000A	22-7/8	1-9/16	98-7/16	126-3/16	151-3/16	581	40	2500	3205	3840
000B	26-1/2	4-3/4	98-7/16	126-3/16	151-3/16	673	121	2500	3205	3840
000C	22-7/8	1-9/16	114-3/16	141-15/16	166-15/16	581	40	2900	3605	4240
000D	34-3/4	3-3/4	114-3/16	141-15/16	166-15/16	883	96	2900	3605	4240
000E	45-13/16	2-1/4	114-3/16	141-15/16	166-15/16	1164	57	2900	3605	4240

TABLE 9A - Dimensions and Weights of Optional Roof Curbs for Model RHH (See FIGURE 8, page 12)

Configuration*	Option Code	RHH	Inches (±1/8)				mm (±3)				Weight	
			A	B	C	D	A	B	C	D	lb	kg
Model RHH and horizontal discharge	CJ8Q	130/180	77-1/2	29-13/16	73-3/4	26-1/16	1,969	757	1,873	662	125	57
		260	77-1/2	46-1/16	73-3/4	42-5/16	1,969	1,170	1,873	1,075	145	66
		350	77-1/2	54-1/16	73-3/4	50-5/16	1,969	1,373	1,873	1,278	155	70
Model RHH PLUS 1: Either Downturn Discharge Plenum (AQ5 or AQ8); OR Mixing Box (MXB1) with horizontal discharge; OR Cooling Coil Cabinet without Reheat (AU5 or AU6) with horizontal discharge	CJ8R	130/180	105-1/4	29-13/16	101-1/2	26-1/16	2,673	757	2,578	662	160	72
		260	105-1/4	46-1/16	101-1/2	42-5/16	2,673	1,170	2,578	1,075	180	82
		350	105-1/4	54-1/16	101-1/2	50-5/16	2,673	1,373	2,578	1,278	190	86
Model RHH PLUS 2: Down Discharge (AQ 5 or AQ8) AND Mixing Box OR Cooling Coil Cabinet without Reheat (AU 5 or 6); OR Mixing Box AND Cooling Coil Cabinet without Reheat (AU 5 or 6) with horizontal discharge	CJ8S	130/180	133	29-13/16	129-1/4	26-1/16	3,378	757	3,283	662	200	91
		260	133	46-1/16	129-1/4	42-5/16	3,378	1,170	3,283	1,075	220	100
		350	133	54-1/16	129-1/4	50-5/16	3,378	1,373	3,283	1,278	230	104
Model RHH PLUS 3: Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1) AND Cooling Coil Cabinet without Reheat (AU5 or AU6)	CJ8T	130/180	160-3/4	29-13/16	157	26-1/16	4,083	757	3,988	662	233	106
		260	160-3/4	46-1/16	157	42-5/16	4,083	1,170	3,988	1,075	253	115
		350	160-3/4	54-1/16	157	50-5/16	4,083	1,373	3,988	1,278	263	119
Model RHH PLUS 1: Cooling Coil Cabinet with Reheat (AU7) with horizontal discharge	CJ8U	130/180	130-1/4	29-13/16	126-1/2	26-1/16	3,308	757	3,213	662	196	89
		260	130-1/4	46-1/16	126-1/2	42-5/16	3,308	1,170	3,213	1,075	216	98
		350	130-1/4	54-1/16	126-1/2	50-5/16	3,308	1,373	3,213	1,278	226	102
Model RHH PLUS 2: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) OR Mixing Box (MXB1) with horizontal discharge	CJ8V	130/180	158	29-13/16	154-1/4	26-1/16	4,013	757	3,918	662	230	104
		260	158	46-1/16	154-1/4	42-5/16	4,013	1,170	3,918	1,075	250	113
		350	158	54-1/16	154-1/4	50-5/16	4,013	1,373	3,918	1,278	260	118
Model RHH PLUS 3: Cooling Coil Cabinet with Reheat (AU7) AND Down Discharge Plenum (AQ5 or AQ8) AND Mixing Box (MXB1)	CJ8W	130/180	185-3/4	29-13/16	182	26-1/16	4,718	757	4,623	662	263	119
		260	185-3/4	46-1/16	182	42-5/16	4,718	1,170	4,623	1,075	283	128
		350	185-3/4	54-1/16	182	50-5/16	4,718	1,373	4,623	1,278	293	133

* See Configurations in Paragraph 4.2. **NOTE:** If there is an evaporative cooling module, the base of the unit under the evaporative cooling module extends beyond the end of the roof curb. An evaporative cooling module does not affect the length of the roof curb.

TABLE 9B - Dimensions for Locations of Bottom Duct Connections as shown in FIGURE 8 for Model RHH

Important NOTE: To ensure proper operation of a Model RHH, the opening through the roof must be the same area as the inside dimension of the roof curb. **Inside area of the roof curb under a Model RHH must be open.**

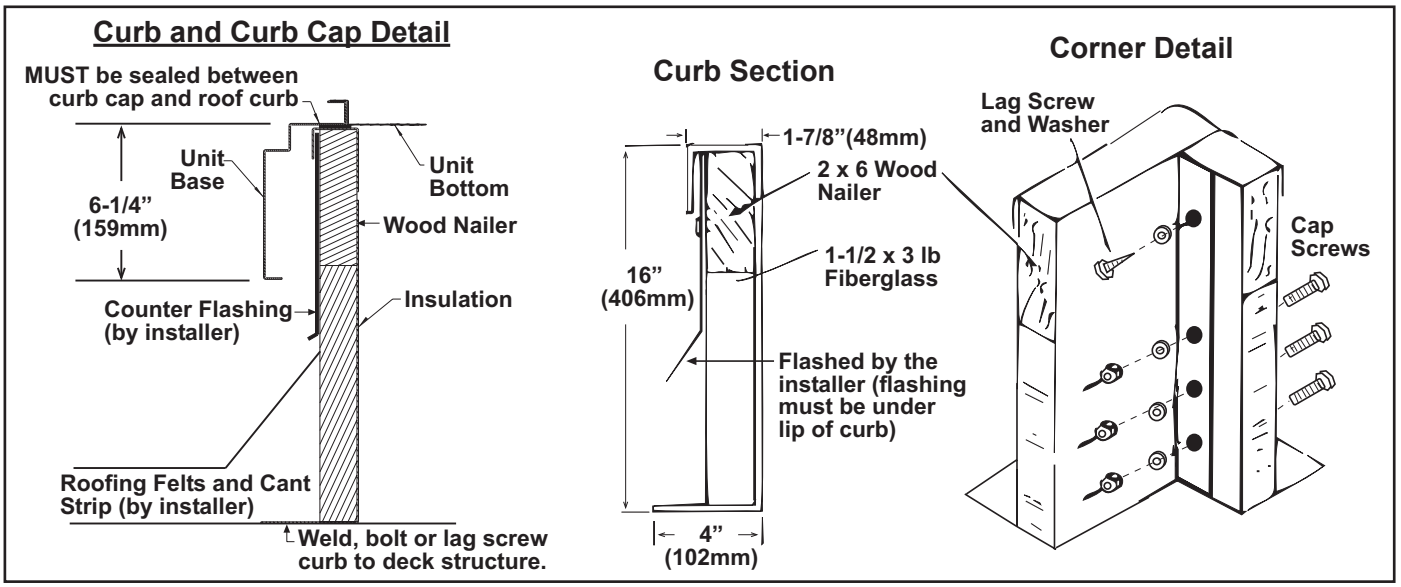
Model RHH	Duct Location Dimensions (inches ±1/8)					Duct Location Dimensions (mm ±3)				
	F	H	K (w/mixing box & downturn)			F	H	K (w/mixing box & downturn)		
	With mixing box and/ or down discharge		No cooling coil module	With cooling coil module		With mixing box and/ or down discharge		No cooling coil module	With cooling coil module	
				No reheat	With reheat				No reheat	With reheat
130/180	22-7/8	1-9/16	107-3/8	135-1/8	160-1/8	581	40	2727	3432	4067
260	34-3/4	3-3/4	107-3/8	135-1/8	160-1/8	883	96	2727	3432	4067
350	45-13/16	2-1/4	107-3/8	135-1/8	160-1/8	1164	57	2727	3432	4067

Roof Curb Assembly and Installation Instructions (see layout in FIGURE 8 and illustrations in FIGURE 9)

Curbs are shipped unassembled. Field assembly and mounting on the roof are the responsibility of the installer. All hardware necessary to assemble the curb is supplied. Additional installation hardware must be field supplied.

IMPORTANT: Before installing roof curb, verify that the size is correct for the system being installed.

FIGURE 9 - Roof Curb Assembly



1. Position curb cross rails and curb side rails as illustrated in **FIGURE 8,** page 12. Using the hardware provided, join the corners as illustrated in the corner detail (**FIGURE 9**).
2. Check the assembly for squareness. Adjust the roof curb so that the diagonal measurements are equal within a tolerance of ±1/8" (3mm).
3. Level the roof curb. To ensure proper condensate drainage and a weathertight seal between the system curb cap and the roof curb, the roof curb must be leveled in both directions with no twist end to end. Shim level as required and secure curb to roof deck before proceeding with flashing.
4. Install field-supplied flashing.
5. Before placing the unit on the curb, apply furnished 1/4" × 1-1/4" foam sealant tape to top surface of curb, making good butt joint at corners. The unit must be sealed to the curb to prevent water leakage into the curb area due to blown rain and capillary action.

5.3 Rigging and Lifting

NOTE: Apply gasketing to the roof curb prior to lifting the unit and setting it on the curb.

Lifting holes in the base are provided for rigging. If the circumstances require a rigging height that is less than 12 feet (3.7M), spreader bars are required. Lift with vertical force only.

Test lift the unit to be sure that it is secure. Lift the unit slowly, following safe lifting procedures. Failure to lift by the manufacturer's instructions could cause damage to the equipment and/or personal injury or death. The equipment manufacturer is not responsible for unsafe rigging or lifting procedures.

DANGER

To prevent injury, death, or equipment damage caused by inadequate or improper rigging, test lift the unit before attempting to place it on a roof. See Hazard Intensity Levels, page 2.

6.0 Mechanical

6.1 Gas Piping and Pressures—Models RDH and RHH

6.1.1 Gas Supply and Connections

WARNING: This appliance is equipped for a maximum gas supply pressure of 1/2 psi, 3.5 kPa, or 14 inches water column. **NOTE:** Supply pressures higher than 1/2 psi require installation of an additional service regulator external to the unit.

Pressure Testing Supply Piping:

Test Pressure Above 1/2 PSI: Disconnect the heater and manual valve from the gas supply which is to be pressure tested. Cap or plug the supply line.

Test Pressure Below 1/2 PSI: Before testing, close the manual valve on the heater.

NOTE: Gas conversion kits are available for changing units with 1-stage and 2-stage gas controls (Option AG1, AG2, AG3, AG15, and AG16) from natural gas to propane or propane to natural gas.

Gas conversion kits do not apply to a heater with a 2-speed venter control system (Option AG8, AG9, AG9H, AG40, AG58, AG60, AG61, AG62, DG1, DG5, D12B, and D12C) or with 8:1 modulation (Options AG58 or D12G).

Contact your distributor, representative, or the factory for information.

All piping must be in accordance with requirements outlined in the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition) or CSA B149.1 (latest edition) Natural Gas and Propane Installation Code. Gas supply piping installation should conform with good practice and with local codes.

These units for use with natural gas are orificed for gas having a heating value of 1000 (±50) BTU per cubic ft. If the gas at the installation does not meet this specification, consult the factory for proper orifice.

Pipe joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or any other chemical constituents of the gas being supplied.

Install a ground joint union and manual shutoff valve upstream of the unit control system. The 1/8" plugged tapping in the shutoff valve provides connection for supply line pressure test gauge. The National Fuel Gas Code requires the installation of a trap with a minimum 3" (76mm) drip leg. Local codes may require a longer drip leg, typically 6" (152mm). See **FIGURE 10.**

WARNING

All components of a gas supply system must be leak tested prior to placing the equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. See Hazard Levels, page 2.

6.0 Mechanical (cont'd)

6.1 Gas Piping and Pressures—Models RDH and RHH (cont'd)

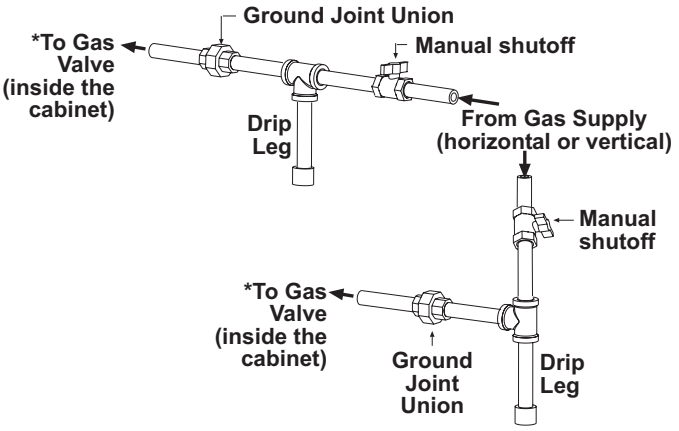
6.1.1 Gas Supply and Connections (cont'd)

TABLE 10A - Gas Connection Sizes

RDH	75, 100, 125, 150, 175, 200	225, 250, 300, 350. 400A
RHH	130 & 180	260 & 350
Natural Gas	1/2"	3/4"
Propane	1/2"	3/4"

NOTE: These are not supply line sizes.

FIGURE 10 - Gas Connection



*See gas connection location on dimension drawing, page 7 or page 9.

TABLE 10B - Sizing Gas Supply Lines

Capacity of Piping—Cubic Feet per Hour based on 0.3" w.c. Pressure Drop
Specific Gravity for Natural Gas: 0.6 (Natural Gas: 1000 BTU/Cubic Ft)
Specific Gravity for Propane Gas: 1.6 (Propane Gas: 2550 BTU/Cubic Ft)

Length of Pipe	Diameter of Pipe											
	1/2"		3/4"		1"		1-1/4"		1-1/2"		2"	
	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane
20'	92	56	190	116	350	214	730	445	1100	671	2100	1281
30'	73	45	152	93	285	174	590	360	890	543	1650	1007
40'	63	38	130	79	245	149	500	305	760	464	1450	885
50'	56	34	115	70	215	131	440	268	670	409	1270	775
60'	50	31	105	64	195	119	400	244	610	372	1105	674
70'	46	28	96	59	180	110	370	226	560	342	1050	641
80'	43	26	90	55	170	104	350	214	530	323	990	604
90'	40	24	84	51	160	98	320	195	490	299	930	567
100'	38	23	79	48	150	92	305	186	460	281	870	531
125'	34	21	72	44	130	79	275	168	410	250	780	476
150'	31	19	64	39	120	73	250	153	380	232	710	433
175'	28	17	59	36	110	67	225	137	350	214	650	397
200'	26	16	55	34	100	61	210	128	320	195	610	372

Note: When sizing supply lines, consider possibilities of future expansion and increased requirements.
Refer to National Fuel Gas Code for additional information on line sizing.

6.1.2 Checking Burner Gas Pressure

NOTE: If unsure of the Gas Control Option Code (AG1, AG2, AG3, AG8, AG9, AG9H, AG15, AG16, AG40, AG58, AG60, AG61, AG62, DG1, DG5, D12B, D12C, or D12G), check the wiring diagram on the heater. All option codes affected by electrical power are listed on the bottom of the wiring diagram after the unit Model and Size.

Inlet Pressure (applies to all gas controls)

Before attempting to measure or adjust valve outlet gas pressure, the inlet (supply) pressure must be within the specified range both when the heater is in operation and on standby. Incorrect inlet (supply) pressure could cause excessive outlet gas pressure immediately or at some future time. If natural gas inlet (supply) pressure is too high, install a regulator in the supply line before it reaches the heater. If natural gas supply pressure is too low, contact your gas supplier.

Inlet pressure to the valve for natural gas must be a minimum of 5" w.c. or as noted on the rating plate and a maximum of 14" w.c. Inlet supply pressure to the valve for propane gas must be a minimum of 11" w.c. and a maximum of 14" w.c.

Manifold Pressure at the Burner Orifice

Measuring manifold gas pressure cannot be done until the heater is in operation. It is included in the "Check After Startup" steps, Paragraph 9.3. The procedure required depends on the type of gas control option:

- Single and Two Stage Options **AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C—Follow INSTRUCTIONS starting below.**
- **Electronic Modulation (2:1 turndown) Options AG8, AG9, AG9H—Follow instructions on pages 17 and 18.**
- **Electronic Modulation (4:1 turndown) Options AG40, D12B—Follow instructions on pages 17 and 18.**
- **Electronic Modulation (8:1 turndown) Options AG58, D12G—Follow instructions on pages 18 and 19.**

All gas pressure measurements should be done with a manometer (fluid-filled gauge) rather than a spring type gauge due to the difficulty of maintaining calibration. Use a water column manometer readable to the nearest tenth of an inch.

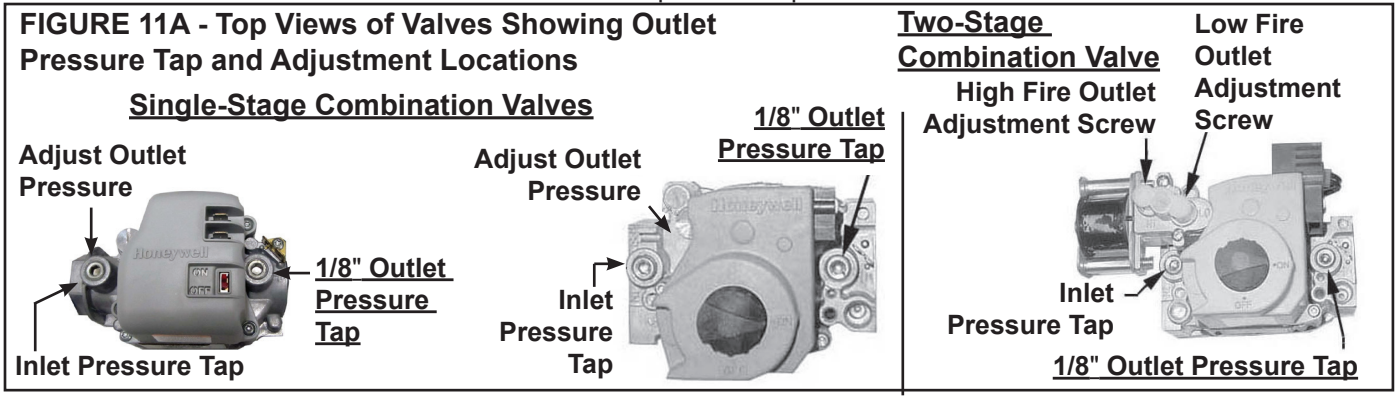
INSTRUCTIONS for single-stage and two-stage gas control options (Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C)

The outlet pressure is regulated by the combination single or two stage gas valve. The combination valve outlet pressure should be as shown in **TABLE 11**, page 20, (for the model size, gas type, gas control option, and altitude of the installation) or as noted on the rating plate.

1) Gas Valve Pressure Tap Locations

Locate the 1/8" outlet pressure tap on the single or two-stage valve (see **FIGURE 11A**). With the manual valve turned off to prevent flow to the gas valve, connect a manometer to the 1/8" outlet pressure tap in the valve. Both high-fire and low-fire outlet pressure can be checked at this pressure tap.

FIGURE 11A - Top Views of Valves Showing Outlet Pressure Tap and Adjustment Locations



2) Measure Outlet Pressure and Adjust (if needed)

Open the manual valve and operate the heater.

Using the manometer connected to the valve, measure the outlet pressure of the single-stage gas valve or high fire on a two-stage valve. To measure low-stage pressure on units with a two-stage valve (Options AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, and D12C), disconnect the wire from the "HI" terminal on the valve. Measure gas pressure with the manometer attached to the valve. Re-connect the wire.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

Normally, when operating at the altitude indicated on the rating plate, adjustments to the factory settings should not be necessary. If adjustment is required, remove the cap from the adjustment screw on the single or two-stage valve. Adjust pressure setting by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure. If an adjustment is made, turn up the thermostat. Cycle the burner once or twice to properly seat the adjustment spring in the valve. Re-check the pressure. When the outlet pressure is right for the installation, remove the manometer and replace the cap. Check for a leak at the pressure tap fitting.

WARNING

Valve outlet gas pressure must never exceed the value listed in TABLE 11 (or as shown on the rating plate).

INSTRUCTIONS for ELECTRONIC MODULATION Gas Control Options AG8, AG9, AG9H, AG40 and D12B

1) Gas Valve Pressure Tap Locations

The manifold includes a single-stage valve and a modulating valve (**FIGURE 11B**). Locate the outlet pressure tap just behind the orifice adapter (see **FIGURE 11A** above). To check high fire outlet pressure, connect a manometer to the outlet pressure tap just behind the orifice adapter.

To check low-fire (bypass pressure), locate the 1/4" NPT pressure tap just behind the orifice adapter as shown in **FIGURE 11C**. Connect a manometer to the 1/4" pressure tap.

FIGURE 11B - Top View of Modulating Valve in AG8, AG9, AG9H, AG40 and D12B

Modulating Valve in Options AG8, AG9, AG9H, AG40 and D12B—DO NOT adjust.



To ensure an accurate high fire reading at the single-stage valve, a minimum signal of 20VDC must be present at the modulating valve.

6.1 Gas Piping and Pressures—Models RDH and RHH (cont'd)

6.1.2 Checking Burner Gas Pressure (cont'd)

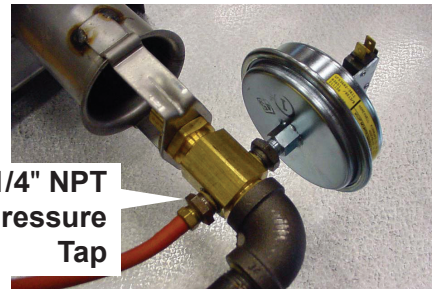


FIGURE 11C - Pressure Tap Location for Measuring Low Fire Outlet (Bypass) Pressure—Electronic Modulation Gas Control Options AG8, AG9, AG9H, AG40 and D12B

WARNING

Measure low-fire pressure at this location only for units with electronic modulation gas control Option AG8, AG9, AG9H, AG40 or D12B).

2) Measure High Fire Pressure and Adjust (if needed)

Open the manual valve and operate the heater.

Using the manometer connected to the single-stage valve, measure the outlet pressure. To ensure an accurate high-fire gas pressure reading at the single-stage valve, a minimum 20VDC signal MUST be present at the modulating gas valve.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

Normally, when operating at the altitude indicated on the rating plate, adjustments to the factory settings should not be necessary. If adjustment is required, remove the cap from the adjustment screw on the single-stage valve. Adjust pressure setting by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure. If an adjustment is made, turn up the thermostat. Cycle the burner once or twice to properly seat the adjustment spring in the valve. Re-check the pressure. When the outlet pressure is right for the installation, remove the manometer and replace the cap. Check for a leak at the pressure tap fitting.

WARNING

Valve outlet gas pressure must never exceed the value listed in TABLE 11 (or as shown on the rating plate).

3) Measure Low Fire (Bypass) Pressure

To measure low-fire (bypass pressure) on electronic modulation gas control Options AG8, AG9, AG9H, AG40 and D12B, disconnect one of the wire leads to the modulating valve. Measure the pressure with the manometer attached to the pressure tap just behind the orifice adapter (**FIGURE 11C**). Re-connect the wire.

DO NOT attempt to adjust the bypass (low-fire) pressure. If bypass pressure is incorrect (see **TABLE 11, page 20**), contact the factory.

INSTRUCTIONS for ELECTRONIC MODULATION Gas Control Options AG58 and D12G)

1) Measure the Manifold Pressure

Turn the manual valve in the gas line off.

Locate the manifold pressure tap; see **FIGURE 12**. Remove the bushing and connect a manometer to the 1/8" pressure tap.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

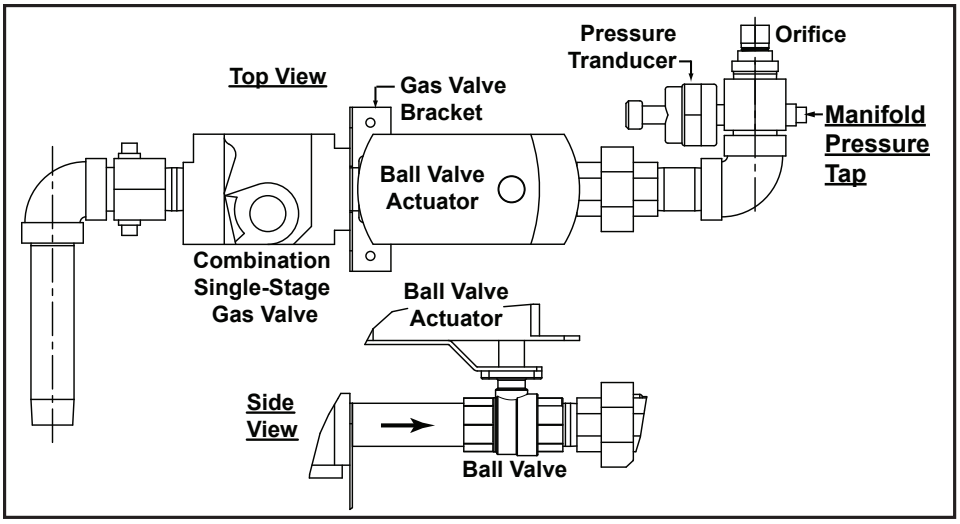
Turn on the manual gas valve. Operate the unit with a call for heat. Verify that the actuator has fully opened the ball valve (highest fire). The ball valve is fully open when the dash marks on the actuator are aligned with the gas piping. With the burner at highest fire, measure the manifold pressure. The manifold pressure should be 3.4" w.c. for natural gas or 10" w.c. for propane.

2) Adjust Pressure at the Single-Stage Valve (if needed)

Turn the manual gas valve off. On the single-stage gas valve (see **FIGURE 11A, page 17**), locate the 1/8" output pressure tap and attach a manometer.

Turn on the manual gas valve. Operate the unit with a call for heat. Check the outlet pressure of the valve with the burner at full fire. Pressure should be 3.5" w.c for natural gas or 10" w.c. for propane. **If adjustment is necessary,** remove the cap from the adjustment screw. Set pressures to correct setting by turning the regulator screws IN (clockwise) to increase pressure. Turn regulator screws OUT (counterclockwise) to decrease pressure.

FIGURE 12 - Gas Manifold with Gas Control Options AG58 and D12G



After an adjustment is made, cycle the heat section. Re-check the outlet pressure of the valve and the manifold pressure. When pressure is correct for highest fire, remove the manometers and replace the caps. Check for a leak at the pressure tap fittings.

3) Lowest fire manifold pressure is regulated by the ball valve actuator in response to signals from the ignition control board. The ball valve was set at the factory and should not need to be checked at startup. For future reference, instructions for checking lowest fire pressure are in Form O-PREEVA included in the literature bag.

6.1.3 High Altitude Operation (Gas-Fired Model RDH or RHH being installed above 2000 ft (610M))

NOTE: **Altitude adjustment does NOT apply to Model RDH or RHH with Gas Control Option AG58 or D12G—Modulating gas control Options AG58 and D12G DO NOT require a gas pressure adjustment derate for high altitude.** The patented control system works on a principle of safe, continuous gas and combustion air monitoring and adjustment. As the mass flow through the combustion system changes, due to the lower oxygen level at high altitude, the control system senses the change, automatically reducing the firing rate of the burner.

Adjustments for High Altitude Operation (does not apply to Models RDH and RHH with Option AG58 or D12G)

If the heater is being installed at an elevation above 2000 ft (610M), check the rating plate to verify that the heater is factory-equipped for the elevation at the installation site. **If the elevation on the rating plate matches the elevation of the installation site, field adjustment for high altitude is not required.**

If the rating plate does not match the elevation of the installation site, high altitude adjustment will need to be done as part of the startup procedure. (High altitude adjustment can only be done while the unit is operating.) During startup, follow the instructions in this section to adjust the valve outlet pressure.

FIGURE 13 - High Altitude (>6000ft/1830M) Pressure Switch Requirement



Pressure Switch

Above 6000 ft (1830M)	Switch PN	Label Color	Setting
RDH 75, 100	197031	Purple	0.35" w.c.
RDH 125	197032	Pink	0.45" w.c.
RDH 150	197029	Light Blue	0.60" w.c.
RDH 175–400 & RHH all Sizes	201160	Brown	1.05" w.c.

NOTE: If unit is above 6000 ft (1830M) elevation and the following conditions apply, installation of a high altitude pressure switch is required. If a replacement switch is needed, contact your distributor for the switch and follow the instructions below to install the high altitude pressure switch before starting the heater.

☐ Elevation on the rating plate is not above 6000 ft (1830M)

☐ Unit has a single or two-stage gas control (Option AG1, AG2, AG3, AG15, AG16, AG60, DG1, DG5, or D12C).

NOTE: If equipped with a two-stage control with a two-speed venter (Options AG8, AG9, AG9H, AG60, AG61, AG62, DG1, DG5, and D12C), there are two pressure switches. Only the high speed pressure switch needs to be changed.

Instructions for changing pressure switch:

1. If the unit is installed, turn off the gas and the power.
2. In the control compartment, locate the pressure switch that needs to be replaced. (**NOTE**: If there are two pressure switches, the high speed switch to be replaced is toward the top of the unit.)
3. Mark and disconnect the two wires attached to the pressure switch.
4. Mark and disconnect the sensing tube(s) from the pressure switch.
5. Locate the two screws holding the switch mounting bracket. Remove the pressure switch. Save the screws.
6. Using the same screws, install the high altitude pressure switch. Attach sensing tube(s) and wires.
7. If installed, turn on the power and the gas.

6.0 Mechanical (cont'd)

6.1 Gas Piping and Pressures—Models RDH and RHH (cont'd)

6.1.3 High Altitude Operation—Gas-Fired Model RDH or RHH being installed above 2000 ft (610M) (cont'd)

If the elevation on the rating plate does not match the elevation of the installation site, follow these instructions to adjust the valve.

Derate by Valve Outlet Pressure Adjustment if needed for <u>High Altitude</u> Operation

Instructions for High Altitude Derate

1. Refer to **TABLE 11** and determine the required valve outlet pressure(s) for the elevation where the heater will be operating. If unsure of the elevation, contact the local gas supplier. If unsure of the type of gas control, check the option list on the unit wiring diagram.

TABLE 11 - Valve Outlet Pressure Settings by Elevation, Gas Control Option, and Type of Gas for Models RDH and RHH

Outlet Pressure Settings (inches w.c.) by Altitude for Installation in the UNITED STATES													
Altitude		Full Rate Outlet Pressure (Single-Stage & 2-Stage High Fire)—Applies to Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F		Full Rate Outlet Pressure with <u>Electronic Modulation</u>—Applies to Options AG8, AG9, AG9H, AG40, and D12B (measured at the outlet of the single-stage valve when there is a minimum of a 20VDC signal at the electronic modulating valve) NOTE: Options do not apply to SHH.		2-Stage Low-Fire Outlet Pressure—Applies to Options AG2, AG3, AG15, AG16		2-Stage Low-Fire Outlet Pressure with Venter Motor Controller—Applies to Options AG60, AG61, AG62, DG1, DG5, D12C		<u>Factory-Set</u> Bypass Pressure with Electronic Modulation—Applies to Options AG40 and D12B		Electronic Modulation Low-Fire Manifold Pressure—Applies to Options AG8, AG9, AG9H	
Feet	Meters	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
0–2000	0–610	3.5	10.0	3.5	10.0	1.8	5.0	0.40	1.8	0.25	1.8	0.9	2.5
2001–3000	611–915	3.1	8.8	3.1	8.8	1.6	4.4	0.35	1.5	0.25	1.8	0.8	2.2
3001–4000	916–1220	3.0	8.5	3.0	8.5	1.5	4.2	0.34	1.4	0.25	1.8	0.8	2.1
4001–5000	1221–1525	2.8	8.1	2.8	8.1	1.5	4.1	0.32	1.4	0.25	1.8	0.7	2.0
5001–6000	1526–1830	2.7	7.7	2.7	7.7	1.4	3.9	0.31	1.3	0.25	1.8	0.7	1.9
6001–7000	1831–2135	2.6	7.4	2.6	7.4	1.3	3.7	0.30	1.3	0.25	1.8	0.7	1.8
7001–8000	2136–2440	2.5	7.1	2.5	7.1	1.3	3.5	0.28	1.2	0.25	1.8	0.6	1.8
8001–9000	2441–2745	2.4	6.7	2.4	6.7	1.2	3.4	0.27	1.1	0.25	1.8	0.6	1.7
Outlet Pressure Settings (inches w.c.) by Altitude for Installation in CANADA													
Altitude		Full Rate Outlet Pressure (Single-Stage & 2-Stage High Fire)—Applies to Options AG1, AG2, AG3, AG15, AG16, AG60, AG61, AG62, DG1, DG5, D12C, D12F		Full Rate Outlet Pressure with <u>Electronic Modulation</u>—Applies to Options AG8, AG9, AG9H, AG40, and D12B (measured at the outlet of the single-stage valve when there is a minimum of a 20VDC signal at the electronic modulating valve) NOTE: Options do not apply to SHH.		2-Stage Low-Fire Outlet Pressure—Applies to Options AG2, AG3, AG15, AG16, D12F		2-Stage Low-Fire Outlet Pressure with Venter Motor Controller—Applies to Options AG60, AG61, AG62, DG1, DG5, D12C		<u>Factory-Set</u> Bypass Pressure with Electronic Modulation—Applies to Options AG40, and D12B		Electronic Modulation Low-Fire Manifold Pressure—Applies to Options AG8, AG9, AG9H	
Feet	Meters	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
0–2000	0–610	3.5	10.0	3.5	10.0	1.8	5.0	0.4	1.8	0.25	1.8	0.9	2.5
2001–4500	611–1373	2.8	8.1	2.8	8.1	1.5	4.1	0.3	1.4	0.25	1.8	0.7	2.0

2. Locate the 1/8" outlet pressure tap on the valve (**FIGURE 11A, page 17**). Turn the or switch knob on the top of the valve to "OFF". Connect a manometer to the 1/8" outlet pressure tap in the valve. Use a water column manometer that is readable to the nearest tenth of an inch. When making the adjustment, turn the adjustment screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

3. **<u>Single-Stage and Two-Stage High Fire Adjustment:</u>** Turn the switch or knob on the top of the valve to "ON". Remove the cap from the pressure adjusting screw and adjust the outlet pressure to the full rate pressure selected from **TABLE 11**.

   <u>Two Stage Low Fire:</u> Disconnect the wire from the "HI" terminal on the gas valve and check low fire pressure. To adjust, turn the low pressure regulator screw to achieve the "2-Stage Low Fire" pressure listed **for the applicable gas control (TABLE 11)**. Re-connect the wire to the gas valve.

   <u>Electronic Modulation Options AG40 and D12B:</u> The electronic modulation valve itself has no high fire adjustment. The only adjustment on the modulation valve is the low-pressure bypass setting which is factory set and does not require field adjustment for high altitude operation.

   However, if the elevation on the rating plate does not match the elevation of the installation, a full rate adjustment is required at the outlet of the combination valve. To make the full rate adjustment, adjust the outlet pressure of the combination gas valve when the modulating valve is fully open (there must be a minimum of a 20 VDC signal at the electronic modulating valve to ensure that it is fully open). Set the outlet pressure of the combination valve to the pressure shown in **TABLE 11**.
4. Turn up the thermostat. Cycle the burner once or twice to properly seat the adjustment spring in the valve. Re-check the pressure(s). When the outlet pressure(s) is right for the installation, remove the manometer and replace the cap. Check for a leak at the pressure tap fitting.

5. With the heater operating, determine that the inlet (supply) pressure to the heater for natural gas is between 5 inches w.c. **(or as noted on the rating plate)** and 14 inches w.c. and for propane between 11 and 14 inches w.c. Take this reading as close as possible to the heater. (Heaters are equipped with a gas valve that has an inlet pressure tap.) If the inlet (supply) pressure is not within the specified range, the inlet (supply) pressure must be corrected and Steps 3 and 4 repeated.
6. Find the High Altitude Adjustment label in the plastic bag that contained these instructions. Using a permanent marker, fill-in the appropriate information from **TABLE 12A or 12B**. Affix the label to a clean, dry, and conspicuous location on the outside of the heater access panel.

High Altitude Capacity Changes for Model RDH with Gas Control Option AG1, AG2, AG3, AG8, AG9, AG9H, AG15, AG16, AG40, AG60, AG61, AG62, DG1, DG5, D12B, or D12C and Model RHH with Option AG1, AG2, AG3, AG15, AG16, or D12C. (Does not apply to AG58 or D12G; see NOTE page 19.)

The input and/or the capacity of the heater changes with altitude. **TABLE 12** below lists inputs and capacities at altitudes from sea level to 9,000 ft (2745M) in the United States and to 4,500 ft (1373M) in Canada for Model RDH. **TABLE 13, page 22,** lists the same information for Model RHH.

TABLE 12 - BTUH Inputs and Capacities by Altitude for Model RDH

BTUH Inputs and Capacities by Altitude in the UNITED STATES for Model RDH

ALTITUDE		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40 and D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40 and D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, and D12B)	
						Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane
Feet	**Meters**	**Size 75**								**Size 100**								**Size 125**							
0–2000	0–610	75,000	60,750	52,500	37,500	24,750	30,000	18,750	30,000	100,000	81,000	70,000	50,000	33,000	40,000	25,000	40,000	125,000	101,250	87,500	62,500	41,250	50,000	31,250	50,000
2001–3000	611–915	70,500	57,105	49,350	35,250	23,265	28,200	17,625	28,200	94,000	76,140	65,800	47,000	31,020	37,600	23,500	37,600	117,500	95,175	82,250	58,750	38,775	47,000	29,375	47,000
3001–4000	916–1220	69,000	55,890	48,300	34,500	22,770	27,600	17,250	27,600	92,000	74,520	64,400	46,000	30,360	36,800	23,000	36,800	115,000	93,150	80,500	57,500	37,950	46,000	28,750	46,000
4001–5000	1221–1525	67,500	54,675	47,250	33,750	22,275	27,000	16,875	27,000	90,000	72,900	63,000	45,000	29,700	36,000	22,500	36,000	112,500	91,125	78,750	56,250	37,125	45,000	28,125	45,000
5001–6000	1526–1830	66,000	53,460	46,200	33,000	21,780	26,400	16,500	26,400	88,000	71,280	61,600	44,000	29,040	35,200	22,000	35,200	110,000	89,100	77,000	55,000	36,300	44,000	27,500	44,000
6001–7000	1831–2135	64,500	52,245	45,150	32,250	21,285	25,800	16,125	25,800	86,000	69,660	60,200	43,000	28,380	34,400	21,500	34,400	107,500	87,075	75,250	53,750	35,475	43,000	26,875	43,000
7001–8000	2136–2440	63,000	51,030	44,100	31,500	20,790	25,200	15,750	25,200	84,000	68,040	58,800	42,000	27,720	33,600	21,000	33,600	105,000	85,050	73,500	52,500	34,650	42,000	26,250	42,000
8001–9000	2441–2745	61,500	49,815	43,050	30,750	20,295	24,600	15,375	24,600	82,000	66,420	57,400	41,000	27,060	32,800	20,500	32,800	102,500	83,025	71,750	51,250	33,825	41,000	25,625	41,000
Feet	**Meters**	**Size 150**								**Size 175**								**Size 200**							
0–2000	0–610	150,000	121,500	105,000	75,000	49,500	60,000	37,500	60,000	175,000	141,750	122,500	87,500	57,750	70,000	43,750	70,000	200,000	162,000	140,000	100,000	66,000	80,000	50,000	80,000
2001–3000	611–915	141,000	114,210	98,700	70,500	46,530	56,400	35,250	56,400	164,500	133,245	115,150	82,250	54,285	65,800	41,125	65,800	188,000	152,280	131,600	94,000	62,040	75,200	47,000	75,200
3001–4000	916–1220	138,000	111,780	96,600	69,000	45,540	55,200	34,500	55,200	161,000	130,410	112,700	80,500	53,130	64,400	40,250	64,400	184,000	149,040	128,800	92,000	60,720	73,600	46,000	73,600
4001–5000	1221–1525	135,000	109,350	94,500	67,500	44,550	54,000	33,750	54,000	157,500	127,575	110,250	78,750	51,975	63,000	39,375	63,000	180,000	145,800	126,000	90,000	59,400	72,000	45,000	72,000
5001–6000	1526–1830	132,000	106,920	92,400	66,000	43,560	52,800	33,000	52,800	154,000	124,740	107,800	77,000	50,820	61,600	38,500	61,600	176,000	142,560	123,200	88,000	58,080	70,400	44,000	70,400
6001–7000	1831–2135	129,000	104,490	90,300	64,500	42,570	51,600	32,250	51,600	150,500	121,905	105,350	75,250	49,665	60,200	37,625	60,200	172,000	139,320	120,400	86,000	56,760	68,800	43,000	68,800
7001–8000	2136–2440	126,000	102,060	88,200	63,000	41,580	50,400	31,500	50,400	147,000	119,070	102,900	73,500	48,510	58,800	36,750	58,800	168,000	136,080	117,600	84,000	55,440	67,200	42,000	67,200
8001–9000	2441–2745	123,000	99,630	86,100	61,500	40,590	49,200	30,750	49,200	143,500	116,235	100,450	71,750	47,355	57,400	35,875	57,400	164,000	132,840	114,800	82,000	54,120	65,600	41,000	65,600
Feet	**Meters**	**Size 225**								**Size 250**								**Size 300**							
0–2000	0–610	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000	250,000	202,500	175,000	125,000	82,500	100,000	62,500	100,000	300,000	243,000	210,000	150,000	99,000	120,000	75,000	120,000
2001–3000	611–915	211,500	171,315	148,050	105,750	69,795	84,600	52,875	84,600	235,000	190,350	164,500	117,500	77,550	94,000	58,750	94,000	282,000	228,420	197,400	141,000	93,060	112,800	70,500	112,800
3001–4000	916–1220	207,000	167,670	144,900	103,500	68,310	82,800	51,750	82,800	230,000	186,300	161,000	115,000	75,900	92,000	57,500	92,000	276,000	223,560	193,200	138,000	91,080	110,400	69,000	110,400
4001–5000	1221–1525	202,500	164,025	141,750	101,250	66,825	81,000	50,625	81,000	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000	270,000	218,700	189,000	135,000	89,100	108,000	67,500	108,000
5001–6000	1526–1830	198,000	160,380	138,600	99,000	65,340	79,200	49,500	79,200	220,000	178,200	154,000	110,000	72,600	88,000	55,000	88,000	264,000	213,840	184,800	132,000	87,120	105,600	66,000	105,600
6001–7000	1831–2135	193,500	156,735	135,450	96,750	63,855	77,400	48,375	77,400	215,000	174,150	150,500	107,500	70,950	86,000	53,750	86,000	258,000	208,980	180,600	129,000	85,140	103,200	64,500	103,200
7001–8000	2136–2440	189,000	153,090	132,300	94,500	62,370	75,600	47,250	75,600	210,000	170,100	147,000	105,000	69,300	84,000	52,500	84,000	252,000	204,120	176,400	126,000	83,160	100,800	63,000	100,800
8001–9000	2441–2745	184,500	149,445	129,150	92,250	60,885	73,800	46,125	73,800	205,000	166,050	143,500	102,500	67,650	82,000	51,250	82,000	246,000	199,260	172,200	123,000	81,180	98,400	61,500	98,400
Feet	**Meters**	**Size 350**								**Size 400A**															
0–2000	0–610	350,000	283,500	245,000	175,000	115,500	140,000	87,500	140,000	400,000	324,000	280,000	200,000	132,000	160,000	100,000	160,000								
2001–3000	611–915	329,000	266,490	230,300	164,500	108,570	131,600	82,250	131,600	376,000	304,560	263,200	188,000	124,080	150,400	94,000	150,400								
3001–4000	916–1220	322,000	260,820	225,400	161,000	106,260	128,800	80,500	128,800	368,000	298,080	257,600	184,000	121,440	147,200	92,000	147,200								
4001–5000	1221–1525	315,000	255,150	220,500	157,500	103,950	126,000	78,750	126,000	360,000	291,600	252,000	180,000	118,800	144,000	90,000	144,000								
5001–6000	1526–1830	308,000	249,480	215,600	154,000	101,640	123,200	77,000	123,200	352,000	285,120	246,400	176,000	116,160	140,800	88,000	140,800								
6001–7000	1831–2135	301,000	243,810	210,700	150,500	99,330	120,400	75,250	120,400	344,000	278,640	240,800	172,000	113,520	137,600	86,000	137,600								
7001–8000	2136–2440	294,000	238,140	205,800	147,000	97,020	117,600	73,500	117,600	336,000	272,160	235,200	168,000	110,880	134,400	84,000	134,400								
8001–9000	2441–2745	287,000	232,470	200,900	143,500	94,710	114,800	71,750	114,800	328,000	265,680	229,600	164,000	108,240	131,200	82,000	131,200								

BTUH Inputs and Capacities by Altitude in CANADA for Model RDH

ALTITUDE		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40 and D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40 and D12B)		Normal Input	Thermal Output Capacity	2-Stage Minimum Input (applies to AG2, AG3, AG15, AG16)	Electronic Modulation Minimum Input (applies to AG8, AG9, AG9H)	2-Stage with Venter Motor Controller Minimum Input (applies to AG60, AG61, AG62, DG1, DG5, D12C)		Modulation Minimum Input (applies to Options AG40, and D12B)	
						Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane					Natural	Propane	Natural	Propane
Feet	**Meters**	**Size 75**								**Size 100**								**Size 125**							
0-2000	0-610	75,000	60,750	52,500	37,500	24,750	30,000	18,750	30,000	100,000	81,000	70,000	50,000	33,000	40,000	25,000	40,000	125,000	101,250	87,500	62,500	41,250	50,000	31,250	50,000
2001-3000	611-915	67,500	54,675	47,250	33,750	22,275	27,000	16,875	27,000	90,000	72,900	63,000	45,000	29,700	36,000	22,500	36,000	112,500	91,125	78,750	56,250	37,125	45,000	28,125	45,000
Feet	**Meters**	**Size 150**								**Size 175**								**Size 200**							
0-2000	0-610	150,000	121,500	105,000	75,000	49,500	60,000	37,500	60,000	175,000	141,750	122,500	87,500	57,750	70,000	43,750	70,000	200,000	162,000	140,000	100,000	66,000	80,000	50,000	80,000
2001-4500	611-1373	135,000	109,350	94,500	67,500	44,550	54,000	33,750	54,000	157,500	127,575	110,250	78,750	51,975	63,000	39,375	63,000	180,000	145,800	126,000	90,000	59,400	72,000	45,000	72,000
Feet	**Meters**	**Size 225**								**Size 250**								**Size 300**							
0-2000	0-610	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000	250,000	202,500	175,000	125,000	82,500	100,000	62,500	100,000	300,000	243,000	210,000	150,000	99,000	120,000	75,000	120,000
2001-4500	611-1373	202,500	164,025	141,750	101,250	66,825	81,000	50,625	81,000	225,000	182,250	157,500	112,500	74,250	90,000	56,250	90,000	270,000	218,700	189,000	135,000	89,100	108,000	67,500	108,000
Feet	**Meters**	**Size 350**								**Size 400A**															
0-2000	0-610	350,000	283,500	245,000	175,000	115,500	140,000	87,500	140,000	400,000	324,000	280,000	200,000	132,000	160,000	100,000	160,000								
2001-4500	611-1373	315,000	255,150	220,500	157,500	103,950	126,000	78,750	126,000	360,000	291,600	252,000	180,000	118,800	144,000	90,000	144,000								

6.1 Gas Piping and Pressures—Models RDH and RHH (cont'd)

6.1.3 High Altitude Operation—Gas-Fired Model RDH or RHH being installed above 2000 ft (610M) (cont'd)

TABLE 13 - BTUH Inputs and Capacities by Altitude for Model RHH

(Does NOT apply to AG58 or D12G; see NOTE on page 19.)

BTUH Inputs and Capacities by Altitude for Model RHH										
Country	Altitude		RHH Size130		RHH Size 180		RHH Size 260		RHH Size 350	
	Feet	Meters	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)	Normal Input (BTU/HR)	Thermal Output Capacity (BTU/HR)
United States	0–2000	0–610	131000	120520	175000	159,250	260,000	236,600	345,000	313,950
	2001–3000	611–915	123140	113289	164500	149,695	244,400	222,404	324,300	295,113
	3001–4000	916–1220	120520	110878	161000	146,510	239,200	217,672	317,400	288,834
	4001–5000	1221–1525	117900	108468	157500	143,325	234,000	212,940	310,500	282,555
	5001–6000	1526–1830	115280	106058	154000	140,140	228,800	208,208	303,600	276,276
	6001–7000	1831–2135	112660	103647	150500	136,955	223,600	203,476	296,700	269,997
	7001–8000	2136–2440	110040	101237	147000	133,770	218,400	198,744	289,800	263,718
	8001–9000	2441–2745	107420	98826	143500	130,585	213,200	194,012	282,900	257,439
	9001–10000	2746–3045	104800	96416	140000	127,400	208,000	189,280	276,000	251,160
Canada	0–2000	0–610	131000	120520	175000	159,250	260,000	236,600	345,000	313,950
	2001–4500	611–1373	117900	108468	157500	143,325	234,000	212,940	310,500	282,555

6.1.4 Optional Gas Pressure Safety Switches

If the manifold is equipped with optional high and/or low gas pressure switches, the switches protect against an upstream gas control malfunction that would cause an increase or decrease in the regulated gas pressure.

The low gas pressure switch is an automatic reset switch that is factory set to activate if the gas pressure is 50% of the minimum as stated on the unit rating plate.

The high gas pressure switch is a manually reset switch that is set to activate if the gas pressure is 125% of the outlet pressure stated on the rating plate.

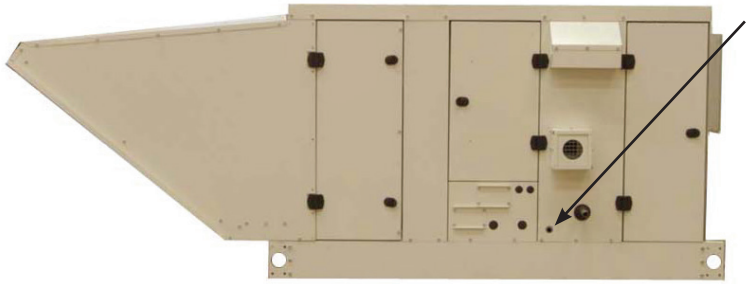
6.2 Heat Section Condensate Drain(s)—Models RDH and RHH

6.2.1 Heat Section Condensate Drain—Model RDH with Option CS2

If Option CS2 was selected, the gas heat section is equipped with a condensate drain with a 3/8" PVC connection. See location in **FIGURE 14A**. This burner condensate drain is required when one or both of these situations exists:

- A cooling coil is installed upstream of the heat section.
- The temperature rise for a makeup air unit is equal to or less than 60°F.

FIGURE 14A - Location of Option CS2 Heat Section Condensate Drain Connection—Model RDH



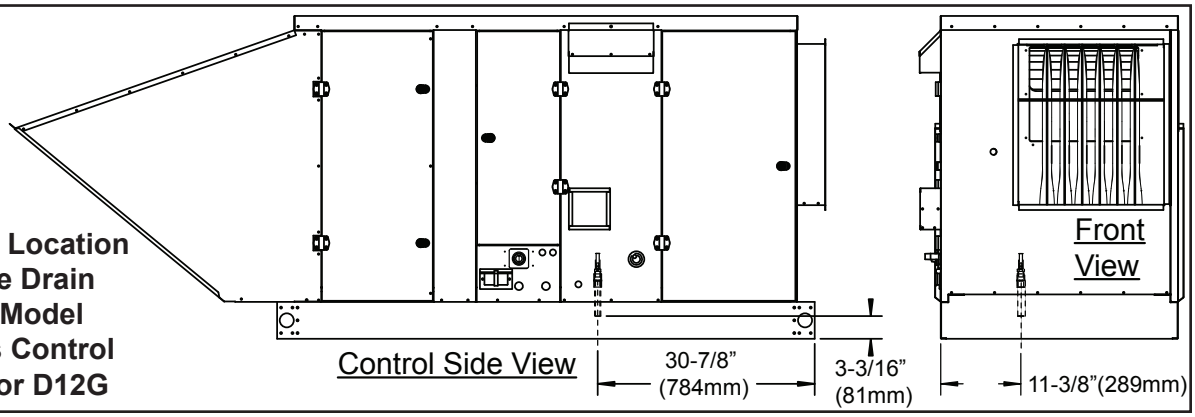
1/2" Male NPT connection for installer to connect a drain line. Put a trap in the line (see Paragraph 6.6.4) and empty into a sanitary drain system.

Periodic cleaning of the condensate disposal system is required.

6.2.2 Condensate Drain—Model RDH with Option AG58 or D12G Modulating Gas Control

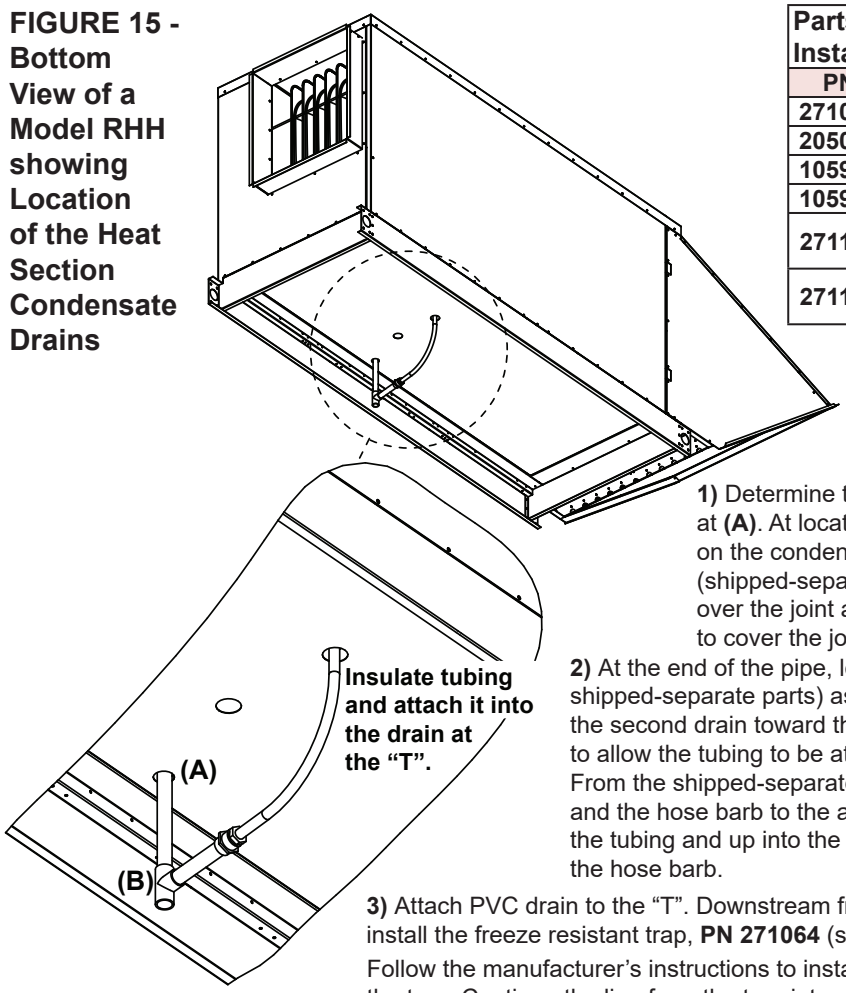
A Model RDH unit with modulating gas control Option AG58 or D12G requires a condensate drain from the vent area. The 1/2" PVC connection is underneath the unit; see **FIGURE 15**. Since this drain will be used during the heating season, the connection is under the unit and the drain should be run down through the inside of the roof curb and into the heated space. Put a trap in the line (see Paragraph 6.6.4) and empty it into a sanitary drain.

FIGURE 14B - Location of Condensate Drain Connection—Model RDH with Gas Control Option AG58 or D12G



6.2.3 Heat Section Condensate Drains—Model RHH High Efficiency Unit

FIGURE 15 - Bottom View of a Model RHH showing Location of the Heat Section Condensate Drains



Parts Provided (Shipped Separately) for Installing Condensate Drains (Kit PN 273811)	
PN	**Description**
271064	Freeze-Resistant Condensate Drain Trap
205037	1/2" Schedule 40 Tee
105944	1/2" Schedule 40 Female Adapter
105948	1/2 × 1/2" Nylon Hose Barb (male)
271183	36" length of pipe insulation (for insulating the drain hose)
271184	36" length of pipe insulation (for insulating the 1/2" PVC drain pipe)

Instructions for Installing Model RHH Heat Section Condensate Drains

NOTE: All PVC drain pipe is provided by the installer. Depending on the installation, a field-provided or optional heat tape may be needed.

1) Determine the length of field-provided 1/2" PVC pipe needed at **(A)**. At location **(A)**, connect the PVC pipe to the coupler on the condensate drain in the unit. Slide the pipe insulation (shipped-separate parts above) over the 1/2" PVC pipe and up over the joint at **(A)**. Secure the insulation so that it will continue to cover the joint at **(A)**. Cut off any excess.

2) At the end of the pipe, location **(B)**, position the Schedule 40 tee (from shipped-separate parts) as illustrated and attach. Extend the tubing from the second drain toward the tee. Determine the length of PVC pipe needed to allow the tubing to be attached. Attach the length of PVC pipe to the tee. From the shipped-separate items, attach the female adapter to the pipe and the hose barb to the adapter. Slide the smaller piece of insulation over the tubing and up into the unit. Secure the insulation. Attach the tubing to the hose barb.

3) Attach PVC drain to the "T". Downstream from the "T", install the freeze resistant trap, **PN 271064** (shown right).

Follow the manufacturer's instructions to install and maintain the trap. Continue the line from the trap into a sanitary drain. **NOTE:** Check codes to be certain that this is permitted—condensate from the heater has a pH of 6 (actual pH may vary depending on fuel and combustion air constituents.

Freeze Resistant Trap, PN 271064



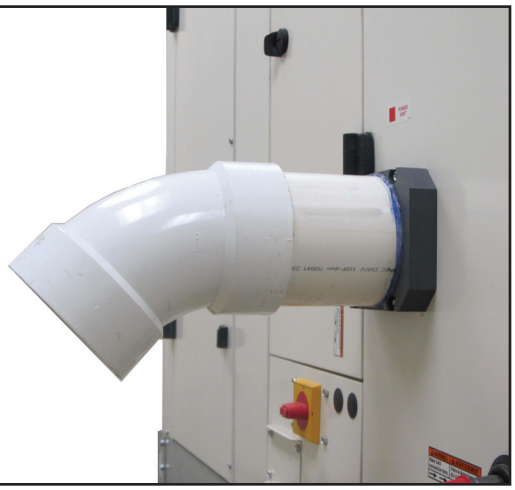
6.3 Venting (Models RDH and RHH)

6.3.1 Venting—Model RHH

Model RHH has a high efficiency condensing heat section. The heat section vents through a Schedule 40 PVC pipe that extends from the side of the unit as shown in **FIGURE 16**. The vent must be terminated with an installer-provided 45° elbow of Schedule 40 PVC or CPVC vent pipe. **NOTE:** In Canada, all PVC vent pipe must be approved to ULC S636.

Attach the elbow in the orientation illustrated so that the flue products are directed downward.

FIGURE 16 - Terminate Vent with 45-Degree Schedule 40 PVC Elbow as Shown; Flue Products Must be Directed Downward



6.0 Mechanical (cont'd)

6.3 Venting—Models RDH and RHH (cont'd)

6.3.2 Venting Model RDH

A Model RDH vents through the screened "box" on the side of the heat section. If local code requires 4-ft (1.2M) vertical clearance between the flue outlet and the fresh air intake of the heating system or the building, install a vertical vent with an optional vent cap. The option package includes the vent cap only. The vent pipe is field supplied. The vent pipe should be the same size as the vent connection diameter listed below. Remove the cover shown in **FIGURE 17A** and follow the illustrated instructions in **FIGURE 17B.**

FIGURE 17A - Remove the Cover from the Flue Outlet

Remove the screened box cover on the vent outlet.

The box is attached on each side with one screw. Remove the four screws and the cover making the vent pipe collar accessible.

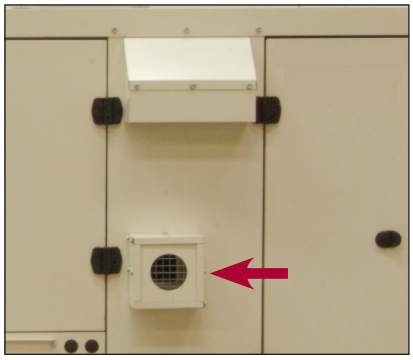


FIGURE 17B - Install a Vertical Vent Pipe and Cap—Maximum Height is 8 ft (2.4M)

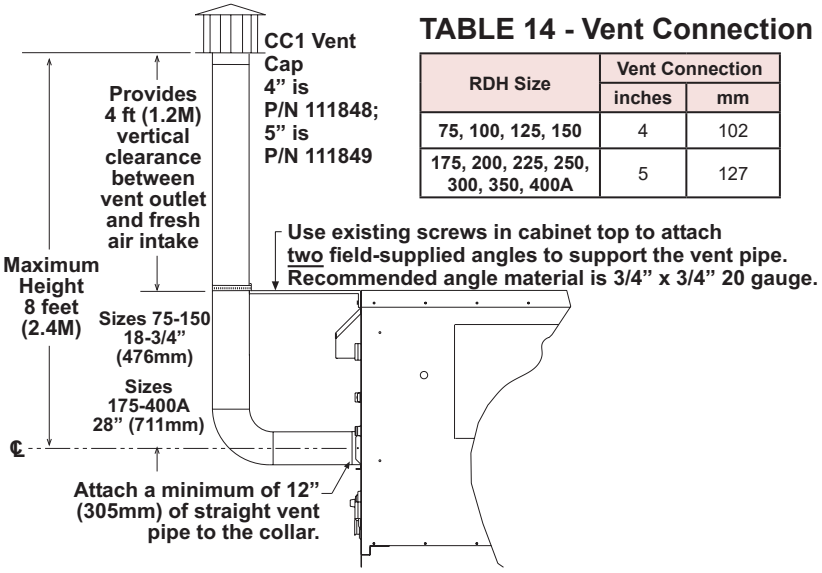


TABLE 14 - Vent Connection Sizes

RDH Size	Vent Connection	
	inches	mm
75, 100, 125, 150	4	102
175, 200, 225, 250, 300, 350, 400A	5	127

6.4 Unit Inlet Air (Supply Air) - Models RDH, REH, RHH, and RXH

Depending on how the unit was ordered, the blower can have a variety of factory-installed and/or field-installed inlets. The cabinet end can be full open with or without a screen; can have a factory-installed duct flange with or without a two-position damper, or a field-installed hood. The blower inlet can have or not have a filter rack with filters.

Or, the blower cabinet inlet end can have an attached combination of modules including a mixing box with either one or two inlets with duct flanges and a variety of controls, a cooling coil module, and/or an evaporative cooling module.

6.4.1 Optional Inlet Duct Flange (factory-installed), Option AR5

Dimensions for attaching duct work are shown in **FIGURE 18A** and **TABLE 15**. The optional duct flange is 1-1/2" (38mm) long with a 3/4" (19mm) wide flange on all sides. The inlet air duct should be attached and sealed. Duct work must have a free area equal to the duct connection.

FIGURE 18A - Optional Inlet Air Duct Flange on the Blower Cabinet, Option AR5

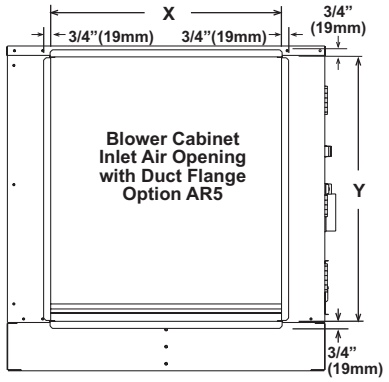


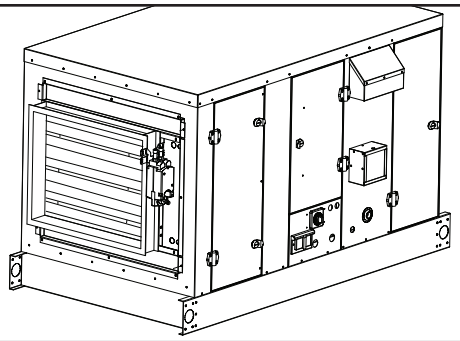
TABLE 15 - Dimensions of Optional Inlet Air Duct Flange

RDH	REH	RHH	RXH	UOM	X	Y
75/100	10A/20A/ 40A	N/A	000A	inches	24-1/2	25-1/16
				mm	622	636
125/150	15B/30B/ 60B	N/A	000B	inches	34-1/2	25-1/16
				mm	876	636
175/200 /225	N/A	130/180	000C	inches	24-1/2	37-5/16
				mm	622	948
250/300	30D/60D/ 90D/120D	260	000D	inches	40-3/4	37-5/16
				mm	1035	948
350/ 400A	40E/80E/ 120E	350	000E	inches	48-3/4	37-5/16
				mm	1238	948

6.4.2 Optional Two-Position Damper (factory installed), Option AR8—Models RDH, REH, RHH, RXH (requires Option AS2 Hood)

The illustration in **FIGURE 18B** shows a two-position damper attached directly to the blower cabinet. If ordered with a cooling coil module, the damper will be attached to the inlet air end of the cooling coil module. Weight added is in **TABLE 5**, page 10.

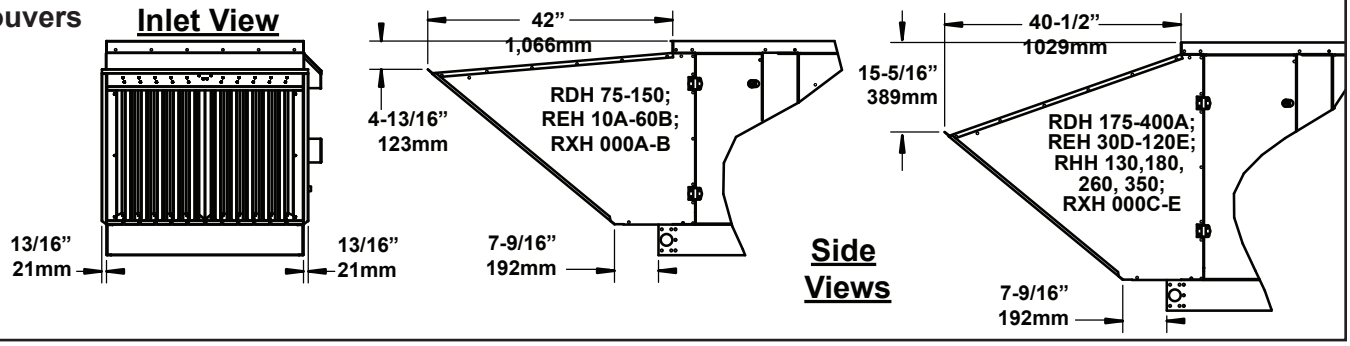
FIGURE 18B - Model RDH unit with Option AR8, On/Off Damper (no mixing box)



6.4.3 Screened Outside Air Hood for 100% Outside Air Opening, Option AS2

The outside air hood is a weatherized, screened hood designed to be field assembled and installed around the horizontal inlet air opening of the mixing box, a cooling coil cabinet, or the blower cabinet. The hood includes moisture-eliminating louvers. A parts list and illustrated instructions are included with the option package.

FIGURE 19A - Dimensions of Option AS2, Screened Outside Air Hood with Moisture Eliminating Louvers



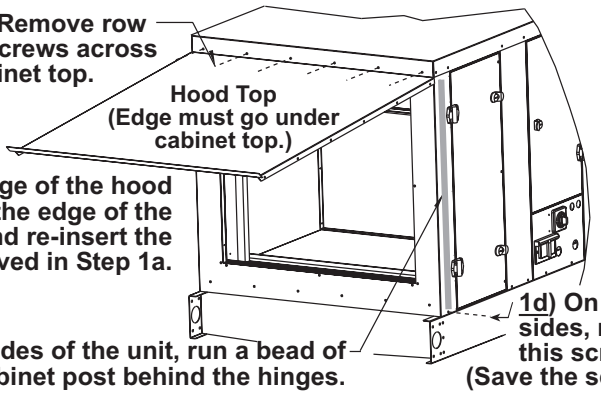
Installation Instructions

Follow the illustrated instructions in **FIGURE 19B**. To avoid possible damage, it is recommended that the outside air hood be installed after the system has been placed on the roof. The air hood should be installed before the blower is operated. Do not install the hood while the system is in operation.Installation of larger sizes requires at least two persons. All screw ends should be inside the hood.

FIGURE 19B - Outside Air Hood Assembly STEPS

STEP 1 - Attach top of outside air hood. Prepare to attach sides.

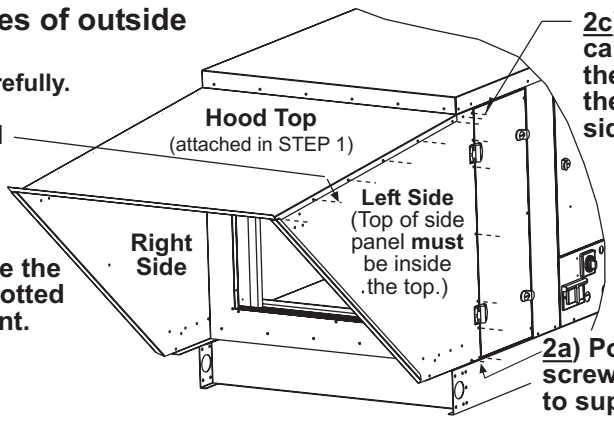
CAUTION: It is recommended that the inlet to the outside air hood NOT be facing into the prevailing wind. Allow 14" minimum clearance from the bottom of the air hood to the mounting surface.



STEP 2 - Attach sides of outside air hood.

NOTE: Select screws carefully.

2b) Position side panel over the cabinet and inside the hood top. Attach the side of the hood to the top with sheetmetal screws. Use the 1/2" screws with the slotted head and standard point.



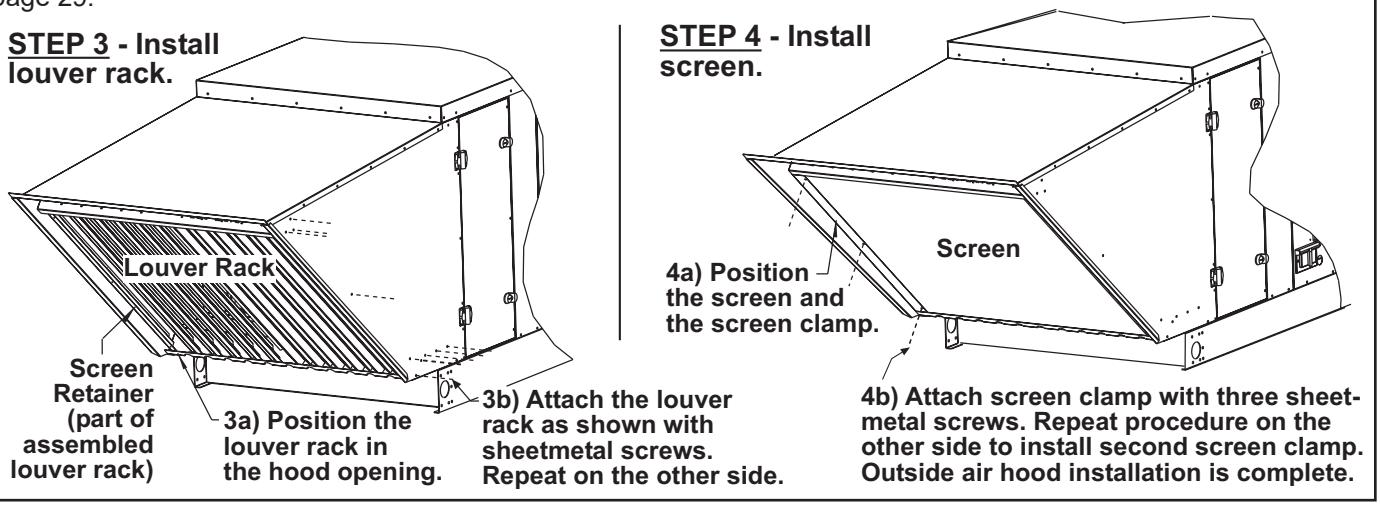
2c) Attach the side of the hood to the cabinet with self-tapping screws. Use the 1/2" hex head/no slot screws with the drill point. Use all the holes (each side requires eight screws).

2d) Repeat the procedure to install the other side.

2a) Position the side,and reinsert the screw removed in STEP 1d). Continuing to support the side panel, go to STEP 2b).

FIGURE 19B - Outside Air Hood Assembly STEPS (cont'd)

INSTALLATION NOTE: If the installation includes damper control Option GE21 or GE22 that requires field installation of a sensor in the outside air inlet, attach the sensor and connect the wires **before STEP 3** below. See Instructions on page 29.



6.4.4 Optional Filter Rack and Filters

Filter rack and filters are factory-installed optional equipment. Depending on which option was ordered, filters may be 2" disposable, 2" or 4" pleated disposable, or 2" permanent.

TABLE 16 - Filter Quantity and Sizes (Quantity and width and height dimensions apply to all type and thickness of filters.)

RDH Sizes	75, 100	125, 150	175, 200, 225	250, 300	350, 400A
REH Sizes	10A, 20A, 40A	15B, 30B, 60B	N/A	30D, 60D, 90D, 120D	40E, 80E, 120E
RHH Sizes	N/A	N/A	130, 180	260	350
RXH Sizes	000A	000B	000C	000D	000E
Filters (Qty) W × H (inches)	(2) 16 × 25	(2) 20 × 25	(2) 16 × 16; (2) 16 × 20	(3) 16 × 16; (3) 16 × 20	(1) 16 × 16; (2) 20 × 20; (3) 16 × 20

If the system does not have an optional cooling coil module, the vertical filter rack is located in the entering air side of the blower cabinet. If the system has an optional draw-through cooling coil module, the filter rack is located in the entering air side of the cooling coil module.

TABLE 17 - Inlet Air Filter Pressure Drops

Pressure Drops for Clean Factory-Installed Filters by Type and Size ("w.c.)

Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
RDH 75, 100; REH 10A, 20A, 40A; RXH 000A	569	0.0	0.0	0.0	0.0
	1000	0.1	0.0	0.1	0.0
	1500	0.1	0.0	0.1	0.1
	1898	0.1	0.1	0.2	0.1
RDH 125, 150; REH 15B, 30B, 60B; RXH 000B	949	0.0	0.0	0.0	0.0
	1250	0.1	0.0	0.1	0.0
	1500	0.1	0.0	0.1	0.0
	2000	0.1	0.0	0.1	0.1
	2500	0.1	0.1	0.2	0.1
	2847	0.2	0.1	0.2	0.1

Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
RDH 175, 200, 225; RHH 130, 180; RXH 000C	1329	0.1	0.0	0.1	0.0
	1650	0.1	0.0	0.1	0.0
	2000	0.1	0.0	0.1	0.1
	2500	0.1	0.1	0.1	0.1
	3000	0.1	0.1	0.2	0.1
	3500	0.2	0.1	0.2	0.2
	4000	0.2	0.1	0.3	0.2
	4271	0.2	0.1	0.3	0.2
RDH 250, 300; REH 30D, 60D, 90D, 120D; RHH 260; RXH 000D	1898	0.1	0.0	0.1	0.0
	2050	0.1	0.0	0.1	0.0
	2500	0.1	0.0	0.1	0.0
	3000	0.1	0.0	0.1	0.1
	3500	0.1	0.0	0.1	0.1
	4000	0.1	0.1	0.1	0.1
	4500	0.1	0.1	0.2	0.1
	5000	0.2	0.1	0.2	0.1
	5500	0.2	0.1	0.2	0.2
	5694	0.2	0.1	0.3	0.2

Size	CFM	Disposable	Permanent Aluminum	Pleated Disposable	
		2"	2"	2"	4"
RDH 350, 400A; REH 40E, 80E, 120E; RHH 350; RXH 000E	2657	0.1	0.0	0.1	0.0
	3300	0.1	0.0	0.1	0.0
	3500	0.1	0.0	0.1	0.1
	4000	0.1	0.0	0.1	0.1
	4500	0.1	0.1	0.1	0.1
	5000	0.1	0.1	0.2	0.1
	5500	0.2	0.1	0.2	0.1
	6000	0.2	0.1	0.2	0.1
	6500	0.2	0.1	0.2	0.2
	7000	0.2	0.1	0.3	0.2
	7400	0.2	0.1	0.3	0.2
	7593	0.3	0.1	0.3	0.2

6.4.5 Optional Mixing Box (Factory-Installed)—RDH, REH, RXH

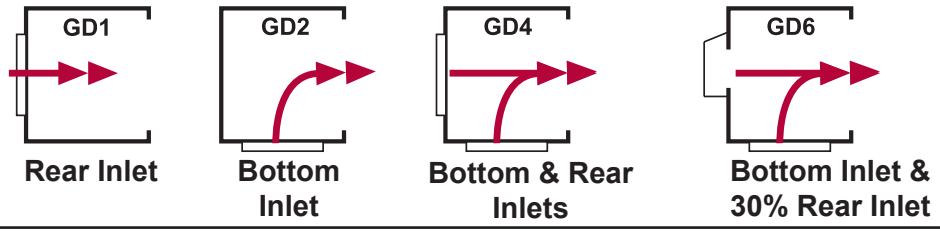
6.4.5.1 Mixing Box Configurations

If installation includes an Option MXB1 mixing box, it is factory installed in one of the configurations illustrated in **FIGURE 20**.

All mixing box inlet air openings have a duct flange (see dimensions in **FIGURE 22**). All inlet air ducts should be attached and sealed. Return air duct must have a free area equal to the return duct connection. See mixing box configurations in **FIGURE 20**.

FIGURE 20 - Option MXB1 Mixing Box Configurations

Side Views—Arrows represent inlet airflow.



Adjust the Damper Linkage (Option GD4)

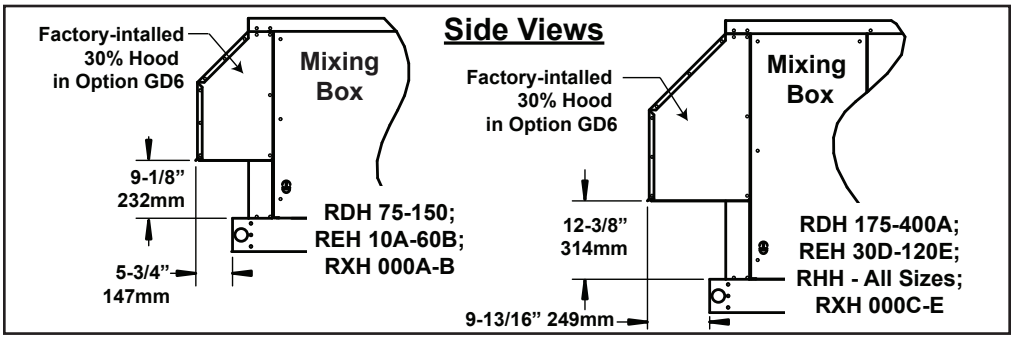
When a mixing box has both an outside air and a return air damper, both dampers are closed for shipping. The linkage for the return air damper must be adjusted prior to use. Follow instructions to adjust damper linkage.

1) Open the door on the side of the mixing box.
2) Loosen the setscrew on the return air damper rod at the damper arm.
3) Manually open the return air dampers. While the dampers are opening, the damper rod and arm will automatically move to its correct position.
4) Tighten the setscrew. Close the door.

6.4.5.2 Mixing Box Dimensions

The 30% outside air hood is installed on the mixing box at the factory when air inlet Option GE1 or GE2 is ordered.

FIGURE 21 - Dimensions of 30% Outside Air Hood in Mixing Box Configuration Option GD6



Duct flange connections are the same size for all mixing box configurations: D × 18-3/8" (467mm) opening with 3/4" (19mm) flanges.

Rear inlet side may have a factory-attached evaporative cooling module or a field-installed outside air hood.

FIGURE 22 - Mixing Box Dimensions

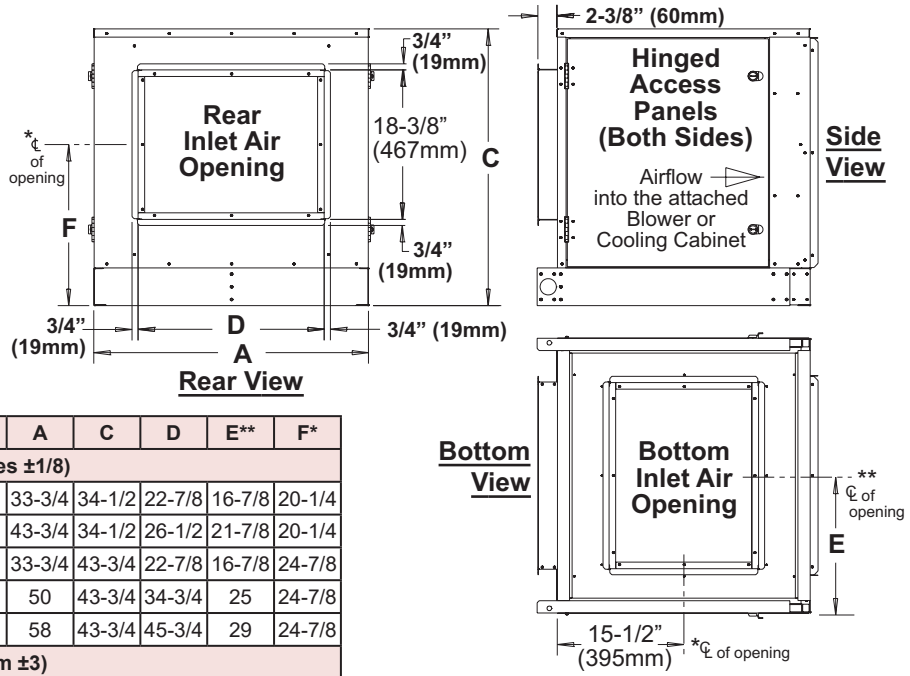


TABLE 18 - Mixing Box Dimensions

RDH	REH	RHH	RXH	A	C	D	E**	F*
Dimensions (inches ±1/8)								
75/100	10A/20A/40A	N/A	000A	33-3/4	34-1/2	22-7/8	16-7/8	20-1/4
125/150	15B/30B/60B	N/A	000B	43-3/4	34-1/2	26-1/2	21-7/8	20-1/4
175/200/225	N/A	130/180	000C	33-3/4	43-3/4	22-7/8	16-7/8	24-7/8
250/300	30D/60D/90D/120D	260	000D	50	43-3/4	34-3/4	25	24-7/8
350/400A	40E/80E/120E	350	000E	58	43-3/4	45-3/4	29	24-7/8
Dimensions (mm ±3)								
75/100	10A/20A/40A	N/A	000A	857	877	581	430	515
125/150	15B/30B/60B	N/A	000B	1111	877	673	557	515
175/200/225	N/A	130/180	000C	857	1112	581	430	633
250/300	30D/60D/90D/120D	260	000D	1270	1112	883	636	633
350/400A	40E/80E/120E	350	000E	1473	1112	1164	738	633

*Centerline of opening is at 1/2 of 18-3/8" = 9-3/16" (1/2 of 467mm = 233.5)

Centerline of opening is at 1/2 of **D. Dimension **E** applies to location of opening for all configurations.

6.4.5.3 Mixing Box Damper and Control Options

Depending on the control option ordered (identified on the wiring diagram), the mixing box may or may not have dampers. Depending on the configuration and controls, dampers may be outside air only or outside and return air with manual or motorized control. Damper motor may be 2-position, 3-position, or modulating and may be controlled by unit operation, unit operation and a damper position dial (potentiometer), discharge temperature, mixed inlet air temperature, building pressure, or a building automation system.

Motorized dampers always close on shutdown.

TABLE 19 - Air Inlet and Damper Controls by Mixing Box Option

Mixing Box Configuration (see FIGURE 20)	Air Inlet Control Option (Check wiring diagram.)	Opening and Dampers	Damper Motor Function (damper position)	Dampers Controlled by
Option GD6	GE1	30% Outside and 100% Return Air	30% outside air maximum; 100% return air (no damper)	Manual damper
	GE2		2-position (open/closed) 30% outside air damper; 100% return air (no damper)	System control (switch or field-supplied time clock)
Option GD1 or GD2	GE3	100% Outside Air Opening only with Dampers	2-position (open or closed)	Unit operation.
	GE4		3-position (2 open positions or closed)	Unit operation with damper "stop" set by unit-mounted adjustable damper dial (potentiometer)
Option GD4	NONE	100% Outside Air and Return Air Openings but no factory-installed dampers or controls		
	GE5	100% Outside and 100% Return Air Openings, both with Dampers	None	Damper controlled by manual quadrant
	GE6		2-position (outside air open or return air open)	System control (switch or field-supplied time clock)
	*GE7			Return air temperature provides warm-up or cool-down by delaying opening of outside air damper
	GE8		3-position (2 mixed positions or return air only)	Unit operation with damper "stop" set by unit-mounted adjustable damper dial (potentiometer)
	GE10		Modulates outside air and return air dampers to provide mixture of outside and return air in response to control	Unit operation with damper "stop" set from remote adjustable damper dial (potentiometer); requires installation of shipped-separate potentiometer; follow manufacturer's instructions
	GE11			Discharge air temperature
	GE12			Discharge air temperature with unit-mounted adjustable damper dial (potentiometer) set to always provide minimum amount of outside air
	*GE13			Discharge air temperature plus return air temperature setting to provide warm-up or cool-down by delaying opening of outside air damper
	*GE14			Discharge air temperature plus return air temperature providing warm-up or cool-down by delaying opening of outside air damper and with unit-mounted adjustable damper dial (potentiometer) set to always provide minimum amount of outside air after delay
	GE15			Building pressure; requires installation of shipped-separate pressure null switch; see page 29 and follow manufacturer's instructions
	GE16			DDC control from field-supplied automated building system
	GE21			Applies to PREEVA® systems with optional cooling operation; outside air damper is controlled by enthalpy (heat content in lb of air) using an economizer logic module. On a call for low stage cooling if the enthalpy of outdoor air becomes low, the outdoor air damper opens to reduce the cooling load in the building. As enthalpy of outdoor air increases, the outdoor air damper closes to a preset minimum condition. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. The economizer is automatically locked out during heating and holds the outdoor air damper at the minimum position setting. Enthalpy sensor is shipped separately for field installation in the outside air inlet. See instructions beginning on page 29.
	GE22			Applies to PREEVA® systems with optional cooling. In cooling mode, both outside air and return air dampers are modulated by enthalpy (heat content in lb of air) using an economizer logic module. On a call for low cooling if the outdoor air enthalpy is lower than the return air enthalpy, the outdoor air damper proportions open. If the outdoor air enthalpy is higher than the return air enthalpy, the outdoor air damper closes to minimum position. If outdoor air enthalpy and return air enthalpy are equal, the outdoor air damper proportions open. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. The economizer is automatically locked out during heating and holds the outdoor air damper at the minimum position setting. Enthalpy sensors are shipped separately for field installation in the return air duct and the outside air inlet. See instructions beginning on page 29.

*GE7 provides ASHRAE Cycle I; GE14 provides ASHRAE Cycle II; GE13 provides ASHRAE Cycle III.

Pressure Null Switch (Field installed to control Outside Air Dampers in Option GE15)

The pressure null switch used in Option GE15 is a Dwyer #1640-0 with a range of 0.01–0.20" w.c. It is shipped separately for field installation. Refer to the following paragraphs and the manufacturer's installation instructions included with the switch.

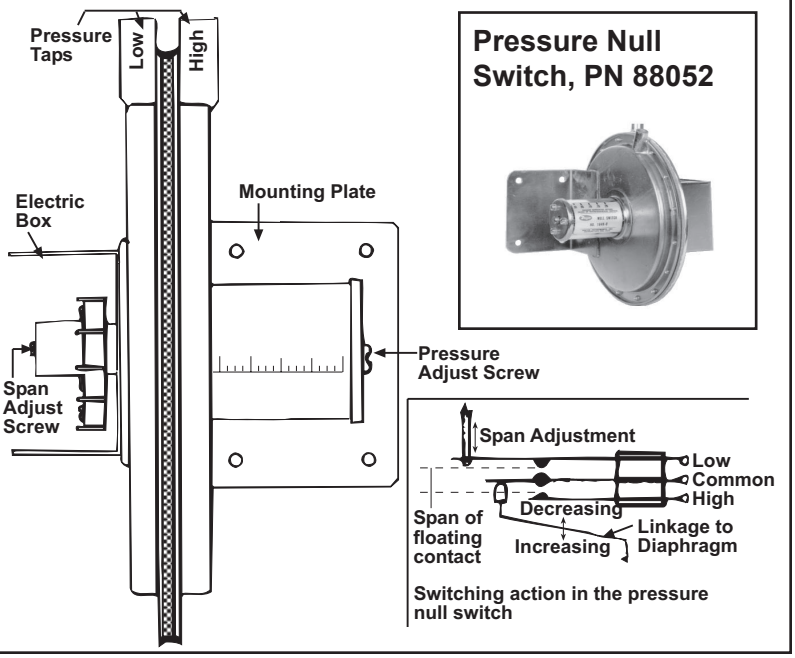
Description and Application: The pressure null switch is a diaphragm operated differential pressure switch used in makeup air applications to control building pressure. It maintains a selected positive or negative pressure setpoint by changing the amount of outside air being introduced to the building through the modulating outside air dampers. As more pressure is required in the building, the pressure null switch activates the damper motor driving the outside air damper towards the full open position and the recirculated air damper towards the closed position. Conversely, as less pressure is required, the switch drives the dampers in the opposite direction.

Pressure Null Switch Installation Instructions

1. Select an indoor location free from excessive vibration where oil or water will not drip onto the switch and where ambient temperature will be within a range of −30°F (dry air) to 110°F.
2. Mount the switch securely with the diaphragm in a vertical plane to ensure proper operation.
3. Connect the pressure taps on the top of the switch to sources of air pressure differential. Metal tubing with 1/4" OD is recommended, but any tubing system which will not unduly restrict the air flow may be used. To maintain a positive building pressure, vent the low pressure tap to the outdoors and allow the high pressure tap to monitor building pressure. To maintain a negative building pressure, reverse the functions of the high and low pressure taps. In either case, be sure that the outdoor vent is protected from the wind and screened from insects.
4. Adjustment of the Switch: The "HIGH" actuation point of the null switch is indicated on a calibrated scale secured to the transparent range screw enclosure. Building pressure is set by turning the adjustment screw. The "Low" actuation point is set by adjusting the span of the null by turning the span adjustment screw. The span range is 0.01–0.03" w.c.
5. See the wiring diagram included with the furnace to make electrical connections.

FIGURE 23 - Pressure Null Switch (used with Inlet Air Option GE15)

IMPORTANT: To eliminate shipping damage to the switch contacts, the manufacturer reduced the span adjustment to zero before shipping. The span should be adjusted prior to using the switch. (If the switch has been installed, disconnect the vent tube so that the null switch is in a neutral position.) Remove the electrical box cover and while observing the contacts, turn the span adjustment screw slowly in a clockwise direction. Continue turning the adjustment screw until you are able to see gaps between the common and both the low and high contacts. A minimum gap provides the greatest sensitivity. The wider the gap the lower the sensitivity.



Enthalpy Sensor(s) - Field installed to control dampers in economizer Options GE21 and GE22)

Option GE21 requires installation of one sensor; Option GE22 requires installation of two sensors. A system with Option GE21 includes one field-installed parts bag. A system with Option GE22 includes two field-installed parts bags. Locate the parts bag(s) shipped inside the unit. Check components against the list below.

TABLE 20 - Components in each Enthalpy Sensor Parts Bag, PN 220686 (Option GE21 requires one parts bag; Option GE22 requires two.)

Qty	Component Description	PN
1	Enthalpy Sensor, Honeywell #C7400A1004	**196290**
1	Blue Wire Assy, 18 ga × 72" with terminals	**220621**
1	Purple Wire Assy, 18 ga × 72" with terminals	**220620**
2	Screws, #6 × 3/4" long	**110650**
2	5/8" Strain Relief, Heyco #SR6N-4	**100392**
4	Stick-on Wire Retainers, Cable Fast-Fastex #8511-29-00	**142678**
2	Plastic Wire Ties	**20913**

6.4 Unit Inlet Air (cont'd)

6.4.5.3 Mixing Box Damper and Control Options (cont'd)

Enthalpy Sensor(s) Installation Instructions:

NOTE: Attach the outside air sensor when installing the outside air hood; see **FIGURE 19B**, pages 25 and 26.

1. Turn off the power (RDH, REH, RHH, RXH) and the gas (RHH and RDH).

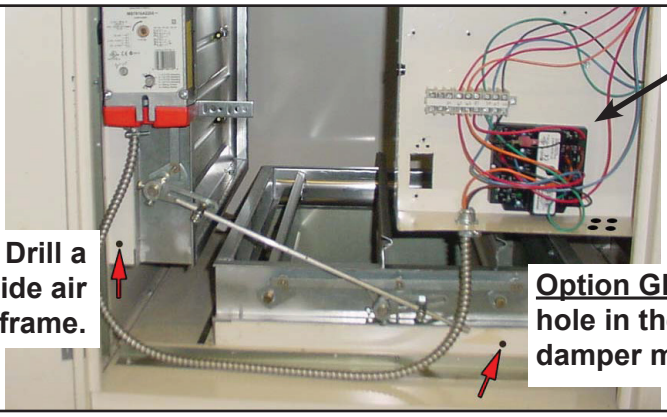
2. Install the Outside Air Enthalpy Sensor—Option GE21 and Option GE22

a) **Attach the Sensor to the Outside Air Hood:** On the same side as the electrical box in the mixing box, position the sensor on the inside of the side of the outside air hood (see **FIGURE 19B**, pages 25 and 26). The sensor may be mounted in any orientation but must be located so that it is exposed to freely circulating air and must be protected from rain, snow, and direct sunlight. Position the sensor in a central location on the side of the hood and attach with the two screws provided.

b) **Wire the Sensor:** Connect the two wires to the sensor as shown on the wiring diagram. Drill a 5/8" hole in the outside air damper mounting frame as illustrated in **FIGURE 24A**. Insert the strain relief bushing. Bring the wires through the opening and route them to the bottom of the electrical box. Use the stick-on wire holders to prevent the wires from interfering with the damper operation. Insert a strain relief bushing in a hole in the bottom of the electrical box and route the wires through. Make connections at the economizer logic module as shown on the wiring diagram.

Installation of Option GE21 control is complete. Refer to **FIGURES 24B and 24C** to set the enthalpy control (economizer logic module). If installing a return air sensor (Option GE22), continue to Step 3.

FIGURE 24A - Mixing Box with Optional Economizer Logic Module



3. Install the Return Air Enthalpy Sensor in the Return Air Duct (Option GE22)

a) **Attach the Sensor:** On the same side as the electrical box in the mixing box, position the sensor on the inside of the return air duct. The sensor may be mounted in any orientation but must be located so that it is exposed to freely circulating air. Position the sensor in a central location on the side of the duct and attach with the two screws provided.

b) **Wire the Sensor:** Connect the two wires to the sensor as shown on the wiring diagram. Drill a 5/8" hole in the return air damper mounting frame as illustrated in **FIGURE 24A**. Insert the strain relief bushing. Bring the wires through the opening and route them to the bottom of the electrical box. Use the stick-on wire holders and the wire ties to prevent the wires from interfering with the damper operation. Insert a strain relief bushing in a hole in the bottom of the electrical box and route the wires through. Make connections at the economizer logic module as shown on the wiring diagram.

Installation of Option GE22 control is complete. Refer to **FIGURES 24B** and **24C** to set the economizer logic module.

Operating Sequence with Economizer Option

On a call for low stage cooling

1. The blower motor is energized.

2. With the outdoor enthalpy less than the return air enthalpy:

a) The stage 1 and 2 cool circuits are locked out.

b) Dampers are positioned by the economizer and mixed air sensor.

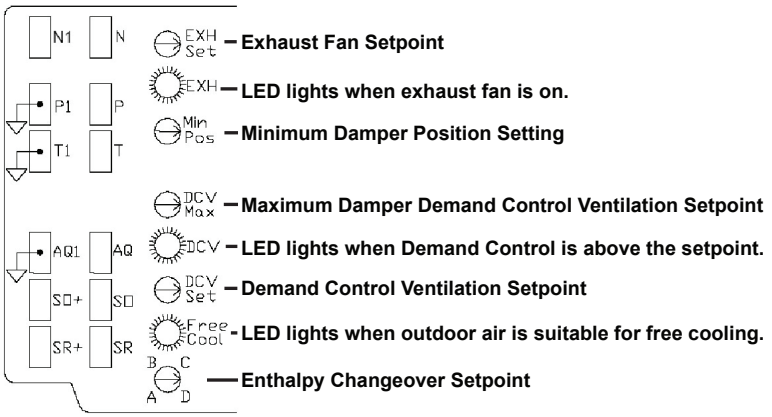
3. With outdoor air enthalpy higher than the return air enthalpy:

a) The stage 1 cool circuit is energized.

b) Dampers are positioned for minimum outside air.

c) On a call for high stage cooling, the stage 2 and 3 circuits are staged appropriately.

FIGURE 24B - Economizer Logic Module Setpoint and LED Locations

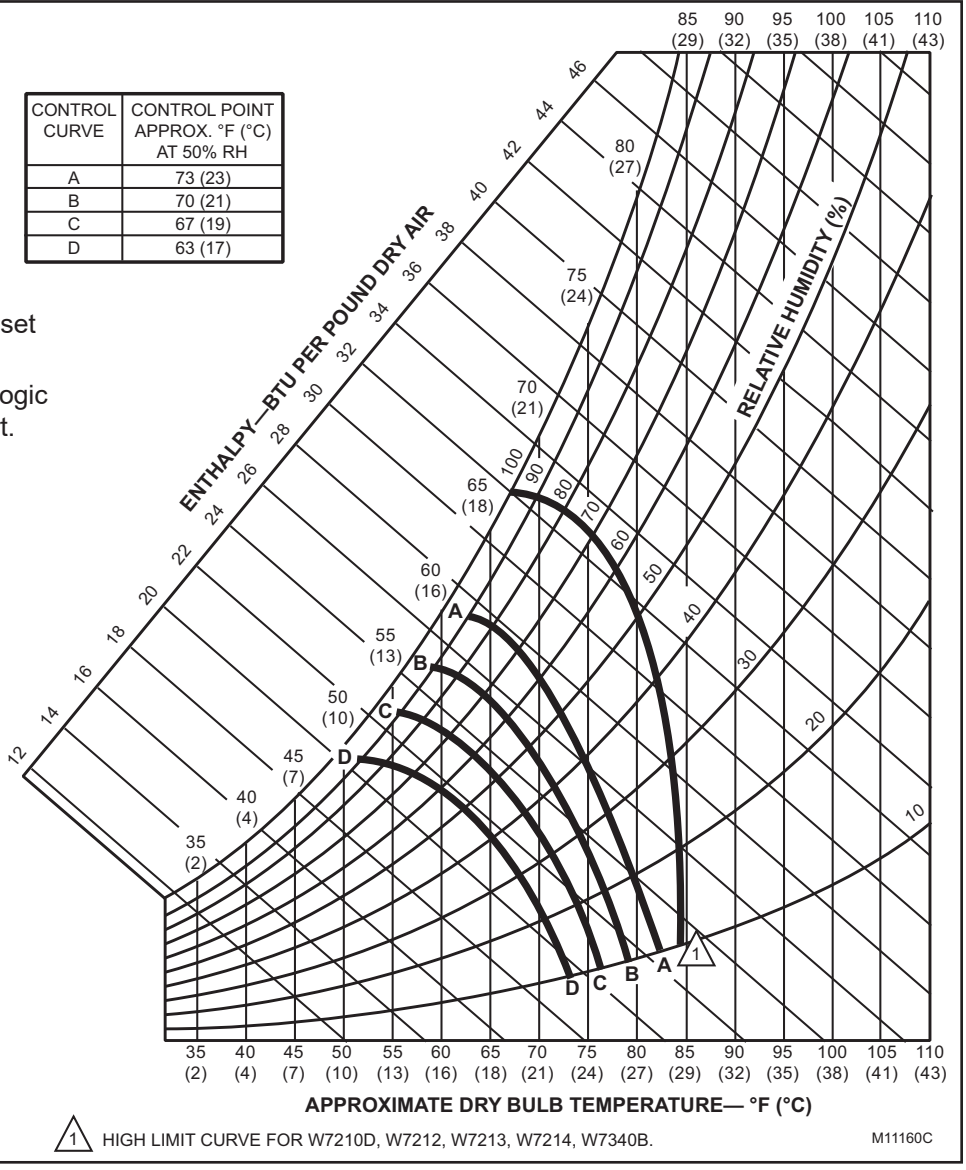


- EXH Set – Exhaust Fan Setpoint
- EXH – LED lights when exhaust fan is on.
- Min Pos – Minimum Damper Position Setting
- DCV Max – Maximum Damper Demand Control Ventilation Setpoint
- DCV – LED lights when Demand Control is above the setpoint.
- DCV Set – Demand Control Ventilation Setpoint
- Free Cool – LED lights when outdoor air is suitable for free cooling.
- A B C D – Enthalpy Changeover Setpoint

FIGURE 24C - Partial Psychometric Chart for Setting Economizer Logic Module (Reprinted with permission from Honeywell)

CONTROL CURVE	CONTROL POINT APPROX. °F (°C) AT 50% RH
A	73 (23)
B	70 (21)
C	67 (19)
D	63 (17)

- **Option GE21:** Use this chart to set economizer logic module.
- **Option GE22:** Set economizer logic module to “D” as shown on chart.



6.5 Optional Evaporative Cooling Module (factory-installed)

6.5.1 Supply and Drain Water Connections

The evaporative cooling module is factory-installed as the “entering air” cabinet on the system base. The evaporative cooling module must be connected to a water supply and to a drain.

Depending on how it was ordered, the cooler has either a recirculating float and pump water control system (Option ECD2) or an AquaSaver microprocessor timed water control system (Option ECD1). All coolers are equipped with 12" cellulose or glass fiber media and may have optional 1" or 2" aluminium pre-filters.

6.0 Mechanical (cont'd)

CAUTION: Water reservoir must be drained and pump motor turned off when outside temperature falls below 32°F (0°C). Pump must never be operated without water in the reservoir. See Hazard Levels, page 2.

6.5 Optional Evaporative Cooling Module (factory installed) (cont'd)

Follow these instructions to field connect the water supply and make necessary checks and adjustments before operating the evaporative cooling module.

NOTE: See **TABLE 5**, page 10 for evaporative cooling module weights.

Water Supply: Connect the water supply to the 1/2" NPT male connection on the control side of the evaporative cooling module. See location in **FIGURE 25**. Install a manual water shutoff valve upstream of the cooling module inlet at a convenient non-freezing location. If necessary, install a bleed line between the manual valve and the cooling module to allow drainage of the line between the shutoff valve and the cooling module.

Fill and Drain Kits (Field-Installed): If the module has a pump and float water control system and is ordered with a fill and drain kit (Option CT1, CT2, or CT3), refer to the illustration in **FIGURE 26**, page 33, to install the automatic fill and drain valves. Refer to the system wiring diagram to make wiring connections.

FIGURE 25 - Evaporative Cooling Module Dimensions and Water Connection Locations

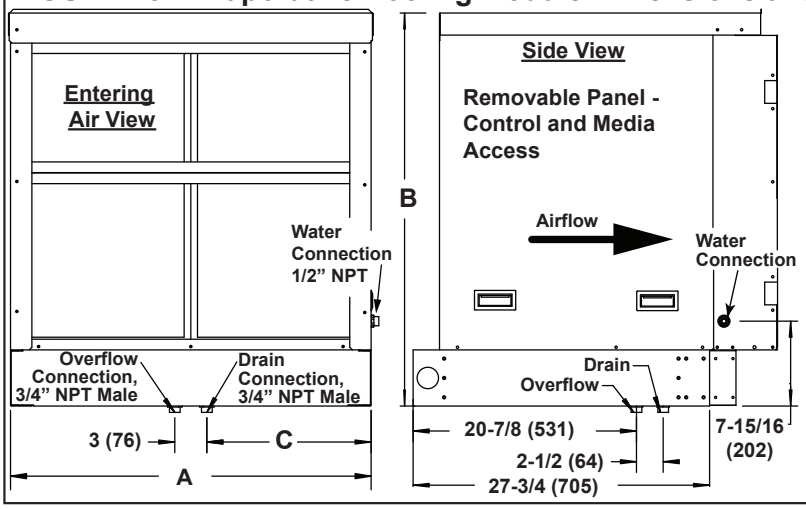


TABLE 21 - Evaporative Cooling Module Dimensions

RDH	REH	RHH	RXH	A	B	C
Dimensions (inches)						
75/100	10A/20A/40A	N/A	000A	33-3/4	34-1/2	15-3/8
125/150	15B/30B/60B	N/A	000B	43-3/4	34-1/2	20-3/8
175/200/225	N/A	130/180	000C	33-3/4	43-3/4	15-3/8
250/300	30D/60D/90D/120D	260	000D	50	43-3/4	23-1/2
350/400A	40E/80E/120E	350	000E	58	43-3/4	27-1/2
Dimensions (mm)						
75/100	10A/20A/40A	N/A	000A	857	876	391
125/150	15B/30B/60B	N/A	000B	1111	876	518
175/200/225	N/A	130/180	000C	857	1111	391
250/300	30D/60D/90D/120D	260	000D	1270	1111	597
350/400A	40E/80E/120E	350	000E	1473	1111	699

Freeze Protection: If a freeze protection option was ordered, the fill valve will not operate at subfreezing temperature. **NOTE:** On an evaporative cooling module with a recirculating pump and float water control system, freeze protection is only available if an optional fill and drain kit is field installed. See **Operating Sequence Section** in **FIGURE 26**, page 33.

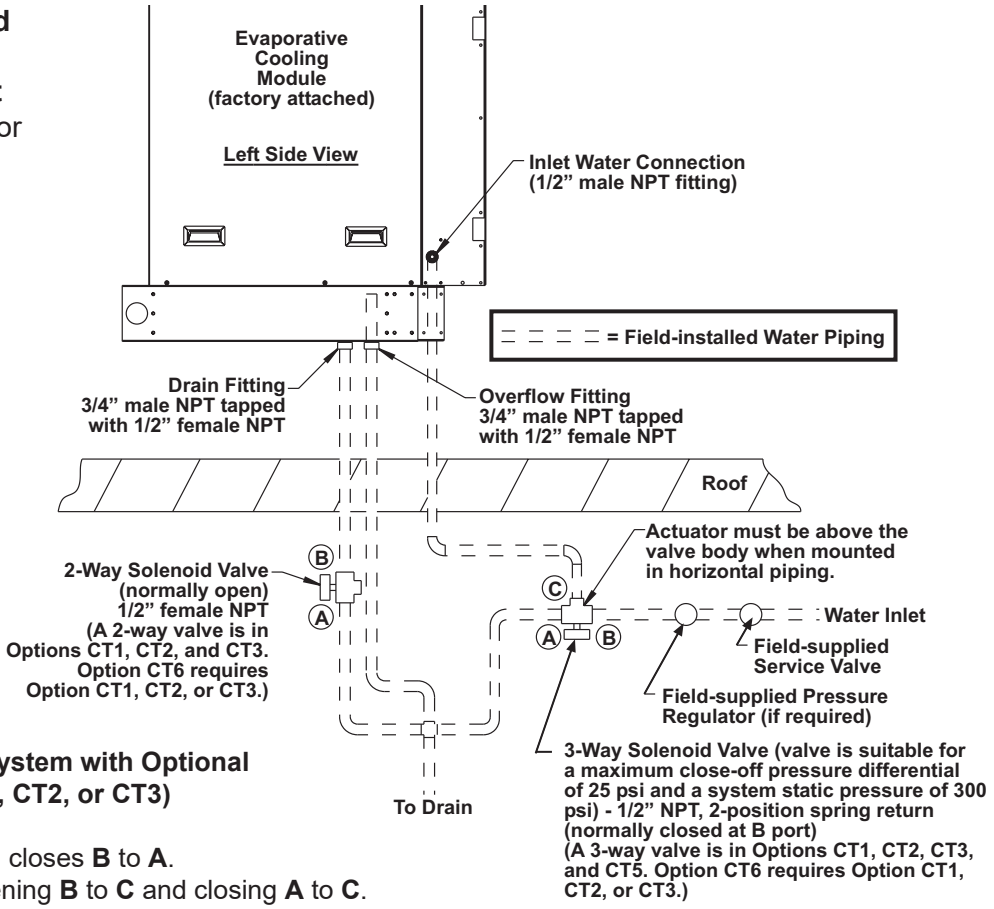
Overflow and Drain: All evaporative **cooling modules** are equipped with an overflow and drain fitting. The fittings are in the cabinet bottom and come complete with a lock nut and a sealing gasket. Check these fittings for tightness before installing the overflow and drain piping. The drain and overflow fitting will accommodate 3/4" NPT fittings and are also tapped with a 1/2" female pipe thread for iron pipe.

Bleed Off: If the module has a recirculating pump and float water control system, it has a bleed off hose. The bleed off hose is attached to a tee in the fill line and must drain into the overflow drain. Make sure that the end of the bleed off line extends into the overflow drain. Adequate bleed off is important to maintaining an efficiently operating system by lessening the concentration of undesirable minerals in the water being circulated through the cooling module. Minerals buildup because evaporation only releases "pure water vapor" causing the concentration of contaminants in the water to increase as the evaporation process continues. The minerals accumulate on the media, in the water lines, on the pump, and in the reservoir.

Water Hammer Arrestor: If the cooling module is equipped with an AquaSaver timed metering system, the operation of the solenoid valve in the water line is controlled by the timer. Due to various water pressures and installation conditions, the water supply line may bang abruptly when the solenoid valve closes. This banging can be minimized by installing an optional water hammer arrestor (Option ECB1) in the supply line. When

FIGURE 26 - Field-Installed Optional Fill and Drain Valves for Pump and Float System (Option CT1, CT2, or CT3) **and**

Freeze Protection Kits (Option CT5 for AquaSaver and Option CT6 for Pump and Float System)



Sequence of Operation with Optional Fill and Drain and/or Freeze Protection Kits

Applies to: Float and Pump System with Optional Fill and Drain Kit (Option CT1, CT2, or CT3)

1) Call for cooling.
2) 2-way valve is energized and closes **B** to **A**.
3) 3-way valve is energized opening **B** to **C** and closing **A** to **C**.
4) During no call for cooling, valves return to normal state.

Applies to: AquaSaver Timed Water System with Optional Freeze Protection (Option CT5)

1) Call for cooling.
2) 3-way valve is energized opening **B** to **C** and closing **A** to **C**.
3) If outside air temperature drops below freeze protection controller setting, 3-way valve is de-energized and AquaSaver 24V solenoid valve remains energized for eight minutes to allow complete system water drainage.
4) During no call for cooling, 3-way valve returns to normal state.

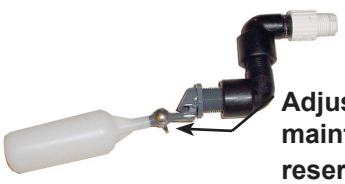
Applies to: Float and Pump System with Optional Fill and Drain Kit (Option CT1, CT2, or CT3) and Freeze Protection (Option CT6)

1) Call for cooling.
2) 2-way valve is energized and closes **B** to **A**.
3) 3-way valve is energized opening **B** to **C** and closing **A** to **C**.
4) If outside air temperature drops below freeze protection controller setting, valves return to normal state.
5) During no call for cooling, valves return to normal state.

installing an optional water hammer arrestor, select an indoor location (above 32°F), either horizontal or vertical, in line with and as close to the solenoid valve as possible. Follow the manufacturer's instructions to install and maintain the water hammer arrestor.

Recirculating Float and Pump Control System: Turn on the water supply and check for good flow. When the float valve (**FIGURE 27**) shuts off the water supply, measure the water depth. The depth of the water should be approximately 3" (76mm). If necessary, adjust the position of the float valve with the wing nut to obtain the proper water level.

FIGURE 27 - Float Valve, PN 216553



1/2" MPT Water Supply Connection

Adjust the float valve position with the wing nut to maintain approximately 3" (76mm) of water in the reservoir.

6.0 Mechanical (cont'd)

6.5 Optional Evaporative Cooling Module (factory installed) (cont'd)

WARNING

Adjust ball valve only when the power is disconnected from the system. Failure to do so can cause electrical shock, personal injury, or death.

FIGURE 28 - Remove side door and locate ball valve (illustration below is from the rear). Both water flow control systems have a ball valve in the water line.



6.5.2 Adjusting Water Flow Over Pads

Proper water flow over the evaporative cooling media is critical to extend the life and maintain the efficiency of the pads. Read the warnings and follow the instructions that apply.

CAUTION: Do not flood the media pads with extreme quantities of water for long periods as this will cause premature breakdown of the media. An even flow from top to bottom of the media with the least amount of water is all that is required to assure maximum efficiency and media life span. More water does not provide more evaporation or more cooling.

Adjusting Water Flow with a Float and Pump Control System: Using the ball valve, located in the length of hose running from the pump to the distribution line inlet (see **FIGURE 28**), adjust the valve handle to allow the flow to completely dampen the media pads from top to bottom.

Operate the unit watching the water flow. After 15 minutes with the blower in operation, the water should have completely dampened the pads but should not be flowing off the entering side of the media. If water is flowing off the entering side of the media, turn the system off, disconnect the power, and reduce the entering water flow.

Adjusting Water Flow with a Timed Metering Control System: **NOTE**: Water flow and pad wetting time should be adjusted at maximum airflow and wet bulb depression to assure complete wetting of the media at the extreme operating conditions.

In addition to adjusting water flow, the timing of the water on/off cycle can be adjusted. Adjustments are correct when **1)** the water rises from the holes in the sprinkler pipe consistently along the entire pipe length, **2)** the media pads wet evenly after a few "ON" cycles (no dry spots or dry streaks), and **3)** a slight amount of excess water collects at the drain at the completion of the "ON" cycle.

1) AquaSaver Water Flow Adjustment: Using the ball valve illustrated in **FIGURE 28**, adjust the water flow so that the water rises above the distribution pipe as illustrated in **FIGURE 29**.

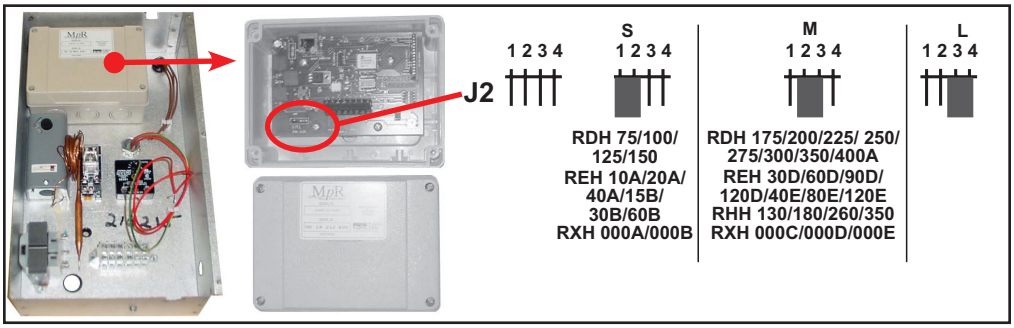
FIGURE 29 - Timed Water System—Use the ball valve in FIGURE 28 to adjust the rise from the distribution (sprinkler) pipe in the evaporative cooling module.



RDH Size	REH Size	RHH	RXH Size	A = Water rise from PVC Sprinkler Pipe
75/100/ 125/150	10A/20A/40A/ 15B/30B/60B	N/A	000A/ 000B	1/8" to 1/2" (3 to 13 mm)
175/200/ 225/250/ 350/400A	30D/60D/90D/ 120D/40E/80E/ 120E	130/180/ 260/350	000C/ 000D/ 000E	1/4" to 1/2" (6 to 13 mm)

2) AquaSaver Timer Adjustment: At any given temperature, the media pads should completely wet from top to bottom during the ON cycle. The microprocessor has three preset timing settings based on media size. The appropriate setting is selected by changing the position of the suitcase jumper at J2 on the microprocessor. Remove the cover to check the setting (see **FIGURE 30**).

FIGURE 30 - AquaSaver Microprocessor Control, PN 205044, in the Junction Box



If the jumper is at the appropriate location, replace the cover. If the jumper needs to be moved, move it to the appropriate setting. The setting will go into effect when the power

is restored. Check the “ON” timing; the media pads should be wet from top to bottom during the ON cycle.

If the preset timing is not suitable for the application, follow the instructions supplied with the microprocessor to change the calibration of the “ON” and/or “OFF” cycle.

All Evaporative Cooing Modules: Check the reservoir for any water leaks. If any small leaks are present, drain the reservoir. Dry and apply a waterproof silicone sealer around corners and welds.

6.6 Optional Cooling Coil Module (Factory-Installed)

6.6.1 Cooling Coil Module General

The draw-through cooling coil module is factory assembled to the entering air side of the system blower cabinet. Depending on which options were ordered, it will house either a single, dual, or 1/3-2/3 circuit DX cooling coil or a chilled water coil with 1/4, 1/2, 3/4, or full circuiting. A DX coil will accommodate the refrigerant specified on the order, either R410A, R134a, or R407c. Verify that the correct refrigerant was specified. If the coil was ordered for the incorrect refrigerant, contact your distributor or the factory for revised capacity ratings and appropriate distributor nozzle(s). Distributor nozzles may be changed in the field by a qualified technician.

If a cooling module was ordered with an optional reheat section (Option AU7L or AU7R), the reheat circuit is factory charged with R410A refrigerant.

DANGER (Applies to Optional Reheat Circuit)

The reheat circuit contains R410A high pressure refrigerant. Hazards exist that could result in personal injury or death. Installation, maintenance, and service should only be performed by an HVAC technician qualified in R410A refrigerant and using proper tools and equipment. DO NOT USE service equipment or tools designed for R22 refrigerant.

IMPORTANT: ***Do not release refrigerant to the atmosphere!*** **If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified HVAC technician.**

The split air-conditioning system requires a field-supplied condensing coil. Follow the instructions provided by the condensing coil manufacturer to make the piping connections. If equipped with a multi-circuit coil, before making connections, blow dry nitrogen into the circuit to determine which distributor goes with which suction line (see connection dimensions in **FIGURE 31** for chilled water or **FIGURE 32A or 32B** for DX coil).

NOTE: If ordered with a Model MASA condensing unit, follow the instructions in Form I-COND (shipped with the condensing unit) for connecting the split system.

The coil module drain trough has an exterior 1" NPT connection. Connect the drain into a sanitary drain system. The condensate trough and drain requires periodic cleaning.

Cooling control depends on which system control was ordered. If digital heating/cooling controls were ordered, see Paragraph 8.3 and the control instruction form for information. If the cooling module was ordered with optional reheat (Option AU7L or AU7R), the reheat circuit is factory charged with R410A refrigerant.

Condensing related controls such as thermal expansion valves and hot gas bypass may have been ordered with the unit (R410-A only) or may be supplied locally.

6.6.2 Cooling Coil Module Dimensions

FIGURE 31 - Dimensions of Chilled Water Cooling Coil Module, Option AU6

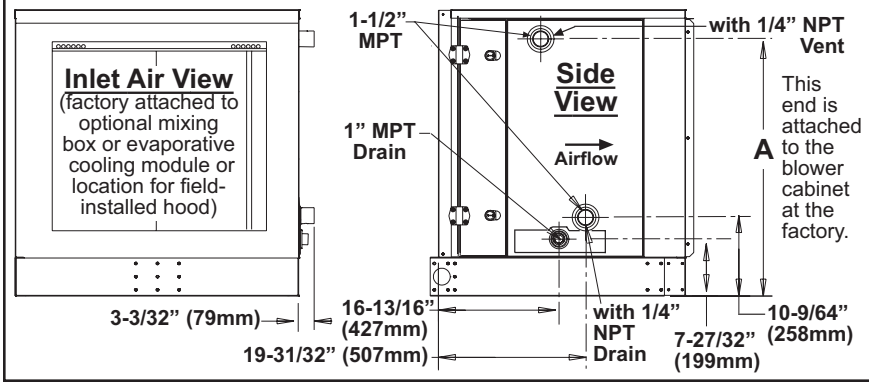


TABLE 22 - Chilled Water Cooling Coil Module Dimensions

RDH Size	REH Size	RHH Size	RXH Size	A	
				inches	mm
75/100/ 125/150	10A/20A/ 40A/15B/ 30B/60B	N/A	000A/ 000B	33-1/4	844
175/200/ 225/250/ 300/350/ 400A	30D/60D/ 90D/120D/ 40E/80E/ 120E	130/ 180/ 260/ 350	000C/ 000D/ 000E	43-7/32	1199

FIGURE 32A - Dimensions of DX Cooling Coil Cabinet without Reheat, Option AU5

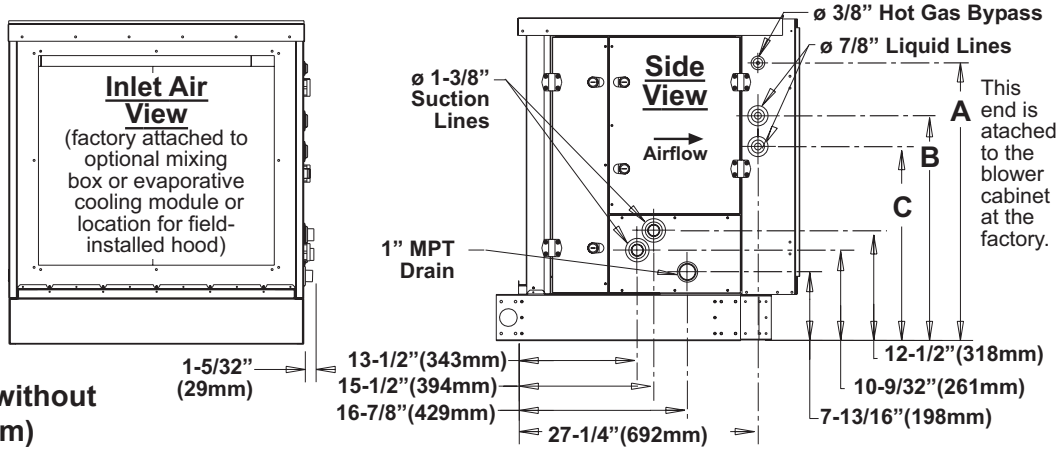


TABLE 23A - Dimensions of DX Cooling Coil Cabinet without Reheat (inches and mm)

Model RDH	Model REH	Model RHH	Model RXH	A	B	C	A	B	C
				Dimensions (inches)			Dimensions (mm)		
75/100/125/150	10A/20A/40A/15B/30B/60B	—	000A/000B	31-9/16	25-9/16	22-1/16	801	649	560
175/200/225/250/300/350/400A	30D/60D/90D/120D/40E/80E/120E	All	000C/000D/000E	40-13/16	34-13/16	23-5/16	1037	884	592

FIGURE 32B - Dimensions of DX Cooling Coil Cabinet with Reheat, Option AU7

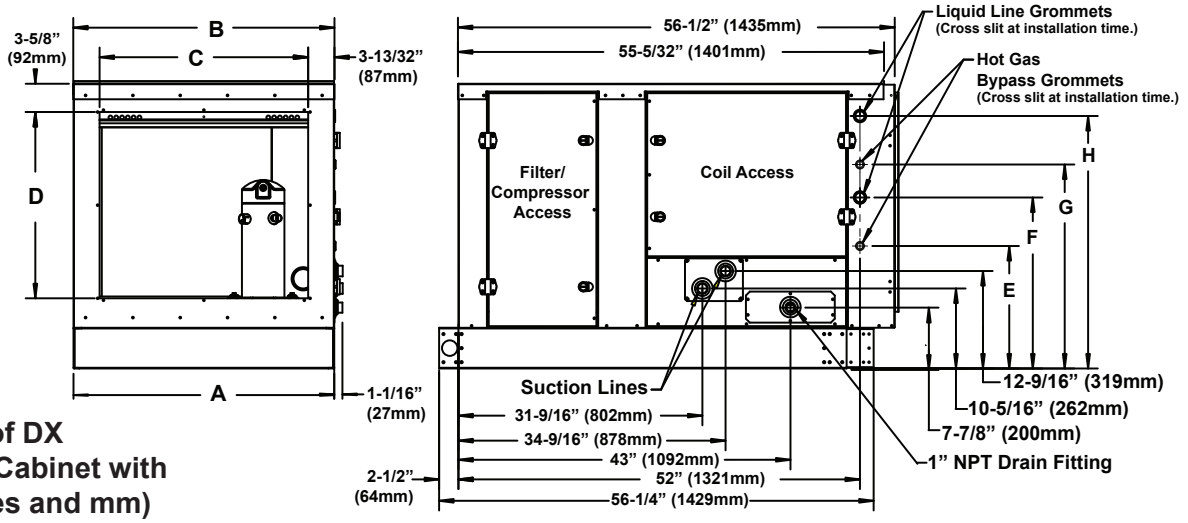


TABLE 23B - Dimensions of DX Cooling Coil Cabinet with Reheat (inches and mm)

Model RDH Size	Model REH Size	Model RHH	Model RXH	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
				Dimensions (inches)								Dimensions (mm)							
75/100	10A/20A/40A	N/A	000A	33-3/4	33-13/16	27	24	15-3/4	22	26-1/4	32-1/2	857	859	686	610	400	559	667	826
125/150	15B/30B/60B	N/A	000B	43-3/4	43-13/16	37	24	15-3/4	22	26-1/4	32-1/2	1111	1113	940	610	400	559	667	826
175/200/225	N/A	130/180	000C	33-3/4	33-13/16	27	33-1/4	17-3/4	24	30-1/4	36-1/2	857	859	686	845	451	610	768	927
250/300	30D/60D/90D/120D	260	000D	50	50-5/32	43-1/4	33-1/4	17-3/4	24	30-1/4	36-1/2	1270	1274	1099	845	451	610	768	927
350/400A	40E/80E/120E	350	000E	58	58-5/32	51-1/4	33-1/4	17-3/4	24	30-1/4	36-1/2	1473	1503	1302	845	451	610	768	927

6.6.3 Ultra-Violet Light, Option UV2

If the cooling module was ordered with an optional ultra-violet light, the fixture is factory installed but the bulb and other components are shipped in the blower compartment for field installation. Follow the instructions on the option installation form shipped in the parts bag. Option UV2 ultra-violet light requires its own power supply and disconnect switch.

CAUTION: Do not touch bulb glass without gloves. Oil from fingerprints will permanently etch bulb and weaken structure. Clean bulb after handling.

WARNING

Do not use UVC lights for service lighting. Never expose eyes or skin to ultra-violet light from any source.

6.6.4 Cooling Module Condensate Drain

A removable drain pan with a 1" NPT drain connection is located below the coil cabinet (see **FIGURE 31 or FIGURE 32A or B**). When connecting the drain line, provide a means of disconnecting the line at or near the cabinet connection to allow the drain pan to be removed for cleaning.

Ensure the system is level and **install a trap in the drain** (see **FIGURE 33A**). Pitch the drain line at least 1/2" (13mm) for every 10 feet (3M) of horizontal run. Drain lines must not interfere with drain pan or access panels. An obstruction in the drain or a poorly designed drain can cause the condensate pan to over flow which could result in unit or building damage.

Drain Trap

If the installation or local code requires, run drain into a waste water system.

The design of the drain trap is important. Since the condensate drain pan is on the blower inlet side, there is a negative pressure at the drain relative to the ambient. The trap height must account for this static pressure difference. Maximum negative static can be determined by reading the negative pressure at the blower inlet and adding 0.2" w.c. to allow for dirty filters.

If dimension “B” is not tall enough, the water seal will not hold and air will be drawn through the drain pipe into the system. If the outlet leg of the trap is too tall, water will back up into the drain pan. As condensate forms during normal operation, the water level in the trap rises until there is a constant outflow. **FIGURE 33A** illustrates the appropriate dimensions for trapping a negative pressure system.

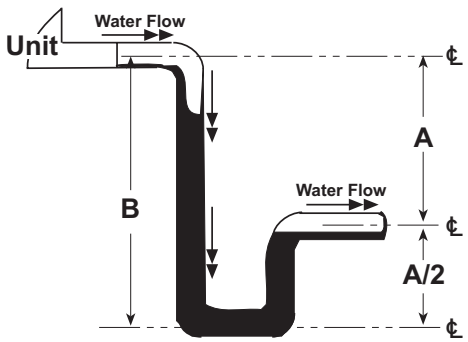
Improper trap design accounts for some condensate drainage system failures, but incorrect use and maintenance of condensate drain traps can also cause problems. The combination of airborne particles and moisture in the air handler can result in algae formation in the drain pan and traps. The traps must be cleaned regularly to avoid blockage that can slow or stop water flow, resulting in backup into the system.

If the drains have a cleanout opening (**FIGURE 33B**), be sure to close the opening after cleaning.

FIGURE 33A - Condensate Drain Trap Dimensions

A = 1" (25mm) for each 1" (25mm) of maximum static pressure *plus* 1" (25mm)

B = A + A/2



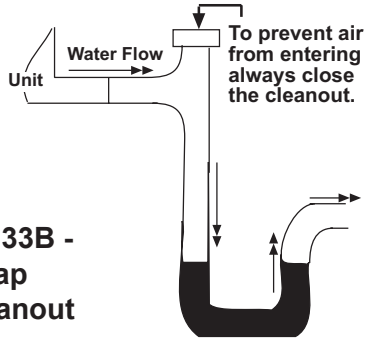


FIGURE 33B - Drain Trap with Cleanout

Condensate Drain Use

Seasonal Usage: At the beginning of the cooling season, inspect and clean the entire cooling coil cabinet including the condensate drain pan. Thoroughly clean dirt, algae, grease, and other contaminates. Inspect condensate drain pans, traps, and piping; fill traps with water to ensure proper operation. During a winter shutdown of the cooling system, it may be desirable to disconnect and remove all water from the trap and drain to prevent freeze damage. If local building codes permit, trap may be filled with an anti-freeze solution. Or piping may be designed with freeze plugs or other freeze protection methods (such as a heat tape).

Year Round Usage: Climates or applications with cooling requirements year round require more frequent inspections of the cooling coil cabinet and condensate drains.

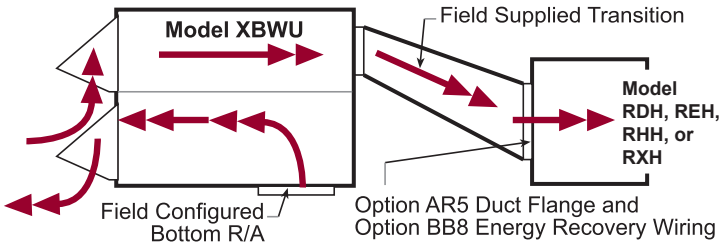
6.7 Optional Energy Recovery Module (Field-Installed)—RDH, REH, RHH, and RXH

If the system is ordered with a Model XBWU energy recovery module, the module is shipped separately for field installation. The unit should have been ordered with a duct flange (Option AR5) and with the optional wiring needed (Option BB8).

The transition duct is field supplied. The roof curb for the energy recovery module is for the energy recovery module only and is either optional with the module or field supplied. Follow the installation instructions with the energy recovery module and the wiring diagram on the unit.

6.7 Optional Energy Recovery Module (field-installed)—RDH, REH, RHH, and RXH (cont'd)

FIGURE 34 - Field-Installed Optional Energy Recovery Module, Option XBWU



ARRANGEMENT FOR USE WITH ENERGY RECOVERY MODULE

6.8 Unit Discharge—RDH, REH, RHH, and RXH

Depending on which model and which options were ordered, there is a horizontal opening with no duct flange (RDH, RHH, or RXH), a horizontal opening with a duct flange (RDH, RHH, RXH, or REH), or a downturn plenum with bottom opening with a duct flange with or without dampers (RDH, RHH, RXH, or REH). Model REH units are for ducted systems only and require a factory-installed duct flange or a downturn plenum.

6.8.1 Optional Downturn Plenum (factory-installed)

If ordered with a downturn plenum, the unit has a bottom opening with a duct flange. See the opening dimensions in **FIGURE 4**, page 9. See **FIGURE 8**, page 12, for the opening dimensions in relation to an optional roof curb.

If ordered with a damper, the damper closes the discharge opening when the unit is not operating.

6.8.2 Horizontal Discharge Duct Flange for REH, RDH, and RXH <u>without</u> a hot water heat module

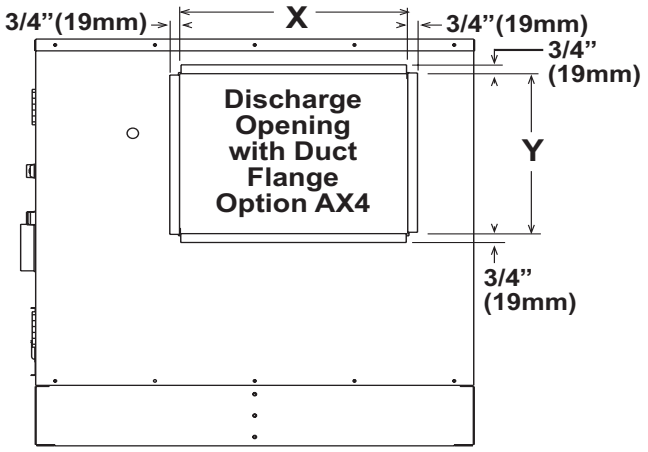
Dimensions for attaching duct work are shown below in **FIGURE 35**. The discharge duct flange extends horizontally 4" (102mm) from the end of the cabinet and has a 3/4" (19mm) wide flange on all sides. Requirements and recommendations are listed in Paragraph 6.8.4 for sizing and attaching duct work.

NOTE: Model REH with horizontal discharge always has a factory-installed duct flange. Duct flange is optional on Models RDH, RHH, and RXH.

FIGURE 35 - Dimensions of Horizontal Discharge Duct Flange on REH, RDH, RHH,& RXH without a hot water heat module (for RXH with a hot water heat module, see Paragraph 6.8.3)

TABLE 24 - Dimensions of Discharge Duct Flange

RDH	REH	RHH	RXH (no heat)	UOM	X	Y
75, 100	10A, 20A, 40A	N/A	000A	inches	17-9/16	13-9/16
				mm	446	345
125, 150	15B, 30B, 60B	N/A	000B	inches	27-9/16	13-9/16
				mm	700	345
175, 200, 225	N/A	130, 180	000C	inches	20-3/4	22-13/16
				mm	527	580
250, 300	30D, 60D, 90D, 120D	260	000D	inches	28-5/8	22-13/16
				mm	727	580
350, 400A	40E, 80E, 120E	350	000E	inches	38-5/16	22-13/16
				mm	973	580



6.8.3 Hot Water Heat Module (RXH Only)

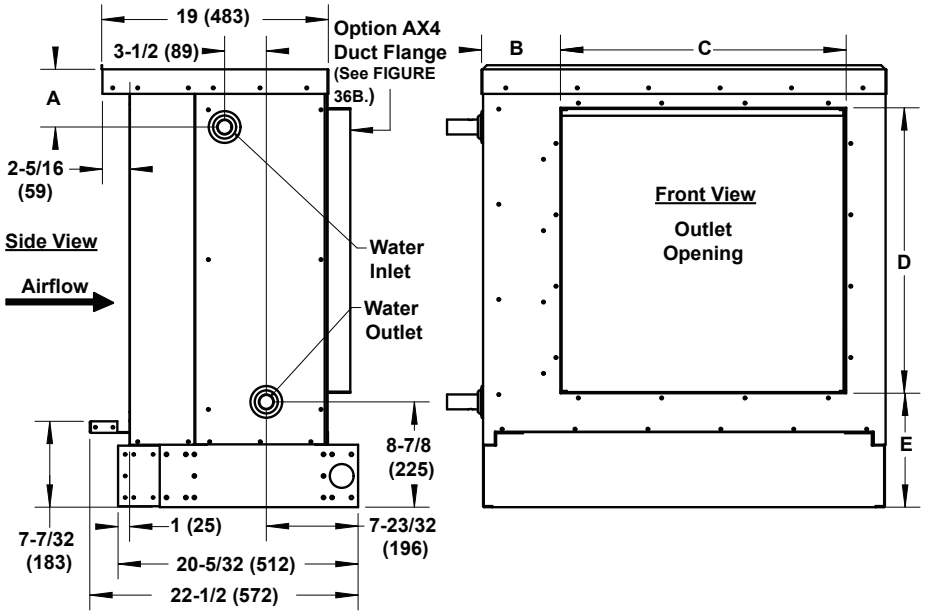
The optional hot water heat module is factory-installed on the unit base at the discharge end of a Model RXH. The module was either ordered with a factory-installed coil or the coil is field-supplied for installation at the job site. Controls are field supplied.

Dimensions: The cabinet height and width are the same as the RXH (see Paragraph 4.2). See **FIGURE 36A** for length and water connection dimensions. For system length, add the length of the module to the RXH length in Paragraph 4.2.

FIGURE 36A - Dimensions of Hot Water Heat Module, Option HW2 (inches (mm))

TABLE 25A - Dimensions

RXH		000A	000B	000C	000D	000E
A	inches	4-27/32			4-1/8	
	mm	123			105	
B	inches	6-5/8			6-7/8	
	mm	168			175	
C	inches	24	34	24	40	48
	mm	610	864	610	1016	1219
D	inches	24		34		
	mm	610		864		
E	inches	9-9/16	8-27/32	8-3/8		
	mm	243	225	213		



Horizontal Discharge Duct Flange for Model RXH <u>with</u> a hot water heat module (for Model RXH without a hot water heat module, see Paragraph 6.8.2). Optional duct flange is factory-installed. See dimensions for connecting duct work in **FIGURE 36B**. See duct connection requirements in Paragraph 6.8.4.

FIGURE 36B - Option AX4, Discharge Duct Flange on Model RXH with Optional Hot Water Heat Module

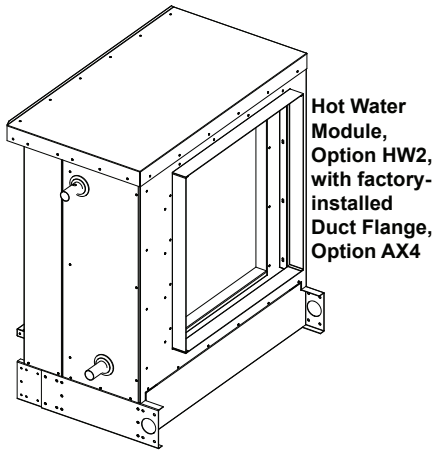


TABLE 25B - Dimensions of Discharge Duct Flange on Model RXH with an Optional Hot Water Heat Module

RXH with Option HW2		H	W
000A	inches	23-3/4	23-15/16
	mm	603	608
000B	inches	23-3/4	33-15/16
	mm	603	862
000C	inches	33-3/4	23-15/16
	mm	857	608
000D	inches	33-3/4	39-15/16
	mm	857	1014
000E	inches	33-3/4	47-15/16
	mm	857	1218

6.8.4 Requirements and Recommendations for Connecting and Installing Duct Work

- **Type of Duct Work:** The type of duct installation to be used depends in part on the type of construction of the roof (whether wood joist, steelbar joist, steel truss, pre-cast concrete) and the ceiling (whether hung, flush, etc.).
- **Duct Work Material:** Rectangular duct should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B & S gauge aluminum.
- **Duct Work Structure:** All duct sections 24 inches (610mm) or wider, and over 48 inches (1219mm) in length, should be cross broken on top and bottom and should have standing seams or angle-iron braces. Joints should be S and drive strip, or locked.
- **Through Masonry Walls:** No warm air duct should come in contact with masonry walls. Insulate around all air ducts through masonry walls with not less than 1/2" (1" is recommended) of insulation.
- **Through Unheated Space:** Insulate all exposed warm air ducts passing through an unheated space with at least 1/2" (1" is recommended) of insulation.
- **Duct Supports:** Suspend all ducts securely from adjacent buildings members. Do not support ducts from unit duct connections.
- **Duct Sizing:** Proper sizing of the supply air duct work is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air

6.0 Mechanical (cont'd)

6.8 Unit Discharge—RDH, REH, RHH, and RXH

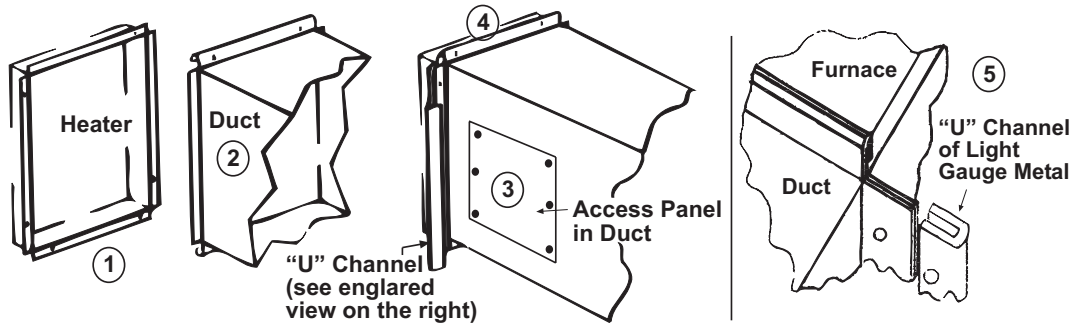
6.8.4 Requirements and Recommendations for Connecting and Installing Duct Work (cont'd)

Conditioning Contractors Association (www.acca.org), 2800 Shirlington Road, Suite 300, Arlington, VA 22206. A manual covering duct sizing in detail may be purchased directly from them.

CAUTION: An external duct system static pressure not within the limits shown on the rating plate, or improper motor pulley or belt adjustment, may overload the motor (see Hazard Levels, page 2).

- **Removable Panel (See FIGURE 37):** The duct work should have a removable access panel. This opening must be accessible when the furnace is in service and should be large enough to view smoke or reflected light, to detect the presence of leaks in the heating equipment, and to check for hot spots on the heat exchanger due to poor air distribution or lack of sufficient air (cfm). The cover for the opening must be attached in such a manner as to prevent leakage.
- **Horizontal Discharge Duct Length:** A minimum horizontal duct run of 24" (610mm) is recommended before turns or branches are made in the duct system to reduce losses at the furnace outlet.
- **Discharge Air Horizontal Connection (See FIGURE 37):** The seal between the heater and the duct must be mechanical. Duct connection should be made with "U" type flanges on the top and bottom of the connecting duct. Slide the duct over the flanges of the heater giving an airtight fit. Provide "U" type channels for the side flanges to ensure tight joints. Fasten "U" channels with sheetmetal screws.
- **Bottom Duct Connection:** To minimize sound and vibration transmission, use a flexible duct connection. Duct must be attached and sealed to provide air tight connection.

FIGURE 37 - Connecting Discharge Duct Work



(1) If the heater has an optional duct flange, the flanges turn out as shown. **(2)** Shape duct connection as shown with "U" on top and bottom and "L" on sides. **(3)** Provide for sealed access panel in the duct work. This opening must be accessible when the furnace is in service and should be large enough to view smoke or reflected light, to detect the presence of leaks in the heating equipment, and to check for hot spots on the heat exchanger due to poor air distribution or lack of sufficient air (cfm). The cover for the opening must be attached in such a manner as to prevent leakage. **(4)** Slide "U" channels over top and bottom flanges on the heater. **(5)** Form field-supplied "U" channels over side connections to seal. Drill and lock with sheetmetal screws.

CAUTION: Joint where supply air duct attaches to the furnace must be sealed securely to prevent air leakage. Leakage can cause poor combustion, shorten heat exchanger life, and cause poor performance. See Hazard levels, page 2.

6.8.5 Discharge Air Sensor for Makeup Air Application

All gas or electric control options for makeup air (except AG40) include a discharge air sensor that requires field installation in the discharge duct. (Sensor is field-supplied with Option AG40.)

Options AG3, AG15, AG16, AG58, AG60, AG61 and AG62 are analog controls. Options AG3 and AG60 have a unit mounted ductstat with a capillary sensor that will fit in the holder in **FIGURE 38**. Options AG16, AG58, AG60, AG61 and AG62 include sensors that require duct mounting using the holder in **FIGURE 38** and field wiring. Follow the instructions below to attach the holder and the sensor.

Sensors in Options DG5, D12B, D12C, D12D, D12E, and D12G are digital and require duct mounting using the holder in **FIGURE 38** and field wiring. Digital control inputs are low-current, resistance-based signals. For optimum temperature control performance the analog and digital inputs (zone sensors, discharge air sensors, etc.) connected to

FIGURE 38 - Discharge Air Sensor Holder, PN 115850, used in Makeup Air Installations



Secure sensor in clip. Position holder so that it shields sensor from direct airflow.

the main digital controller should be routed to the unit in one of the following manners:

- In separate conduits, isolated from 24 VAC controls and line voltage power to the unit, ***OR***
- If the main controller sensor wires are to be run in the same conduit as the 24 VAC control wiring, the sensor wiring must be completed using shielded cable and bundled separately from the 24 VAC control wiring. The shield must be drained at the unit and taped on the opposite end.

See **TABLE 26A** for wire gauge and length requirements of digital control signal wiring.

NOTE: Sensor wire supplied with the FX05 digital controller is 22AWG. There is no sensor wire supplied with the FX06 controller; it must be field-supplied.

TABLE 26A - Digital Control Signal Wire Gauge and Length

Maximum Sensor Wire Length for less than 1°F Signal Error		
Wire Gauge	**Maximum Sensor Wire Length (Digital Control)**	
AWG	Feet	Meters
14	800	244
16	500	152
18	310	94
20	200	61
22	124	38

TABLE 26B - Sensor Data for Johnson A99 Series Temperature Sensors used in DG and D12 Options (Resistance VS Temperature)

°F	°C	Ohms
-40	-40	613
-31	-35	640
-22	-30	668
-13	-25	697
-4	-20	727
5	-15	758
14	-10	789
23	-5	822
32	-0	855
41	5	889
50	10	924
59	15	960
68	20	997
77	25	1035
86	30	1074
59	35	1113
104	40	1153
113	45	1195
122	50	1237
131	50	1279
140	60	1323
149	65	1368
158	70	1413
167	75	1459
176	80	1506
185	85	1554
194	90	1602
203	95	1652
212	100	1702
221	105	1753
230	110	1804
239	115	1856
248	120	1908

Instructions for Installing Discharge Air Sensor in the Duct Work

1. Installation requires the discharge air sensor holder including the box cover.
2. Determine a location in the duct work to install the sensor. Select a location a sufficient distance from the outlet to provide a good mixture of discharge air temperature. If installing Options AG3 or AG60 with a capillary sensor, determine the location based on the length of the capillary tubing.

   If installing wiring to the sensor, select a location a sufficient distance from the outlet to provide a good mixture of discharge air temperature. According to the latest edition of AMCA Standard 201, in straight ducts, the air is typically well mixed a minimum of five equivalent duct diameters from the discharge of the unit with equivalent duct diameter defined as equal to the square root of 4AB/3.14. “A” and “B” are the duct cross-sectional dimensions.

   Example: **Supply duct work cross-sectional dimension is 24" × 12" (610mm × 305mm).**

   $$5 \times \sqrt{\frac{4 \times 12 \times 24}{3.14}} = 96" \qquad 5 \times \sqrt{\frac{4 \times 305 \times 610}{3.14}} = 2435mm$$

   Solution: Locate the sensor a minimum of 96" (2435mm) from the outlet of the unit.

   NOTE: If the length of the discharge duct is less than 8 ft (2.4M), a mixing vane is recommended for mixing the discharge air.

   Do not mount the sensor in the duct work after a split in the supply as that will cause loss of control in the duct that does not house the sensor.
3. The position of the sensor holder is important. The holder will extend 9-3/16" (233mm) into the duct work.

   In horizontal duct work, locate the sensor assembly in the top, middle of the duct with the sensor probe extending vertically down into the center of the airstream.

   In vertical duct work, locate the sensor assembly in the middle of the side of the duct that corresponds with the top middle of the discharge outlet.

   Turn the holder so that the element will be shielded from direct airflow and will sense the air temperature as it flows through the holes in the holder.

   At the selected location in the duct work, mark the diamond-shaped hole required for the sensor holder. Cut the hole no larger than required, approximately 1" × 1" (25mm × 25mm).
4. The procedure for installing the sensor and attaching the holder depends on whether the sensor is a capillary or an electrical sensor. Follow the instructions that apply.

   Capillary Sensor (Option AG3 and AG60): Locate the sensor capillary and run it out through the hole in the discharge panel of the heater. Determine where the sensor capillary should enter the box and remove the knockout. Put the capillary

6.0 Mechanical (cont'd)

6.8 Unit Discharge—RDH, REH, RHH, and RXH

6.8.5 Discharge Air Sensor for Makeup Air Application (cont'd)

through the hole and secure the bulb to the clip in the holder. Slide the holder into the duct work. Using four field-supplied No. 6 sheetmetal screws, attach the box portion of the holder to the duct work. Attach the cover on the box.

Sensor with Wire (Options AG15, AG16, AG58, AG61, AG62, DG5, D12B, D12C, D12D, D12E, and D12G and field-supplied sensor for Option AG40):

Push the element into the clip in the holder. Determine where the sensor wire should enter the box and remove the knockout. Slide the holder into the duct work. Using four field-supplied No. 6 sheetmetal screws, attach the box portion of the holder to the duct work. Attach a field-supplied cable connector to the box, connect the sensor wire, and attach the box cover.

If sensor is digital, follow the wiring instructions above. To test the accuracy of the sensor, measure the ohms. Refer to **TABLE 26B** (left) to determine the corresponding temperature.

6.9 Blowers, Belts, and Drives (RDH, REH, RHH, RXH)

6.9.1 Belts and Belt Tension

Check belt tension. Proper belt tension is important to the long life of the belt and motor. A loose belt will cause wear and slippage. Too much tension will cause excessive motor and blower bearing wear. Adjust the belt tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (19mm) (see **FIGURE 39**). After correct tension is achieved, re-tighten the locknut on the adjustment screw. Be sure that the belt is aligned in pulleys.

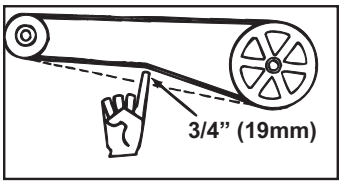


FIGURE 39 - Check Belt Tension

Linked Belts: If the belt needs tightening, the recommended method of tightening the belt length is to count the number of links and remove one link for every 24. (A link is made up of two joining sections of belt. For easier removal of links, turn the belt inside out. But be sure to turn it back before installing. If belt is removed or replaced, be sure to align directional arrows on the belt to the proper drive rotation.) The belt tension should be checked after the first 24 hours of running at full load and at regular maintenance inspections. Be sure that the belt is aligned in the pulleys.

Solid Belts: Adjust the belt tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (19mm) (see **FIGURE 39**). After correct tension is achieved, re-tighten the locknut on the adjustment screw. Be sure that the belt is aligned in the pulleys.

6.9.2 Adjusting Blower Speed

The blower speed may be adjusted to achieve the desired outlet temperature, as long as the adjustment is within the temperature rise and the static pressure limits shown on the furnace rating plate. Motors are factory set between maximum and minimum blower speeds.

If the duct resistance is low, the blower may deliver too high an air volume. If the resistance is very low, the blower may deliver excess air volume to overload the motor, causing the overload protector to cycle the motor. Reducing the blower speed will correct these conditions. If duct work is added to an installation, it may be necessary to increase the blower speed. Decreasing blower speed will increase outlet temperature; increasing blower speed will decrease outlet temperature.

At final adjustment, amperes should not exceed motor nameplate amp rating. The installation must be adjusted to obtain a temperature rise within the range specified on the furnace rating plate.

The belt drive on these units is equipped with an adjustable pulley which permits adjustment of the blower speed. Follow these instructions to adjust the blower speed.

1. Turn off the gas (RDH & RHH) and the electric power (RDH, REH, RHH, RXH).
2. Loosen belt tension and remove the belt.
3. Loosen the set screw on the side of the pulley away from the motor.
4. **To increase the blower speed,** turn the adjustable half of the pulley inward. **To decrease the blower speed,** turn the adjustable half of the pulley outward. One turn of the pulley will change the speed 8-10%.
5. Tighten the set screw on the flat portion of the pulley shaft.
6. Replace the belt and adjust the belt tension. Adjust tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (see **FIGURE 39**). Retighten the lock nut on the adjusting screw. Be sure that the belts are aligned in the pulley grooves properly and are not angled from pulley to pulley.
7. Turn on the power (RDH, REH, RHH, RXH)) and the gas (RDH & RHH). Set the control to call for heat.
8. Check the motor amps with an ammeter. The maximum motor amp rating on the motor nameplate must not be exceeded.

When service is complete, check for proper operation.

6.9.3 Blower Rotation

Rotation may be changed on single-phase motors by re-wiring in the motor terminal box. Three-phase motors may be reversed by interchanging two wires on the 3-phase supply connections.

6.9.4 Optional Variable Frequency Drive (VFD)

If ordered with a VFD, it may be either factory or field installed. If field-installed, follow the manufacturer's instructions and refer to the wiring diagram on the unit. Minimum ambient temperature for a VFD is 18°F. Maximum distance from the unit is 50 feet.

When an optional VFD is ordered, the motor operates on two speeds as determined by the electrical frequency. High speed is used for cooling and low speed for heating. 60 hertz is the maximum high speed. Maximum speed for low speed heating is the frequency that will provide the maximum temperature rise of the heater.

Maximum allowable temperature rise for a Model RDH is 70°F with an aluminized heat exchanger or 100°F with a stainless steel heat exchanger. (**NOTE**: If equipped with modulating gas control Option AG40, AG58, D12B, or D12G and a stainless steel heat exchanger, a maximum temperature rise of 120°F is permitted).

Model RHH has a maximum 70° temperature rise with an optional 120°.

Follow the VFD controller manufacturer's instructions that are packaged with the heater (in the owner's envelope) to program the VFD settings. The formula for motor speed is N=120xf/p where N is speed; f is frequency; and p is number of poles (3600 RPM motor has 2 poles; an 1800 RPM motor has 4 poles).

Example 1:

1800 RPM motor on 60Hz; N = 120 × 60/4 = 1800 (1800 is synchronous speed; assume 2% slip).

Motor will run between 1750 and 1790 RPM at full load depending on design.

Example 2:

Run the same motor at 45Hz (120 × 45/4 = 1350).

1350 RPM less 2% slip equals about 1300 RPM.

7.0 Electrical Supply and Wiring

7.1 General

All electrical wiring and connections including electrical grounding must be made in accordance with the National Electric Code ANSI/NFPA No. 70 (latest edition) or, in Canada, the Canadian Electrical Code, Part I-C.S.A. Standard C22.I. Check any local ordinances or utility company requirements that apply.

7.2 Supply Wiring

NOTE: If the system has an optional convenience outlet or UVC light, both of those options require a separate 115 volt power supply.

Check the rating plate on the heater for the supply voltage and the current requirements. A separate line voltage supply with fused disconnect switch should be run directly from the main electrical panel to the unit, making connections in the electrical compartment. Supply wiring enters the cabinet either on the control side below the electrical compartment door or in line directly below through the base. **Seal all electrical entrance openings with field-supplied bushings.**

Before turning on the power, check and tighten all electrical terminals.

TABLE 27A - Supply Wiring Size—Models RDH, RHH, and RXH

Field-Supplied Wiring Size—Models RDH, RHH, and RXH							
Voltage/Phase	115/1		208–230/1	208–230/3		460/3	575/3
Motor HP's	1/4–1/2	1	1–1-1/2	1/4–3	5	1/4–5	1/2–5
Wire Gauge	14	12	14	14	12	14	14
BX Cable	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"

TABLE 27B - Supply Wiring Size—Model REH

Field-Supplied THHN, THWN or THWN-2 Wiring and Conduit Minimum Size for Model REH														
Voltage/Phase	**208/1**				**230/1**									
kW	10	15	20	30	10	15	20	30						
Ampacity	74	96	119	164	78	104	130	182						
75°C Wire Gauge	#4	#3	#1	#2/0	#4	#2	#1	#3/0						
Conduit Trade Size	1	1	1-1/4	1-1/2	1	1	1-1/4	2						
Voltage/Phase	**208/3**							**230/3**						
kW	20	30	40	60	80	90	120	20	30	40	60	80	90	120
Ampacity	66	92	118	142	184	205	267	74	104	134	161	209	233	305
75°C Wire Gauge	#4	#3	#1	#1/0	#3/0	#4/0	300kcmil	#4	#2	#1/0	#2/0	#4/0	250kcmil	350kcmil
Conduit Trade Size	1	1-1/4	1-1/2	1-1/2	2	2	2-1/2	1	1-1/4	1-1/2	2	2	2-1/2	3
Voltage/Phase	**460/3**							**575/3**						
kW	20	30	40	60	80	90	120	20	30	40	60	80	90	120
Ampacity	37	52	67	81	105	117	153	31	44	56	67	88	98	128
75°C Wire Gauge	#8	#6	#4	#4	#2	#1	#2/0	#10	#8	#6	#4	#3	#3	#1
Conduit Trade Size	3/4	3/4	1	1	1-1/4	1-1/2	2	1/2	3/4	3/4	1	1-1/4	1-1/4	1-1/2

7.2.1 Supply Voltage

The electric supply to the unit must meet stringent requirements for the system to operate properly. Voltage supply should be within ±10% or as stated on the rating plate. Maximum imbalance on a 3-phase system is 2%. Follow instructions below to check.

7.0 Electrical (cont'd)

7.2 Supply Wiring (cont'd)

CAUTION: If this unit is allowed to operate on an electric supply that is not within the specified tolerances, the product warranty shall be void (see Hazard Levels, page 2).

NOTE: These requirements and procedures would also apply to compressors on the condensing unit.

7.2.1 Supply Voltage (cont'd)

If the power supply is not within these tolerances, contact the power company prior to operating the system.

Check Voltage Supply: See voltage use range on the rating plate. Measure (and record) each supply leg voltage at all line disconnect switches. Readings must fall within the allowable range.

Check Voltage Imbalance (applies to units with optional reheat compressor): In a 3-phase system, excessive voltage imbalance between phases will cause compressor motor to overheat and eventually fail. Maximum allowable imbalance is 2%. To determine voltage imbalance, use recorded voltage measurements taken above in the following formula.

Key:	V1, V2, V3 = line voltages as measured VA (average) = $\frac{(V1 + V2 + V3)}{3}$ VD = line voltage (V1, V2, or V3) that deviates farthest from average (VA)
Formula:	% Line Voltage Imbalance = $\frac{[100 \times (VA - VD)]}{VA}$

Reheat Compressor Wiring (applies to units with optional reheat compressor): A 3-phase scroll compressor must be phased correctly or compressor will operate in reverse. **Since there is a chance of unknowingly connecting the power in such a way as to cause compressor rotation in reverse, it is important to check this on startup.**

CAUTION: Be sure to connect pressure gauges to the suction and discharge lines before startup so that compressor rotation can be checked immediately. Scroll compressors will be destroyed if operated in the wrong direction (see Hazard Levels, page 2).

Before initial startup, connect refrigerant pressure gauges to the compressor suction and discharge lines. At startup, initiate a call for reheat, and observe the gauges. **If the suction pressure rises and discharge pressure drops, the compressor is operating in reverse and should be shut down. (**After several minutes of operation in reverse, the compressor's internal protector will trip. If a compressor is repeatedly allowed to restart and run in reverse, the compressor will be permanently damaged.) **Turn off the power and switch the 3-phase line voltage wiring connections before restarting the unit.**

Blower Motor Wiring: Check rotation of the blower. If rotation is not correct, three-phase motor may be reversed by interchanging two wires on the 3-phase supply connection.

7.2.2 Supply Wiring Options

WARNING (Models RDH and RHH): If you turn off the power supply, turn off the gas.

Disconnect Switch: A disconnect switch is available as optional equipment or may be supplied locally. When installing the disconnect switch, be careful that the conduit and switch housing are clear of all service doors. Allow at least four feet (1.2M) of service room between the disconnect switch and any service panels. When providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size 1.25 times the maximum total input amps.

DANGER

To prevent injury or death due to electrocution or contact with moving parts, lock an open disconnect switch (see Hazard Levels, page 2).

Optional On/Off Switch, Option BA6: The unit may be equipped with a cabinet-mounted non-fusible, lockable, service on/off switch. The switch is conveniently located on the control side of the unit.

Optional Phase Loss or Low/High Voltage Protection, Opt BF15 or BF14: A 3-phase system may be equipped with an optional phase loss protection device. Option BF15 is an auto-reset control that shuts down the unit on phase loss or phase reversal. Option BF14 performs the same function but will also shut down the unit on high or low voltage condition.

7.3 Unit Wiring Requirements and Wiring Diagrams

Each unit has a custom wiring diagram in the control compartment. All optional electrical components ordered with the unit are shown on the wiring diagram. Codes for options ordered are listed across the bottom of the diagram. To identify option codes, see list in **APPENDIX**, page 64.

CAUTION: If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for sensor lead wires which must be 150°C. See Hazard Levels, page 2.

7.4 Control Wiring

7.4.1 Control Wiring Requirements

The heater is equipped with a low voltage (24V) control circuit. Control wiring connected to a thermostat, a switch, a discharge air temperature sensor, a remote temperature selector or sensor, an amplifier, or the valve must not be run close to or inside conduit with power or ignition wires.

TABLE 28 - 24V Field Control Wiring Length/Gauge

Total Wire Length	Distance from Unit to Control	Minimum Recommended Wire Gauge
150ft (46M)	75ft (23M)	18
250ft (76M)	125ft (38M)	16
350ft (107M)	175ft (53M)	14

IMPORTANT (but does not apply to ignition control board used with modulating controls AG58 and D12G): When using a multimeter to troubleshoot the 24 volt circuit, place the meter's test leads into the 5 or 9 pin connectors located on the ignition control board **(FIGURE 52**, page 58). Do not remove connectors or terminals from the electrical components. Doing so can result in misinterpreted readings due to the ignition control board's fault mode monitoring circuits.

TABLE 29 - Maximum Digital Control Sensor Wire Length for less than 1°F Signal Error

Wire Gauge	Maximum Sensor Wire Length (Digital Control)	
AWG	Feet	Meters
14	800	244
16	500	152
18	310	94
20	200	61
22	124	38

Digital Control Signal Wiring Recommendations and Requirements

For optimum temperature control performance the manufacturer recommends that the analog and digital inputs (zone sensors, discharge air sensors, etc.) connected to the main controller (used in heating/cooling control DG and D12 Options) be routed to the unit in one of the following manners:

1) In separate conduits, isolated from 24 VAC controls and line voltage power to the unit, ***OR***
2) If the digital sensor wires are to be run in the same conduit as the 24 VAC control wiring, the sensor wiring must be completed using shielded cable and bundled separately from the 24 VAC control wiring. The shield must be drained at the unit and taped on the opposite end.

See **TABLE 29** (left) for digital control sensor wire gauge and length requirements.

7.4.2 Analog or Digital Controls

Type of control varies with option selection (identified on the unit wiring diagram). Control may be analog or digital depending on option selected. Option EG1, EG2, AG1, AG2, AG3, AG15, AG16, AG58, AG60, AG61, and AG62 controls are analog; Option DG1, DG5, D12B, D12C, D12D, D12E, and D12G controls are digital. Option AG40 is designed for digital control from a field-supplied source. Optional controls are identified on the wiring diagram supplied with the heater. **NOTES:** All systems with reheat Option AU7 have an Option D12 digital control.

Digital Control Systems have a Programmable Unit-Mounted Control and a Room Command Module

If using a digital control system, the unit is factory equipped with a programmable controller.

Digital control Options DG1 and DG5 also include a room command module. The type of room command module depends on whether the control system has a discharge or a room temperature controlled setpoint. A room command module with an adjustable room temperature setpoint (45°F–95°F) included with Option DG1 control systems is illustrated in **FIGURE 40A**, page 46. A room command module with a discharge air setpoint included with Option DG5 the control systems is shown in **FIGURE 40B**. The discharge air setpoint can be adjusted ±6°. Discharge temperature controls may also have an optional room-mounted override sensor.

IMPORTANT: The digital controller inputs are low-current, resistance-based signals. See special wiring recommendations above for digital sensor wiring.

Digital control Options D12B, D12C, D12D, D12E, and D12G do not include a room command module. The space temperature sensor module with adjustable setpoint control and room override illustrated in **FIGURE 40C** is available as an option.

7.0 Electrical (cont'd)

7.4 Control Wiring (cont'd)

7.4.2 Analog or Digital Controls (cont'd)

Digital Control Systems (cont'd)

If ordered with an optional expansion card, a digital control system will provide weekday and weekend scheduling of start/stop operation or interface to a field-supplied Johnson N2 or Lonmark building automation system.
See the control instruction manual for additional information.

FIGURE 40A - Room Command Module, PN 211423, Sensing Space Temperature for Digital Controls, Option DG1



FIGURE 40B - Room Command Module, PN 211424, Sensing Discharge Temperature for Digital Controls, Option DG5



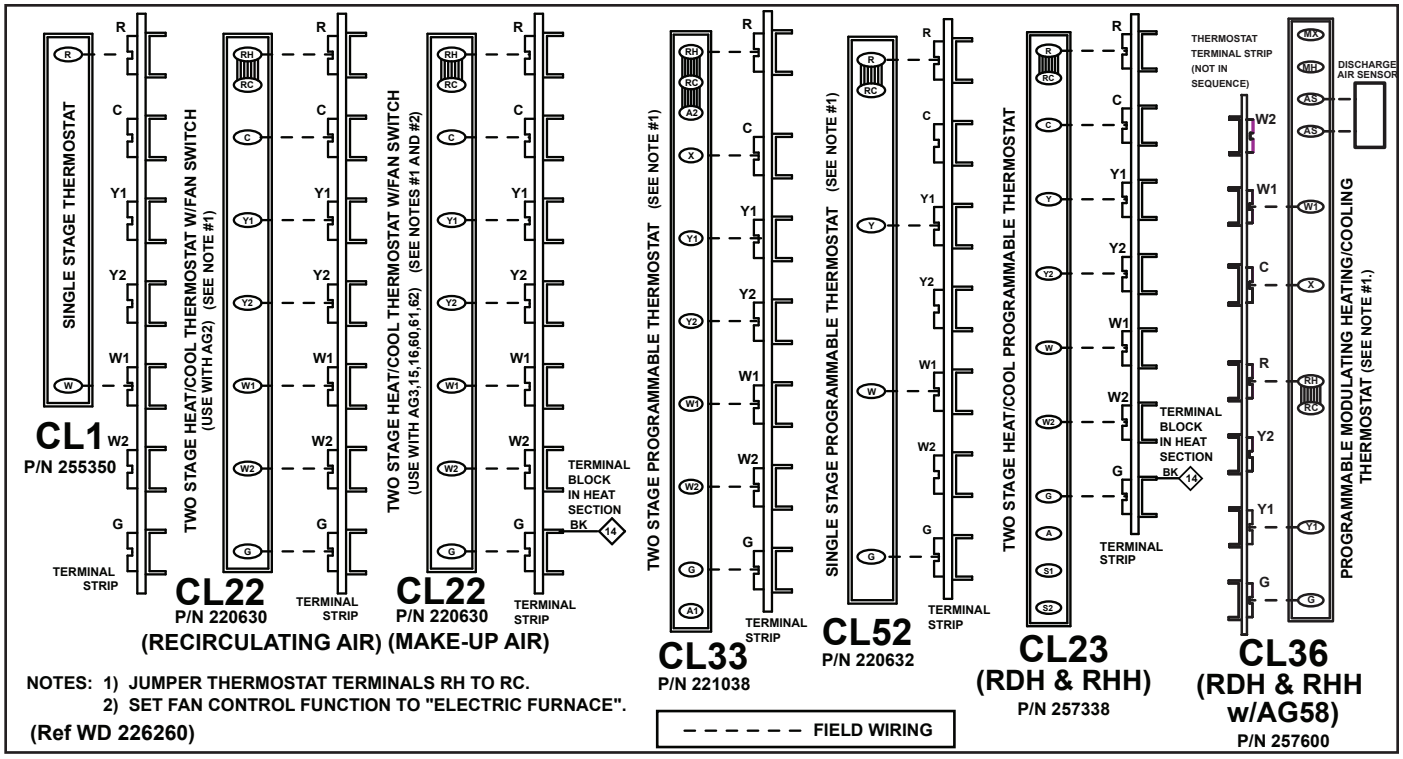
FIGURE 40C - Room Command Module, Option CL67, PN 260599 Sensing Discharge Temperature for Digital Controls, Options D12B, D12C, D12D, D12E, D12G



Analog Control System Requires an Optional or Field-Supplied Thermostat

If using an analog control system, use either an optional or a field-provided low-voltage (24V) thermostat. (A thermostat is not supplied.) Install the thermostat according to the manufacturer's instructions. Depending on the control system option, select either a single-stage or two-stage thermostat.

FIGURE 41 - 24V Single-Stage and Two-Stage Thermostat Wiring



7.5 Electrical Operating Components

7.5.1 High Temperature Limit Control—RDH/RHH

All units are equipped with a temperature activated auto reset capillary-type limit control. The control is factory set and is non-adjustable. If the setpoint is reached, the limit control will interrupt the electric supply to the gas valve. This safety device provides protection in the case of motor failure or lack of airflow due to a restriction at the inlet or outlet.

CAUTION: The auto reset limit control will continue to shut down the heater until the cause is corrected. Never bypass the limit control; hazardous conditions could result (see Hazard Intensity Levels, page 2).

7.5.2 Reverse Airflow Limit Control—RDH/RHH

All units are equipped with a temperature activated auto reset reverse airflow limit control. The control is factory set and is non-adjustable. If the setpoint is reached, the limit control will interrupt the electric supply to the gas valve. This safety device provides protection in the case of motor failure or lack of airflow due to a restriction at the outlet.

7.5.3 Combustion Air Pressure Switch (Air Proving Switch)—RDH/RHH

NOTE: Above 6000 ft (1830 M) elevation, a high altitude pressure switch may be required. See Paragraph 6.1.3.

The combustion air proving switch is a pressure switch that monitors air pressure to ensure that proper combustion airflow is available. The switch is a single pole/normally open device which closes when a negative pressure is sensed in the venter housing.

On startup when the heater is cold, the sensing pressure is at the most negative level, and as the heater and flue system warm up, the sensing pressure becomes less negative. After the system has reached equilibrium (about 20 minutes), the sensing pressure levels off.

If a restriction or excessive flue length or turns cause the sensing pressure to be outside the switch setpoint, the pressure switch will function to shutoff the main burner. The main burner will remain off until the system has cooled and/or the flue system resistance is reduced.

TABLE 30 lists the switch setpoints for sea level operating conditions.

Models equipped with two-speed venter motor operation have two combustion air proving switches. When the venter is operated at high speed, the “high speed” combustion air proving switch monitors the combustion airflow to ensure adequate airflow for safe and efficient operation. During low speed venter operation, when fuel gas input rate is reduced, a second “low speed” combustion air proving switch monitors the combustion airflow to ensure adequate air flow for safe and efficient operation.

DANGER

Models RDH and RHH proper venting flow. NEVER bypass combustion air proving switch(es) or attempt to operate the unit without the venter running and proper flow in the vent system. Hazardous conditions could result. See Hazard Levels, page 2.

TABLE 30A - Model RDH Pressure Switch Settings

RDH Size	High Speed				Low Speed	
	Applies to ALL gas control options EXCEPT AG58 & D12G		Applies to gas control options AG58 & D12G		Applies only to units with gas controls using 2-speed venter*	
	Switch PN	Setting (" w.c.)	Switch PN	Setting (" w.c.)	Switch PN	Setting (" w.c.)
75	**197030**	0.40	N/A		**205442**	0.20
100	**197030**	0.40	N/A		**205444**	0.30
125	**196388**	0.50	N/A		**205444**	0.30
150	**197028**	0.65	N/A		**205444**	0.30
175	**201158**	1.10	**197029**	0.60	**197030**	0.40
200	**201158**	1.10	**197078**	0.80	**197030**	0.40
225	**201158**	1.10	**197078**	0.80	**197030**	0.40
250	**201158**	1.10	**207171**	0.70	**197030**	0.40
300	**201158**	1.10	**207171**	0.70	**197030**	0.40
350	**201158**	1.10	**197078**	0.80	**197030**	0.40
400A	**201158**	1.10	**207171**	0.70	**197030**	0.40

***Gas control options with 2-speed venter are AG8, AG9, AG9H, AG40, AG60, AG61, AG62, DG1, DG5, D12B, and D12C.**

TABLE 30B - Model RHH Pressure Switch Settings

RHH Size	High Speed			
	Applies to ALL gas control options EXCEPT AG58 & D12G		Applies to gas control options AG58 & D12G	
	Switch PN	Setting (" w.c.)	Switch PN	Setting (" w.c.)
130	**201161**	1.30	**201160**	1.05
180	**201161**	1.30	**201160**	1.05
260	**201159**	1.40	**201160**	1.05
350	**221228**	2.30	**201160**	1.05

7.5.4 Blower Motor (RDH/REH/RHH/RXH) and Venter Motor (RDH and RHH)

Use an ammeter to check blower motor amps. Amps may be adjusted downward by reducing blower RPM or by increasing duct system static pressure (see Paragraph 6.9.2.).

TABLE 31 lists full load amps of open-type blower motors by HP and voltage. This chart can be used for sizing line wiring but should not be interpreted as the exact motor

7.0 Electrical (cont'd)

7.5 Electrical Operating Components (cont'd)

7.5.4 Blower Motor (RDH/REH/RHH/RXH) and Venter Motor (RDH and RHH) (cont'd)

amps. See the motor rating plate for exact motor specifications. Do not exceed amp rating on the motor nameplate.

TABLE 31 - FLA of Single Speed, Open Dripproof Motors

Full Load Amps—Blower Motors (Open) Single Speed (Average Values)									
HP	**1/4**	**1/3**	**1/2**	**3/4**	**1**	**1-1/2**	**2**	**3**	**5**
115V 1PH	4.6	6.0	8.2	11.0	13.0	15.0	24.6	N/A	N/A
208V 1PH	2.3	3.0	4.1	5.5	7.5	7.8	12.3	13.7	25.5
230V 1PH	2.3	3.0	2.3	5.4	6.5	7.5	12.3	12.4	23.0
208V 3PH	1.1	1.9	2.5	2.9	4.0	5.6	7.0	9.0	13.4
230V 3PH	1.4	1.6	3.0	2.6	3.7	5.0	6.6	8.6	13.2
460V 3PH	0.75	0.80	1.5	1.3	2.0	2.8	3.5	4.3	6.6
575V 3PH	N/A	N/A	.90	1.0	1.4	2.0	2.6	3.6	5.4

Venter motor amps for a 115 volt or 575 volt unit are 1.5 amps; venter motor amps for a 208, 230, or 460 volt unit are .8 amps.

7.5.5 Electrical Heating Elements—Model REH

Electric heating modules in Model REH are made up of two to six 5kw or three to twelve 10 kw heating elements depending on size and voltage of the unit. The elements are bracketed together to make up the electric heat section assembly.

The electric heat section has either heating only analog controls (Option EG1 or EG2) or digital heating/cooing controls (Option D12E or D12D). With Option EG1, operation of the heating elements is controlled by a single stage thermostat. With Option EG2, the heat section provides two-stages of heat in response to a two-stage thermostat. Digital control is either two stage (Option D12E) or modulating (Option D12D).

See Paragraph 8.3.2 and the control instruction form (CP-PREEEVA-D12 B/C/D/E/F/G) for digital control information.

FIGURE 42A - Sample of one Electric Heating Element in the Electric Heat Assembly

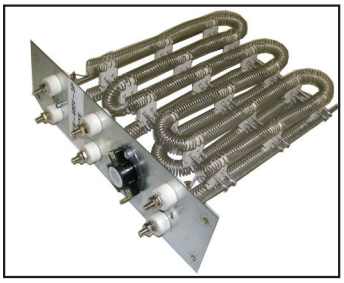
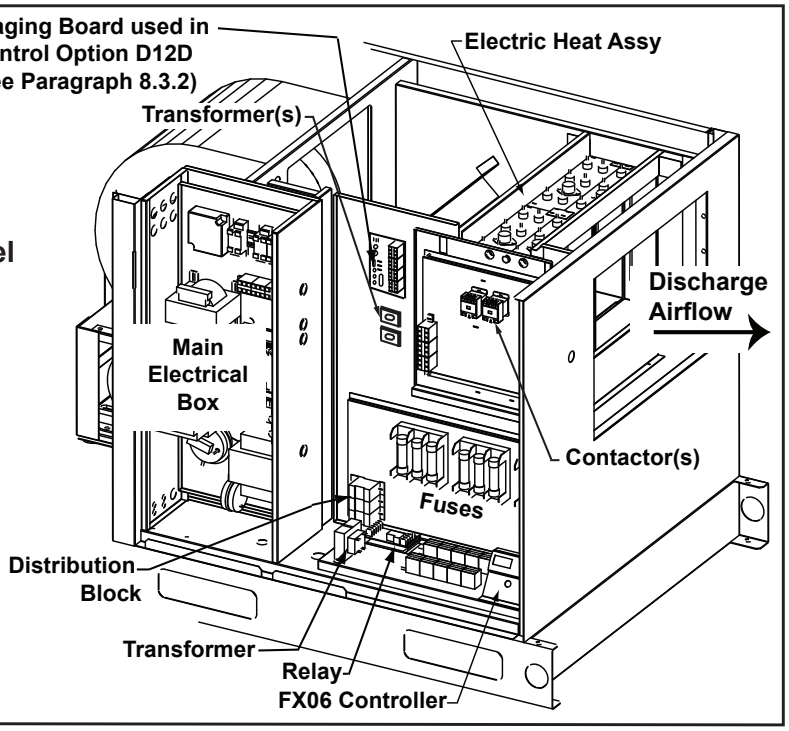


FIGURE 42B - Electric Heat Section—Model REH



7.6 Other Optional Electrical Components

Optional electrical components ordered with the unit are identified on the wiring diagram. For a list of wiring diagram option codes and descriptions, see **APPENDIX**, page 65.

7.6.1 Convenience Outlet, Option BC2—RDH, REH, RHH, RXH

If the unit is equipped with a convenience outlet, it will have an externally accessible, weatherproof 115 volt, duplex, ground fault outlet on the control side of the cabinet. **A separate 115 volt power supply is required.**

7.6.2 Reheat Module (Options AU7L and AU7R) Compressor—RDH, REH, RHH, RXH

The compressor in the optional reheat module is a high efficiency hermetic scroll type that is factory charged with R410A refrigerant. The compressor has a low pressure cutoff (LPCO) switch for protection against damage due to a loss of charge. This protection prevents short cycling on the internal overload (IOL) which can pump the oil out of the compressor. The compressor also has a manual reset high pressure cutout (HPCO).



Compressor - Reheat circuit is charged at the factory with R410A Refrigerant

TABLE 32 - Reheat Compressor

Compressor Model	ARI Tonnage	208/240V 1 PH		208/240V 3 PH		460V 3 PH		575V 3 PH	
		RLA	LRA	RLA	LRA	RLA	LRA	RLA	LRA
ZP29K5	2.4	14.1	77.0	9.0	71.0	5.6	38.0	3.8	36.5
ZP57K3	4.8	30.1	158.0	20.5	155.0	9.6	75.0	7.6	54.0

NOTE: See Operation/Maintenance Form O-PREEVA (in the Literature Bag), for additional information on compressor maintenance and R410A refrigerant.

IMPORTANT: ***Do not release refrigerant to the atmosphere!*** **If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified HVAC technician.**

DANGER

This reheat circuit contains R410A high pressure refrigerant. Hazards exist that could result in personal injury or death. Installation, maintenance, and service should only be performed by an HVAC technician qualified in R410A refrigerant and using proper tools and equipment. DO NOT USE service equipment or tools designed for R22 refrigerant.

Modulating Reheat, Option AUR1

With modulating reheat, a sensor monitors the air temperature as it leaves the reheat coil. Based on a potentiometer setpoint and the sensor signal, the board will open or close a refrigerant bypass valve. Changing the amount of refrigerant hot gas being added to the refrigerant liquid before it enters the pre-cool coil will “modulate” the function of the pre-cool and reheat coils to provide the desired leaving air temperature.

7.6.3 Remote Console for Controls—RDH, REH, RHH, RXH



If the system includes an optional control console, it is shipped separately for field installation. A selection of remote consoles is available with a variety of combinations of factory-mounted controls. All consoles include burner and blower indicator lights and may include a dirty filter indicator light (see below); a cooling on indicator light; an on/off switch; a summer/winter/off control switch; a heat/vent/cool system switch; and/or a potentiometer for damper control. The thermostat or room command module may also be mounted on the console. Depending on the console selected, it may be 10-3/4" (273mm) or 15-3/4" (400mm) in length. All consoles are 7-5/8" (194mm) high and 2-5/8" (67mm) deep. Consoles may be flush or recess mounted. If recessing (not using the mount ring) subtract 7/8" (22mm) from the height and width.

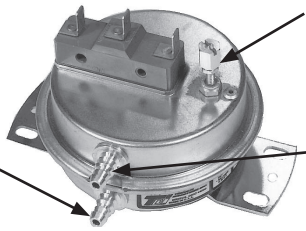
Wire the controls on the remote console according to the wiring diagram. Refer to **TABLE 28** on page 45 for minimum control wire gauge by length.

Dirty Filter Switch: If there is a dirty filter indicator light on the console, there is a dirty filter switch in the unit. After the unit is started, before continuous operation, the dirty filter switch must be set.

Instructions for Setting Dirty Filter Switch (FIGURE 43)

With clean filters in place; all doors closed (except electrical compartment); and the blower opening, increase the pressure setting by adjusting the setscrew on the switch clockwise until the filter light is energized or the screw is bottomed out. At that point, adjust the setscrew three full turns counter clockwise or until the screw is top ended. At that setpoint, the filter light will be activated at approximately 50% filter blockage.

FIGURE 43 - Dirty Filter Switch, PN 105507—Must be Set Prior to Continuous Operation)



Set screw (on front of switch) must be manually adjusted after the system is in operation.

Positive pressure connection is toward the “back or bottom” of the switch (senses air inlet side of filters)

Negative pressure connection is toward the “front or top” of the switch (senses blower side of filters)

7.6 Other Optional Electrical Components (cont'd)

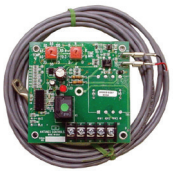
7.6.4 Firestat, Option BD4 or BD5—RDH, REH, RHH, RXH



Option BD4 (factory-installed) or Option BD5 (field-installed) 200°F firestat is **PN 42782**. Firestat Option BD4 is factory installed in the mixing box to sense the temperature of the return air. Firestat Option BD5 is shipped separately for field installation in the discharge duct work.

The firestat will shutdown the unit if temperature setpoint is reached. Comply with local building codes.

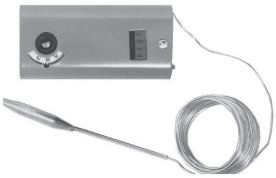
7.6.5 Discharge Temperature Low Limit (Freezestat), Option BE2—RDH, REH, RHH, RXH



Limit control, **PN 211480**, is factory installed to monitor the temperature of the discharge air. Setpoint of automatic reset control is adjustable.

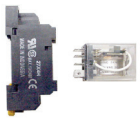
NOTE: Not needed with digital controls; standard function of the digital controller.

7.6.6 High Ambient Limit Control (burner cutoff), Option BN2—RDH, REH, RHH, RXH



The high ambient limit control monitors the temperature of the outside air and activates to shutoff the burner if the setpoint is reached. The control has an adjustable setpoint and resets automatically. **PN is 126170.**

7.6.7 Exhaust Fan Interlock Relay, Option BG9—RDH, REH, RHH, RXH



A DPDT plug-in relay is installed for coordination of unit operation with the operation of the building exhaust fan. Plug-in relay **PN is 211411; socket PN is 211415**.

7.6.8 Smoke Detector, Option SA1—RDH, REH, RHH, RXH



This photoelectric smoke detector is shipped separately to be installed in the discharge duct work. Follow installation instructions supplied with the control and the wiring on the unit wiring diagram. Comply with local building codes. PN of the device is **159553.**

8.0 Controls and Operation

8.1 Gas Valve—Model RDH and Model RHH

Gas-fired furnaces are equipped with a 24-volt combination valve which includes the automatic electric on-off valve the pressure regulator, the safety pilot valve, and the manual shutoff valve. Valve on/off function is controlled by the room thermostat or digital controller.

WARNING

The operating valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting the unit to ensure positive closure (see Hazard Levels, page 2).

8.2 Analog Controls for Heating or Heating/Makeup Air

8.2.1 Single-Stage Operation—Recirculated Heating Only (Option AG1 applies to Model RDH and Model RHH; Option EG1 applies to Model REH)

The single-stage gas valve on Models RDH and RHH allows for single-stage control from a single-stage, 24-volt thermostat. On Model REH, the heating elements are controlled by a single-stage, 24-volt thermostat.

The thermostat can either be selected as an option or be field supplied. Follow the thermostat manufacturer's instructions for installation. Make wire connections according to the wiring diagram.

8.2.2 Two-Stage Operation—Recirculated Heating Only (Option AG2 applies to Model RDH and Model RHH; Option EG2 applies to Model REH)

On Models RDH and RHH, a two-stage combination gas control valve provides for low fire (70%) or high fire (100%) operation controlled by a two-stage thermostat. First stage (low fire) is factory set. Both high and low stages are controlled by a Servo regulator, maintaining constant gas input under wide variations in gas supply pressure. See instructions packed with the unit for specific gas valve specifications, wiring, and operating instructions.

On a Model REH, staging of heat from the heating elements is controlled by the two-stage thermostat.

A two-stage thermostat can either be selected as an option or be field supplied. Follow the thermostat manufacturer's instructions and the wiring diagram.

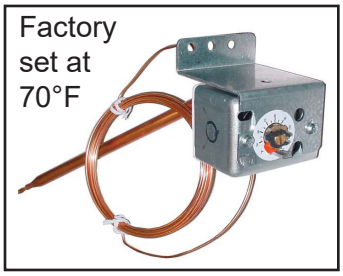
8.2.3 Two-Stage Operation—Makeup Air Heating Only Application (Option AG3, AG15, or AG16)

Two-stage makeup air units are equipped with a two-stage gas valve, but instead of control from a two-stage room thermostat, the outlet air temperature is monitored and controlled by a two-stage ductstat. When the discharge air temperature drops to the setpoint, factory-set low fire is energized. If low fire (70%) cannot satisfy the ductstat setting, high fire (100%) is energized.

A makeup air application is usually adjusted to discharge an outlet air temperature between 65°F and 75°F. In all applications, the allowable temperature rise of the furnace in the installation dictates the limits of the ductstat temperature setting.

Depending on the option selected, the factory-installed sensor is either field-connected by capillary tubing to the unit-mounted ductstat (**FIGURE 44A**) or electrically connected to a remote electronic temperature selector (**FIGURE 44B**). The remote temperature selector with stage adder is available with or without a display module.

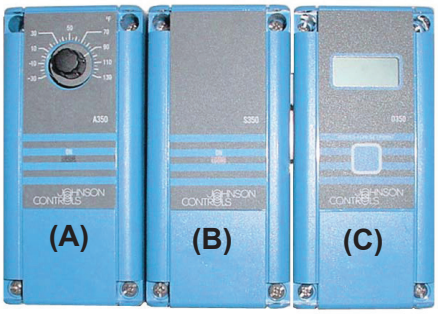
FIGURE 44A - Unit-mounted Ductstat, PN 211481, in Options AG3 and AG60



Optional Unit-Mounted Ductstat with Capillary Tubing (Option AG3): The control illustrated in **FIGURE 44A** has an adjustable range from 50° to 120°F with a fixed differential of 2-1/2°F. Due to different CFM settings and outside air temperatures, the average downstream outlet temperature may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired average outlet air temperature.

Optional Ductstat with Electronic Remote Setpoint Module (Options AG15 and AG16): The factory-installed sensing probe must be field-wired to a remote temperature selector. The temperature selector has an operating range to 120°F. Follow the wiring diagram with the unit and the manufacturer's instructions for wiring and installation. **CAUTION:** Be sure heat/cool selector switch is set at "Heat" position. There will be one module for selecting temperature and one-stage adder module. The optional digital display module is only in Option AG16 (see **FIGURE 44B)**.

FIGURE 44B - Remote Temperature Selector, Stage-Adder Module, and Optional Display Module for Ductstat Control in Two-Stage Makeup Air Control Options (Option AG15, AG16, AG61, and AG62)
(A) Temperature Selector, PN 115848;
(B) Stage Adder, PN 115849;
(C) Display Module, PN 115852



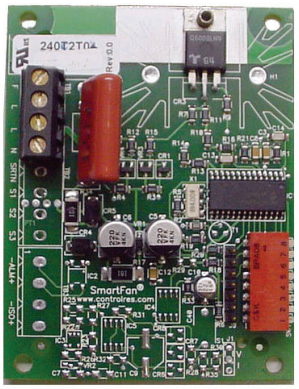
8.2.4 Constant Discharge Air Temperature with Maintained Thermal Efficiency—Makeup Air Heating Only Application (Options AG60, AG61, AG62)

Two-Speed Venter System in Options AG60, AG61, and AG62: A proprietary electronically controlled venter system provides the correct quantity of combustion air to maintain an overall average of 81% thermal efficiency through a range of gas inputs from 100 to 33 percent for natural gas and through a gas input range of 100 to 40 percent for propane gas. The venter's low speed operation is controlled by an electronic board (**FIGURE 45**) and a two-stage ductstat (either **FIGURE 44A or 44B**).

The proprietary electronically controlled venter system always operates at high speed during pre-purge and post-purge periods. Speed selection occurs after there is a call for burner ignition.

Optional Unit-Mounted Ductstat with Capillary Tubing (Option AG60): Uses the unit-mounted control shown in **FIGURE 44A** with an adjustable range from 0° to 120°F. Due to different CFM settings and outside air temperatures, the average downstream outlet temperature will be constant but may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired outlet air temperature.

FIGURE 45 - Venter Speed Control Board in Control Options AG8, AG9, AG9H, AG40, AG58, AG60, AG61, AG62, DG1, DG5, D12B or D12C



8.0 Controls and Operation (cont'd)

8.2 Analog Controls for Heating or Heating/Makeup Air (cont'd)

FIGURE 46 - Maxitrol Signal Conditioner, PN 134170 used in Option AG40

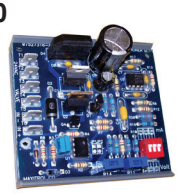


FIGURE 46B - Amplifier in Options AG8 (PN 260864); AG9 and AG9H (PN 260863 for both)



8.3 Digital Controls for Heating/Cooling, Makeup Air, and Dehumidification—Models RDH, REH, RHH, and RXH

FIGURE 47 - Programmable Digital Controller, Johnson Controls FX05 used in all DG Options



For explanation on the settings and functions of the FX05 programmable control, see Form CP-PREEVA-DG with FX05.

8.2.4 Constant Discharge Air Temperature with Maintained Thermal Efficiency (cont'd)

Optional Ductstat with Electronic Remote Setpoint Module (Options AG61 and AG62): The factory-installed sensing probe must be field-wired to the 0-120°F remote temperature selector illustrated in **FIGURE 44B**.

The remote modules are shipped separately for field installation. Follow the wiring diagram with the unit and the manufacturer's instructions for wiring and installation. **CAUTION:** Be sure heat/cool selector switch is set at "Heat" position.

There will be one module for selecting temperature and one-stage adder module.

The optional digital display module is used only in Option AG62 (see **FIGURE 44B**).

8.2.5 Modulation Gas Control with Field Supplied Digital Control

Optional Modulation Gas Control with Field-Supplied Controller (Option AG40):

The programmable digital controller is not supplied. The unit is equipped with a Maxitrol signal conditioner (**FIGURE 46**) that accepts an input signal of either 4–20 milliamps or 0-10 volts from a field-supplied controller and converts it to the 0–20 volt DC current required to control the modulating valve. Temperature selection or building management is controlled by customer-supplied software.

8.2.6 Optional Electronic Modulation

Electronic Modulation between 50% and 100% Firing Rate (Options AG8, AG9 & AG9H)

Depending on the heat requirements as established by the thermistor sensor, the burner modulates between 100% and 50% firing. The thermistor is a resistor that is temperature sensitive in that as the surrounding temperature changes, the Ohms resistance changes through the thermistor. This change is monitored by the solid state control center (amplifier) which furnishes varying DC current to the modulating valve to adjust the gas input.

Each modulating valve is basically a regulator with electrical means of raising and lowering the discharge pressure. When no DC current is fed to this device, it functions as a gas pressure regulator, supplying 3.5" w.c. pressure to the main operating valve.

Refer to the wiring diagram supplied with the furnace for proper wiring connections. Electronic modulation control systems for makeup air applications controlled by a field-installed duct sensor (see Paragraph 6.7.3) and temperature selector (55–90°F) are identified as either Option AG8 or Option AG9 & AG9H. The temperature selector setting for Option AG8 is on the amplifier; Option AG9 & AG9H has a remote temperature selector. Both systems are available with an override thermostat.

8.3.1 Optional Digital Heating/Cooling/Makeup Air Controls, Options DG1 or DG5—Model RDH only

Application NOTES: Options DG 1 does not apply to units with reheat pump (dehumidification), Option AU7L or AU7R. Model RDH with Option AU7 requires D12B, D12C, or D12G; see Paragraph 8.3.2.

Digital control systems (Option DG1) has a unit-mounted, factory-wired, 24 volt, DDC programmable controller (**FIGURE 47**); a venter speed control board (**FIGURE 45**); and a room command module (either **FIGURE 48A or 48B**).

The two DG control sequences include a wall-mounted Fan/Heat/Cool/Auto Switch.

Option DG1: Room control with 2-stage gas heating and 3-stage cooling control. The wall mount interface allows the user to adjust the space setpoint from 45°F to 95°F and select the unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

Option DG5: Room control with 2-stage gas heating and 3-stage cooling control. The wall mount interface allows the user to adjust the discharge air temperature ± 6°F from the factory-mounted controller setpoint and select unit mode. Unit modes are Cool Only, Heat Only, Fan Only, Auto Mode, and Off.

The heating and cooling equipment will cycle to maintain the active heating discharge or space temperature setpoint, based upon the unit mode and time of day schedule.

	Analog Inputs	Digital Inputs	Digital Outputs	Analog Outputs
Unit Control Points (Control Options DG1 and DG5)	1) Space Temperature/Discharge Air Temperature	1) Dirty Filter	1) Fan	1) Modulating Gas Valve
	2) Space Temperature Setpoint (45–90°F) or (±6°F Warmer/Cooler)	2) Temporarily Unoccupied Override	2) Heat Stage 1	2) Not Used
	3) Outdoor Air Temperature	3) Occupied/Unoccupied	3) Heat Stage 2 4) Cool Stage 1	—
	4) Mode Slider—Heat, Cool, Auto, Fan, Off	4) Air Proving/Phase Loss	5) Cool Stage 2	
		5) Boost Mode	6) Cool Stage 3	

Two-Speed Venter System in Options DG1 and DG5 (also applies to modulation Option AG40 with field-supplied control)

A proprietary electronically controlled venter system provides the correct quantity of combustion air to maintain an overall average of 81% thermal efficiency through a range of gas inputs from 100 to 25 percent for natural gas and through a gas input range of 100 to 40 percent for propane gas. The venter's low speed operation is controlled by an electronic board (**FIGURE 45,** page 51) and a gas pressure switch that senses outlet gas pressure. The venter is operated at a reduced voltage when the outlet gas pressure is below 1.7 inches w.c. for natural gas units and for propane units when the outlet gas pressure is below 5.0 inches w.c.

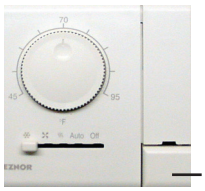
The proprietary electronically controlled venter system always operates at high speed during prepurge, postpurge, and the ignition periods. Speed selection occurs after flame is proven.

Sequence of Operation

Options DG1 is a space temperature control. Option DG5 is a discharge air temperature control. With all four options, a wall-mounted sensor and setpoint dial controls the functionality. With discharge air temperature control (DG5), the wall sensor is disabled and a discharge sensor is used to control the temperature. The wall unit shown in **FIGURE 48A** is used with Option DG1; it has a 45°F to 95°F adjustment dial to set the desired space temperature. The wall unit shown in **FIGURE 48B** is used with Option DG5; it has a ±6°F warmer/cooler adjustment dial for the discharge air temperature setpoint. Both wall units have a mode slider and an unoccupied mode override button. The slider selects the functionality of the unit: Cool Only, Heat Only, Fan Only, Auto Mode, Off.

The dial value will be the working heating or cooling setpoint depending on the mode. In the **auto mode,** the dial is the midpoint value between the cooling and heating setpoint. Example: (variable DB = 2°F default) If the dial is set to 72°F, the cooling and heating setpoints for unit operation are 70°F and 74°F respectively.

FIGURE 48A - Room Command Module, PN 211423, in Option DG1



Push Button

Provides on-off and heat/vent/cool mode selection; room temperature selection; and has a push button for unoccupied override.

FIGURE 48B - Room Command Module, PN 211424, in Option DG5



Push Button

Provides on-off and heat/vent/cool mode selection; adjusts discharge air temperature ±6°; and has a push button for unoccupied override.

Mode Slider Function

Cool Only: The unit will allow only the cooling to function. There is an adjustable parameter "OC" outdoor ambient temperature lockout setting below which mechanical cooling will not be allowed to operate.

Heat Only: The unit will allow only the heating to function. There is an adjustable parameter "OH" outdoor ambient temperature setting above which heating will not be allowed to operate.

Fan Only: The unit will allow only the fan to run. The fan will run only in occupied mode if the external contact is closed (Binary input #3). If the contact is open, the fan will not run.

Auto Only: The unit will be allowed to provide heating and cooling, providing the outdoor ambient conditions are met. The heating setpoint and cooling setpoint are controlled by "HSP" and "CSP" settings and the setpoint dial (warmer/cooler adjust or the Setpoint dial setting), and the value of DB.

Off: The unit will shut down all functionality – neither heating, cooling nor fan will be allowed to operate.

Note: Hold the Enter key on the controller for 15 seconds to access the variable screens. (SUO should appear.) Use the down arrow to go to SSI. Press the enter button. If the value is ON, the sensor with the setpoint overlay is active. If the value is OFF, the sensor with the warmer/cooler adjust should be used. Use the up/down arrows to toggle between ON/OFF and press the enter button to save. This setting can also be changed in CommPro (nciWallStatSelect). See the control instruction manual for more information.

8.3.1 Optional Digital Heating/Cooling/Makeup Air Controls, Options DG1 and DG5—Model RDH only (cont'd)

Fan Operation

When the slide is not in the OFF position and the unit is in the Occupied Mode based upon the input, the fan will run continuously. In the Unoccupied Mode, the fan will only run on a call for heating or cooling. The fan will be off if the slide is in the OFF mode. Upon a call for the fan to run, if the air proving switch does not make after 180 seconds, the unit shuts down. Turn the unit FX05 controller OFF then ON, or press the UP and Down arrows simultaneously for 5 seconds, to reset the alarm condition. When the unit is locked out, heating and cooling functions will be disabled. Control will display a flashing "AP".

If cooling or heating operations are energized and fan proof is lost for three seconds, the cooling or heating functions will be shut down, fan will be de-energized, and "AP" will flash on the display.

In the unoccupied mode, when the slider switch is moved to the OFF position, or the call for heating or cooling ends, the fan will run for an additional 30 seconds before shutting off. This fan delay time is adjustable using variable "Fod".

Occupied Mode

Unit will control to the Occupied Setpoints.

Cooling or Heating Slider Mode & Dial Setpoint (Option DG1): The dial setting is the working heating or cooling setpoint.

Auto Slider Mode & Dial Setpoint (Option DG1): The dial setting is the midpoint for the working heating and cooling setpoint. The actual setpoint is adjusted by a value of "db" (deadband) which has a default value of 2°F.

The cooling setpoint = dial setting + db = 72°F + 2°F = 74°F

The heating setpoint = dial setting + db = 72°F − 2°F = 70°F

Auto, Cooling, or Heating Slider Mode, & Warmer/Cooler Dial (Option DG5): The value HSP or CSP in the controller becomes the active heating and cooling setpoint basis. The warmer/cooler adjusts the setpoint by ±6°F.

"HSP", default 68°F

"CSP", default 72°F

The cooling setpoint = dial setting + CSP = +6°F + 72°F = 78°F

The cooling setpoint = dial setting + CSP = -6°F + 72°F = 66°F

The heating setpoint = dial setting + HSP = +6°F + 68°F = 74°F

The heating setpoint = dial setting + HSP = -6°F + 68°F = 62°F

Note: When variable SSI = ON, Room Command Module with setpoint scale should be used (DG1). When SSI = OFF, Room Command Module with warmer/cooler scale should be used (DG5).

Unoccupied Mode

Unit will control to the Unoccupied Temperature Setpoints. The unoccupied setpoints are the working Heating Setpoint minus the value of "UoU" which has a default of 10°F and the working Cooling Setpoint plus the value of "UoU".

Auto Slider Mode & Dial Setpoint (Option DG1):

The cooling setpoint = dial setting + db + UoU = 72°F + 2°F + 10°F = 84°F

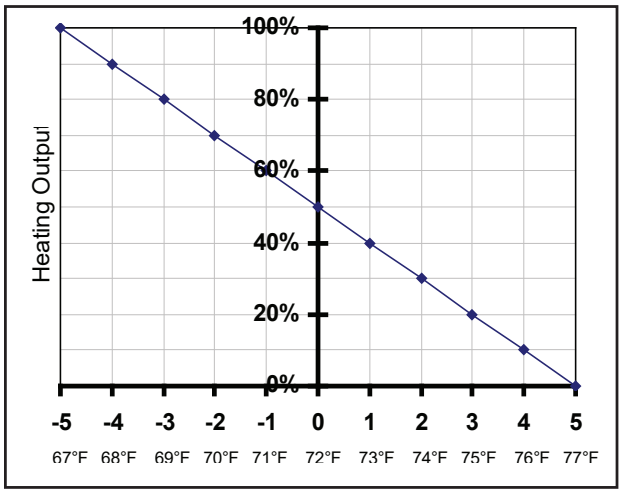
Boost Mode: Unit will add an adjustable amount BOU (nciBoostModeOffset) (default 5°F) to the working heating setpoint and subtract from the working cooling setpoint. Boost Mode will only operate in Heating Only or Cooling Only modes. Boost is not available in Auto Mode.

Example: Cooling Slider Mode & Dial Setpoint:

The cooling setpoint = dial setting + BOU = 72°F − 5°F = 67°F

Heating Operation: The unit will initiate heating if the temperature sensed at the space sensor or discharge falls below the "HSP" setpoint by the value of the heating proportional band, "HPB" (Default value 5°F). When it does, full heating turns on (high fire). The analog output will modulate to 100% full fire for 180 seconds to

Temperature Difference From Setpoint and Heating Output



ensure proper burner ignition. With modulating control, the gas valve will then modulate to a position, linearly with the proportional band, “HPB”. For staged control (Option DG1 or DG5), the unit will switch to low fire when the heating output required from the proportional band is less than the SSO (5% default) for 30 seconds. The unit switches back to high fire if the gas signal calls for 90% capacity or “SSH” value. Heating will completely turn off when the space or discharge air temperature is above HSP + deadband “HDB”.

Example: Heating will enable when

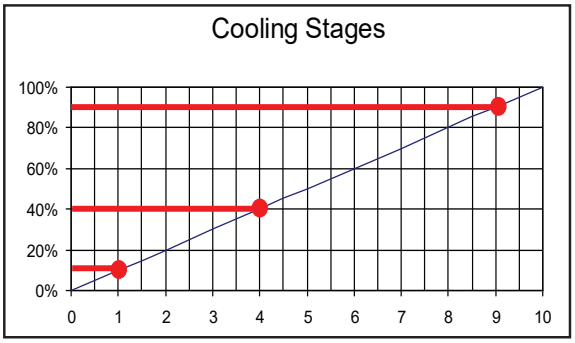
Temperature < *WHSP* – *HSP* – *HDB* < *72*°F – *5*°F – *0*°F < *67*°F

So, when the space temperature drops below 67°F, the signal to the gas valve is 100% and the burner ignites. After the 180 seconds, if the temperature is 72°F, the signal to the gas valve will be 50%.

Heating is disabled when the ambient temperature is above the lockout value “oH” (default 62°F).

Cooling Operation: The unit will initiate cooling if the temperature sensed at the space sensor (discharge air sensor) climbs above the WCSP into the Cooling proportional band, CPB. The cooling stages are based on C1, C2, and C3 values.

Example: If the working cooling setpoint (WCSP) is 72°F, stage 1 cooling turns on when space temp (discharge air temp) increases to 73°F (10% of the 10°F CPB). Stage 2 turns on when space temp increases to 76°F (40% of the 10°F CPB). Stage 3 turns on when the space temperature increases to 81°F (90% of the 10°F CPB).



As the space temperature moves back towards WCSP, stage 3 turns off at 40% call for cooling, stage 2 turns off at 10% call for cooling, and stage 1 turns off at 5% cooling call. There is a non-adjustable minimum 240 second interstage time delay. In addition, cooling ambient temperature lockout values prevent individual stages from being enabled until the outside air temperature is above oC, oC2, and oC3 values.

Compressor inter-stage delay time and compressor minimum on time are controlled by the nciClgStgTime which is defaulted at 240 seconds. This means that if stage 1 has just begun, stage 2 cannot start for 240 seconds. Once stage 1 has begun, it must run for 240 seconds before it will be turned off.

8.3.2 Optional Digital Heating/Cooling/ Dehumidification (Reheat) Controls, Options D12B, D12C, D12D, D12E, D12G—Applies to RDH, REH, RHH, or RXH (Required with All Dehumidification Units, Option AU7)

These digital control options are for neutral air control and can have an optional space reset control. These are the only control options that apply to RDH, REH, RHH, and RXH units with dehumidification (Option AU7L or AU7R).

The programmable controller (**FIGURE 49**) used with these options has a built-in time clock card for energy savings and better management of the specific application. If equipped with the optional serial communication card, the controller is compatible with either the LON or N2open BAS protocol.

If your unit was ordered with either Option D12B, D12C, D12D, D12E, or D12G, refer to Form CP-PREEVA-D12 B/C/D/E/F/G in the Literature Bag, for more detailed information on these four digital control systems.

The microprocessor unit (Model FX06, **FIGURE 49**) in control Options D12B, D12C, D12D, D12E, and D12G is custom programmed for the PREEVA® models. Control features include:

- Custom 3-step control sequence of cooling and dehumidification (reheat) control
- Modulation or 2-stage gas heat control
- SCR control or two stage electric heat
- Fully integrated outdoor ambient lockouts based on outdoor dry bulb/dewpoint or enthalpy

8.0 Controls and Operation (cont'd)

8.3 Digital Controls (cont'd)



FIGURE 49 - FX06 in D12B, D12C, D12D, D12E, and D12G

NOTE: For explanation on the settings and functions of the FX06 programmable control, see Form CP-PREEVA-D12 B/C/D/E/F/G. If the unit being installed has a special FX07 controller, contact your Representative or the factory for control information.)

Digital Control (FX06) Applications by Control Option Code

8.3.2 Optional Digital Heating/Cooling/Dehumidification (Reheat) Controls, Options D12B, D12C, D12D, D12E, D12G (cont'd)

- Alarm and equipment shutdown features
- Service/Commissioning Test Mode
- Integrated timer functions for cooling and heating

There are four buttons that can be used for adjusting setpoints, viewing unit status, and enabling unit test or shutdown modes. The controller display will indicate unit status (on, off, or alarm), discharge air temperature, outdoor air temperature, dewpoint, and enthalpy. When equipped with a wall-mounted sensor (Option CL67), space temperature will be displayed.

When the unit is called to operate, the main blower will run continuously in occupied mode and intermittently in unoccupied mode. The unit operates based on the four **Discharge Air Temperature Setpoints** listed below:

1. Standard (Neutral) Heating Discharge Air Temperature Setpoint
2. Space Heating Discharge Air Temperature Setpoint
3. Standard (Neutral) Cooling Discharge Air Temperature Setpoint
4. Space Cooling Discharge Air Temperature Setpoint

The heating and cooling equipment will cycle to maintain the active discharge air temperature setpoint for occupied and unoccupied modes. Heating and cooling may be locked out of operation based upon outdoor air temperature and enthalpy conditions.

If equipped with reheat, the control will also activate the dehumidification circuit to maintain a neutral discharge air temperature setpoint and related dewpoint based upon outdoor air and space conditions.

Option D12B—applies to RDH: Control is factory programmed for electronic modulation gas heating, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

Option D12G—applies to RDH and RHH: Control is factory programmed for electronic deep modulation gas heating, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

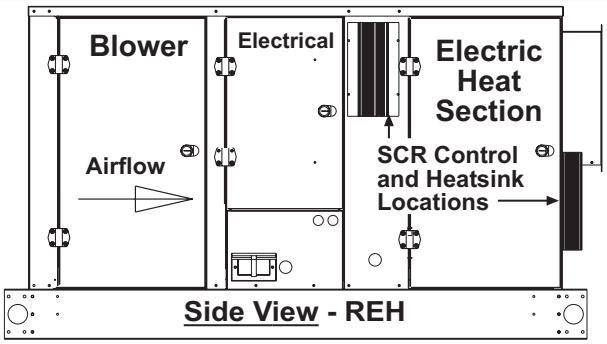
Option D12C—applies to RDH, RHH, and RXH (no heat): Control can be factory programmed for two-stage gas heating, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

Option D12E—applies to REH: Control is factory programmed with neutral air control for 2-stage electric heat, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional. **NOTE:** Option D12D is not recommended for makeup air applications.

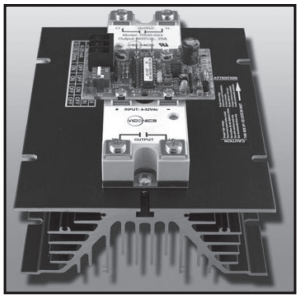
Option D12D—applies to REH: Control is factory programmed with recirculating control for electric heat with SCR modulation, with 3-stage cooling, and with or without optional dehumidification (reheat). Space reset control is optional.

Model REH units with Option D12D have additional controls to provide the electric heat modulation. Depending on their size (amp draw), REH units with Option D12D are equipped with one or two SCR power controllers. To provide comfort level heating in response to the system controller, the SCR controllers cause modulation of specified

FIGURE 50 - Locations of the SCR Power Controls with Heatsinks used on Model REH with Modulating Heat Control Option D12D



SCR Power Control and Heatsink in Option D12D (one or two required depending on amps)



WARNING

The heatsink on the SCR power controllers is HOT to the touch.

DANGER

High voltages are present on the terminals of the SCR power controller(s).

heating elements while other elements are turned on and off or staged. Depending on size, staging is controlled either by the FX06 controller or an additional staging module.

All of the D12 options include an outside air relative humidity transmitter. Depending on whether the unit includes a mixing box, the sensor is either factory-mounted in the mixing box or shipped separately for field installation in the inlet duct. The sensor sequences compressor operation based on outdoor dewpoint. It is recommended for humid and temperate climates.

FIGURE 51 - Optional Space Mounted Accessories with Digital D12 Control Options



Option CL67, **PN 260599**, Space Temperature Sensor, has adjustable setpoint control and unoccupied override. Follow the instructions included with the sensor and the wiring diagram to install.



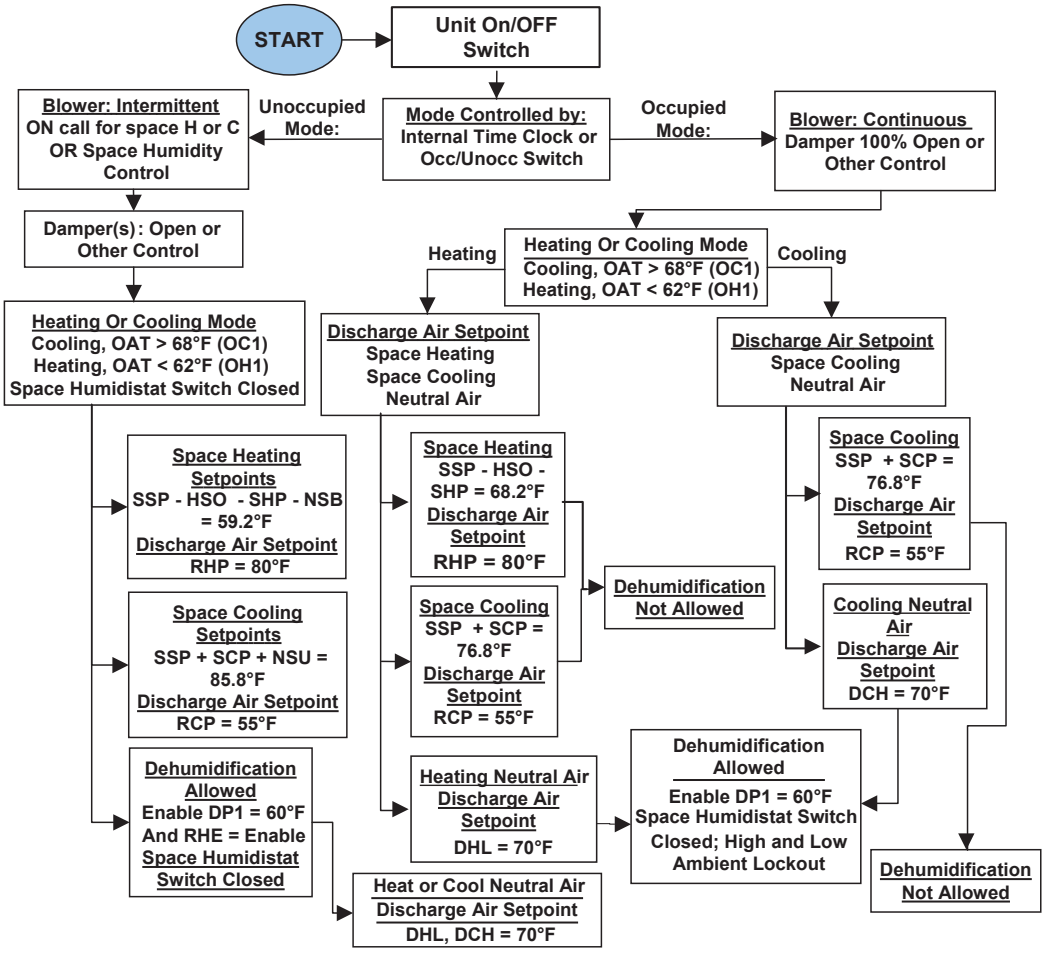
Option CL47, Room Dehumidistat, is shipped separately for field installation. The relative humidity inputs control reheat operation. Follow the instructions included with the control and the wiring diagram to install. **NOTE**: Applicable with reheat (Option AU7 or AU8) only.

Option RB2A, **PN 223125**, Remote User Interface, provides access to all the same functions as the FX06 controller except Test Mode.

Display Lights	
Symbol and 01 - 08	
Unit ON/OFF	Alarm
Comp #1 ON	Reheat ON
Comp #1 ON	Not Used
Stg #1 Heat ON	Not Used
Stg #1 Heat ON	Not Used



Sequence of Operation with Default FX06 Settings (in D12 Options)



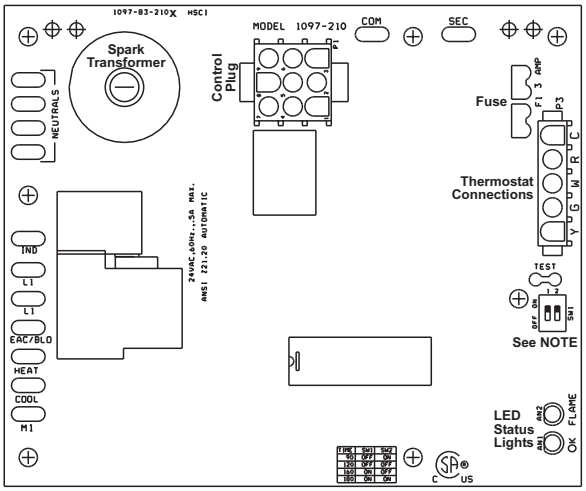
8.0 Controls and Operation (cont'd)

8.4 Ignition Systems—Model RDH and Model RHH

This furnace is equipped with a direct spark integrated control module (circuit board). The module monitors the safety devices and controls the operation of the venter motor and the gas valve between heat cycles. There is one of two control modules depending on the gas control option.

8.4.1 Ignition Control Module used in all control options EXCEPT Option AG58 and Option D12G

FIGURE 52 - DSI Integrated Control Module (circuit board)



Control Status—Green LED Codes

Steady ON ... Normal Operation, No call for heat
Fast Flash .... Normal Operation, Call for heat
1 Flash ..... System Lockout, Failed to detect or sustain flame
2 Flashes ..... Pressure switch did not close within 30 seconds of venter motor
3 Flashes ..... High limit switch open
4 Flashes ..... Pressure switch is closed before venter motor is energized
Steady OFF . Blown Fuse, No Power, or Defective Board

Flame Status—Yellow LED Codes

Steady ON ... Flame is sensed
Slow Flash ... Weak flame (current below 1.0 microamps ±50%)
Fast Flash .... Undesired Flame (valve open and no call for heat)

NOTE: Set "blower off" dip switch setting to 45 seconds for makeup air application. Refer to the table on the module for the appropriate settings.

NOTE: Abnormal Heat Cycle Functions and Ignition System Fault Models for this ignition controller are explained in the Operation/Maintenance/ Service Manual, Form O-PREEVA.

Normal Heat Cycle Operating Sequence

1) Call for Heat: The heating/cooling system controller calls for heat. The ignition system circuit board checks to see that the limit switch is closed and the pressure switch is open. If the limit switch is open, the circuit board responds as defined in the "Abnormal Heat Cycle, Limit Switch Operation". If the pressure switch is closed, the circuit board will do four flashes on the green LED and wait indefinitely for the pressure switch to open. If the pressure switch is open, the circuit board proceeds to prepurge.

2) Prepurge: The circuit board energizes the venter motor and waits for the pressure switch to close. If the pressure switch does not close within 30 seconds of the venter motor energizing, the circuit board will do two flashes on the green LED. The circuit board will leave the venter motor energized indefinitely as long as the call for heat remains and the pressure switch is open.

When the pressure switch is proven closed, the circuit board begins the prepurge time. If flame is present any time while in prepurge, the prepurge time is restarted. If flame is present long enough to cause lockout, the circuit board responds as defined in "Fault Modes, Undesired Flame".

The ignition system circuit board runs the venter motor for a 20 second prepurge time, then proceeds to the ignition trial period.

3) Ignition Trial Period: The ignition system circuit board energizes the spark and main gas valve. The venter remains energized. If flame is sensed during the first 16 seconds, the spark is de-energized. If flame has not been sensed during the first 16 seconds, the control de-energizes the spark output and keeps the gas valve energized for an additional one second flame proving period. If flame is not present after the flame proving period, the control de-energizes the gas valve and proceeds with ignition re-tries as specified in "Abnormal Heat Cycle, Ignition Retry". If flame is present, the circuit board proceeds to steady heat.

4) Steady Heat: Circuit board inputs are continuously monitored to ensure limit and pressure switches are closed, flame is established (sensor on both burner sections), and the system controller call for heat remains. When the call for heat is removed, the ignition system circuit board de-energizes the gas valve and begins postpurge timing.

5) Post Purge: The venter motor output remains on for a 45 second postpurge period after the system controller is satisfied.

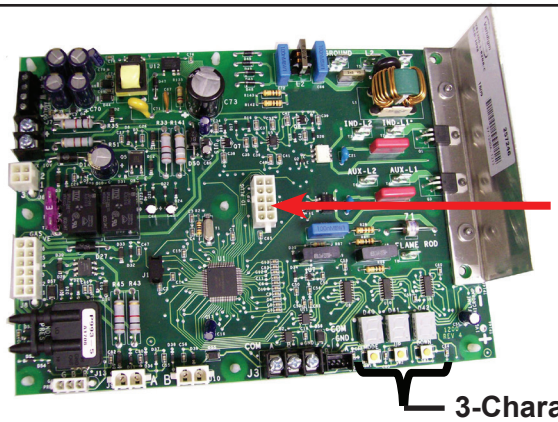
8.4.2 Ignition Control Module used in Deep Modulation Control Options AG58 and D12G

IMPORTANT: The control module is **PN 260252 for all sizes of Model RDH** and **PN 260917 for all sizes of RHH** heat sections. However, the ID plug on each board is unique for each model, size, and type of gas. A replacement board will require either a new ID plug or reuse of the ID plug from the board being replaced.

NOTE: Operating and Lockout Error Codes displayed on the ignition controller 3-character display (**FIGURE 53**) are listed in Troubleshooting Paragraph in the Operation/Maintenance/ Service Manual, Form O-PREEVA.

Integrated Control Module for Gas Control Options AG58 and D12G: The control module is located in the control compartment with an additional board to control spark that is attached to the removable shield on the end of the burner. Except for the replaceable parts shown, do not attempt to disassemble either board. Each heating season check the lead wires for insulation deterioration and good connections.

FIGURE 53 - Integrated Control Module (Circuit Board), for Deep Modulation Options AG58 and D12G

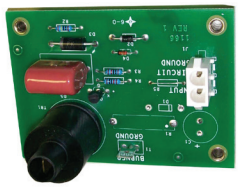


If replacement is required, these boards must be replaced with identical parts.

The control has a built-in, self-diagnostic capability. The control continuously monitors its own operation and the operation of the heat section including direct spark ignition, safety and modulating valves, and venter motor speed. The 3-digit display on the control indicates the current system state, warnings, failures, and test modes.

LED 3-Character Display (displayed on power up)	
Display Info (example only)	**Description**
RDH	Furnace series or model name
400	Heat Section Size
nAt or LP	Fuel type
1.01	Software version

FIGURE 54 - Spark Ignition Board, PN 257975, is located on the removable shield at the end of the burner.



CAUTION: Due to high voltage on the spark wire and electrode, do not touch when energized (see Hazard Levels, page 2).

8.4.3 Ignitor Location

Proper location of the ignitor to the burner is shown in **FIGURE 55A**. Ignitor spark gap is shown in **FIGURE 55B**. The ignitor is the same for all gas control options.

FIGURE 55A - Ignitor Location

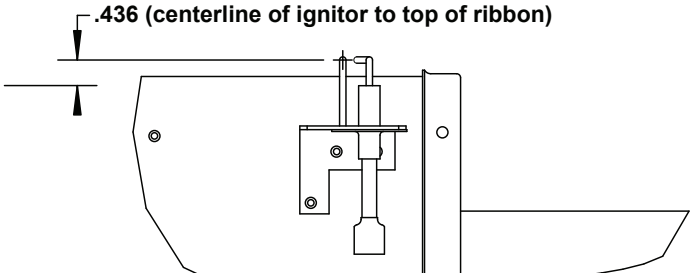
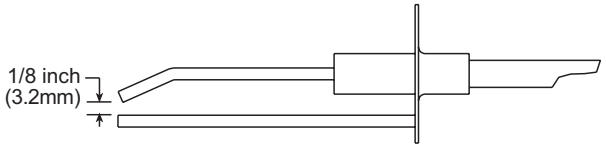


FIGURE 55B - Ignitor Spark Gap



9.0 Commissioning and Startup

9.1 General

Assumptions: All connections are made; actual startup is imminent. Site is clean; all excess supplies, scraps, and debris have been removed. Clean filters are in place. Doors are open for checks.

Warnings and checks apply to all units unless indicated.

DANGER

To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open when doing checks prior to startup. See Hazard Levels, page 2.

9.2 Checklist Prior to Startup

Important NOTE: When the unit is started for the first time, complete the startup form on page 64. Keep with the unit for future reference.

9.2.1 All Systems Checklist Prior to Startup:

- ☐ Check clearances. All clearances must be as illustrated in Paragraph 4.1.
- ☐ Verify the electrical supply matches the unit (refer to the rating plate).
- ☐ Check the wiring for loose connections or damaged wire. Tighten connections. Replace damaged wiring (see Paragraph 7.0 or the wiring diagram for replacement wiring requirements).
- ☐ Check field wiring and controls against the wiring diagram. Be sure that wire gauges are as required for the electrical load. All field wiring must be compliance with the National Electric Code and local regulations.
- ☐ Be certain that the electrical entrances are sealed against the weather.
- ☐ Check that fuses or circuit breakers are in place and sized correctly.
- ☐ Be certain optional manual reset controls (firestat and high gas pressure switch) are reset.
- ☐ If any changes are required to factory settings, be sure they have been made (refer to control instructions shipped with the unit).
- ☐ **IMPORTANT: Before applying power, check blower pulley, blower wheel, and motor pulley to be sure they are secure to the shafts. Check blower and pulleys for free movement.** Check belt tension and alignment (Paragraph 6.9).
- ☐ Verify the removal of all shipping supports.
- ☐ Check discharge duct connection (Paragraph 6.8.4).

9.2.2 Gas Heat (RDH and RHH) Checklist Prior to Startup

- ☐ Check gas piping for leaks and proper supply gas pressure (6.0" w.c. minimum / 14.0" w.c. maximum). Bleed gas lines of trapped air.
  - a) Turn manual shutoff valve to off position.
  - b) Turn gas supply on.
  - c) Observe gas meter for movement, or
  - d) Attach pressure gauge readable to 0.1" w.c. and after turning gas on for ten seconds, turn gas supply off. No change in pressure should occur over a three-minute period.
  - e) If either c) or d) above indicate a leak, locate leak by brushing a soapy solution on all fittings. Bubbles will appear at the leak. Repair and repeat tests.
- ☐ Be sure that both flue discharge and combustion air openings are free of obstructions.
- ☐ If installed in California, verify that California Warning Label is displayed (see Paragraph 1.4).
- ☐ Model RDH equipped with Option CS2, verify that the burner condensate drain is connected, the trap is full, and that the line empties into a sanitary drain (Paragraphs 6.2.1 & 6.6.4).
- ☐ Model RDH equipped with modulating gas control AG58 or D12G, verify that the vent area condensate drain which exits from the bottom of the unit, is connected, the trap is full, and that it empties into a sanitary drain (Paragraphs 6.2.2 & 6.6.4).
- ☐ Model RHH, verify that the Heat section and vent area condensate drains which exit from the bottom of the unit, are connected, the trap is full, and that the line empties into a sanitary drain (Paragraphs 6.2.2 & 6.6.4).

9.2.3 Mixing Box Damper (if equipped)

- ☐ If the installation has a mixing box with two dampers, adjust damper linkage (Paragraph 6.4.5.1).

9.2.4 Cooling (if equipped) Checklist Prior to Startup:

- ☐ Verify that the condensate drain(s) are connected and properly trapped (see Paragraphs 6.2 and 6.6.4).
- ☐ Verify that the refrigerant circuits are charged with the appropriate refrigerant and leak tested according to the condensing unit instructions.

9.3 Startup Warnings and Checklist

CAUTION: If equipped with a cooling module with reheat, the crankcase heater must be allowed to warm up for at least 24 hours prior to startup. Disable cooling controls before turning on power to warmup crankcase heaters (see Hazard Levels, page 2).

- ☐ Close and latch the doors.
  IMPORTANT: If equipped with digital controls, when turning on the main controller for the first time, be sure to push and hold the Function Key for five seconds. This should cause the first LED to light. If the LED light is lit, the controller will remain on and allow for remote control even after a power outage. If the LED light is not lit, it will be necessary on restart the controller at the unit after a power outage.
- ☐ Read and follow the preparation instructions below on power supply voltage phasing. When ready, turn on the power. Turn on the gas.

Power Supply Voltage Phasing

Because it is possible to unknowingly connect 3-phase power in such a way as to cause the blower and, if there is an optional reheat compressor, the scroll compressor to rotate in reverse, it is very important to check this on startup.

Blower Rotation: Check rotation on startup. If blower rotation is not correct, reverse by interchanging two wires on the 3-phase supply connection to the blower motor.

Check Reheat Compressor (If Equipped): Connect refrigerant pressure gauges to the suction and discharge lines of the compressor and an electric meter to the power supply.

CAUTION: Be sure to connect pressure gauges to the suction and discharge lines before system startup so that compressor rotation can be checked immediately. A scroll compressor will be destroyed if allowed to operate in the wrong direction (see Hazard Levels, page 2).

Adjust the controller so that a call for reheat exists. Immediately at startup, observe the gauges. If the suction pressure rises and discharge pressure drops, the compressor is operating in reverse and must be shut down. Turn off the power and switch the 3-phase line voltage wiring connections before restarting the unit.

IMPORTANT NOTE: If allowed to operate for several minutes in reverse, the compressor's internal protector will trip. If a compressor is repeatedly allowed to restart and run in reverse, the compressor will be permanently damaged.

- ☐ Check heat operation.

WARNINGS

For your safety, read before operating. If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or death.

- **RDH and RHH: These appliances do not have a pilot. They are equipped with an ignition device which automatically lights the burner. Do not try to light the burner manually**
- **Before operating, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.**

WHAT TO DO IF YOU SMELL GAS

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Leave your building immediately.**
- **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call your fire department.**

- **RDH and RHH: Use only your hand to turn the gas control ON/OFF knob on the gas valve. Never use tools. If the valve ON/OFF knob will not turn by hand, do not try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.**
- **RDH and RHH: Should overheating occur, or the gas supply fail to shut off, turn off the manual gas valve to the appliance before shutting off the electrical supply.**
- **Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.**

☐ Adjust the control so that a call for heat exists. Observe for complete sequencing.

Operating Instructions and Heating Sequence of Operation—Gas-Fired Models RDH and RHH

1. Set thermostat at lowest setting.
2. Turn off all electric power to the appliance.
3. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand. Open the door and locate the gas control (ON/OFF) knob on the gas valve.
4. Turn the gas control knob clockwise to "OFF".
5. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. **If you smell gas, STOP!** and follow the steps in the **WARNINGS** printed above or on the Operating Label on the heater. If you do not smell gas, proceed to the next step.
6. Turn the gas control knob counterclockwise to "ON".
7. Close and latch access door.
8. Turn on the electric power to the heater.
9. Set thermostat or other control to the desired setting.

NOTE: If the appliance does not operate, follow the instructions "To Turn Off Gas to Appliance" printed below (and on the Operating Label on the heater) and call your service technician.

10. Control calls for heat, energizing the venter motor.
11. Venter pressure switch closes, firing the unit.
12. Burner flame is sensed and in 30 seconds after the gas valve is energized, the blower motor is energized.
13. If the flame is extinguished during the main burner operation, the integrated control system closes the main valve and must be reset by interrupting power to the control circuit (see lighting instructions on the heater).

TO TURN OFF GAS TO THE APPLIANCE

1) Set thermostat to lowest setting
2) If service is to be performed, turn off all electric power to the appliance.
3) Open the access door.
4) Turn the gas control knob clockwise to "OFF". Do not force.
5) Close and latch the door.

DANGER

The gas burner in Models RDH and RHH is designed to provide safe, complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion which produces carbon monoxide, a poisonous gas that can cause death.

Safe operation of indirect-fired gas burning equipment requires a properly operating vent system which vents all flue products to the outside atmosphere. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

Operating and Heating Sequence—Electric Heat Model REH

Turn on power to the unit

- Outside air dampers open
- Damper end switch closes energizing the blower motor
- Unit is controlled by FX06 controller (with sensors in outside and discharge air)
- Temperature control staging is based on sensor setpoints and inputs

Heating Sequence—Model REH:

1) On a call for heat from the FX06 controller, the blower energizes
2) Supply air switch closes and the first stage of electric heat is energized
3) Subsequent staging is controlled by the FX06 controller (Option D12E) or by the FX06 controller with modulation control from the SCR power controller (Option D12D)

☐ **Models RDH and RHH:** With the unit in operation, measure valve outlet gas pressure. If operated at high altitude, adjust outlet gas pressure for altitude if required.
See information and instructions in Paragraph 6.1.2 and 6.1.3.

☐ **Models RDH and RHH:** Turn the unit off and on, pausing two minutes between each cycle. Observe for smooth ignition. On two-stage or modulating burner systems, manipulate temperature adjustment slowly up and down to see if control is sequencing or modulating properly.

☐ If the system is equipped with an optional dirty filter switch, set the switch. Follow the instructions in Paragraph 7.6.3.

☐ If the system is equipped with a reheat pump, check the refrigerant subcooling and superheat.

Instructions for Checking and Adjusting the Subcooling of an Isolated Circuit acceptable subcooling readings range from 14° to 18°F (7.8° to 10°C).

Measure and record temperature and pressure of the liquid line at the condenser coil outlet.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 66,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Chart (STEP 2)
_____°F (°C) − _____°F (°C) = _____°F (°C) degrees of Subcooling

Instructions for Checking and Adjusting the Superheat of an Isolated Circuit (Superheat should be in the 8° to 12°F (4.5° to 6.7°C) range.)**:**

Measure and record temperature (insulate probe from surrounding air temperature) and pressure in the suction line at the compressor inlet.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 66,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Table (STEP 2)
_____°F (°C) − _____°F (°C) = _____°F (°C) degrees of Superheat

☐ Place "Literature Bag" containing Limited Warranty, this booklet, the operation manual, and any optional information including the digital control instructions in an accessible location near the heater. Follow the instructions on the envelope.

☐ **IMPORTANT:** After at least 8 hours but no longer than a week of operation, recheck the blower wheel, all set screws, blower pulley, motor pulley, and belt tension. Make any required adjustments.

APPENDIX

STARTUP FORM

Fill out the applicable sections and keep for future reference.

Job Name:		**Contractor Contact:**	
Street Address		**Contractor Phone:**	
City, State, Zip		**Model #**	
Date:		**Serial #**	
Contractor:		**Tag:**	

Start-Up Checklist

NOTE: See Paragraph 9.0 for complete list.

General Checks	Reference
NOTE: Checks may not apply depending on option selection.	
□ Inspect unit for damage.	Paragraph 3.0
□ Verify shipping brackets are removed.	
□ Check fuses/breakers for correct sizing. (Check rating plate for electrical requirements.)	
□ Check clearances.	Paragraph 4.1
□ Check all condensate connections. Fill all traps.	Paragraph 6.2 & Paragraph 6.6
□ Verify air filters are installed.	
□ Inspect dampers.	
□ Tighten all screws on pulleys and fans.	Paragraph 6.9
□ Check and tighten all electrical terminals.	
□ Seal electrical entrances.	
□ Check optional dirty filter switch.	Paragraph 7.6.3
□ Check for manual resets (firestat, high gas pressure switch).	
□ Verify all copper tubing is isolated and does not rub.	
□ Verify crankcase heater energized 24 hrs before startup.	

Blower Assembly				
□ Fan alignment	Motor HP: _____ Name Plate Amps: _____			
□ Belt tension	Motor Make/Amps:	L1	L2	L3
□ VAV controls	_____	_____	_____	_____

Gas Heating Section	□ LP	□ Natural Gas
□ Leak test gas piping		
□ Purge air from lines		
□ Check Inlet Gas Pressure	Maximum:	14" w.c. for both natural gas and LP
Actual Gas Inlet Pressure: _____	Minimum:	As listed on the unit rating plate
□ Check Manifold Pressure (As listed on the rating plate.)		
Actual Manifold Gas Pressure:_____		

Electric Heating Section		
Heater Number and Amps:		
1		
2		
3		
4		
5		
6		

Reheat Compressor Data						
Outdoor Air Conditions:				Dry Bulb: _____		Wet Bulb: _____
Circuit	**L1**	**L2**	**L3**	**Name Plate RLA**	**Head Pressure PSIG**	**Suction Pressure PSIG**
Reheat						

Wiring Diagram Option Identification

The Option Codes for these electrical options are shown on the wiring diagram. Custom diagram lists only the options ordered.

Option Code	Brief Description
AG1	Analog Heating Control, 1-Stage
AG2	Analog Heating Control, 2-Stage
AG3	Analog Heating/Makeup Air, 2-Stage unit-mounted ductstat
AG15	Analog Heating/Makeup Air, 2-Stage remote ductstat w/dial
AG16	Analog Heating/Makeup Air, same as AG15 with display
AG40	Analog Heating/Makeup Air, converts to digital for field supplied BMS
AG58	Analog Heating/Makeup Air, electronic modulation 8:1 turndown
AG60	Analog Heating/Makeup Air, same as AG3 plus 33% low fire
AG61	Analog Heating/Makeup Air, same as AG15 plus 33% low fire
AG62	Analog Heating/Makeup Air, same as AG61 with display
AK1	115/1 Supply Voltage
AK2	208/1 Supply Voltage
AK3	230/1 Supply Voltage
AK5	208/3 Supply Voltage
AK6	230/3 Supply Voltage
AK7	460/3 Supply Voltage
AK8	575/3 Supply Voltage
AL2	1/4 HP 1725 RPM open dripproof motor
AL3	1/3 HP 1725 RPM open dripproof motor
AL4	1/2 HP 1725 RPM open dripproof motor
AL5	3/4 HP 1725 RPM open dripproof motor
AL6	1 HP 1725 RPM open dripproof motor
AL7	1-1/2 HP 1725 RPM open dripproof motor
AL8	2 HP 1725 RPM open dripproof motor
AL9	3 HP 3600 RPM open dripproof motor
AL10	5HP 3600 RPM open dripproof motor
AL19	1/4 HP 1725 RPM totally enclosed motor
AL20	1/3 HP 1725 RPM totally enclosed motor
AL21	1/2 HP 1725 RPM totally enclosed motor
AL22	3/4 HP 1725 RPM totally enclosed motor
AL23	1 HP 1725 RPM totally enclosed motor
AL24	1-1/2 HP 1725 RPM totally enclosed motor
AL25	2 HP 1725 RPM totally enclosed motor
AL26	3 HP 3600 RPM totally enclosed motor
AL27	5 HP 3600 RPM totally enclosed motor
AN2	Contactor, IEC
AN10	Motor Starter with Overloads
AR8	On/Off Damper (no mixing box)
AU7	Cooling Coil Cabinet with DX Coil and Reheat Pump
AUR1	Modulating Reheat
BA6	Disconnect Switch, flush-mounted, lockable, non-fusible
BC2	Convenience Outlet (requires separate power supply)
BD4	Firestat, 200°F
BD5	Firestat, 200°F (field-installed)
BE2	Low Limit, Discharge Temperature
BF14	Phase Loss/Low Voltage Protection, with AK5, AK6, AK7 only
BF15	Phase Loss/Phase Reversal Protection, 3-phase only
BG7	Plugin DPDT Relay, specified operation
BG9	Plugin DPDT Relay, Exhaust Fan Interlock
BHB1	Time Clock Card, with DG 1, 2, 5, 6
BHB2	N2 Card, with DG 1, 2, 5, 6 and D12 B, C, D, E, F, G
BHB3	LonMark Card, with DG 1, 2, 5, 6 and D12 B, C, D, E, F, G
BN2	Limit Control, High Ambient (burner cutoff)
BP2	Gas Pressure Safety Switch, High
BP3	Gas Pressure Safety Switch, Low
BP4	Gas Pressure Safety Switches, High and Low
CL1	Thermostat, 1-stage heat, 24V, 40-80°F
CL3	Thermostat, 1-stage heat, 24V, 40-90°F
CL8	Thermostat, 2-stage heat/cool, 24V, 40-90°F, non-programmable
CL33	Thermostat, 2-stage heat/cool, 24V, programmable
CL36	Thermostat, Modulating Heat/cool with 3-stage cooling

Option Code	Brief Description
CL52	Thermostat, 1-stage heat/cool, 24V, 45-88°F, programmable 5/2 day
CL67	Space Temperature Sensor/Override, with D12 B, C, D, E
CT1	Evap Cooler Fill & Drain Kit, 120/1 with AK1, AK7, AK8
CT2	Evap Cooler Fill & Drain Kit, 208/1 with AK2, AK5
CT3	Evap Cooler Fill & Drain Kit, 240/1 with AK3, AK6
CT5	Evap Cooler Freeze Protection, AquaSaver controls
CT6	Evap Cooler Freeze Protection, with CT 1, 2, or 3
D12B	Digital Control w/FX06, Neutral Air/Discharge Air Temp Control (applies to RDH with or without reheat)
D12C	Digital Control w/FX06, Space Temp Cntrl, w/Discharge Air Reset (applies to RDH with or without reheat)
D12D	Digital Control w/FX06, Neutral Air/Discharge Air Temp Control (applies to REH with SCR (modulating) heating control and 3-stage cooling with or without reheat)
D12E	Digital Control w/FX06, Recirculating Air Temp Control (applies to REH with 2-stage heating and 3-stage cooling with or without reheat) (not recommended for makeup air)
DF12	Digital Control w/FX06, Space Temperature, 2-stage heating/3-stage cooling (applies to RHH)
D12G	Digital Control w/FX06, Gas-fired electronic modulation with 8:1 turndown; 3-stage cooling; with or without reheat; discharge air temperature control
DG1	Digital Control w/FX05, Space Temperature, 2-stage heating/3-stage cooling (applies to RDH without reheat)
DG5	Digital Control w/FX05, Discharge Air Temperature, 2-stage htg/3-stage clng (applies to RDH without reheat)
ECD1	Evap Cooler AquaSaver meter water flow system
EG1	Analog Heating Control, 1-stage thermostat
EG2	Analog Heating Control, 2-stage thermostat
GE3	Damper Control, Outside air, 2-position motor
GE5	Damper Control, Outside air, 3-position motor
GE6	Damper Control, Outside & Return, 2-position motor
GE7	Damper Control, Outside & Return, 2-position mtr w/warmup
GE8	Damper Control, Outside & Return, 3-position, unit potentiometer
GE10	Damper Control, Outside & Return, 3-position, remote potentiometer
GE11	Damper Control, Outside & Return, modulating, mixed air
GE12	Damper Control, Outside & Return, modulating, mixed air w/min
GE13	Damper Control, Outside & Return, modulating, mixed air w/warmup
GE14	Damper Control, Outside & Return, mod, mixed air w/min & warmup
GE15	Damper Control, Outside & Return, modulating, building pressure
GE16	Damper Control, Outside & Return, modulating, BMS control
GE21	Damper Control, Outside & Return, modulating, enthalpy
GE22	Damper Control, Outside & Return, modulating, dual reference enthalpy
SA1	Duct Photoelectric Smoke Detector
T4 XX	Thermal Expansion Valve (R410A only)
UV2	Germicidal Lamp
VFD1	Variable Frequency Drive
VFD2	Variable Frequency Drive (requires field installation)

Pressure/Temperature Chart for Checking Superheat and Subcooling

NOTE: If equipped with a cooling coil cabinet with dehumidification, the dh circuit is factory charged with R410A refrigerant.

NOTE: Information in this chart was taken from the Temperature Pressure Chart printed in Form IC-2-04 by the Sporlan Valve Company, Washington, MO 63090

Pressure/Temperature Chart for Checking Superheat & Subcooling					
Saturation Temperature		Pressure (psig) by Refrigerant			
(°F)	(°C)	R22	R410A	R407C	R134a
0	-17.8	24.0	48.2	18.9	6.5
5	-15.0	28.3	55.0	22.8	9.1
10	-12.2	32.8	62.3	27.1	12.0
15	-9.4	37.8	70.2	31.8	15.1
20	-6.7	43.1	78.7	36.9	18.4
25	-3.9	48.8	87.8	42.4	22.1
30	-1.1	54.9	97.5	48.4	26.1
35	1.7	61.5	107.9	54.8	30.4
40	4.4	68.6	118.9	61.7	35.0
45	7.2	76.1	130.7	69.1	40.0
50	10.0	84.1	143.3	77.1	45.4
55	12.8	92.6	156.6	106.0	51.2
60	15.6	101.6	170.7	116.2	57.4
65	18.3	111.3	185.7	127.0	64.0
70	21.1	121.5	201.5	138.5	71.1
75	23.9	132.2	218.2	150.6	78.6
80	26.7	143.7	235.9	163.5	86.7
85	29.4	155.7	254.6	177.0	95.2
90	32.2	168.4	274.3	191.3	104.3
95	35.0	181.9	295.0	206.4	113.9
100	37.8	196.0	316.9	222.3	124.1
105	40.6	210.8	339.9	239.0	134.9
110	43.3	226.4	364.1	256.5	146.3
115	46.1	242.8	389.6	274.9	158.4
120	48.9	260.0	416.4	294.2	171.1
125	51.7	278.1	444.5	314.5	184.5
130	54.4	297.0	474.0	335.7	198.7
135	57.2	316.7	505.0	357.8	213.5
140	60.0	337.4	537.6	380.9	229.2
145	62.8	359.1	571.7	405.1	245.6
150	65.6	381.7	607.6	430.3	262.8
155	68.3	405.4	645.2	456.6	281.0

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NOTES:

Operation / Maintenance / Service

Applies to: **High Efficiency Models RHH & SHH; Indoor PreevA® Models PDH, PEH, PXH, SDH; and Outdoor PreevA® Models RDH, REH, RXH**

High Efficiency, Condensing Models



Outdoor Model RHH



Indoor Model SHH

Outdoor PreevA® Models



Model RXH



Model RDH
(with outside air hood)



Model REH

Indoor PreevA® Models



Model PXH



Model SDH



Model PDH



Model PEH

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1.0 General

1.1 Hazard Labels and Notices

This booklet includes operation, maintenance, and service information. Before beginning any procedure, carefully review the information, paying particular attention to the warnings. Handling of refrigerant should only be performed by a certified HVAC technician and in compliance with all codes and requirements of authorities having jurisdiction.

Definitions of Hazard Intensity Levels used in this Manual

There are warning labels on the unit and throughout this manual. For your safety, comply with all warnings during installation, operation, and service of this system. See definitions of Hazard Intensity Levels of warnings below.

HAZARD INTENSITY LEVELS

1. **DANGER: Failure to comply will result in severe personal injury or death and/or property damage.**
2. **WARNING: Failure to comply could result in severe personal injury or death and/or property damage.**
3. **CAUTION: Failure to comply could result in minor personal injury and/or property damage.**

1.2 DANGER Warnings and Requirements

DANGER

Turn off the power before performing all maintenance procedures (except to check refrigerant pressure and temperature). Lock disconnect switch in OFF position. When you turn off the power supply, turn off the gas (gas-fired units). See Hazard Intensity Levels, page 2.

IMPORTANT: Do not release refrigerant to the atmosphere! If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified HVAC technician.

DANGER

If equipped with a DX cooling coil module, this unit will contain refrigerant and may contain R410A high pressure refrigerant.

- **If equipped with a reheat pump, the reheat circuit is charged with R410A refrigerant.**
- **If attached to a MASA condenser unit, the cooling circuit is charged with R410A refrigerant.**
- **If attached to a field-supplied condenser unit, consult the condenser unit information to identify the type of refrigerant.**

All procedures involving any type of refrigerant should only be performed by a qualified HVAC technician.

In addition, hazards exist with R410A that could result in personal injury or death. Installation, maintenance, and service should only be performed by an HVAC technician qualified in R410A refrigerant and using proper tools and equipment. Due to much higher pressure of R410A refrigerant, DO NOT USE service equipment or tools designed for R22 refrigerant.

2.0 Maintenance and Service Information

This unit will operate with a minimum of maintenance. To ensure long life and satisfactory performance, a heating or heating/cooling system that is operated under normal conditions should be inspected and cleaned according to the Maintenance Schedule. If in an area where an unusual amount of dust or soot or other impurities are present in the air, more frequent maintenance is recommended.

When any service is completed, be careful to reassemble correctly to ensure that no unsafe conditions are created. When re-lighting, always follow the lighting instructions on the heater.

NOTE: If replacement parts are required, use only factory-authorized parts. Use of unauthorized parts will void the manufacturers warranty.

2.1 Maintenance Schedule

The following procedures should be carried out at least annually. The heating section should be inspected and cleaned at the beginning of the heating season. The cooling section should be inspected and cleaned at the beginning of the cooling season. See **FIGURE 1A,** for Model SDH, PDH, SHH, RDH, PXH, RHH, and RXH control locations in the electrical compartment. See **FIGURE 1B**, page 6, for control locations in Models PEH and REH. See the paragraphs indicated in the schedule for maintenance procedure information.

Basic Heat Section, Blower Section, and Optional Modules

All Models -

- Check the filters. Clean or replace as needed. (Paragraph 3.1)
- Clean all dirt, lint, and grease from the motor and blower,
- Check the belt for tension and wear. Replace a belt that may fail before next scheduled maintenance. (Paragraph 3.2)
- Check all wiring for any damaged wire. Replace damaged wiring. Check the unit wiring diagram for requirements.
- Systems with Option AR8 (dampers/no mixing box) - Check the dampers; clean as needed. (Paragraph 3.6)

Gas-Fired Models PDH, SDH, SHH, RDH, and RHH -

- Clean all dirt, lint, and grease from the venter assembly.
- Check the heat exchanger both internally and externally. (Paragraph 3.4.1)
- Check the burner for scale, dust, or lint accumulation. Clean if needed. (Paragraph 3.4.2)
- Check the gas valve to ensure that gas flow is being shutoff completely. (Paragraph 3.4.6)
- Check the vent or vent/combustion air system for soundness. Clean openings. Replace any parts that do not appear sound.
- Clean the heat section condensate drain line (two on Models RHH and SHH; one on other models with Option CS2).
- **Model SHH** - Clean the vent condensate drain line.

Electric Heat Models PEH and REH

- Clean all dirt, lint, and grease from the heating elements and heat section cabinet.

Optional Mixing Box - See Paragraph 3.6

- Check the mixing box and dampers. Clean as needed.

Optional Cooling Coil Module - See Paragraph 3.7

- Clean the condensate pan and drain.
- Clean the cooling coil.

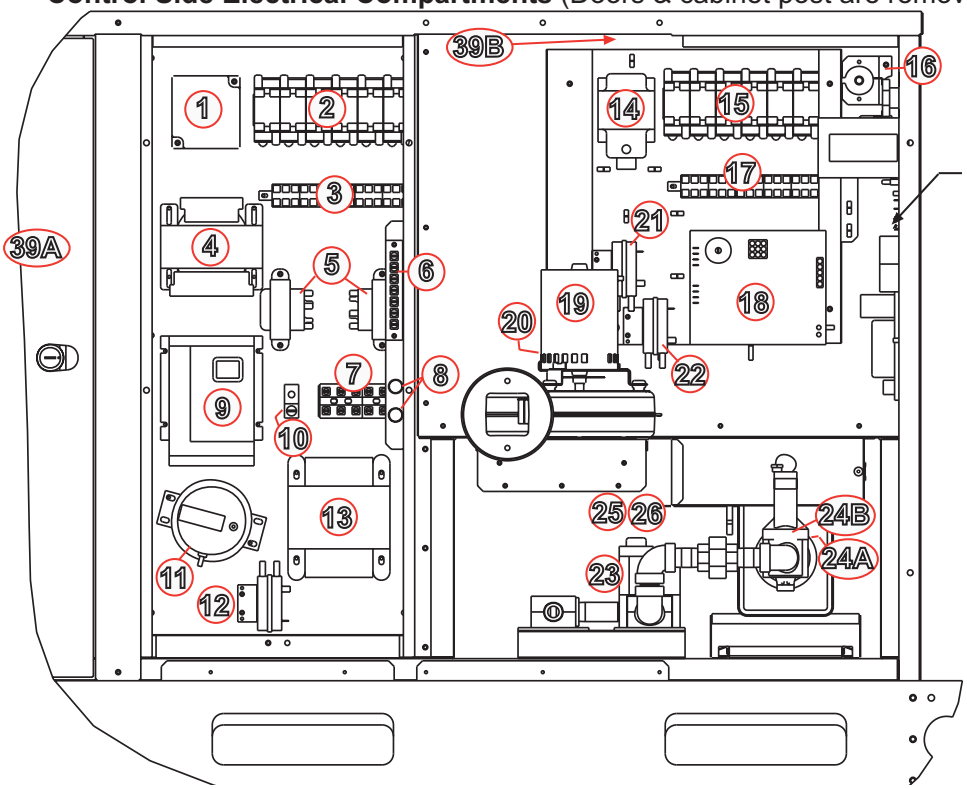
Optional Evaporative Cooling Module - See Paragraph 3.8

- Clean or replace the media. Clean the optional filters.
- Flush the water distribution line.
- Clean the pump screen and pump (pump and float system).

2.2 Control Locations

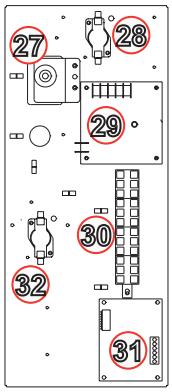
FIGURE 1A - Standard & Optional Control Locations - Models PDH, SDH, RDH, SHH, PXH, RHH, RXH

Control Side Electrical Compartments (Doors & cabinet post are removed.)

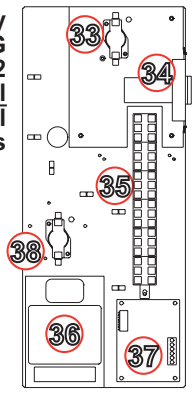


Secondary Panel Location

Secondary Panel for Analog AG Control Options



Secondary Panel for DG and D12 Digital Control Options



In the Left Electrical Compartment (high voltage and low voltage):

1) Optional Phase Loss Control (Option BF)
2) Plug-in Relays
3) Terminal Blocks
4) Transformer (for optional evaporative cooling module)
5) Transformers (right for controller; left for signal conditioner)
6) Terminal Board for thermostat
7) Line Voltage Terminal Blocks
8) Fuse Holders
9) Motor Starter or Variable Frequency Drive (Option VFD)
10) Grounding Lug
11) Optional Dirty Filter Switch (Remote Console Option)
12) Air Proving Switch
13) Transformer (venter motor, 460 & 575 volt PDH/SDH/RHH/SHH, plus 208 & 230 volt SHH & RHH)

Primary Panel in the Heat Section Electrical Compartment (low voltage):

14) Transformer (damper)
15) Plug-in Relays
16) High Temperature Limit Control
17) Terminal Blocks
18) Integrated Control Module (circuit board)
19) Venter Motor
20) Venter Motor Capacitor (hidden by venter motor)
21) High Speed Combustion Air Pressure Switch
22) Low Speed Combustion Air Pressure Switch (units with 2-speed venter, Opts AG 40, 60, 61, 62; DG 1, 2, 5, 6; D12 B, C) **or** Models RHH, SHH - Condensate Pressure Switch

Gas Train Components (for D12G or AG58, see page 12):

23) Single-Stage or Two-Stage Gas Valve)
24A) Pressure Switch for Modulation (Options AG40; DG 2 & 6; and D12B)
24B) Modulating Gas Valve (Options AG40; DG 2 & 6; & D12B)
25) Optional High Gas Pressure Switch (Opt BP2 not shown)
26) Optional Low Gas Pressure Switch (Opt BP3 not shown)

Secondary Panel in the Heat Section Electrical Compartment with Analog Controls (low voltage):

27) Unit-Mounted Ductstat (Options AG 3, 60)
28) Time Delay Relay (Venter)
29) Optional Freezestat (Option BE2)
30) Terminal Blocks
31) Optional Venter Speed Controller (Opts AG 58, 60, 61, 62)
32) Time Delay Relay (Speed change, Opts AG 58, 60, 61, 62)

Secondary Panel in the Heat Section Electrical Compartment showing low voltage Digital Controls and Opt AG40 for field-supplied computer control:

33) Time Delay Relay (Venter)
34) Programmable Controller (Opts DG 1, 2, 5, 6; D12 B/C/F/G)
35) Terminal Blocks
36) Signal Conditioner (Options DG 2, 6; AG40; D12 B, C)
37) Venter Speed Cntrllr (Opt DG 1, 2, 5, 6; AG40; D12 B/C/G)
38) Time Delay Relay (Speed change, Opts DG 1, 2, 5, 6; AG40; and D12 B/C/G)

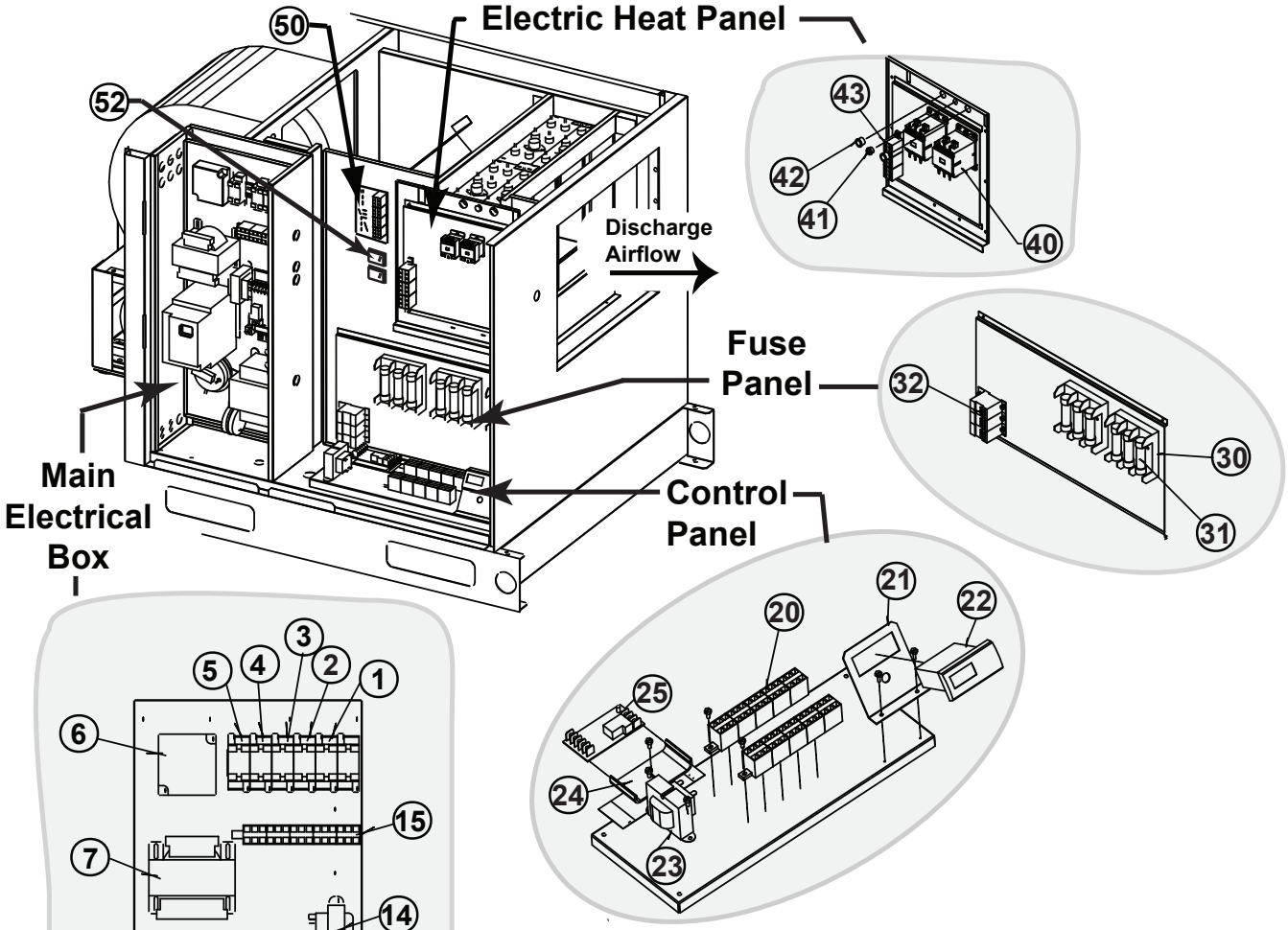
Other:

39A) Reverse Flow Limit Switch (in the blower cabinet on RDH/PDH/SDH Sizes 75-150)
39B) Reverse Flow Limit Switch (on heat section wall above the electrical compartment on RDH/PDH/SDH Sizes 175-400A and all RHH and SHH)
40) Safety Door Switch (SDH and SHH) on Heat Section Door (not shown in **FIGURE 1A**)
41) Optional Convenience Outlet (Option BC2) - requires its own electrical supply (on the cabinet panel below the left electrical compartment door; not shown in **FIGURE 1A**)
42) Optional Lockable Service Switch (Option BA6) (on the cabinet panel below the left electrical compartment door; not shown in **FIGURE 1A**
43) Vent Temperature Limit (RHH & SHH)

2.0 Maintenance and Service Information (cont'd)

2.2 Control Locations (cont'd)

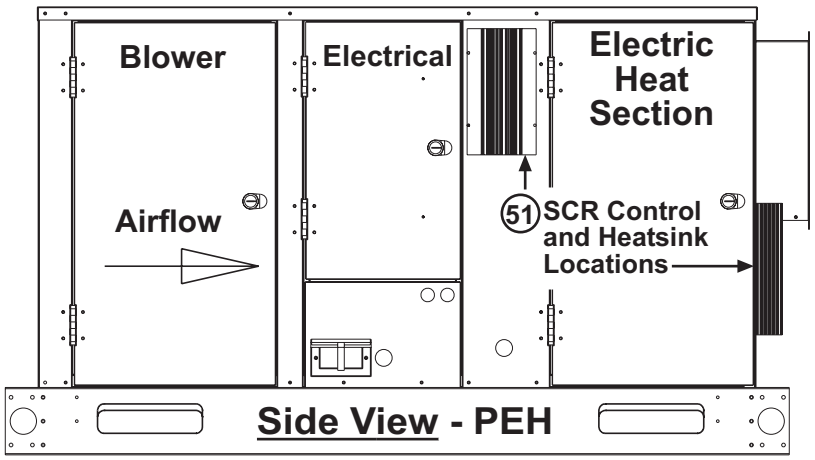
FIGURE 1B - Standard and Optional Control Locations - Electric Heat Models PEH and REH



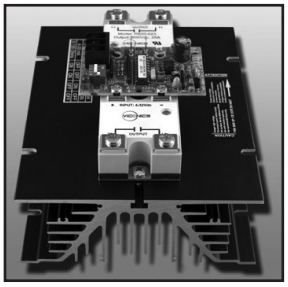
Main Electrical Box	
1	Exhaust Relay
2	Cool Relay
3	Damper Permissive Relay
4	Speed Change Relay
5	Blower/Damper Relay
6	Phase Loss Relay
7	Evaporative Cooler Transformer
8	Compressor Contactor
9	VFD or Motor Starter
10	Dirty Filter Switch
11	Air Proving Switch
12	460, 575/240 KVA Transformer
13	Line Voltage Terminal Blocks
14	FX06 Transformer
15	Terminal Blocks
Control Panel	
20	Terminal Block 24V
21	Controller Bracket
22	FX06 Controller
23	Transformer
24	Relay Mounting Track (with reheat/dehumidification only)
25	Relay (with reheat/dh only)

Fuse Panel	
30	Fuse Block
31	Fuse
32	Distribution Block
Electric Heat Panel	
40	Contactor
41	Strain Relief
42	Bushing
43	Terminal Block
Other Electric Heat Section Controls	
50	Staging Panel used in some Option D12D controls (depends on size and voltage) is on the Electric Heat Header Panel
51	SCR Power Controller(s) with Heatsink in Option D12D is on the Cabinet (side, front, or both) - See FIGURE 1C.
52	Transformer(s)

FIGURE 1C - Locations of the SCR Power Controls with Heatsinks used on Model REH and PEH units with Modulating Heat Control Option D12D



SCR Power Control and Heatsink in Option D12D (one or two required depending on amps)



DANGER

High voltages are present on the terminals of the SCR power controller(s).

3.0 Maintenance Procedures

3.1 Filters - All Models

Check the filters.

Clean permanent filters, allow to dry, and re-install.

Replace dirty disposable filters. Exposure to humid makeup air can accelerate filter degradation. Systems with disposable filters require more frequent filter inspection.

PDH/SDH/RDH Sizes	75/100	125/150	175/200/225	250/300	350/400A
PEH/REH Sizes	10A/20A/ 40A	15B/30B/ 60B	N/A	30D/60D/ 90D/120D	40E/80E/120E
PXH/RXH	000A	000B	000C	000D	000E
RHH/SHH	N/A	N/A	130/180	260	350
Filters - (Qty) Width x Height in inches	(2) 16 x 25	(2) 20 x 25	(2) 16 x 16; (2) 16 x 20	(3) 16 x 16; (3) 16 x 20	(1) 16 x 16;(2) 20 x 20; (3) 16 x 20

Dirty Filter Switch - If equipped with a dirty filter switch, check the condition of the sensing tubes to be sure that they are not blocked. Check the wiring connections. To set a new switch, see Installation Manual, Paragraph 7.6. Replacement switch is **P/N 105507.**

3.2 Belt, Blower, and Motor - All Models

Remove dirt and grease from the motor and blower.

Check the belt for wear and tension. Adjust belt tension as needed. Adjust the belt tension by turning the adjusting screw on the motor base. Replace worn belts. (**IMPORTANT:** If a belt is replaced, after 8 hours of operation, recheck the tension.)

Linked Belts - If the belt needs tightening, the recommended method of tightening the belt length is to count the number of links and remove one link for every 24. (A link is made up of two joining sections of belt. For easier removal of links, turn the belt inside out. But be sure to turn it back before installing. If belt is removed or replaced, be sure to align directional arrows on the belt to the proper drive rotation.) The belt tension should be checked after the first 24 hours of running at full load and at regular maintenance inspections. Be sure that the belt is aligned in the pulleys.

Solid Belts - Adjust the belt tension by turning the adjusting screw on the motor base until the belt can be depressed 3/4" (19mm). After correct tension is achieved, re-tighten the locknut on the adjustment screw. Be sure that the belt is aligned in the pulleys.

The motor supplied has lifetime lubrication and sleeve bearings. If the motor has been replaced with one that has oil cups or grease fittings, lubricate the motor.

Check current draw to motor rating plate.

Blower bearings are permanently lubricated cartridge ball bearings and do not require greasing.

3.0 Maintenance Procedures (cont'd)

3.3 Electrical Compartment

Check the wiring and connections. Replace any wiring that is deteriorated.

CAUTION: If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for sensor lead wires which must be 150°C. See Hazard Intensity Levels, page 2.

Controls identified below apply to all models unless specifically listed.

3.3.1 Reverse Flow Limit Control - PDH, SDH, RDH, RHH, SHH



P/N 211754

Function: The reverse flow limit control is an automatically reset, temperature activated safety control.

Service: If it is determined that the reverse flow limit control needs replacing, use only a factory-authorized replacement part that is designed for the size of heater.

Location: PDH/SDH/RDH 75-150 in the blower section. PDH/SDH/RDH 175-400 and all RHH/SHH in the heat section. For approximate location, see **FIGURE 1A,** page 5.

3.3.2 Transformer



Service: Use a voltmeter to verify that there are 24 volts output from a transformer. If the transformer is not functioning, it must be replaced. Use a replacement transformer identical to the factory-installed model.

Location: See **FIGURE 1A,** page 5, or **1B**, page 6, for location.

3.3.3 Door Switch - Models SDH, SHH



P/N 217262

Function: Prevents unit from operating when the heat section door is open.

Service: If it is determined that the door switch needs replacing, use only a factory-authorized replacement part that is designed for the heater.

Location: Models SDH/SHH heat section.

3.3.4 Condensate Pressure Switch - Models RHH & SHH



P/N 217085

Function: If the condensate drain is blocked causing the sensing pressure to be outside the switch setpoint, the pressure switch will shutoff the gas valve. The gas valve will remain off until the problem is corrected.

Service: If it is determined that the condensate pressure switch needs replacing, use only a factory-authorized replacement part that is designed for the heater.

Location: See **FIGURE 1A,** page 5, Item 22, for location.

3.3.5 Built-in On/ Off Control Switch, Option BA6



Function: Optional lockable service control switch.

Service: If it is determined that the control switch needs to be replaced, use only the factory-authorized replacement part that is designed for the heater.

Location: Switch is conveniently mounted below the electrical compartment on the outside of the unit.

Application: The switch on Models PDH, SDH, SHH, PXH, RHH, RDH, and RXH is **P/N 205908**. The switch used on Models PEH and REH differs by size; see chart below.

OPTION BA6 REQUIRED DISCONNECT SIZE for Electric Heat MODELS PEH and REH (AMPS)						
	208/1/60	**240/1/60**	**208/3/60**	**240/3/60**	**460/3/60**	**575/3/60**
10 KW	80	100	N/A	N/A	N/A	N/A
15 KW	100	125	N/A	N/A	N/A	N/A
20 KW	125	200	80	80	60	60
30 KW	200	200	100	125	60	60
40 KW	N/A	N/A	125	200	80	60
60 KW	N/A	N/A	200	200	100	100
80 KW	N/A	N/A	200	250	125	125
90 KW	N/A	N/A	250	N/A	200	125
120 KW	N/A	N/A	N/A	N/A	200	200
Available Disconnect Switch Sizes (Amps): 60 (P/N 205906), 80 (P/N 205907), 100 (P/N 205908), 125 (P/N 207678), 200 (P/N 207679) and 250 (P/N 222422)						
Note: These ratings are based upon 115% of the total FLA for heat modules plus motor.						

3.3.6 Ignition Control Module for Gas Heat Section - applies to all gas controls <u>EXCEPT</u> Options D12G and AG58

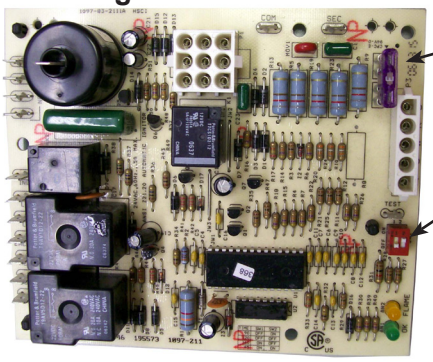
DSI Integrated Control Module (circuit board) - The module monitors the operation of the heater including ignition. The only replaceable component is the 3 amp Type ATC or ATO fuse. If the fuse is blown, the problem is most likely an external overload. Correct the problem and replace the fuse.

Do not attempt to disassemble the control module. However, each heating season check the lead wires for insulation deterioration and good connections.

Proper operation of the direct spark ignition system requires a minimum flame signal of 1.0 microamps as measured by a microampmeter.

Reference: For Troubleshooting and explanation of LED lights, see Paragraph 4.1.

DSI Integrated Control Module (Circuit Board), P/N 195573



Only replaceable part is a type ATC or ATO 3 amp fuse (Color Code Violet), P/N 201685

Set "blower off" dip switch setting to 45 seconds for makeup air application. Refer to the table on the control for the appropriate settings.

Normal Heat Cycle Operating Sequence

1) Call for Heat - The heating/cooling system controller calls for heat. The ignition system circuit board checks to see that the limit switch is closed and the pressure switch is open. If the limit switch is open, the circuit board responds as defined in the "Abnormal Heat Cycle, Limit Switch Operation". If the pressure switch is closed, the circuit board will do four flashes on the green LED and wait indefinitely for the pressure switch to open. If the pressure switch is open, the circuit board proceeds to prepurge.

2) Prepurge - The circuit board energizes the venter motor and waits for the pressure switch to close. If the pressure switch does not close within 30 seconds of the venter motor energizing, the circuit board will do two flashes on the green LED. The circuit board will leave the venter motor energized indefinitely as long as the call for heat remains and the pressure switch is open.

When the pressure switch is proven closed, the circuit board begins the prepurge time. If flame is present any time while in prepurge, the prepurge time is restarted. If flame is present long enough to cause lockout, the circuit board responds as defined in "Fault Modes, Undesired Flame".

The ignition system circuit board runs the venter motor for a 20 second prepurge time, then proceeds to the ignition trial period.

3) Ignition Trial Period - The ignition system circuit board energizes the spark and main gas valve. The venter remains energized. If flame is sensed during the first 16 seconds, the spark is de-energized. If flame has not been sensed during the first 16 seconds, the control de-energizes the spark output and keeps the gas valve energized for an additional one second flame proving period. If flame is not present after the flame proving period, the control de-energizes the gas valve and proceeds with ignition re-tries as specified in "Abnormal Heat Cycle, Ignition Retry". If flame is present, the circuit board proceeds to steady heat.

4) Steady Heat - Circuit board inputs are continuously monitored to ensure limit and pressure switches are closed, flame is established (sensor on both burner sections), and the system controller call for heat remains. When the call for heat is removed, the ignition system circuit board de-energizes the gas valve and begins postpurge timing.

5) Post Purge - The venter motor output remains on for a 45 second postpurge period after the system controller is satisfied.

Abnormal Heat Cycle Functions

<u>Interrupted Call for Heat</u> - If the system controller call for heat is removed before the flame is recognized, the circuit board will run the venter motor for the post purge period and de-energize all outputs.

If the call for heat is removed after successful ignition, the circuit board will de-energize the gas valve and run the venter motor through post purge.

<u>Ignition Retry</u> - If flame is not established on the first trial for ignition period, the ignition system circuit board de-energizes the gas valve, and the venter motor remains

3.0 Maintenance Procedures (cont'd)

3.3 Electrical Compartment (cont'd)

3.3.6 Ignition Control Module Gas Heat Section - applies to all gas controls except Options D12G and AG58 (cont'd)

Abnormal Heat Cycle Functions (cont'd)

energized for an inter-purge period of 10 seconds. The spark and gas valve are then re-energized, and the circuit board initiates another trial for ignition.

If flame is not established on the second trial for ignition, the circuit board de-energizes the gas valve and venter motor remains energized. The spark and gas valve are re-energized and the circuit board initiates another trial for ignition.

If flame is not established on the third trial for ignition period, the circuit board de-energizes the gas valve, and the venter motor remains energized for an inter-purge period of 10 seconds. The circuit board then re-energizes the gas valve and spark and initiates another trial for ignition.

If flame is not established on the fourth trial for ignition (initial try plus 3 re-tries), the circuit board de-energizes the gas valve and goes into lockout. The circuit board goes to one flash on the green LED to indicate ignition failure lockout.

Limit Switch Operation - The limit switch is ignored unless a call for heat is present (W energized). If the limit switch is open and a call for heat is present, the control de-energizes the gas valve, runs the blower motor on heat speed, and runs the induced draft (venter) motor. The control will be in soft lockout and flashing fault code "3", before returning to normal operation.

When the limit switch re-closes or the call for heat is lost, the control runs the induced draft motor through post purge and runs the blower through the selected fan off delay.

Pressure Switch - If the pressure switch opens before the trial for ignition period, the venter motor will run through the pressure switch recognition delay (2 seconds), the gas valve will be de-energized, and the venter motor will run through the postpurge time. The ignition system circuit board will re-start the heat cycle at the pressure switch proving state if the call for heat still exists.

Pressure switch opening for less than 2 seconds during the trial for ignition period shall not interrupt the heat cycle. (Gas valve will de-energize while the pressure switch is open.)

If the pressure switch opens after a successful ignition, the circuit board will de-energize the gas valve. If flame is lost before the end of the 2 second pressure switch recognition delay, the circuit board will respond to the loss of flame. If the pressure switch remains open for 2 seconds and the flame remains, the circuit board de-energizes the gas valve and the venter motor runs through postpurge.

Ignition System Fault Modes

Undesired Flame - If flame is sensed longer than 20 seconds while the gas valve is de-energized, the circuit board shall energize the venter motor. When flame is no longer sensed, the venter motor will run through postpurge. The circuit board will do a soft lockout, but will still respond to open limit and flame. The FLAME (yellow) LED shall flash rapidly when lockout is due to undesired flame.

Gas Valve Relay Fault - If the circuit board senses the gas valve as energized for more than one second when the circuit board is not attempting to energize the gas valve, or the gas valve is sensed as not energized when it is supposed to be energized, then the circuit board will lockout with the green LED off. The control assumes either the contacts of the relay driving the gas valve have welded shut, or the sensing circuit has failed. The venter motor is forced off to open the pressure switch to stop gas flow unless flame is present.

If the gas valve was sensed as closed when it should be open, and has not de-energized after the venter motor was shutoff for 15 seconds, then the venter motor is re-energized to vent the unburned gas.

Soft Lockout - The circuit board shall not initiate a call for heat while in lockout. The circuit board will still respond to an open limit and undesired flame. Lockout shall automatically reset after one hour. Lockout may be manually reset by removing power from the circuit board for more than one second or removing the call for heat for more than one and less than 20 seconds.

Hard Lockout - If the circuit board detects a fault on the board, the status LED will be de-energized, and the circuit board will lockout as long as the fault remains. A hard lockout will automatically reset if the hardware fault clears.

Power Interruption - During a momentary power interruption or at voltage levels below the minimum operating voltage (line voltage or low voltage) the ignition system will self-recover without lockout when voltage returns to the operating range.

Power interruptions of less than 80mS shall not cause the circuit board to change operating states. Power interruptions greater than 80mS may cause the circuit board to interrupt the current operating cycle and re-start.

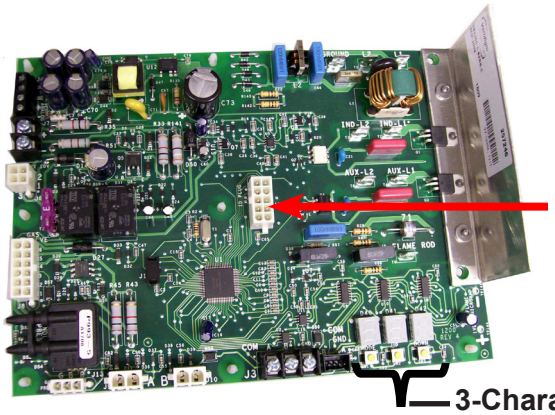
3.3.7 Ignition Control Module and Spark Board for Gas Heat Section with Option AG58 or D12G - applies to RDH Sizes 175-400, RHH, & SHH

IMPORTANT: The board has an ID plug that is unique for each model, size, and type of gas. A replacement board will require either a new ID plug or reuse of the ID plug from the board being replaced.

Integrated Control Module for Gas Control Options AG58 and D12G - The control module is located in the control compartment with an additional board to control spark that is attached to the removable shield on the end of the burner. Except for the replaceable parts shown, do not attempt to disassemble either board. Each heating season check the lead wires for insulation deterioration and good connections.

If replacement is required, these boards must be replaced with identical parts.

Integrated Control Module (Circuit Board) used in Gas Control Options AG58 and D12G

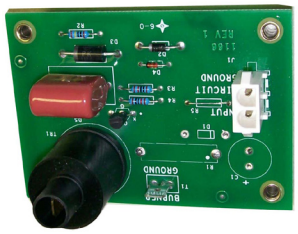


REFERENCE: Operating and Lockout Error Codes displayed on the ignition controller 3-character display are listed in Troubleshooting Paragraph 4.2.

The control has a built-in, self-diagnostic capability. The control continuously monitors its own operation and the operation of the heat section including direct spark ignition, safety and modulating valves, and venter motor speed. The 3-digit display on the control indicates the current system state, warnings, failures, and test modes.

LED 3-Character Display (displayed on power up)	
Display Info (example only)	Description
RDH	Furnace series or model name
400	Heat Section Size
nAt or LP	Fuel type
1.01	Software version

Spark Ignition Board, P/N 257975, is located on the removable shield at the end of the burner.



CAUTION: Due to high voltage on the spark wire and electrode, do not touch when energized. See Hazard Intensity Levels, page 2.

1) Call for Heat - The FX06 controller or 7350M thermostat calls for heat (there is a closure between "R" and "W" and at least 2 VDC to the analog input). The ignition system circuit board will check the modulating valve position and move to lightoff position. It checks to see that the limit switch is closed and the pressure switch is open. If the pressure switch is closed, the circuit board will wait indefinitely for the switch to open. If the switch is open, the circuit board proceeds to prepurge.

2) Prepurge - After the actuator moves to its lightoff position, the circuit board energizes the venter motor and waits for the pressure switch to close. If the pressure switch does not close at the beginning of a heat cycle, the venter motor will run for two minutes, then cycle off for 30 seconds, then on for two minutes, and so forth indefinitely.

When the pressure switch is proven closed, the venter motor ramps up to the appropriate lightoff speed and the circuit board begins the prepurge time. If flame is

3.0 Maintenance Procedures (cont'd)

3.3 Electrical Compartment (cont'd)

3.3.7 Ignition Control Module - Gas Heat Section with Control Option AG58 or D12G (cont'd)

Modulating Gas Control Sequence of Operation - applies to Gas Control Option AG58 or D12G (cont'd)

present any time while in prepurge, the prepurge time is restarted. If flame is present long enough to cause lockout, refer to the Troubleshooting Guide in Paragraph 4.2. The ignition system circuit board runs the venter motor for a 30-second prepurge time, then proceeds to the ignition trial period.

3) Ignition Trial Period - The ignition system circuit board energizes the spark and main gas valve. The venter remains energized. If flame is sensed during the first 6 seconds, the spark is de-energized. If flame has not been sensed during the first 6 seconds, the control de-energizes the spark output and keeps the gas valve energized for an additional one second flame proving period. If flame is not present after the flame proving period, the control de-energizes the gas valve and proceeds with three ignition re-tries as specified in "Abnormal Heat Cycle, Ignition Retry". If flame is present, the circuit board proceeds to steady heat. After three re-tries, the board will lockout for one hour. It will require a cycling of power to reset before the one-hour limit.

4) Modulating Heat - As long as the call for heat exists, the circuit board not only modulates the gas to precisely meet varying load conditions, but also modulates the combustion air to maintain stable performance and optimize thermal efficiency across the entire modulating range. Circuit board inputs are continuously monitored to ensure limit switch is closed and flame is established. When the call for heat is removed, the ignition system circuit board de-energizes the gas valve and begins postpurge timing.

5) Post Purge - The venter motor output remains on for a 45 second postpurge period after the system controller is satisfied.

3.4 Gas-Fired Heat Section - PDH, SDH, RDH, RHH, & SHH

3.4.1 Heat Exchanger Maintenance

The gas furnace section includes a patented TCORE^{2}® burner and primary heat exchanger. High efficiency Models RHH & SHH also have a secondary heat exchanger. Remove any external dirt or dust accumulation. Visually check the heat exchanger for cracks and holes. If a crack or hole is observed, replace the heat exchanger.

NOTE: Inspection of the lower portion of the heat exchanger is done with the burner removed. See the Burner Maintenance section below for information on inspecting the lower portion of the heat exchanger.

3.4.2 Burner Maintenance

This heater is equipped with a TCORE^{2}® burner.

Inspect the burner/control compartment annually to determine if cleaning is necessary. If there is an accumulation of dirt, dust, and/or lint, clean the compartment and follow the instructions below to remove and the burner for inspection and/or cleaning.

CAUTION: Use of eye protection is recommended.

Burner Removal Instructions

1. Outside the cabinet, shut the gas supply off at the manual valve ahead of the union.
2. Turn off electric supply.
3. Open the burner cabinet door.
4. Loosen the screw holding the burner shield end and remove the burner shield end. (See **FIGURE 2**.)
5. At the union closest to the burner, disconnect the gas supply. Do not allow the portion of the gas train attached to the venturi tube to rotate.
6. **Remove Burner Assembly** - The burner assembly is designed to slide out of the heater for inspection and/or service. Carefully pull the burner assembly end (with pipe nipple attached) out of the heater. To completely remove the burner assembly, disconnect the sensor and ignitor wires. Slide the burner out of the cabinet.

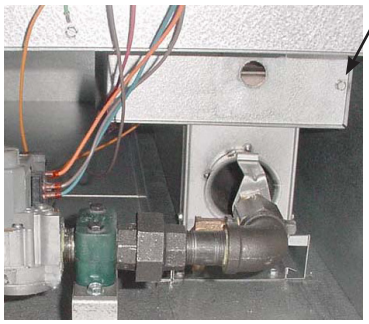
Inspect and Clean the Burner

With the burner assembly accessible, shine a flashlight on the burner ribbons. Look for carbon buildup, scale, dust, lint, and/or anything that might restrict flow through the spaces between the burner ribbons.

If it is determined that the burner needs to be cleaned, hold the burner assembly so that any foreign material will fall away from the burner, use a stiff bristle brush to loosen and remove any foreign material(s). If the burner is excessively dirty, remove one of the burner end caps. Remove the four screws that hold the end cap to the burner housing. Lightly tap the end cap to remove it.

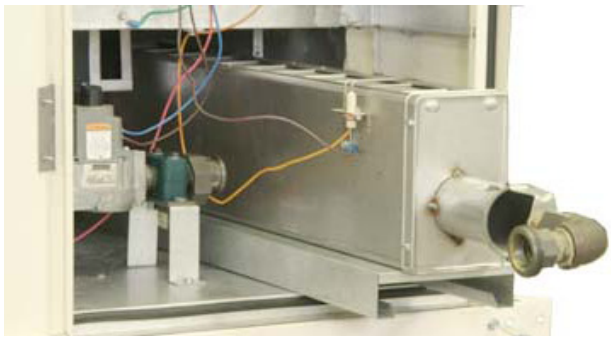
Clean all foreign material from the burner and venturi. After the burner is thoroughly clean, replace the end cap making certain that it is tight against the burner housing. **NOTE**: If any of the burner components are damaged or deteriorated, replace the burner assembly.

FIGURE 2 - Burner assembly is designed to slide out of the cabinet.

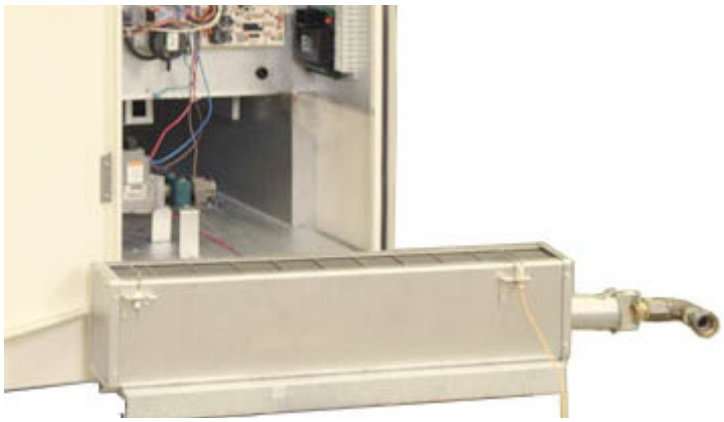


Loosen screw to remove burner shield end. Screw will stay attached to shield.





Disconnect the gas supply at the union closest to the burner.
Pull the burner forward.



To remove the burner, disconnect the flame sensor wires and the ignitor. Pull the burner until it slides off the support rails.

Inspect the Lower Portion of the Heat Exchanger (with burner removed)

At the burner flame entrance of each tube, shine a bright light into each heat exchanger section. With the light shining into the heat exchanger, observe the outside for visible light. Repeat this procedure with each heat exchanger section. If any light is observed, replace the heat exchanger.

Instructions to Re-Install the Burner (See FIGURE 2.)

1. Position the burner on the rails and slide the burner assembly part way into the cabinet. Re-attach the sensor and ignitor wires. Slide the burner into “working” position.
2. Re-attach the gas train. Do not allow the portion of the gas train attached to the venturi tube to turn. Be sure the burner is positioned correctly. Check to be sure that the orifice is secure and positioned correctly.
3. Re-attach the burner shield end.
4. Close and latch the burner cabinet door.
5. Turn on the electric and the gas. Check for proper operation.

3.4.3 Burner Orifice

The burner orifice usually only needs to be replaced when installing a gas conversion kit. If ordering a replacement orifice only, give BTUH content and specific gravity of gas, as well as the model and serial number of the unit. When removing or replacing the burner orifice be careful not to damage the venturi tube and/or the bracket.

3.0 Maintenance Procedures (cont'd)

3.4 Gas-Fired Heat Section - PDH, SDH, RDH, RHH, & SHH (cont'd)



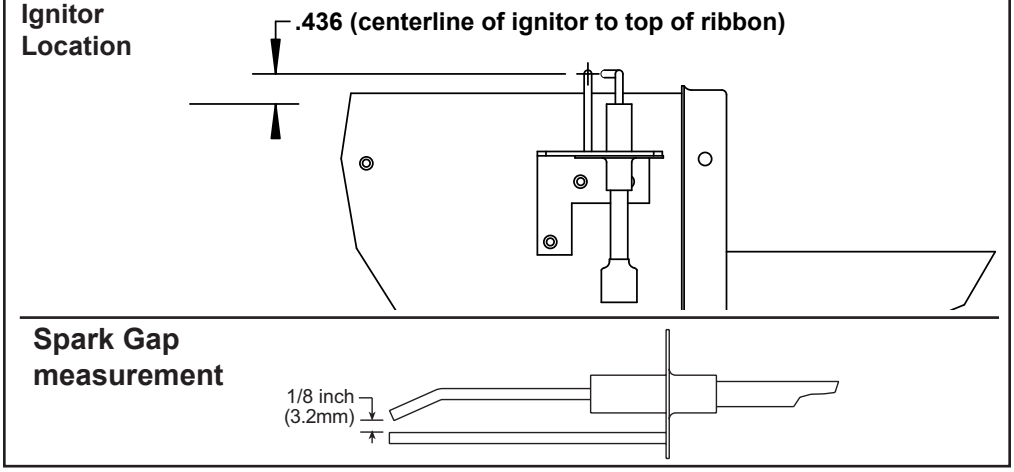
Ignitor, P/N 209339

3.4.4 Ignition System

Ignitor - Locate the ignitor. Disconnect the wire; remove the screw and the ignitor. Clean the ignitor assembly with an emery cloth.

Spark gap must be maintained to 1/8". **IMPORTANT:** When re-assembling, the brown ground wire must remain attached to the ignitor.

FIGURE 3 - Ignitor Location and Spark Gap



CAUTION: Due to high voltage on the spark wire and electrode, do not touch when energized. See Hazard Intensity Levels, page 2.

Flame Sensor, P/N 209973

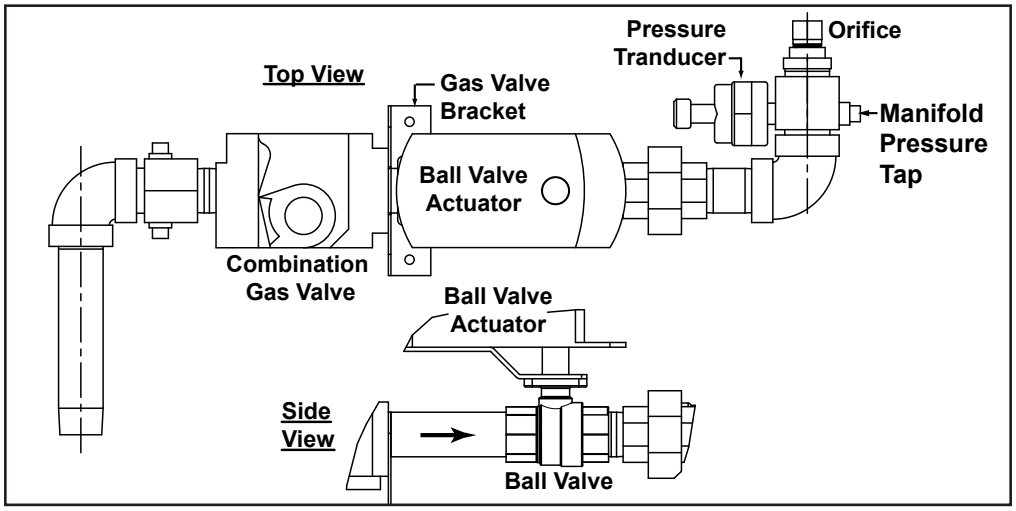


Flame Sensor - Locate the flame sensor. Disconnect the wire; remove the screw and the flame sensor. Clean with an emery cloth.

3.4.5 Gas Train Components

The gas train components differ depending on the gas control option selected. See the location of gas train components in **FIGURE 1A,** page 5, and below in **FIGURE 4**.

FIGURE 4 - Gas Train Component Locations for a Burner with 8:1 turndown (Modulating Gas Control Option AG58 or D12G) - applies only to Model RDH Sizes 175-400, Model RHH, and Model SHH

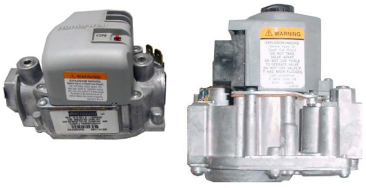


Single-Stage and Two-Stage Gas Valves

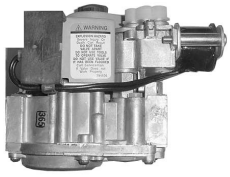
Carefully remove external dirt accumulation and check wiring connections.

The combination gas valve must be checked annually to ensure that the valve is shutting off gas flow completely.

Single-Stage Gas Valves



Two-Stage Gas Valve



WARNING

The operating valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting to the unit to ensure positive closure.

CAUTION: DO NOT bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure causing excess overfire and heat exchanger failure.

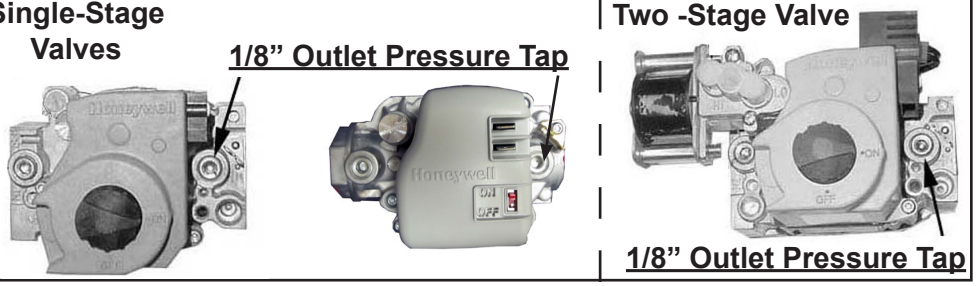
Instructions for checking valve shutoff:

1) Locate the 1/8" NPT pressure tap on the combination valve (**FIGURE 5**).

2) With the manual valve turned off to prevent flow to the gas valve, connect a manometer to the 1/8" outlet pressure tap in the valve. **NOTE:** A manometer (fluid-filled gauge) is recommended.

3) Turn the manual valve to the ON position and the heater OFF. Use your finger to fully block the main burner orifice for several seconds. Observe the manometer with the orifice blocked. If any pressure is indicated, the gas valve is leaking. **A leaking gas valve must be replaced before the heater is put back in operation.**

FIGURE 5 - Pressure Tap for Checking Gas Flow Shutoff



Modulating Gas Valve and Gas Pressure Switch - Options AG40, DG2, DG6, D12B



Natural Gas Pressure Switch , P/N 211130



Propane Pressure Switch , P/N 211710



Valve

Function: The gas valve controls modulation and the gas pressure switch monitors gas pressure to control operation of the two-speed venter.

Service: The modulation gas valve and switches have no field maintenance requirements except careful removal of external dirt accumulation and checking of wiring connections.

Use only factory-authorized parts.

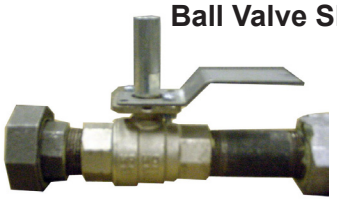
Location: See **FIGURE 1A**, page 5, for location.

Modulating Gas Valve - Options AG58, D12G

The gas train has a ball valve with an actuator (see **FIGURE 6**) to control gas flow. The ball valve and actuator are located downstream of the combination single-stage valve as shown in **FIGURE 4**.

Carefully clean external dirt accumulation from the actuator.

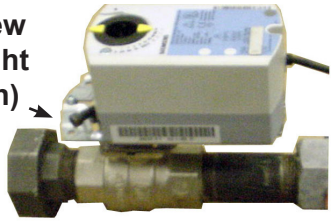
FIGURE 6 - Ball Valve and Actuator in Gas Control Options AG58 and D12G



Ball Valve with actuator removed

Ball Valve Actuator Modulates the Gas Flow

Actuator Set Screw (shown on the right or closed position)



Modulating System Gas Valve (Ball Valve and Actuator) Adjustment

Inspect the position of the ball valve shaft.

- In the fully open position, the dash marks on the top of the shaft should be aligned with the gas piping.
- In the fully closed position, the dash marks on the top of the shaft should be aligned at a 90° angle across the gas piping.

If the ball valve shaft is not properly aligned or if the manifold pressure does not match the settings in the chart started below, the ball valve will need to be adjusted.

Manifold Pressure (" w.c.) Measured at the Pressure Tap by the Gas Transducer - Gas Control Option AG58 or D12G

RDH Size	RHH/ SHH	Gas Type	High Setting 100% on ModHeat	Low Setting 0% on ModHeat
175	130	Natural	3.4	0.15
		Propane	10.0	0.30

(continued)

3.0 Maintenance Procedures (cont'd)

3.4 Gas-Fired Heat Section - PDH, SDH, RDH, RHH, & SHH (cont'd)

3.4.5 Gas Train Components (cont'd)

Manifold Pressures for Option AG58 or D12G Gas Modulation System (cont'd)

Manifold Pressure (" w.c.) Measured at the Pressure Tap by the Gas Transducer - Gas Control Option AG58 or D12G (cont'd)				
RDH Size	**RHH/ SHH**	**Gas Type**	**High Setting 100% on ModHeat**	**Low Setting 0% on ModHeat**
200	180	Natural	3.4	0.15
		Propane	10.0	0.25
225	--	Natural	3.4	0.15
		Propane	10.0	0.30
250	--	Natural	3.4	0.15
		Propane	10.0	0.25
300	260	Natural	3.4	0.15
		Propane	10.0	0.30
350	--	Natural	3.4	0.15
		Propane	10.0	0.25
400A	350	Natural	3.4	0.15
		Propane	10.0	0.25

To adjust AG58 or D12G gas modulation ball valve on Model SHH, RHH, or RDH (Sizes 175-400), follow instructions below:

1. Checking modulation requires a 0-10 DC volt generator and a manometer capable of reading to 0.10" w.c. .
   a) Connect the manometer to the manifold pressure tap next to the transducer (**FIGURE 4**, page 14).
   b) Connect the leads from the 0-10 DC volt generator to the "analog + and _" screw terminals on the control board after marking, removing, and capping the wires already at those terminals.
   c) Initiate a call for heat with either the thermostat (Option CL36, modulating wall heating/cooling Model T7350M) if equipped with Option AG58 or the FX06 controller (refer to Form CP-PREEVA-D12B/D/E/F/G) if equipped with Option D12G.
2. Run the unit at 100% by setting the DC voltage at 10 volts; measure the manifold pressure. If the manifold pressure matches the High Setting value in the chart (above), continue to Step No. 3. If the manifold pressure does not match the value in the chart and the ball valve is fully or close to fully open, adjust the pressure screw(s) on the Honeywell valve (See **FIGURE 5** and the **CAUTION** on page 15) until the pressure matches the chart. When the manifold pressure measured at the manometer matches the pressure listed in the chart, make a note for future reference of the position of the ball valve stem in relation to the dash marks on the actuator.
3. Reduce the DC volts to 2 volts and allow the ball valve to go to its lowest setting. Check the manifold pressure on the manometer. If the manifold pressure matches the Low Setting value in the chart, skip to Step No. 4. If the manifold pressure does not match the low (0%) value on the chart, the ball valve will need to be adjusted. Follow these steps:
   a) While the unit is still firing at 0% modulation, remove the ball valve actuator. To do this, locate the screw on the rear of the actuator and remove it. Loosen the actuator set screw (See **FIGURE 6,** page 15), and carefully remove the actuator by lifting it straight up. Do not disconnect any wires.
   b) Using adjustable pliers, slowly turn the ball valve stem until the manifold pressure on the manometer matches the low setting on the chart.
   Important NOTE: If the valve is adjusted too far closed and the flame goes out, let the unit recycle and then manually open the ball valve to the 100% open position noted in Step No. 2. When the unit is firing at full fire, re-attach the actuator to the ball valve, and repeat the procedure beginning with Step No. 2.
   c) When the manometer readings match the values in the chart and before re-installing the actuator, the burr left on the ball valve stem from the previous set screw setting needs to be removed. Either lightly file the burr on the valve stem to prevent the set screw from returning to the previous position or remove the valve stem, rotate it 180° so that the set screw contacts the opposite side of the stem, and re-install the valve stem.
   d) Re-install the actuator making sure it is level on the ball valve mounting plate.
   e) Re-check the setting by going to full fire (Set **DC volts to 10 volts**) and then returning to 2 volts. Measure the manifold pressure. The adjusted gas pressure should be close to the value on the chart. If not, repeat the procedure.
4. When the settings are in agreement with the chart and testing is complete, remove the manometer. Remove the wire leads from the DC volt generator and replace the thermostat or FX06 control wiring.

Gas Manifold Transducer - part of Gas Control Options AG58 or D12G

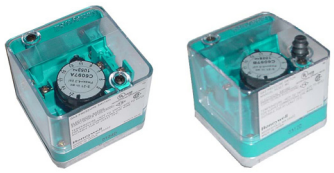


Location: See FIGURE 4, page 14 .

Function: With Option AG58 or D12G gas control, the transducer reads the manifold pressure and sets the venter motor speed to precisely match the designed combustion settings.

Service: If the transducer needs to be replaced, use only a factory-authorized replacement part designed for the purpose.

Optional Gas Pressure Switches



Location: Low pressure switch is at the entrance to the gas train. The high pressure switch is at the burner end.

Function: To monitor gas pressure and shut down the heat section if gas pressure becomes too low or too high. The low pressure switch is an auto reset type and is set at 50% of the maximum manifold pressure. The high pressure switch requires manual reset and is set at 125% of manifold pressure.

Service: There are no replaceable parts and the settings are non-adjustable. If replacement is required, use identical factory-authorized safety switches.

3.4.6 Venter Motor, Wheel, and Pressure Sensing Tap

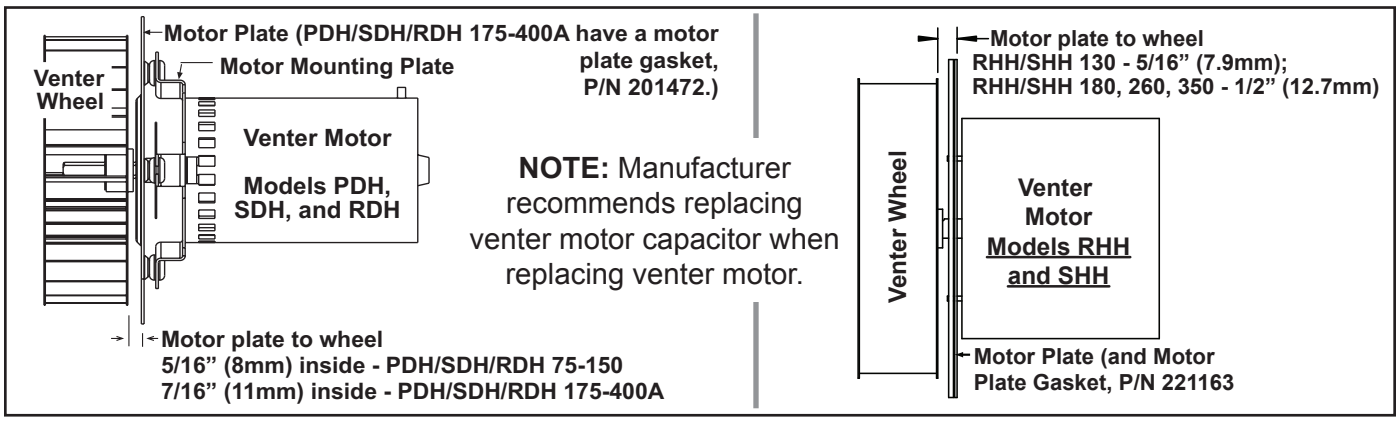
Remove dirt and grease from the motor casing, the venter housing, pressure sensing tap, and the venter wheel. Venter motor bearings are permanently lubricated.

Follow these instructions for replacement of the venter motor and wheel assembly. Keep all hardware removed to be used in re-assembling and installing the replacement parts.

Venter Motor and Wheel Assembly Replacement Instructions

1. Turn off the gas and disconnect the electric power.
2. Open the burner/control compartment door panel.
3. Disconnect the two or three venter motor wires at the DSI control or the venter speed control board, capacitor wires at the capacitor (if applicable), and ground screw (located on the control panel).
4. Holding the venter motor, remove the three, four, or six screws that attach the venter motor mounting plate to the venter housing. Remove the motor and wheel assembly from the heater.
5. Re-assemble with the replacement venter motor and wheel assembly. See **FIGURE 7,** for correct spacing. If there is a motor plate gasket, check it. If the gasket is damaged, replace it.

FIGURE 7 - Venter Wheel Position on Shaft



6. Follow the wiring diagram to connect the venter wires.
7. Close the door panel. Restore power to the heater and turn on the gas. Light, following the instructions on the lighting instruction plate. Check for proper operation.

Vent Temperature Limit Switch - RHH & SHH



P/N 221158

Function: The vent temperature limit switch is a manual reset, temperature activated safety control. Its purpose is to prevent the vent gas temperature from exceeding a temperature that will harm the PVC vent pipe. Setpoint is 145°F.

Service: If the vent temperature limit switch is activated, identify and correct the cause before resetting the switch. The switch could be activated by one or more of the following:

3.0 Maintenance Procedures (cont'd)

3.4 Gas-Fired Heat Section - PDH, SDH, RDH, SHH (cont'd)

3.4.6 Venter Motor, Wheel, and Pressure Sensing Tap (cont'd)

Vent Temperature Limit Switch (cont'd) - Models RHH & SHH

- Manifold gas pressure is too high
- The heat content of the fuel is too high
- Reduced circulating airflow due to dirty and/or plugged air moving components
- Excess dirt on the heat exchangers
- Failed heat exchanger (s)

Location: On the side of the venter housing.

3.4.7 Combustion Air Pressure Switch



Function: Monitors flow of combustion air.

Service: If it is determined that the pressure switch needs replacing, use only the factory-authorized replacement part that is designed for the model and size of heater being serviced. Two-stage units with a two-speed venter and units with electronic modulation have two pressure switches. **NOTE:** A single-stage or two-stage unit operating above 6000 ft elevation requires a high altitude high speed pressure switch.

Location: See **FIGURE 1A,** page 5, for location.

P/N's & Settings - Models SDH, PDH, RDH				
SDH, PDH, RDH Size	**High Speed** (applies to all gas controls)		**Low Speed** (applies only to units with gas controls using a 2-speed venter)	
	Switch P/N	Setting (" w.c.)	Switch P/N	Setting (" w.c.)
75	197030	0.4	**205442**	0.2
100	197030	0.4	**205444**	0.3
125	196388	0.5	**205444**	0.3
150	197028	0.7	**205444**	0.3
175	201158	1.1	**197030**	0.4
200	201158	1.1	**197030**	0.4
225	201158	1.1	**197030**	0.4
250	201158	1.1	**197030**	0.4
300	201158	1.1	**197030**	0.4
350	201158	1.1	**197030**	0.4
400A	201158	1.1	**197030**	0.4

P/N's & Settings - RHH & SHH		
RHH/ SHH Size	**High Speed** (applies to all gas controls)	
	Switch P/N	Setting (" w.c.)
130	**201161**	1.3
180	**201161**	1.3
260	**201159**	1.4
350	**221228**	2.3

3.4.8 High Temperature Limit Control

Sizes 75-150, **P/N 210854**
Sizes 175-225, **P/N 210855**
Sizes 250-400, **P/N 211066**



Function: The limit control is an automatically reset, temperature activated safety control with a capillary sensor. Sensor is extended across the heater discharge.

Service: If it is determined that the limit control needs replacing, use only a factory-authorized replacement part that is designed for the size of heater.

Location: For switch location, see **FIGURE 1A,** page 5.

3.4.9 Vent or Vent/ Combustion Air System

Check the complete system at least once a year. Inspection should include all joints, seams, concentric adapter box (Model SDH), combustion air inlet opening, and the vent terminal cap. Clean openings. Replace any defective parts. Refer to the venting manual for requirements.

On a Model SHH, clean the vent condensate drain. After cleaning, fill the trap with water.

3.4.10 Heat Section Condensate Drain(s)

At the beginning of the cooling season or more often if needed, clean the heat section condensate drain(s). (Models PDH, SDH, and RDH will have none or one. Model SHH will have one or two.) Before starting the unit, fill traps with water to ensure proper operation. If condensate drain is not needed in the winter, drain the trap before heating season. If condensate drain is used in below freezing temperature, provide a means of freeze protection.

3.5 Electric Heat Section - Models PEH, REH

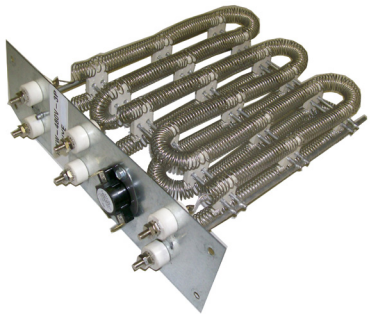
WARNING

Turn off the power locking the disconnect switch. Allow the heating elements to cool.

CAUTION: Wearing eye protection is recommended when cleaning the heating elements and cabinet.

3.5.1 Electric Heating Elements

Single Heating Element
(Each heat section includes an assembly of single elements.)



Service: Check the heating elements at the beginning of the heating season. Carefully clean all dust and dirt from the heating elements using a brush or steel wool. With a vacuum or air hose, clean the inside of the cabinet especially the bottom and sides where dirt and dust will accumulate.

If a replacement is needed, order a complete heat section assembly (5kw single phase or 10kw three phase).

Location: See the control location illustration in **FIGURE 1B and 1C**, pages 6 and 7.

Service: The electric heat section has a transformer, relay, digital controller, contactors, fuses, and a distribution block.

Quantities and types of fuses and contactors depend on the size of unit.

If the electric heat section has SCR control (Option D12D), the controller(s) with heatsink are positioned as shown in **FIGURE 1C**.

DANGER

High voltages are present on the terminals of the SCR power controller(s).

If replacements are required, check with your distributor and use only factory-authorized parts.

3.6 Dampers and Controls

Reference NOTE: Codes for electrical options are listed on the wiring diagram.

Inlet Air Dampers

Location: Dampers and damper motors are located in either the blower section (Option AR8) or the optional mixing box (GE Options).

Function: Dampers operate in response to the control selected. Damper controls are shown below.

Service: Clean dampers and controls of dust and dirt.

2-Position Damper Motor (Options AR8 and GE 3, 6, 7)

Damper Motor



Function: The 2-position damper motor opens and closes the dampers in response to unit operation, a system switch, or a field-supplied time clock.
Motor closes dampers on heater shutdown.

Service: There is no service required on this motor other than external cleaning. If the motor needs replaced, replace with an identical damper motor or damper motor replacement kit.

Modulating Motor (Options GE 4, 8, 10, 11, 12, 13, 14, 15, 16, 21, 22)

Function: The modulating damper motor actuates the dampers in response to discharge air temperature, building pressure, or DDC control. Some options have damper "stops" or warmup (or cooldown) delay based on return air temperature. Motor closes dampers on heater shutdown.

Service: There is no service required on this motor other than external cleaning. If the motor needs replaced, replace with an identical damper motor.

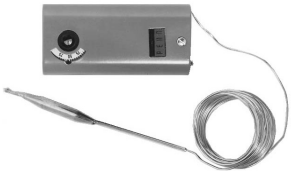
Potentiometer, P/N 16110



Potentiometer (adjustable damper dial) (Options GE 4, 8, 10, 14)

Function: The potentiometer is a manually set switch used with modulating dampers to set a minimum outside air damper opening. Depending on the option selected, it is either mounted in the mixing box or remotely located.

Service: If the potentiometer needs replaced, replace it with an identical switch.



Return Air Controller, P/N 126170

Return Air Controller (Options GE 7, 13, 14)

Function: The return air controller senses the temperature of the incoming return air. On a two-position outside air damper system, it activates the motor to open and close the outside air damper. On a modulating system, the return air controller maintains 100% return air until the set temperature is reached at which point the mixed air controller (with or without potentiometer) controls the dampers based on the mixed air control setting. When in the heating mode, the temperature of the "mixed" return and outside air entering the heater must always be 35°F or above.

Service: If the controller needs replaced, replace it with an identical control.

3.0 Maintenance Procedures (cont'd)

3.6 Dampers and Controls (cont'd)

Mixed Air Controller, P/N 16109



Mixed Air Controller (Options GE 11, 12, 13, 14)

Function: The mixed air controller senses the temperature of the air entering the heater. It automatically operates the damper motor to modulate the outside and return air dampers based on the temperature setting. When in the heating mode, the temperature of the "mixed" return and outside air entering the heater must always be 35°F or above.

Service: If the controller does not function properly, replace it with an identical control.



Pressure Null Switch, P/N 88052

Pressure Null Switch (Option GE15)

Function: The pressure null switch is a diaphragm operated differential pressure switch used in makeup air applications to control building pressure. It maintains a selected positive or negative pressure setpoint by changing the amount of outside air being introduced to the building through the modulating outside air dampers. As more pressure is required in the building, the pressure null switch activates the damper motor driving the outside air damper towards the full open position and the recirculated air damper towards the closed position. Conversely, as less pressure is required, the switch drives the dampers in the opposite direction.

Service: Check wiring connections and sensor tubes. If the controller needs replaced, replace it with an identical control.

Economizer Logic Module, P/N 220637





Enthalpy Sensor, P/N 196290

Economizer Logic Module and Enthalpy Sensor (Options GE 21, 22)

Function: The economizer logic module is used in makeup air cooling applications to control the outside air damper to provide the most economical inlet air mixture. During economizer logic module operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. The economizer logic module is automatically locked out during heating and holds the outdoor air damper at the minimum position setting.

Service: Check wiring connections. If the economizer logic module or sensor needs replaced, replace it with an identical control.

3.7 Optional Cooling Coil Module

WARNING

If equipped with optional ultra-violet light, DO NOT use light for service lighting. Never expose eyes or skin to ultra-violet light.

3.7.1 Cooling Coil

Inspect the cooling coil at the beginning of the cooling season or more often if needed. Open the coil cabinet door. Inspect the coil for debris, dirt, grease, lint, mold, or any element which would obstruct heat transfer or airflow. Inspect coils and tubing for physical damage. Inspect feeders, piping connections, coil headers, and return bends for signs of fatigue, rubbing, and physical damage.

To clean the coils, use the proper tools and follow the instructions carefully to avoid damaging the coil. Use of a non-acid based coil cleaner is recommended. Due to possible damage to the coil, high pressure spray is not recommended.

Instructions:

1. Verify that the electrical power has been turned off and disconnect switch locked.
2. Open the coil cabinet door.
3. Use a soft brush to remove any dirt and debris from both sides of the coil.
4. Spray with cold or warm (not hot) water and a cleaning solution (non-acid based coil cleaner is recommended). Due to possible damage to the coil, high pressure spray is not recommended. First spray the leaving airflow side, then the inlet airflow side. As much as possible, spray the solution perpendicular to the face of the coil. Follow the instructions on the cleaning solution. When cleaning process is complete, rinse both sides with cool, clean water.

3.7.2 Condensate Pan and Drain

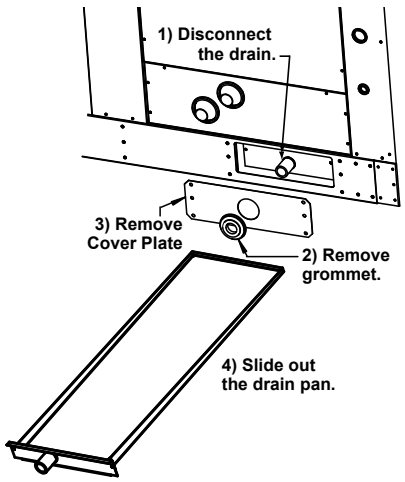
At the beginning of the cooling season or more often if needed, clean the cooling cabinet condensate drain pan, traps, and piping. The drain pan will slide out of the unit for cleaning. To remove the drain pan, disconnect the drain, remove the screws holding the small plate around the drain, remove the grommet, remove the plate, and carefully slide out the drain pan. (See **FIGURE 8**.)

After cleaning, re-install all parts and fill traps with water to ensure proper operation. The combination of airborne particles and moisture in the air handler can result in

algae formation in the drain pan and traps. The drain pan and traps must be cleaned regularly to avoid blockage that can slow or stop water flow, resulting in backup into the cabinet.

FIGURE 8 - Slide Out Drain Pan

NOTE: Indoor unit is illustrated. Outdoor unit is the same except drain is in the bottom panel not the base.



3.7.3 Optional Ultra-Violet Light

WARNING

DO NOT use ultra-violet light for service lighting. Never expose eyes or skin to ultra-violet light.

The ultra-violet light is located in the blower compartment. It has its own power supply. Disconnect all power before performing maintenance or service.

Replace the bulb(s) periodically to maintain design specifications Replace the bulb(s) after 6000 hours of operation or one year, whichever comes first. For best performance, replace the bulb(s) at the beginning of each cooling season.

The bulb(s) should be light blue when lit. If the bulb color changes to red or flickers, replace the bulb. Output can be checked with a UVC radiometer. Replace bulb when output falls to 70% of initial reading.

Use factory-authorized replacement bulb only. Other bulbs may plug into the fixture but could cause overheating and should not be used.

3.7.4 Optional Reheat Module

Reheat Module Coils - Follow the instructions in Paragraph 3.7.1 to clean the reheat module coils.

Reheat Module Compressor Maintenance and Replacement

Compressor Handling Do not lift compressor by copper tubing. To prevent internal damage, compressors ***must ALWAYS be held upright.***

DANGERS

The reheat circuit is a high pressure system. Hazards exist that could result in personal injury or death. It is therefore required that the removal and installation of this scroll compressor be performed by a technician qualified in R410A refrigerant. See Hazard Intensity Levels, page 2.

Never use oxygen to pressurize a refrigeration system. Oxygen can explode on contact with oil and could result in personal injury or death. When using high pressure gas such as nitrogen for this purpose, ALWAYS USE A PRESSURE REGULATOR that can control the pressure down to 1 or 2 psig. Failure to use a regulator will result in extremely high pressure which could exceed the burst pressure of the compressor or other system components and result in personal injury or death. See Hazard Intensity Levels, page 2.

WARNING

For your safety, wear eye protection, gloves, and protective clothing when handling refrigerant and oil and when brazing. Have a fire extinguisher nearby. See Hazard Intensity Levels, page 2.

3.0 Maintenance Procedures (cont'd)

3.7 Optional Cooling Coil Module (cont'd)

3.7.4 Optional Reheat Module (cont'd)

Refrigerant System Maintenance

The following instructions include major points of consideration that will ensure proper installation and protect you from potential personal injury. Please use the following 13 Steps as a checklist, taking each item in order before proceeding to the next. If more information is required, contact the Factory Distributor.

DANGER

To avoid electrical shock, power to the compressor MUST REMAIN OFF during performance of Steps 1 through 9 below. LOCK DISCONNECT SWITCH OFF (open).

☐ ***Step 1*. Verify Proper Application**

Verify that the replacement compressor is identical to the model being replaced. All system components are matched to the compressor. Replacing a compressor with a model other than the manufacturer specified replacement for these PREEVA® units will void the product warranty. See part numbers for R410A reheat pump compressors listed in the table below.

☐ ***Step 2*. Determine Cause of Initial Failure and Remove the Compressor**

In order to prevent a second failure, the cause of the original failure must be determined. Identify the cause and make the necessary repairs.

CAUTION: DO NOT LIFT compressor by copper tubing; damage will occur. Compressor must remain upright.

WARNING

Wear eye protection and gloves when handling refrigerant or oil and when brazing.

a) BEFORE REMOVING THE FAULTY COMPRESSOR, remove refrigerant charge using proper recovery procedures. Call 1-800-441-9450 for the name of the nearest Dupont authorized distributor or 1-800-ASK-KLEA (IGI) for information on their refrigerant reclaim programs.

b) Disconnect wires. All compressor wiring is connected using a black molded plastic plug. Remove the plug from the compressor.

c) Open access ports so that pressure does not build up in the system. Before unbrazing stubs from the compressor, cut suction and discharge tubing with a tubing cutter.

Replacement Scroll Compressors for Reheat Module (R410A Refrigerant) **IMPORTANT: The Model of the replacement compressor MUST BE IDENTICAL to removed compressor.**	SDH, PDH, RDH	SHH, RHH	PEH, REH	PXH, RXH	ARI Tonnage	Voltage	Compressor Model*	P/N
	75, 100, 125, 150, 175, 200, 225	130, 180	10A, 20A, 40A, 15B, 30B, 60B	000A, 000B, 000C	2.4	208-240/1/60 (AK2 and AK3)	ZP29K5E-PFV	**216673**
						208-240/3/60 (AK5 and AK6)	ZP29K5E-TF5	**216674**
						460/3/60 (AK7)	ZP29K5E-TFD	**216675**
						575/3/60 (AK8)	ZP29K5E-TFE	**234055**
	250, 300, 350, 400A	260, 350	30D, 60D, 90D, 120D, 40E, 80E, 120E	000D, 000E	4.8	208-240/1/60 (AK2 and AK3)	ZP57K3E-PFV	**216685**
						208-240/3/60 (AK5 and AK6)	ZP57K3E-TF5	**216686**
						460/3/60 (AK7)	ZP57K3E-TFD	**216687**
						575/3/60 (AK8)	ZP57K3E-TFE	**216688**

*Model No. of replacement R410A scroll compressor must be identical to the one removed including the **"E"** (ZP29Kx**E**-xxx) which indicates POE compressor oil.

WARNING

Have a fire extinguisher near. The compressor contains oil. There is a risk of fire when unbrazing stubs.

Use a high temperature torch to disconnect the suction line and the discharge line from the compressor.

d) Remove the mounting bolts and the compressor. Save the mounting hardware to attach the grommets and sleeves shipped with the replacement compressor.

e) To test for acid and to assure excess oil does not remain in the circuit, remove oil from the failed compressor. Measure the amount of oil.

CAUTION: In addition to the required eye protection and gloves, care should be taken in handling POE oil because it may cause damage to certain plastics and roofing materials. See Hazard Intensity Levels, page 2.

If the oil taken from the compressor and measured is found to be significantly lower than listed in the table below, clean the excess oil through use of suction and liquid line filter driers. **Beginning in Step 4, follow the same procedure as for burnout cleanup.**

Use an acid test kit to check the oil for acid. **If acid is found, beginning in *Step 4*, follow procedures indicated for burnout cleanup**.

Dispose of oil and compressor using an approved environmentally safe disposal method.

Compressor Oil Charge		
PDH/SDH/RDH	75/100/25/150/175/200/225	250/300/350/400A
SHH/RHH	130/180	260/350
PXH, RXH	000A/000B/000C	000D/000E
PEH/REH	10A/20A/40A/15B/30B/60B	30D/60D/90D/120D/40E/80E/120E
Compressor	**ZP29K**	**ZP57K**
POE Oil (oz.)	**21**	**52**

☐ *Step 3*. Mount the Replacement Compressor

Do not remove the dust cover or rubber shipping plugs until all other system connections are complete (i.e. new liquid line filter drier(s) installed and all tubing changes made - see *Steps 4 and 5*). The amount of time the compressor is open to the atmosphere must be kept to a minimum.

Use the new mounting grommets and sleeves that are shipped with the compressor to mount it. The sleeves will prevent over compression of the grommets. Re-use the mounting bolts from the compressor that was removed. The mounting bolts will bottom out when tight.

☐ *Step 4.* Install New Filter Drier(s) (Select procedure that applies.)

IF the oil measured in Step 2 was not significantly less than the amount shown in the table or the test for acid in ***Step 2* did NOT indicate burnout** , install a new R410A refrigerant liquid line filter drier. The filter drier must be rated for no less than 600 psig and be the proper size for the circuit. Because R410A refrigerant requires POE oil which absorbs moisture quickly, it is important to change the filter drier any time the circuit is opened.

It is recommended to use a tubing cutter when cutting out a filter drier as the desiccant absorbs and holds moisture better when it is cool. Heat from a torch may cause moisture to leave the filter and be absorbed in the oil.

Continue to ***Step 5***.

IF the oil measured in ***Step 2*** was significantly less than shown in the table or the test for acid in ***Step* 2 did indicate compressor burnout**, do the following:

a) Install a liquid line filter drier. **If there is acid**, install an acid removing filter drier. Size the acid-removing filter drier at least one capacity size larger than normally required for the circuit.

b) Install a temporary filter drier in the suction line. When there is acid, a 100% activated alumina suction filter drier is recommended. The suction line drier should be sized properly for the circuit and have a service access fitting to monitor pressure drop across the drier. (**NOTE**: Suction line filter drier must be removed after 72 hours of operation.)

Step 12 includes the remaining procedures required for cleanup of a burnout. Continue to ***Step 5***.

☐ *Step 5.* Braze on Suction and Discharge Lines

CAUTION: Do not leave system open to the atmosphere any longer than minimum required for installation. POE oil in the compressors is extremely susceptible to moisture absorption. Always keep ends of tubing sealed during installation. See Hazard Intensity Levels, page 2.

Reheat Module Compressor Maintenance and Replacement (cont'd)

Brazing materials must be able to withstand the high pressure of R410A refrigerant. A high temperature, silver phosphate type brazing with 5% or greater alloy is recommended.

To prevent oxidation, purge tubing with 2-3 psig of regulated dry nitrogen while it is being brazed. After the unit has been properly leak tested, the nitrogen remaining in the circuit can be used as part of the purge while brazing. Open the service valve as needed to release the nitrogen. Do not allow moisture to enter the system.

The installer is responsible for brazing and for complying with appropriate standard refrigerant piping procedures.

CAUTION: All brazing should be done using a 2 to 3 psig dry nitrogen purge flowing through the pipe being brazed. See Hazard Intensity Levels, page 2.

CAUTION: Do not open the service valves until after the condenser unit circuits are leak tested. See Hazard Intensity Levels, page 2.

CAUTION: When brazing, protect all painted surfaces and components from excessive heat. Wet wrap all valves but do not allow moisture to enter the tubing. See Hazard Intensity Levels, page 2.

☐ *Step 6*. Check Reheat Refrigerant Circuit for Leaks

After installation is complete, pressurize the system with helium or dry nitrogen to approximately 150 psi (maximum pressure is 450 psi). Check for leaks using soap bubbles or other leak-detecting methods. Repair as needed to ensure a leak free circuit.

☐ *Step 7*. Evacuate the Reheat Circuit

Use a vacuum pump and micron gauge. The circuit must be evacuated to hold a 500 micron vacuum. Vacuum must be pulled on both the discharge (high) and suctions (low) side. Do the suction side first; and the compressor discharge side second. To establish that a circuit is leak-free and moisture-free, a standing vacuum test is recommended. Close off the valve to the vacuum pump and observe the micron gauge. If the vacuum gauge does not rise above 500 microns in one minute, the evacuation should be complete. If the vacuum gauge does rise above 500 microns in one minute, evacuation is incomplete or the system has a leak. Repeat as needed until evacuation is complete.

NOTE Evacuation will not remove moisture from POE oil. Moisture must be prevented from getting in the oil.

Continue and/or repeat ***Steps 6 and 7*** until evacuation is complete.

CAUTION: Do not use the replacement compressor as an evacuation assist and *never* apply voltage to a compressor while it is in a vacuum. See Hazard Intensity Levels, page 2.

Moisture and air are harmful to the system because they increase the condensing temperature, raise the discharge gas temperature, cause formation of acids, and cause oil breakdown.

CAUTION: Do not leave a circuit open to the atmosphere any longer than minimum required for installation. POE oil in the compressor is extremely susceptible to moisture absorption. Evacuation will not remove moisture from POE oil. See Hazard Intensity Levels, page 2.

☐ *Step 8*. Check the Electrical System

After the system has been evacuated, reconnect the electrical plug to the compressor or the wires to the compressor terminals. It is a normal practice to replace all starting components any time a compressor is changed.

WARNING

Do not apply voltage to the compressor when the plug is removed or terminals disconnected. See Hazard Intensity Levels, page 2.

Crankcase Heater

Connect the crankcase heater. The crankcase heater is energized continuously and is extremely important to proper compressor operation and long life.

The crankcase heater must be energized for at least 24 hours before starting the unit or after a power outage of more than 8 hours. Be sure to disable reheat controls before turning on power to warmup crankcase heater.

CAUTION: Crankcase heater must be allowed to warm up for at least 24 hours prior to startup. Disable reheat controls before turning on power to warmup crankcase heater. See Hazard Intensity Levels, page 2.

☐ ***Step 9*. Charge the Reheat Pump Circuit (R410A refrigerant only.)**

Follow the instructions below to charge the circuit. R410A refrigerant MUST BE charged as a LIQUID.

NOTE: Outdoor temperature must be between 70-95°F (21-35°C) for verifying superheat and subcooling. If temperature is not within this range, consult the factory service department before charging.

Check the rating plate for the reheat circuit charge. Charge the refrigerant slowly through the gauge port on the liquid line. R410A refrigerant must be charged as a liquid. R410A refrigerant cylinders are rose colored (pink) and have a dip tube for charging liquid from an upright position. If there is no dip tube, verify that the refrigerant is R410A and turn the cylinder upside down.

WARNING

Do not release refrigerant to the atmosphere. When adding or removing refrigerant, the qualified technician must comply with all national, state/province, and local laws.

☐ ***Step 10* . System Startup**

Connect refrigerant pressure gauges and electric meters.

CAUTION: Be sure to connect pressure gauges to the suction and discharge lines before start-up so that compressor rotation can be checked immediately. Scroll compressors will be destroyed if allowed to operate in reverse. See Hazard Intensity Levels, page 2.

Record the ambient temperature. Adjust the system controller so that a call for cooling exists.

NOTE: If the system has digital controls, outdoor ambient lockouts may prevent mechanical cooling. Temporarily override lockouts by lowering the cooling setpoint. (Refer to the digital programmable control instruction manual.) When testing is complete, reset the controller.

Because it is a possible to unknowingly connect 3-phase power in such a way as to cause the scroll compressor to rotate in reverse, it is very important to check this on startup.

Immediately at startup, observe the gauges. If the suction pressure rises and discharge pressure drops, the compressor is operating in reverse and must be shut down. Turn off the power and switch the 3-phase line voltage wiring connections before restarting the unit.

(*Important NOTE:* If allowed to operate for several minutes in reverse, the compressor's internal protector will trip. If a compressor is repeatedly allowed to restart and run in reverse, the compressor will be permanently damaged.)

3.0 Maintenance Procedures (cont'd)

3.7 Optional Cooling Coil Module (cont'd)

3.7.4 Optional Reheat Module (cont'd)

Reheat Module Compressor Maintenance and Replacement (cont'd)

☐ ***Step 11*. Check Circuit Subcooling and Superheat of Reheat Circuit**

PREPARATION:

☐ To verify superheat and subcooling, outdoor temperature must be between 70-95°F (21-35°C). If temperature is not within this range, consult the factory service department before charging.

☐ Operate for 30 minutes for system to stabilize.

Check SUBCOOLING of the Reheat Circuit - Measure and record temperature and pressure of the liquid line at the condenser coil outlet in the reheat circuit.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 38,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Chart (STEP 2)
_____°F (°C) - _____°F (°C) = _____°F (°C) degrees of Subcooling

Recommended reheat circuit subcooling with outdoor temperature range of 70-95°F (21-35°C) is 14-18°F (7.8-10°C).

Too much subcooling indicates a refrigerant overcharge. To reduce the subcooling, remove excess refrigerant. Too little subcooling indicates a refrigerant undercharge. To increase subcooling, slowly add R410A refrigerant.

WARNING

Do not release refrigerant to the atmosphere. When adding or removing refrigerant, the qualified technician must comply with all national, state/province, and local laws.

Determine SUPERHEAT of the Reheat Circuit - Measure and record temperature (insulate probe from surrounding air temperature) and pressure in the suction line at the compressor inlet of the reheat circuit.

STEP 1) Record Measurements: Temperature = _____°F (°C) and Pressure = _____ psig

STEP 2) From **Temperature/Pressure Conversion Chart**, **APPENDIX, page 38,** convert Measured Pressure (STEP 1) to _____°F (°C)

STEP 3) Subtract Measured Temperature (STEP 1) from Temperature from Conversion Table (STEP 2)
_____°F (°C) - _____°F (°C) = _____°F (°C) degrees of Superheat

Recommended reheat circuit superheat at is 8-12°F (4.5-6.7°C).

Typically, too much superheat indicates that the evaporator coil is undercharged. Too little superheat typically indicates that the evaporator coil is overcharged and may potentially flood liquid refrigerant to the compressor. To reduce the superheat, adjust the thermal expansion valve by turning the adjusting stem counterclockwise. To increase the superheat, adjust the thermal expansion valve by turning the adjusting stem clockwise.

☐ ***Step 12*. (Select the procedure that applies.)**

IF the oil measured in ***Step 2*** was significantly less than in the table on page 21 or the acid test in ***Step 2*** indicated a burnout, do the following:

a) Operate the unit for several hours. Check the pressure drop through the

temporary suction line filter drier. If the pressure drop exceeds 8 psig, recover the refrigerant, replace the suction line filter drier with the same type as removed, replace the liquid line filter drier, evacuate the circuit, and re-charge with the recovered refrigerant).

Continue to monitor the pressure drop through the suction line filter drier and repeat the process above until the pressure does not exceed 8 psig after several hours of operation. (NOTE: System must be allowed to run no more than 72 hours with a suction line filter drier.)

b) Allow the system to operate for 4-8 hours. Recover the refrigerant and take an oil sample. Retest the oil for acid.

c) If the test for acid is negative, remove the suction line filter drier, replace the liquid line drier, evacuate, and re-charge the system with the recovered refrigerant.

If the test indicates acid, replace both the liquid line filter drier and the suction line filter drier and repeat b) and c).

CAUTION: After cleanup is complete, remove the suction line filter drier. See Hazard Intensity Levels, page 2.

d) Verify subcooling and superheat (refer to ***Step 11***).

e) When the system is operating properly, remove the gauges.

IF the oil measured in ***Step 2*** was not significantly less than that shown in the table on page 21 or the acid test in ***Step 2*** did not indicate a compressor burnout, continue to the review in ***Step 13***.

☐ ***Step 13*** **. Review *ALL Steps* to ensure that nothing was overlooked.**

3.7.5 Modulating Reheat Control (Option AUR1)

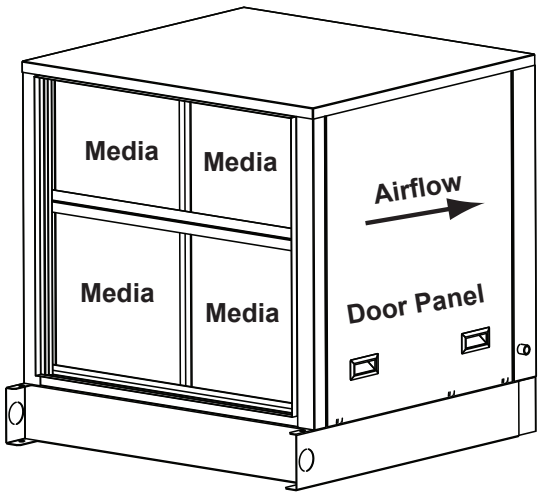
Function: Units with modulating reheat control (Option AUR1) have a temperature control board with a potentiometer, an air temperature sensor, and an electric discharge bypass valve. When reheat is active, the sensor monitors the air temperature as it leaves the reheat coil. Based on the potentiometer setpoint, the board will open or close the bypass valve. If the leaving air temperature is higher than the setpoint, the board will open the valve adding refrigerant hot gas to the refrigerant liquid before it enters the pre-cool coil. This reduces the coil's ability to absorb the heat, and thus, the reheat coil's ability to reject. If the leaving air temperature is lower than the setpoint, the opposite occurs.

Service: Check the wiring connections at the board. The board is polarity sensitive; positive connects to terminal 1 and negative to terminal 2.

The valve may be tested by measuring the resistance of the leads. Remove the power and the leads from the board before testing. Resistance between the black and white leads should be about 75 Ohms. Resistance between the green and red leads should be within 5% of the white and black.

Use only factory-authorized replacement parts.

3.8 Optional Evaporative Cooling Module



When equipped with an evaporative cooling module, the evaporative cooling module is always the first module in system. Air enters the system through the evaporative cooling media.

See the heater installation manual for additional information about the operation of the evaporative cooling module.

3.0 Maintenance Procedures (cont'd)

3.8 Optional Evaporative Cooling Module (cont'd)

WARNING

Disconnect all power to the unit before doing any maintenance. Failure to do so can cause electrical shock, personal injury, or death.

Pre-Filters and Media - Over time, excessive amounts of dirt or mineral deposits may begin to build up on the pre-filters and media. Annually, wash scale and dirt from the metal pre-filters (pre-filters are optional and may not be on your cooler) and the entering surface of the media.

Remove the pre-filters (remove the door and slide out). Clean the metal pre-filters with soap and water and rinse thoroughly.

Clean the entering side of the media using a garden hose, mild soap, and a **soft** bristled brush. When the media becomes too clogged with mineral deposits and dirt that it cannot be cleaned, the pads should be replaced. The average pad life expectancy is approximately three cooling seasons. Order replacement media pads from your distributor.

Qty and Sizes of Evaporative Cooling Media and Pre-Filters

Media - 12" Glacier-Cor® or Glasdek®					
PDH/SDH/RDH	**PEH/REH**	**PXH/RXH**	**RHH/SHH**	**(Qty) Dimensions - inches**	**(Qty) Dimensions - mm**
75, 100	**10A, 20A, 40A**	**000A**	**N/A**	(2) 27-3/32 x 12; (1) 27-3/32 x 7-1/2	(2) 688 x 305; (1) 688 x 191
125, 150	**15B, 30B, 60B**	**000B**	**N/A**	(2) 27-3/32 x 12; (1) 27-3/32 x 5-1/2	(2) 688 x 305; (1) 688 x 140
175, 200, 225	**N/A**	**000C**	**130 ,180**	(2) 36 x 12; (1) 36 x 7-1/2	(2) 914 x 305; (1) 914 x 191
250, 300	**30D, 60D, 90D, 120D**	**000D**	**260**	(3) 36 x 12; (1) 36 x 11-3/4	(3) 914 x 305; (1) 914 x 298
350, 400A	**40E, 80E, 120E**	**000E**	**350**	(4) 36 x 12; (1) 36 x 7-3/4	(4) 914 x 305; (1) 914 x 197

Optional Pre-Filters for Evaporative Cooling Module - 1" or 2" Aluminum Filters							
PDH/SDH/RDH	**PEH/REH**	**PXH/RXH**	**RHH/SHH**	**(Qty) Dimensions - inches**		**(Qty) Dimensions - mm**	
				Top Row	**Bottom Row**	**Top Row**	**Bottom Row**
75, 100	**10A, 20A, 40A**	**000A**	**N/A**	(2) 16 x 12	(2) 16 x 16	(2) 406 x 305	(2) 406 x 406
125*, 150*	**15B*, 30B*, 60B***	**000B***	**N/A**	(1) 16 x 12; (1) 26 x 12	(1) 16 x 16; (1) 16 x 25	(2) 406 x 305; (1) 660 x 305	(1) 406 x 406; (1) 406 x 635
175, 200, 225	**N/A**	**000C**	**130 ,180**	(2) 16 x 12	(2) 16 x 16	(2) 406 x 305	(2) 406 x 406
250*, 300*	**30D*, 60D*, 90D*, 120D***	**000D**	**260**	(3) 16 x 12	(3) 16 x 25	(3) 406 x 305	(3) 406 x 635
350*, 400A*	**40E*, 80E*, 120E***	**000E**	**350**	(1) 16 x 12; (2) 20 x 12	(1) 16 x 25; (2) 20 x 25	(1) 406 x 305; (2) 508 x 305	(1) 406 x 635; (2) 508 x 635
NOTE: Glacier-Cor® and Glasdek® are trademarks of Munters Corporation.							
* These sizes require a filter stop gasket in each row.							

WARNING

Do not expose pump motor or any part of the electrical box to water. Evaporative cooling pump is NOT submersible.

Water Pump and Inlet Basket Screen on a Float and Pump System - Annually, the pump and inlet basket screen should be removed, disassembled, and cleaned.

1. Disconnect the power supply to the unit.
2. Remove the door panel. Disconnect the two-line voltage power supply wires from the terminal block inside the electrical box. See **FIGURE 9**.
3. Disconnect the water feed line hose from the upstream side of the ball valve.

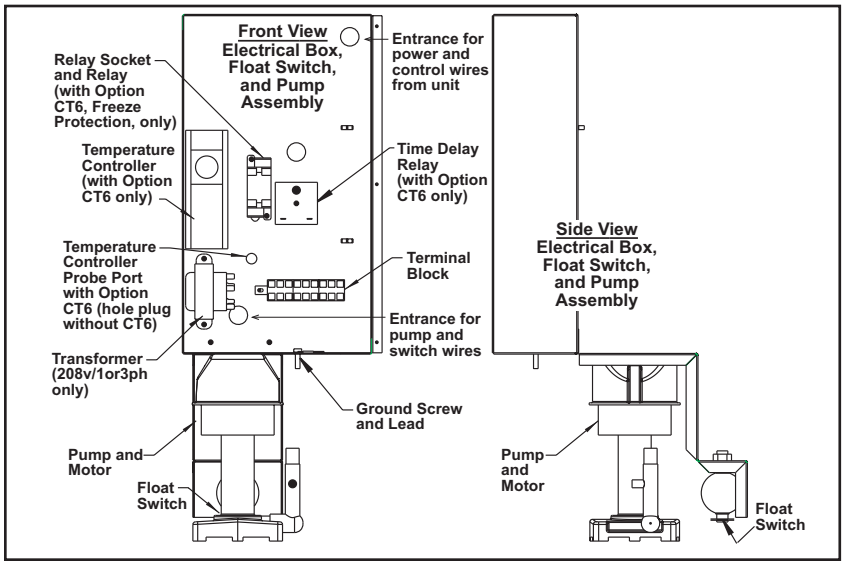


FIGURE 9 - Remove electrical box/pump/ float switch as an assembly. Shown here with Option CT6, Freeze Protection controls.

4. Remove the three sheetmetal screws holding the electrical box to the cooling module. Remove the electrical box/pump/float switch as an assembly.
5. Remove the mesh screen from around the pump and clean any buildup of debris and dirt. Carefully remove the base cover plate from the bottom of the pump. Using a mild soap solution, wash all deposits from the inside of the pump and remove all debris from the impeller.
6. Reassemble the pump. Replace the parts in exact reverse order, being careful that everything is returned to its original position.

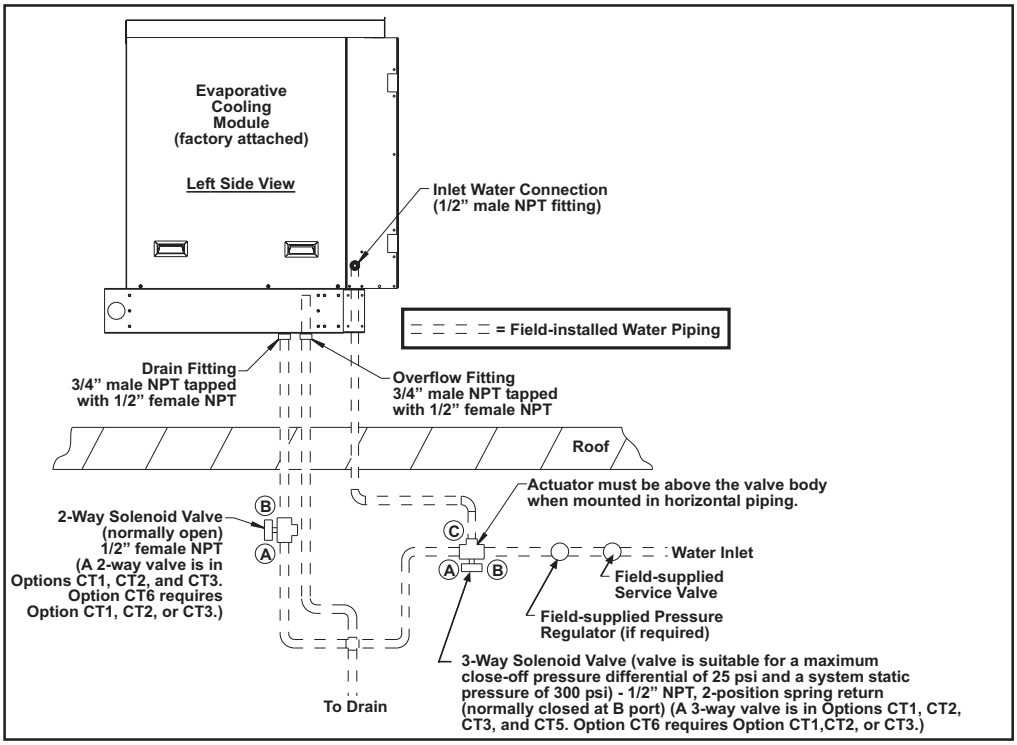
Water Distribution Line - Annually, the water distribution line should be flushed of debris and contaminants.

1. Disconnect the power supply to the unit.
2. Remove the access panel and the media pads.
3. Remove the water feed line from the downstream side of the ball valve.
4. Force a fresh water supply through the water inlet hose to thoroughly flush the distribution line.
5. Reassemble being careful to install media with airflow direction as marked on the media pads.

Troubleshooting the Operation of an Evaporative Cooling Module

PROBLEM	PROBABLE CAUSE	REMEDY
Pump doesn't run (pump & float system) – Unit is calling for cooling (i.e. console control switch is in cool or summer position) and reservoir is full.	**1.** Electrical connections.	**1.** Verify all electrical connections. Verify correct voltage at pump terminals in the junction box. See wiring diagram.
	2. Electric float switch..	**2.** Check position of the actuators on the electric float switch.
	3. Dirty pump.	**3.** Clean pump.
	4. Defective pump.	**4.** Replace pump.
Required water level (3"/76mm) not being maintained (pump & float control system).	**1.** Float valve.	**1.** Adjust float valve..
	2. Optional drain and fill valves.	**2.** Check valves for proper operation.
	3. Drain leaking.	**3.** Tighten drain fittings.
Water running off of media pads.	**1.** Excessive water flow.	**1.** Adjust ball valve in distribution line.
	2. Media pads need cleaned or replaced.	**2.** Clean or replace media pads.
Water not distributing evenly.	**1.** Distribution line clogged.	**1.** Flush distribution line..
	2. Holes in distribution line turned.	**2.** Check position of distribution line. Holes should be spraying upward toward diffuser. If not positioned with holes toward top, adjust position of distribution line.
	3. Pump not running on correct voltage (pump and float control system).	**3.** Check voltage at pump terminal in cooling module junction box.
Media pads becoming clogged and discolored quickly (scale and salt deposits).	**1.** Bleedoff line clogged or inadequate bleedoff (pump and float control system).	**1.** Clean bleed line. A uniform buildup of minerals on the entering air face of the media indicates insufficient bleedoff. Increase the rate until the mineral deposits dissipate.
	2. Excessive water flow.	**2.** Reduce flow by adjusting ball valve in distribution line..
Water blowoff from media pads or water being pulled from reservoir.	**1.** Media pads installed incorrectly.	**1.** Install media pads with airflow as shown on pads.
	2. Water level not 3" (76mm) (pump and float control system).	**2.** See second problem listed (Required water level not being maintained).

FIGURE 10 - Water Connection and Field-Installed Fill and Drain Valves for Pump and Float System and Freeze Protection Kits

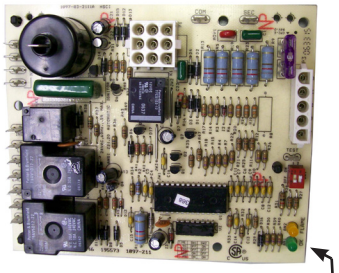


3.0 Maintenance Procedures (cont'd)

3.9 Hot Water Heat - applies only to Model PXH or Model RXH with Option HW2 Hot Water Heat Module

The closed hot water system requires a proper water treatment program with regular water analyses, adequate regulated drains, and periodic inspection. Check for dirt or debris that could inhibit airflow. Clean with low pressure air blower or water. Follow the coil and control manufacturer's instructions for maintenance and service.

4.0 Troubleshooting



Lights

IMPORTANT: When using a multimeter to troubleshoot the 24 volt circuit, place the meter's test leads into the 5 or 9 pin connectors located on the ignition control. Do not remove connectors or terminals from the electrical components. Doing so can result in misinterpreted readings due to the ignition control board's fault mode monitoring circuits.

4.1 Check the Lights on the DSI Integrated Control Module (Circuit Board) - PDH, SDH, SHH, RHH, and RDH

NOTE: Applies to all models listed and all sizes except Model RDH 175-400A Model RHH, and Model SHH **with** Gas Control Option AG58 or D12G (See Paragraph 4.2.)

The integrated circuit board monitors the operation of the heater and includes two LED signal lights that indicate normal operation and various abnormal conditions. If the heater fails to operate properly, check this signal to determine the cause and/or to eliminate certain causes. LED is visible through viewport on Models SDH and SHH. Open the door panel on Models PDH and RDH.

Do not attempt to repair the DSI integrated control module; the only field replaceable component is the fuse.

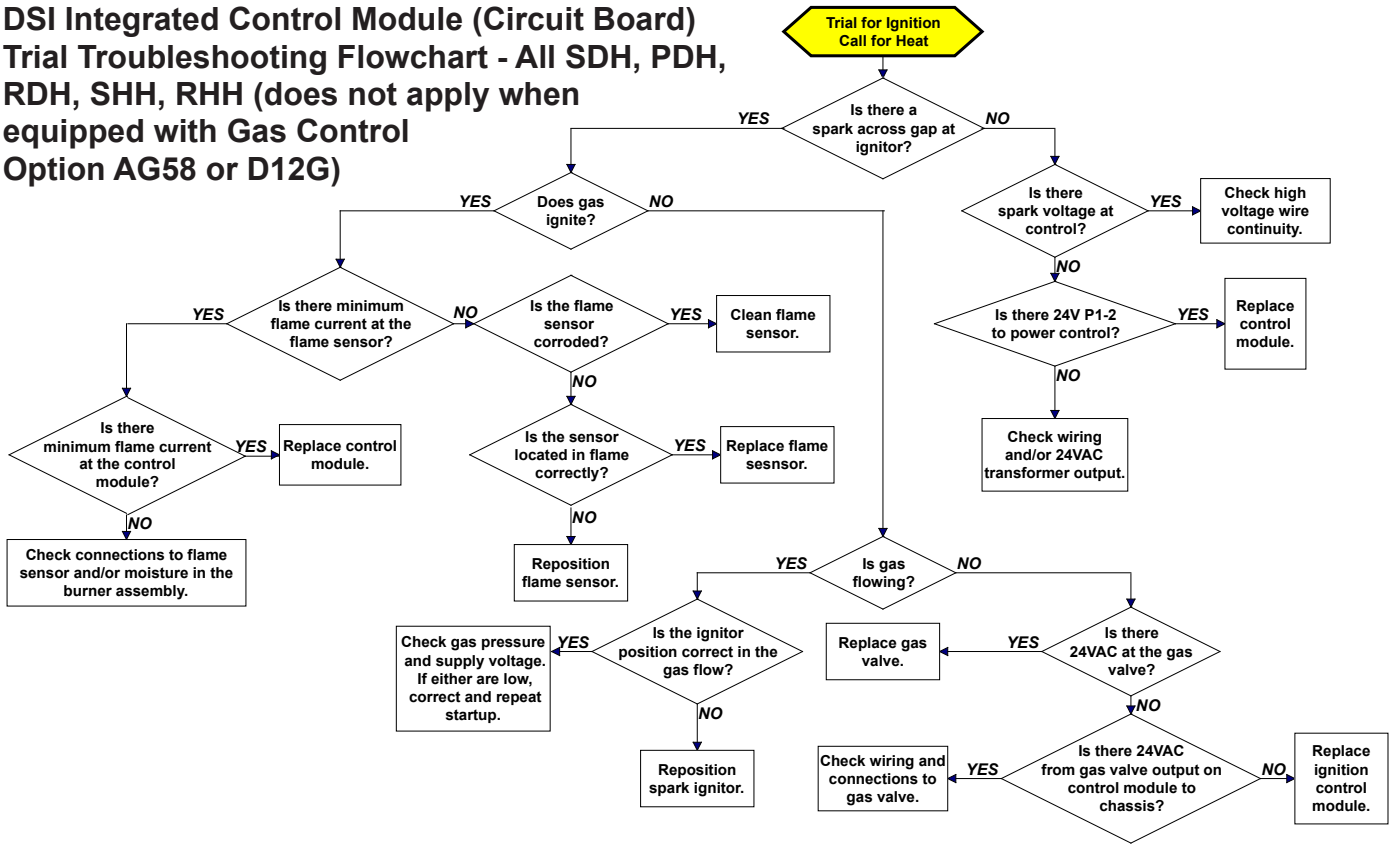
Control Status - Green LED Codes

Steady ON .... Normal Operation, No call for heat
Fast Flash ..... Normal Operation, Call for heat
1 Flash ..... System Lockout, Failed to detect or sustain flame
2 Flashes ..... Pressure Switch Did Not Close within 30 Seconds of Venter Motor
3 Flashes ..... High Limit Switch Open
4 Flashes ..... Pressure switch is closed before venter motor is energized
Steady OFF .. Blown Fuse, No Power, or Defective Board

Flame Status - Yellow LED Codes

Steady ON .... Flame is sensed
Slow Flash .... Weak flame (current below 1.0 microamps ±50%)
Fast Flash ..... Undesired Flame (valve open and no call for heat)

DSI Integrated Control Module (Circuit Board) Trial Troubleshooting Flowchart - All SDH, PDH, RDH, SHH, RHH (does not apply when equipped with Gas Control Option AG58 or D12G)

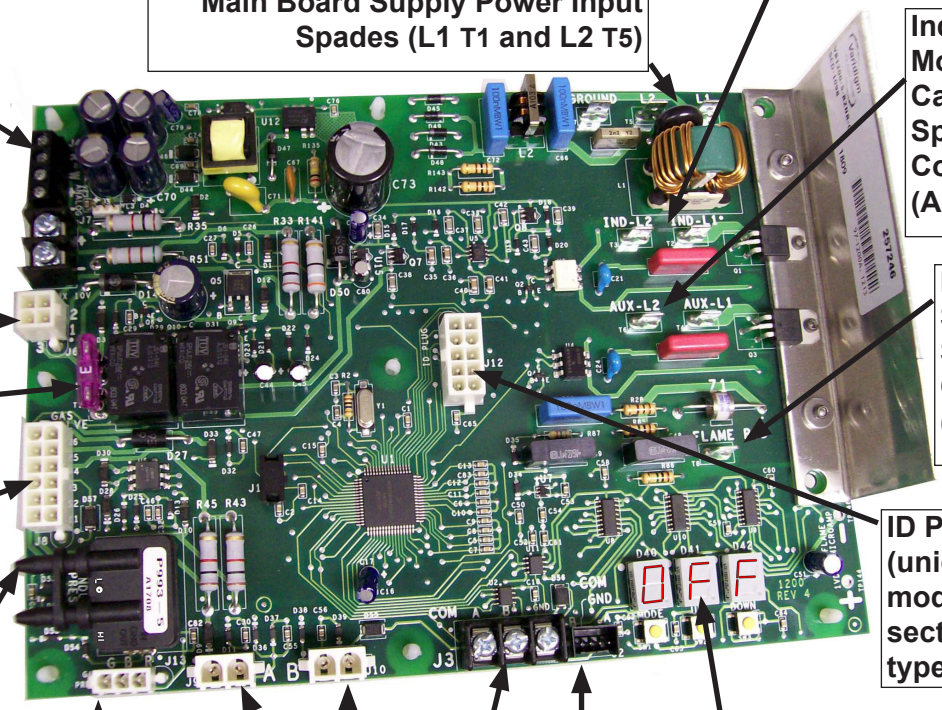


4.2 Troubleshooting - Modulating Control Module used on Model RDH Sizes 175-400, Model RHH, or Model SHH with Gas Control Option AG58 or D12G

The control that operates the furnace has a built-in, self-diagnostic capability. The control continuously monitors its own operation and the operation of the system. The LED on the control indicates the current state, warnings, failures, and test modes.

Normal Furnace Operation Display		
LED Display	Heat Mode	Description
OFF	OFF Mode (OFF)	System Idle - Control board has power, no faults found, no call for heat.
Pur	PURGE Mode (Pur)	System is purging the heat exchanger – No gas on, no flame, venter motor runs for the specified purge timings. Purge cycles occur immediately before and after each burner operation.
Ign	IGNITION Mode (Ign)	System is initiating burner operation – Ignitor energized, modulating valve moved to ignition setting, gas on. Maintained for the trial-for-ignition period and the five-second flame stabilization period.
HEA	WARM-UP Mode (HEA) (Board Self Check)	Period between Ignition and Run – System checks completed before modulation control begins.
run	RUN Mode (run)	Normal modulating operation.
rEt	Ignition Retry (rEt)	System has had a failed ignition attempt or has lost flame during burner operation and is beginning another ignition cycle.

Deep Modulation (Option AG58 and D12G) Ignition Board is in the Control Compartment (See FIGURE 1A, page 5.)



Inducer Motor Main Power Connection Spades (IND-L2 T3 and IND-L1 T2)

Main Board Supply Power Input Spades (L1 T1 and L2 T5)

Inducer Motor Capacitor Spade Connection (AUX-L2 T6)

Contactor Signal Input Terminals (J4)

Board Power and Signal (J6)

Flame Sensor Spade Connection (T8)

Control Board Fuse (3A)

Plug Connection for Board Control Points (J8)

- **Ball Valve Actuator Power, Drive Voltage, and Feedback Signal**
- **Off Board Digital Venter Air Pressure Switch and Unit Primary Limit Switch**

ID Plug (unique by model, heat section size, & type of gas)

J9, J10, J3, and J2 are not currently used.

3 Character LED Display used to show deep modulation board codes for status, alarm, and error information.

Gas Manifold PSI Transducer Plug 3-wire (red, black, and green) Wiring Connection (J13)

On board Air Pressure Sensor for Monitoring Inducer Pressure.

Venter Sensing Tubing is connected from Venter housing to "LO" pressure input point on air sensing transducer.

4.2 Troubleshooting - Modulating Control Module used on Model RDH Sizes 175-400, Model RHH, or Model SHH with Gas Control Option AG58 or D12G (cont'd)

Gas Heat Section Modulating Control Option AG58 or D12G FUNCTIONAL ALERTS

Code	Alert	Description	Probable Causes	Solutions
A01	Failed ignition attempt (AO1) *Maximum number of allowed retries not met*	The flame could not be established during the trial for ignition period. This alert indicates the maximum number of retries has not been exceeded and furnace operation will continue with another ignition attempt.	See E08 in the LOCKOUT ERRORS section, pages 33-34.	See E08 in the LOCKOUT ERRORS section, pages 33-34.
A02	Lost Flame (AO2)	The flame sensor signal has been lost after flame is established during a call for heat. This alert is displayed during the RECYCLE period prior to the next ignition attempt.	A. Flame sensor coated	1. Clean flame rod sensor.
			B. Flame sensor improperly mounted or grounded	1. Check flame sensor wiring integrity and ceramic for cracks.
				2. Re-install / replace flame sensor.
			C. Unstable flame pattern	1. Verify that the spacing between the burner body and the burner shield is equal across the entire length of the burner.
				2. Check that the seals between the heat exchanger header and heat exchanger tubes are sound; refer to Paragraph 4.1.1.
				3. Ensure that the heat section door gasket is in place and the doors are properly aligned
			D. Insufficient intermediate gas manifold pressure through main gas safety valve	1. Check for faulty gas valve wiring.
				2. Check 24 VAC to gas valve assembly.
				3. Check inlet pressure to safety gas valve.
				4. Check outlet pressure from the safety gas valve.
				5. Replace safety gas valve if faulty.
			E. Insufficient gas manifold pressure to burner through modulating ball valve assembly	1. Check voltage to gas valve actuator. (2-10 VDC depending on model)
				2. Check alignment and set screw connection between ball valve and actuator. See Paragraph 4.3.
A03	Insufficient Combustion Air (AO3) *Furnace functional*	Furnace cannot achieve desired combustion air flow due to blockage or high altitude operation resulting in a de-rate of the furnace.	A. High altitude operation	1. Normal operation. Furnace automatically de-rates for high altitude conditions.
			B. Partially blocked vent	1 Check air inlet and outlet for blockage.
				2. Check venting configuration for excessive venting length, improper sizing, etc.
			C. Leak in sensing hose	1. Check sensing hose for cracks, crimps, or loose connections.
			D. Low Line Voltage	1. Check the line voltage to the control board. Voltage should be within 10% of nameplate.
			E. Faulty venter assembly	1. Verify that the venter assembly is functioning properly by referring to the sensing pressure chart on page 16..
A04	Limited Low Fire (AO4)	Automatic adaptive program is currently limiting the lower range of modulation to avoid flame loss at minimum fire conditions. The alert is displayed during the run cycle once a flame-out condition has triggered the Limited Low Fire function. This function is reset by cycling power to the board.	A. Low gas line pressure	1. Ensure gas supply is connected to furnace and check for proper line pressure.
			B. Insufficient intermediate gas manifold pressure through gas safety valve	1. Check for faulty gas valve wiring.
				2. Check 24 VAC to gas valve assembly.
				3. Check inlet pressure to safety gas valve.
				4. Check outlet pressure from the safety gas valve – adjust as needed.
				5. Replace safety gas valve if faulty.
			C. Faulty burner operation	1. Check burner orifice for proper size and blockage.
			D. Faulty flame sensor	1. Check flame rod wiring and connections.
				2. Check for proper alignment of flame rod.
				3. Clean flame rod sensor.
			E. Improper alignment of the modulating actuator and the gas ball valve.	1. Check that the alignment of the actuator to the ball valve is correct. The valve must be in the fully open position when the actuator is energized (ACTUATOR DRIVE = 9.6 VDC or greater).
				2. Ensure that the setscrew on the actuator is tightened to the ball valve stem.
			F. Blocked or improper venting	1. Check air inlet and outlet for blockage.
				2. Check venting configuration for excessive venting length, improper sizing, etc.
A05	Weak Flame Signal (AO5)	The flame signal level is less than optimal for this furnace. Maintenance of the flame sensing components is advised.	A. Flame sensor coated	1. Clean flame rod sensor.
			B. Flame sensor improperly mounted or grounded	1. Check flame sensor wiring integrity and ceramic for cracks.
				2. Re-install / replace flame sensor.
			C. Unstable flame pattern	1. Verify that the spacing between the burner body and the burner shield is equal across the entire length of the burner.
				2. Check that the seals between the heat exchanger header and heat exchanger tubes are sound; refer to Paragraph 4.1.1.
				3. Ensure that the heat section door gasket is in place and the door is properly aligned.

Gas Heat Section Modulating Control Option AG58 or D12G LOCKOUT ERRORS

Code	Alert	Description	Probable Causes	Solutions
888	Ignition Board Failure (888)	Ignition board start-up checks have detected an error.	A. Faulty transformer	1. Check 24-volt transformer for correct output.
				2. Check connections and wiring to control board and other components connected to the 24 volt source.
				3. Replace if necessary.
			B. Faulty control board	1. Turn off power to the furnace, wait 30 seconds and turn power back on. Re-try ignition sequence and see if the system responds.
				2. Replace control board if necessary.
E01	Failed Ignition (EO1) *Maximum Retries (3) Exceeded*	The flame could not be established during multiple trial-for-ignition periods (3). The maximum number of retries has been exceeded and the furnace is in a lockout condition.	A. Insufficient gas line pressure	1. Insure gas supply is connected to furnace and check for proper line pressure.
			B Gas valve control turned “OFF”	1. Turn gas valve to the “ON” position
			C. No spark from direct spark ignition	1. Check ignition voltage (115 VAC from board to transformer) and wiring.
				2. Check 24 VAC transformer for DSI board.
				3. Reverse polarity on 2-wire plug feeding the spark board.
			D. Insufficient intermediate gas manifold pressure through gas safety valve	1. Check for faulty gas valve wiring.
				2. Check 24 VAC to gas valve assembly.
				3. Check inlet pressure to safety gas valve.
				4. Check outlet pressure from the safety gas valve – adjust as needed.
				5. Replace safety gas valve if faulty.
			E. Insufficient gas manifold pressure to burner through modulating ball valve assembly	1. Check voltage to gas valve actuator. (7 - 10 VDC depending on model)
				2. Check alignment and setscrew connection between ball valve and actuator (See procedure in Paragraph 4.3.).
			F. Burners do not light	1. Check spark rod assembly for proper location, spark gap, etc.
				2. Verify that the spacing between the burner body and the burner shield is equal across the entire length of the burner.
				3. Check burner orifice for proper size and blockage.
			G. Burners light and remain lit for about 5 seconds	1. Check flame rod wiring and connections.
				2. Check for proper alignment of flame rod.
				3. Clean flame rod sensor.
E02	Primary Limit / Fuse Failure (EO2)	The control board safety fuse has blown or the primary temperature limit has opened indicating safe operating temperatures for this furnace have been exceeded.	A. Improper circulating airflow	1. Check filter / replace if dirty.
				2. Check for improperly sized duct system.
				3. Check for faulty blower motor.
				4. Check for faulty blower motor wiring.
			B. Primary limit switch failure	1. Check for an open primary limit switch at ambient temperature.
			C. Fuse is blown	1. Check and replace fuse on the board.
				2. Make sure fuse socket is tight, crimp fuse terminals if necessary.
			D. Faulty primary limit switch wiring	1. Check primary limit wiring continuity from the switch to the control board.
E03	Modulation Valve Failure (EO3)	The control lost the position feedback from the modulating gas valve actuator.	A. Faulty modulation valve actuator wiring	1. Ensure wiring is connected per unit wiring diagram.
				2. Check for loose pins or bad connections.
				3. Check for frayed wiring or shorts to ground.
			B. Modulation valve actuator failure	1. Ensure actuator has 24 V power.
				2. Ensure actuator is receiving signal from the control board (2-10 VDC).
				3. Check for actuator feedback to the control board (2-10 VDC)
E04	Air Sensor Failure (EO4) *Pressure Sensor Reading Low*	The air sensor reading is too low for operating conditions or the air pressure switch closed when the sensor indicates low flow *The pressure switch MUST be open prior to venter activation*.	A. Faulty wiring or connections	1. Check pressure switch wiring.
				2. Check inducer wiring.
				3. Check for plugged or disconnected vacuum hoses.
			B. Faulty pressure switch	1. Replace pressure switch.
			C. Faulty pressure sensor, located on the board	1. Replace board.
E05	Air Sensor Failure (EO5) *Pressure Sensor Reading High*	The air sensor reading is too high when the venter is off or the air pressure switch open when the sensor indicates high flow. *The pressure switch MUST close to initiate an ignition sequence.*	A. Faulty wiring or hose connections	1. Check pressure switch wiring.
				2. Check venter motor wiring.
				3. Check for broken or disconnected vacuum hoses.
			B. Blocked or improper venting	1. Check air inlet and outlet for blockage.
				2. Check venting configuration for excessive venting length, improper sizing, etc.
			C. Faulty pressure switch	1. Replace pressure switch.

(continued)

4.2 Troubleshooting - Modulating Control Module used on Model RDH, RHH, or SHH with Opt AG58 or D12G (cont'd)

Gas Heat Section Modulating Control LOCKOUT ERRORS (cont'd)				
Code	Alert	Description	Probable Causes	Solutions
E06	Gas Sensor Failure (EO6) *Pressure Sensor Reading Low*	The gas transducer reading is too low compared to the expected value for the modulating gas valve actuator position. *When the furnace is operating at 75% or higher -- greater than 8 VDC analog input voltage - the manifold pressure sensor must read 1.4" w.c. or higher*	A. Modulating actuator/ball valve not properly aligned	1 Perform modulating system gas valve alignment procedure; see Paragraph 4.3.
			B. Line pressure too low	1. Ensure line pressure is properly adjusted for the gas and application. Correct as needed.
			C. Intermediate regulated pressure to low	1. Ensure the safety gas valve(s) are properly adjusted to the specified outlet pressure. Adjust per the installation instructions as necessary.
			D. Wrong gas pressure sensor installed.	1. Ensure the proper gas transducer - either natural gas or propane - is installed. Replace as needed.
			E. Gas pressure sensor faulty	1. Ensure gas manifold transducer is installed properly and wired per the unit wiring diagram. Replace as necessary.
E07	Gas Sensor Failure (EO7) *Pressure Sensor Reading High*	The gas transducer reading is too high compared to the expected value for the modulating gas valve actuator position. *When the furnace is operating at 75% or lower - less than 8 VDC analog input voltage -- the manifold pressure sensor must read 2.8" w.c. or lower.*	A. Modulating actuator / ball valve not properly aligned	1. Perform modulating system gas valve alignment procedure; see Paragraph 4.3.
			B. Line pressure too high	1. Ensure the line pressure is properly adjusted for the gas and application. Correct as necessary.
			C. Intermediate regulated pressure too high	1. Ensure the safety gas valve(s) are properly adjusted to the specified outlet pressure. Adjust per the installation instructions as necessary.
			D. Wrong gas pressure sensor installed	1. Ensure gas sensor -- either natural or propane -- is installed. Replace as necessary.
			E. Gas pressure sensor faulty	1. Ensure gas sensor is installed properly and wired per the unit wiring diagram. Replace as necessary.
E08	Improper Flame Signal (EO8)	Control senses flame present when the gas valve is commanded off.	A. Flame remains lit in "Off" cycle	1. Gas valve leaks - check wiring to remove continuous 24V to gas valve.
				2. Gas valve is stuck open – remove, repair, or replace gas valve.
E09	No Firing Rate Input (EO9)	Call for heat is sensed (R & W closed) but firing rate is below defined voltage threshold for furnace operation.	A. Faulty wiring into the "Analog +" and "Analog –" terminals	1. Ensure wiring is connected per unit wiring diagram.
				2. Check for loose pins or bad connections.
				3. Check for frayed wiring or shorts to ground.
			B. No signal from source.	1. Check firing rate input voltage – must be greater than 1.5 VDC.
				2. Troubleshoot controller providing firing rate input to the deep modulation ignition control board.
E8d	Invalid I.D. Plug (Eid)	The installed I.D. plug is not valid for this control board.	A. Incorrect I.D. plug installed	1. Ensure I.D. plug is correct for the furnace – check label.
				2. Ensure I.D. plug is properly inserted into the mating connector on the control board.
				3. With the I.D. plug installed, cycle power to the furnace. The board will display the I.D. plug identity upon power-up.
				4. Install correct I.D. plug as needed.

4.3 Troubleshooting - Blower Section (All Models - SDH, PDH, RDH, PEH, REH, RHH, SHH, PXH, RXH) and Gas-Fired Heat Section (SDH, PDH, RDH, RHH, SHH)

PROBLEM	PROBABLE CAUSE	REMEDY
Venter motor will not start - Models SDH/ PDH/RDH/SHH/ RHH	**1.** No power to unit.	**1.** Turn on power; check supply fuses or main circuit breaker.
	2. No 24 volt power to integrated circuit board.	**2.** Turn up thermostat; check control transformer output.
	3. Integrated circuit board fuse blown.	**3.** Correct cause. Replace fuse (type ATC or ATO, 32VDC, 3A).
	4. No power to venter motor.	**4.** Tighten connections at circuit board and/or motor and terminals. Check venter motor capacitor.
	5. Integrated circuit board defective.	**5.** Replace integrated circuit board.
	6. Venter motor capacitor defective.	**6.** Replace venter motor capacitor.
	7. Defective venter motor.	**7.** Replace venter motor. NOTE: Manufacturer recommends replacing capacitor when replacing venter motor.
Burner will not light - Models SDH/PDH/RDH/ SHH/RHH	**1. SHH -** Vent temperature switch activated.	**1.** Identify reason (see Paragraph 3.4.6, page 16) and correct. Reset switch.
	2. SHH - Heat exchanger condensate drain pressure switch activated.	**2.** Clean condensate drain. Verify flow. Fill traps with water and restart heater.
	3. Manual valve not open	**3.** Open manual valve.
	4. Air in the gas line.	**4.** Bleed gas line (initial startup only).
	5. Gas pressure too high or too low.	**5.** Supply pressure should be 5-14" w.c. for natural gas or 11-14" w.c. for propane.
	6. No Spark:	**6.**
	a) Loose wire connections.	a) Be certain all wire connections are solid.
	b) Transformer failure.	b) Be sure 24 volts is available.
	c) Incorrect spark gap.	c) Maintain spark gap at 1/8".

Burner will not light (cont'd)	d) Spark cable shorted to ground.	d) Replace worn or grounded spark cable.
	e) Spark electrode shorted to ground.	e) Replace if ceramic spark electrode is cracked or grounded.
	f) Burner not grounded.	f) Make certain integrated circuit board is grounded to ignitor.
	g) Circuit board not grounded.	g) Make certain integrated circuit board is grounded to furnace chassis.
	h) Unit not properly grounded.	h) Make certain unit is properly field grounded to earth ground and properly phased (L1 to hot lead L2 to neutral).
	i) Integrated circuit board fuse blown.	i) Correct cause. Replace fuse (type ATC or ATO, 32VDC, 3A).
	j) Faulty integrated circuit board.	j) If 24 volt is available to the integrated circuit board and all other causes have been eliminated, replace board.
	7. Lockout device interrupting control circuit by above causes.	**7.** Reset lockout by interrupting control at the thermostat or main power.
	8. SDH or SHH - Interlock door switch open	**8.** Close access door or replace switch.
	9. Combustion air proving switch not closing.	**9.**
		a) Make sure unit is properly vented.
		b) Remove obstructions from vent.
		c) Replace faulty tubing to pressure switch.
	10. Faulty combustion air proving switch.	**10.** Replace combustion air proving switch.
	11. Main valve not operating.	**11.**
	a) Defective valve.	a) If 24v is measured at the valve connections and valve remains closed, replace valve.
	b) Loose wire connections.	b) Check and tighten all wiring connections.
	12. Integrated circuit board does not power main valve.	**12.**
	a) Loose wire connections.	a) Check and tighten all wiring connections.
	b) Flame sensor grounded.	b) Be certain flame sensor lead is not grounded or insulation or ceramic is not cracked. Replace as required.
	c) Incorrect gas pressure.	c) Supply pressure should be 5-14" w.c. for natural gas or 11-14" w.c. for propane.
Burner cycles on and off - SDH/ PDH/RDH/SHH/ RHH	**1.** Gas pressure too high or too low.	**1.** Supply pressure should be 5-14" w.c. for natural gas or 11-14" w.c. for propane.
	2. Burner not grounded	**2.** Make certain integrated circuit board is grounded to ignitor.
	3. Circuit board not grounded.	**3.** Make certain integrated circuit board is grounded to furnace chassis.
	4. Faulty integrated circuit board.	**4.** If 24 volt is available to the integrated circuit board and all other causes have been eliminated, replace board.
	5. Combustion air proving switch not closing.	**5.**
		a) Make sure unit is properly vented.
		b) Remove obstructions from vent.
		c) Replace faulty tubing to pressure switch.
	6. Faulty combustion air proving switch.	**6.** Replace combustion air proving switch.
	7. Flame sensor grounded.	**7.** Be certain flame sensor lead is not grounded or insulation or ceramic is not cracked. Replace as required.
	8. Cracked ceramic at sensor.	**8.** Replace sensor.
	9. Incorrect polarity.	**9.** Reverse line volt leads to integrated circuit board.
	10. Pin terminal loose at 9-pin plug.	**10.** Replace wire harness.
No heat - SDH/ PDH/RDH/SHH/ RHH	**1.** Incorrect valve outlet pressure or orifice.	**1.** Check valve outlet pressure. See rating plate for manifold pressure.
	2. Cycling on limit control.	**2.** Check air throughput.
	3. Improper thermostat location or adjustment	**3.** See thermostat manufacturer's instructions.
	4. SHH - Vent temperature switch activated.	**4.** Identify reason (see Paragraph 3.4.6, page 16) and correct. Reset switch.
	5. SHH - Heat exchanger condensate drain pressure switch activated.	**5.** Clean condensate drain. Verify flow. Fill traps with water and restart heater.
Blower motor (<u>all Models</u>) or venter motor (SDH/PDH/ SHH/RHH/RDH) will not run	**1.** Circuit open.	**1.** Check wiring and connections.
	2. Defective integrated circuit board.	**2.** Replace board.
	3. Defective capacitor, starter, or motor.	**3.** Replace defective part(s).
Blower motor (<u>all Models</u>) or venter motor (PDH/SDH/ RDH/SHH/RHH) turns on and off while burner is operating	**1.** Motor overload device cycling on and off.	**1.** Check motor load against motor rating plate. Replace motor if needed.
Blower motor (<u>all Models</u>) or venter motor (SDH/ PDH/RDH/SHH/ RHH) cuts out on overload	**1.** Low or high voltage supply.	**1.** Correct electric supply.
	2. Defective motor.	**2.** Replace motor.
	3. Poor air flow.	**3.** Clean motor, blower, blower guard, filter, and coils.
	4. Defective bearing or lubrication.	**4.** Lubricate bearings (motor permitting) or replace motor
Blower motor (all Models) cuts out on overload	**1.** Improper motor pulley and/or adjustment.	**1.** Check motor pulley and belt..
	2. Improper static pressure in ductwork	**2.** Adjust duct system dampers.
	3. Low voltage.	**3.** Check power supply.

4. Troubleshooting (cont'd)
4.4 Troubleshooting - Electric Heat Section (PEH, REH)

PROBLEM	PROBABLE CAUSE	REMEDY
Unit does not operate	1. No power to unit	1. Turn on power; check supply fuses or main circuit breaker.
	2. Blown fuses	2. Check and replace if necessary.
	3. Defective or incorrect wiring.	3. Check wiring and connections. Refer to wiring diagram provided with unit.
	4. Defective or burned out control transformer	4. Check secondary voltage with voltmeter. Replace if necessary.
Fan operates but element does not heat	1. Dirty filters	1. Check filters and clean or replace if necessary.
	2. Defective air proving switch	2. Check and replace if necessary.
	3. Blown element fuses	3. Check and replace element fuses if necessary.
Insufficient heat	1. Burned out element	1. Turn off power and check element resistance with ohmmeter. Replace if open.
	2. Blown fuses	2. Check and replace if necessary.
	3. Cycling on limit control	3.
		a) Check air throughput (temperature rise).
		b) Check motor rpm against nameplate rating. Replace motor if speed is too slow.
		c) Defective limit control. Check wiring and connections. Check continuity through control and replace if necessary.
	4. Defective or incorrect wiring.	4. Check wiring and connections. Refer to wiring diagram provided with unit.

4.5 Troubleshooting - Refrigeration Circuit (All Models with a DX Cooling Module)
Consult the condensing unit literature for more specific information.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Compressor will not start.	1. Power off, loose electrical connections or fuse open.	1. Check disconnect switch, fuses and wiring. Replace parts or repair as necessary
	2. Compressor contactor not closing.	2. Check voltage to contactor coil, transformer, slave relay, system. Replace parts as necessary.
	3. Internal compressor thermal overload open.	3. If compressor is hot, allow 2 hours to cool. See D. below.
	4. Compressor defective.	4. Check compressor for electrical failure. Compressor may be seized; check refrigerant. If necessary, replace compressor.
	5. High or low pressure switch open or defective.	5. If manual reset (high pressure), reset switch. (Switch opens at 600 psi and will not reset above 400 psi.) If auto reset (low pressure) does not reset and everything else is OK, replace low pressure switch.
B. Compressor starts but cuts out on low pressure (switch activates at 35 psig.)	1. Low refrigerant charge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11*.
	2. Airflow restricted.	2. Check for dirty evaporator coil, dirty filters, dampers closed, iced evaporator coil, improper belt, check motor amps, check duct design.
	3. Restriction in refrigerant line.	3. Check subcooling and superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11*. Check operation of the thermal expansion valve. Check for pressure drop across the filter drier.
	4. Defective low pressure switch.	4. Check switch (opens 35 psi; closes 50 psi). If defective, replace switch
C. Compressor starts but cuts out on high pressure switch.	1. Refrigerant overcharge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11*.
	2. Condenser fan motor defective.	2. Check fan motor.
	3. Condenser coil inlet obstructed or dirty.	3. Check coil and inlet clearances and for possible air recirculation.
	4. Air or non-condensables in system.	4. Check high side equalized pressure reading with equivalent outdoor temperature.
	5. Defective high pressure switch.	5. Check switch (opens at 600 psi and will not reset above 400 psi.). If defective, replace high pressure switch..
	6. Restriction in discharge or liquid line.	6. Check subcooling and superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11*. Check operation of thermal expansion valves.
D. Compressor cuts out on thermal overload.	1. Low voltage.	1. Check voltage.
	2. Sustained high discharge pressure.	2. Check running amperage and conditions described in I.
	3. High suction and discharge pressures.	3. Check thermal expansion valve setting, check for air in system.
	4. Defective compressor overload.	4. If compressor is hot, allow compressor to cool for 2 hrs. Recheck for open circuit.
	5. Improper refrigerant charge.	5. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11*.
	6. Bearings or pistons too tight.	6. Check for low oil level.
	7. Allow time for compressor to cool.	7. Check dome temperature of the compressor.
E. Noisy compressor.	1. Reverse rotation.	1. Check at startup. If the suction pressure rises and the discharge pressure drops, shut down the compressor. Switch the 3-phase wiring connections.
	2. Refrigerant overcharge.	2. Check pressures and subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11*.
	3. Liquid floodback.	3. Check thermal expansion valve setting. Check subcooling for refrigerant overcharge; see condensing unit manual or Paragraph 3.7.4, *Step 11*.
	3. Tubing rattle.	3. Dampen tubing vibration by taping or clamping. Carefully bend tubing away from contact where possible.
	4. Compressor defective.	4. Check internal parts. Replace defective parts or compressor.

F. Noisy unit operation.	1. Blower rotational noise.	1. Check blower, motor and drive for faulty adjustment or noisy bearings, loose parts, and/or blower out of balance.
	2. Air noise.	2. Check ductwork. Air velocity too high.
	3. Chattering contactor.	3. Check for adequate control voltage, check for shorts or breaks, check thermostat, check contact points.
	4. Tubing rattle.	4. Dampen by taping or clamping, carefully bend tubing away from contact when possible.
G. High suction pressure	1. Excessive load on evaporator coil.	1. Check superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Check for high entering wet bulb temperature. Check for excessive air.
	2. Compressor is unloaded.	2. Check head pressure. Check thermal expansion valve. If valve is not functioning properly, check pressure drop across filter drier.
	3. Expansion valve not secured to suction line or defective.	3. Check the thermal expansion valve; ensure bulb is attached properly and insulated.
H. High discharge pressure.	1. Refrigerant overcharge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Adjust refrigerant charge.
	2. Thermal expansion valve setting.	2. Check superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Adjust valve as needed.
	3. Air inlet to condenser dirty or obstructed.	3. Check for proper clearances and possible air recirculating.
	4. Condenser fan motor defective.	4. Check condenser fan motor and capacitor.
I. Suction pressure is too low.	1. Refrigerant undercharge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Add refrigerant as needed.
	2. Thermal expansion valve setting.	2. Check superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Adjust valve as needed.
	3. Blower running backward.	3. Interchange any two wires from 3 phase disconnect.
	4. Loose blower, pulley or belts.	4. Check drive pulley alignment, belt tension.
	5. Defective or improperly adjusted expansion valve.	5. Check superheat and adjust thermal expansion valve.
	6. Dirty filter.	6. Check filter and evaporator coil.
	7. Too little airflow or low entering air temperature.	7. Check airflow and entering air wet bulb conditions.
	8. Restriction in suction or liquid line.	8. Check refrigerant circuit for restriction.
J. Head pressure too low.	1. Insufficient refrigerant charge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Check for leak. Repair; add refrigerant.
	2. Defective or improperly adjusted expansion valve.	2. Check superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Adjust thermal expansion valve.
	3. Low suction pressure.	3. See “I. Suction pressure too low” above.
	4. Defective compressor.	4. See “G. High suction pressure” above.
K. Compressor short cycles.	1. Improper refrigerant charge.	1. Check subcooling and superheat; see condensing unit manual or Paragraph 3.7.4, *Step 11.*.
	2. Defective high or low pressure control.	2. Check high or low pressure switch.
	3. Liquid floodback.	3. Possible tight bearings, see above.
	4. Defective expansion valve.	4. Check superheat and thermal expansion valve.
	5. Poor air distribution.	5. Check ductwork for recirculating.
	6. High discharge pressure.	6. See “H. High discharge pressure” above.
	7. Leaking discharge valves in compressor.	7. See “G. High suction pressure” above.
L. Running cycle is too long or unit operates continuously.	1. Refrigeration undercharged.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Add refrigerant.
	2. Dirty filter or evaporator coil.	2. Check filter, coil, and airflow.
	3. Dirty or clogged condenser coil.	3. Check coil and airflow.
	4. Air or other non-condensables in system.	4. Check equalized high side pressure with equivalent outdoor temperature.
	5. Defective compressor.	5. See “high suction pressure” above.
	6. Restriction in suction and liquid line.	6. Check for restrictions in refrigerant circuit.
	7. Control contacts stuck.	7. Check wiring.
M. Supply air temperature is too high.	1. Refrigerant undercharge or leak in system.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Check for leaks.
	2. Evaporator plugged with dirt or ice.	2. Check evaporator, airflow, and filter.
	3. Improperly adjusted or defective expansion valve.	3. Check superheat & adjust thermal expansion valve, check bulb.
	4. Defective compressor.	4. Check compressor for proper operation.
	5. High discharge pressure.	5. See “high discharge pressure” above.
	6. Airflow is too high.	6. Check external static pressure.
N. Supply air temperature is too low.	1. Airflow is too low.	1. Check evaporator coil; check filters, check for closed dampers or grills, check drive for loose parts, belts, or misalignment; check external static pressure.
	2. Return air temperature too low.	2. Check entering air wet bulb conditions.
O. Liquid line is too hot.	1. Refrigerant undercharge.	1. Check subcooling; see condensing unit manual or Paragraph 3.7.4, *Step 11.* Adjust refrigerant.
	2. High discharge pressure.	2. See H. above.

APPENDIX

Pressure/ Temperature Chart for R410A Refrigerant for Checking Reheat (dehumidification) Circuit Subcooling and Superheat

NOTE: For pressure/ temperatures for checking subcooling and superheat of the cooling circuit with a refrigerant other than R410A, refer to the heat/cool system (I-PDH/SDH/PEH/SHH/ PXH or I-PreevA RDH/ REH) or condenser installation manual. The reheat circuit is always R410A refrigerant.

NOTE: Information in this chart was taken from the Temperature Pressure Chart printed in Form IC-2-04 by the Sporlan Valve Company, Washington, MO 63090.

R410A Refrigerant		
Pressure	Temperature	
PSI	°F	°C
1.8	-55	-48.3
4.3	-50	-45.6
7.0	-45	-42.8
10.1	-40	-40.0
13.5	-35	-37.2
17.2	-30	-34.4
21.4	-25	-31.7
25.9	-20	-28.9
27.8	-18	-27.8
29.7	-16	-26.7
31.8	-14	-25.6
33.9	-12	-24.4
36.1	-10	-23.3
38.4	-8	-22.2
40.7	-6	-21.1
43.1	-4	-20.0
45.6	-2	-18.9
48.2	0	-17.8
49.5	1	-17.2
50.9	2	-16.7
52.2	3	-16.1
53.6	4	-15.6
55.0	5	-15.0
56.4	6	-14.4
57.9	7	-13.9
59.3	8	-13.3
60.8	9	-12.8
62.3	10	-12.2
63.9	11	-11.7
65.4	12	-11.1
67.0	13	-10.6
68.6	14	-10.0
70.2	15	-9.4
71.9	16	-8.9
73.5	17	-8.3
75.2	18	-7.8
77.0	19	-7.2
78.7	20	-6.7
80.5	21	-6.1
82.3	22	-5.6
84.1	23	-5.0
85.9	24	-4.4
87.8	25	-3.9
89.7	26	-3.3
91.6	27	-2.8

R410A Refrigerant		
Pressure	Temperature	
PSI	°F	°C
93.5	28	-2.2
95.5	29	-1.7
97.5	30	-1.1
99.5	31	-0.6
101.6	32	0.0
103.6	33	0.6
105.7	34	1.1
107.9	35	1.7
110.0	36	2.2
112.2	37	2.8
114.4	38	3.3
116.7	39	3.9
118.9	40	4.4
121.2	41	5.0
123.6	42	5.6
125.9	43	6.1
128.3	44	6.7
130.7	45	7.2
133.2	46	7.8
135.6	47	8.3
138.2	48	8.9
140.7	49	9.4
143.3	50	10.0
156.6	55	12.8
170.7	60	15.6
185.7	65	18.3
201.5	70	21.1
218.2	75	23.9
235.9	80	26.7
254.6	85	29.4
274.3	90	32.2
295.0	95	35.0
316.9	100	37.8
339.9	105	40.6
364.1	110	43.3
389.6	115	46.1
416.4	120	48.9
444.5	125	51.7
474.0	130	54.4
505.0	135	57.2
537.6	140	60.0
571.7	145	62.8
607.6	150	65.6
645.2	155	68.3

Wiring Diagram
Option Identification

The Option Codes for these electrical options are shown on the wiring diagram.

Option Code	Brief Description
AG1	Analog Heating Control - 1-Stage
AG2	Analog Heating Control - 2-Stage
AG3	Analog Heating/Makeup Air - 2-Stage unit-mounted ductstat
AG15	Analog Heating/Makeup Air - 2-Stage remote ductstat w/dial
AG16	Analog Heating/Makeup Air - same as AG15 with display
AG40	Analog Heating/Makeup Air - converts to digital for field supplied BMS
AG58	Analog Heating/Makeup Air - electronic modulation 8:1 turndown (SHH)
AG60	Analog Heating/Makeup Air - same as AG3 plus 33% low fire
AG61	Analog Heating/Makeup Air - same as AG15 plus 33% low fire
AG62	Analog Heating/Makeup Air - same as AG61 with display
AK1	115/1 Supply Voltage
AK2	208/1 Supply Voltage
AK3	230/1 Supply Voltage
AK5	208/3 Supply Voltage
AK6	230/3 Supply Voltage
AK7	460/3 Supply Voltage
AK8	575/3 Supply Voltage
AN2	Contactor, IEC
AN10	Motor Starter with Overloads
AR8	On/Off Inlet Air Damper with Duct Flanges
AU7	Cooling Coil Cabinet with DX Coil and Reheat Pump
AUR1	Modulating Reheat
BA6	Disconnect Switch - Flush-mounted, lockable, non-fusible
BB8	Wiring for Energy Recovery Module
BC2	Convenience Outlet (requires separate power supply)
BD4	Firestat, 200°F
BD5	Firestat, 200°F (field installed)
BE2	Low Limit, Discharge Temperature
BE4	Evaporator Frostat for Coils
BF14	Phase Loss/Low Voltage Protection - with AK5, AK6, AK7 only
BF15	Phase Loss/Phase Reversal Protection - 3 phase only
BG7__	Plugin DPDT Relay - Specified operation
BG9	Plugin DPDT Relay - Exhaust Fan Interlock
BHB1	Time Clock Card - with DG 1, 2, 5, 6
BHB2	N2 Card - with DG 1, 2, 5, 6 and D12 B, C, D, E
BHB3	LonMark Card - with DG 1, 2, 5, 6 and D12 B, C, D, E
BN2	Limit Control - High Ambient (burner cutoff)
BP4	Gas Pressure Safety Switches, High and Low
CL1	Thermostat - 1-stage heat, 24V, 40-80°F
CL22	Thermostat - 24v non programmable, 1 or 2-stage
CL23	Thermostat - 24v, 2-stg heat/cool, touch screen, programmable
CL33	Thermostat - 2-stage heat/cool, 24V, programmable
CL36	Thermostat - Modulating Heat/cool with 3-stage cooling
CL52	Thermostat - 1-stage heat/cool, 24V, 45-88°F, programmable 5/2 day
CL67	Space Temperature Sensor/Override - with D12 B, C, D, E
CN1__	3-Position Switch - specified operation
CN3__	2-Position Switch - specified operation
CP__	Disconnect Switch (field installed)
CT1	Evap Cooler Fill & Drain Kit - 120/1 with AK1, AK7, AK8
CT2	Evap Cooler Fill & Drain Kit - 208/1 with AK2, AK5
CT3	Evap Cooler Fill & Drain Kit - 240/1 with AK3, AK6
CT5	Evap Cooler Freeze Protection - AquaSaver controls
CT6	Evap Cooler Freeze Protection - with CT 1, 2, or 3

Option Code	Brief Description
D12B	Digital Control w/FX06 - Neutral Air/Discharge Air Temp Control (applies to PDH or SDH with or without reheat)
D12C	Digital Control w/FX06 - Space Temp Cntrl w/Discharge Air Reset (applies to SDH or PDH with or without reheat)
D12D	Digital Control w/FX06 - Neutral Air/Discharge Air Temp Control (applies to PEH with SCR (modulating) heating control and 3-stage cooling with or without reheat)
D12E	Digital Control w/FX06 - Recirculating Air Temp Control (applies to PEH with 2-stage heating and 3-stage cooling with or without reheat) (not recommended for makeup air)
D12F	Digital Control w/FX06 - Space Temperature, 2-stage heating / 3-stage cooling (applies to SHH)
D12G	Digital Control w/FX06 - Gas-fired electronic modulation with 8:1 turn-down; 3-stage cooling; with or without reheat; discharge air temperature control (applies to SHH)
DG1	Digital Control w/FX05 - Space Temperature, 2-stg heating/3-stg cooling (applies to PDH or SDH without reheat)
DG2	Digital Control w/FX05 - Space Temperature elec mod htg/3-stg clng (applies to PDH or SDH without reheat)
DG5	Digital Control w/FX05 - Discharge Air Temperature, 2-stg htg/3-stg clng (applies to PDH or SDH without reheat)
DG6	Digital Control w/FX05 - Discharge Air Temperature elec mod htg/3 stg clng (applies to PDH or SDH without reheat)
ECD1	Evap Cooler AquaSaver meter water flow system
ECD2	Evap Cooler Recirculating Pump Control
EG1	Analog Heating Control - 1 Stage thermostat (PEH)
EG2	Analog Heating Control - 2 Stage thermostat (PEH)
GE3	Damper Control - Outside air, 2-position motor
GE5	Damper Control - Outside air, 3-position motor
GE6	Damper Control - Outside & Return, 2-position motor
GE7	Damper Control - Outside & Return, 2-position mtr w/warm up
GE8	Damper Control - Outside & Return, 3-position, unit potentiometer
GE10	Damper Control - Outside & Return, 3-position, remote potentiometer
GE11	Damper Control - Outside & Return, modulating, mixed air
GE12	Damper Control - Outside & Return, modulating, mixed air w/min
GE13	Damper Control - Outside & Return, modulating, mixed air w/warm up
GE14	Damper Control - Outside & Return, mod, mixed air w/min & warm up
GE15	Damper Control - Outside & Return, modulating, building pressure
GE16	Damper Control - Outside & Return, modulating, BMS control
GE21	Damper Control - Outside & Return, modulating, enthalpy
GE22	Damper Cntrl - Outside & Return, modulating, dual reference enthalpy
RB2A	Remote Display - Control Options D12B-G
RC__	Remote Console - lights, switches, optional sensors
SA1	Duct Photoelectric Smoke Detector
T4 XX	Thermal Expansion Valve (R410A only)
UV2	Germicidal Lamp
VFD1	Variable Frequency Drive
VFD2	Variable Frequency Drive (requires field installation)
VFD3	Variable Freuency Drive (supplied by others)

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INSTALLATION RECORD (TO BE COMPLETED BY INSTALLER)

Model	Serial No.	Date of Installation	Notes
	Installer	Distributor	
Name			
Company			
Address			
Phone No.			

For more information on Reznor HVAC products:

- **Contact your local Reznor representative at 1-800-695-1901**
- **Refer to the technical specifications, manuals, and consumer materials found at www.reznorhvac.com**

Intertek

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PREEVA-IOM (05-26) REV-A