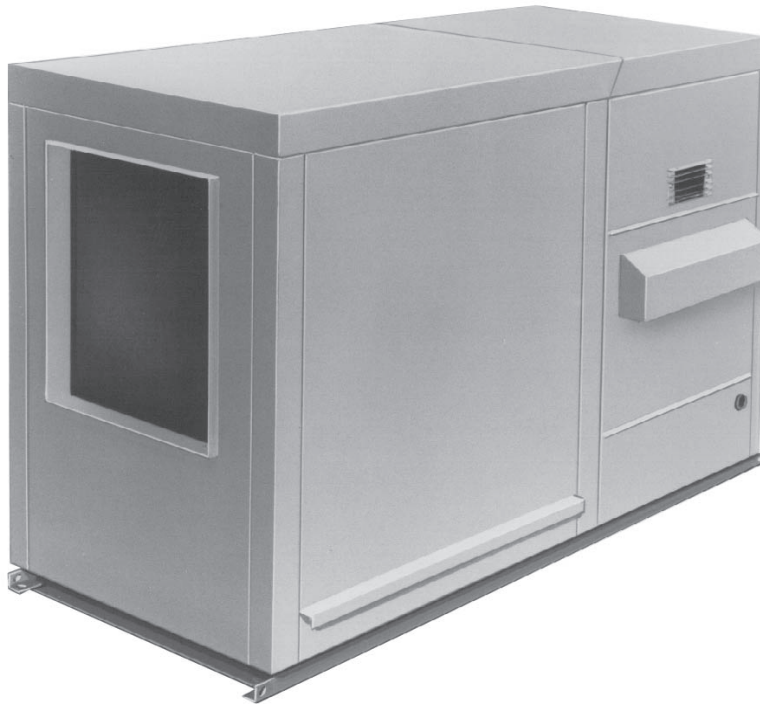


OUTDOOR PACKAGED DUCT FURNACE AND BLOWER INSTALLATION, OPERATION, AND MAINTENANCE

MODEL RPB



⚠ 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.

TABLE OF CONTENTS

GENERAL INFORMATION	3
References	3
Important Safety Information	4
Warranty	4
Installation Codes	5
Unit Location	5
Hazards of Chlorine	5
Combustion Air Requirements	5
Curb Cap Base	5
Dimensions	5
Weights	7
Clearances	7
INSTALLATION	7
Uncrating/Unpacking	7
Shipped-Separate Parts	8
Mounting Support Structure	8
Bottom Duct Connections	9
Optional Curb (Option CJ1 or CJ2) Assembly	9
Field-Supplied Support Assembly	11
Mounting	12
Duct Connections	12
Requirements and Suggestions for Connecting and Installing Ducts	12
100% Outside Air Hood (Option AS2)	14
Screened Air Hood for 30% Outside Air Opening	14
Evaporative Cooling Module (Option AS3, AS4, AS5, or AS8)	14
Discharge Air Temperature Sensor Installation	14
Venting Connections	16
Piping Connections	16
Gas Supply Pressure	16
Gas Supply Piping	17
Supply Piping Connections	17
Electrical Connections	19
Control Wiring	20
CONTROLS	22
Thermostat	22
Remote Console	22
Combustion Air Proving Switch	22
Blower Fan Control	22
Limit Control	23
Reverse Flow Limit Control	23
High Ambient Limit Control	23
Airflow Proving Switch (Makeup Air with Option BW1)	23
Variable Frequency Drive	23
Combination Gas Valve	23
Optional Two-Stage Control (Heating Only Application)	23
Optional Two-Stage Control (Makeup Air Application)	24
Optional Ductstat with Capillary Tubing (Option AG3)	24
Optional Ductstat with Electronic Remote Setpoint Module (Option AG15)	25
Optional Electronic Modulation	25
Electronic Modulation Between 50% and 100% Firing Rate (Option AG7, AG8, or AG9)	25
Computer-Controlled Electronic Modulation Between 50% and 100% Firing Rate (Option AG21)	26
Electronic Modulation Between 20–28% and 100% Firing Rate (Option AG39)	26
Electronic Modulation Between 20–28% and 100% Firing Rate (Option AG40)	27
Pilot and Ignition Systems	29
Burners and Carryover System	29

TABLE OF CONTENTS—CONTINUED

Dampers and Damper Controls	30
Pressure Null Switch.	30
Dirty Filter Switch	30
OPERATION	31
Pre-Startup Checklist	31
Startup	31
Post-Startup Checklist	32
ADJUSTMENTS.	32
Belts, Blowers, and Drives	32
Checking and Adjusting Belt Tension	32
Adjusting Blower Speed	33
Reversing Blower Rotation	33
Blower Motor Load and Amp Adjustment	33
Pressure Null Switch Adjustment	34
Measure and Adjust Manifold (Outlet) Gas Pressure	35
High Elevation (>2,000 Feet/609 Meters) Installations	36
Conversion to LP (Propane)	36
Dirty Filter Switch Adjustment.	37
Burner Air Shutter Adjustment	38
Damper Linkage Adjustment.	38
MAINTENANCE.	39
Service Checklist	39
Maintenance Procedures	39
Combination Gas Valve Maintenance	39
Burner Rack Maintenance.	40
Cleaning Pilot and Burners	41
Spark Ignition System Maintenance	42
Heat Exchanger Cleaning	43
TROUBLESHOOTING	45
INSTALLATION RECORD (TO BE COMPLETED BY INSTALLER).	48

GENERAL INFORMATION

- This unit has been tested for capacity and efficiency so as to provide many years of safe and dependable comfort providing it is properly installed and maintained. With regular maintenance, this unit will operate satisfactorily year after year. Abuse, improper use, and/or improper maintenance can shorten the life of the appliance and create unsafe hazards.
- To achieve optimum performance and minimize equipment failure, it is recommended that periodic maintenance be performed on this unit. The ability to properly perform maintenance on this equipment requires certain tools and mechanical skills.
- This unit is design-certified to ANSI and CSA standards by the Canadian Standards Association and is approved for installation in the United States and in Canada. The furnaces are approved for use with either natural gas or propane. The type of gas for which the furnace is equipped, the correct firing rate, and electrical requirements are shown on the unit's rating plate.

References

Table 1. Related Technical Manuals Available from Factory Distributor

Type	Form*	PN
Replacement parts	HRPD-RP-RPL	263984
Control system guide	OPT-D19-D21-D22-D23	1042481
Maxitrol amplifier replacement kit installation	OPT-AG7,8,9,9H	262319
Outside air hood installation	RPB-RPBL-AS2	132901
30% screened air hood installation	OPT-AIR-HOOD	131794
Evaporative cooling module installation	OPT-AS3,4,5,8	160202
Ignition controller replacement kit installation	OPT-IGN-CNTRL	134704
Gas conversion	OPT-GC	143147

*Also available at www.reznorhvac.com.

GENERAL INFORMATION—CONTINUED

Important Safety Information

Please read all information in this manual thoroughly and become familiar with the capabilities and use of your appliance before attempting to operate or maintain this unit. Pay attention to all dangers, warnings, cautions, and notes highlighted in this manual. Safety markings should not be ignored and are used frequently throughout to designate a degree or level of seriousness.

DANGER: A danger statement describes a potentially hazardous situation that if not avoided, will result in severe personal injury or death and/or property damage.

WARNING: A warning statement describes a potentially hazardous situation that if not avoided, can result in severe personal injury and/or property damage.

CAUTION: A caution statement describes a potentially hazardous situation that if not avoided, can result in minor or moderate personal injury and/or property damage.

NOTE: A note provides important information that should not be ignored.

DANGER

- **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.**
- **Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury, or death. Read these installation, operation, and maintenance instructions thoroughly before installing or servicing this equipment.**

WARNING

For your safety, read the warning labels on the unit.

NOTES:

- **Installation 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.**
- **Read this manual and become familiar with the installation requirements of your particular furnace. If you do not have knowledge of local requirements, check with the local gas company or any other local agencies who might have requirements concerning this installation.**
- **The instructions in this manual apply only to the model RPB packaged duct furnace and blower.**

Warranty

Refer to the limited warranty information on the warranty card in the owner's envelope. Warranty is void if:

- a. Furnaces 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. Furnace air throughput is not adjusted within the range specified on the rating plate.

Installation Codes

These units must be installed in accordance with local building codes. In the absence of local codes, in the United States, the unit must be installed in accordance with NFPA/ANSI Z223.1 (latest edition), *National Fuel Gas Code*. A Canadian installation must be in accordance with CSA B149.1, *Natural Gas and Propane Installation Code*. This code is 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.

Unit Location

- Select a location that complies with the requirements in this manual.
- There are a variety of factors, such as system application, building structure, dimensions, and weight, that contribute to selecting the location.
- The location must comply with the **Clearances** section.
- If the unit is equipped with an outside air hood, it is recommended that the inlet to the hood not be facing into the prevailing wind.

Hazards of Chlorine

NOTE: Remember, chlorine is heavier than air. This fact should be kept in mind when determining the installation location of heaters and building exhaust systems.

The presence of chlorine vapors in the combustion air of 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 form a solution with any condensation 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 unit with regard to exhausters or prevailing wind directions.

Combustion Air Requirements

The combustion air and flue gas openings are carefully designed screened openings located on the side of the unit just above the control access panel. Location of the flue opening directly above the air intakes discourages recirculation of combustion products.

Curb Cap Base

Outdoor systems are equipped with a load bearing curb cap which forms an integral part of the unit. This curb cap has welded joints and has a skirt that fits over a roof curb to provide a weatherproof installation. Four holes are provided at the curb cap corners for lifting the unit. These holes do not interfere with unit weatherproofing. The curb cap is not designed to be placed directly on the roof surface. The system may be mounted on an optional roof curb purchased with the unit, a field-supplied roof curb, or field-supplied supports. If the system has a downturn plenum and/or a bottom return air opening, a roof curb is recommended to provide a weatherproof installation as well as more workable clearances for ductwork.

Dimensions

⚠ CAUTION ⚠

To ensure complete weather resistance, an outside air hood or evaporative cooling module is required.

NOTE: The two-position discharge dampers in option AQ8 fit in the discharge air opening. The damper motor fits inside the downturn plenum cabinet.

GENERAL INFORMATION—CONTINUED

Dimensions—Continued

NOTES:

Inches (mm)

Burner and control access shown left-hand side. Specify right-hand side for opposite access and connections.

*Height from top of cabinet to top of curb cap.

**Height from top of cabinet to bottom of cabinet side.

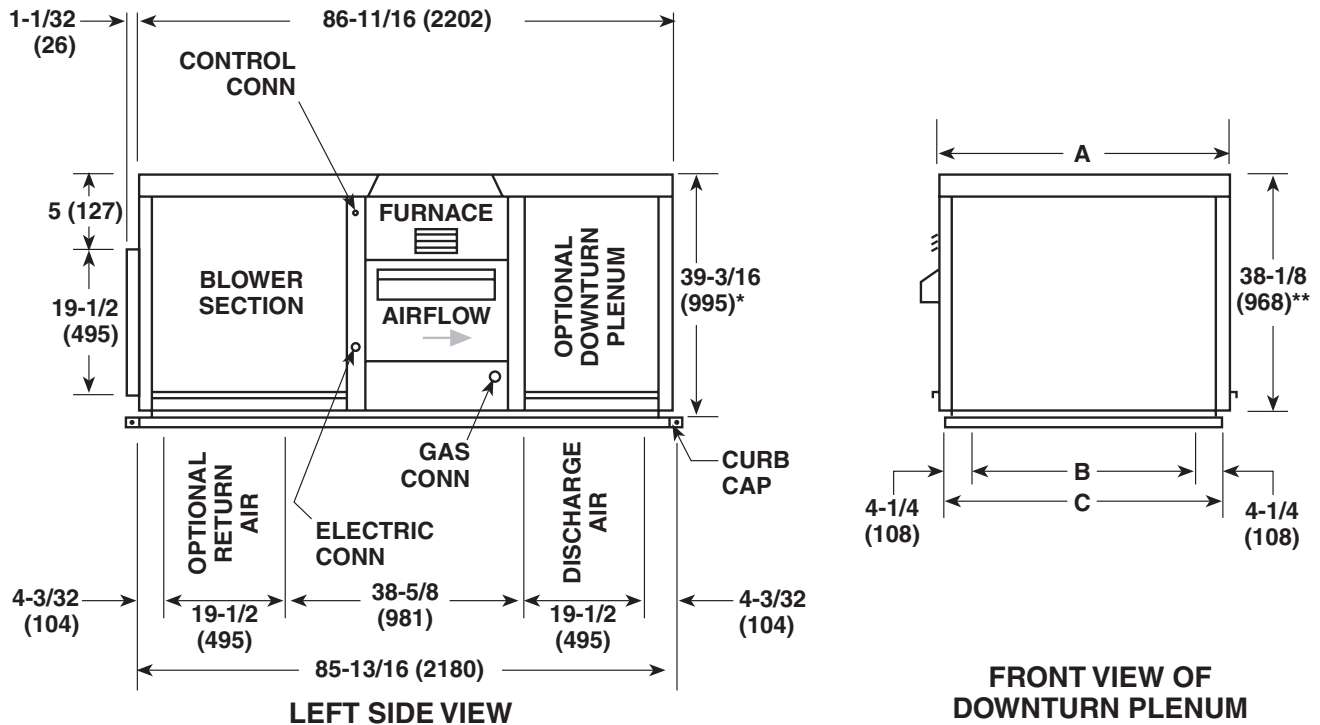
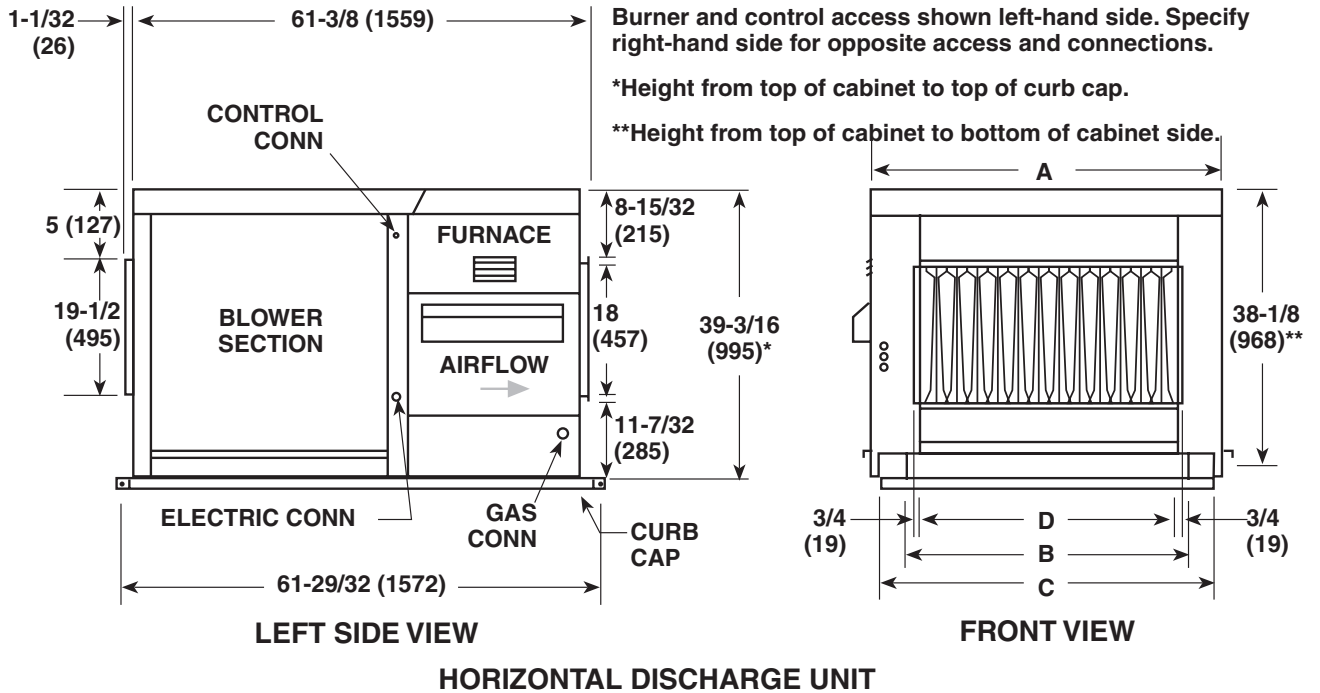


Figure 1. Dimensions (Refer to [Table 2](#))

Dimension (See Figure 1)	Unit Size					
	125	150, 175	200, 225	250, 300	350	400
	Inches (mm)					
A	28-5/8 (727)	34-1/8 (867)	39-5/8 (1006)	47-7/8 (1216)	53-3/8 (1356)	58-7/8 (1495)
B	17-3/8 (441)	22-7/8 (581)	28-3/8 (721)	36-5/8 (930)	42-1/8 (1070)	47-5/8 (1210)
C	25-7/8 (657)	31-3/8 (797)	36-7/8 (937)	45-1/8 (1146)	50-5/8 (1286)	56-1/8 (1426)
D	15-1/4 (387)	20-3/4 (527)	26-1/4 (667)	34-1/2 (876)	40 (1016)	45-1/2 (1156)
Standard horizontal air inlet	19-1/2 (495) × B					
Optional return air (bottom)						
Optional vertical discharge air with option AQ5 or AQ8 plenum						
Standard horizontal discharge air	18 (457) × D					

Weights

Section	Unit Size					
	125	150, 175	200, 225	250, 300	350	400
	Net Weight (Pounds (kg))					
Blower and furnace	482 (219)	520 (236)	534 (242)	588 (267)	630 (286)	662 (300)
Downturn plenum, factory-installed (option AQ5)*	166 (75)	177 (80)	196 (89)	229 (104)	253 (115)	271 (123)
Outside air inlet hood (option AS2)*	70 (32)	76 (34)	79 (36)	87 (39)	92 (42)	96 (44)
Roof curb, basic unit (option CJ1)*	90 (41)	95 (43)	101 (46)	111 (50)	117 (53)	123 (56)
Roof curb, unit with downturn plenum (option CJ2)*	112 (51)	118 (54)	124 (56)	133 (60)	139 (63)	145 (66)

*Add listed weight to shipping weight of unit.

Clearances

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 (50°C) above the surrounding ambient temperature is not exceeded. For safety, adequate combustion air, and convenient installation and service, ensure that the clearances listed in [Table 4](#) are provided.

Unit Surface	Minimum Clearance (Inches (mm))
Top	36 (915)
Control side	6 (152) + width of furnace
Side opposite controls	6 (152)
Bottom, to combustibles	0 (0)*
Bottom, to noncombustibles	0 (0)

*When the unit is installed on a roof curb on a combustible roof, the roof area enclosed within the curb must be either ventilated, left open, or covered with noncombustible material that has an R-value of at least 5.0.

INSTALLATION

NOTE: Before installation, make preparations for necessary supplies, tools, and manpower.

Uncrating/Unpacking

- This furnace was test-operated and inspected at the factory prior to crating and was in operating condition. If the furnace has incurred any damage in shipment, document the damage with the transporting agency and immediately contact an authorized Reznor® distributor. If you are an authorized Distributor, follow the FOB freight policy procedures.
- Check the rating plate for the gas specifications and electrical characteristics of the furnace to ensure that they are compatible with the gas and electric supplies at the installation site.

INSTALLATION—CONTINUED

Shipped-Separate Parts

- Check to see if there are any field-installed options that need to be connected to the furnace prior to installation.
- Shipped-separate options could include a roof curb, a screened outside air hood, a gas shutoff valve, a [thermostat](#), a different control switch, a remote console, a manual fan switch, a vertical vent terminal, a gas supply regulator, and/or a disconnect switch.
- If the unit is equipped with an optional evaporative cooling module, a water hammer arrestor or fill and drain or freeze kit could be shipped separately.
- Some gas control options will have parts either shipped loose with the heater or shipped separately. If the unit is equipped with any of the gas control options listed in [Table 5](#), ensure that these parts are available at the job site.

Table 5. Shipped-Separate Parts for Gas Control Options

Application	Option	Part(s)
Heating	AG7	Thermostat (PN 48033)
Makeup air	AG3	Control switch (PN 29054)
	AG8	Control switch (PN 29054), sensor and mixing tube (PN 48041)
	AG9	Control switch (PN 29054), remote temperature selector (PN 48042), sensor and mixing tube (PN 48041)
	AG15	Control switch (PN 29054), remote temperature selector (PN 115848), stage adder module (PN 115849), discharge air sensor holder (PN 115850), discharge air sensor holder bracket (PN 213612)
	AG39	Remote temperature selector (PN 174849), temperature sensor (PN 133228), mixing tube (PN 90323)

NOTE: If an optional remote console is ordered, the control switch and temperature selector may be mounted on the console.

Mounting Support Structure

⚠ WARNING ⚠

Before installation, check the supporting structure to ensure that it has sufficient load-carrying capacity to support the weight of the unit.

⚠ CAUTION ⚠

- Before installing the curb, verify that the size is correct for the system being installed.
- Whether using an optional roof curb available with the system or a field-supplied curb, the curb must be secure, square and level.
- **IMPORTANT:** The area enclosed by the roof curb must comply with [Table 4](#). If the roof is constructed of combustible materials, the area within curb must be either ventilated, left open, or covered with non-combustible material that has an R-value of at least 5.0.

NOTES:

- Prior to installation, ensure that the method of support is in agreement with all local building codes and is suited to the climate.
- If the area within the curb is left open, higher radiated sound levels may result.
- The system can have a variety of configurations that affect installation. If the system does not have a downturn plenum, the discharge is horizontal.

Bottom Duct Connections

The blower section and optional downturn plenum have duct flanges for connection to return air and supply air ducts. Duct opening sizes and curb spacing are shown in [Figure 2](#).

NOTE: [Figure 2](#) shows dimensions for currently-manufactured curbs that are available from the system manufacturer. The measurement from the duct openings to inside edge of roof curb is 1-5/8 inches (41 mm). Duct openings should be 1 inch larger than the duct size for installation clearance.

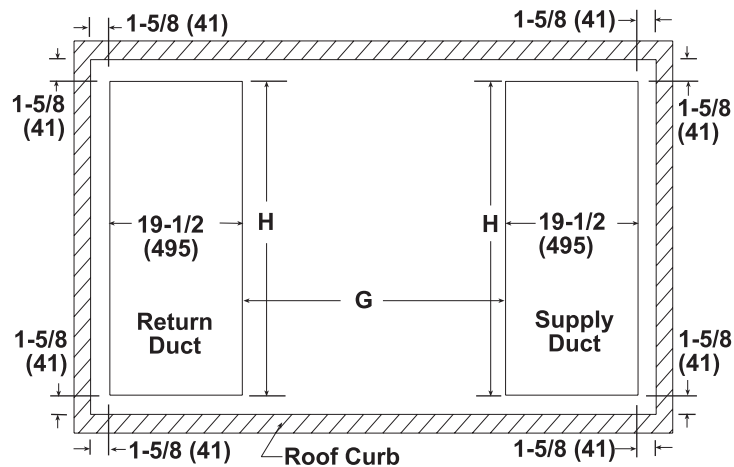


Figure 2. Bottom Duct Opening Dimensions (Refer to [Table 6](#))

Table 6. Bottom Duct Opening Dimensions						
Dimension (See Figure 2)	Unit Size					
	125	150, 175	200, 225	250, 300	350	400
Inches (mm)						
H	17-3/8 (441)	22-7/8 (581)	28-3/8 (721)	36-5/8 (930)	42-1/8 (1070)	47-5/8 (1210)
G*	38-5/8 (981)					

*With downturn plenum (option AQ5 or AQ8).

Optional Curb (Option CJ1 or CJ2) Assembly

NOTE: Curbs are shipped unassembled. Field-assembly and mounting on the roof are the responsibility of the installer. All required hardware necessary to complete the assembly is provided.

1. Position and connect cross rails and side rails as shown in [Figure 3](#).
2. Check assembly for squareness—adjust as necessary so that diagonal measurements are equal within $\pm 1/8$ -inch (± 3 -mm) tolerance.

⚠ CAUTION ⚠

Curb must be leveled in both directions with no twist end-to-end to ensure good weather-tight seal between unit's curb cap and curb.

3. Level curb as necessary using shims.
4. Secure curb to roof deck using hardware provided.
5. Install field-supplied flashing.

NOTE: The system can have a variety of configurations that affect installation. [Figure 3](#) shows a unit with an option AQ5 or AQ8 downturn plenum, which is factory-installed as part of the packaged system. If the system does not have a downturn plenum, the discharge is horizontal.

INSTALLATION—CONTINUED

Mounting Support Structure—Continued

Optional Curb (Option CJ1 or CJ2) Assembly—Continued

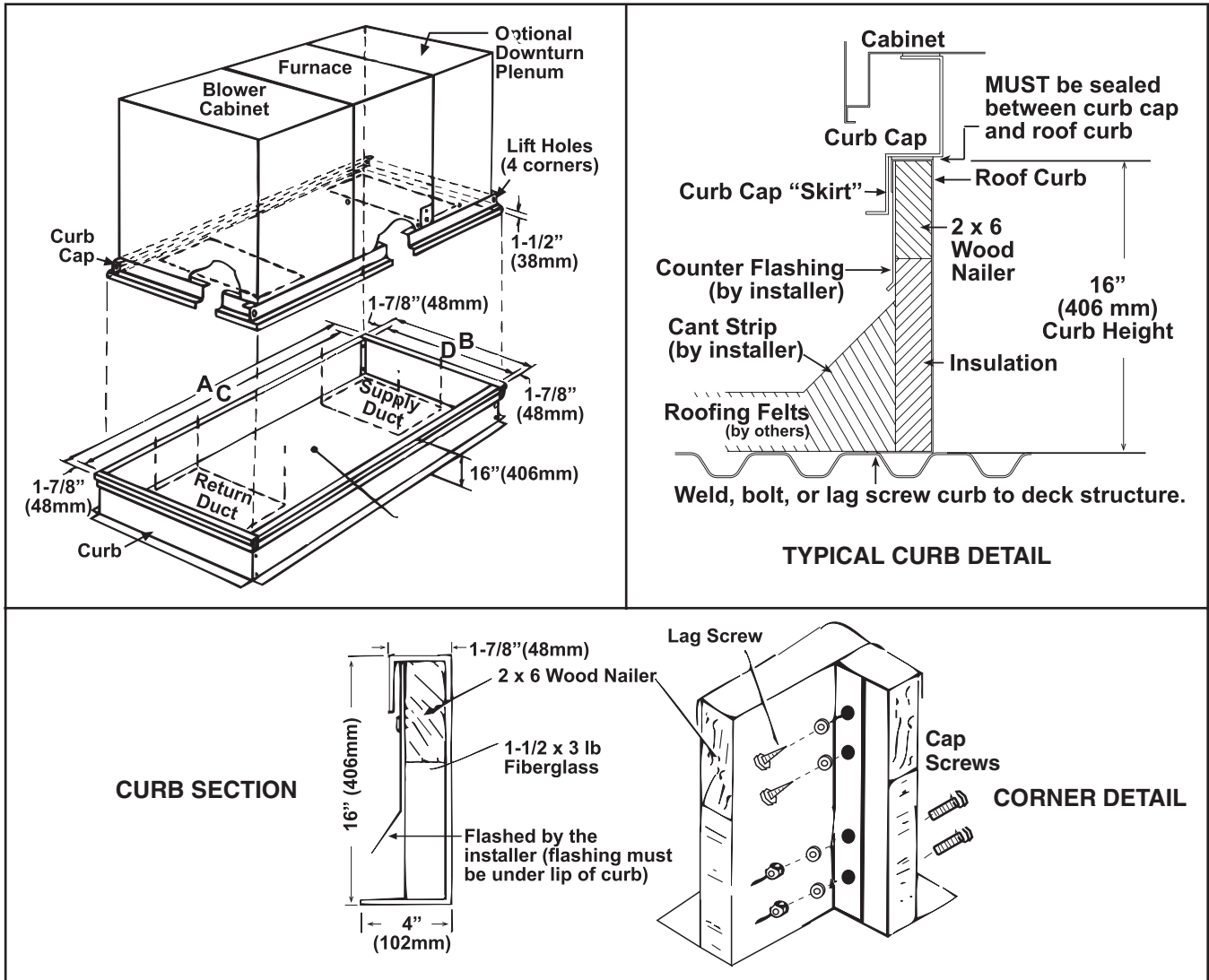


Figure 3. Optional Curb Assembly (Refer to Table 7)

Table 7. Optional Curb Dimensions							
Dimension (See Figure 3)	Option*	Unit Size					
		125	150, 175	200, 225	250, 300	350	400
Inches (mm)							
A	CJ1	60-5/8 (1540)					
	CJ2	84-9/16 (2148)					
B	CJ1, CJ2	24-5/16 (618)	29-13/16 (757)	35-5/16 (897)	43-9/16 (1106)	49-1/16 (1246)	54-1/2 (1384)
C**	CJ1	56-15/16 (1446)					
	CJ2	80-13/16 (2053)					
D**	CJ1	20-9/16 (522)	26-1/16 (662)	31-9/16 (802)	39-13/16 (1011)	45-5/16 (1151)	50-13/16 (1291)
	CJ2	20-9/16 (522)	26-1/16 (662)	31-9/16 (802)	39-13/16 (1011)	45-5/16 (1151)	50-13/16 (1291)
E***	CJ2	25-7/8 (657)	31-3/8 (797)	36-7/8 (937)	45-1/8 (1146)	50-5/8 (1286)	56-1/8 (1426)
F***		99-5/32 (2519)	104-21/32 (2658)	110-5/32 (2798)	118-7/16 (3008)	123-15/16 (3148)	129-7/16 (3288)

*Option CJ2 is for units with a factory-installed downturn plenum (option AQ5 or AQ8).
 **Roof opening dimensions.
 ***Inside dimension of curb cap.

Field-Supplied Support Assembly

NOTE: If considering this type of installation in snow areas, it is recommended that the 4 × 4 wooden rails underneath the system be on a cross-support structure at least 12 inches higher than the roof surface. Whether the supports are mounted directly on the roof or placed up on an additional structure, the horizontal length of the system should be supported by two 4 × 4 treated wooden rails.

1. Cut treated 4 × 4 wooden rails for length in accordance with dimension A (see **Figure 4**, DETAIL A).
2. Space rails in accordance with dimension B (see **Figure 4**, DETAIL A) so that curb cap skirt fits over edge of boards with rails sitting inside horizontal length of curb cap. If rails are being laid directly on roof, position them as shown in **Figure 4**, DETAIL A).
3. If rails are not being placed directly on roof surface, install cross-supports underneath rails at ends of unit and at all cabinet joints: between blower cabinet and furnace section and between furnace and optional downturn plenum (see **Figure 4**, DETAIL B).

NOTE: The field-supplied, weather-resistant cross-support structure must be adequate for the weight of the system. Cross-supports should run the entire width of the system to support the rails at the recommended locations (see **Figure 4**, DETAIL A).

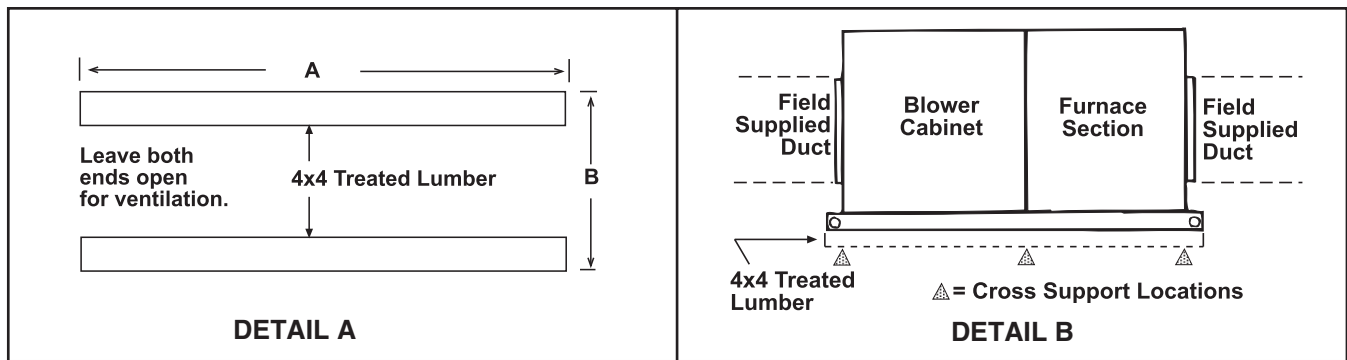


Figure 4. Field-Supplied Support Assembly (Refer to Table 8)

Table 8. Field-Supplied Support Assembly Dimensions						
Dimension (See Figure 4)	Unit Size					
	125	150, 175	200, 225	250, 300	350	400
Inches (mm)						
A	60-5/8 (1540)					
	84-9/16 (2148)*					
B	24-5/16 (618)	29-13/16 (757)	35-5/16 (897)	43-9/16 (1106)	49-1/16 (1246)	54-1/2 (1384)

*With downturn plenum (option AQ5 or AQ8). Although dimensions are included for units with a downturn plenum cabinet, it is strongly recommended that a full roof curb be used on an installation with a downturn plenum cabinet and/or a bottom return air duct.

INSTALLATION—CONTINUED

Mounting

⚠ DANGER ⚠

Use a suitable hoist to lift the unit (refer to [Weights](#) section). Lifting holes are provided for rigging. Use spreader bars when lifting to prevent chains or cables from damaging the unit.

⚠ CAUTION ⚠

IMPORTANT: To prevent damage from wind blown rain and capillary action, the top surface of the curb **MUST be sealed using 1/4-inch × 1-1/4-inch sealant tape or two 1/4-inch beads of suitable sealant.**

NOTE: If the system includes an outside air hood, install it after the unit is in place.

1. Apply furnished 1/4-inch × 1-1/4-inch foam sealant tape or two 1/4-inch beads of suitable sealant to top surface of curb, making good butt joints at corners.
2. Lift unit using suitable hoist and spreader bars and set it on curb or rails. If set on rails, leave ends open underneath for ventilation.

Duct Connections

- **Inlet air:** Depending on how the unit was ordered, the blower cabinet can have a variety of outside air and return air inlets. Check the unit to be aware of the inlet air requirements for your installation.
 - a. The cabinet end can be open, requiring a field-installed hood (option AS2), or the cabinet end can have a duct flange.
 - b. Options AR6 and AR7 have a 30% outside air hood and a one-louver damper.
 - c. If the unit is ordered with an evaporative cooling module (option AS3, AS4, AS5, or AS8), the module is factory-installed on the blower cabinet and is the point of entry for outside air.
 - d. With either a hood or a duct flange, the inlet can have a damper. Dampers are available in a variety of configurations with a variety of controls (AR options).
 - e. When ordered, a filter rack with a variety of filter options, is factory-installed in the blower cabinet. Refer to the replacement parts manual listed in [Table 1](#) for replacement filters.
- **Supply air discharge:** The system has either a horizontal or vertical discharge air opening with a duct flange. If the discharge outlet is vertical, the system was ordered with a factory-installed downturn plenum (AQ option).
- **Air opening dimensions:** Refer to [Table 2](#).

Requirements and Suggestions for Connecting and Installing Ducts

- **Type of ductwork:** The type of duct installation to be used depends in part on the construction type of the roof—whether wood or steel bar joist, steel truss, or pre-cast concrete—and the ceiling—whether hung, flush, etc.
- **Ductwork material:** Rectangular duct should be constructed of galvanized iron—not lighter than No. 26 US gauge—or aluminum—No. 24 B&S gauge.
- **Ductwork structure:** All duct sections 24 inches (610 mm) or wider and over 48 inches (1,219 mm) 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 duct through masonry walls with 1-inch (not less than 1/2-inch) of insulation.
- **Through unheated space:** Insulate all exposed warm air ducts passing through an unheated space with 1-inch (not less than 1/2-inch) 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 duct size is the Air Conditioning Contractor's Association, 2800 Shirlington Road, Suite 300, Arlington, VA 22206 (www.acca.org). A manual covering duct sizing in detail may be purchased directly from them.

⚠ CAUTION ⚠

To prevent possible motor overloading, ensure that the external duct system static pressure is within the limits shown on the rating plate and that the motor pulley and belt are properly adjusted.

- **Access panels:** Install removable access panels (see [Figure 5](#)) on both the upstream and downstream sides of the furnace. The access panels must be accessible when the furnace is in service and should be a minimum of 6 × 10 inches (152 × 254 mm) in size so smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. Ensure that the access panels are installed in such a manner so as to prevent leakage.

⚠ CAUTION ⚠

The joint where the supply air duct attaches to the furnace must be sealed securely to prevent air leakage into draft hood or burner rack area. Leakage can cause poor combustion and pilot problems, can shorten heat exchanger life, and can cause poor performance.

- **Supply air duct/furnace horizontal connection:** The seal between the furnace and the duct must be mechanical using U-type flanges on the top and bottom of the connecting duct to ensure tight joints and an airtight fit. Refer to [Figure 5](#) and perform the following steps:
 - Ensure that flanges on the furnace (heat exchanger) turn out as shown.
 - Shape duct connection as shown: U-type on top and bottom and L-type on sides.
 - Slide U-channels over furnace top and bottom flanges making connection.
 - Form U-channels to seal sides (see [DETAIL A](#)) and drill and lock with sheet metal screws.
- **Bottom duct/furnace connection:** On outdoor models, insert ducts from below the roof deck through the roof opening into the heater. Form 1-inch (25-mm) flanges, fold over, and fasten with sheet metal screws inside the heater. Gain access to the unit by removing side panels from the blower and downturn plenum sections. Ducts must be attached and sealed to provide airtight connections.
- **Return air duct/furnace connection:** All return air ducts should be attached and sealed to the return air flanges to provide airtight connections.
- **Return air duct/grill size:** Ensure that return air ducting or grills have a free area equal to the size of the return duct connection.

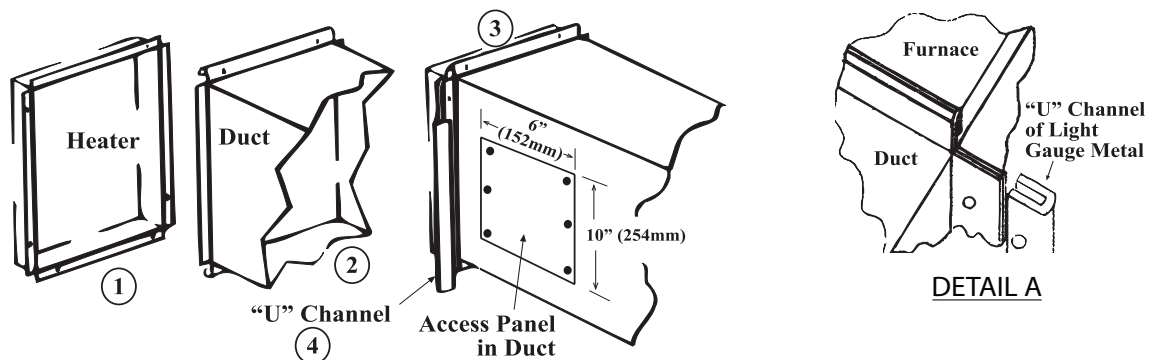


Figure 5. Connecting Ductwork to Furnace

INSTALLATION—CONTINUED

Duct Connections—Continued

100% Outside Air Hood (Option AS2)

⚠ CAUTION ⚠

It is recommended that the inlet to the outside air hood NOT be facing into the prevailing wind. Allow a minimum clearance of 14 inches (356 mm) from the bottom of the air hood to the mounting surface.

Option AS2 is a weatherized, screened hood designed to be field-assembled and installed around the horizontal inlet air opening of the blower cabinet. The air hood includes factory-assembled louvers designed to help eliminate moisture from the inlet air. Complete installation instructions are packaged with the air hood and are listed in [Table 1](#).

Screened Air Hood for 30% Outside Air Opening

The outside air hood included in the air inlet options that have a 30% outside air opening (options AR6 and AR7) is shipped separately for field-installation. Complete installation instructions are packaged with the air hood and are listed in [Table 1](#).

Evaporative Cooling Module (Option AS3, AS4, AS5, or AS8)

The evaporative cooling module is factory assembled, installed and wired. No additional roof mounting is necessary. Refer to the installation manual listed in [Table 1](#) to field-connect the water supply and to make necessary checks and adjustments before operating the cooling module.

Discharge Air Temperature Sensor Installation

- Makeup air option AG3 (refer to [Optional Ductstat with Capillary Tubing \(Option AG3\)](#) section) has a ductstat with a capillary sensor that is factory-installed in the unit discharge.
 - Makeup air options AG8, AG9, AG15, AG39, and AG40 require field installation of the sensor in the discharge ductwork.
 - Option AG15 includes a box and sensor holder. Options AG8, AG9, and AG39 include a sensor and mixing tube.
 - On units with option AG40, the discharge sensor is field-supplied.
 - Follow the instructions below to install the sensor in the ductwork.
1. Determine distance of sensor from unit:
 - a. Ensure that there is sufficient distance from outlet to have good mixture of discharge air temperature.

NOTES:

- **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 duct cross-sectional dimensions).**
 - **Locate the sensor a minimum of 96 inches (2,435 mm) from the outlet of the unit.**
 - **If the length of the discharge duct is less than 8 feet (2.4 meters), a mixing vane is recommended for mixing the discharge air. Do not mount the sensor in the ductwork after a split in the supply as this will cause loss of control in the duct that does not house the sensor.**
-

- b. Refer to following formula for calculating sensor placement. This example assumes cross-sectional dimensions for supply ductwork of 24 × 12 inches (610 × 305 mm):

$$5 \text{ equivalent duct diameters} \times \sqrt{\frac{4 \times 12 \times 24}{3.14}} = 96 \text{ inches}$$

$$5 \text{ equivalent duct diameters} \times \sqrt{\frac{4 \times 305 \times 610}{3.14}} = 2435 \text{ millimeters}$$

2. Determine orientation of sensor:
 - a. In horizontal ductwork, position sensor in top-middle of duct with sensor probe extending vertically down into center of air stream.
 - b. In vertical ductwork, position sensor in middle of duct that corresponds with top-middle of discharge outlet.
3. Secure sensor in ductwork:
 - a. For units with option AG3, sensor is factory-installed.
 - b. For units with option AG8, AG9, AG15, or AG39:
 - (1) Position of sensor in duct is also important—mixing tube shown in **Figure 6**, DETAIL A is 12 inches (305 mm) long and holder shown in **Figure 6**, DETAIL B extends 9-3/16 inches (233 mm) into ductwork.
 - (2) Turn holder so that element is shielded from direct airflow and will sense air temperature as it flows through holes in holder.
 - (3) At selected ductwork location, mark diamond-shaped hole—approximately 1 × 1 inch (25 × 25 mm—required for sensor holder or round hole required for mixing tube and cut hole no larger than necessary.
 - (4) For units with option AG8, AG9 or AG39, slide mixing tube (see **Figure 6**, DETAIL A) into ductwork and attach sensor.
 - (5) For units with AG15, push element into clip in holder (see **Figure 6**, DETAIL B), slide holder into ductwork, and position holder so that it shields sensor from direct airflow. Secure box portion of holder to ductwork using four field-supplied #6 sheet metal screws.
 - c. For units with option AG40, install field-supplied sensor in accordance with instructions provided with sensor.

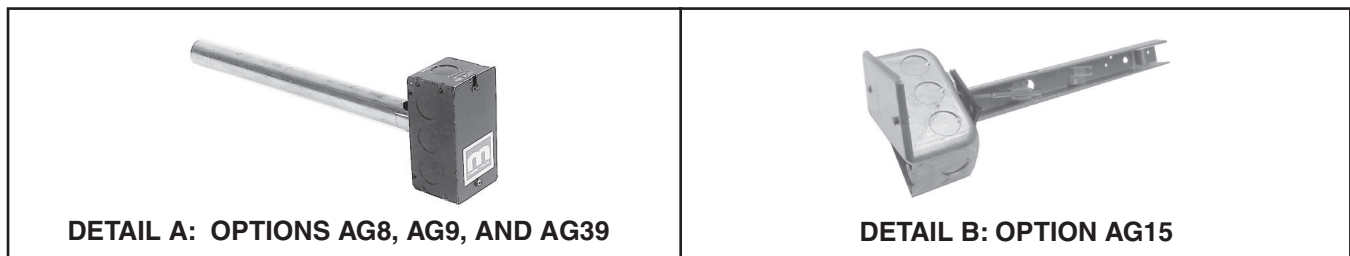


Figure 6. Discharge Air Temperature Sensor and Holder

4. Connect sensor wires:
 - a. For units with option AG15:
 - (1) Determine where sensor wire should enter box and remove knockout.
 - (2) Secure field-supplied cable connector to box, connect sensor wire, and install box cover.
 - b. For all options, ensure that all sensor wires are connected in accordance with wiring diagram provided with unit.

INSTALLATION—CONTINUED

Venting Connections

- Locate power-vented furnaces so that flue discharge is not directed at fresh air inlets. The flue discharge openings are located on the side of the furnace just above the control access panel. The position of this opening discourages recirculation of combustion products and provides for furnace operation in all normal weather conditions.
- **Optional vertical flue discharge (option CC3):** These power vented furnaces are certified with 4 feet of vertical pipe connected as shown in **Figure 7**, DETAIL A. The distance is measured from the top of the unit to the bottom of the vent cap. The vent pipe and supports are field-supplied. Optional vertical vent piping provides compliance with local codes that require either 10-foot horizontal or 4-foot vertical clearance between the flue outlet and the fresh air intake of the heating system and/or building. The option package (PN 45021) includes the 5-inch vent cap, the adapter assembly, and the seal plate as shown in **Figure 7**, DETAIL B. Attach venter seal plate and oval adapter assembly with sheet metal screws. Use venter seal plate as drill template.

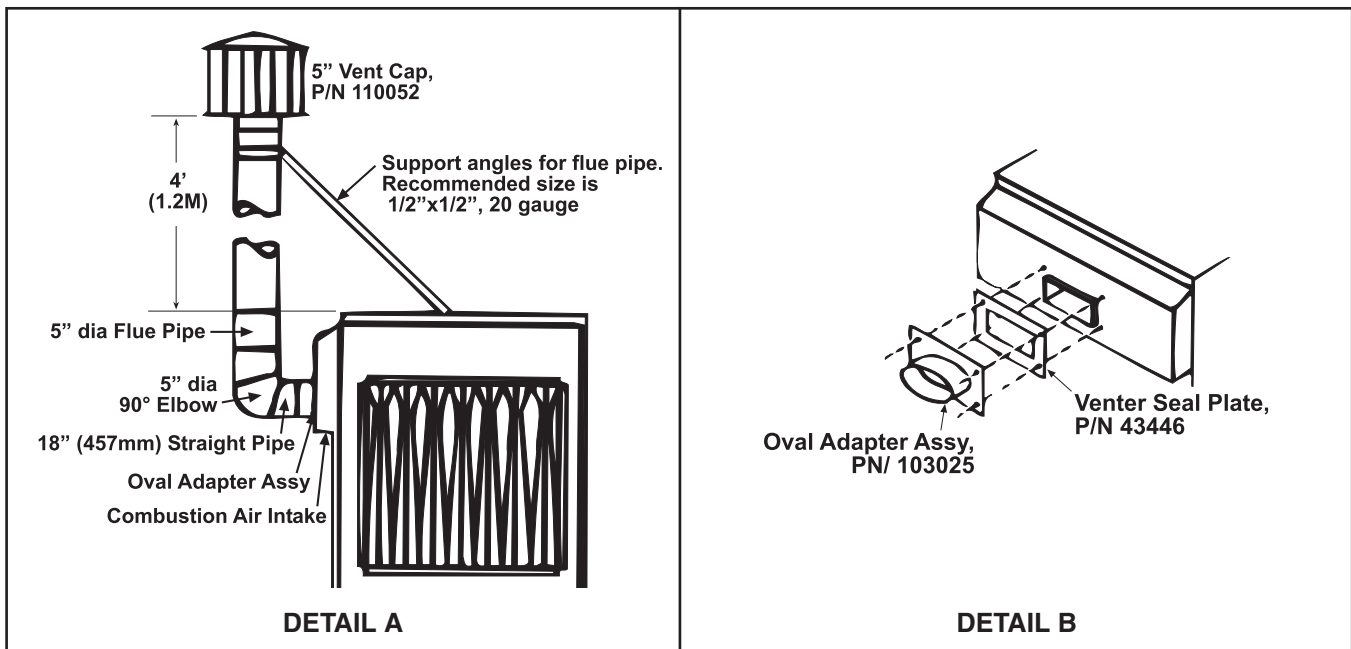


Figure 7. Optional Vertical Flue Discharge

Piping Connections

Gas Supply Pressure

The unit is equipped for a maximum gas supply pressure of 1/2 psi, 3.5 kPa, or 14 IN WC.

NOTES:

Supply pressure higher than 1/2 psi requires the installation of an additional service regulator external to the unit.

PRESSURE TESTING SUPPLY PIPING

- Test pressures *above* 1/2 psi—disconnect the heater and manual valve from the gas supply line to be tested. Cap or plug the supply line.
 - Test pressures *below* 1/2 psi—before testing, close the manual valve on the heater.
-

⚠ DANGER ⚠

- All components of a gas supply system must be leak tested prior to placing equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. Failure to comply could result in personal injury, property damage, or death.
- 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.

- All piping must be in accordance with requirements outlined in the *National Fuel Gas Code* ANSI/Z223.1 (latest edition) or the *Natural Gas and Propane Installation Code* CSA B149.1 (refer to [Installation Codes](#) section).
- Gas supply piping installation should conform with good practice and with local codes.
- The heater is orificed for operation with natural gas having a heating value of 1,000 (±50) BTU per cubic foot or with propane gas having a heating value of 2,550 (±100) BTU per cubic foot. Sizing of gas supply lines depends on piping capacity and is based on cubic feet per hour based on a 0.3 IN WC pressure drop, a 0.6 specific gravity for natural gas at 1,000 BTU per cubic feet, and a 1.6 specific gravity for propane at 2,550 BTU per cubic feet. If the gas at the installation does not meet this specification, consult the factory for proper orificing.
- Variables for sizing gas supply lines are listed in [Table 9](#). 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 Supply Line Sizes

Length of Pipe (Feet)	Diameter of Pipe (Inches)											
	1/2		3/4		1		1-1/4		1-1/2		2	
	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas
Cubic Feet per Hour												
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

Supply Piping Connections

- Install a ground joint union and manual shutoff valve upstream of the unit control system. The 1/8-inch plugged tapping in the shutoff valve provides connection for the supply line pressure test gauge. The *National Fuel Gas Code* requires the installation of a trap with a minimum 3-inch drip leg. Local codes may require a longer drip leg, typically 6-inch (see [Figure 8](#), DETAIL A).
- Gas connection location and requirements are shown in [Figure 8](#), DETAIL B.
- Install the gas supply piping so that when the union is disconnected, the supply pipe will not interfere with the removal of the burner rack (see [Figure 8](#), DETAIL C). The burner rack slides out of the control side of the furnace.
- Seal the opening for the gas supply pipe with the grommet provided.
- After all connections are made, disconnect the pilot supply at the control valve and bleed the system of all air. Reconnect the pilot line and leak test all connections by brushing on a soap solution.
- Gas connections sizes are listed in [Table 10](#).

INSTALLATION—CONTINUED

Piping Connections—Continued

Supply Piping Connections—Continued

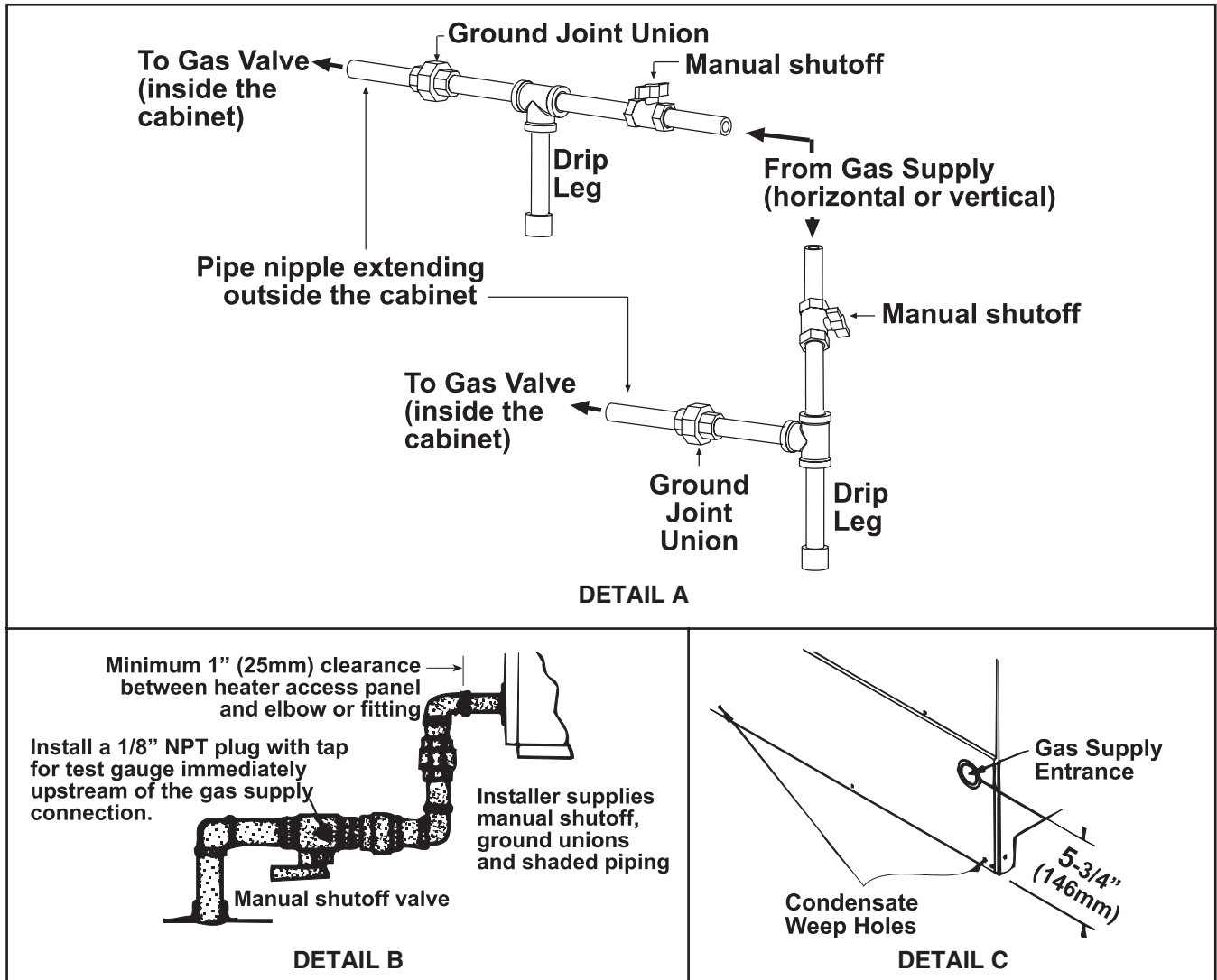


Figure 8. Gas Connections

Table 10. Gas Connection Sizes

Gas Type	Unit Size	
	125–250	300–400
	Connection Size (Inches (mm))	
Natural gas	1/2 (13)	3/4 (19)
Propane	1/2 (13)	

NOTE: The above are not supply line sizes. They are gas connection sizes for a standard unit.

Electrical Connections

⚠ 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 the sensor lead wires, which must be rated at 150°C.
- All external wiring must be within approved conduit and have a minimum temperature rise of 60°C.
- Keep electric and gas supply components clear of service panels.

NOTE: Ensure that all wiring is in accordance with the wiring diagram provided with the unit. Electrical options are identified on this wiring diagram. Refer to separate instruction sheets for any optional equipment provided.

- All electrical wiring and connections, including electrical grounding, MUST be made in accordance with local, state, and national codes and regulations and with the *National Electric Code* (ANSI/NFPA 70) or, in Canada, the *Canadian Electric Code*, Part 1 (CSA C.22.1).
- Check any local ordinances or gas company requirements that apply.
- Check the rating plate on the heater for the supply voltage and for 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 junction box.
- **Convenience outlet:** When a convenience outlet (option BC) is included, a separate power supply must be provided to the receptacle. This circuit MUST BE on a ground fault breaker to meet requirements.
- **Disconnect switch:** A disconnect switch is a required part of this installation. Switches are available as options or parts or may be supplied locally. When ordered as an optional component, the disconnect switch is shipped separately. The disconnect switch may be fusible or non-fusible. When providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size according to 1.25 × maximum total input amps. When installing, ensure that the conduit and switch housing are clear of furnace panels and inspection plates. Allow at least 4 feet (1.2 meters) of service room between the switch and removable panels (see [Figure 9](#)). Refer to [Table 11](#) for field-supplied wiring sizes—from disconnect to electrical box—for connection to the motor contactor or starter.

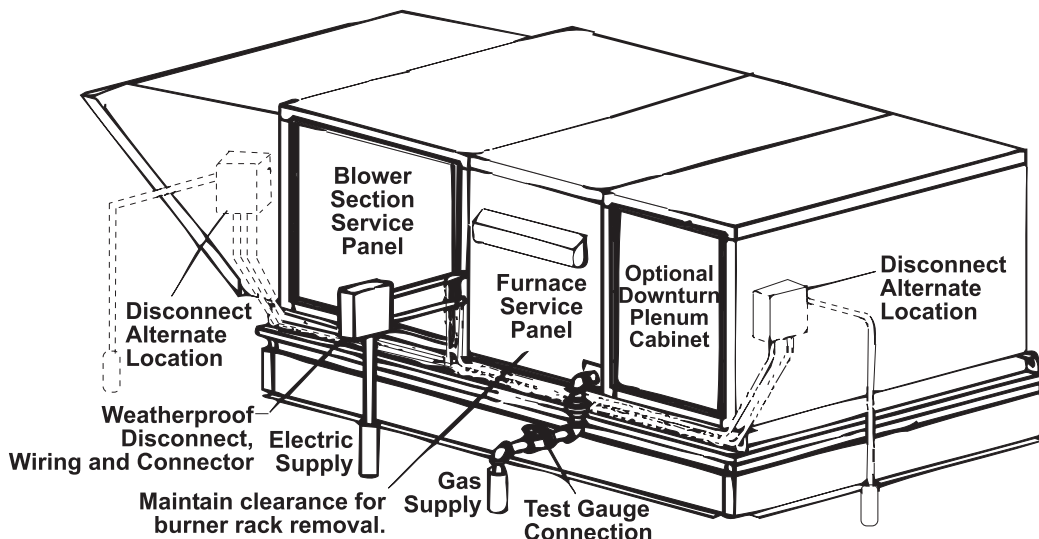


Figure 9. Disconnect Switch Locations

INSTALLATION—CONTINUED

Electrical Connections—Continued

Table 11. Field-Supplied Wiring Sizes			
Voltage/Phase	Motor HP	Wire Gauge	BX Cable
208–230/1	1–1-1/2	14	3/8-inch
208–230/3	1/4–3	14	
	5	12	
460/3	1/4–5	14	
575/3	1/2–5	14	

Control Wiring

- There are a variety of optional controls (see [Figure 10](#)) available as part of the gas and air control options. Optional shipped-separate heating and makeup air controls could include a single or two-stage **thermostat**, system switches, Selectrastat, discharge temperature low limit, an automatic night setback device, a Maxitrol temperature selector, a potentiometer, a pressure null switch, or a combination of these controls. Install controls according to the manufacturer's instructions packaged with the heater. Refer to [Table 12](#) for amp ratings of optional controls. Refer to [Table 13](#) for the recommended maximum length and minimum gauge of control wiring.

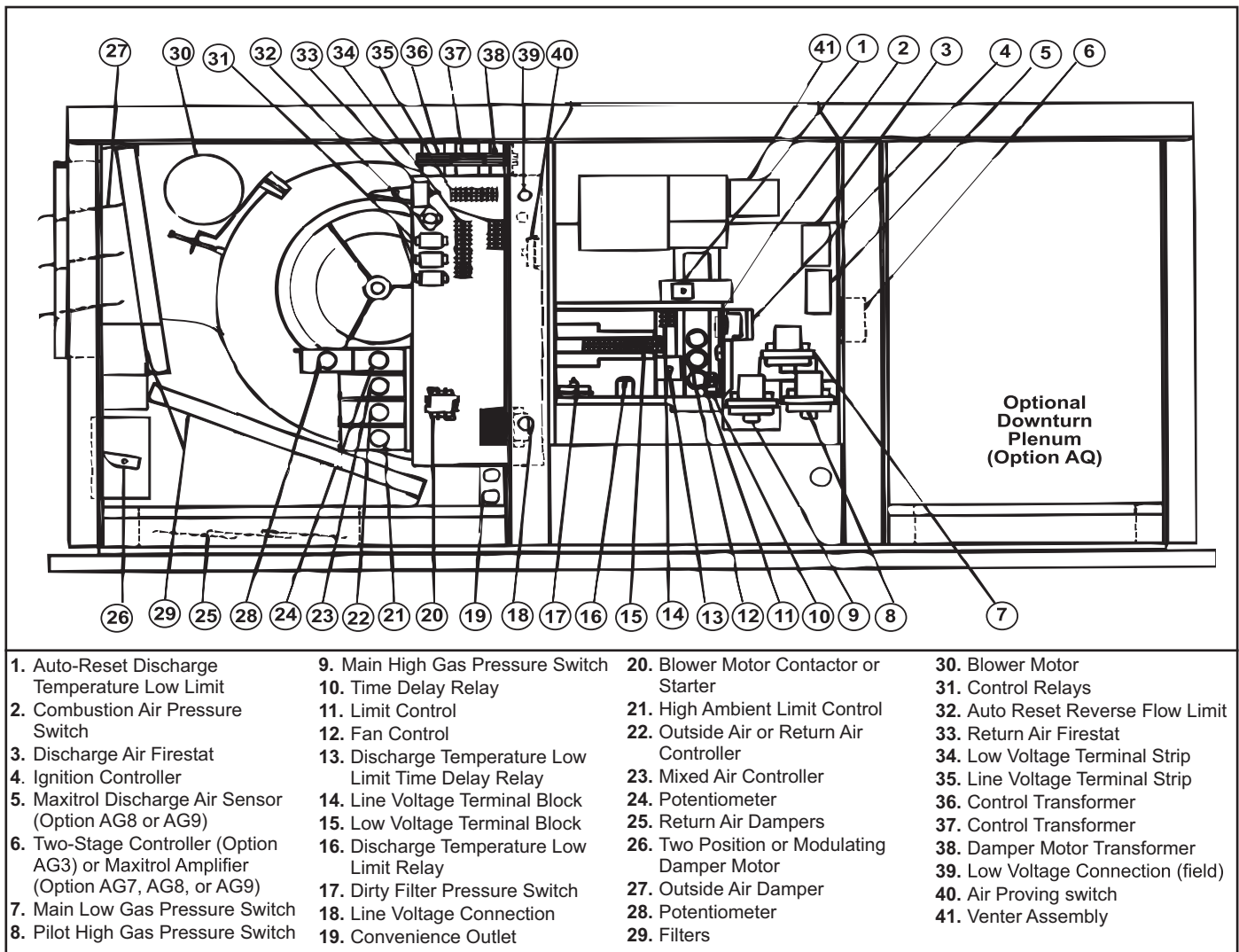


Figure 10. Control Locations

Control	Ampere Rating (Maximum Amps)
Fan control	0.12
Time delay relay heater	0.10
Relay coil	0.12
Motor contactor coil	0.33
Spark ignition system	0.10
Maxitrol gas control system	0.50
Single-stage gas valve	0.60
Two-stage gas valve	0.60

Distance from Unit to Control (Feet (Meters))	Minimum Recommended Wire Gauge (AWG)	Total Wire Length (Feet (Meters))
75 (23)	#18	150 (46)
125 (38)	#16	250 (76)
175 (53)	#14	350 (107)

⚠ CAUTION ⚠

Ensure that the thermostat has an adequate VA rating for the total requirements. Add the coil rating of all relays and match the thermostat rating.

- **Thermostat:** A 24V thermostat must be used to actuate low voltage gas controls. If line voltage from the thermostat to the unit is desired, consult the factory representative. Thermostats should be located 5 feet (1.5 meters) above the floor on an inside wall, not in the path of warm or cold air currents and not in corners where air may be pocketed. Do NOT install on cold air walls. For specific connection details, refer to instruction packet with the thermostat. If more than one unit is cycled from one thermostat, separately activated relays must be substituted at unit thermostat connections.
- **Remote console:** If the unit being installed includes an optional remote console, it is shipped separately for field installation. All consoles include indicator lights for the blower and burner. Consoles may include a dirty filter indicator light, a cooling indicator light, an ON/OFF switch, a summer/off/winter switch, a heat/vent/cool switch, a potentiometer, a thermostat, and/or a Maxitrol temperature selector. Consoles are shipped separately for remote installation and may be either mounted on a wall or recessed.
- **Maxitrol system:** Control wires connected to a Selectrastat, 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. Doing so may cause the unit to function erratically or may destroy the amplifier. If shielded wires are used, shield must be insulated and grounded at the amplifier location only.
- **Pressure null switch:**
 - a. Select indoor location free from excessive vibration where oil or water will not drip onto switch and where ambient temperature is -30°F (dry air) to 110°F.
 - b. Mount switch with diaphragm in vertical plane. Switch is position-sensitive and is calibrated to operate properly when diaphragm is vertical. Mount switch securely.
 - c. Connect pressure taps on top of switch to sources of air pressure differential. Metal tubing with 1/4-inch OD is recommended, but any tubing system that does not unduly restrict air flow may be used. To maintain positive building pressure, vent low pressure tap to outdoors and allow high pressure tap to monitor building pressure. To maintain negative building pressure, reverse functions of high and low pressure taps. In either case, ensure that outdoor vent is protected from wind and is screened from insects.
 - d. Adjustment of switch: HIGH actuation point of switch is indicated on calibrated scale secured to transparent range screw enclosure. Building pressure is set by turning adjustment screw. LOW actuation point is set by adjusting span of null by turning span adjustment screw. Span range is 0.01 to 0.03 IN WC.
 - e. Refer to wiring diagram provided with unit to make electrical connections.

CONTROLS

Control locations are shown in [Figure 10](#). For information on system controller options D19, D21, D22, and D23, refer to the control system guide listed in [Table 1](#).

Thermostat

A [thermostat](#) is not standard equipment but is an installation requirement. Use either an optional [thermostat](#) available with the system or a field-supplied [thermostat](#). Install according to the [thermostat](#) manufacturer's instructions.

Remote Console

A selection of remote consoles is available with certain appropriate combinations of controls factory mounted. All consoles include indicator lights for the blower and burner, an off/on system switch, and terminal block wiring.

Combustion Air Proving Switch

⚠ DANGER ⚠

Safe operation requires proper venting flow. Never bypass the combustion air proving switch or attempt to operate the unit without the venter running and proper flow in the vent system. Hazardous conditions could result.

- The combustion air proving switch ensures that proper combustion airflow is available. The switch is a single-pole, double-throw switch that senses pressure caused by the flow of combustion air from the venter. The switch is designed to close when a decreasing pressure is sensed in the outlet duct of the gas collection box.
- At startup when the furnace is cold, the sensing pressure is at the most negative level. As the furnace and the flue system warm up, the sensing pressure becomes less negative. After the system has reached equilibrium (approximately 20 minutes), the sensing pressure levels off. If a restriction or if excessive flue length or turns cause the sensing pressure to become less than the switch setpoint, the pressure switch will function to shut off the main burners. The main burners will remain off until the system has cooled and/or the flue system resistance is reduced. Refer to [Table 14](#) for approximate water column negative pressure readings and combustion air proving switch setpoints for sea level operating conditions.

Unit Size	Factory Setpoint	Startup Cold	Equilibrium
Units Without Option AG39 or AG40			
All	-0.58 (±0.05) IN WC	-1.05 IN WC	-0.73 IN WC
Units with Option AG39 or AG40			
125–225	-0.58 (±0.05) IN WC	-1.30 (±0.20) IN WC	-1.05 (±0.10) IN WC
250–400	-0.58 (±0.05) IN WC	-1.20 (±0.20) IN WC	-0.95 (±0.10) IN WC

Blower Fan Control

NOTE: To replace the blower fan control on units manufactured *before* NOV 2004, a replacement kit (PN [209184](#)) is required.

The blower fan is controlled as follows:

- After the gas valve opens, there is a time delay of blower fan operation to prevent the discharge of cold air.
- Blower fan operation continues after the [thermostat](#) is satisfied, as determined by the fan time delay.
- To ensure that the blower fan can continue to operate, the power supply to the furnace **MUST NOT** be interrupted except for when servicing the unit.

NOTE: If the customer wants the furnace off at night, the gas valve circuit **SHOULD BE OPENED by a single-pole switch wired in series with the [thermostat](#). Some thermostats are provided with this feature. Multiple units controlled from a single [thermostat](#) are shut off in the same manner. For proper operation, ensure that the blower fan control is wired correctly.**

Limit Control

Heaters are equipped with a non-adjustable high limit switch that shuts off the gas in the event of motor failure, lack of air due to dirty filters, or restrictions at the inlet or outlet of the unit.

Reverse Flow Limit Control

These outdoor furnaces are factory-equipped with an automatic-reset reverse flow limit control. This control is located in the blower compartment, is mounted in the blower junction box adjacent to the blower inlet opening, and is wired in series with the main limit control mounted on the heat exchanger duct side. In case of belt breakage or motor failure, the limit control will be opened by the high temperatures caused by reverse flow from the heat exchanger to the blower compartment, thus breaking the circuit to the automatic electric gas valve and preventing burner operation.

High Ambient Limit Control

The optional high ambient limit control functions to shut off the burner when the entering outside air reaches a set temperature. The temperature setting is field-adjustable from 0°F to 100°F.

Airflow Proving Switch (Makeup Air with Option BW1)

The optional airflow proving switch ensures that the circulating air blower provides an adequate amount of airflow prior to the unit being fired. The switch is a single-pole/normally-open device that closes when an increase in pressure above the setpoint is sensed in the circulating air blower. Contacts are set to close at 0.10 IN WC (+0.05 or -0.02 IN WC). The switch is located in the blower junction box.

Variable Frequency Drive

- When an optional variable frequency drive 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.
- Follow the variable frequency controller manufacturer's instructions that are packaged with the heater (in the owner's envelope) to program the variable frequency drive settings. The formula for motor speed is $N = 120 \times f/p$ where N = speed, f = frequency, p = number of poles, a 3,600-rpm motor has two poles, and an 1800-rpm motor has four poles. For example, for an 1,800-rpm motor at 60Hz, $N = 120 \times 60/4 = 1800$ (1,800 = synchronous speed, assume 2% slip).
- The motor will run between 1,750 and 1,790 rpm at full load depending on design. For the same motor run at 45Hz, $120 \times 45/4 = 1350$ (1,350 rpm less 2% slip = about 1,300 rpm).

Combination Gas Valve

WARNING

The combination gas valve is the prime safety shutoff. To ensure positive closure, all gas supply lines must be free of dirt or scale before connecting them to the unit.

All furnaces are equipped with a 24V combination gas valve that includes the automatic electric ON/OFF valve controlled by the room [thermostat](#), the pressure regulator, the safety pilot valve, and the manual shutoff valve. The standard combination gas valve allows for single-stage control from a single-stage, 24V [thermostat](#).

Optional Two-Stage Control (Heating Only Application)

The standard combination control valve is replaced with a two-stage combination gas control valve providing for low fire or high fire operation controlled by a two-stage [thermostat](#). The first stage (low fire) is factory-set (not field-adjustable). Both low fire and high fire stages are controlled by a Servo regulator that maintains constant gas input under wide variations in gas supply pressure. Refer to the instructions provided with the unit for gas valve specifications, wiring, and operating instructions.

CONTROLS—CONTINUED

Optional Two-Stage Control (Makeup Air Application)

- 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 discharge air temperature drops to the setpoint, low fire is energized. If low fire cannot satisfy the ductstat setting, high fire is energized.
- Makeup air applications are usually adjusted to maintain discharge 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 selection, the factory-installed sensor is either field-connected by capillary tubing to the unit-mounted ductstat (see **Figure 11**, DETAIL A), which is factory-set at 70°F, or electrically-connected to a remote electronic temperature selector (see **Figure 11**, DETAIL B).

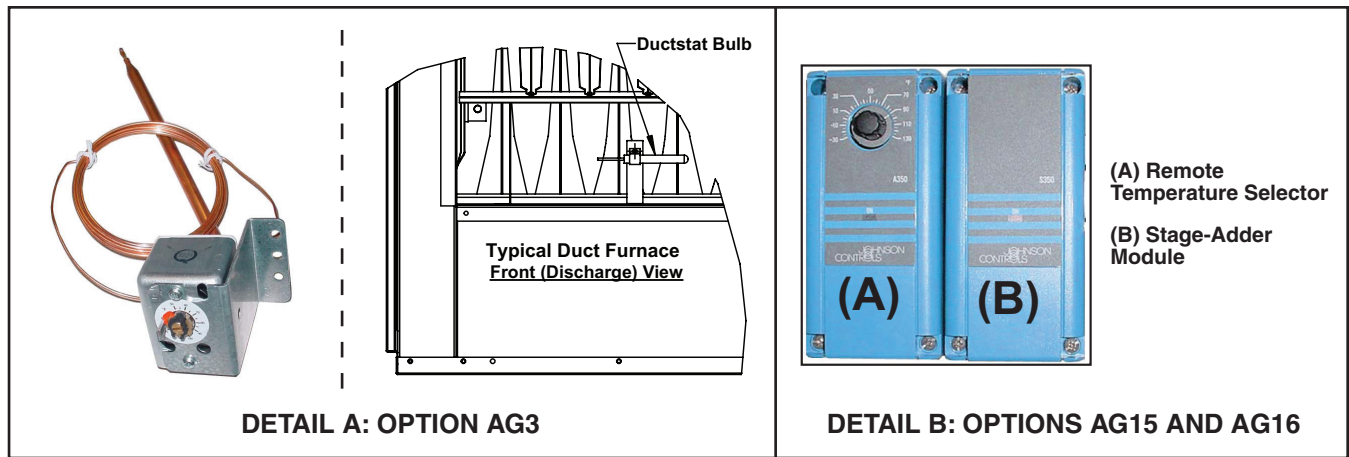


Figure 11. Ductstat Options

Optional Ductstat with Capillary Tubing (Option AG3)

The unit-mounted ductstat shown in **Figure 11**, DETAIL A has an adjustable range between 0°F and 100°F with a fixed differential of 3°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 (Option AG15)

The field-installed sensing probe is field-wired to the remote temperature selector shown in [Figure 11](#), DETAIL B, which has a temperature operating range to 130°F. The remote modules and sensing probe are shipped separately for field-installation. Follow the wiring diagram provided with the unit and the manufacturer's instructions for wiring and installation. One module is for selecting temperature and one module is a one-stage adder module.

⚠ CAUTION ⚠

Ensure that the heat/cool selector switch on the remote temperature selector is positioned to *Heat*.

Optional Electronic Modulation

NOTE: Unit sizes 350 and 400 with electronic modulation require a minimum natural gas supply pressure of 6 IN WC.

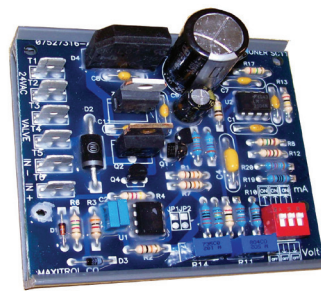
The type and capability of the electronic modulation system depends on the option selected. Electronic modulation options are identified by a suffix to the serial No. printed on the heater rating plate. AG7 is identified as MV-1, AG8 is identified as MV-3, AG9 is identified as MV-4, AG21 is identified as MV-A, AG39 is identified as MP-1, and AG40 is identified as MP-2.

Electronic Modulation Between 50% and 100% Firing Rate (Option AG7, AG8, or AG9)

- Depending on the heat requirements 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) that furnishes varying DC current to the modulating valve to adjust the gas input.
- Each modulating valve is basically a regulator with the 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 to supply 3.5 IN WC pressure to the combination gas valve.
- Refer to the wiring diagram provided with the furnace for proper wiring connections.
- Electronic modulation for heating that is controlled by a specially-designed room [thermostat](#) (60–85°F) is identified as option AG7.
- Electronic modulation for makeup air application that is controlled by a duct sensor and temperature selector (55–90°F) is identified as option AG8 or AG9. The temperature selector setting for option AG8 is on the amplifier (see [Figure 12](#)). Option AG9 has a remote temperature selector. Both systems are available with an override [thermostat](#).



AMPLIFIER



SIGNAL CONDITIONER

Figure 12. Maxitrol Amplifier and Signal Conditioner

CONTROLS—CONTINUED

Optional Electronic Modulation—Continued

Computer-Controlled Electronic Modulation Between 50% and 100% Firing Rate (Option AG21)

- With option AG21, the furnace is equipped with a Maxitrol signal conditioner (see [Figure 12](#)) that operates much the same way as the amplifier above to control the regulator valve. The signal conditioner accepts an input signal of either 4–20 milliamps or 0–10V from a customer-supplied control device such as a computer.
- With the dip switches on the conditioner positioned to ON, the conditioner accepts a 4–20 milliamp signal. With the dip switches on the conditioner positioned to OFF, the conditioner accepts a 0–10V signal. The conditioner converts the signal to the 0–20V DC current required to control the modulating valve.

Electronic Modulation Between 20–28% and 100% Firing Rate (Option AG39)

NOTE: Option AG39 is available only with natural gas and is not available on unit size 350.

- Depending on its size, a furnace equipped with option AG39 has a 20–28% turndown ratio. The furnace will ignite at any input rate in the available range and will maintain average thermal efficiencies equal to or greater than the thermal efficiency at full fire.
- The gas train (see [Figure 13](#)) includes a single-stage gas valve, a modulating valve, and two gas pressure switches. The burner rack is equipped with one flash carryover and a regulated gas lighter tube system. The carryover lighter tube receives its gas supply through the regulator simultaneously with the gas to the burner. Control of the system is through a Maxitrol amplifier (see [Figure 12](#)) with a corresponding remote temperature dial.

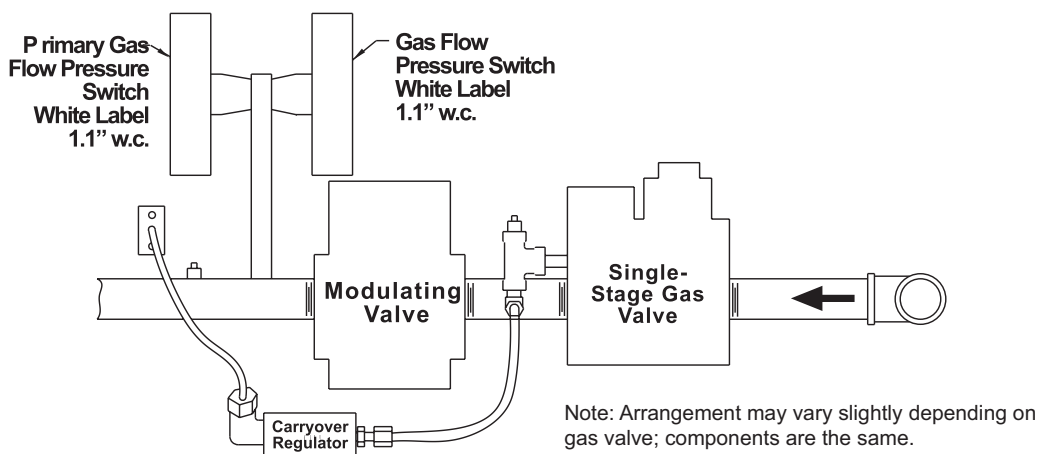


Figure 13. Option AG39 Manifold Arrangement

- The gas supply (refer to pressure requirements in [Table 15](#)) connects to the single-stage gas valve. To compensate for additional pressure loss through the modulating valve, the single-stage gas valve has a custom outlet pressure setting higher than when it is used on a standard gas manifold. The pilot tubing connects to the pilot port on the single-stage gas valve.

Table 15. Options AG39 and AG40 Pressure Requirements

Unit Size	Maximum Turndown (%)	Input Range (MBH)	Factory-Set Inlet Pressure to Modulating Valve (IN WC)	Required Gas Supply Pressure (IN WC)
125	20	25–125	3.9	5.0
150	27	40.3–150	3.7	5.0
175	23	40.3–175	3.7	5.0
200	26	51.8–200	3.9	5.0
225	23	51.8–225	3.9	5.0
250	28	69–250	4.0	5.0
300	23	69–300	4.0	5.0
400	25	100–400	4.4	6.0

- When the valve receives a call for heat from the amplifier and pilot is established, gas flow from the single-stage valve goes to both the modulating valve and the regulated lighter tube system. When the signal from the amplifier to the modulating valve requires less-than-high fire operation, the modulating valve functions to lessen the gas flow to the burner to reduce the input rate to that which is necessary to maintain the desired temperature. When the input rate is reduced enough to decrease the gas pressure to 1.1 IN WC, the primary gas pressure switch in the manifold activates the gear motor that controls the bypass damper in the venter/combustion air system. The bypass damper opens to divert some of the incoming air directly into the flue duct to reduce air flow through the burner. Safety switches monitor the position of the bypass damper. When the gas pressure rises to >1.1 IN WC, the bypass damper closes.
- **Sensor:** The duct temperature sensor and mixing tube are shipped loose for field installation in the discharge duct. Refer to the [Discharge Air Temperature Sensor Installation](#) section for instructions on locating the sensor in the ductwork.
- This uniquely-designed modulation system requires combustion air pressure settings different from the standard system. Refer to [Table 14](#) for the approximate combustion air proving switch settings at sea-level operation and to [Figure 14](#) for troubleshooting option AG39.

Electronic Modulation Between 20–28% and 100% Firing Rate (Option AG40)

NOTE: Option AG40 is available only with natural gas and is not available on unit size 350.

- With option AG40, the furnace is equipped with a Maxitrol signal conditioner (see [Figure 12](#)) that receives an input signal of either 4–20 milliamps or 0–10V from a customer-supplied control device such as a computer.
- With the dip switches on the conditioner positioned to ON, the conditioner accepts a 4–20 milliamp signal. With the dip switches on the conditioner positioned to OFF, the conditioner accepts a 0–10V signal. The conditioner converts the signal to the 0–20V DC current required to control the modulating valve. The heater functions and is equipped in the same way as option AG39 except that with computer control, the temperatures are selected through the software and there is no temperature selector or duct sensor.
- Refer to [Table 15](#) for option AG40 pressure requirements and to [Figure 14](#) for troubleshooting option AG40.
- This uniquely-designed modulation system requires combustion air pressure settings different from the standard system. Refer to [Table 14](#) for the approximate combustion air proving switch settings at sea-level operation.

CONTROLS—CONTINUED

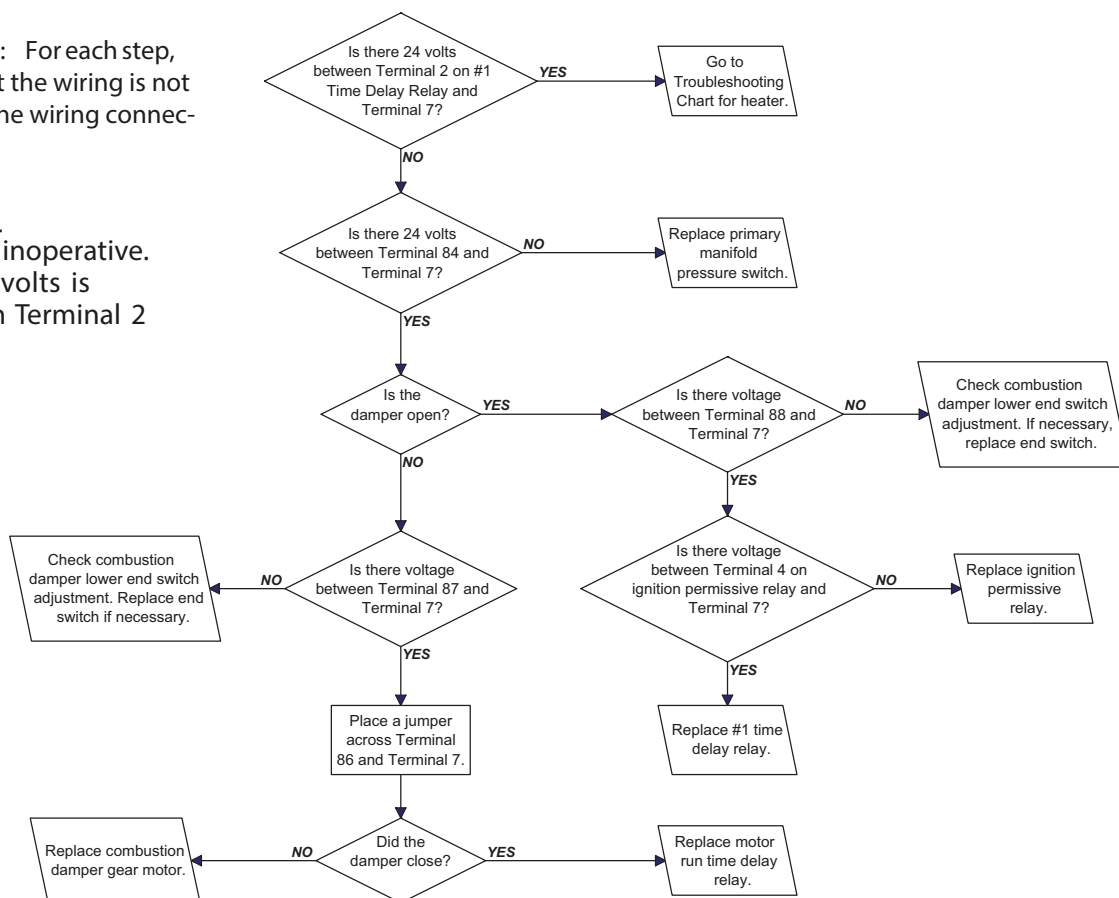
Optional Electronic Modulation—Continued

Electronic Modulation Between 20–28% and 100% Firing Rate (Option AG40)—Continued

General Instructions: For each step, check to ensure that the wiring is not defective and that the wiring connections are secure.

Symptom - Part 1:

Main burners are inoperative. Assumes that 24 volts is available between Terminal 2 and Terminal 7.



Symptom - Part 2:

Steady call for heat - burner cycles.

Assumes that 24 volts is available between Terminals 11 and 7 and Terminals 2 and 7.

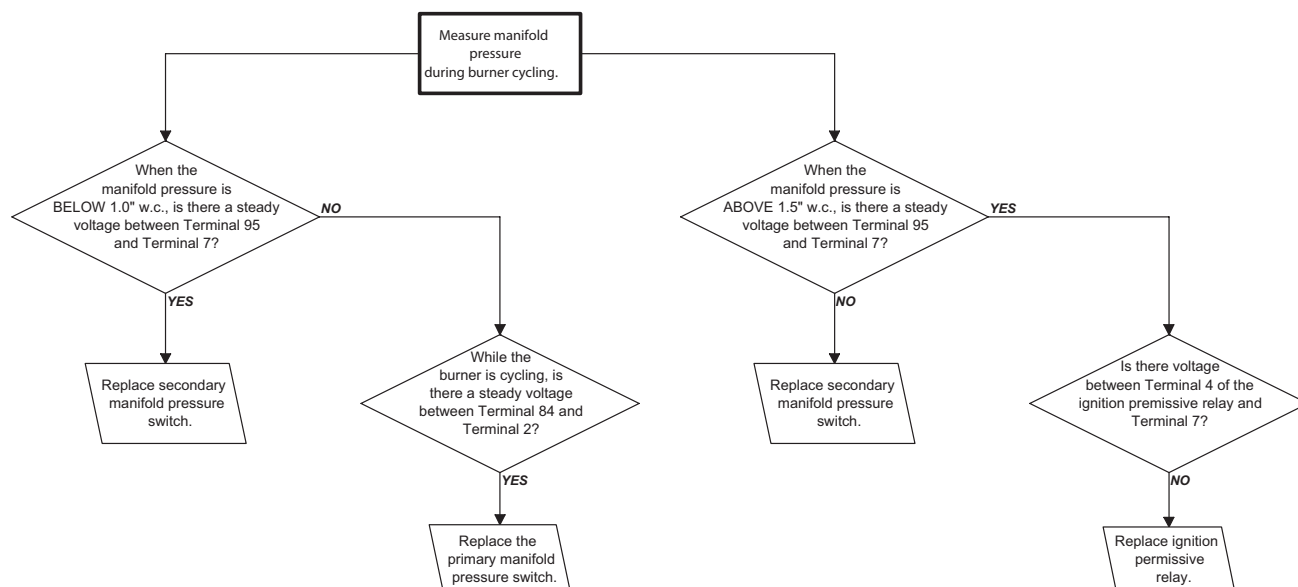


Figure 14. Troubleshooting Guide for Checking Bypass Combustion Air Damper Safety Circuit on Units with Option AG39 or AG40

Pilot and Ignition Systems

⚠ WARNING ⚠

Due to high voltage on the pilot spark wire and pilot electrode, do not touch when energized.

- **Pilot:** The horizontal pilot is located in the control end of the burner rack (see [Figure 15](#)) and is accessible after the control compartment panel has been removed. All pilots are target type with lint-free feature. Pilot gas pressure should be the same as supply line pressure (refer to [Gas Supply Pressure](#) section). If required, adjust the pilot flame length to approximately 1-1/4 inch using pilot adjustment screw in control valve body.

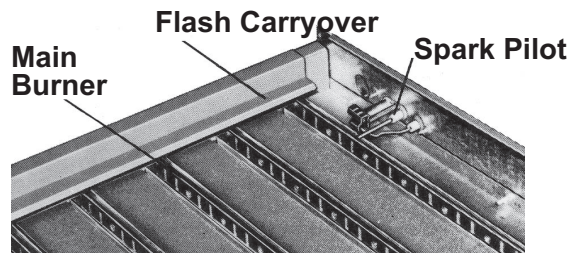


Figure 15. Typical Burner Rack with Spark Pilot

- **Intermittent spark ignition safety pilot systems:** There are two types of intermittent spark pilots: one type shuts off the pilot gas flow between the cycles and the other not only shuts off the pilot gas flow between cycles but also has a lockout device that stops the gas flow to the pilot if the pilot fails to light in 120 seconds. This lockout feature has a 1-hour retry or requires manual reset by interruption of the [thermostat](#) circuit. Propane units installed in Canada require the spark ignition system with the lockout device. Refer to the wiring diagram supplied with the heater for pilot system identification and wiring. Spark pilot without lockout is designated as option AH2 or with lockout is option AH3.
- **Ignition controller:** As part of the intermittent safety pilot system, the ignition controller provides high voltage spark to ignite pilot gas and also acts as the flame safety device. After ignition of the pilot gas, the ignition controller electronically senses the pilot flame. A low voltage DC electrical signal is imposed on the separate metal probe in the pilot assembly. The metal probe is electrically insulated from ground. The pilot flame acts as a conduction path to ground to complete the DC circuit and prove pilot flame. Proper operation of the electronic spark ignition system requires a minimum flame signal of 0.2 microamps, as measured by a microammeter. With pilot flame proven, the ignition controller energizes the main gas valve.

Burners and Carryover System

- **Burners:** These duct furnaces have individually-formed steel burners with accurately die-formed ports to provide controlled flame stability without lifting or flashback with either natural or propane gas. All burners are lightweight and are factory-mounted in an assembly that permits all of the burners to be removed as a unit for inspection or service.

NOTE: Natural gas burner racks (except when equipped with electronic modulation option AG39 or AG40) are equipped with two flash carryovers. Propane gas burners are equipped with one flash carryover and a regulated gas lighter tube system.

- During regular service, check the main burner ports, the carryover assemblies, and the orifices for cleanliness.

CONTROLS—CONTINUED

Dampers and Damper Controls

For information on damper control options (see [Figure 16](#)), refer to the wiring diagram provided with the unit. To adjust dampers, refer to the [Damper Linkage Adjustment](#) section.

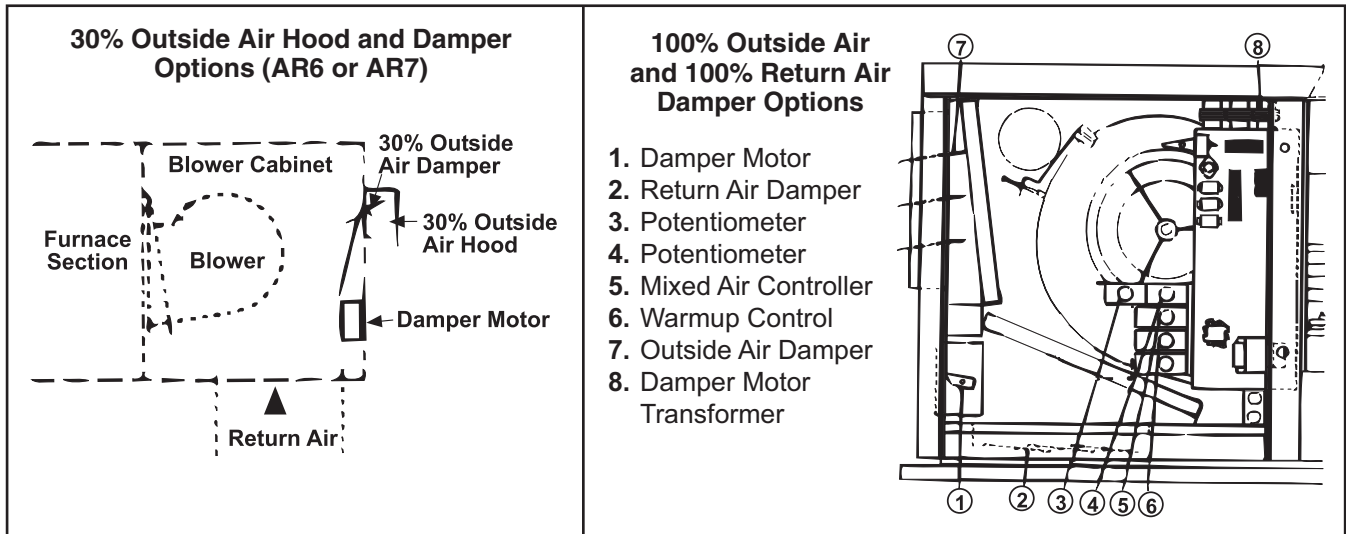


Figure 16. Damper Controls

Pressure Null Switch

The pressure null switch used to control outside air dampers in inlet air option AR23 is a Dwyer #1640-0 with a range of 0.01–0.20 IN WC. It is shipped separately for field installation—refer to the manufacturer’s installation instructions included with the switch. 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. To adjust the switch, refer to the [Pressure Null Switch Adjustment](#) section.

Dirty Filter Switch

The optional dirty filter pressure switch is used to provide warning to the user by energizing an indicator light on an optional remote console. The light indicates that the filters are in need of cleaning or changing. The adjustable, single-pole/normally-open differential switch closes when an increase in pressure differential above the setpoint, is sensed across the filter bank. The dirty filter switch is located in the furnace section. To adjust the dirty filter switch, refer to the [Dirty Filter Switch Adjustment](#) section.

OPERATION

⚠ WARNING ⚠

To ensure safety, follow the lighting instructions located on the outlet box cover.

Pre-Startup Checklist

- Ensure that electrical supply is in accordance with voltage rating on unit's rating plate.
- Ensure that all field wiring is in accordance with wiring diagram and that wire gauges are as required for electrical load.
- Ensure that electrical entrances are sealed against the weather.
- Ensure that fuses or circuit breakers are in place and are sized correctly.
- Ensure that condensate drain holes in the corners of the cabinet are open.
- Ensure that clearances from combustibles are in accordance with **Clearances** sections).
- Check piping for leaks and proper gas line pressure and bleed trapped air from gas lines (refer to **Supply Piping Connections** section):
 - a. Turn OFF manual shutoff valve.
 - b. Turn ON gas supply.
 - c. Observe gas meter for movement or attach pressure gauge readable to 0.1 IN WC and, after turning gas ON for 10 seconds, turn OFF gas supply—no change in pressure should occur over 3-minute period.
 - d. If step c indicates leak, locate leak by brushing soapy solution on all fittings—bubbles will appear at any leaks.
 - e. Repair any leaks and repeat test.
- Check to ensure that flue discharge openings are free from obstructions.

Startup

1. Close all panels tightly.
2. Turn ON electric and gas supply to furnace.
3. Adjust **thermostat** or ductstat so that call for heat exists.
4. Observe for complete sequencing of safety pilot and ignition (refer to **Table 16**).

Table 16. Sequence of Operation

Step	Action	Observe
1	Set thermostat at its lowest setting	
2	Turn ON electric and main and manual gas valves	Firing rate is controlled by thermostat Blower motor operates from fan time delay
3	Set thermostat at desired setting— thermostat calls for heat	Venter motor is energized after 15-second (approximate) time delay Venter flow switches from NC to NO contacts to energize pilot gas valve and spark gap to produce pilot flame on each operating cycle Sensing probe proves presence of pilot flame and energizes safety switch portion of control to deenergize spark gap and energize main valve Main gas ignites and unit fires at full rate
4	If flame is extinguished during main burner operation, safety switch closes main valve and recycles spark gap	On unit equipped with controller with lockout, if pilot is not established within 120 seconds (approximately), unit locks out for 1 hour unless reset by interrupting power to control circuit

OPERATION—CONTINUED

Post-Startup Checklist

- ❑ Observe burner flame at full fire. Natural gas flame should be about 1-1/2 inches in height with blue coloring. Propane gas flame should be approximately same height with blue coloring. Yellow tipping may appear on propane gas. If yellow extends beyond 1/2- to 3/4-inch, adjust air shutters (refer to **Burner Air Shutter Adjustment** section). If shutter adjustment does not reduce yellowing, check for gas leaks at control manifold or orifice fitting.
- ❑ Turn unit OFF and ON, pausing 2 minutes between each cycle. Observe to verify 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. Raising temperature setting drives burner on or to full fire.
- ❑ Using manometer or slant gauge readable up to 14 IN WC, check orifice manifold for operating pressure on full fire. Natural gas should be 3.5 IN WC at this point. Propane gas should be 10 IN WC at this point. Variations from these pressures are not recommended as ignition and efficiency performance can be adversely affected by improper pressure adjustment (refer to **Measure and Adjust Manifold (Outlet) Gas Pressure** section).
- ❑ Place owner's envelope containing Limited Warranty Card, this manual, and any optional information in accessible location near heater. Follow instructions on envelope.

⚠ DANGER ⚠

- **The gas burner in this gas-fired equipment is designed and equipped to provide safe, controlled, 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 that vents all flue products to the outside atmosphere. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD THAT COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.**
- **Always comply with the combustion air requirements in the installation codes and instructions.**
- **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.**

ADJUSTMENTS

Belts, Blowers, and Drives

Checking and Adjusting 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. Check belt tension as shown in **Figure 17**.
- If the belt cannot be depressed 3/4 inches (19 mm), as shown in **Figure 17**, adjust the belt tension as follows:
 - a. Ensure that belt is aligned in pulley grooves properly and is not angled from pulley to pulley.
 - b. Loosen adjusting screw locknut on motor base and turn adjusting screw until belt can be depressed 3/4 inches (19 mm).
 - c. When correct belt tension is achieved, retighten adjusting screw locknut.

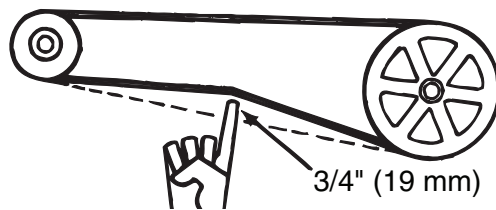


Figure 17. Checking Belt Tension

Adjusting Blower Speed

- Blower speed may be adjusted to achieve the desired outlet temperature as long as the adjustment is within the temperature rise and 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 increases outlet temperature. Increasing blower speed decreases 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 that permits blower speed adjustment. Adjust the blower speed as follows:
 - a. Shut OFF gas and electric power.
 - b. Loosen belt tension and remove belt.
 - c. Loosen setscrew on side of pulley away from motor.
 - d. To increase blower speed and decrease outlet temperature, turn adjustable half of pulley inward. To decrease blower speed and increase outlet temperature, turn adjustable half of pulley outward. One turn of pulley changes speed 8–10%.
 - e. Tighten setscrew on flat portion of pulley shaft.
 - f. Replace belt and adjust belt tension in accordance with [Checking and Adjusting Belt Tension](#) section.
 - g. Turn ON gas and electric power and light heater in accordance with instructions on lighting instruction plate.
 - h. Check motor amps using ammeter (maximum motor amp rating on motor nameplate must not be exceeded).
 - i. When adjustment is complete, check for proper operation.

Reversing Blower Rotation

Each blower housing is marked for proper rotation. Rotation may be changed on single-phase motors by rewiring in the motor terminal box. Rotation may be changed on three-phase motors by interchanging two wires on the three-phase supply connections.

Blower Motor Load and Amp Adjustment

- Amps may be adjusted downward by reducing blower rpm or by increasing duct system static pressure. Use an ammeter to check blower motor amps.
- See the motor rating plate for exact motor specifications. Do not exceed the amp rating on the motor nameplate.
- [Table 17](#), which lists the Full Load Amps (FLA) of blower motors (open) based on Horsepower (HP) and Voltage (V), can be used for sizing line wiring but should not be interpreted as the exact motor amps.

ADJUSTMENTS—CONTINUED

Blower Motor Load and Amp Adjustment—Continued

Table 17. FLA of Blower Motors (Open, Single-Speed, Average Values)									
Voltage/Phase	HP								
	1/4	1/3	1/2	3/4	1	1-1/2	2	3	5
FLA									
208V/1PH	2.10	3.20	5.10	6.30	7.50	8.30	11.30	14.00	28.00
230V/1PH	2.30	2.80	4.40	5.50	6.50	7.50	10.20	12.40	26.00
208V/3PH	1.10	1.40	2.30	2.90	3.70	5.60	7.00	9.00	13.40
230V/3PH	1.40	1.60	2.00	2.60	3.20	5.00	6.60	8.60	13.20
460V/3PH	0.75	0.80	1.00	1.30	1.60	2.70	3.50	4.30	6.60
575V/3PH	—				1.10	1.60	2.10	3.60	5.40

Pressure Null Switch Adjustment

NOTE: IMPORTANT: To eliminate shipping damage to the pressure null switch contacts, the manufacturer reduced the span adjustment to zero before shipping.

The span should be adjusted prior to using the pressure null switch (see [Figure 18](#)) as follows:

1. If switch has been installed, disconnect vent tube so that switch is in neutral position.
2. Remove electrical box cover and, while observing contacts, turn span adjustment screw slowly in clockwise direction.
3. Continue turning adjustment screw until you are able to see gaps between common and both low and high contacts—minimum gap provides greatest sensitivity—wider gap provides lower sensitivity.

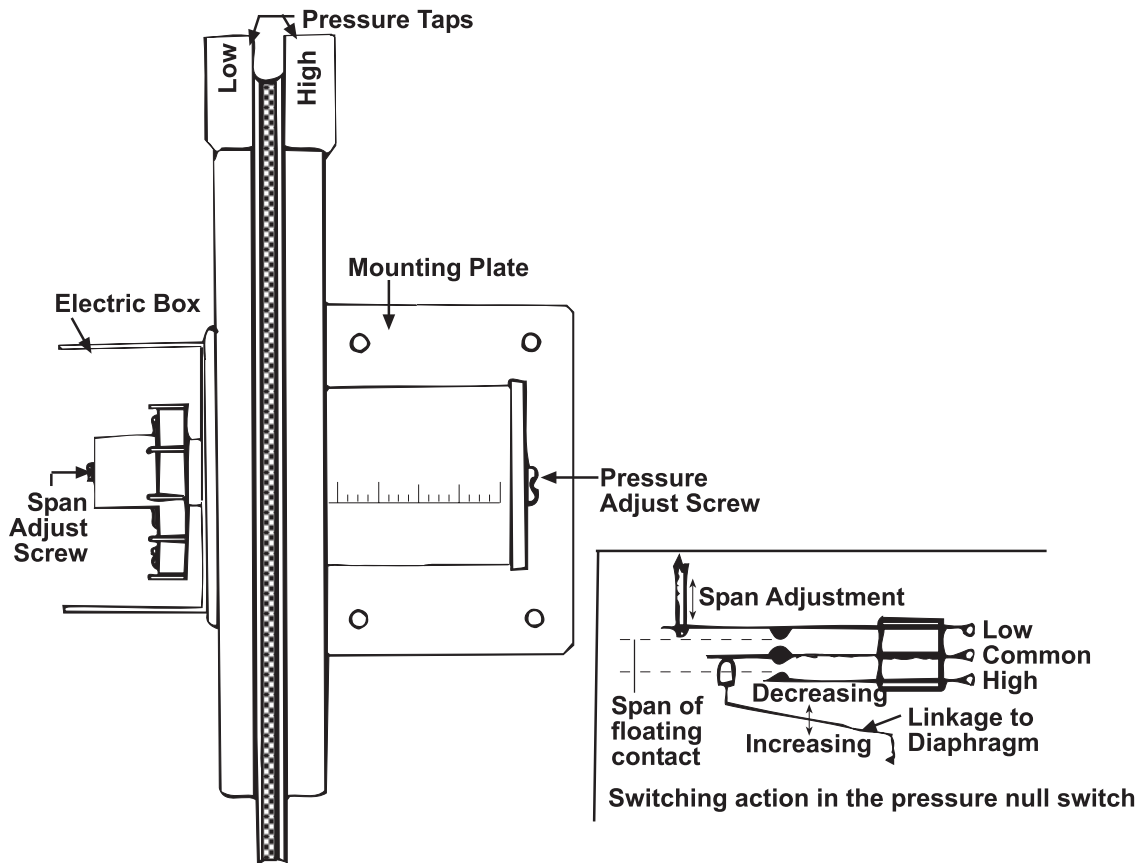


Figure 18. Pressure Null Switch Adjustment

Measure and Adjust Manifold (Outlet) Gas Pressure

Measuring manifold gas pressure cannot be done until the heater is in operation (refer to **OPERATION** section).

- **For natural gas:** When the heater leaves the factory, the combination valve is set so that the outlet gas pressure of a single-stage valve or high fire of a two-stage valve is regulated to 3.5 IN WC. Low fire on a two-stage valve is set to 1.8 IN WC. Inlet supply pressure to the valve must be a minimum of 5 IN WC or as noted on the rating plate and a maximum of 14 IN WC.

NOTE: Always check the rating plate for minimum gas supply pressure.

- **Minimum natural gas supply pressure:** Requirements vary based on size of burner and the gas control option. Most units require a minimum of 5 IN WC natural gas as stated above, but sizes 350 and 400 with electronic modulation require a minimum of 6 IN WC natural gas supply pressure. Sizes 300 and 350 with mechanical modulation require 7 IN WC.
- **For propane gas:** When the heater leaves the factory, the combination valve is set so that the outlet gas pressure of a single-stage valve or high fire of a two-stage valve is 10 IN WC. Low fire on a two-stage valve is set to 5 IN WC. Inlet pressure to the valve must be a minimum of 11 IN WC and a maximum of 14 IN WC.

⚠ WARNING ⚠

- **Manifold gas pressure must never exceed 3.5 IN WC for natural gas or 10 IN WC for propane gas.**
 - **Before attempting to measure or adjust manifold gas pressure, the inlet (supply) pressure must be within the specified range for the gas being used, both when the heater is in operation and when it is on standby. Incorrect inlet pressure could cause excessive manifold gas pressure immediately or at some future time.**
-

NOTE: A manometer (fluid-filled gauge) is recommended rather than a spring-type gauge due to the difficulty of maintaining calibration of a spring-type gauge.

1. With the manual valve (on the combination valve) positioned to prevent flow to the main burners, connect a manometer to the 1/8-inch pipe outlet pressure tap in the valve.
 2. Open the valve and operate the heater. Measure the gas pressure to the manifold. To measure the low-stage pressure on units equipped with a two-stage valve, disconnect the wire from the HI terminal on the valve. Be sure to reconnect the wire.
-

⚠ CAUTION ⚠

DO NOT bottom out the gas valve regulator screw. This can result in excessive overfire and heat exchanger failure due to unregulated manifold pressure.

3. Normally, adjustments to the factory-preset regulator should not be necessary. If adjustment is necessary, set pressure to correct settings by turning the regulator screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease pressure. Consult the valve manufacturer's literature provided with the furnace for more detailed information.

ADJUSTMENTS—CONTINUED

Measure and Adjust Manifold (Outlet) Gas Pressure—Continued

High Elevation (>2,000 Feet/609 Meters) Installations

NOTES:

- High elevation (>2,000 feet/609 meters) application with this unit depends on the installation elevation and the heating value of the gas. At high elevations, the heating value of natural gas is always lower than the heating value at sea level.
 - Deration is necessary to compensate for low atmospheric pressure at high elevations. Generally this will require obtaining the gas heating value from the local gas utility and replacing the burner orifices.
-

For high elevation (>2,000 feet/609 meters) installations that require orifice replacement, replace the burner orifices as follows:

1. Determine model number and rated input (BTUh) from unit's rating plate.
2. Determine appropriate orifice replacement (refer to [Table 18](#)) for installation elevation.
3. Unthread existing gas orifices from gas manifold.

⚠ DANGER ⚠

- Do not use Teflon tape or pipe joint compound on the orifice threads. The hole in the orifice may become blocked and may cause fire, explosion, property damage, carbon monoxide poisoning, personal injury, or death.
 - Use only using factory-supplied orifices. Do not attempt to drill out orifices in the field. Improperly drilled orifices may cause fire, explosion, carbon monoxide poisoning, personal injury, or death.
-
4. Thread replacement gas orifices into gas manifold. To prevent cross-threading, hand-tighten orifices into gas manifold until snug and then tighten one-half to one turn using wrench.

⚠ DANGER ⚠

DO NOT use an open flame to check for gas leaks.

5. Check all connections for gas leaks using commercial leak-detecting fluid or rich soap and water solution. Leaks are indicated by presence of bubbles. If leak is detected, tighten connection. If leak cannot be stopped by tightening connection, replace part(s).

Conversion to LP (Propane)

⚠ DANGER ⚠

Conversion to LP (propane) gas must be performed by qualified service personnel using a factory-supplied conversion kit. Failure to use the proper conversion kit can cause fire, explosion, property damage, carbon monoxide poisoning, personal injury, or death.

If LP (propane) conversion is required, convert the unit in accordance with form *OPT-GC* listed in [Table 1](#). When conversion is complete, verify that the input rate is correct.

Table 18. High Elevation Burner Orifices

Installation Altitude (Feet (Meters))	Installation Location	Unit Size	Natural Gas		Propane	
			PN	Orifice Size	PN	Orifice Size
2001–3000 (611–915)	US	125, 175, 225, 300, 350, 400	84437	#42	11834	#54
		150,250	38678	#45	11830	#55
		200	11833	#44	11830	#55
2001–4500 (611–1373)	Canada	125, 175, 225, 300, 350, 400	11828	#43	11834	#54
		150,250	38678	#45	11830	#55
		200	11833	#44	11830	#55
3001–4000 (916–1220)	US	125, 175, 225, 300, 350, 400	11828	#43	11834	#54
		150,250	38678	#45	11830	#55
		200	11833	#44	11830	#55
4001–5000 (1221–1525)	US	125, 175, 225, 300, 350, 400	11828	#43	11834	#54
		150,250	38678	#45	11830	#55
		200	11833	#44	11830	#55
5001–6000 (1526–1830)	US	125, 175, 225, 300, 350, 400	11828	#43	97360	1.35 mm
		150,250	16590	#46	39658	#56
		200	38678	#45	39658	#56
6001–7000 (1831–2135)	US	125, 175, 225, 300, 350, 400	11833	#44	97360	1.35 mm
		150,250	84853	#47	39658	#56
		200	38678	#45	39658	#56
7001–8000 (2136–2440)	US	125, 175, 225, 300, 350, 400	11833	#44	11830	#55
		150,250	84853	#47	39658	#56
		200	16590	#46	39658	#56
8001–9000 (2441–2745)	US	125, 175, 225, 300, 350, 400	38678	#45	11830	#55
		150, 250	40414	#48	39658	#56
		200	84853	#47	39658	#56
9001–10,000 (2746–3045)	US	125, 175, 225	16590	#46	11830	#55
		150, 250	40414	#48	39658	#56
		200	84853	#47	39658	#56
		300, 350, 400	38678	#45	11830	#55

Dirty Filter Switch Adjustment

After the unit is started but before continuous operation, the dirty filter switch must be set as follows:

1. With clean filters in place, blower doors closed, and blower operating, decrease pressure setting by adjusting setscrew on switch (see **Figure 19**) clockwise until indicator light is energized or setscrew is bottomed out.
2. At that point, adjust setscrew three full turns counterclockwise or until setscrew is top-ended.
3. At that setpoint, indicator light will be activated at approximately 50% filter blockage.

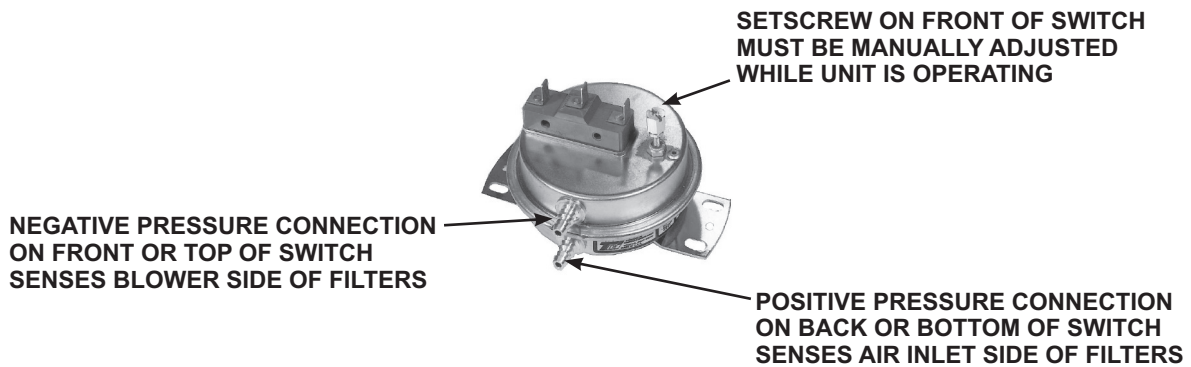


Figure 19. Dirty Filter Switch

ADJUSTMENTS—CONTINUED

Burner Air Shutter Adjustment

⚠ DANGER ⚠

Failure to adjust air shutters according to directions could cause property damage, personal injury, and/or death.

NOTES:

- A limited amount of yellow-tipping is permissible for liquefied petroleum gases. Natural gas should not display any yellow-tipping.
- When making the adjustment, close the air shutters no more than is necessary to eliminate the problem condition.
- Air shutters are required on propane gas units but are optional on natural gas units. A slotted burner air adjustment screw on the end manifold bracket moves the air shutters and adjusts all burners simultaneously. Turn the adjustment screw clockwise to open the air shutter or counterclockwise to close the air shutter.
- After the furnace has been in operation for 15 minutes, close the air shutter until the flame turns yellow. Open the shutter until yellow disappears.

Damper Linkage Adjustment

When units are equipped with dampers, the dampers are closed during shipment. When there are both return air and outside air dampers, the return damper linkage (see [Figure 20](#)) must be adjusted prior to use as follows:

1. Loosen setscrew on return air damper rod at damper arm.
2. Manually open return air dampers. While dampers are opening, damper rod and arm will automatically move to their correct positions.
3. Tighten setscrew.

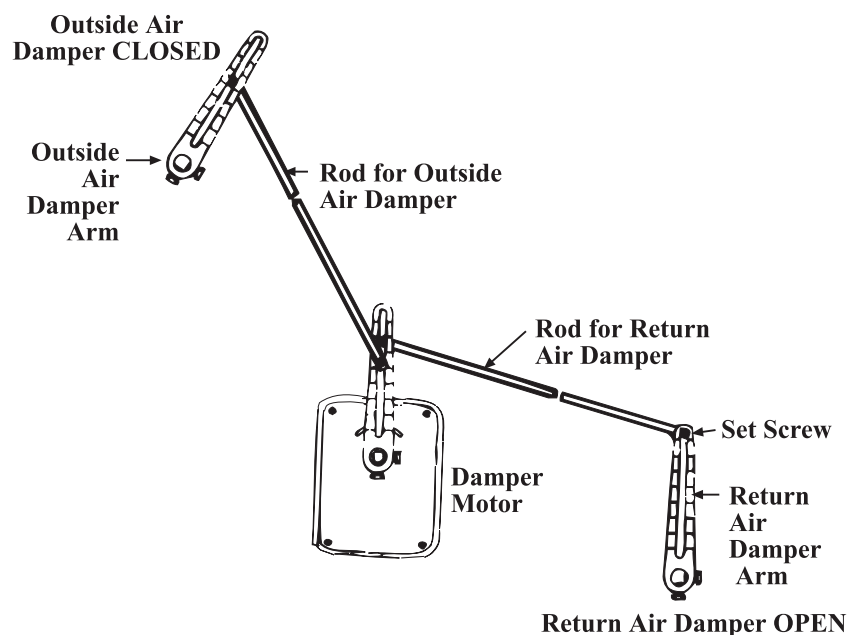


Figure 20. Damper Linkage

MAINTENANCE

WARNING

If you turn OFF the power supply, turn OFF the gas.

CAUTION

When cleaning, wearing eye protection is recommended.

NOTE: Use only factory-authorized replacement parts.

This unit will operate with a minimum of maintenance. To ensure long life and satisfactory performance, a furnace that is operating under normal conditions should be inspected every 4 months. If the furnace is operating in an area where an unusual amount of dust, soot, or other impurities are present in the air, more frequent inspection is recommended.

Service Checklist

The following section is designed to aid a qualified service person in maintaining and servicing this equipment. At a minimum, perform the following annually:

- Inspect filters and clean or replace as necessary.
- Inspect blower and belt—check belt for tension, wear, and alignment (adjust or replace as needed) and clean dirt from blower and motor.
- Check gas valve to ensure that gas flow is being shut off completely.
- Clean heat exchanger both internally and externally.
- Check pilot burner and main burners for scale, dust, or lint accumulation and clean as necessary.
- Clean all dirt and grease from primary and secondary combustion air openings.
- Check flue products outlet and clean as necessary.
- Check vent cap in optional extended vent system and replace any parts that do not appear sound.
- Check main burner ports, carryover assemblies, and orifices for cleanliness.
- Check wiring for any damaged wire—replace damaged wiring (refer to [Electrical Connections](#) section for wiring requirements)

Maintenance Procedures

Combination Gas Valve Maintenance

WARNING

The combination gas valve is the prime safety shutoff. To ensure positive closure, all gas supply lines must be free of dirt or scale before connecting them to the unit.

Remove external dirt accumulation and check wiring connections. The combination gas valve must be checked annually as follows to ensure that the valve is completely shutting off gas flow.

1. Locate 1/8-inch FPT INLET pressure tap on combination gas valve (see [Figure 21](#)).

NOTE: A manometer (fluid-filled gauge) with an inches water column scale is recommended.

2. With field-installed manual valve closed to prevent flow to gas valve, connect manometer to 1/8-inch FPT INLET pressure tap (see [Figure 21](#)).

MAINTENANCE—CONTINUED

Maintenance Procedures—Continued

Combination Gas Valve Maintenance—Continued

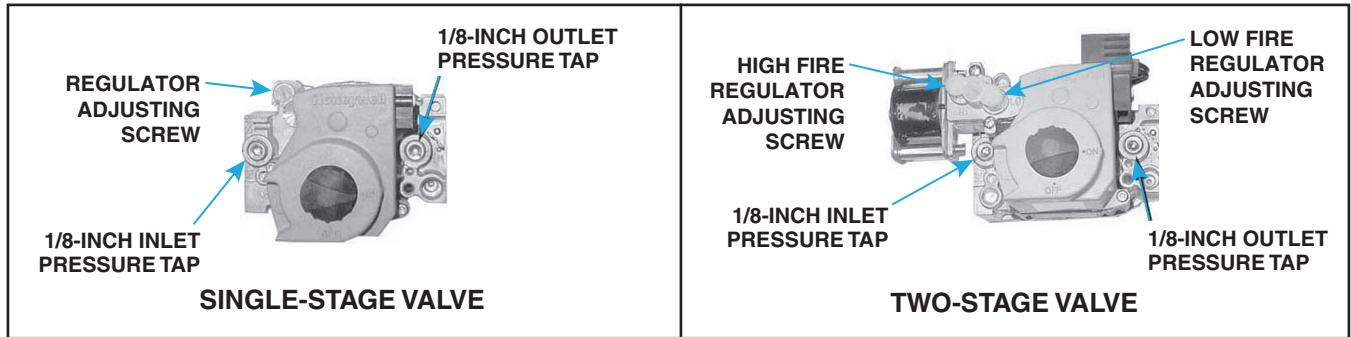


Figure 21. Combination Gas Valve Test Connections

3. With field-installed manual valve closed, turn up **thermostat** to fire unit and to allow unit to go through one trial for ignition.
4. Reset **thermostat** to shut OFF unit and observe manometer for 2 to 3 minutes for indication of gas pressure. No pressure should be indicated on manometer. If manometer indicates gas pressure, field-installed manual gas valve must be replaced or repaired before combination gas valve can be checked.
5. If manometer does not indicate gas pressure, slowly open field-installed manual gas valve. After manometer indicates that gas pressure has reached equilibrium, close manual shutoff valve.

NOTE: Refer to Gas Supply Pressure section for operational pressure settings and instructions for checking pressure settings.

6. Observe gas pressure on manometer. There should be no loss of gas pressure. If manometer indicates loss of gas pressure, replace combination gas valve before placing heater in operation.

Burner Rack Maintenance

Remove, disassemble, clean, reassemble, and re-install burner rack as follows:

1. Remove burner rack:
 - a. Turn OFF gas and electric supply.
 - b. Remove control access side panel.
 - c. Disconnect any pilot lines and flame sensor leads.
 - d. Mark and disconnect electric valve leads.
 - e. Uncouple union in gas supply.
 - f. Remove sheet metal screws in top corners of burner rack assembly.
 - g. Pull drawer-type burner rack out of furnace.
2. Disassemble burner rack:

NOTE: Natural gas burner racks manufactured *before* MAR 1995 may have a lighter tube carryover system. Break the lighter tube connection at the orifice and remove the supply tubing, the drip shield, and the lighter tube.

- a. For natural gas burner rack, remove flash carryover system from manifold end of burner rack.
- b. For propane gas burner rack:
 - (1) Break lighter tube connection at regulator and remove lighter tube orifice supply tubing.
 - (2) Remove retaining screws in drip shield and remove shield.
 - (3) Remove retaining screws and slide out lighter tube.

- c. Pull main burners horizontally away from injection opening and lift out.
 - d. Remove manifold bracket screws and remove manifold.
 - e. Remove burner orifices.
 - f. Remove screws and lift out pilot burner.
3. Clean burner rack in accordance with instructions in [Cleaning Pilot and Burners](#) section.
 4. Re-assemble and re-install burner rack by reversing above steps, being careful not to create any unsafe conditions.

Cleaning Pilot and Burners

⚠ WARNING ⚠

To prevent injury when cleaning pilot and burners, wearing eye protection is recommended.

⚠ CAUTION ⚠

To prevent damage to pilot orifice, do not ream the orifice.

If the pilot flame appears short and/or yellow, check the pilot orifice for blockage caused by lint or dust accumulation.

1. Remove the pilot orifice and clean it using compressed air.
2. Check and clean the aeration slot in the pilot burner.
3. Clean the metal sensing probe and the pilot hood with an emery cloth and wipe off the ceramic insulator.
4. Check the spark gap (see [Figure 22](#)), which should be maintained to 7/64 inch.

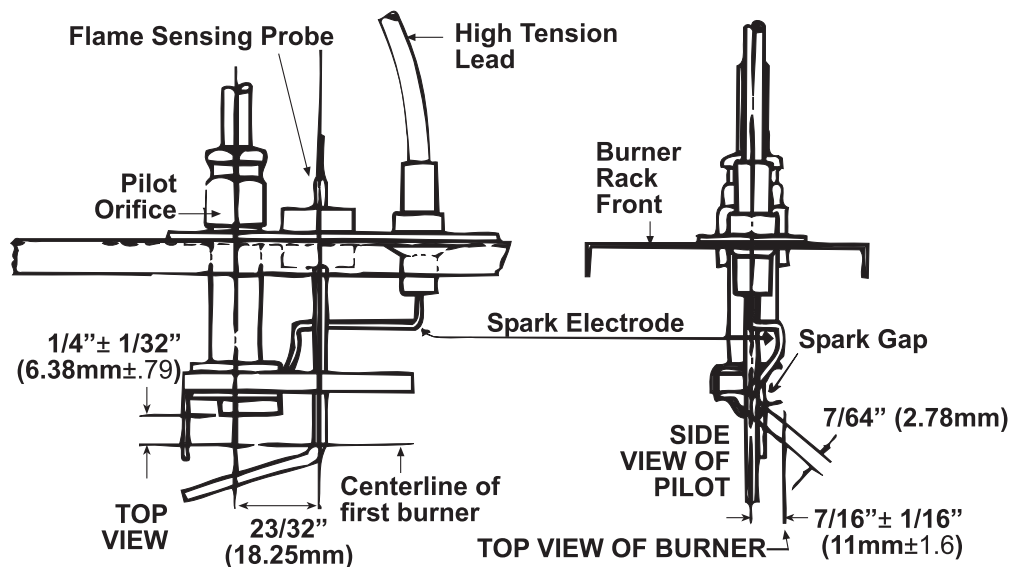


Figure 22. Pilot Assembly Spark Gap

5. After the pilot is cleaned, blow away any dirt using compressed air.
6. Clean the main burners and burner orifices using compressed air.

⚠ CAUTION ⚠

When cleaning burner ports, do not use anything that might change the port size.

7. Use an air nozzle to blow out scale and dust accumulation from the burner ports. Alternate blowing compressed air through the burner ports and then through the venturi. Use a fine wire to dislodge any stubborn particles from the burner ports.
8. Clean the burner rack carryover systems using compressed air.

MAINTENANCE—CONTINUED

Maintenance Procedures—Continued

Spark Ignition System Maintenance

⚠ WARNING ⚠

Due to high voltage on pilot spark wire and pilot electrode, do not touch when energized.

NOTE: When checking for spark with the pilot burner assembly removed from the burner rack, the pilot assembly must be grounded to the heater for proper spark.

1. If no spark occurs, check the following:
 - a. Using microammeter, measure voltage between terminals TH and 7 on ignition controller. Voltage should be at least 20V and no higher than 32V. Refer to **TROUBLESHOOTING** section if no voltage is observed.
 - b. Check for short to ground in high tension lead and/or ceramic insulator.
 - c. Verify that pilot spark gap (see **Figure 22**) is approximately 7/64 inch.
 - d. If the above conditions are normal and no spark occurs, replace the ignition controller.

NOTE: If replacing an earlier model of ignition controller (see **Figure 23**), order a replacement kit (PN **257472** for a unit with recycling gas control option AH2 or PN **257473** for a unit with gas control with lockout option AH3). Option codes are listed on the unit wiring diagram.



RECYCLING IGNITION CONTROLLER
FOR GAS CONTROL OPTION AH2,
UTEC MODEL 1003-638A
(PN **257009**): REPLACE WITH
REPLACEMENT KIT (PN **257472**)



IGNITION CONTROLLER WITH
LOCKOUT FOR GAS CONTROL
OPTION AH3, UTEC MODEL 1003-514
(PN **257010**): REPLACE WITH
REPLACEMENT KIT (PN **257473**)

Figure 23. Obsolete Ignition Controllers

2. If the main gas valve fails to open with a normal full-size pilot flame established, check the following:
 - a. If voltage between black and brown leads on main gas valve is 20–32 VAC and there is no main gas flow with built-in manual valve in FULL OPEN position, main valve is defective.
 - b. If there is no voltage between black and brown leads on main gas valve, check for disconnected or shorted flame sensor lead or flame sensor probe.
3. If the above conditions are normal and main gas flow is still off, the ignition controller is probably defective. Do not attempt to service the ignition controller as it does not contain any replaceable components.

NOTES:

- For cleaning the inner surfaces of the heat exchanger, an air hose, a long (18- to 24-inch) stiff brush of 1/2-inch diameter or heavy wire with steel wool securely attached, a flashlight, and a mirror are needed.
- Depending on whether or not the furnace is designed for high CFM (model prefix H), there may be directional baffles between the heat exchanger tubes. The standard furnace has baffles between the heat exchanger tubes. High CFM furnaces have only the top baffle support, which does not need to be removed for cleaning.
- Furnaces designed to provide high-efficiency heating have V-shaped baffles in the top of each heat exchanger tube. High-efficiency furnaces manufactured before MAR 1995 have a C prefix in their model designation. All furnaces manufactured after FEB 1995 are designed for high-efficiency and include the heat exchanger V-baffles.

1. Clean heat exchanger outer surfaces (circulating air side):
 - a. Gain access by removing inspection panels in ductwork or remove ductwork.
 - b. For standard (not high CFM) furnaces, remove baffle screws (see [Figure 24](#)) and lift each airflow baffle slightly and slide forward. Remove all baffles from heat exchanger.
 - c. Remove accumulated dust and grease deposits from heat exchanger tubes and baffles using brush and/or air hose.
 - d. Reinstall airflow baffles removed in step 1b and secure using baffle screws.
 - e. Secure ductwork as necessary.

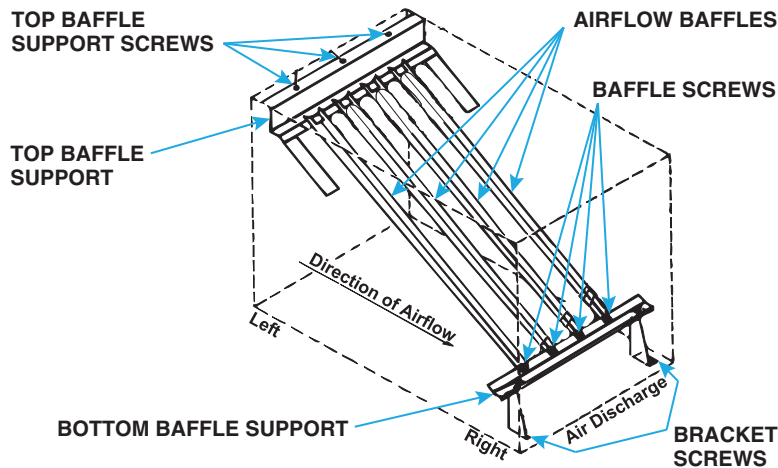


Figure 24. Airflow Baffles

MAINTENANCE—CONTINUED

Maintenance Procedures—Continued

Heat Exchanger Cleaning—Continued

2. Clean heat exchanger inner surfaces (combustion gas side):
 - a. Remove burner rack assembly in accordance with [Burner Rack Maintenance](#) section.
 - b. Remove heat exchanger V-baffles (see [Figure 25](#)):
 - (1) Remove ends of flue gas collection box.
 - (2) On control side of furnace, remove venter assembly and flue outlet duct to gain access to collection box end.
 - (3) For unit sizes 125–300, remove screw that secures one tube baffle retaining angle on each inside wall of collection box and remove angle.
 - (4) For unit size 400, remove inner baffle from flue collection box: on control side, align inner baffle with slot in collection box edge and pull inner baffle until it clears heat exchanger. Remove screw at each end and slide flue diverter out of furnace.
 - (5) Pull V-baffles out of heat exchanger.
 - c. Clean inner surfaces using furnace brush or piece of heavy wire to which piece of steel wool is attached. Scrub tube walls to remove any accumulated dust, rust, and/or soot.
 - d. Clean V-tubes and reassemble heat exchanger.
 - e. Install burner rack assembly in accordance with [Burner Rack Maintenance](#) section.
3. Check furnace for proper operation.

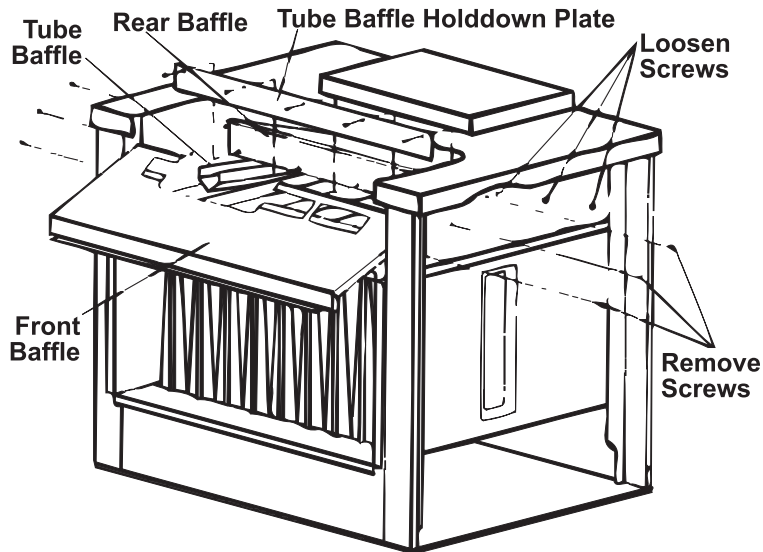


Figure 25. Heat Exchanger V-Baffles Removal

TROUBLESHOOTING

NOTE: If the furnace is equipped with electronic modulation option AG39 or AG40, see [Figure 14](#) for additional troubleshooting guidelines.

Table 19. Troubleshooting

Symptom	Probable Cause	Remedy
A. Venter motor will not start	1. No power to furnace	Turn ON power and check supply fuses or circuit breaker
	2. No 24V power to venter relay	Turn up thermostat and check control transformer output Check for loose or improper wire connections
	3. Defective venter relay	Replace defective part
	4. Defective motor or capacitor	Replace defective part
B. Pilot will not light with venter operating	1. Manual valve not open	Open manual valve
	2. Air in gas line	Bleed gas line
	3. Dirt in pilot orifice	Remove pilot orifice and clean with compressed air or solvent
	4. Gas pressure too high or too low	Adjust gas pressure (refer to Measure and Adjust Manifold (Outlet) Gas Pressure section)
	5. Kinked pilot tubing	Replace tubing
	6. Pilot valve does not open	If 24V power is available at valve, replace valve
	7. No spark	
	a. Loose wire connections	Ensure that all wires connections are solid
	b. Transformer failure	Ensure that 24V power is available
	c. Incorrect spark gap	Maintain spark gap at 7/64 inch
	d. Spark cable shorted to ground	Replace worn or grounded spark cable
	e. Spark electrode shorted to ground	Replace pilot if ceramic spark electrode is cracked or grounded
	f. Drafts affecting pilot	Ensure that all panels are in place and are tightly secured to prevent drafts at pilot
	g. Ignition control not grounded	Ensure that ignition control is grounded to furnace chassis
	h. Faulty ignition controller	If 24V power is available to ignition controller and all other causes have been eliminated, replace ignition control
	8. Optional lockout device interrupting control circuit due to above causes	Reset lockout by interrupting control at thermostat
9. Faulty combustion air proving switch	Replace combustion air proving switch	
C. Pilot lights but main valve will not open	1. Manual valve not open	Open manual valve
	2. Main valve not operating	
	a. Defective valve	If 24V power is available at valve connections and valve remains closed, replace valve
	b. Loose wire connections	Check and tighten all wiring connections
	3. Ignition control does not power main valve	
	a. Loose wire connections	Check and tighten all wiring connections
	b. Flame sensor grounded, pilot lights, and spark continues	Ensure that flame sensor lead is not grounded and that insulation or ceramic is not cracked; replace as required
	c. Incorrect gas pressure	Adjust gas pressure (refer to Measure and Adjust Manifold (Outlet) Gas Pressure section)
	d. Cracked ceramic at sensor	Replace sensor
	e. Faulty ignition controller	If all checks listed in Spark Ignition System Maintenance section indicate no other cause, replace ignition controller (do not attempt to repair ignition controller, which has no field-replaceable parts)
	f. Poor microamp signal	Adjust pilot regulator

TROUBLESHOOTING—CONTINUED

Table 19. Troubleshooting—Continued		
Symptom	Probable Cause	Remedy
D. Insufficient heat with heater operating	1. Dirty filters in blower system	Clean or replace filters
	2. Incorrect manifold pressure	Check manifold pressure (refer to Measure and Adjust Manifold (Outlet) Gas Pressure section)
	3. Limit control cycling on	Check air throughput
	4. Improper thermostat location or adjustment	Refer to thermostat manufacturer's instructions
	5. Belt slipping on blower	Adjust belt tension (refer to Checking and Adjusting Belt Tension section)
	6. Fan control improperly wired	Ensure that wiring connections are in accordance with wiring diagram
	7. Defective fan control	Replace fan control
	8. Blower set for too low temperature rise	Decrease blower speed (refer to Adjusting Blower Speed section) or increase static pressure
E. Motor will not run	1. Circuit open	Check wiring and connections
	2. Inoperative fan control	Replace fan control
	3. Fan control improperly wired	Ensure that wiring connections are in accordance with wiring diagram
	4. Inoperative contactor	Replace contactor
	5. Defective motor	Replace motor
F. Motor turns ON and OFF while burner is operating	1. Motor overload device cycling	Verify motor load against motor rating plate Replace motor or overload device
	2. Three-phase motor rotating in opposite direction	Interchange two legs of supply connections
G. Motor cuts out on overload	1. Improper motor pulley adjustment	Ensure that motor pulley is properly-adjusted (refer to Adjusting Blower Speed section)
	2. Improper static pressure on duct system	Adjust dampers in duct system
	3. Low voltage	Check power supply

NOTES

INSTALLATION RECORD (TO BE COMPLETED BY INSTALLER)

Installer:

Name _____
Company _____
Address _____

Phone _____

Distributor (company from which the unit was purchased):

Company _____
Contact _____
Address _____

Phone _____

Model _____ **Serial No.** _____ **Date of Installation** _____

Specific installation notes (i.e., location, amps, gas pressure, temperature, voltage, adjustments, warranty, etc.):

BUILDING OWNER OR MAINTENANCE PERSONNEL:

For service or repair:

Contact the Installer listed above.

If you need additional assistance, contact the Distributor listed above.

For more information, contact your Factory Representative.

