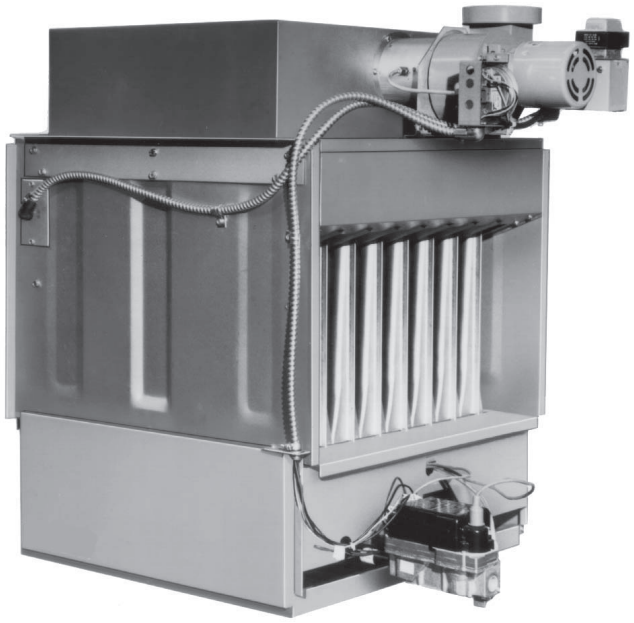
REZNOR®

Revision: EEDU-IOM (01-23) 150492-E

Supersedes: EEDU-IOM (10-22) 150492-D

INDOOR POWER-VENTED DUCT FURNACE INSTALLATION, OPERATION, AND MAINTENANCE

MODEL EEDU



⚠ 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.

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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.

References

Table 1. Related Technical Manuals Available from Factory Distributor

Type	Form*	PN
Replacement parts	EEDU-RPL	263547
Maxitrol amplifier replacement kit installation	OPT-AG7,8,9,9H	262319
Replacement gas valves	P-VALVES	263995
Gas conversion	OPT-GC	143147
Ignition controller replacement kit installation	OPT-IGN-CNTRL	134704
Pressure switch replacement kit installation	EEDU-PRESS-SW	177140

*Also available at **www.reznorhvac.com**.

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.

⚠ 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.**
- **The instructions in this manual apply only to the model EEDU duct furnace.**

Warranty

Refer to the limited warranty form in the literature bag provided with the unit. The warranty is void if:

- Furnaces are used in atmospheres containing flammable vapors or atmospheres containing chlorinated or halogenated hydrocarbons or any contaminant (silicone, aluminium oxide, etc.) that adheres to the spark ignition flame sensing probe.
- Wiring is not in accordance with the diagram provided with the unit.
- Unit is installed without proper clearances to combustible materials or is located in a confined space without proper ventilation and air for combustion (refer to **Combustion Air Requirements** and **Clearances** sections).
- Furnace air throughput is not adjusted within the range specified on the rating plate.

Installation Codes

- The unit is design-certified by the Canadian Standards Association for commercial/industrial use in both the United States and Canada.
- The unit is 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 characteristics are shown on the unit rating plate.
- 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.

- Clearances from the heater and vent to construction or material in storage must conform with the *National Fuel Gas Code* ANSI Z223.1 (latest edition) pertaining to gas-burning devices and such material must not attain a temperature over 160°F by continued operation of the heater.
- **Special installations (aircraft hangars/garages):** in the United States, installation in an aircraft hangar should be in accordance with NFPA No. 409 (latest edition), *Standard for Aircraft Hangars*, in public garages in accordance with NFPA No. 88A (latest edition), *Standard for Parking Structures*, and in repair garages in accordance with NFPA No. 88B (latest edition), *Standard for Repair Garages*. In Canada, installations in aircraft hangars, parking garages, and repair garages should be in accordance with the requirements of the enforcing authorities and with CSA B149.1 codes.

Unit Location

⚠ CAUTION ⚠

Do not locate the unit where it may be exposed to liquid spray, rain, or dripping water.

- A duct furnace is designed for connection to an inlet and an outlet duct and depends on an external air handler. Location must be in accordance with **Clearances** section.
- There are a variety of factors such as system application, building structure, dimensions, and weight that contribute to selecting the location. Read the installation information in this manual and select a location that complies with the requirements.

Combustion Air Requirements

⚠ WARNING ⚠

The unit is designed to take combustion air from the space in which it is installed and is not designed for connection to an outside combustion air intake duct. Connecting this furnace to an outside combustion air intake duct voids the warranty and could cause hazardous operation.

- The unit is designed to take combustion air from the space in which it is installed. The air that enters into the combustion process is vented to the outdoors. Sufficient air must enter the equipment location to replace the air exhausted through the vent system.
- Modern construction methods involve a greater use of insulation, improved vapor barriers, and weather-stripping. The result is that buildings are generally much tighter structurally than they have been in the past. The combustion air supply for gas-fired equipment can be affected by these construction conditions because infiltration that would have existed in the past may not be adequate. Extensive use of exhaust fans aggravates the situation. In the past the filtration of outside air assumed in heat loss calculations (one air change per hour) was assumed to be sufficient. However, current construction methods may now require the introduction of outside air into the room or building through wall openings or ducts.
- Under all conditions, enough air must be provided to ensure there will not be a negative pressure condition within the equipment room or space. A positive seal must be made in all return-air connections and ducts.
- Requirements for combustion air and ventilation air depend upon whether the unit is located in a confined or unconfined space. A ***confined*** space is defined as a space whose volume is <50 cubic feet per 1,000 BTUh of the installed appliance input rating. An ***unconfined*** space is defined as a space whose volume is ≥50 cubic feet per 1,000 BTUh of the installed appliance input rating.
- Even a slight leak can create a negative pressure condition in a confined space and can affect combustion. Do not install a unit in a confined space without providing wall openings leading to and from the space. Depending on the combustion air source, provide openings near the floor and ceiling for ventilation and air for combustion as shown in **Figure 1** and as listed in **Table 2**.

NOTE: For further details or other approved methods on supplying combustion air to a confined space, refer to the *National Fuel Gas Code* ANSI Z223.1a (latest edition).

Combustion Air Requirements—Continued

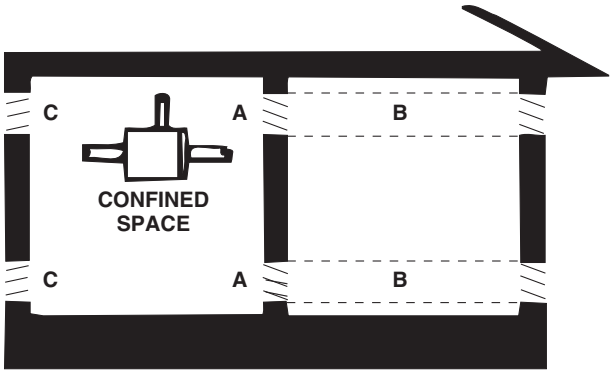


Figure 1. Confined Space Combustion Air Openings (Refer to Table 2)

Table 2. Determining Confined Space Combustion Air Requirements

Letter*	Air Source	Required Opening Size	Calculate Combustion Air Requirements
A	Air inside building	1 square inch free area per 1000 BTUh	Add total BTUh of all appliances in confined space and divide by figures at left for square inch free area size of each (top and bottom) opening
		Never <100 square inches free area for each opening	
B	Outside air through duct	1 square inch free area per 2000 BTUh	
C	Direct outside air	1 square inch free area per 4000 BTUh	

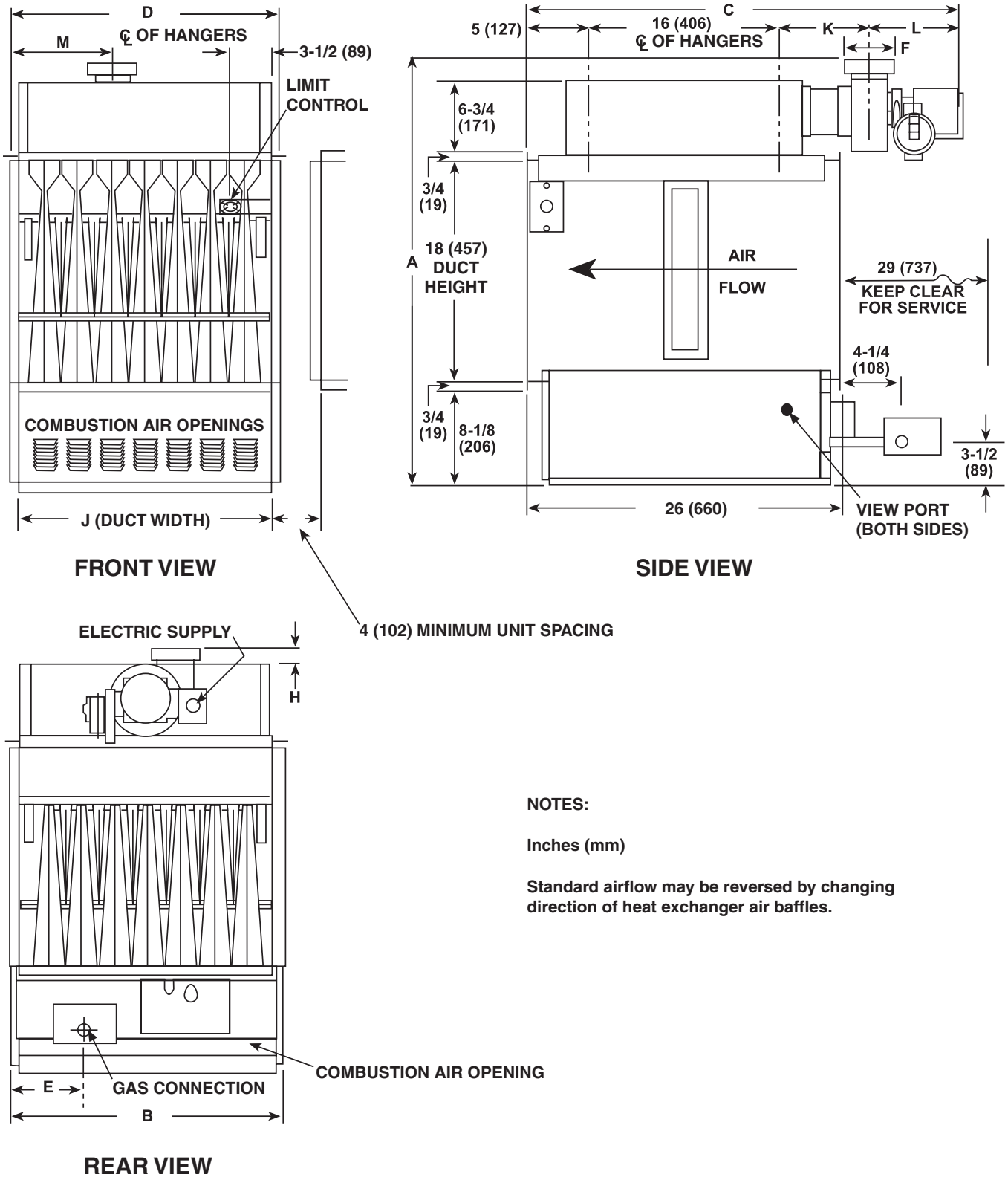
*See Figure 1.

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.

Dimensions



NOTES:

Inches (mm)

Standard airflow may be reversed by changing direction of heat exchanger air baffles.

Figure 2. Dimensions

Dimensions—Continued

Table 3. Dimensions

Dimension (See Figure 2)	Unit Size								
	075, 100	125, 140	170	200	225	250	300	350	400
	Inches (mm)								
A	35 (889)				35-3/4 (908)		36 (914)		
B	14-1/4 (362)	17 (432)	19-3/4 (502)	22-1/2 (572)	25-1/4 (641)	28 (711)	33-1/2 (851)	39 (991)	44-1/2 (1130)
C	35-11/16 (906)						38-1/8 (968)		
D	14-5/8 (371)	17-3/8 (441)	20-1/8 (511)	22-7/8 (581)	25-5/8 (651)	28-3/8 (721)	33-7/8 (860)	39-3/8 (1000)	44-7/8 (1140)
E	4-3/8 (111)					7-1/8 (181)	9-7/8 (251)	12-5/8 (321)	15-3/8 (391)
F	4 (102)				5 (127)		6 (152)		
H	5/8 (16)				1-3/8 (35)		1-5/8 (41)		
J	12-1/2 (318)	15-1/4 (387)	18 (457)	20-3/4 (527)	23-1/2 (597)	26-1/4 (667)	31-3/4 (806)	37-1/4 (946)	42-3/4 (1086)
K	7-1/4 (184)						9-9/16 (243)		
L	7-7/16 (189)						7-5/8 (194)		
M	4-5/8 (117)	6 (152)	7-3/8 (187)	8-3/4 (222)	10-1/8 (257)	11-1/2 (292)	13-7/8 (352)	16-5/8 (422)	19-3/8 (492)

Clearances

The unit must be installed so that clearances are provided for combustion air space, for service and inspection, and for proper spacing from combustible construction. Clearance to combustibles is defined as the necessary minimum distance from the heater to a surface or object that ensures that a surface temperature does not exceed 90°F above the surrounding ambient temperature. Table 4 lists required clearances.

NOTE: The required service clearance is shown in Figure 2.

Table 4. Clearances

Unit Surface	Minimum Clearance (Inches (mm))
Front, top, and flue connector	6 (152)
Sides and bottom	12 (305)
Rear	29 (737)

Weights

Table 5. Weights

Unit Size									
075, 100	125	140	170	200	225	250	300	350	400
Net Weight (Pounds (kg))									
104 (47)	126 (57)	128 (58)	150 (68)	172 (78)	194 (88)	216 (98)	262 (119)	306 (139)	328 (149)

INSTALLATION

Unpacking and Inspection

- The unit was test-operated and inspected at the factory prior to crating and was in operating condition.
- If, upon removing it from its crate, the unit has been found to have incurred any damage in shipment, document the damage with the transporting agency and contact an authorized Factory Distributor. If you are an authorized Distributor, follow the FOB freight policy procedures.

⚠ CAUTION ⚠

Ensure that EXCESSIVE shipping vibration has not caused the burner rack assembly to drop off the support rails into the bottom pan.

- Remove the panel from the bottom rear of the furnace (refer to **Burner Rack and Pilot Maintenance** section) and check the burner rack assembly. The burner rack drawer should be setting level with each side on a support rail. If the burner rack assembly is positioned properly, close the back panel.
- If the burner rack has fallen, remove the screws holding the burner rack assembly and pull out the burner rack drawer. Reassemble by sliding the burner rack drawer into the heater, ensuring that both sides are resting on the support rails. Reattach to the support brackets underneath the burners, reinsert the burner rack screws, and close the back panel.

Pre-Installation Checklist

- ❑ 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.
- ❑ Read this booklet 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.
- ❑ Before beginning, make preparations for necessary supplies, tools, and manpower.
- ❑ Check to see if there are any field-installed options that need to be assembled/installed prior to unit installation.
- ❑ Shipped-separate options could include a gas shutoff valve, a vent cap, a condensate drain fitting, a thermostat, a hanger kit, a coupling kit, and/or a fan control.
- ❑ Some gas control options will either have parts shipped loose with the unit or shipped separately. If the unit is equipped with any of the options listed in **Table 6**, ensure that these parts are available at the installation site.

Table 6. Gas Control and Makeup Air Control Options

Type	Option	Included Components (PN)
Gas control (heating)	AG7	Amplifier (260863), thermostat (48033)
Makeup air control*	AG3	Control switch (29054), gasket (7726), gasket retainer plate (7727)
	AG8	Temperature sensor and mixing tube (48041), amplifier (260864), control switch (29054)
	AG9	Remote temperature selector (48042), temperature sensor and mixing tube (48041), amplifier (260863), control switch (29054)
	AG15	Remote temperature selector (115848), stage adder module (115849), control switch (29054), 115-24V (103055), 208/230-24V transformer (103497), 1/2-inch transformer locknut (16222), discharge sensor holder (115850), discharge air sensor holder bracket (213612), temperature sensor (115815)
	AG21	Signal conditioner (134170), conditioner relay (14747), 115-24V transformer (103055), 1/2-inch transformer locknut (16222), fuse box (12697), fuse box cover (12698), hole plugs—quantity three (16451)

*All of the makeup air options also require a shipped-separate fan control (option CQ1, PN 57960), which should be at the job site.

Pre-Installation Modifications

High CFM Conversion

This unit was factory assembled with the air throughput range listed on the rating plate. If the application requires a higher CFM than listed on the rating plate, the unit may be converted for lower temperature rise and higher CFM. The conversion will change the air throughput range as specified in **Table 7**. Verify the unit size on the heater rating plate and, after confirming that this conversion is correct for the unit, perform the following procedure:

Table 7. High Air Throughput

Unit Size	Minimum	Maximum
	CFM	
075	855	2778
100	1140	3704
125	1425	4630
140	1595	5185
170	1937	6296
200	2279	7407
225	2564	8333
250	2849	9259
300	3175	11,111
350	3704	12,963
400	4233	14,815

⚠ DANGER ⚠

- **This conversion shall be done by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion, or the production of carbon monoxide may cause property damage, personal injury, or loss of life. The qualified service agency performing this work assumes responsibility for the conversion of this appliance to provide for higher CFM.**
- **These instructions are designed to prepare the duct furnace for increased air throughput conversion prior to installation. If your duct furnace is already installed, for your safety, turn OFF the gas and electric supply before servicing.**

NOTE: Before performing this conversion, determine if airflow is being reversed or if other field-installed options apply. Perform desired procedure in accordance with Pre-Installation Modifications section.

1. Remove heat exchanger baffles (see **Figure 3**):
   a. Remove support bracket screws and slide entire baffle assembly out of heat exchanger.
   b. Reinstall screws to plug holes.
   c. For unit sizes 075 and 100, conversion is complete. Proceed to step 3.

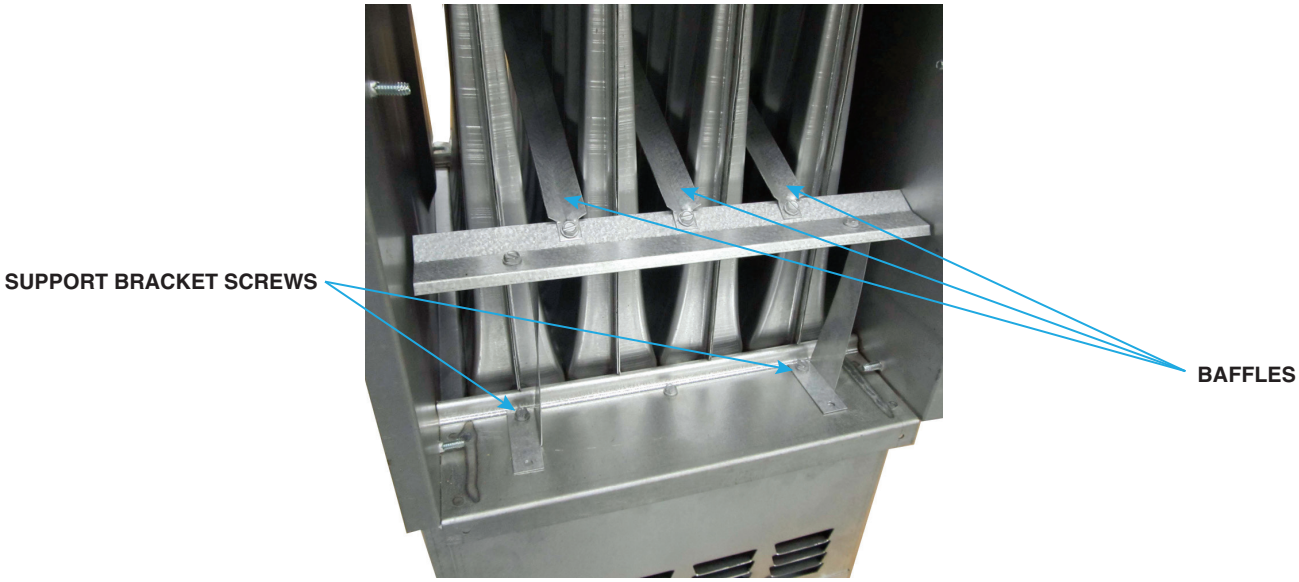


Figure 3. Heat Exchanger Baffle Removal

2. Remove side finger baffles on unit sizes 125–400 (see **Figure 4**):

NOTE: DO NOT remove the side finger baffles on unit sizes 075 and 100.

   a. At entering air side of heat exchanger, locate side finger baffles and remove two side finger baffle screws from each baffle.

   b. Remove both side finger baffles.

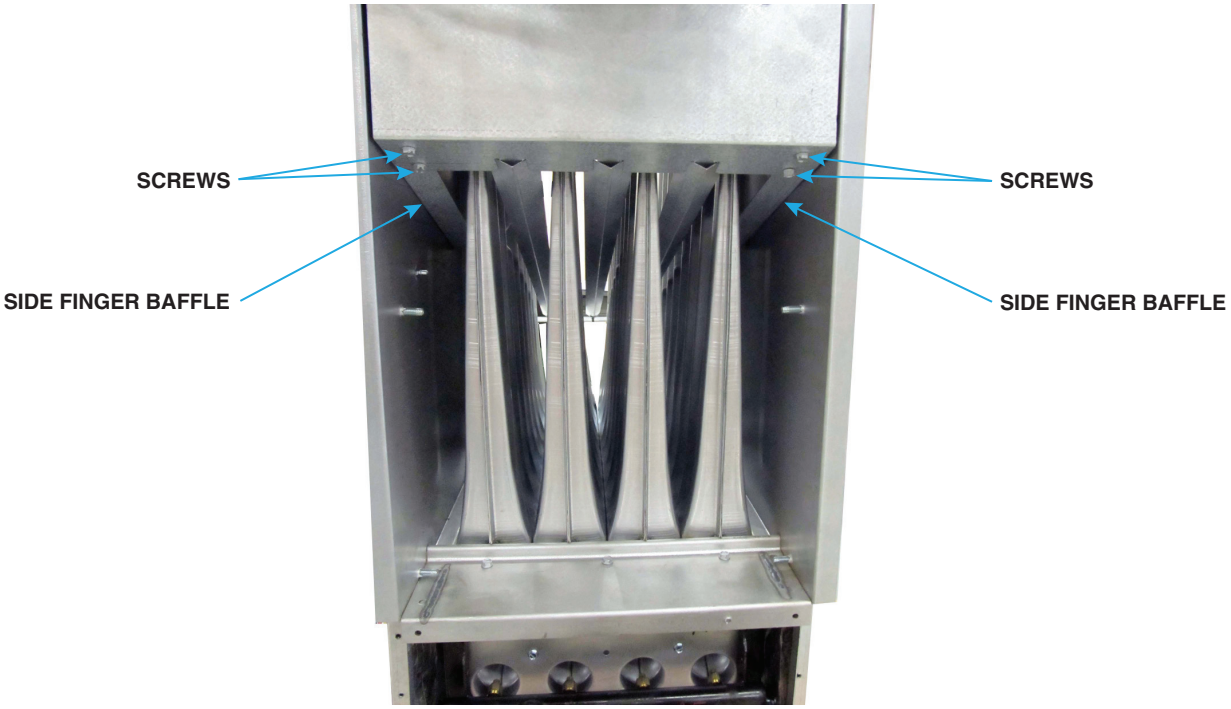


Figure 4. Side Finger Baffle Removal

3. Install field conversion label (see **Figure 5**):

   a. Fill in field conversion label (PN 263310) from literature bag.

   b. Adhere label to unit on clean dry surface adjacent to rating plate.

4. Test unit for proper operation ensuring that air throughput is in accordance with **Table 7**.

Pre-Installation Modifications—Continued

High CFM Conversion—Continued

IMPORTANT

This appliance has been converted on
Cet appareil a été converti _____ ***(date)*** _____
to _____ cfm maximum throughput
au _____ pi³/min consommation maximum
to _____ cfm minimum throughput
au _____ pi³/min consommation minimum
by / par ***(name & address of company making this conversion)*** ,
with kit no. / avec la kit no ***263308*** .
which accepts the responsibility that this conversion has been properly made.
qui accepte la responsabilité que cette conversion a été correctement faite.

263310

Figure 5. Field Conversion Label

Reverse Airflow Conversion

Duct furnaces are equipped with directional air baffles between the heat exchanger tubes. Facing the control compartment of the furnace, the standard direction of airflow is from the rear of the furnace (gas valve location) toward the front of the furnace. If the installation site requires airflow from the front to the rear, the unit may be field-adapted by relocating the limit control and reversing the position of the directional air baffles as follows:

NOTE: When reversing airflow, the limit control MUST be relocated to the discharge end of the heat exchanger.

1. Remove limit control (see **Figure 6**, DETAIL A):
   a. If unit has optional outer side panels, locate limit control and remove outer side panel on that side of furnace.
   b. Remove limit control bracket screws and remove limit control/bracket assembly. Do not disconnect limit control wires.
   c. Carefully pull limit control/bracket assembly through hole.
2. Reverse direction of airflow baffles (see **Figure 6**, DETAIL B):
   a. Remove baffle screws and lift each airflow baffle slightly and slide forward. Remove all baffles from heat exchanger.
   b. Remove top baffle support screws and remove top baffle support. Reposition and secure support on opposite end of heat exchanger using screws.
   c. Remove bracket screws and remove bottom baffle support and bracket assembly. Reinstall bracket screws to plug holes in heat exchanger bottom. Reposition bottom baffle support and bracket assembly on opposite end of heat exchanger and secure using field-supplied sheet metal screws.
   d. Reinstall airflow baffles removed in step 2a and secure using baffle screws.
3. Reinstall limit control removed in step 1:
   a. Measure down 4-1/2 inches (114 mm) and across 1-11/16 inches (43 mm) at discharge end on same side of heat exchanger. Using that center point, punch 2-1/4-inch (57-mm) diameter hole in side panel.
   b. With limit control on heat exchanger side of bracket, slide limit control/bracket assembly through hole and secure bracket using two sheet metal screws.

NOTE: If cable connections need to be moved, after the limit control is installed, secure them using field-supplied sheet metal screws. Reinstall screws to plug all holes in the side panel.

c. Cover all original factory-made limit control holes using field-supplied sheet metal plate. Do not leave any open holes in side panel or heat exchanger bottom. Unit is now ready for installation with airflow from front to rear (gas valve side).

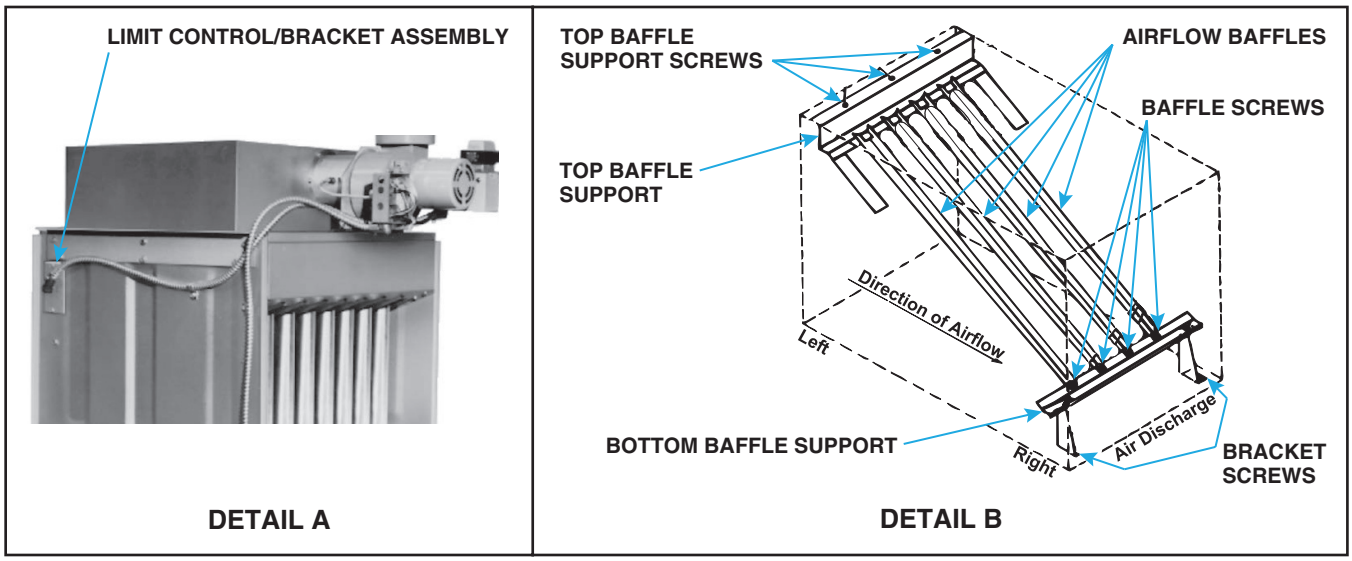


Figure 6. Limit Control and Airflow Baffles

Coupling Additional Furnaces Together

Coupling of furnaces is done using optional coupling kits, which are listed in **Table 8**. Couple two, three, four, or five furnaces together as follows. Item numbers in parentheses refer to **Figure 7** and **Table 9**.

Table 8. Optional Furnace Coupling Kits

Option	For Number of Units	PN
CR1	2	57963
CR2	3	82654
CR3	4	82655
CR4	5	82656

1. Position tie plate (1) below hanger angle (2) and secure tie plate to first furnace using threaded socket assemblies (3). Tighten threaded socket assemblies firmly.

NOTE: The tie plate (1) MUST be under both hanger angles (2).

2. Position second furnace next to first furnace so that tie plate (1) is below hanger angle (2). Secure tie plate to hanger angle using bolts (4), lockwashers (5), and nuts (6).
3. Position filler plates (7) as shown in **Figure 7**, DETAIL B. Using filler plate as template, drill 1/8-inch diameter holes and secure filler plates using sheet metal screws (8). Offset of filler plate allows alignment with unit duct flanges (see **Figure 8**, DETAIL A).

NOTES:

- **Coupled units require access panels (see Figure 8, DETAIL B) in the top or bottom of the outlet ductwork for limit control service and observation of coupled units (refer to Duct Connections section).**
- **Refer to Figure 8, DETAIL B and Table 10 for coupled furnace front view dimensions.**

Pre-Installation Modifications—Continued

Coupling Additional Furnaces Together—Continued

Table 9. Coupling Kit Components

Item No.	Component	Description	PN	Quantity*
1	Plate	Tie	57965	1
2	Angle	Hanger	—	2
3	Socket assembly	Threaded	9557	2
4	Bolt	Hex head, 3/8-16 × 1-1/4-inch-long	5095	2
5	Lockwasher	Split ring	5197	2
6	Nut	Spotweld	—	2
7	Plate	Filler	57964	2
8	Screw	Sheet metal, #10 × 1/2-inch-long	11813	20

*Quantities listed are for option CR1 coupling kit (PN 57963) for two furnaces.

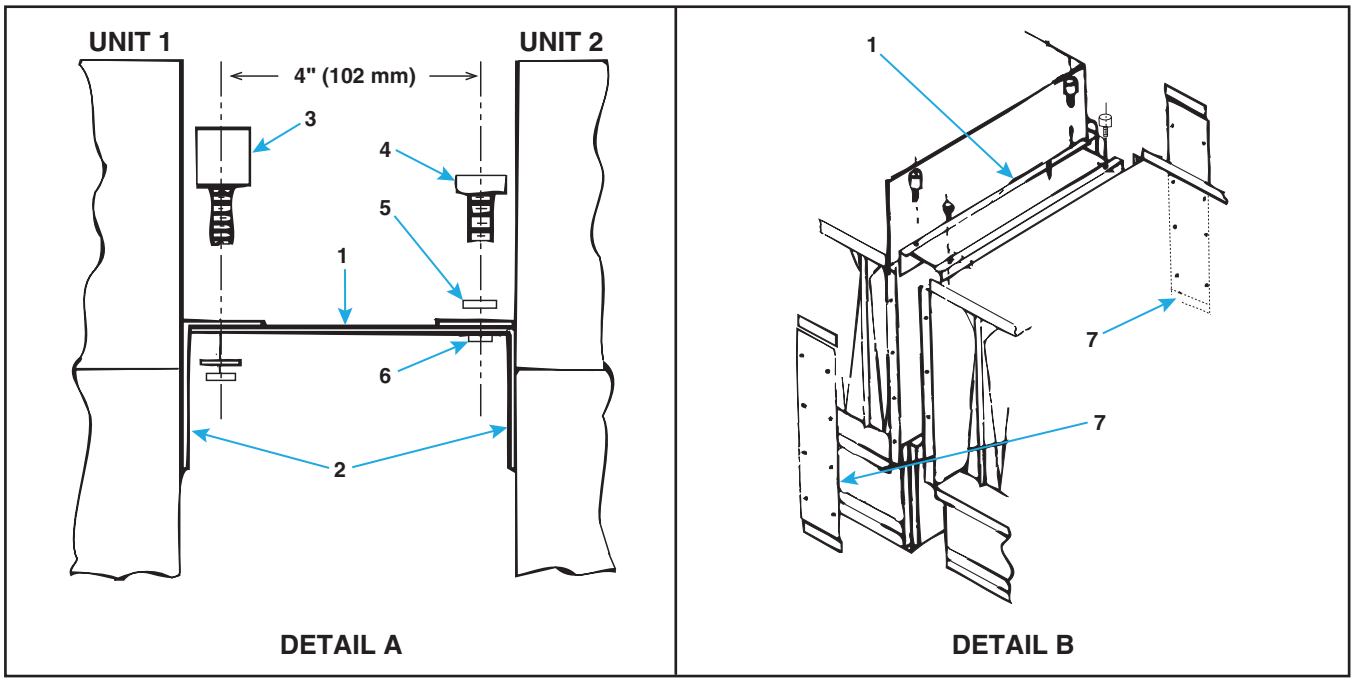


Figure 7. Coupling Kit Installation

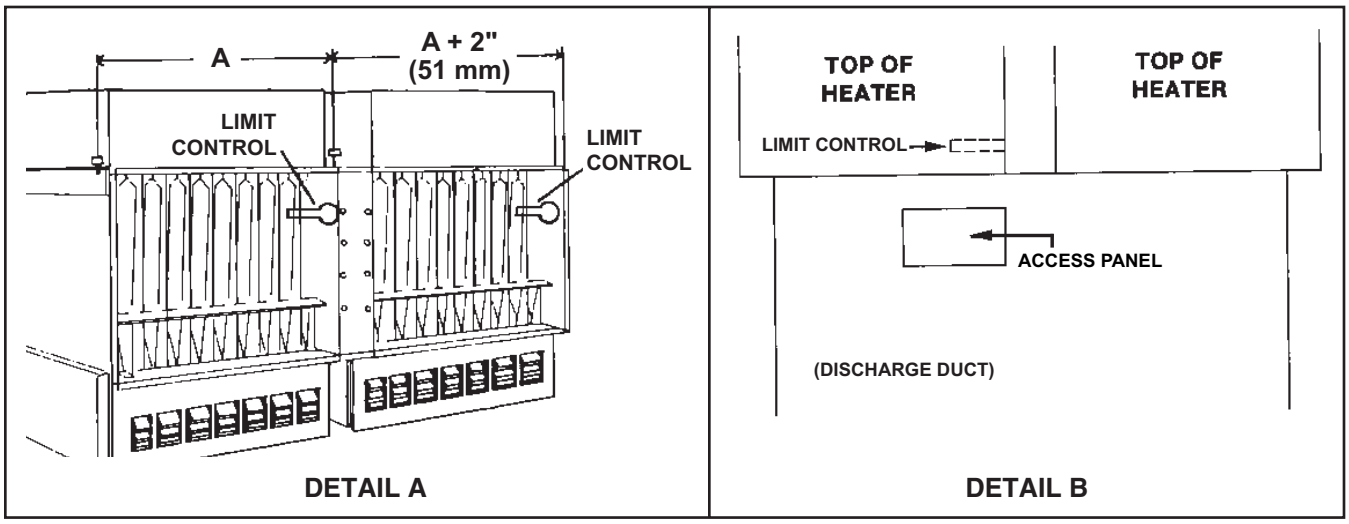


Figure 8. Front and Top Views of Coupled Furnaces

Table 10. Coupled Furnace Front View Dimensions

Unit Size	Dimension A*	
	Inches	Millimeters
075, 100	14-5/8	371
125, 140	17-3/8	441
170	20-1/8	511
200	22-7/8	581
225	25-5/8	651
250	28-3/8	721
300	33-7/8	860
350	39-3/8	1000
400	44-7/8	1140

*See Figure 8, DETAIL A.

Mounting Furnace

⚠ WARNING ⚠

- **Before installing the furnace, check the supporting structure to be used to verify that it has sufficient load-carrying capacity to support the weight (refer to Weights section) of the unit.**
- **Service and combustion air clearances (refer to Clearances section) apply to both suspended and mounted furnaces.**
- **The furnace must be level for proper operation. DO NOT place or add additional weight to a suspended furnace.**

Mounting Furnace—Continued

Suspension-Mounting

- The furnace is provided with four 15/32-inch (12 mm) diameter holes for mounting using four-point suspension as shown in **Figure 9**.
- To determine the center line for the hangers, refer to dimension A listed in **Table 10**.
- The hardware required is shown in **Figure 9**, DETAIL A and includes four 7/16-16 threaded rods, four split ring lockwashers, and eight 7-16 nuts.
- A hanger adapter kit (option CK3, PN 57959) with four free-turning threaded sockets (PN 9557) for 1-inch pipe (see **Figure 9**, DETAIL B) is available.
  a. Remove lockwasher and nut from swivel connector.
  b. Install bolt down through hole in hanger bracket and secure using lockwasher and nut.
  c. Repeat steps b and c for all hanger brackets.

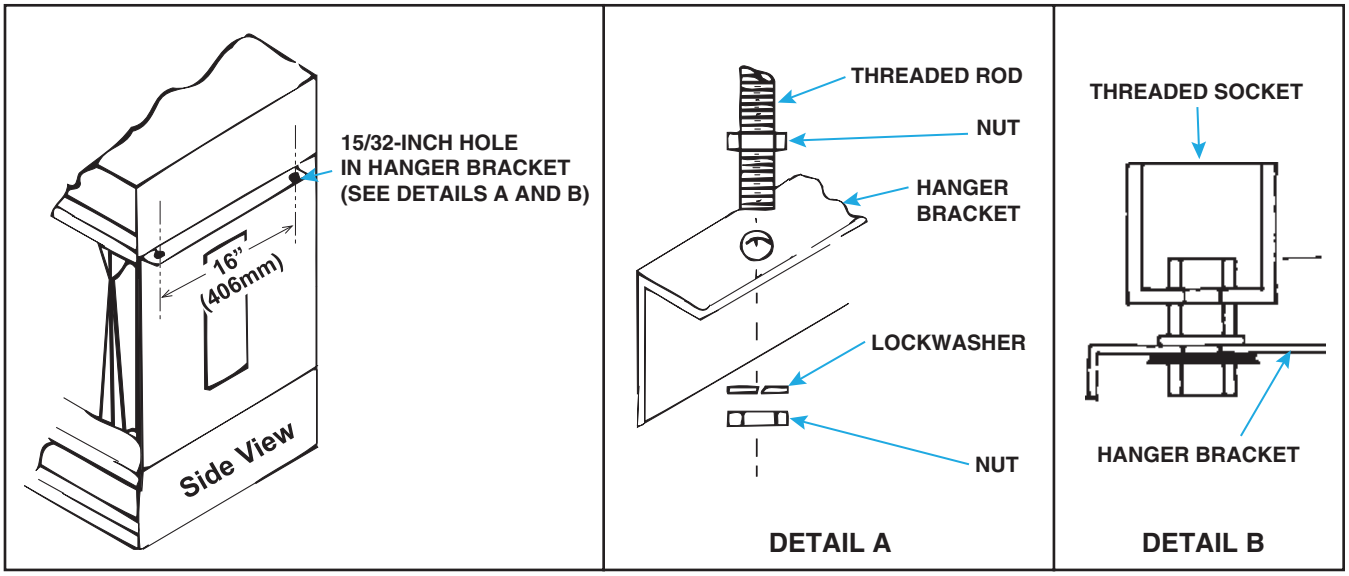


Figure 9. Suspension-Mounting of Single Furnace

Base-Mounting

⚠ DANGER ⚠

When the furnace is base-mounted on combustible material, a minimum clearance of 12 inches (305 mm) is required. The base or legs used for base-mounting must be made of non-combustible material.

Base-mount the furnace as follows:

1. Remove two hanger brackets from their standard positions and install them at their base-mounting positions as shown in **Figure 10**, DETAIL A.
2. Install four leg brackets (see **Figure 10**, DETAIL B) from base-mounting kit (PN 1034022). Secure leg brackets with screws provided in existing holes in front. Drill new leg bracket holes in rear.

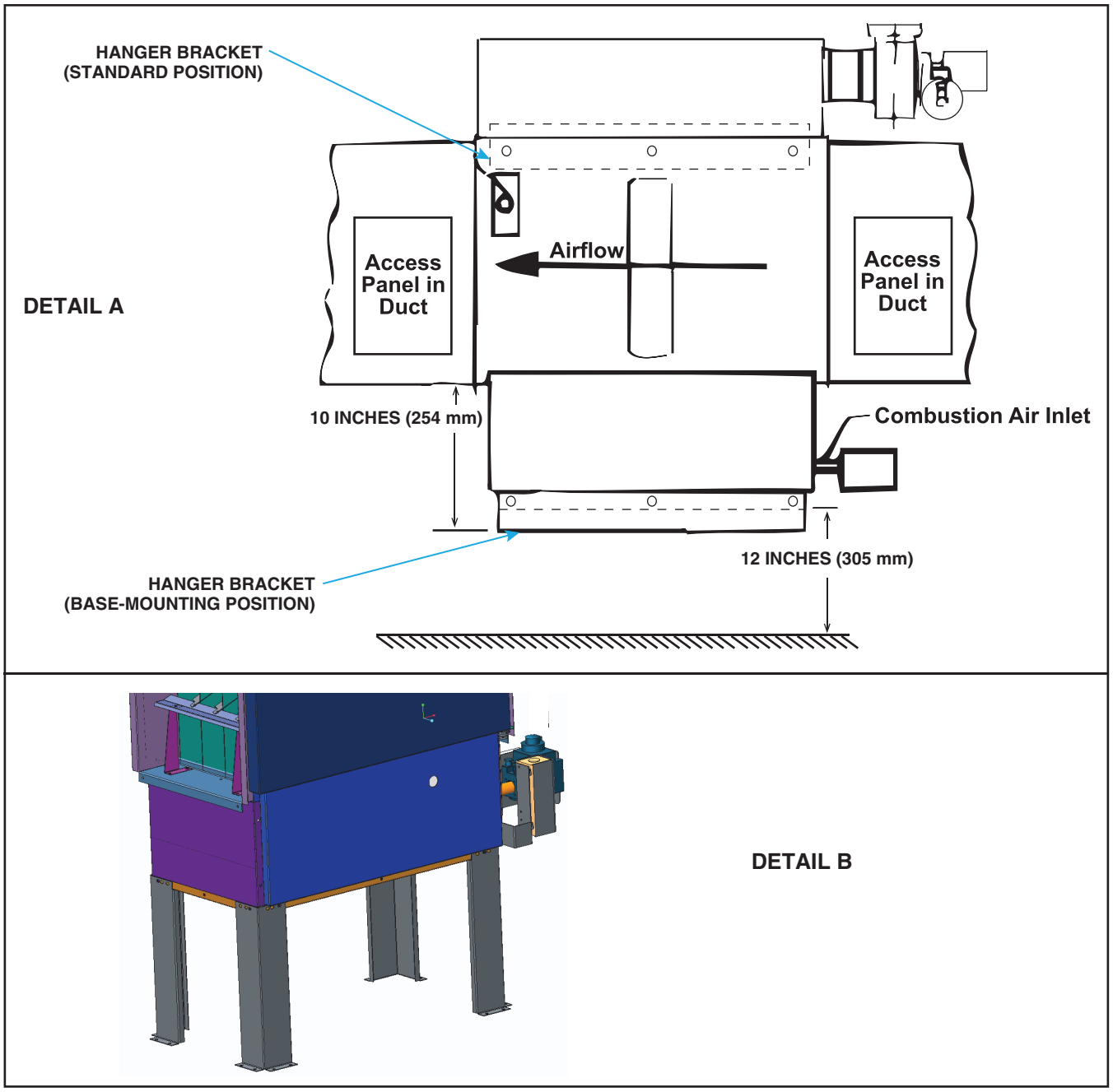


Figure 10. Base-Mounting Single Furnace

Piping Connections

Gas Supply Pressure

The unit is equipped for a maximum gas supply pressure of 1/2 psi, 3.4 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.**

Gas Supply Piping

⚠ 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 CSA B149.1 (refer to **Installation Codes** section).
- Gas supply piping installation shall conform with good practice and with local codes.
- Duct furnaces are 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 2,500 (±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 11**. 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 11. 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	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
	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

- Gas connections are shown in **Figure 11** and gas connections sizes are listed in **Table 12**.
- 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 11**).
- After all connections are made, disconnect the pilot supply at the control valve and bleed the system of air. Reconnect the pilot line and leak-test all connections by brushing on a soap solution.

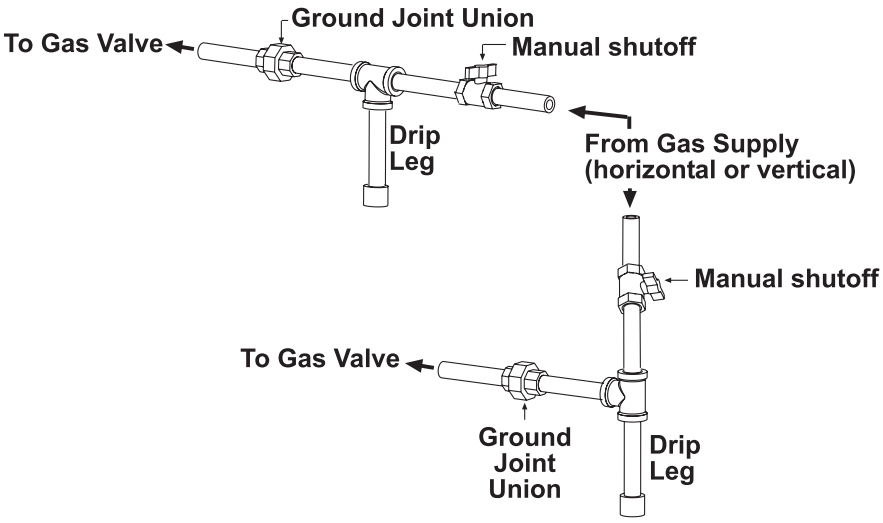


Figure 11. Supply Piping Connection

Table 12. Gas Connection Sizes

Unit Size	Natural Gas	Propane
	Connection (Inches)*	
075–250	1/2	1/2
300–400	3/4	1/2

*Connection size to single-stage valve (not gas supply line size).

Condensate Drain Installation

Condensate can form in the heat exchanger of furnaces installed as makeup air units or when installed downstream from a cooling coil. Under these conditions, a drain flange (option CS1, PN 31765) may be installed on the furnace bottom as follows:

NOTE: A 4-inch (102-mm) minimum clearance is required under the furnace if a 90-degree street elbow is used.

1. Install drain flange in bottom of furnace casing as shown in **Figure 12** and secure using two machine screws (#10-32 × 1-inch-long) and nuts.

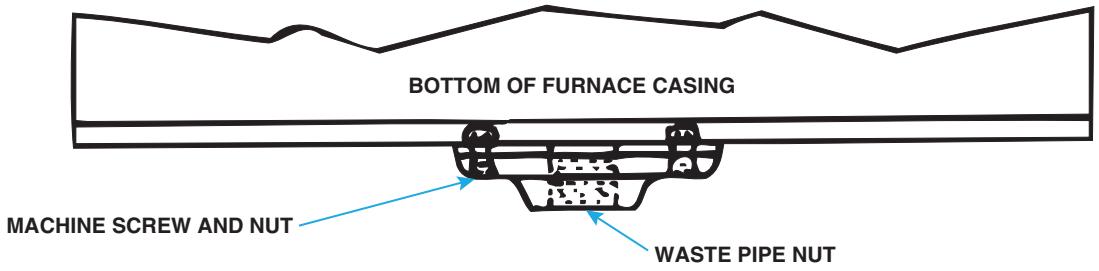


Figure 12. Condensate Drain

Piping Connections—Continued

Condensate Drain Installation—Continued

2. Install 3/4-inch waste pipe nut in drain flange.
3. Seal all corners and four square holes in bottom pan edge using RTV sealant.
4. Terminate drain outside of building.

NOTE: Periodic cleaning of the condensate collector and disposal system is required.

Vent Connections

⚠ DANGER ⚠

- **Failure to provide proper venting could result in death, serious injury, and/or property damage. Unit must be installed with a flue connection and proper vent to the outside of the building. Follow installation codes and all venting instructions. Safe operation of any gas-fired equipment requires a properly operating vent system, correct provision for combustion air, and regular maintenance and inspection.**
- **Units installed in multiples require individual vent pipe runs and vent caps. Manifolding of vent runs is not permitted due to possible recirculation of combustion products into the building and possible back pressure effects on the combustion air proving switch.**

- Venting must be in accordance with the *National Fuel Gas Code* Z223.1 (latest edition) or CSA B149.1 *Natural Gas and Propane Installation Code*, and all local codes. Local requirements supersede national requirements.
- These power-vented units are designed to operate safely and efficiently with either a horizontal or vertical vent. For maximum fuel savings, a horizontal vent run is recommended.
- If a vent cap is shipped with the unit, it is packaged attached to the venter housing. Detach the vent cap from the housing.

Specific Venting Requirements

Read all of the following before installing venting:

- **Type of vent pipe:** use either vent pipe approved for a category III heater or appropriately sealed single-wall pipe—if at least half of the equivalent length of the vent system is vertical, vent pipe approved for a category I heater may be used. Single-wall pipe or double-wall (type B) vent pipe are suitable for use with a category I heater.
- **Vent pipe diameter:** Use only one of the flue pipe diameters listed in **Table 13** for the furnace size being installed. The standard venter (flue) outlet diameters are 4-inch for unit sizes 075–200, 5-inch for unit sizes 225 and 250, or 6-inch for unit sizes 300–400.If the pipe used in the vent run is larger than the diameter of the venter outlet (refer to **Table 13**), make the transition at the venter outlet.

Table 13. Maximum Permissible Vent Lengths				
Vent Pipe Diameter (Inches)	Unit Size	Feet (Meters)		
		Maximum Vent Length*	Reduced Length for Each Elbow Used**	
			90-Degree Elbow	45-Degree Elbow
Standard Vent Pipe Diameters				
4	075	40 (12.2)	6 (1.8)	3 (0.9)
	100–200	50 (15.2)	7 (2.1)	3.5 (1.1)
5	225, 250	50 (15.2)	9 (2.7)	4.5 (1.4)
6	300–400	50 (15.2)	11 (3.4)	5.5 (1.7)
Optional (Increased) Vent Pipe Diameters				
5	170	60 (18.3)	9 (2.7)	4.5 (1.4)
	200	70 (21.3)	9 (2.7)	4.5 (1.4)
6	225	70 (21.3)	11 (3.4)	5.5 (1.7)
	250	70 (21.3)	12 (3.7)	6 (1.8)
7	300	70 (21.3)	13 (4.0)	6.5 (2.0)
	350	80 (24.3)	13 (4.0)	6.5 (2.0)
	400	90 (27.4)	14 (4.3)	7 (2.1)
*If the system contains all vertical pipe or a combination of vertical and horizontal vent pipe, the length may be increased 1 foot for each foot of vertical pipe—up to a maximum increase of 10 feet for unit sizes 075–125 or 20 feet for unit sizes 140–400.				
**Reduce the maximum vent length by the amount indicated for each elbow used.				

- **Vent system joints:** vent system joints depend on the installation and the type of pipe being used:
  a. **If installed as a category III heater (required if more than half of the equivalent length of the vent system is horizontal) and single-wall vent pipe is being used:** use at least two non-corrosive screws per vent pipe joint and seal all joints to prevent leakage of flue gases into the building. For sealing joints, tape suitable for 550°F is recommended (required in California).
  b. **If installed as a category III heater (required if more than half of the equivalent length of the vent system is horizontal) and vent pipe specifically approved for category III vent systems is being used:** follow the pipe manufacturer's instructions for proper sealing.
  c. **If installed with a category I vent system (allowed only if at least half of the equivalent length of the vent system is vertical):** use at least two non-corrosive screws per vent pipe joint on single-wall pipe or follow the pipe manufacturer's instructions for joining double-wall pipe. Refer to the **Vent Termination (Vent Pipe and Vent Cap)** section for installing a vent cap to double-wall pipe.
- **Vent system support:** support lateral runs every 6 feet (1.8M), using a non-combustible material such as strap steel or chain. Do not rely on the heater for support of either horizontal or vertical vent pipe.
- **Condensation:** single-wall vent pipe exposed to cold air or run through unheated areas must be insulated. Where extreme conditions are anticipated, install a means of condensate disposal.
- **Vent terminal (pipe and vent cap):** terminate the vent system with a vent cap (option CC1):
  a. In most cases the vent cap is the same size as the vent run. Units installed in the United States that are ordered with an optional vent cap and all units ordered for Canada have a vent cap packaged with the heater. If the standard size vent pipe listed in **Table 13** is used, install the vent cap provided.
  b. If a vent cap is not included or if an optional (increased) size vent pipe listed in **Table 13** is used, install an option CC1 vent cap in the appropriate size.
  c. Refer to the **Vent Termination (Vent Pipe and Vent Cap)** section for vertical or horizontal vent termination requirements. The vent terminal section may be either single-wall or double-wall (type B) vent pipe.
  d. If double-wall pipe is used in the vent terminal, follow the instructions in the **Vent Termination (Vent Pipe and Vent Cap)** section to attach the vent cap and to connect the double-wall pipe to the single-wall or category III vent pipe run.

NOTE: If the vent run is 7-inch vent pipe, install an 8-inch vent cap using a tapered enlarger.

Vent Connections—Continued

Rotating Venter Outlet

⚠ WARNING ⚠

Only the venter housing may be rotated. The motor and combustion air proving switch MUST remain as received from the factory. Unsafe or improper operation will result if the standard position is varied (refer to Combustion Air Proving Switch section).

NOTE: A minimum of 12 inches (305 mm) of straight pipe is required at the venter outlet (or transition fitting) before installing an elbow in the vent system. An elbow should never be attached directly to the venter.

The venter is factory-installed as shown in **Figure 13**, DETAIL A. If required, the venter housing may be rotated as shown in **Figure 13**, DETAIL B. The vent may be run in one of three directions (1, 2, or 3) as shown. Rotate the venter housing as follows:

1. Remove three screws (save for reinstallation) that secure venter housing to outlet duct (pipe from furnace to venter). Ensure that venter housing assembly remains in place.
2. Remove three screws that secure motor plate to venter housing.
3. While holding motor, rotate venter housing to alternate position (1, 2, or 3) as shown in **Figure 13**, DETAIL B and reinstall motor plate to housing using three screws. To ensure correct venter wheel alignment, holes are provided in motor plate.
4. Using holes in venter housing as template, drill three 1/8-inch diameter holes in outlet duct and secure venter housing in its rotated position to outlet duct using three screws removed in step 1.

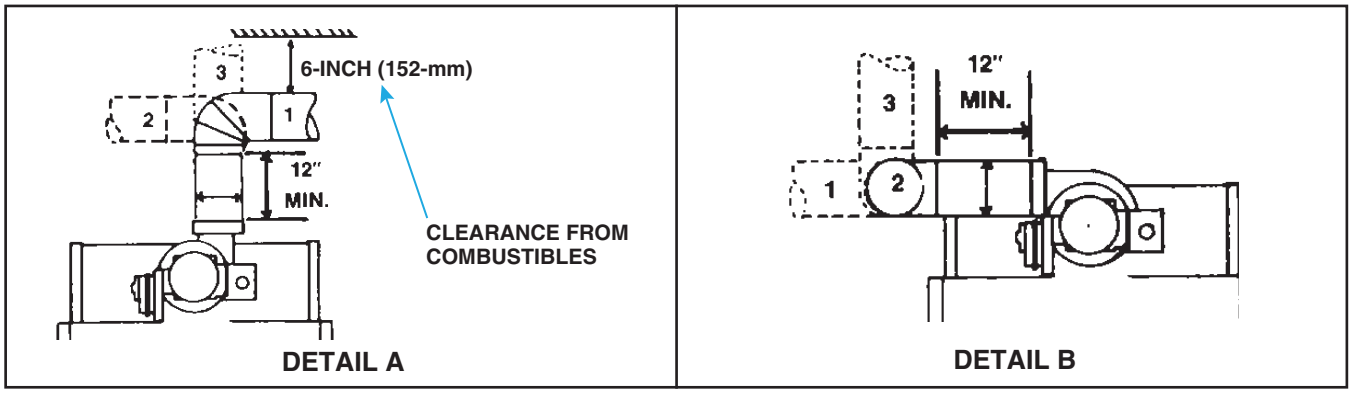


Figure 13. Rotating Venter Outlet

Vent Termination (Vent Pipe and Vent Cap)

Requirements for both vertical and horizontal vent termination are shown in **Figure 14**, **Figure 15**, **Figure 16**, and **Figure 17**. Instructions follow for connecting double-wall (type B) pipe to a vent cap or to a single-wall or category III vent pipe.

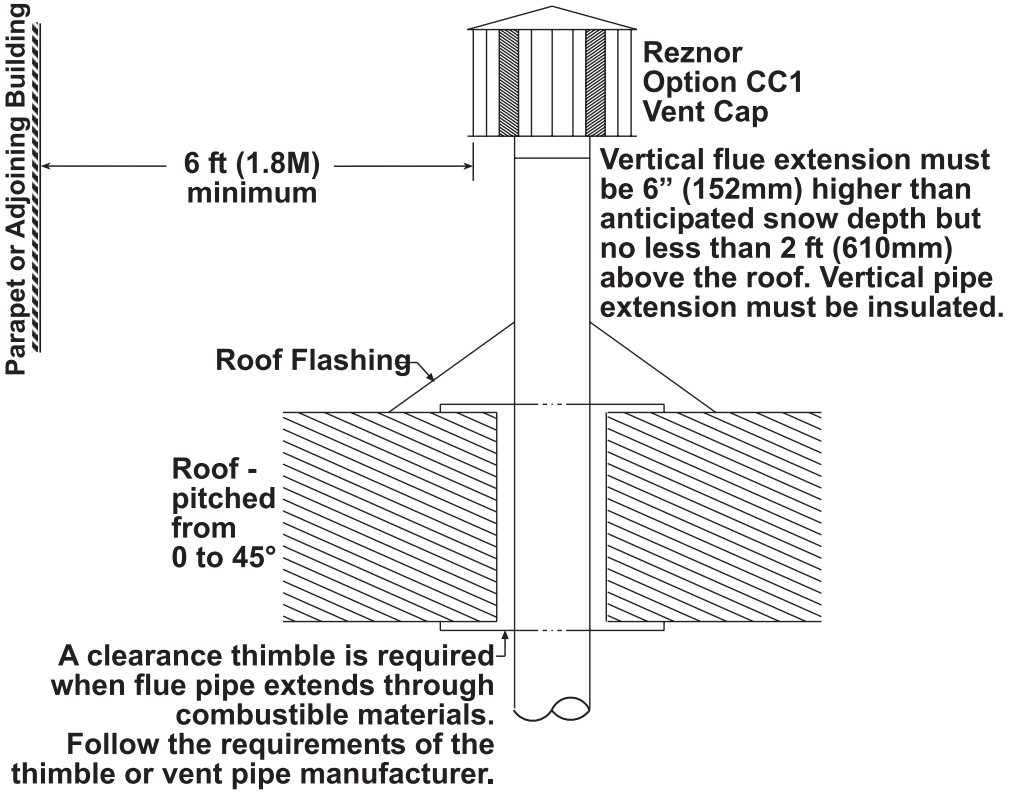


Figure 14. Vertical Vent Termination—Single-Wall Vent Run and Single-Wall Terminal End

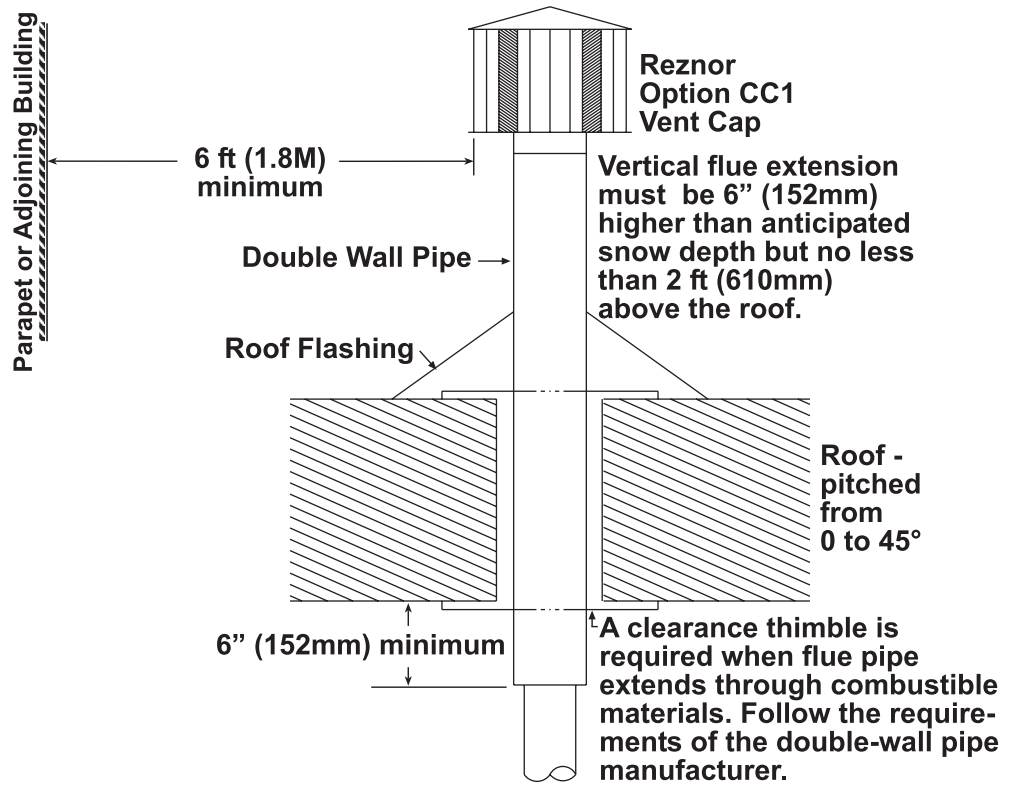
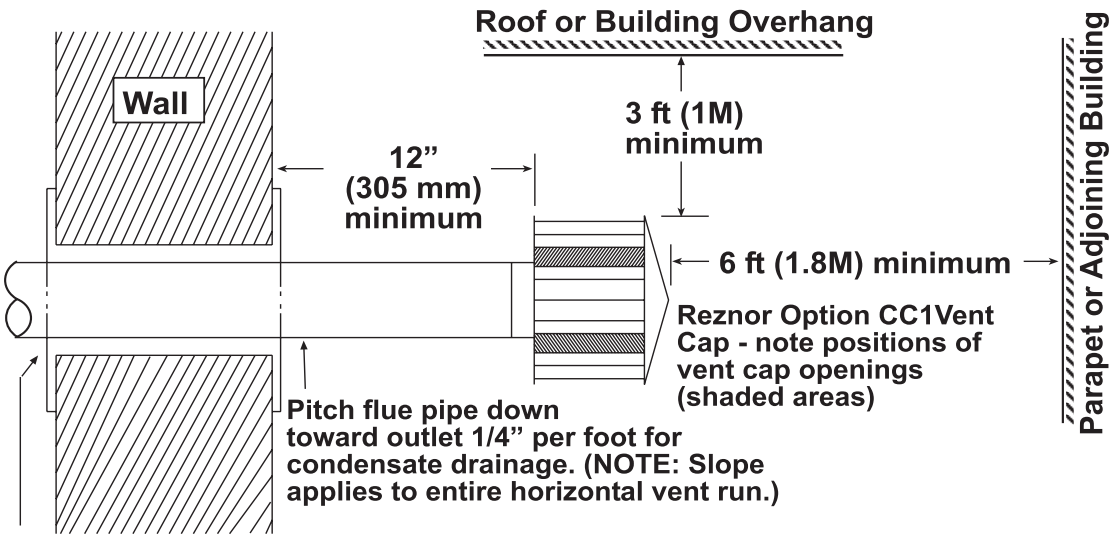


Figure 15. Vertical Vent Termination—Single-Wall Vent Run and Double-Wall Terminal End

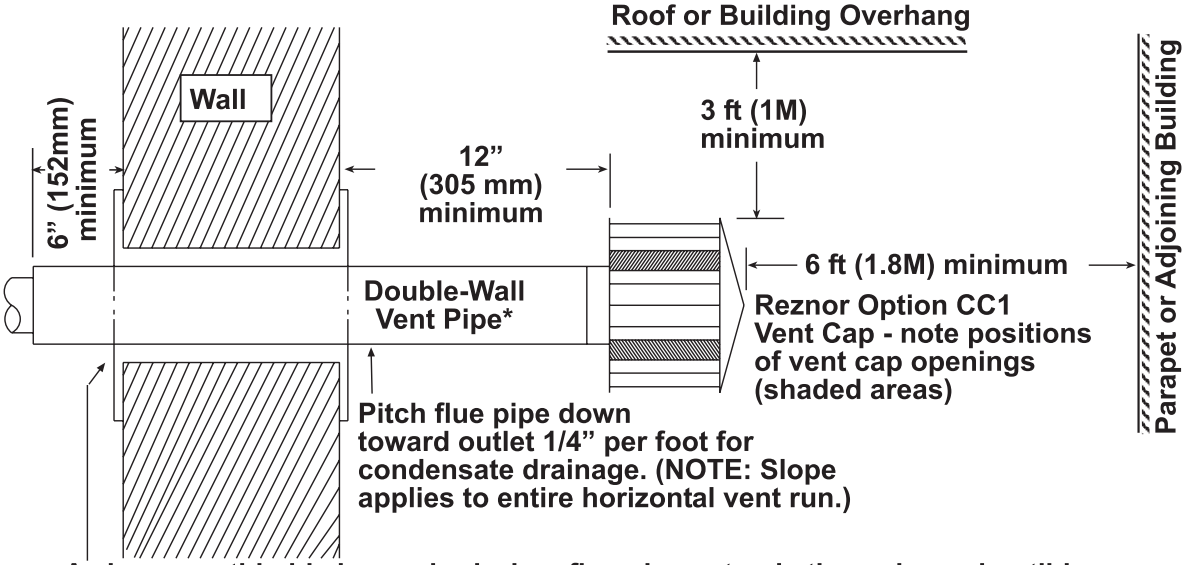
Vent Connections—Continued

Vent Termination (Vent Pipe and Vent Cap)—Continued



A clearance thimble is required when flue pipe extends through combustible materials. Follow the instructions of the thimble or vent pipe manufacturer.

Figure 16. Horizontal Vent Termination—Single-Wall Vent Run and Single-Wall Terminal End



A clearance thimble is required when flue pipe extends through combustible materials. Follow the requirements of the double-wall pipe manufacturer.

Figure 17. Horizontal Vent Termination—Single-Wall Vent Run and Double-Wall Terminal End

- **Connect double-wall (type B) pipe to a vent cap as follows:**
  a. Apply continual 3/8-inch bead of silicone sealant around circumference of vent cap collar (see **Figure 18**, DETAIL A) to prevent any water inside vent cap from running down double-wall pipe.
  b. Before sealant has any time to dry, insert collar on vent cap as far as possible inside inner wall of double-wall pipe (see **Figure 18**, DETAIL B).
  c. Apply additional silicone sealant to fully close any gaps between vent cap and double-wall pipe to prevent water from entering double-wall pipe.
  d. Secure vent cap to double wall pipe by drilling hole and inserting 3/4-inch-long sheet metal screw into vent cap collar (see **Figure 18**, DETAIL C). Do not overtighten screw.

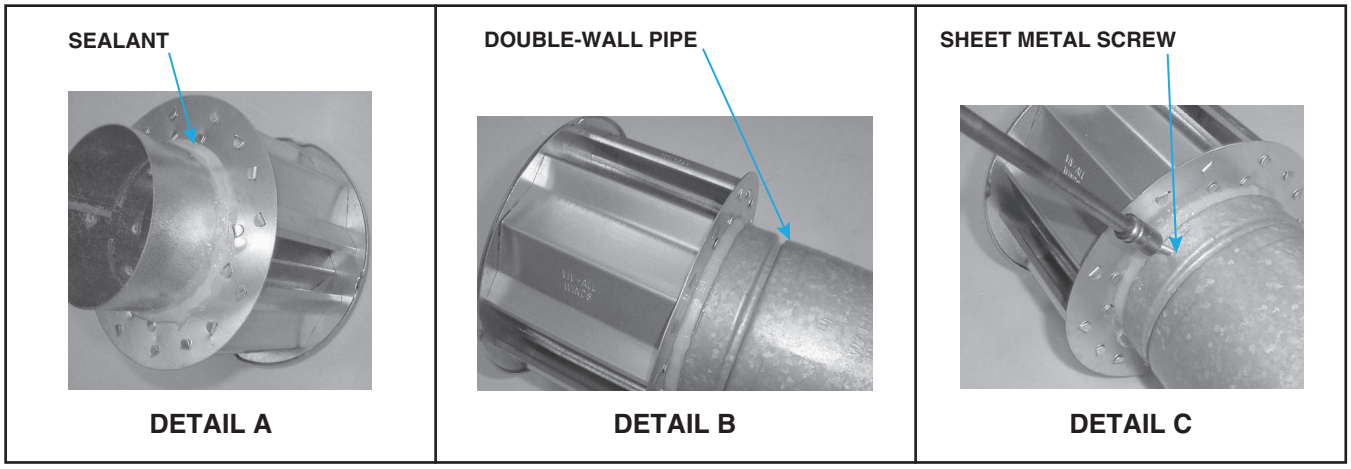


Figure 18. Connecting Double-Wall (Type B) Pipe to Vent Cap

- **Connect double-wall (type B) pipe to a single-wall or category III vent pipe as follows:**
  a. Apply continual 1/4-inch bead of silicone sealant (see **Figure 19**, DETAIL A) around circumference of pipe.
  b. Before sealant has any time to dry, insert pipe with sealant into inner wall of double-wall pipe (see **Figure 19**, DETAIL B) until bead of sealant contacts inner pipe to create sealed joint.
  c. Drill three small holes—spaced equally around double-wall pipe—below sealant ring (see **Figure 19**, DETAIL C) and insert 3/4-inch-long sheet metal screws to secure joint. Do not overtighten screws.

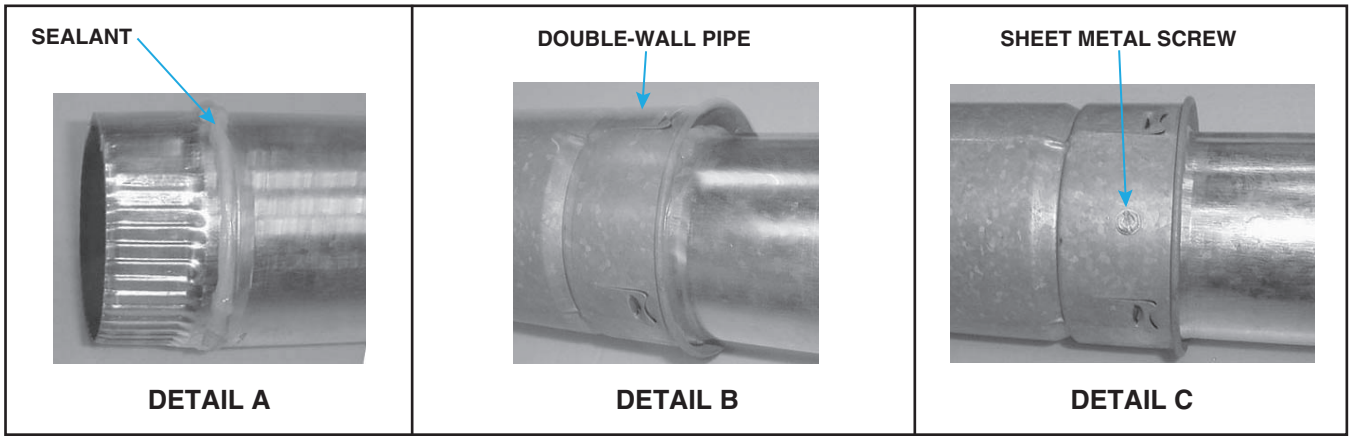


Figure 19. Connecting Double-Wall (Type B) Pipe to Single-Wall or Category III Vent Pipe

Vent Connections—Continued

Vent Termination Clearances

⚠ DANGER ⚠

- **To prevent combustion products from entering the occupied space, all vent terminations must be positioned or located away from fresh air intakes, doors, and windows. Failure to comply could result in severe personal injury or death and/or property damage.**
- **Consider local snow depth conditions. The vent must be at least 6 inches (152 mm) above the anticipated snow depth.**

⚠ WARNING ⚠

- **Do not locate a vent termination where it may cause hazardous frost or ice accumulations on adjacent property surfaces.**
- **Maintain the required clearance from the wall to the vent terminal cap for stability under wind conditions and to protect the building.**

NOTES:

- **Local codes supersede all provisions in these instructions and in *National Fuel Gas Code* Z223.1.**

HORIZONTAL VENT TERMINATIONS:

- **The location of the termination of the horizontal vent system must be in accordance with *National Fuel Gas Code* Z223.1.**
- **Products of combustion can cause discoloration of some building finishes and deterioration of masonry materials. Applying a clear silicone sealant that is normally used to protect concrete driveways can protect masonry materials. If discoloration is an esthetic problem, relocate the vent or install a vertical vent.**

Ensure that distance of vent termination from adjacent public walkways and buildings and window and building openings complies with local codes. Absent any local codes, distance must comply with *National Fuel Gas Code* Z223.1. Refer to **Table 14** to ensure that horizontal vent terminal location complies with minimum clearance requirements.

Table 14. Minimum Clearance Requirements for Horizontal Vent Terminal

Component/Structure	Minimum Clearance, All Directions Unless Specified (Feet (Meters))
Forced air inlet within 10 feet (3.1 meters)*	3 (0.9) above
Combustion air inlet of another appliance	6 (1.8)
Mechanical air supply inlet to any building	Canada: 6 (1.8)
Any building opening (door, window, or gravity air inlet)	4 (1.2) horizontal and below
	1 (0.3) above
Gas meter,** electric meter, and relief equipment	US: 4 (1.2) horizontal
	Canada: 6 (1.8) horizontal
Gas regulator**	US: 3 (0.9) horizontal
	Canada: 6 (1.8) horizontal
Adjoining building or parapet	6 (1.8)
Adjacent public walkway	7 (2.1) above
Grade (ground level)	3 (0.9) above
*Does not apply to the inlet of a direct vent appliance.	
**Do not terminate the vent directly above a gas meter or service regulator.	

Duct Connections

⚠ CAUTION ⚠

Joints where ducts attach to furnace must be sealed securely to prevent air leakage into burner rack area. Leakage can cause poor combustion, poor performance, and pilot problems and can shorten heat exchanger life.

NOTE: Make adjustments to ductwork as necessary to obtain a temperature rise and static pressure within the ranges specified on the heater rating plate.

Ductwork Requirements

- **Type:** the type of duct installation to be used depends in part on the construction type of the roof (wood joist, steel bar joist, steel truss, or pre-cast concrete) and ceiling (hung, flush, etc.).
- **Material:** rectangular duct should be constructed of not lighter than #26 US gauge galvanized iron or #24 B&S gauge aluminum.
- **Size:** proper sizing of supply air ductwork is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air Conditioning Contractors 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.
- **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.
- **Ductwork through masonry walls:** no warm air duct should come in contact with masonry walls. Insulate around all air ducts through masonry walls with not less than 1/2 inch (1 inch is recommended) of insulation.
- **Ductwork through unheated space:** insulate all exposed warm air ducts passing through an unheated space with at least 1/2 inch (1 inch is recommended) of insulation.
- **Supports:** suspend all ducts securely from buildings members. Do not support ducts from unit duct connections.
- **Removable panels:** ducts should have removable access panels on both upstream and downstream sides of the furnace. These openings must be accessible when the furnace is in service and should be a minimum of 6 × 10 inches in size so smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The covers for the openings must be attached in such a manner as to prevent leakage (refer to **INSTALLATION** section).
- **Supply air duct/furnace horizontal connection:** the seal between the furnace and the duct must be mechanical. The connection should be made using U-type flanges on the top and bottom of the connecting duct. Slide the duct over the flanges of the heater to provide an airtight fit. Provide U-channels for the other side flanges to ensure tight joints. Use sheet metal screws to fasten ducts and U-channels to the furnace flange (refer to **INSTALLATION** section).
- **Connection dimensions:** connection dimensions (inches (mm)) are shown in **Figure 20** and listed in **Table 15**.

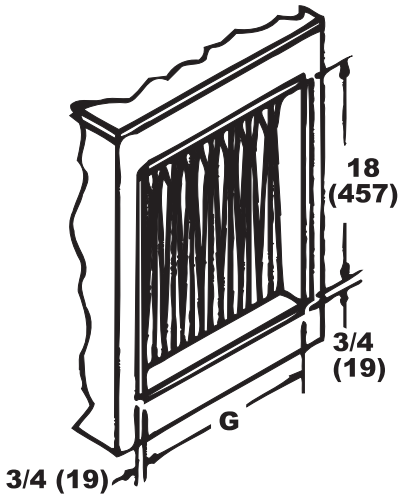


Figure 20. Ductwork Connection Dimensions (Refer to Table 15)

Duct Connections—Continued

Ductwork Requirements—Continued

Table 15. Ductwork Connection Dimensions

Unit Size	Dimension G*	
	Inches	Millimeters
075, 100	12-1/2	318
125, 140	15-1/4	387
170	18	457
200	20-3/4	527
225	23-1/2	597
250	26-1/4	641
300	31-3/4	806
350	37-1/4	946
400	42-3/4	1086

*See **Figure 20**.

Discharge Air Temperature Sensor Installation

- All makeup air options (options AG3, AG8, AG9, and AG15) require field-installation of the discharge air temperature sensor in the discharge ductwork.
- On units with option AG3, the factory-installed unit-mounted ductstat has a capillary tube with a sensor bulb that must be moved out the way—before installing the ductwork—and then field-installed in the discharge duct.
- On units with option AG8 or AG9 the discharge sensor includes a sensor and mixing tube.
- On units with option AG15, the discharge sensor includes a box and sensor holder.
- Install the sensor in the ductwork as follows:

1. Determine distance of sensor from unit:
   a. For sensor with capillary tubing (option AG3), select ductwork location so that minimum length of capillary tubing will be inside ductwork.
   b. 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.**

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

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

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

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:
      (1) Ductstat and sensor are connected by permanently-attached capillary tube. Before connecting ductwork, remove shipping angle and capillary tube sensor bulb with bracket and clip from its shipping position on furnace (see **Figure 21**, DETAIL A).

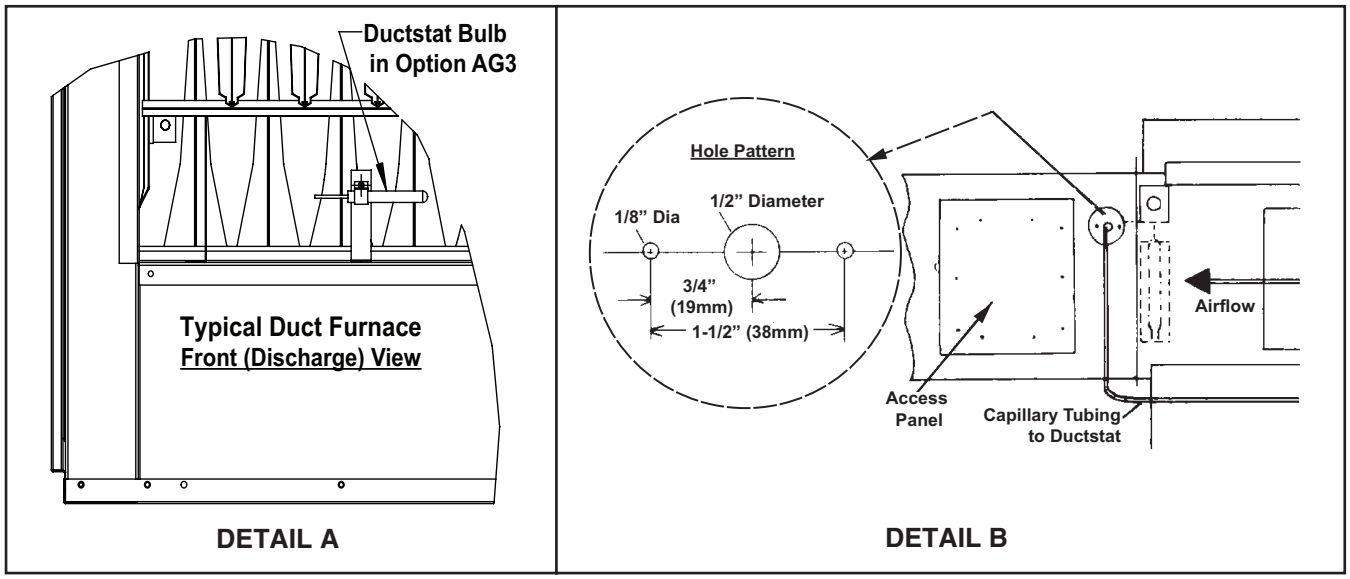


Figure 21. Capillary Sensor Bulb Installation (Option AG3)

NOTE: Because the sensor is larger than the tubing, a gasket and gasket retainer plate are needed to plug the hole and to protect the capillary tubing where it passes through the ductwork. These parts are shipped loose with the furnace (refer to Table 6). Two field-supplied sheet metal screws are needed to secure the plate.

(2) Drill holes in ductwork in accordance with hole pattern shown in **Figure 21**, DETAIL B.

(3) Remove ductwork access panel (see **Figure 21**, DETAIL A).

(4) Remove sensor bulb from bracket and push sensor through 1/2-inch hole. While reaching through access hole, use retaining clip to reinstall sensor to bracket.

(5) Slide gasket (cut slit) and hole retainer plate over capillary tubing. With gasket next to ductwork, install hole retaining plate and secure using field-supplied sheet metal screws.

(6) Close ductwork access panel.

Duct Connections—Continued

Discharge Air Temperature Sensor Installation—Continued

b. For units with option AG8, AG9, or AG15:

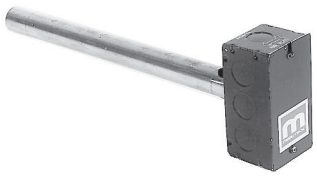
(1) Position of sensor in duct is also important—mixing tube shown in **Figure 22**, DETAIL A is 12 inches (305 mm) long and holder shown in **Figure 22**, DETAIL B extends 9-3/16 inches (233 mm) into ductwork.

(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 or AG9, slide mixing tube (see **Figure 22**, DETAIL A) into ductwork and attach sensor.

(5) For units with AG15, push element into clip in holder (see **Figure 22**, 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.



DETAIL A: OPTIONS AG8 AND AG9

DETAIL B: OPTION AG15

Figure 22. 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.

Duct Furnace Airflow

- The duct furnace must be installed on the positive pressure side of the field-supplied blower.
- The air distribution must be even over the entire heat exchanger. Turning vanes should be employed in elbows or turns in the air inlet to ensure proper air distribution (refer to **Duct Furnace Blower Connections** section).
- The air throughput must be within the CFM range stated on the heater rating plate.
- If it is determined that the blower CFM is greater than allowed or desirable, refer to the **Bypass Duct Construction** section for instructions on determining the correct size of bypass duct required or refer to the **High CFM Conversion** section for instructions on converting the furnace for a higher CFM application.
- To determine temperature rise, the inlet and outlet air temperatures should be measured at points not affected by heat radiating from the heat exchanger. **Table 16** lists the approved temperature rise range with the required CFM and the internal pressure drop for each size of unit.

Table 16. Pressure Drop and Temperature Rise					
Unit Size	Temperature Rise*				
	50°F	60°F	70°F	80°F	90°F
	CFM/Pressure Drop				
075	1105/0.24	920/0.16	790/0.10	695/0.07	615/0.05
100	1475/0.43	1225/0.30	1050/0.21	920/0.16	815/0.12
125	1840/0.49	1535/0.33	1315/0.25	1150/0.20	1020/0.17
140	2065/0.65	1720/0.43	1475/0.32	1290/0.24	1145/0.20
170	2505/0.67	2085/0.46	1790/0.33	1565/0.25	1390/0.19
200	2945/0.67	2455/0.46	2105/0.35	1840/0.26	1635/0.20
225	3315/0.69	2765/0.47	2370/0.36	2070/0.27	1840/0.21
250	3685/0.67	3070/0.45	2630/0.34	2300/0.26	2045/0.20
300	4420/0.70	3685/0.47	3160/0.35	2765/0.27	2455/0.22
350	5160/0.75	4300/0.52	3685/0.38	3225/0.28	2565/0.23
400	5895/0.77	4915/0.52	4210/0.38	3685/0.28	3275/0.22
*80% thermal efficient.					

Duct Furnace Blower Connections

⚠ WARNING ⚠

The furnace must be installed on the positive pressure side of the air-circulating blower.

- Blowers should be bottom horizontal discharge when coupled to the duct furnace.
- When a top horizontal discharge blower is connected to the duct furnace, ensure that sufficient length of duct is provided to permit even flow of air at the end of the duct. Or, baffles may be inserted between the blower and the heater to assure an even flow of air across the heat exchanger.
- Proper arrangements of blower and duct furnace with respect to angle of approach of the duct connection and the arrangement of the discharge opening of the blower are shown in **Figure 23**.

Duct Connections—Continued

Duct Furnace Blower Connections—Continued

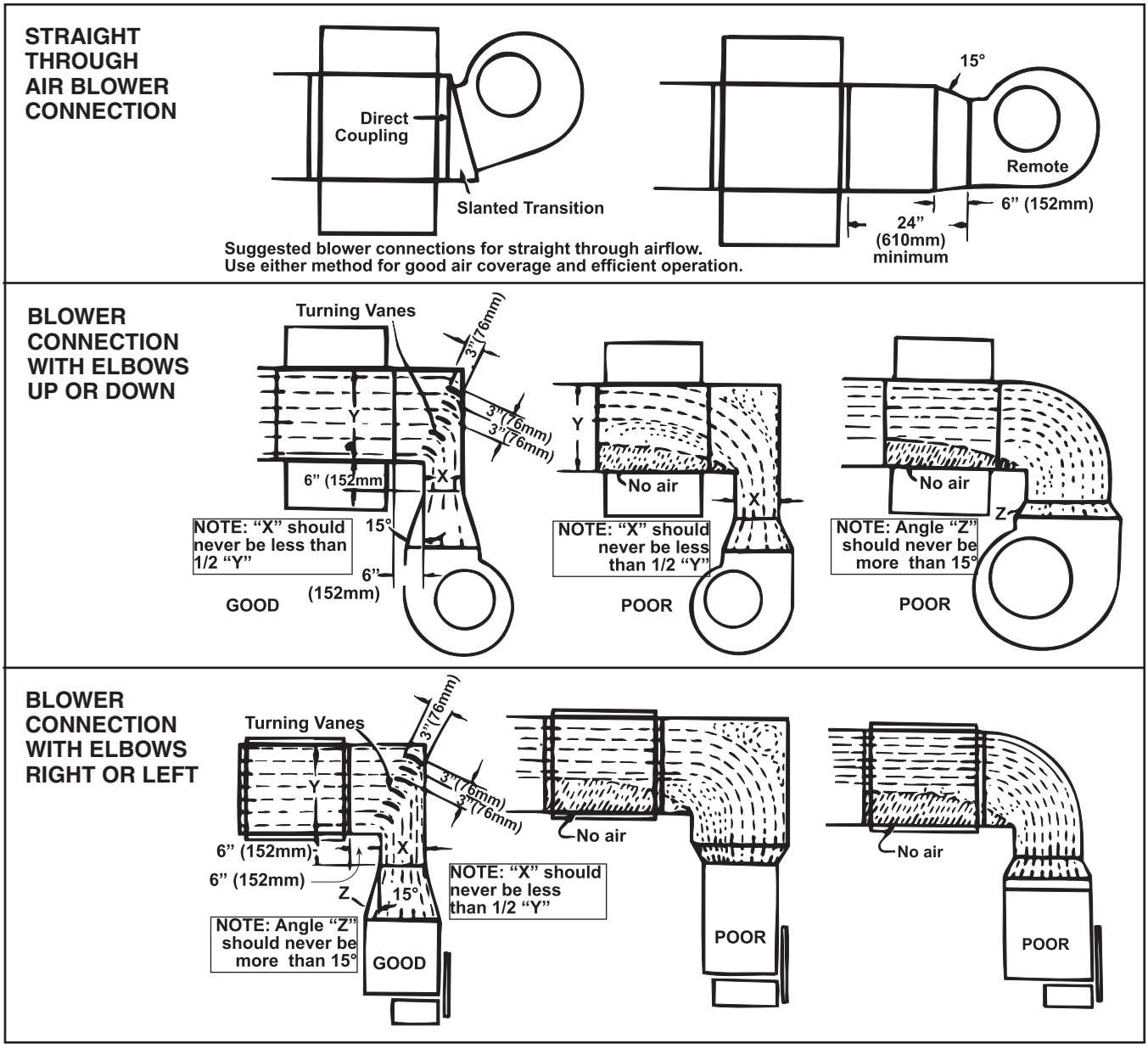


Figure 23. Duct Furnace Blower Connections

Bypass Duct Construction

When the air throughput CFM is greater than desirable or permissible for the unit, a bypass duct (see **Figure 24**) may be constructed. Locate the bypass duct on the side of the furnace opposite the controls and 2 inches from the heat exchanger side panel. Extend the bypass duct 18 inches (457 mm) beyond the furnace on both the inlet and outlet ends. Determine the correct size of the bypass duct as follows:

1. Refer to **Table 16** to determine pressure drop and allowable CFM for furnace being installed. For example: unit size **170** @ **70°F** temperature rise = pressure drop of **0.33** and CFM of **1,790**.
2. Subtract allowable CFM from blower CFM to determine how much air must be diverted through bypass duct. For example: blower CFM of **3,000** – allowable CFM of **1,790** = bypass CFM of **1,210**.
3. Refer to **Table 17** to determine bypass duct size as follows:
   a. Go to column closest to pressure drop through heater.
   b. Move down to CFM closest (round up) to CFM determined in step 2.
   c. Move to left column to determine required bypass duct size. For example: in pressure drop column **0.35**, move down to bypass CFM row **1,520** and move left to dimension A column **5 inches**.

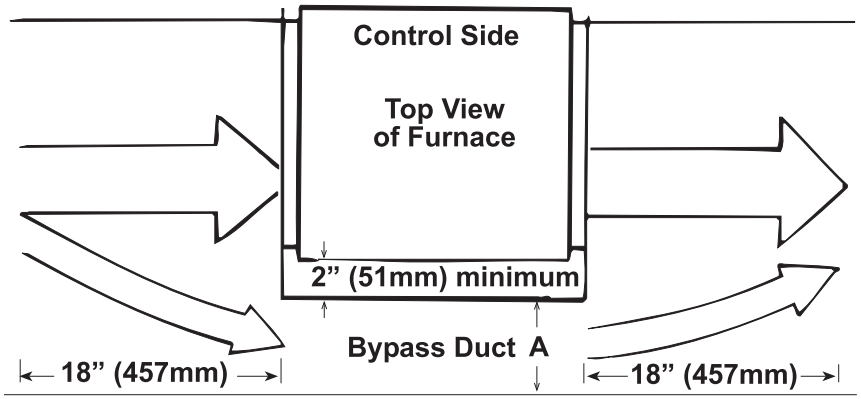


Figure 24. Bypass Duct Dimensions

Table 17. Bypass Duct Size

Dimension A (Inches (mm))*	Pressure Drop Through Furnace								
	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
	Bypass CFM								
3 (76)	490	530	610	700	780	830	900	960	1010
4 (102)	630	750	870	980	1090	1160	1250	1310	1400
5 (127)	850	1010	1190	1300	1410	1520	1640	1730	1810
6 (152)	1050	1290	1480	1650	1800	1940	2090	2200	2320
7 (178)	1250	1510	1760	1960	2180	2320	2500	2650	2800
8 (203)	1490	1810	2100	2350	2560	2760	2940	3110	3290
9 (229)	1700	2100	2400	2700	2970	3200	3400	3600	3800
10 (254)	1920	2350	2760	3090	3650	4020	4300	4550	4800

*See **Figure 24**.

NOTE: Not all capacities are covered above. If your installation is not covered, consult your distributor or the factory representative to determine the appropriate size of the bypass duct.

Duct Connections—Continued

Ductwork-to-Furnace Connections

See **Figure 25**, DETAIL A for numbers that refer to the following steps to connect the ductwork to the furnace:

1. Install flanges on heater turned out as shown.
2. Shape duct connection with U-channel on top and bottom and L-channel on sides as shown.
3. Slide U-channel over heater flange to make connection as shown.
4. Form U-strips to seal ends as shown. Drill fastener holes and secure using sheet metal screws.

NOTES:

- **To prevent leakage, ensure that duct joints are sealed as shown in Figure 25, DETAIL B.**
- **The seals between the furnace and the duct must be mechanical U-channels as shown in Figure 25, DETAIL C.**

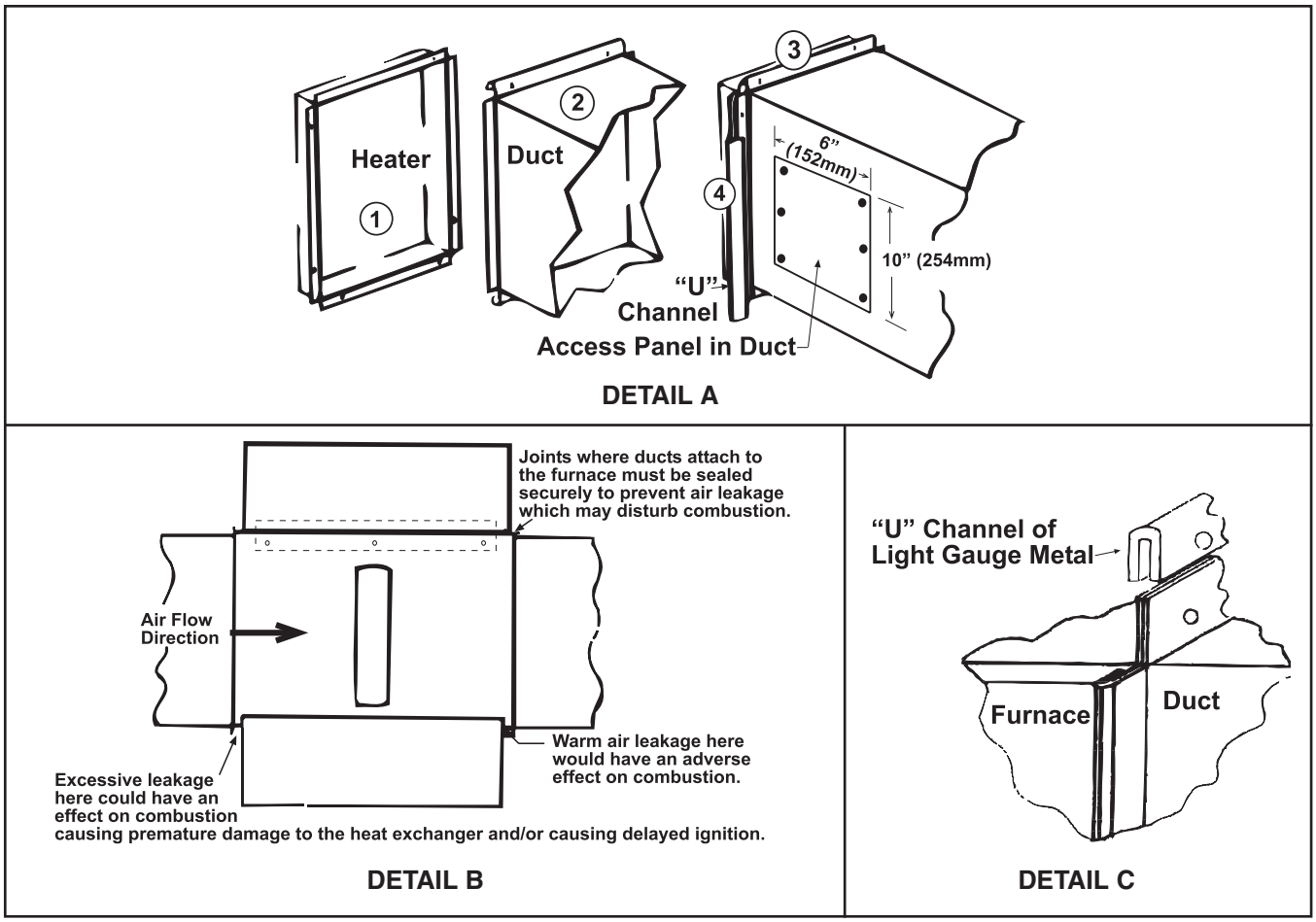


Figure 25. Connecting Ductwork to Furnace

Electrical Connections

⚠ WARNING ⚠

- **If you turn OFF the electrical power supply, turn OFF the gas.**
- **All electrical wiring and connections, including electrical grounding, MUST be completed in accordance with local, state, and national codes and regulations and with the *National Electric Code* (ANSI/NFPA 70) or in Canada with the *Canadian Electrical Code* Part 1 C.S.A. C.22.1.**
- **The installer should be aware of any local ordinances or gas company requirements that might apply.**

⚠ CAUTION ⚠

If any of the unit's original wire must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for sensor lead wires, which must be 150°C.

NOTE: Specific wiring diagrams that include standard and factory-installed options are provided with the unit. Ensure that all wiring is in accordance with these wiring diagrams.

- Check the rating plate on the heater for the supply voltage and current requirements.
- A separate line voltage supply with fused disconnect switch should be run directly from the main electrical panel to the furnace, making connection to leads in the junction box.
- The disconnect switch is a required part of this installation. Switches are available, as options or parts, or may be purchased locally. When ordered as an optional component, the disconnect switch is shipped separately.
- The disconnect switch may be fusible or non-fusible. When installing the disconnect switch, 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.
- All external wiring must be within approved conduit and have a minimum temperature rise rating of 60°C. Conduit from the disconnect switch must be run so as not to interfere with the service panels of the furnace.

Electrical Connections for Field-Installed Options

⚠ WARNING ⚠

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

For field-installed options that require electrical connections in the electrical box (see **Figure 26**), refer to the instruction sheet and wiring diagram provided in the option package.

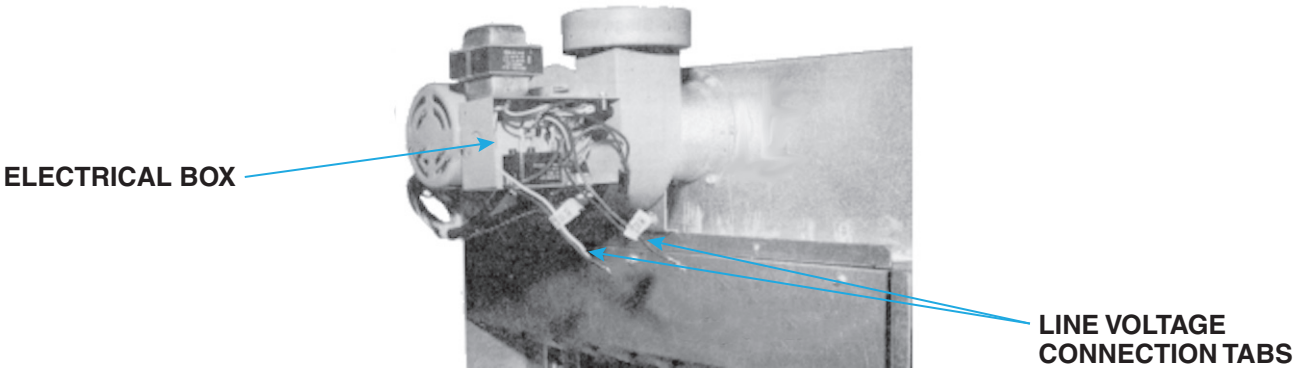


Figure 26. Wiring Field-Installed Options

Thermostat Installation

⚠ CAUTION ⚠

If applicable, ensure that the thermostat has an adequate VA rating for the total requirements. Add the coil ratings of all relays and match the thermostat rating.

- A thermostat is not standard equipment but is an installation requirement. Use either an optional thermostat available with the heater or a field-supplied thermostat. Install according to the thermostat manufacturer's instructions.
- A 24-volt 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.
- Labeled thermostat leads are provided in the heater junction box for connection of thermostat wiring.
- 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 thermostat on cold air walls. For specific connection details, refer to instructions with the thermostat.
- If more than one unit is cycled from one thermostat, separately-activated relays must be substituted at unit thermostat connections.
- If using a low voltage thermostat with a heat anticipator, set the anticipator at full load control amps.

CONTROLS

Unit controls are described in the following paragraphs.

Combustion Air Proving Switch

⚠ DANGER ⚠

Safe operation of this unit 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 is a pressure-sensitive switch that monitors air pressure to ensure that proper combustion airflow is available. The switch is a single-pole normally-open device that closes when a decreasing pressure is sensed in the outlet duct of the flue gas collection box.
- At startup when the heater is cold, the sensing pressure is at the most negative level. As the heater and flue system warm up, the sensing pressure becomes less negative. After the system has reached equilibrium (about 20 minutes), the sensing pressure levels off.
- If a restriction, 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. **Table 18** lists the approximate water column negative pressure readings and switch setpoints for sea level operating conditions.

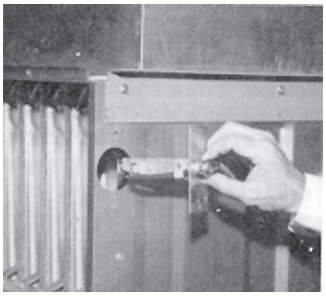
Table 18. Pressure Switch Sea Level Operating Conditions

Operating Condition	Pressure Reading (IN WC)
Startup cold	–1.00
Equilibrium	–0.60
Setpoint OFF	–0.48
Setpoint ON	–0.65

Limit Switch

- A non-adjustable high limit switch mounted at the outlet air side of the heat exchanger acts to shut off the gas supply in the event of air handler motor failure, lack of correct airflow (refer to **Duct Furnace Airflow** section), or restriction due to filters and/or duct design.
- Depending on accessibility, the limit switch may be serviced from either outside the unit or inside through the access panel in the discharge duct (see **Figure 27**). When units are installed side by side, the service access panel must be in either the top or bottom of the ductwork for limit switch service (refer to **Coupling Additional Furnaces Together** and **Ductwork Requirements** sections).

INSIDE



OUTSIDE

Figure 27. Limit Switch Access

Fan Control

- The fan control is a field-installed option that is required with makeup air gas control options.
- The fan control provides delay of fan operation preventing circulation of cold air and fan operation as long as the unit is hot. The fan control provides additional safety by keeping the fan in operation in the event that the gas valve fails to close when the thermostat is satisfied.
- To ensure that the fan can continue to operate, the power supply to the heater MUST NOT be interrupted except when servicing the heater.
- Install the fan control as follows (see **Figure 28**, DETAIL A):

⚠ WARNING ⚠

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

a. Drill four 1/8-inch (3-mm) mounting holes and one 13/16-inch (20.6-mm) hole for element.
b. Install gasket provided supplied in fan option kit between fan control and duct.
c. Secure fan control using four screws.

- See **Figure 28**, DETAIL B for the installation of option CQ1 fan control kit (PN 57960):
  - Fan control is Honeywell #L4064A1347 (PN 147611)
  - Larger motors or 3PH require use of contactor or starter
  - Recommended dial setting for most conditions is 130°F ON and 100°F OFF
  - Conduit is field-supplied for wiring fan control to field-supplied blower

Fan Control—Continued

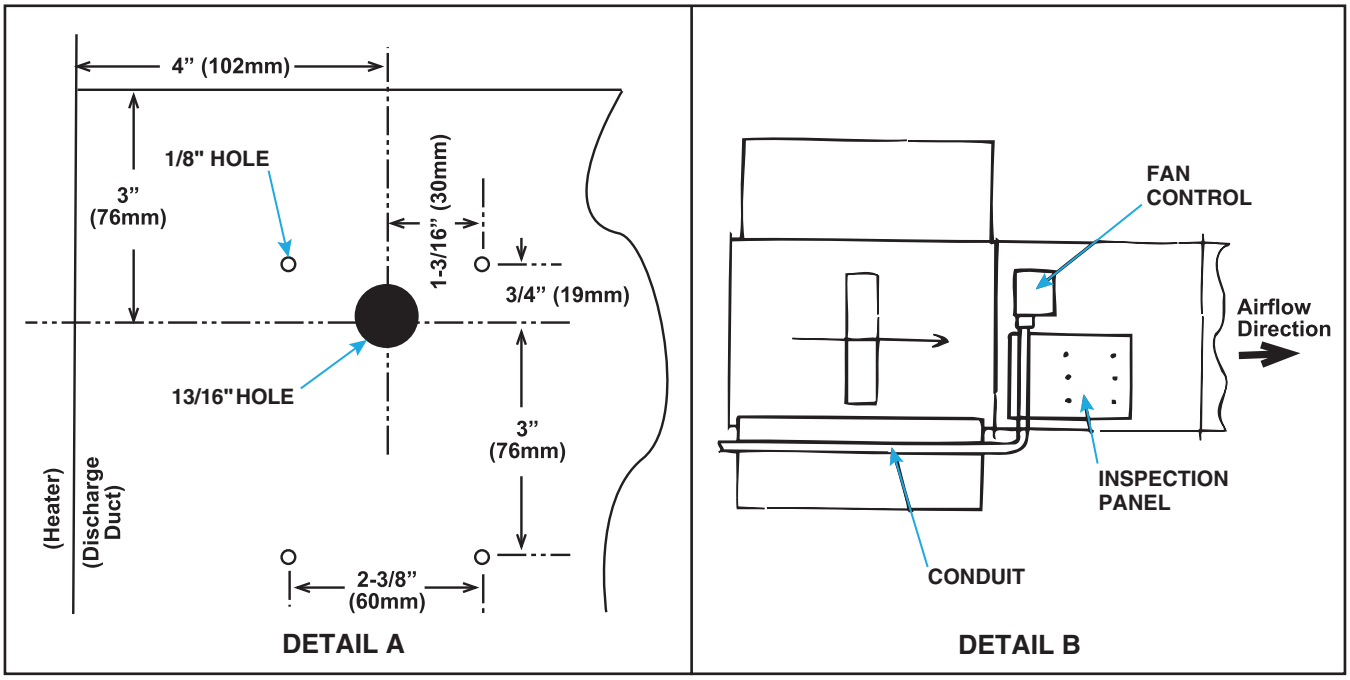


Figure 28. Fan Control Installation

- For proper operation, ensure that fan control wiring is in accordance with **Figure 29** and the **Electrical Connections for Field-Installed Options** section.
- If the heater is to be turned 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 turned off in the same manner.

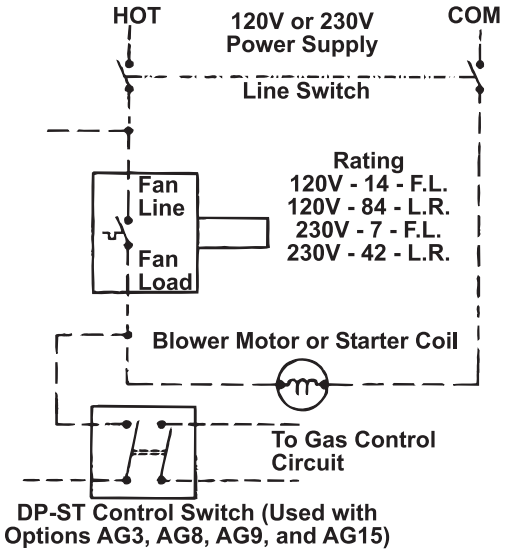


Figure 29. Typical Fan Control Wiring Diagram

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 an automatic electric ON-OFF valve controlled by the room thermostat, a pressure regulator, and a manual shutoff valve. The standard combination gas valve allows for single-stage control from a single-stage, 24V thermostat.

Optional Two-Stage Operation (Heating Only)

NOTE: This option is not available on unit size 075 propane models.

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

Optional Two-Stage Operation (Makeup Air)

NOTE: The makeup air option requires a field-installed fan control (refer to Fan Control section). This option is not available on unit size 075 propane models.

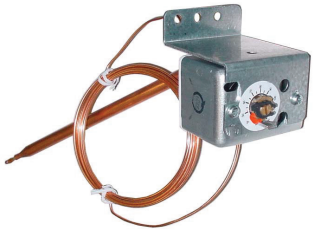
- Two-stage makeup air units are equipped with a two-stage gas valve, but instead of control from a two-stage room thermostat, the outlet air temperature is monitored and controlled by a two-stage ductstat. When the discharge air temperature drops to the setpoint, low fire is energized. If low fire cannot satisfy the ductstat setting, high fire is energized.
- Makeup air applications are usually adjusted to discharge an outlet air temperature between 65°F and 75°F. In all applications, the allowable temperature rise of the furnace in the installation dictates the limits of the ductstat temperature setting.
- Depending on the option selection, the factory-installed sensor is either field-connected by capillary tubing to the unit-mounted ductstat (option AG3) or electrically-connected to a remote electronic remote temperature selector (option AG15).

Option AG3

- Includes ductstat (PN 41700) with capillary tubing (see **Figure 30**, DETAIL A).
- The ductstat is attached to the furnace and is connected by a capillary tubing to the sensor.
- For shipping the sensor is temporarily mounted on a bracket on the inner part of the furnace duct side.
- Refer to the **Discharge Air Temperature Sensor Installation** section for instructions on relocating the sensor bulb to the discharge duct.
- The dial has an adjustable range from 60° to 100°F with a fixed differential of 3°F.
- Due to different CFM settings and outside air temperatures, the average downstream outlet air temperature may not match the ductstat exactly. After the installation is complete, adjust the ductstat to achieve the desired average outlet air temperature.

Optional Two-Stage Operation (Makeup Air)—Continued

Option AG3—Continued



DETAIL A: OPTION AG3

(A) REMOTE TEMPERATURE SELECTOR
(B) STAGE-ADDER MODULE

DETAIL B: OPTION AG15

Figure 30. Ductstat Options

Option AG15

- Includes ductstat with electronic remote setpoint module (see **Figure 30**, DETAIL B).
- The remote modules and a required transformer are shipped separately for field-installation.
- The sensor is shipped separately for installation in the discharge duct (refer to **Discharge Air Temperature Sensor Installation** section).
- Follow the wiring diagram provided with the unit and the manufacturer's instructions for wiring and installation.
- There will be one module for selecting temperature and one-stage adder module.
- The remote temperature selector has a temperature operating range to 130°F.

⚠ CAUTION ⚠

The remote temperature selector heat/cool selector switch is factory-set in the cool position. For proper function, set the switch to the heat position.

NOTE: Do not wire the remote module to the control transformer on the furnace.

Optional Electronic Modulation

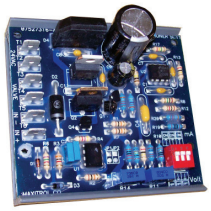
NOTE: These options require the option CQ1 field-installed fan control (refer to Fan Control section).

- 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 number printed on the heater rating plate. AG7 is identified as MV-1, AG8 is identified as MV-3, AG9 is identified as MV-4, and AG21 is identified as MV-A.
- Refer to the wiring diagram supplied with the furnace for proper wiring connections.

Options AG7, AG8, and AG9

- Electronic modulation between 50% and 100% firing rate (see **Figure 31**, DETAIL A).
- Depending on the heat requirements as established by the thermistor sensor, the burner modulates between 100% and 50% firing. The thermistor is a resistor that is temperature sensitive in that as the surrounding temperature changes, the ohms resistance changes through the thermistor. This change is monitored by the solid state control center (amplifier) that furnishes varying DC current to the modulating valve to adjust the gas input. The amplifier is shipped separately for field-mounting.
- Each modulating valve is basically a regulator with electrical means of raising and lowering the discharge pressure. When no DC current is fed to this device, it functions as a gas pressure regulator, supplying 3.5 IN WC pressure to the main operating valve.
- Electronic modulation for heating controlled by a specially-designed room thermostat (60–85°F) is identified as option AG7.
- Electronic modulation control systems for makeup air applications controlled by a duct sensor (refer to **Discharge Air Temperature Sensor Installation** section) and temperature selector (55–90°F) are identified as either option AG8 or AG9. The temperature selector setting for option AG8 is on the amplifier. Option AG9 has a remote temperature selector. Both systems are available with an override thermostat.

DETAIL A: OPTIONS AG7, AG8, AND AG9



DETAIL B: OPTION AG21

Figure 31. Electronic Modulation Options

Option AG21

- Computer-controlled electronic modulation between 50% and 100% firing rate (see **Figure 31**, DETAIL B).
- With this option the furnace is equipped with a Maxitrol signal conditioner that operates much the same way as the amplifier above to control the regulator valve. The conditioner accepts an input signal of either 4–20 milliamps or 0–10 volts from a customer-supplied control device such as a computer. With the dip switches on the conditioner in the ON positions, the conditioner accepts a 4–20 milliamp signal. In the OFF positions, the conditioner accepts a 0–10V signal. The conditioner converts the signal to the 0–20 volt DC current required to control the modulating valve.
- The conditioner, a conditioner relay, a transformer, a fuse box with cover, and hardware are shipped separately for field installation. Follow the conditioner manufacturer's instructions and the wiring diagram supplied with the unit.

Pilot and Ignition Systems

- **Gas-fired intermittent pilot is standard:**
  a. The vertical pilot is located under the aeration panel on the control end of the burner tray and is accessible only after the burner rack has been removed. Remove the pilot for maintenance or service, such as checking the wiring and cleaning (refer to **Burner Air Adjustment (Propane Units Only)** section). Pilot is target type with lint-free feature.
  b. Pilot gas pressure should be the same as supply line pressure (refer to **Gas Supply Pressure** section). If required, adjust the pilot adjustment screw in the control valve body so that pilot flame length is approximately 1-1/4 inches.
- **Intermittent spark ignition safety pilot system:**
  a. 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.
  b. The lockout feature has a 1-hour retry or requires manual reset by interruption of the control circuit.
  c. Propane units require the spark ignition with lockout.

⚠ WARNING ⚠

Do not touch pilot spark wire and pilot electrode when energized due to high voltage.

NOTES:

- **When checking for spark with the pilot burner removed from the burner rack, the pilot assembly must be grounded to the heater for proper spark.**
- **If replacing an earlier model of ignition controller, order replacement kit (PN 257472 for a unit with recycling gas control option AH2 or PN 257473 for option AH3 gas control with lockout). Option codes are listed on the unit wiring diagram.**

- **If no spark, check the following:**
  a. Voltage between terminals TH and 7 should be at least 20V and no higher than 32V. Refer to **TROUBLESHOOTING** section if no voltage is observed.
  b. Short to ground in the high tension lead and/or ceramic insulator.
  c. Pilot spark gap should be approximately 7/64 inch.
  d. If the above conditions are normal and no spark occurs, replace the ignition controller.
- **Ignition controller:**
  a. As part of the intermittent safety pilot systems, the ignition controller provides the high voltage spark to ignite the pilot gas and also acts as the flame safety device.
  b. After ignition of the pilot gas, the ignition controller electronically senses the pilot flame.
  c. 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.
  d. The pilot flame acts as a conduction path to ground that completes the DC circuit and proving pilot flame. With pilot flame proven, the ignition controller energizes the main gas valve.
  e. Ignition controller with lockout for option AH3 gas control (UTEC #1003-514, PN 257010) is shown in **Figure 32**, DETAIL A.
  f. Recycling ignition controller for option AH2 gas control (UTEC #1003-638A, PN 257009) is shown in **Figure 32,** DETAIL B.

DETAIL A

DETAIL B

Figure 32. Ignition Controllers

OPERATION

⚠ DANGER ⚠

- **The gas burner in this gas-fired equipment is designed and equipped to provide safe, complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion, which produces carbon monoxide, a poisonous gas that can cause death. Safe operation of indirect-fired gas burning equipment requires a properly-operating vent system 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 in the Combustion Air Requirements section. 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. Indoor units installed in a confined space must be supplied with air for combustion as required by code and in the Combustion Air Requirements section. MAINTAIN THE VENT SYSTEM IN A STRUCTURALLY-SOUND AND PROPERLY-OPERATING CONDITION.**

Pre-Startup Checklist

- ❑ Check suspension—unit must be secure and level.
- ❑ Ensure that electrical supply matches voltage rating of furnace as listed on unit rating plate.
- ❑ Ensure that all field wiring is in accordance with wiring diagram.
- ❑ Ensure that wire gauges are as required for electrical load.
- ❑ Ensure that that fuses or circuit breakers are in place and are sized correctly.
- ❑ Ensure that clearances from combustibles are in accordance with **Clearances** section.
- ❑ If installed in confined space, ensure that furnace has adequate combustion air supply (refer to **Combustion Air Requirements** section).
- ❑ Ensure that vent system is installed in accordance with **Vent Connections** section.
- ❑ Check piping for for proper gas line pressure and for leaks as follows:
  a. Turn manual shutoff valve OFF.
  b. Turn gas supply ON.
  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 gas supply OFF. No change in pressure should occur over a 3-minute period.
  d. If leak is indicated, locate leak by brushing leak-detecting solution on all fittings. Bubbles will appear at leak. Repair and repeat test.
- ❑ Bleed gas lines of trapped air (refer to **Supply Piping Connections** section).

Startup

Turn ON the electric and gas supply to the furnace. Adjust the thermostat or ductstat so that a call for heat exists. Observe operating sequence listed in **Table 19** for complete sequencing of safety pilot and ignition.

Table 19. Operating Sequence

Operation	Result
1. Set thermostat to lowest setting	—
2. Turn ON power to unit	
3. Turn ON main and pilot manual gas valves	
4. Set thermostat to desired setting	Thermostat calls for heat, which energizes venter motor
	Pressure switch closes, which energizes 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
	Switch action deenergizes spark gap and energizes main gas valve
	On units with optional fan control, fan control senses heat exchanger temperature, which energizes fan or blower motor of air handler
	If pilot flame is extinguished during main burner operation, sensing probe detects absence of flame and causes safety switch to close main valve
	On units with standard intermittent spark pilot systems, spark gap recycles
	On units with optional spark ignition with lockout, if pilot is not established within timing cycle (approximately 120 seconds), unit locks out and must be reset by interrupting power to control circuit

Post-Startup Checklist

- ❑ With unit in operation, measure manifold gas pressure—pressure for natural gas should be 3.5 IN WC and 10 IN WC for propane gas (refer to **Manifold Gas Pressure Measurement and Adjustment** section).
- ❑ Turn unit OFF and ON, pausing two minutes between each cycle—observe for smooth ignition.
- ❑ On two-stage or modulating burner systems, manipulate temperature adjustment slowly up and down to see if control is sequencing or modulating properly—raising temperature setting drives burner ON or to full fire.
- ❑ Observe burner flame at full fire—natural gas flame should be about 1-1/2 inches in height with blue coloring.
- ❑ Propane gas flame at full fire should be about 1-1/2 inches in 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 Adjustment (Propane Units Only)** section).
- ❑ Check limit control—with heater on, completely block off distribution air—limit control should open within few minutes, shutting off gas supply to main burners.
- ❑ Place owner's envelope that contains Limited Warranty Card, this manual, and any optional information in accessible location near heater—follow instructions on envelope.

ADJUSTMENTS

The adjustments described in the following paragraphs can be accomplished only after the heater is in operation.

Manifold Gas Pressure Measurement and Adjustment

NOTE: Consult the valve manufacturer's literature provided with the furnace for more detailed information.

⚠ WARNING ⚠

Manifold gas pressure must never exceed 3.5 IN WC for natural gas or 10 IN WC for propane gas.

Normally, adjustment to the factory-preset regulator should not be necessary. 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 on standby. Incorrect inlet pressure could cause excessive manifold gas pressure immediately or at some future time. Measure and adjust the manifold gas pressure as follows:

NOTE: A manometer (fluid-filled gauge) with an inches water column scale is recommended for gas pressure measurement rather than a spring-type gauge due to the difficulty of maintaining the calibration of a spring-type gauge.

1. With manual valve on combination valve positioned to prevent flow to main burners, connect manometer to 1/8-inch pipe outlet pressure tap (see **Figure 33**) on valve.

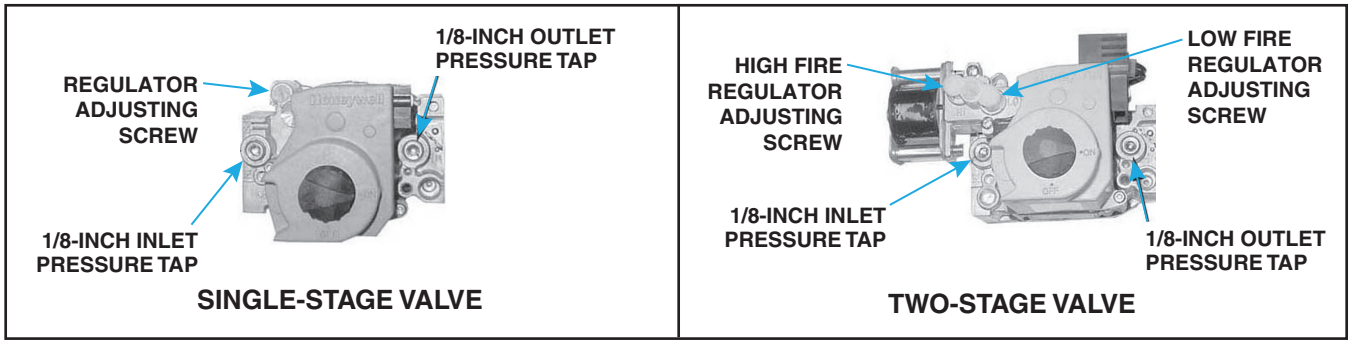


Figure 33. Combination Gas Valve Pressure Taps

2. To measure low stage pressure on units equipped with two-stage valve, disconnect wire from HI terminal on valve.
3. Open valve and operate heater and observe manometer reading.

NOTES:

- **Natural gas units leave the factory with the combination valve 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 must be a maximum of 14 IN WC. Always check the rating plate for the minimum gas supply pressure. Minimum supply pressure requirements vary based on the size of the burner and the gas control option. Most units require a minimum of 5 IN WC, but units with electronic modulation may require a minimum of 6 IN WC.**
- **Propane units leave the factory with the combination valve 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.**

Manifold Gas Pressure Measurement and Adjustment—Continued

⚠ CAUTION ⚠

Do not bottom out the gas valve regulator adjusting screw. This can result in unregulated manifold pressure, which may cause overfire and heat exchanger failure.

4. Adjust pressure as necessary to required setting by turning regulator adjusting screw (see **Figure 33**)—IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease pressure.
5. If wire from HI terminal on valve was disconnected in step 2, reconnect wire.

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 20**) for installation elevation.

Table 20. Burner Orifices

Installation Elevation (Feet (Meters))	Unit Size									
	075		100, 125		140, 170, 200, 225		250		300, 350, 400	
	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
	PN (Orifice Size)									
US										
0–2001 (0–610)	38678 (#45)	63003 (1.20 mm)	11792 (#41)	61652 (1.45 mm)	45870 (#38)	61653 (1.55 mm)	45871 (#39)	61653 (1.55 mm)	45871 (#39)	9789 (#53)
2001–3000 (611–915)	16590 (#46)	39658 (#56)	84437 (#42)	11834 (#54)	45871 (#39)	9789 (#53)	87391 (#40)	9789 (#53)	87391 (#40)	11834 (#54)
3001–4000 (916–1220)	84853 (#47)	63922 (1.15 mm)	84437 (#42)	11834 (#54)	87391 (#40)	9789 (#53)	11792 (#41)	9789 (#53)	11792 (#41)	11834 (#54)
4001–5000 (1221–1525)	84853 (#47)	63922 (1.15 mm)	84437 (#42)	11834 (#54)	11792 (#41)	61652 (1.45 mm)	11792 (#41)	61652 (1.45 mm)	11792 (#41)	11834 (#54)
5001–6000 (1526–1830)	84853 (#47)	63922 (1.15 mm)	11828 (#43)	97360 (1.35 mm)	11792 (#41)	61652 (1.45 mm)	84437 (#42)	61652 (1.45 mm)	84437 (#42)	11834 (#54)
6001–7000 (1831–2135)	40414 (#48)	40416 (#57)	11828 (#43)	97360 (1.35 mm)	84437 (#42)	61652 (1.45 mm)	84437 (#42)	61652 (1.45 mm)	84437 (#42)	11834 (#54)
7001–8000 (2136–2440)	40414 (#48)	40416 (#57)	11833 (#44)	11830 (#55)	84437 (#42)	11834 (#54)	11828 (#43)	11834 (#54)	11828 (#43)	11834 (#54)
8001–9000 (2441–2745)	39651 (#49)	40416 (#57)	11833 (#44)	11830 (#55)	11828 (#43)	11834 (#54)	11828 (#43)	11834 (#54)	11828 (#43)	11830 (#55)
Canada										
0–2001 (0–610)	38678 (#45)	63003 (1.20 mm)	11792 (#41)	61652 (1.45 mm)	45870 (#38)	61653 (1.55 mm)	45871 (#39)	61653 (1.55 mm)	45871 (#39)	9789 (#53)
2001–4500 (611–1373)	84853 (#47)	63922 (1.15 mm)	84437 (#42)	11834 (#54)	11792 (#41)	61652 (1.45 mm)	11792 (#41)	61652 (1.45 mm)	11792 (#41)	11834 (#54)

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 the gas conversion manual listed in **Table 1**. When conversion is complete, verify that the input rate is correct.

ADJUSTMENTS—CONTINUED

Burner Air Adjustment (Propane Units Only)

⚠ DANGER ⚠

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

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

This duct furnace has individually-formed steel burners with accurately die-formed ports to provide controlled flame stability with either natural gas or propane without lifting or flashback. The burners are lightweight and are factory-mounted in an assembly that permits them to be removed as a unit for inspection or service. All burners are equipped with two flash carryover systems that receive a supply of gas simultaneously with the main burner. Burner air shutters are not normally required on natural gas furnaces. Air shutters are supplied on propane gas units and may require adjustment as follows:

1. Operate heater for about 15 minutes with air shutters open.

NOTE: When making the adjustment, close the air shutters no more than is necessary to eliminate the problem condition.

2. Turn slotted screw that moves air shutters and adjusts all burners simultaneously on end manifold bracket—clockwise to open shutters or counterclockwise to close shutters. Close air shutters and observe flame for yellow-tipping.

NOTE: A limited amount of yellow-tipping is permissible for propane gas. Other fuels should not display any yellow-tipping.

3. Open air shutters until yellow disappears.

MAINTENANCE

⚠ WARNING ⚠

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

The unit is designed to operate with a minimum of maintenance. However, to ensure long life and satisfactory performance, routine service is recommended. When servicing, follow standard safety procedures and those specific instructions and warnings in this manual.

Service Checklist

⚠ CAUTION ⚠

Eye protection is recommended when cleaning the unit.

- ❑ Under normal conditions, inspect furnaces at beginning of each heating season and once every 4 months. If furnace is located where an unusual amount of dust, soot, or other impurities are contained in the air, more frequent inspection is recommended.
- ❑ Clean heat exchanger inside and out (annually at minimum).
- ❑ Clean all dirt and grease from combustion air openings (annually at minimum).
- ❑ Check combination gas valve to ensure that gas flow is being shut off completely (annually at minimum).
- ❑ Check pilot burner and main burners for scale, dust, or lint accumulation and clean as necessary (annually at minimum).
- ❑ Check soundness of vent system and replace parts as necessary (annually at minimum).
- ❑ Check wiring for damage and replace as necessary (annually at minimum).

⚠ CAUTION ⚠

Use only factory-authorized replacement parts.

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 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. Turn OFF field-installed manual gas shutoff valve to prevent flow to combination gas valve.

NOTE: A manometer (fluid-filled gauge) with an inches water column scale is recommended for gas pressure measurement rather than a spring-type gauge due to the difficulty of maintaining the calibration of a spring-type gauge.

2. Connect manometer to 1/8-inch inlet pressure tap on valve (see **Figure 33**).
3. Observe manometer reading for 2 to 3 minutes. No gas pressure should be indicated on manometer.
4. If manometer indicates any gas pressure, manual gas shutoff valve must be replaced or repaired before combination gas valve can be checked.
5. If manometer does not indicate gas pressure, slowly open manual gas shutoff valve.
6. After manometer reading indicates that gas pressure has reached equilibrium, close manual gas shutoff valve and observe gas pressure. Manometer reading should indicate no loss of gas pressure. If loss of pressure is indicated, replace combination gas valve before placing heater in operation as follows:
   a. Install/replace bushing and compression nut as necessary before installing replacement valve.
   b. Use pipe joint compound that is resistant to liquefied petroleum gas.
   c. Adjust field-supplied gas supply piping as necessary.
   d. Leak test all joints using leak-testing solution.

Burner Rack and Pilot Maintenance

1. Remove burner rack assembly:
   a. Turn OFF gas supply.
   b. Turn OFF electric supply.
   c. Remove two screws from each side of bottom rear panel located on manifold side of furnace and remove panel.
   d. Disconnect valve's electric leads and mark for correct reconnection.
   e. Uncouple gas supply union.
   f. Remove two sheet metal screws in bottom of burner rack assembly and pull drawer-type burner rack out of furnace.
2. Disassemble burner rack:
   a. Remove screws at rear of burner drawer and remove flash carryover system.
   b. Remove burner hold-down clamp under pilot inside burner drawer.
   c. Pull main burners away—horizontally—from injection opening and lift out.

Maintenance Procedures—Continued

Burner Rack and Pilot Maintenance—Continued

3. Clean pilot:

⚠ CAUTION ⚠

- **Do not ream the orifice.**
- **If pilot flame is short and/or yellow, check pilot orifice for blockage caused by lint or dust accumulation.**

NOTES:

- **The pilot is located (see Figure 34, DETAIL A) under the aeration panel on the control end of the burner tray and is accessible only after the burner rack assembly has been removed.**
- **When re-installing a vertical spark pilot, be sure to include the pilot hole cover plate (see Figure 34, DETAIL B).**

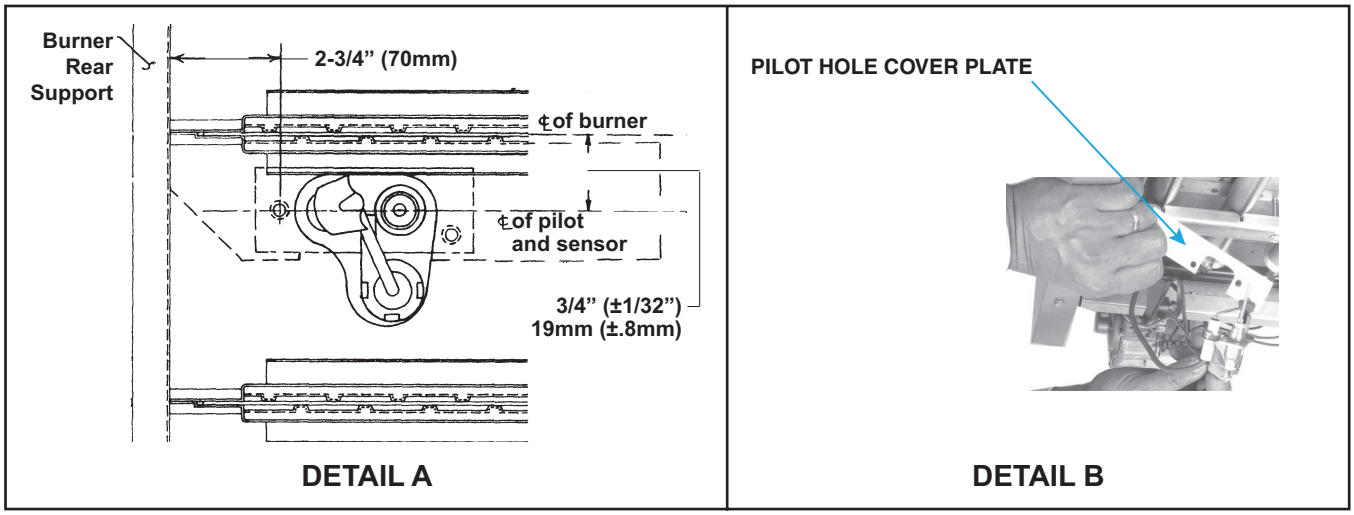


Figure 34. Pilot Location and Installation

a. Remove the pilot orifice and clean with air pressure.
b. Check and clean the aeration slot in the pilot burner.
c. Clean metal sensing probe and pilot hood with emery cloth and wipe off ceramic insulator.
d. Check spark gap and ensure that gap is maintained to be 0.1 inch as shown in Figure 35.

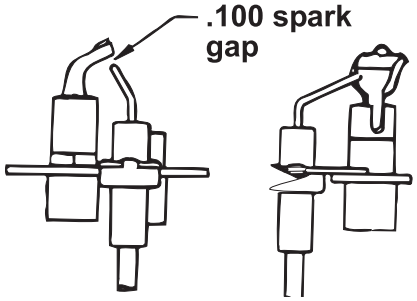


Figure 35. Pilot Spark Gap

e. After pilot is cleaned, blow away any dirt using compressed air.

f. Adjust pilot flame to approximately 1-1/4 inches by removing capscrew from combination valve adjustment screw and turning screw.

⚠ WARNING ⚠

Do not touch pilot spark wire and pilot electrode when energized due to high voltage.

NOTE: No periodic maintenance of the ignition control box is required. However, each season the lead wires should be checked for insulation deterioration and good connections. Proper operation of the electronic spark ignition system requires a minimum flame signal of 0.2 microamps as measured by a microampmeter. Do not attempt to disassemble the ignition controller. There are no field-replaceable components in the control enclosure.

g. Check electronic spark ignition wire leads to ensure good connections and no insulation damage.

NOTE: Normally it not necessary to clean the main burners, but during the annual cleaning of the heat exchanger tubes, it is wise to inspect the burners for plugged ports.

4. Clean main burners as necessary:
   a. Using air pressure, blow out scale and dust accumulation from burner ports.
   b. Blow air pressure through burner ports and venturi.
   c. Use fine wire to dislodge any stubborn particles. Do not use anything that might change orifice port size (refer to **Table 21**.
5. Clean burner rack flash carryover systems using air pressure.
6. Reassemble burner rack and replace burner rack assembly by reversing steps 2 and 1, being careful not to create any unsafe conditions.

Table 21. Burner Orifice Size

Unit Size	Natural Gas			Propane		
	PN	Quantity	Drill Size	PN	Quantity	Drill Size
075	38678	4	45	63003	4	1.2 mm
100	11792	4	41	61652	4	1.45 mm
125		5			5	
140	45870	5	38	61653	5	1.55 mm
170		6			6	
200		7			7	
225		8			8	
250	45871	9	39	61653	9	1.55 mm
300	45871	11	39	9789	11	53
350		13			13	
400		15			15	

Heat Exchanger Cleaning

1. Clean heat exchanger outer surfaces (circulating air side):
   a. Gain access by removing inspection panels in ductwork or remove ductwork.

NOTE: If the heater has been converted to high CFM in accordance with High CFM Conversion section, the baffles will have already been removed.

   b. Remove baffles between heat exchanger tubes in accordance with **Reverse Airflow Conversion** section.
   c. Remove accumulated dust and grease deposits from heat exchanger tubes and baffles using brush and/or air hose.
   d. Re-install baffles in accordance with **Reverse Airflow Conversion** section.
   e. Secure ductwork as necessary.

Maintenance Procedures—Continued

Heat Exchanger Cleaning—Continued

2. Clean heat exchanger inner surfaces (combustion gas side):

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. The required procedure depends on the size of the furnace and the date of manufacture.**
- **Unit sizes 075, 100, and 125 DO NOT have heat exchanger V-baffles. Unit sizes 140–400 manufactured *after* OCT 1995 have heat exchanger V-baffles. Unit sizes 140–400 manufactured *before* NOV 1995 DO NOT.**

   a. Remove burner rack assembly in accordance with **Burner Rack and Pilot Maintenance** section.

   b. For all unit size 75, 100, and 125 models and for unit size 140–400 models manufactured ***before*** NOV 1995, clean inner surfaces using furnace brush or piece of heavy wire to which piece of steel wool is attached. Brush up and down within tubes until all soot is removed. Clean outside space between lower portions of heat exchanger tubes to remove any accumulated dust or light deposits using air hose or brush.

   c. For unit sizes 140–400 manufactured ***after*** OCT 1995, ensure that flue pipe is supported and remove three screws that secure venter housing to outlet duct—pipe from furnace to venter—venter assembly will remain in place. Remove six screws used to secure flue collection box to top of furnace and remove flue collection box to expose heat exchanger tubes. V-shaped tube baffles on top of heat exchanger can now be removed and cleaned using brush and air hose.

   d. Install burner rack assembly in accordance with **Burner Rack and Pilot Maintenance** section.

3. Check furnace for proper operation.

Venter Maintenance

Remove dirt from the outer surface of the venter motor, which is permanently lubricated so no oiling is required. Check the venter relay, which controls the venter motor, to ensure that its contacts are connected properly. Contact failure will cause the venter motor to not run or, if the contacts fail to open, the venter motor will not shut off.

TROUBLESHOOTING

Table 22. Troubleshooting

Symptom	Probable Cause	Remedy
A. Venter motor will not start	1. No power to unit	Turn on power
		Check supply fuses or circuit breaker
	2. No 24V power to venter relay	Turn up thermostat
		Check control transformer output
		Check and tighten all wiring connections as necessary
	3. Venter relay defective	Replace relay
	4. Defective motor or capacitor	Replace motor or capacitor

Table 22. Troubleshooting—Continued		
Symptom	**Probable Cause**	**Remedy**
B. Pilot will not light (venter operating)	1. Manual valve not open	Open manual valve
	2. Air in gas line	Bleed gas line
	3. Dirt in pilot orifice	Remove and clean with compressed air or solvent (do not ream)
	4. Gas pressure too high or too low	Adjust supply pressure (refer to **Manifold Gas Pressure Measurement and Adjustment** section)
	5. Kinked pilot tubing	Replace tubing
	6. Pilot valve does not open	If 24V is available at valve, replace valve
	7. No spark	
	a. Loose wire connections	Check and tighten all wiring connections as necessary
	b. Transformer failure	Ensure that 24V is available
	c. Incorrect spark gap	Maintain spark gap at 0.1 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 draft at pilot
	g. Ignition control not grounded	Ensure that ignition control is grounded to furnace chassis
	h. Faulty ignition controller	If 24V is available to ignition controller and all other causes have been eliminated, replace ignition control
	8. Optional lockout device interrupting control circuit by 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 is measured at valve connections and valve remains closed, replace valve
	b. Loose wire connections	Check and tighten all wiring connections as necessary
	3. Ignition control does not power main valve	
	a. Loose wire connections	Check and tighten all wiring connections as necessary
	b. Flame sensor grounded while pilot lights and spark continues	Ensure that flame sensor lead is not grounded or insulation or ceramic is not cracked; replace as necessary
	c. Gas pressure incorrect	Adjust supply pressure (refer to **Manifold Gas Pressure Measurement and Adjustment** section)
	d. Cracked ceramic at sensor	Replace sensor
	e. Faulty ignition controller	If all checks indicate no other cause, replace ignition controller
		Do not attempt to repair ignition controller, which has no field-replaceable components
D. No heat (heater operating)	1. Dirty filter(s)	Clean or replace filter(s)
	2. Incorrect manifold pressure or orifices	Check manifold pressure (refer to **Manifold Gas Pressure Measurement and Adjustment** section)
	3. Cycling on limit control	Check air throughput (refer to **Duct Furnace Blower Connections** section)
	4. Improper thermostat location or adjustment	Refer to thermostat manufacturer's instructions
	5. Belt slipping on blower	Adjust belt tension
E. Cold air delivered	1. Fan control improperly located or adjusted	Relocate or adjust fan control (refer to **Fan Control** section)
F. Cold air delivered at startup	1. Defective fan control	Replace fan control
G. Cold air delivered during operation	1. Blower set for too low temperature rise	Slow down blower or increase static pressure
	2. Incorrect manifold pressure	Check manifold pressure (refer to **Manifold Gas Pressure Measurement and Adjustment** section)
H. Motor will not run	1. Circuit open	Check and tighten all wiring connections as necessary
	2. Fan control inoperative	Replace fan control
	3. Defective motor or capacitor	Replace motor or capacitor
I. Motor turns ON and OFF while burner is operating	1. Fan control improperly located or adjusted	Relocate or adjust fan control (refer to **Fan Control** section)
	2. Defective fan control	Replace fan control
	3. Motor overload device cycling ON and OFF	Check motor load against motor rating plate
		Replace motor as necessary
	4. Three-phase motor rotating in opposite direction	Interchange two legs on supply connections
J. Blower motor cuts out on overload	1. Improper motor pulley and/or adjustment	Check air throughput (refer to **Duct Furnace Blower Connections** section)
	2. Improper static pressure in the duct system	Adjust duct system dampers
	3. Low voltage	Check power supply

NOTES

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.

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