Installation / Operation / Maintenance

Applies to: Model EEDU Indoor, Power-Vented Duct Furnace

Model EEDU Duct Furnace

⚠ WARNING:

FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in serious injury, death, or property damage.

Be sure to read and understand the installation, operation, and service instructions in this manual.

Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damage.

- **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.**
- **Installation and service must be performed by a qualified installer, service agency, or the gas supplier.**

Table of Contents

1.0 General

1.1 Hazard Labels and Notices

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

Definitions of HAZARD INTENSITY LEVELS used in this Manual

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

1.2 General Installation Information

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.

WARNING

Gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances. See Hazard Intensity Levels, above.

1.3 Warranty

Refer to the limited warranty form in the "Literature Bag".

Warranty is void if.....

a. 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.

b. Wiring is not in accordance with the diagram furnished with the heater.

c. Unit is installed without proper clearances to combustible materials or located in a confined space without proper ventilation and air for combustion. (See Paragraphs 2.2 and 4.2.)

d. Furnace air throughput is not adjusted within the range specified on the rating plate.

1.4 Installation Codes

The duct furnaces covered in this manual are design-certified by the Canadian Standards Association for commercial/industrial use in both the United States and Canada. The furnaces are approved for use with either natural gas or propane. The type of gas for which the furnace is equipped, the correct firing rate, and electrical 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 the National Fuel Gas Code NFPA54/ANSI Z223.1 (latest edition). A Canadian installation must be in accordance with the CSA B149.1 Natural Gas and Propane Installation Code. These codes are available from CSA Information Services, 1-800-463-6727. Local authorities having jurisdiction should be consulted before installation is made to verify local codes and installation procedure requirements.

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.

2.0 Furnace Location

2.1 General Recommendations

A duct is designed for connection to an inlet and an outlet duct and depends on an external air handler. Location must comply with the clearances listed in Paragraph 4.2. There are a variety of factors, such as system application, building structure, dimensions, and weight, that contribute to selecting the lotion. Read the installation information in this manual and select a location that complies with the requirements.

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

2.2 Combustion Air Requirements

A Model EEDU duct furnace is designed to take combustion air from the space in which the furnace 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 the greater use of insulation, improved vapor barriers and weather-stripping, with the result that buildings generally are 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.

WARNING

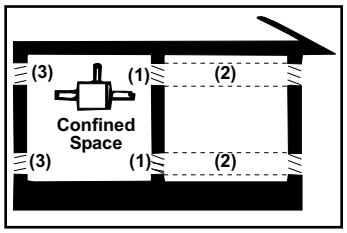
A Model EEDU duct furnace is designed to take combustion air from the space in which it is installed and is not designed for connection to an outside combustion air intake duct. Connecting this furnace to an outside combustion air intake duct voids the warranty and could cause hazardous operation. See Hazard Intensity Levels, page 2.

Requirements for combustion air and ventilation air depend upon whether the unit is located in a confined or unconfined space. An "unconfined space" is defined as a space whose volume is not less than 50 cubic feet per 1000 BTUH of the installed appliance. Under all conditions, enough air must be provided to ensure there will not be a negative pressure condition within the equipment room or space. A positive seal must be made in all return-air connections and ducts. Even a slight leak can create a negative pressure condition in a confined space and affect combustion.

2.0 Furnace Location (cont'd)

2.2 Combustion Air Requirements (cont'd)

FIGURE 1 - Confined Space: A space whose volume is less than 50 cubic feet per 1000 BTUH of the installed appliance input rating.



Installation in a Confined Space

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

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

1. Air from inside the building -- openings 1 square inch free area per 1000 BTUH. Never less than 100 square inches free area for each opening. See (1) in **FIGURE 1**.

2. Air from outside through duct -- openings 1 square inch free area per 2000 BTUH. See (2) in **FIGURE 1**.

3. Air direct from outside -- openings 1 square inch free area per 4000 BTUH. See (3) in **FIGURE 1**.

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

Hazards of Chlorine

The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine will, when exposed to flame, precipitate from the compound, usually freon or degreaser vapors, and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid which readily attacks all metals including 300 grade stainless steel.

Care should be taken to separate these vapors from the combustion process. This may be done by wise location of the furnace with regard to exhausters or prevailing wind direction. Remember, chlorine is heavier than air. This fact should be kept in mind when determining installation locations of heating equipment and building exhaust systems.

3.0 Uncrating and Preparation

3.1 Uncrating and Inspection

This furnace was test operated and inspected at the factory prior to crating and was in operating condition. If the furnace has incurred any damage in shipment, document the damage with the transporting agency and contact an authorized Factory Distributor. If you are an authorized Distributor, follow the FOB freight policy procedures.

<u>Important</u> CAUTION: Remove the panel from the bottom rear of the furnace (See Paragraph 10.2.2, page 27) and check the burner rack assembly. The burner rack "drawer" should be setting level with each side on a support rail. Check to assure that EXCESSIVE shipping vibration has not caused the burner rack assembly to "drop off" the support rails into the bottom pan. 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". Re-assemble by sliding the burner rack "drawer" into the heater, being sure that both sides are resting on the support rails. Re-attach to the support brackets underneath the burners. Re-insert the burner rack screws and close the back panel.

3.2 Preparing the Furnace for Installation

Check the rating plate for the gas specifications and electrical characteristics of the furnace to be sure 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 to the furnace prior to installation.

Option Parts -- Some gas control options will have parts either shipped loose with the heater or shipped separately. If your unit is equipped with any of the gas control options in the table, be sure these parts are available at the job site.

Heating -- Gas Control Option	**Option AG7 -** Amplifier, **P/N 260863**; Thermostat, **P/N 48033**
Makeup Air -- Control Options **(All of the makeup air options also require a shipped-separate fan control, Option CQ1 (P/N 57960), which should be at the job site.)**	**Option AG3 -** Control Switch, **P/N 29054**; Gasket, **P/N 7726**; Gasket Retainer Plate, **P/N 7727**
	Option AG8 - Temperature Sensor and Mixing Tube, **P/N 48041**; Amplifier, **P/N 260864**; Control Switch, **P/N 29054**
	Option AG9 - Remote Temperature Selector, **P/N 48042**; Temperature Sensor and Mixing Tube, **P/N 48041**; Amplifier, **P/N 260863**; Control Switch, **P/N 29054**
	Option AG15 - Remote Temperature Selector, **P/N 115848**; Stage Adder Module, **P/N 115849**; Control Switch, **P/N 29054**; Transformer 115 to 24V, **P/N 103055** or 208/230 to 24V, **P/N 103497**; and 1/2" locknut, **P/N 16222** (for transformer); Discharge Sensor Holder, **P/N 115850**; Discharge Air Sensor Holder Bracket, **P/N 213612;** Temperature Sensor,**P/N 115815**
	Option AG21 - Signal Conditioner, **P/N 134170**; Conditioner Relay, **P/N 14747**; Transformer 115 to 24V, **P/N 103055**; Fuse Box, **P/N 12697**; Fuse Box Cover, **P/N 12698**; (3) Hole Plugs, **P/N 16451**; Transformer Locknut, **P/N 16222**

Other 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.

3.2.1 Converting Furnace for Higher CFM Application

This furnace 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, refer to the requirements and instructions in the **APPENDIX,** page 30.

3.2.2 Instructions for Reversing Airflow by Changing Directional Air Baffles in the Heat Exchanger

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 re-locating the limit control and reversing the position of the directional air baffles.

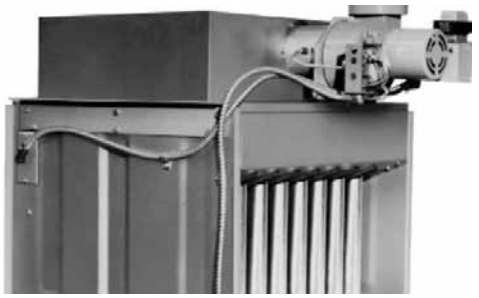
Instructions for Reversing Airflow

1. Refer to **FIGURE 2A**. Remove the screws attaching the limit control bracket to the side of the furnace. Carefully pull the bracket/control assembly through the hole. (Do not disconnect wires.)

FIGURE 2A - Limit Control Location - When reversing airflow, the limit control must be re-located. The limit control MUST be on the discharge end of the heat exchanger

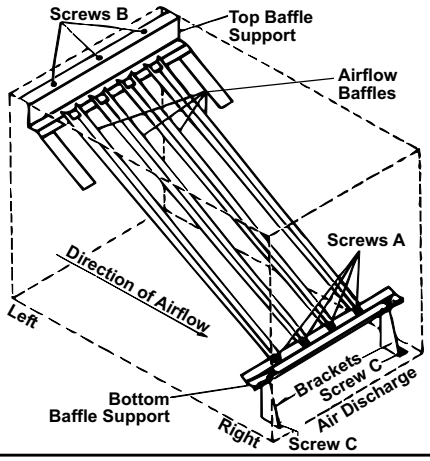
NOTE: If the unit has optional outer side panels, locate the limit control and remove the outer panel on that side of the furnace.

Location of the factory-installed Limit Control Bracket on a Furnace with Standard Airflow Direction →



2. Refer to **FIGURE 2B** and follow Steps a)-d) to reverse the direction of the baffles.

FIGURE 2B - Model EEDU has a top and bottom support assembly and individual baffles.



a) Remove Screws "A". Individually lift each baffle slightly and slide forward. Remove all baffles completely from the heat exchanger.
b) Remove Screws "B" and the top baffle support assembly. Re-position the assembly on the opposite end of the heat exchanger and attach.
c) Remove Screws "C" and the assembled bottom baffle support and brackets. Plug the holes in the heat exchanger bottom by re-inserting the screws in the holes. Position the assembly on the opposite end of the heat exchanger and attach using field-supplied sheetmetal screws.
d) Re-install all of the individual baffles by reversing procedure in Step a) above.

3. Relocate the limit control.

a) At the discharge end on the same side of the heat exchanger, measure down 4-1/2" (114mm) and across 1-11/16" (43mm). Using that point as the center, punch a 2-1/4" (57mm) diameter hole in the side panel.

NOTE: It may be necessary to move cable connections. Re-insert screws to plug all holes in the side panel. After the limit control is installed, the cable connections may be re-attached using field-supplied sheetmetal screws.

3.0 Uncrating and Preparation (cont'd)

3.2 Preparing the Furnace for Installation (cont'd)

3.2.2 Instructions for Reversing Airflow (cont'd)

b) With the limit control on the heat exchanger side of the bracket, slide the limit control/bracket assembly into the hole. Attach the bracket with two sheetmetal screws.

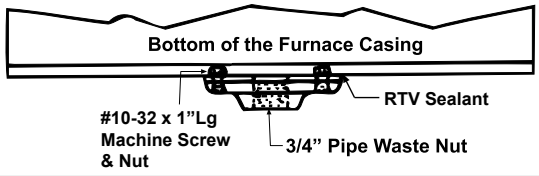
c) Cover all of the original factory-made limit control holes with a field-supplied sheetmetal plate. Do not leave any open holes in the side panel or the heat exchanger bottom.

4. The furnace is now ready for installation with the airflow from front to rear (gas valve side).

3.2.3 Install Condensate Drain, Option CS1

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, may be installed on the furnace bottom as shown in **FIGURE 3.** When using Option CS1, seal all corners and the four square holes in the bottom pan edge. **NOTE:** A 4-inch (102mm) minimum clearance is required under the furnace if a 90° street elbow is used.

FIGURE 3 - Condensate Drain, Option CS1 (P/N 31765)



Seal holes in bottom pan with RTV sealant. Terminate drain outside of building. Periodic cleaning of the condensate collector and disposal system is required.

3.2.4 Coupling Two, Three, Four, or Five Furnaces

Coupling of furnaces is done using optional coupling kits -- Option CR1 for two units, Option CR2 for three units, Option CR3 for four units, or Option CR4 for five units. Refer to the illustrations and follow the instructions.

<u>Instructions for Coupling Furnaces</u> (Refer to FIGURES 4A, 4B, 4C, 4D)

1. Position tie plate **below hanger angle**. Attach the tie plate to the first furnace using threaded socket assemblies. Secure fasteners firmly.

2. Move the second furnace next to the first furnace. **Position so that the tie plate is below the hanger angle**. Secure the tie plate to the hanger angle using the 3/8-16 bolts, the washers, and the spotweld nuts on the tie plate.

3. Position the filler plates to furnaces as shown in **FIGURE 4A**. Using a filler plate as a template, drill 1/8" diameter holes. Attach filler plates using the sheetmetal screws provided. Offset of filler plate allows alignment with unit duct flanges. See **FIGURE 4C**.

4. Coupled units require access panels in the top or bottom of the outlet duct for limit control service. See **FIGURE 4D** and Paragraph 6.3.4.

Coupling Kit Components, Option CR1 (P/N 57963), for Two Furnaces		
Qty	P/N	Description
2	**57964**	Filler Plate
1	**57965**	Tie Plate
2	**9557**	Threaded Socket Assembly
2	**5095**	3/8-16 x 1-1/4" lg Hex Head Bolts
2	**5197**	Split Ring Lock Washer
20	**11813**	#10 x 1/2" lg Sheetmetal Screws
<u>Additional Kits</u>:		
<u>3 Furnaces</u> - Option CR2 (P/N 82654)		
<u>4 Furnaces</u> - Option CR3 (P/N 82655)		
<u>5 Furnaces</u> - Option CR4 (P/N 82656)		

FIGURE 4A - Coupling Furnaces

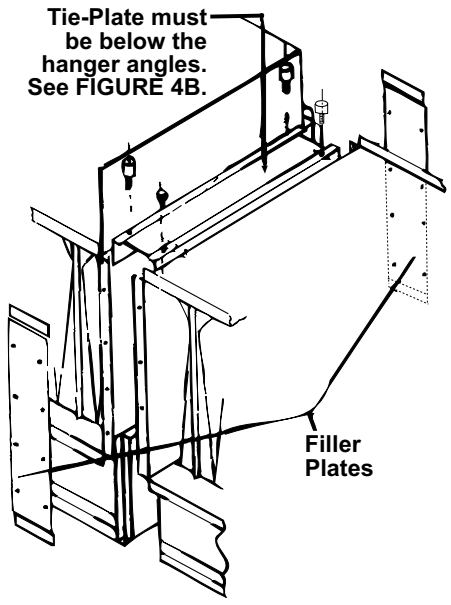
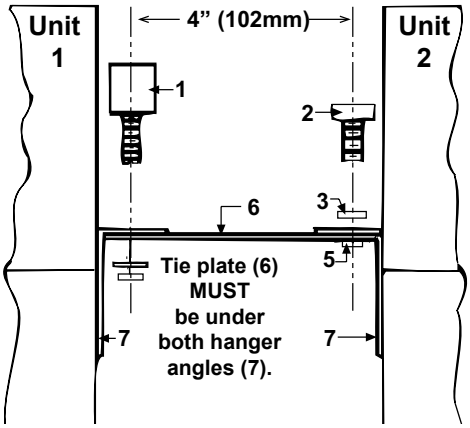
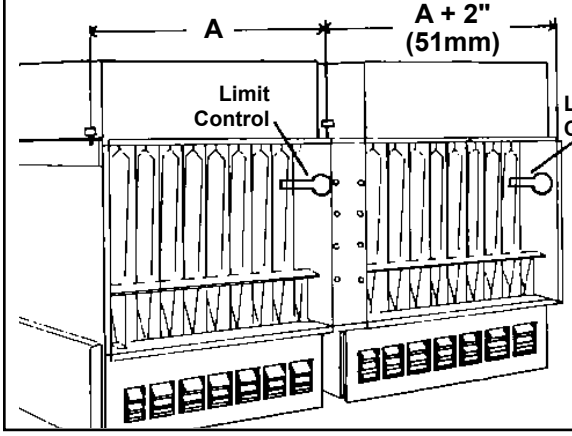


FIGURE 4B - Installing Coupling Kit Tie Plate



Item	Description	Item	Description
1	Socket Assembly	5	Spotweld Nut
2	Bolt	6	Tie Plate
3	Lockwasher	7	Hanger Angles

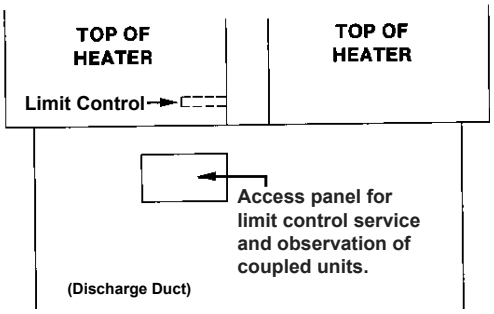
FIGURE 4C - Front View of Coupled Furnaces



Size	"A"	
75-100	14-5/8"	371mm
125-140	17-3/8"	441mm
170	20-1/8"	512mm
200	22-7/8"	581mm
225	25-5/8"	651mm
250	28-3/8"	721mm
300	33-7/8"	860mm
350	39-3/8"	1000mm
400	44-7/8"	1140mm

FIGURE 4D - Top View of Coupled Furnaces

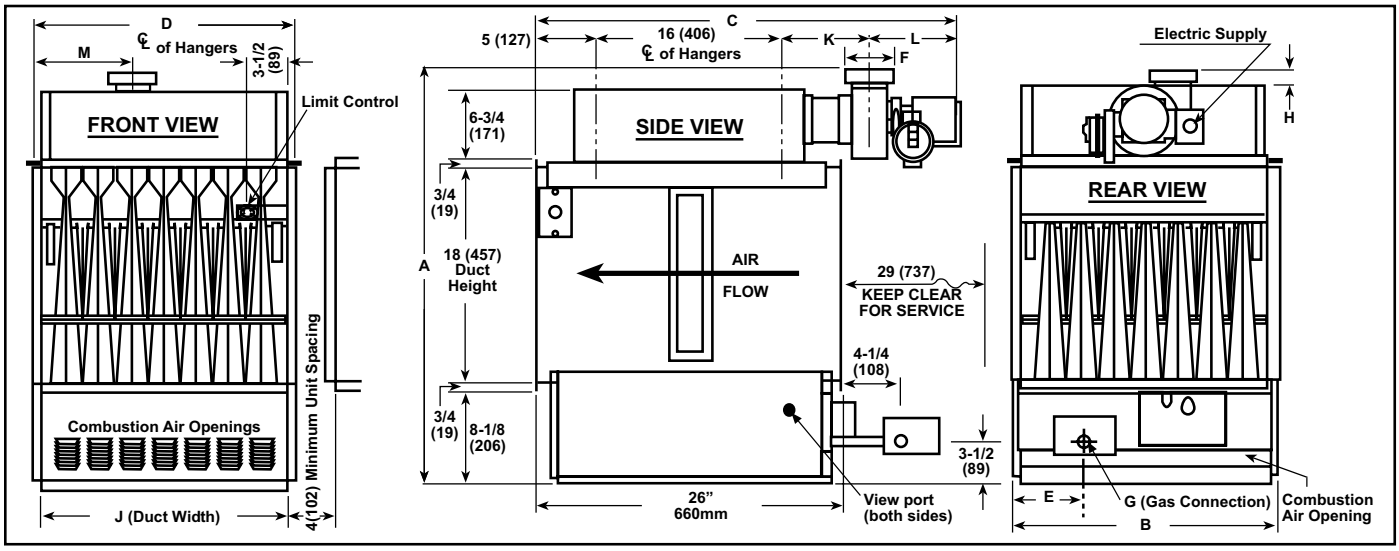
(NOTE: Access panel may be in top or bottom of ductwork.)



4.0 Dimensions and Clearances

4.1 Dimensions

FIGURE 5 - Model EEDU Dimensions - inches (mm)



Size	A	B	C	D	E	F	G-Nat	G-Pro	H	J	K	L	M
Dimensions- inches													
75, 100	35	14-1/4	35-11/16	14-5/8	4-3/8	3-15/16	1/2	1/2	5/8	12-1/2	7-1/4	7-7/16	4-5/8
125, 140	35	17	35-11/16	17-3/8	4-3/8	3-15/16	1/2	1/2	5/8	15-1/4	7-1/4	7-7/16	6
170	35	19-3/4	35-11/16	20-1/8	4-3/8	3-15/16	1/2	1/2	5/8	18	7-1/4	7-7/16	7-3/8
200	35	22-1/2	35-11/16	22-7/8	4-3/8	3-15/16	1/2	1/2	5/8	20-3/4	7-1/4	7-7/16	8-3/4
225	35-3/4	25-1/4	35-11/16	25-5/8	4-3/8	4-15/16	1/2	1/2	1-3/8	23-1/2	7-1/4	7-7/16	10-1/8
250	35-3/4	28	35-11/16	28-3/8	7-1/8	4-15/16	1/2	1/2	1-3/8	26-1/4	7-1/4	7-7/16	11-1/2
300	36	33-1/2	38-1/8	33-7/8	9-7/8	5-15/16	3/4	1/2	1-3/8	31-3/4	9-9/16	7-5/8	13-7/8
350	36	39	38-1/8	39-3/8	12-5/8	5-15/16	3/4	1/2	1-3/8	37-1/4	9-9/16	7-5/8	16-5/8
400	36	44-1/2	38-1/8	44-7/8	15-3/8	5-15/16	3/4	1/2	1-3/8	42-3/4	9-9/16	7-5/8	19-3/8
Dimensions - mm													
75, 100	889	362	906	371	111	100	13	13	16	318	184	189	117
125, 140	889	432	906	441	111	100	13	13	16	387	184	189	152
170	889	502	906	511	111	100	13	13	16	457	184	189	187
200	889	572	906	581	111	100	13	13	16	527	184	189	222
225	908	641	906	651	111	125	13	13	35	597	184	189	257
250	908	711	906	721	181	125	13	13	35	667	184	189	292
300	914	851	968	860	251	151	19	13	35	806	243	194	352
350	914	991	968	1000	321	151	19	13	35	946	243	194	422
400	914	1130	968	1140	391	151	19	13	35	1086	243	194	492

4.2 Clearances

NOTE: See **FIGURES 5 and 7** for illustrations of service clearances.

Unit must be installed so that clearances are provided for combustion air space, service and inspection, and for proper spacing from combustible construction. Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. See table on top of page 8.

4.0 Dimensions & Clearances (cont'd)

4.2 Clearances (cont'd)

Required Clearances					
Front	**Top**	**Flue Connector**	**Sides**	**Bottom**	**Rear**
6"	6"	6"	12"	12"	29"
152mm	152mm	152mm	305mm	305mm	737mm

5.0 Suspending or Mounting the Furnace

Before installing the furnace, check the supporting structure to be used to verify that it has sufficient load-carrying capacity to support the weight of the unit.

Service and combustion air clearances apply to both suspended and mounted heater.

WARNING

Units must be level for proper operation. Do not place or add additional weight to the suspended furnace. See Hazard Intensity Levels, page 2.

5.1 Weights

Net Weight by Size											
Size	**75**	**100**	**125**	**140**	**170**	**200**	**225**	**250**	**300**	**350**	**400**
Lbs	104	104	126	128	150	172	194	216	262	306	328
kg	47	47	57	58	68	78	88	98	119	139	149

5.2 Suspending the Furnace

The furnace is provided with four 15/32" (12mm) diameter holes to provide four-point suspension. To suspend the unit, use 7/16"-16 threaded rod and the hardware shown in **FIGURE 6A**. See **FIGURE 6A, right side,** for details. **NOTE:** A hanger adapter kit Option CK3 with swivels for 1" pipe is available. See **FIGURE 6B**.

FIGURE 6A - Suspending a Single Furnace

"A"		
Size	inches	mm
75-100	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

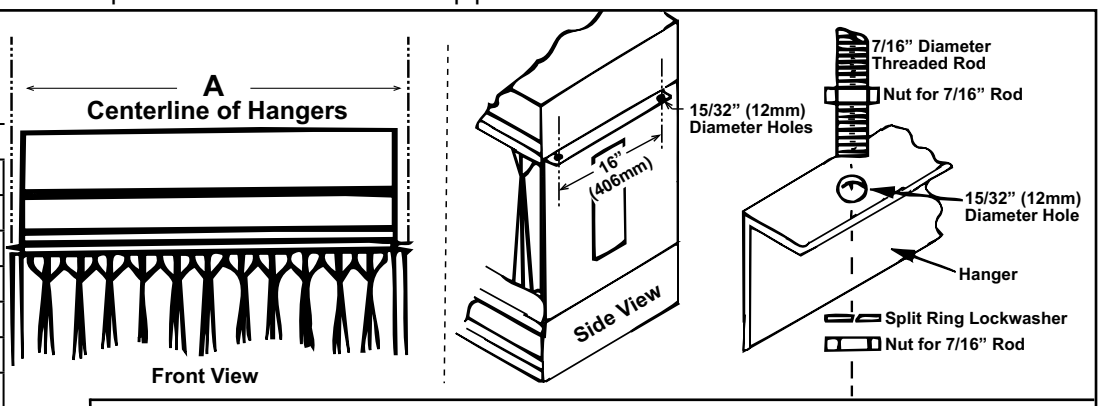
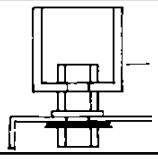


FIGURE 6B - Option CK3 Hanger Kit (P/N 57959) with four threaded sockets



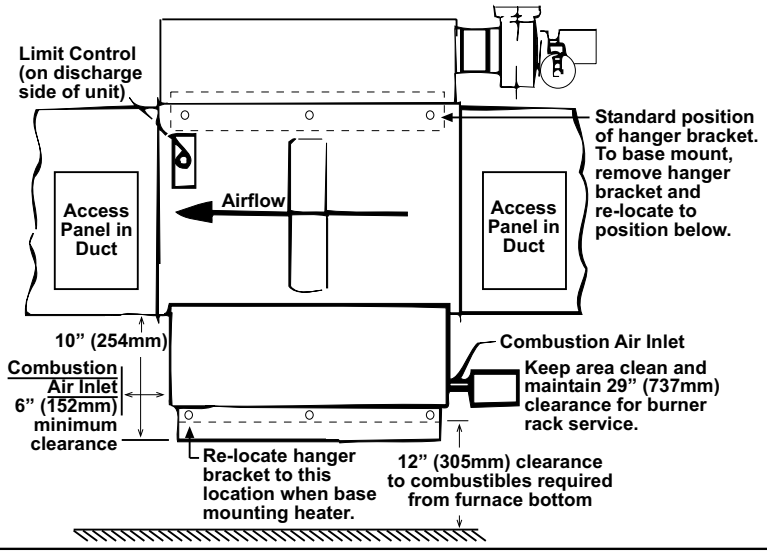
Free-turning threaded socket (1" pipe)

5.3 Mounting the Furnace

Change position of the hanger bracket as shown in **FIGURE 7**.

When the furnace is mounted on combustible material, a minimum clearance of 12" (305mm) is required.

FIGURE 7 - Base-Mounted Furnace



6.0 Mechanical

6.1 Gas Piping and Pressures

6.1.1 Gas Supply and Connections

This appliance is equipped for a maximum gas supply pressure of 1/2 psi, 3.4 kPa, or 14 inches water column. NOTE: Supply pressure higher than 1/2 psi requires 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 which is to be tested. Cap or plug the supply line.

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

Sizing Gas Supply Lines

Capacity of Piping

Cubic Feet per Hour based on 0.3" w.c. Pressure Drop

Specific Gravity for Natural Gas -- 0.6 (Natural Gas -- 1000 BTU/Cubic Ft)

Specific Gravity for Propane Gas -- 1.6 (Propane Gas -- 2550 BTU/Cubic Ft)

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

Note: When sizing supply lines, consider possibilities of future expansion and increased requirements.

Refer to National Fuel Gas Code for additional information on line sizing.

All piping must be in accordance with requirements outlined in the National Fuel Gas Code ANSI/Z223.1 (latest edition) or CSA-B149.1 and B149.2 (See Paragraph 1.4). Gas supply piping installation should conform with good practice and with local codes.

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

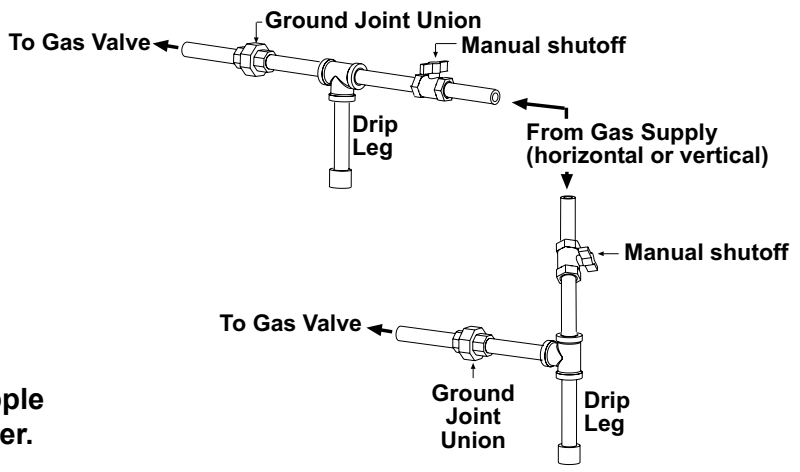
Pipe joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or any other chemical constituents of the gas being supplied.

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

FIGURE 8 - Supply Piping Connection

Gas Connection to Single-Stage Valve (Not Gas Supply Line Size)		
Unit Size	75-250	300-400
Natural Gas	1/2"	3/4"
Propane	1/2"	1/2"

NOTE: To permit burner removal, this nipple must extend beyond the edge of the heater.



6.0 Mechanical (cont'd)

6.1 Gas Piping and Pressures (cont'd)

6.1.1 Gas Supply and Connections (cont'd)

Gas connection sizes are shown in **FIGURE 8**. 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.

WARNING

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.

Manifold or Orifice (Valve Outlet) Pressure Settings

Measuring manifold gas pressure cannot be done until the heater is in operation. It is included in the steps of the "Check-Test-Start" procedure in Paragraph 9.0. The following warnings and instructions apply.

WARNING

Manifold gas pressure must never exceed 3.5" w.c. for natural gas and 10" w.c. for propane gas.

For Natural Gas: When the heater leaves the factory, the combination valve is set so that the outlet gas pressure of a single-stage valve or high fire of a two-stage valve is regulated to 3.5" w.c. Low fire on a two-stage valve is set to 1.8" w.c. Inlet supply pressure to the valve must be a minimum of 5" w.c. or **as noted on the rating plate** and a maximum of 14" w.c. **NOTE: Always check the rating plate for 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" w.c. of natural gas as stated above, but units with electronic modulation may require a minimum of 6" w.c. natural gas supply pressure.

For Propane: When the heater leaves the factory, the combination valve is set so that the outlet gas pressure of a single-stage valve or high fire of a two-stage valve is 10" w.c. Low fire on a two-stage valve is set to 5" w.c. Inlet pressure to the valve must be a minimum of 11" w.c. and a maximum of 14" w.c.

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 on standby. Incorrect inlet pressure could cause excessive manifold gas pressure immediately or at some future time.

Instructions to Check Manifold Pressure:

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

1) With the manual valve (on the combination valve) positioned to prevent flow to the main burners, connect a manometer to the 1/8" pipe outlet pressure tap in the valve. **NOTE:** A manometer (fluid-filled gauge) is recommended rather than a spring type gauge due to the difficulty of maintaining calibration of a spring type gauge.

2) Open the valve and operate the heater. Measure the gas pressure to the manifold. To measure the low stage pressure on units equipped with a two-stage valve, disconnect the wire from the "HI" terminal on the valve. (Be sure to reconnect wire.)

Normally adjustments should not be necessary to the factory preset regulator. If adjustment is necessary, set pressure to correct settings by turning the regulator screw IN (clockwise) to increase pressure. Turn regulator screw OUT (counterclockwise) to decrease pressure.

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

6.2 Venting

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. (Horizontal vent run is recommended for maximum fuel savings.)

If a vent cap is shipped with the heater, it is packaged attached to the venter housing. Detach the vent cap from the housing.

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 listed in Paragraph 1.4 and all venting instructions. Safe operation of any gas-fired equipment requires a properly operating vent system, correct provision for combustion air (See Paragraph 2.2) and regular maintenance and inspection. See Hazard Intensity Levels, page 2.

DANGER

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.

Specific Venting Requirements (read all before installing)

1. Type of Vent Pipe

Use either vent pipe approved for a Category III heater or appropriately sealed single-wall pipe. Or, 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.

Use only one of the flue pipe diameters listed in the Vent Length Tables for the furnace size being installed.

2. Venter (Flue) Outlet

Size	Venter Outlet Diameter
75 - 200	4"
225 - 250	5"
300 - 400	6"

Venter Outlet Attachment Requirements:

- ☐ If the pipe used in the vent run is larger than the diameter of the venter outlet (See **Vent Length Table 2**, page 12), make the transition at the venter outlet.
- ☐ The venter is factory-installed as illustrated in **FIGURE 9A**. If required, the venter housing may be rotated as shown in **FIGURE 9B**. The vent may be run in either of the three directions as indicated by 1, 2, and 3 in the illustrations. Follow the instructions to rotate the venter housing.

  Instructions for Rotating Venter Housing

  1) Remove the three screws (save screws) that attach the venter housing to the outlet duct (pipe from furnace to the venter). The assembly will remain in place.

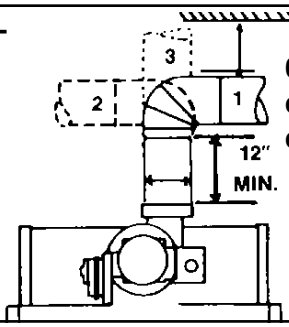
  2) Remove the three screws holding the motor plate to the venter housing. Holding the motor, rotate the venter housing to the alternate position (See **FIGURE 9B**). Re-attach the motor plate to the housing. To ensure correct venter wheel alignment, holes are provided in the motor plate.

  3) Using the holes in the venter housing as a template, drill three 1/8" diameter holes in the outlet duct. Re-attach the venter housing to the outlet duct using the three screws removed in Step 1). Rotation is complete.

WARNING

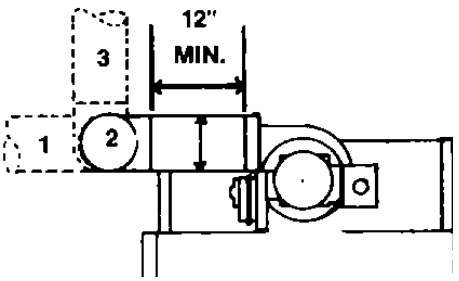
Only the venter housing may be rotated. The motor and combustion air proving switch MUST remain as received from the factory. Unsafe or improper operation will result if the standard position is varied. See Paragraph 8.1 for explanation of combustion air proving switch.

FIGURE 9A - Factory-Installed Position of the Venter Housing



6" (152mm) clearance from combustibles

FIGURE 9B - Alternate Position of the Venter Housing



- ☐ A minimum of 12" (305mm) 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.

6.0 Mechanical (cont'd)

6.2 Venting (cont'd)

Specific Venting Requirements (cont'd)

3. Vent Length Tables

* Tables 1&2 - Reduce the maximum vent length by the amount indicated for each elbow used.

NOTE 1: If the system contains all vertical pipe or a combination of vertical and horizontal vent pipe, the Maximum Permissible Vent Length shown in TABLES 1 and 2 may be increased one foot for each foot of vertical pipe, up to a maximum increase of 10 feet for Model Sizes 75 - 125 and up to 20 feet for Model Sizes 140 - 400.

TABLE 1: Maximum Permissible Vent Lengths with Standard Vent Pipe Diameters

Size	Vent Pipe Diameter (inches)	Maximum Vent Length (see NOTE 1 left)	Equivalent Straight Length* - ft (M)	
			90°Elbow	45°Elbow
75	4	40 ft (12.2 M)	6 (1.8)	3 (.9)
100	4	50 ft (15.2 M)	7 (2.1)	3.5 (1.1)
125	4	50 ft (15.2 M)	7 (2.1)	3.5 (1.1)
140	4	50 ft (15.2 M)	7 (2.1)	3.5 (1.1)
170	4	50 ft (15.2 M)	7 (2.1)	3.5 (1.1)
200	4	50 ft (15.2 M)	7 (2.1)	3.5 (1.1)
225	5	50 ft (15.2 M)	9 (2.7)	4.5 (1.4)
250	5	50 ft (15.2 M)	9 (2.7)	4.5 (1.4)
300	6	50 ft (15.2 M)	11 (3.4)	5.5 (1.7)
350	6	50 ft (15.2 M)	11 (3.4)	5.5 (1.7)
400	6	50 ft (15.2 M)	11 (3.4)	5.5 (1.7)

TABLE 2: Optional Maximum Permissible Vent Lengths

(Requires an increase in vent pipe diameter.)

Size	Vent Pipe Diameter (inches)	Maximum Vent Length (see NOTE 1 left)	Equivalent Straight Length* - ft (M)	
			90°Elbow	45°Elbow
170	5	60 ft (18.3 M)	9 (2.7)	4.5 (1.4)
200	5	70 ft (21.3 M)	9 (2.7)	4.5 (1.4)
225	6	70 ft (21.3 M)	11 (3.4)	5.5 (1.7)
250	6	70 ft (21.3 M)	12 (3.7)	6 (1.8)
300	7	70 ft (21.3 M)	13 (4.0)	6.5 (2.0)
350	7	80 ft (24.3 M)	13 (4.0)	6.5 (2.0)
400	7	90 ft (27.4 M)	14 (4.3)	7 (2.1)

4. Vent System Joints - Vent system joints depend on the installation and the type of pipe being used.
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). **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.

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 **FIGURE 10A** when attaching vent cap to double-wall pipe.

5. Vent System Support - Support lateral runs every six 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.

6. 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.

7. Vent Terminal (Pipe and Vent Cap) - Terminate the vent system with an Option CC1 vent cap that in most cases is the same size as the vent run. Heaters to be installed in the United States that are ordered with an optional vent cap and all heaters ordered for Canada have a vent cap packaged with the heater. If the "standard" size vent pipe listed in Vent Length Table 1 is used; install the vent cap provided.

If a vent cap is not included or if a non-standard size (Vent Length Table 2) of vent pipe is used, provide an Option CC1 vent cap in the appropriate size. **NOTE**: If the vent run is 7" vent pipe, install an 8" vent cap using a tapered enlarger.

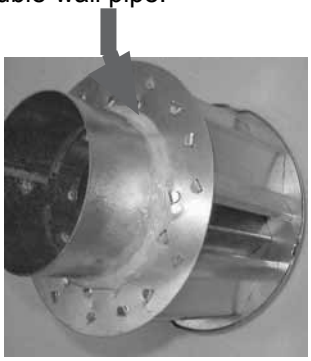
See the illustrations in **FIGURES 11A and 11B** for requirements of either vertical or horizontal vent termination. The vent terminal section may be either single-wall or double-wall (Type B) vent pipe.

If double-wall pipe is used in the vent terminal, follow the instructions in **FIGURE 10A** to attach the vent cap and in **FIGURE 10B** to connect the double-wall pipe to the single-wall or Category III vent pipe run.

FIGURE 10A - Attaching Double-Wall (Type B) Pipe to a Vent Cap

Figure 10A - STEP 1

Place a continual 3/8" bead of silicone sealant around the circumference of the vent cap collar. This will prevent any water inside the vent cap from running down the double-wall pipe.



Do STEP 2 immediately following STEP 1.

Figure 10A - STEP 2

Insert the collar on the vent cap inside the inner wall of the double-wall pipe. Insert as far as possible. Add additional silicone sealant to fully close any gaps between the vent cap and the double wall pipe. This is necessary to prevent water from entering the double wall pipe.

Figure 10A - STEP 3

Secure the vent cap to the double wall pipe by drilling and inserting a 3/4" long sheetmetal screw into the vent cap collar. Do not over tighten screw.

FIGURE 10B - Attaching Double-Wall (Type B) Pipe to a Single-Wall or Category III Vent Pipe

Figure 10B - STEP 1

On the single-wall pipe or Category III pipe, place a continual 1/4" bead of silicone sealant around the circumference.

Do STEP 2 immediately following STEP 1.

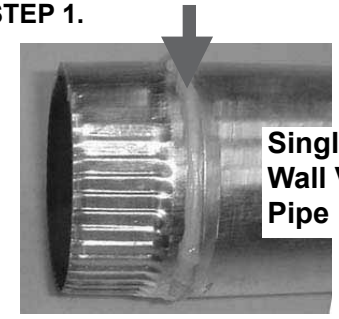


Figure 10B - STEP 2

Insert the pipe prepared with sealant into the inner pipe of the double-wall pipe until the bead of sealant contacts the inner pipe creating a sealed joint.

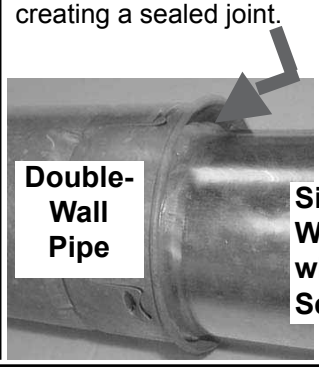


Figure 10B - STEP 3

Spaced equally around the double-wall pipe, drill three small holes below the sealant ring. Insert 3/4 inch long sheetmetal screws to secure the joint. Do not overtighten screws.

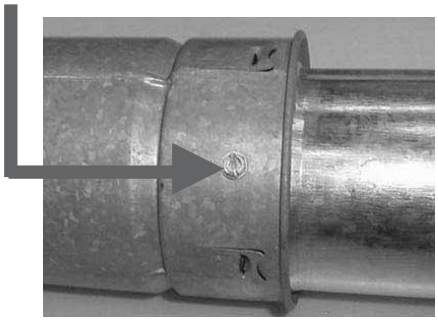
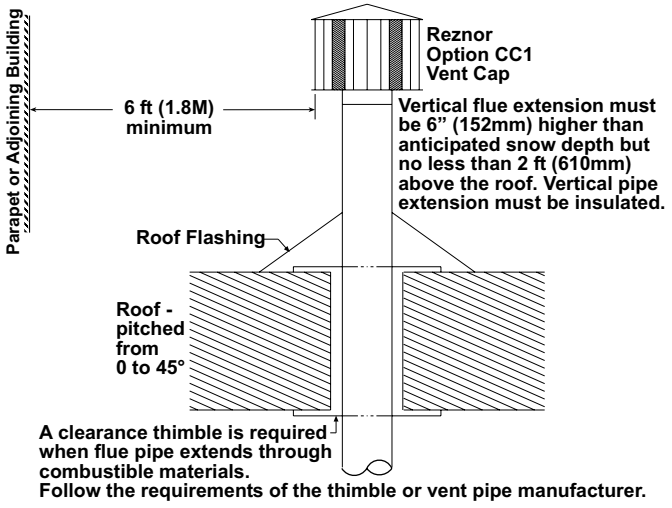


FIGURE 11A - Vertical Vent Terminal

Single-Wall or Category III Vent Run and Single-Wall Terminal End



Single-Wall or Category III Vent Run and Double-Wall Terminal End

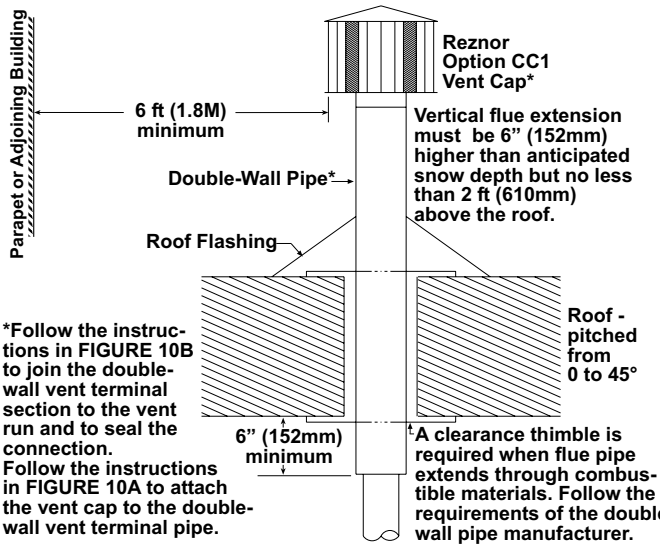
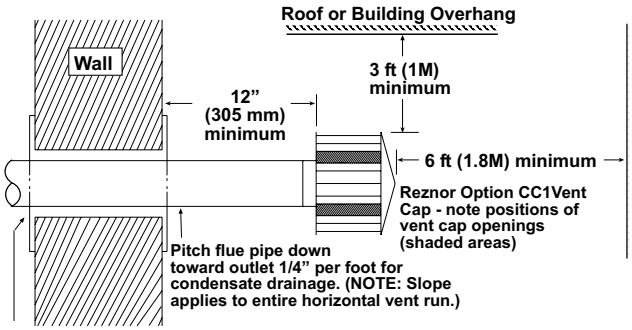
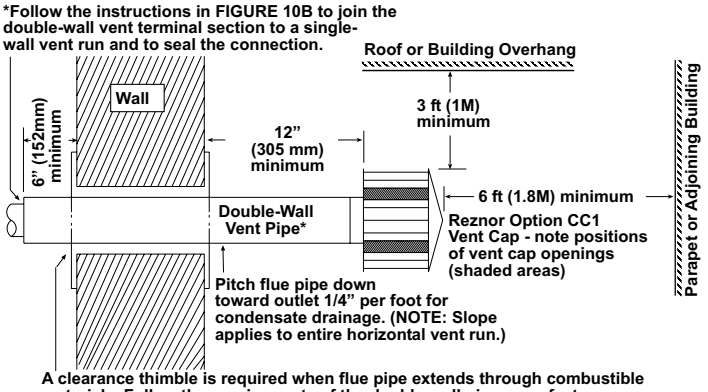


FIGURE 11B - Horizontal Vent Terminal

Single-Wall or Category III Vent Run and Single-Wall Terminal End



Single-Wall or Category III Vent Run and Double-Wall Terminal End



Horizontal Vent Terminal (FIGURE 11B) Clearances

The location of the termination of the horizontal vent system must be in accordance with National Fuel Gas Code Z223.1. See table for required minimum clearances.

If the vent terminal is to be installed near ground level, position it at least six inches above maximum anticipated snow depth.

NOTE: Maintain the required clearance from the wall to the vent terminal cap for stability under wind conditions and to protect the building.

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.

Structure	Minimum Clearances for Vent Termination Location (all directions unless specified)
Forced air inlet within 10 ft (3.1m)	3 ft (0.9m) above
Combustion air inlet of another appliance	6 ft (1.8m)
Door, window or gravity air inlet (any building opening)	4 ft (1.2m) horizontally
	4 ft (1.2m) below
	3 ft (0.9m) above
Electric meter, gas meter * and relief equipment	4 ft (1.2m) horizontally
Gas regulator *	3 ft (0.9m)
Adjoining building or parapet	6 ft (1.8m)
Grade (ground level)	7 ft (2.1m) above
*Do not terminate the vent directly above a gas meter or service regulator.	

6.3 Duct Furnace Airflow

6.3.1 Pressure Drop and Temperature Rise by Size

To determine temperature rise, the inlet and outlet air temperatures should be measured at points not affected by heat radiating from the heat exchanger. The Temperature Rise and Pressure Drop chart shows the approved temperature rise range with the required CFM and the internal pressure drop for each size of unit.

The duct furnace must be installed on the positive pressure side of the field-supplied blower. The air throughput must be within the CFM range stated on the heater rating plate. 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 (See Paragraph 6.3.2).

Size	75		100		125		140		170		200		225		250		300		350		400	
Temperature Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
Model EEDU (80% thermal efficient)																						
50°F	1105	0.24	1475	0.43	1840	0.49	2065	0.65	2505	0.67	2945	0.67	3315	0.69	3685	0.67	4420	0.70	5160	0.75	5895	0.77
60°F	920	0.16	1225	0.30	1535	0.33	1720	0.43	2085	0.46	2455	0.46	2765	0.47	3070	0.45	3685	0.47	4300	0.52	4915	0.52
70°F	790	0.10	1050	0.21	1315	0.25	1475	0.32	1790	0.33	2105	0.35	2370	0.36	2630	0.34	3160	0.35	3685	0.38	4210	0.38
80°F	695	0.07	920	0.16	1150	0.20	1290	0.24	1565	0.25	1840	0.26	2070	0.27	2300	0.26	2765	0.27	3225	0.28	3685	0.28
90°F	615	0.05	815	0.12	1020	0.17	1145	0.20	1390	0.19	1635	0.20	1840	0.21	2045	0.20	2455	0.22	2565	0.23	3275	0.22

If it is determined that the blower CFM is greater than allowed or desirable, see Paragraph 6.3.3 for instructions on determining the correct size of bypass duct required or see the **APPENDIX,** page 30, for instructions on converting the furnace for a higher CFM application.

6.3.2 Duct Furnace Blower Connections

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. Blowers should be bottom horizontal discharge when coupled to the duct furnace. When a top horizontal discharge blower is connected to the duct furnace, be sure 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. See illustrations in **FIGURE 12 A, B, and C.**

WARNING

The furnace must be installed on the positive pressure side of the air-circulating blower. See Hazard Intensity Levels, page 2.

FIGURE 12A - Straight through Air Blower Connection

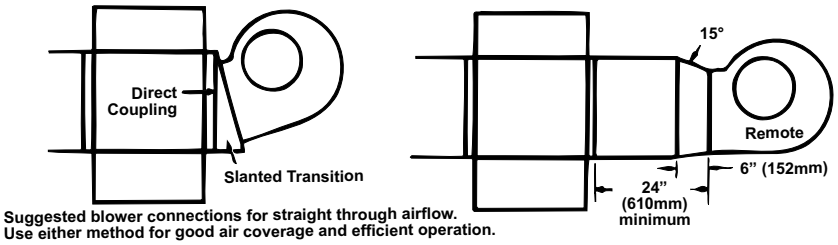


FIGURE 12B - Blower Connection With Elbows Up or Down

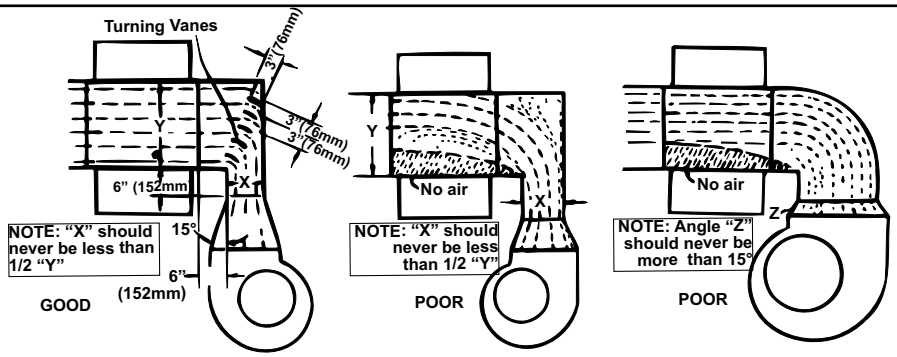
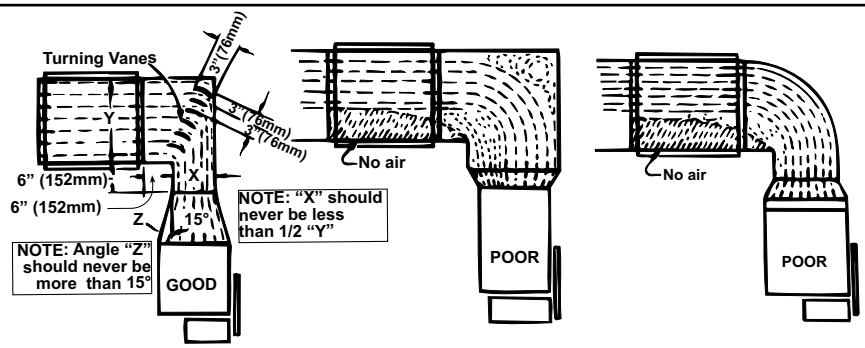


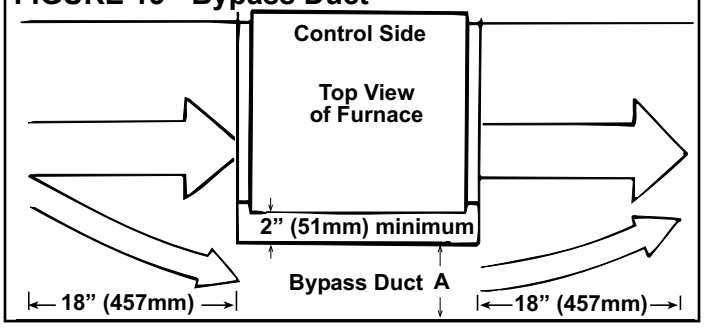
FIGURE 12C - Blower Connection with Elbows Right or Left



6.3.3 Constructing Bypass Duct

When the CFM of air throughput is greater than desirable or permissible for the unit, a bypass duct may be constructed. Follow these instructions to determine the correct size of the bypass duct.

FIGURE 13 - Bypass Duct



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

Directions for Sizing Bypass Duct

1) From the tables in Paragraph 6.3.1, find the pressure drop (P.D.) and the allowable CFM for the furnace that is being installed.

Example: Standard Size 170 @ 70°F temperature rise; P.D. .33; CFM 1790

6.0 Mechanical (cont'd)

6.3 Duct Furnace Airflow (cont'd)

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

Directions for Sizing Bypass Duct (cont'd)

2) Subtract the allowable CFM from the actual CFM of the installation to determine how much air must be diverted through the bypass duct.

Example: Blower CFM 3000
Allowable CFM -1790
Bypass CFM 1210

3) Go to the column in the Bypass CFM Chart that is closest to the pressure drop through the heater. Move down in that column until you find the larger CFM closest to the answer in Step 2).

Example: Go to P.D. Column .35; move down to Bypass CFM 1520

4) Move to the left column to find out the required size of the bypass duct.

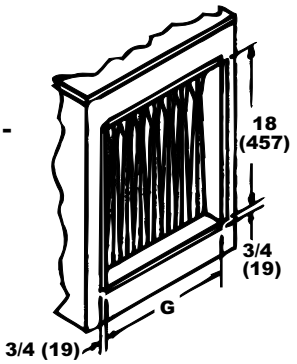
Example: Bypass Duct Size is 5"

Locate the bypass duct on the side of the furnace opposite the controls and 2" from the heat exchanger side panel. Extend the bypass duct 18" (457mm) beyond the furnace on both the inlet and outlet ends.

6.3.4 Duct Connections

NOTE: If the furnace is equipped with a unit-mounted ductstat (Option AG3), the sensing bulb must be removed from the mounting bracket (save the retainer clip) before the ductwork can be attached. See instructions in Paragraph 8.4.3 for re-mounting the sensor.

FIGURE 14 - Duct Connection Dimensions - inches (mm)



Size	G	
75, 100	12-1/2"	318mm
125, 140	15-1/4"	387mm
170	18"	457mm
200	20-3/4"	527mm
225	23-1/2"	597mm
250	26-1/4"	641mm
300	31-3/4"	806mm
350	37-1/4"	946mm
400	42-3/4"	1086mm

Requirements and Suggestions for Connecting and Installing Ducts

- **Type of Ductwork** - The type of duct installation to be used depends in part on the type of construction of the roof (whether wood joist, steel bar joist, steel truss, pre-cast concrete) and the ceiling (whether hung, flush, etc.).
- **Ductwork Material** - Rectangular duct should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B & S gauge aluminum.
- **Ductwork Structure -** All duct sections 24 inches (610mm) or wider, and over 48 inches (1219mm) in length, should be cross broken on top and bottom and should have standing seams or angle-iron braces. Joints should be S and drive strip, or locked.
- **Through Masonry Walls** - No warm air duct should come in contact with masonry walls. Insulate around all air duct through masonry walls with not less than 1/2" (1" is recommended) of insulation.
- **Through Unheated Space** - Insulate all exposed warm air ducts passing through an unheated space with at least 1/2" (1" is recommended) of insulation.
- **Duct Supports** - Suspend all ducts securely from adjacent buildings members. Do not support ducts from unit duct connections.
- **Duct Sizing** - Proper sizing of the supply air ductwork is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air Conditioning Contractors Association, 2800 Shirlington Road, Suite 300, Arlington, VA 22206 (www.acca.org). A manual covering duct sizing in detail may be purchased directly from them.
- **Removable Panels** - The 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" x 10" 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. See **FIGURE 15A**.
- **Supply Air Duct/Furnace Horizontal Connection** - The seal between the furnace and the duct must be mechanical. Duct connection should be made with "U" type flanges on the top and bottom of the connecting duct. Slide the duct over the flanges of the heater giving an airtight fit. Provide "U" type channels for the other side flanges to ensure tight joints. Use sheetmetal screws to fasten ducts and "U" channels to the furnace flange. See **FIGURES 15B and 15C**.

CAUTION: Joints where ducts attach to furnace must be sealed securely to prevent air leakage into burner rack area. Leakage can cause poor combustion, pilot problems, shorten heat exchanger life and cause poor performance. See Hazard Intensity Levels, page 2.

FIGURE 15A - Connecting Ductwork to the Furnace

1) Flanges on the heater turn out as shown.
2) Shape duct connection as shown -- "U" on top and bottom; "L" on sides.
3) Slide "U" form over heater flange making connection.
4) Form "U" strips to seal ends. Drill and lock with sheetmetal screws.

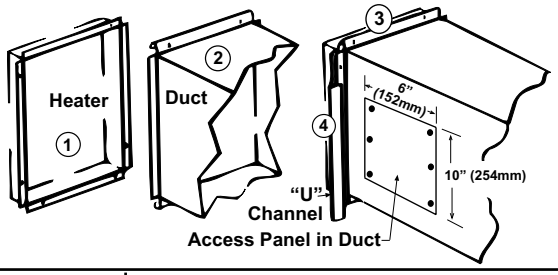


FIGURE 15B - Attachment of Duct to Furnace

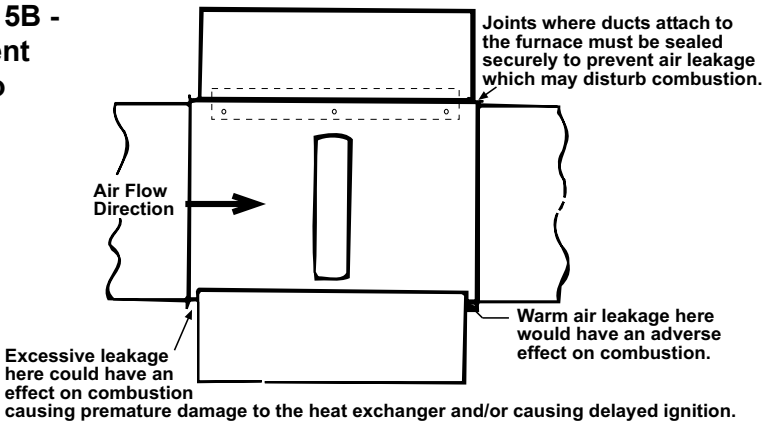
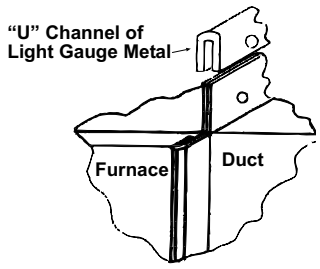


FIGURE 15C - The seals between the furnace and the duct must be mechanical. "U" channel method as illustrated.



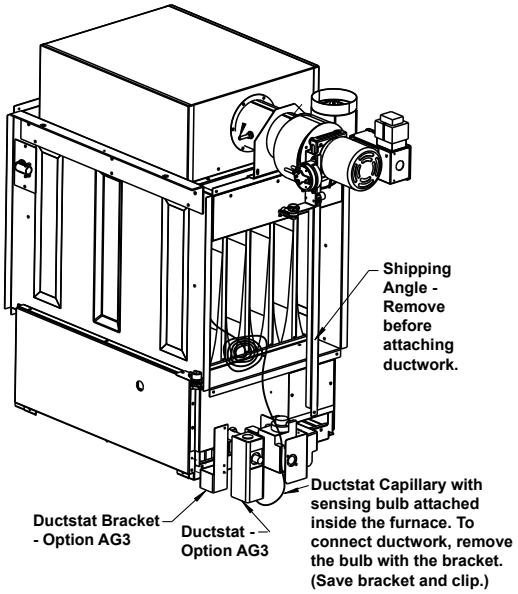
6.3.5 Discharge Air Sensor for Makeup Air Application

All makeup air options (Options AG3, AG15, AG8, and AG9) require that the sensor be field-installed in the discharge ductwork. Follow the instructions that apply.

Option AG3 (two-stage makeup air) - The unit-mounted ductstat has a capillary tube with a sensor bulb. The capillary and bulb must be moved out the way before installing ductwork and then field-installed in the discharge duct. Refer to **FIGURE 16A** and follow the instructions.

FIGURE 16A - Installing Capillary Sensor Bulb in Discharge Ductwork (Option AG3)

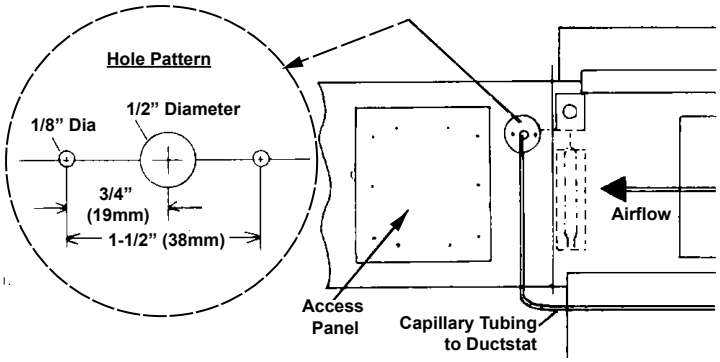
The ductstat and the sensor are connected by a permanently attached capillary tubing. Before attaching ductwork, remove the capillary tubing sensor bulb with the bracket from its shipping position on the inside of the furnace. After the ductwork is attached to the furnace, follow the instructions on the right to install the sensor bulb in the discharge duct.



Instructions to Install Sensing Bulb in the Discharge Duct

Since the sensor is larger than the tubing, a gasket and gasket retainer plate are needed to plug the hole and protect the capillary tubing where it passes through the ductwork. These parts were shipped loose with the furnace (See Paragraph 3.2). Two field-supplied sheetmetal screws will be needed to attach the plate.

1) Drill the Holes - Refer to the illustration below and select a location on the ductwork so that a minimum length of capillary tubing will be inside the ductwork. Following the "hole pattern", drill holes in the ductwork. Remove the ductwork access panel (**FIGURE 15A**).



2) Install the Sensor - Remove the sensor bulb from the bracket. Push the sensor through the 1/2" hole. Reaching through the access hole, use the retaining clip to re-attach the sensor to the bracket.

3) Install the Gasket and Retainer Plate - Slide the gasket (cut a slit) and hole retainer plate over the capillary tubing. With the gasket next to the ductwork, attach the hole retaining plate with field-supplied sheetmetal screws (as illustrated above). Close the ductwork access panel.

6.0 Mechanical (cont'd)

6.3 Duct Furnace Airflow (cont'd)

FIGURE 16B - Discharge Air Sensor Holder, P/N 115850, used in Makeup Air Option AG15

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

FIGURE 16C - Discharge Air Sensor and Mixing Tube used in Electronic Modulation Options AG8 and AG9

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

Options AG15 (2-stage valve with remote ductstat) and **Options AG8 and AG9** (electronic modulation with duct sensor) require field installation of the sensor in the discharge ductwork. Option AG15 uses the box and sensor holder in **FIGURE 16B**. Options AG8 and AG9 include a sensor and mixing tube as illustrated in **FIGURE 16C**. Follow the instructions below to install the sensor in the ductwork.

For control information, see Paragraph 8.4.

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

1. Depending on the option, the sensor will be as shown in either **FIGURE 16B or 16C**. See Paragraph 3.2 for a list of shipped-separate components by option.
2. Determine a location in the ductwork to install the sensor.

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

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

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

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

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

   Do not mount the sensor in the ductwork after a split in the supply as that will cause loss of control in the duct that does not house the sensor.
3. The position of the sensor holder or mixing tube is important. The holder in **FIGURE 16B** will extend 9-3/16” (233mm) into the ductwork. The mixing tube in **FIGURE 16C** is 12" (305mm) long.

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

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

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

   At the selected location in the ductwork, mark the diamond-shaped hole [approximately 1” x 1” (25mm x 25mm)] required for the sensor holder or the round hole needed for the mixing tube. Cut the hole no larger than required.
4. **<u>Option AG15</u> -** Push the element into the clip in the holder. Determine where the sensor wire should enter the box and remove the knockout. Slide the holder into the ductwork. Using four field-supplied No. 6 sheetmetal screws, attach the box portion of the holder to the ductwork. Attach a field-supplied cable connector to the box, connect the sensor wire, and attach the box cover.

   <u>Options AG8 and AG9</u> - Slide the mixing tube into the ductwork and attach the sensor. Connect the wires as shown on the wiring diagram.

7.0 Electrical Supply and Wiring

7.1 General

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

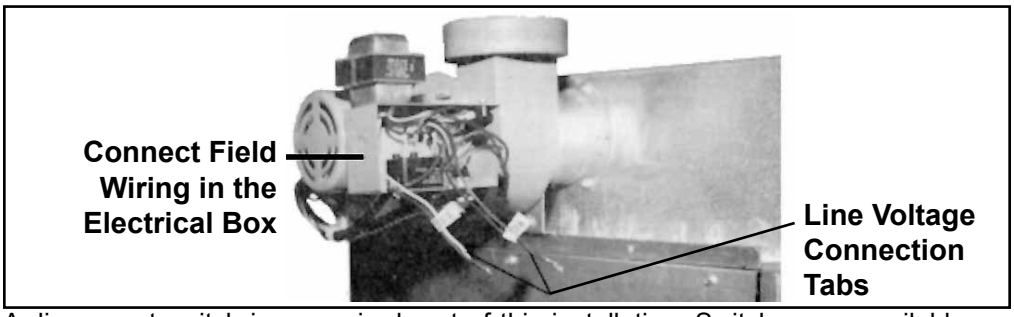
7.2 Supply Voltage and Wiring

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. 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.

If the heater has field-installed options that require electrical connections, consult the instruction sheet and wiring diagram supplied in the option package.

FIGURE 17 - Field Wiring Connections



WARNING

If you turn off the power supply, turn off the gas. See Hazard Intensity Levels, page 2.

Disconnect Switch

A 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.

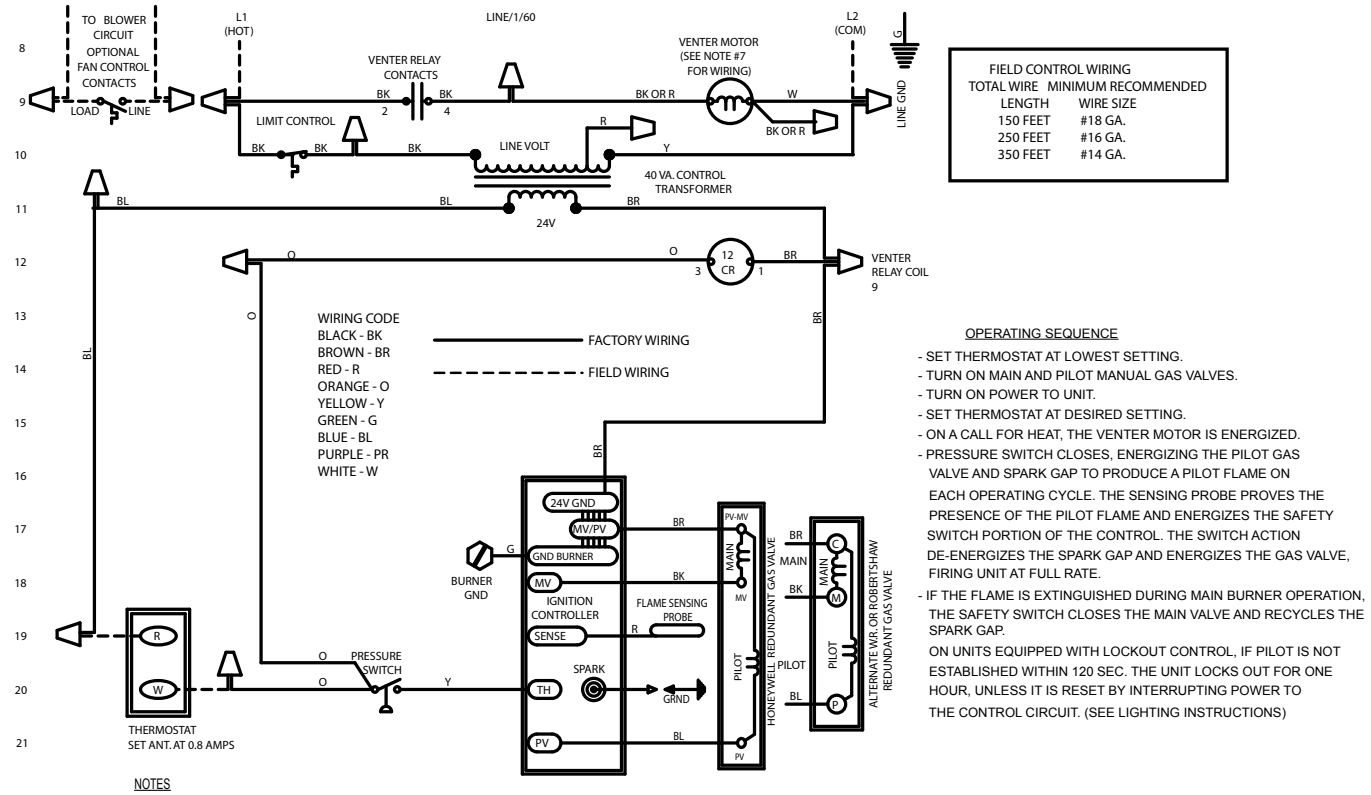
The disconnect switch may be fusible or non-fusible. When installing, be careful that the conduit and switch housing are clear of furnace panels and inspection plates. Allow at least four feet (1.2M) of service room between the switch and removable panels.

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

7.3 Typical Wiring Diagrams

Specific wiring diagrams that include standard and factory-installed options are included with the heater. See typical wiring diagrams in **FIGURES 18A and 18B**.

FIGURE 18A - Single-Stage with Intermittent Spark Pilot System with or without Lockout



NOTES

- DOTTED WIRING SUPPLIED AND INSTALLED BY OTHERS.
- CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF A LEAST 105° C., EXCEPT FOR ENERGY CUT-OFF OR SENSOR LEAD WIRE WHICH MUST BE 150° C.
- LIMIT WIRE TO BE #18 GA. 200 C. SF-1 OF SEW-1.
- USE #14 GA. WIRE FOR LINE WIRING TO UNIT.
- LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SIZES SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
- ON 208/230V. UNITS THE CONTROL TRANSFORMER HAS A DUAL VOLTAGE PRIMARY. FOR 208V. UNITS USE BLACK AND RED LEADS (CAP YELLOW). FOR 230V. UNITS USE BLACK AND YELLOW LEADS (CAP RED). ON 115V. UNITS THE CONTROL TRANSFORMER IS SINGLE VOLTAGE PRIMARY. USE BLACK AND YELLOW LEADS FOR 115V. SECONDARY SIDE OF TRANSFORMER (24V.) USE BLUE AND BROWN LEADS.
- ON 75-250 208V UNITS, THE VENTER MOTOR WIRES ARE BLACK AND WHITE (CAP RED) ON 75-250 230V UNITS, THE VENTER MOTOR WIRES ARE RED AND WHITE (CAP BLACK) ON 75-250 115V UNITS AND 300-400 UNITS ALL VOLTAGES, THE VENTER MOTOR WIRES ARE BLACK AND WHITE.

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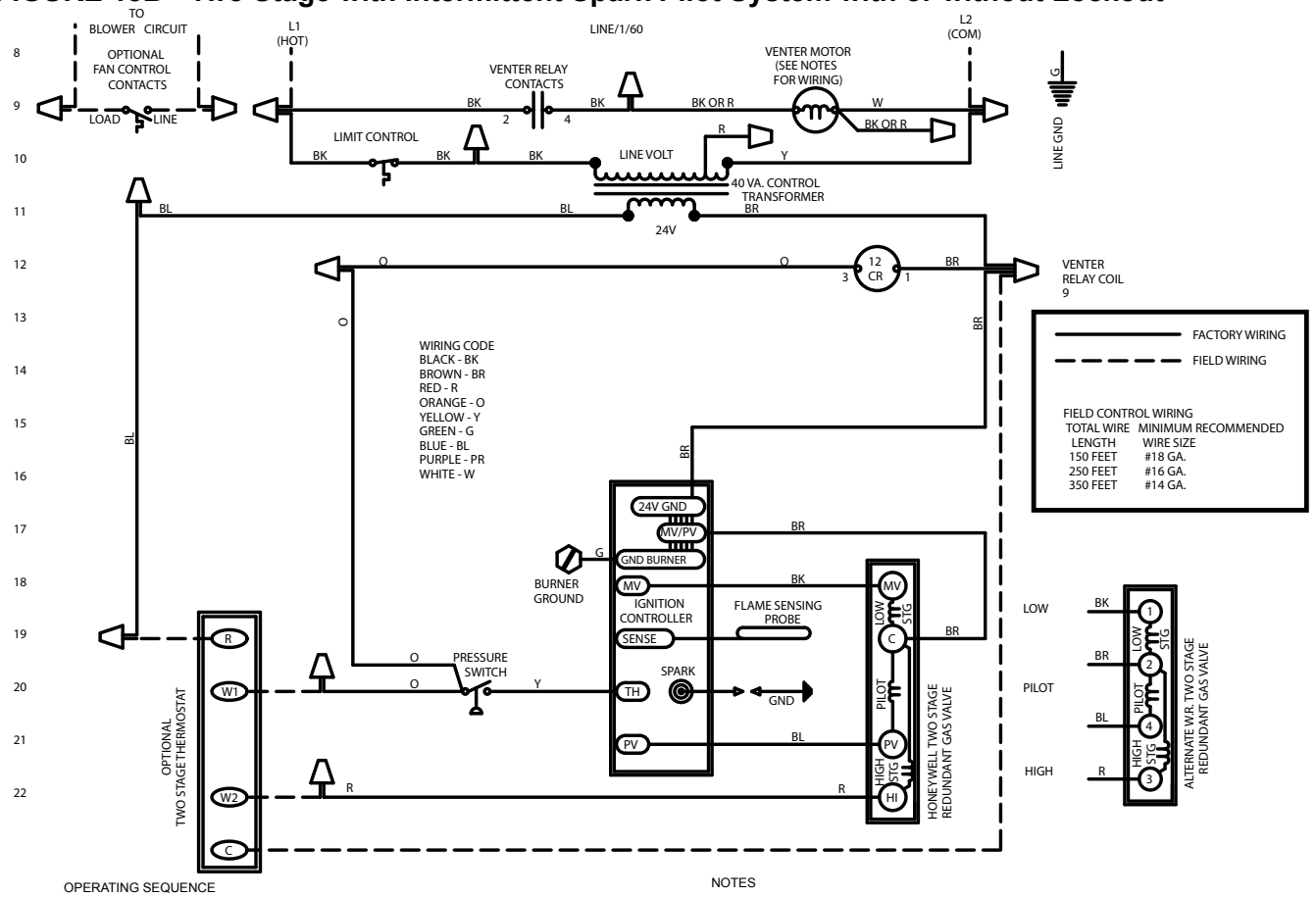
7.0 Electrical Supply and Wiring (cont'd)

7.3 Typical Wiring Diagrams (cont'd)

FIGURE 18B - Two Stage with Intermittent Spark Pilot System with or without Lockout



OPERATING SEQUENCE

- SET THERMOSTAT SWITCH AT "OFF" POSITION.
- TURN ON MAIN AND PILOT MANUAL GAS VALVES.
- TURN ON POWER TO UNIT.
- SET THERMOSTAT SWITCH AT "ON" POSITION.
- LOW STAGE OF THERMOSTAT CALLS FOR HEAT ENERGIZING THE VENTER MOTOR.
- PRESSURE SWITCH CLOSED ENERGIZING THE PILOT GAS VALVE AND SPARK GAP TO PRODUCE A PILOT FLAME ON EACH OPERATING CYCLE. THE SENSING PROBE PROVES THE PRESENCE OF THE PILOT FLAME AND ENERGIZES THE SAFETY SWITCH PORTION OF THE CONTROL. THE SWITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE LOW STAGE GAS VALVE.
- BLOWER MOTOR ENERGIZED FROM HEAT EXCHANGER TEMPERATURE.
- HIGH STAGE OF THERMOSTAT CALLS FOR HEAT ENERGIZING THE HIGH STAGE GAS VALVE, FIRING UNIT AT FULL RATE.
- IF THE FLAME IS EXTINGUISHED DURING MAIN BURNER OPERATION, THE SAFETY SWITCH CLOSES THE MAIN VALVE AND RECYCLES THE SPARK GAP.

  ON UNITS EQUIPPED WITH LOCKOUT CONTROL, IF PILOT IS NOT ESTABLISHED WITHIN 120 SEC. THE UNIT LOCKS OUT FOR ONE HOUR, UNLESS IT IS RESET BY INTERRUPTING POWER TO THE CONTROL CIRCUIT. (SEE LIGHTING INSTRUCTIONS)
- FAN CONTROL KEEPS THE BLOWER CIRCUIT ENERGIZED WHILE THE UNIT IS HOT.

NOTES

- DOTTED WIRING SUPPLIED AND INSTALLED BY OTHERS.
- CAUTION: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF A LEAST 105 DEGREES C., EXCEPT FOR SENSOR LEAD WIRE WHICH MUST BE 150 DEGREES C.
- LIMIT WIRE TO BE #18 GA. 200 C. SF-1 OF SEW-1.
- USE #14 GA. WIRE FOR LINE WIRING TO UNIT.
- LINE AND BLOWER MOTOR BRANCH CIRCUIT WIRE SIZES SHOULD BE OF A SIZE TO PREVENT VOLTAGE DROP BEYOND FIVE PERCENT OF SUPPLY LINE VOLTAGE.
- ON 208/230V. UNITS THE CONTROL TRANSFORMER HAS A DUAL VOLTAGE PRIMARY. FOR 208V. UNITS USE BLACK AND RED LEADS (CAP YELLOW). FOR 230V. UNITS USE BLACK AND YELLOW LEADS (CAP RED). ON 115V. UNITS THE CONTROL TRANSFORMER IS SINGLE VOLTAGE PRIMARY. USE BLACK AND YELLOW LEADS FOR 115V. SECONDARY SIDE OF TRANSFORMER (24V.) USE BLUE AND BROWN LEADS.
- ON 75-250 208V UNITS, THE VENTER MOTOR WIRES ARE BLACK AND WHITE (CAP RED) ON 75-250 230V UNITS, THE VENTER MOTOR WIRES ARE RED AND WHITE (CAP BLACK) ON 75-250 115V UNITS AND 300-400 UNITS ALL VOLTAGES, THE VENTER MOTOR WIRES ARE BLACK AND WHITE.

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7.4 Thermostat and Control Wiring

CAUTION: If applicable, make sure the thermostat has an adequate VA rating for the total requirements. Add coil rating of al relays and match thermostat rating. See Hazard Intensity Levels, page 2.

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 five feet (1.5M) above the floor on an inside wall, not in the path of warm or cold air currents, 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.

8.0 Controls

8.1 Combustion Air Proving Switch

Pressure Switch Table

Start-Up Cold
-1.0" w.c.
Equilibrium
-0.60" w.c.
Set Point "Off"
-0.48" w.c.
Set Point "On"
-0.65" w.c.

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 which closes when a decreasing pressure is sensed in the outlet duct of the flue gas collection box.

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

If a restriction or excessive flue length or turns cause the sensing pressure to 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. The Table lists the approximate water column negative pressure readings and switch setpoints for sea level operating conditions.

DANGER

Safe operation of this unit requires proper venting flow. NEVER bypass combustion air proving switch or attempt to operate the unit without the venter running and the proper flow in the vent system. Hazardous conditions could result. See Hazard Intensity Levels, page 2.

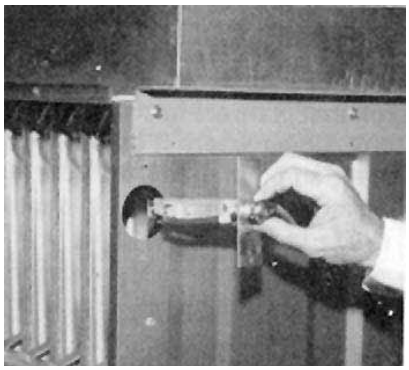
8.2 Limit Switch

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 (See Paragraph 6.3), or restriction due to filters and/or duct design. See **FIGURE 19** for mounting and service.

Depending on accessibility, the limit switch may be serviced from either the outside of the unit or from the inside through the access panel in the discharge duct. 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. (See Paragraphs 3.2.3 and 6.3.4.)

FIGURE 19 - Access to the limit switch depends on the installation.

View of limit switch from "inside" the furnace



Access to limit switch from "outside" the furnace

8.3 Fan Control (Optional, Field Installed)

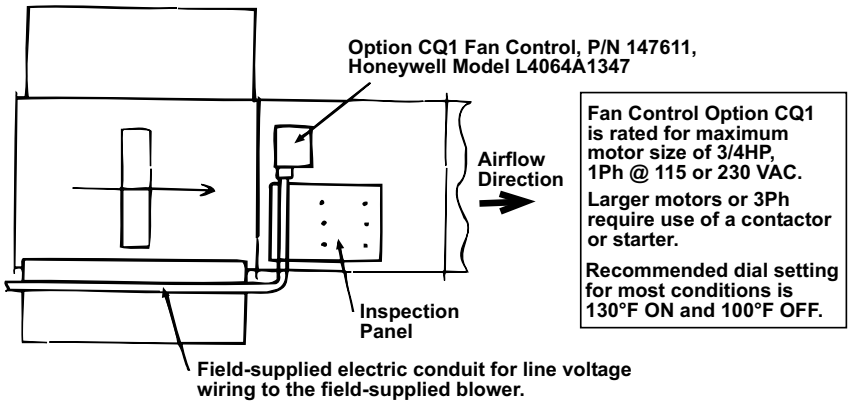
NOTE: Required with makeup air gas control options; see Paragraphs 8.4.3 and 8.4.4.

1. Fan control provides the following: a) Delay of fan operation preventing circulation of cold air, and b) Fan operation as long as the unit is hot.
2. 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.

FIGURE 20A - Installation of Optional Fan Control Kit, Option CQ1 (P/N 57960)

WARNING

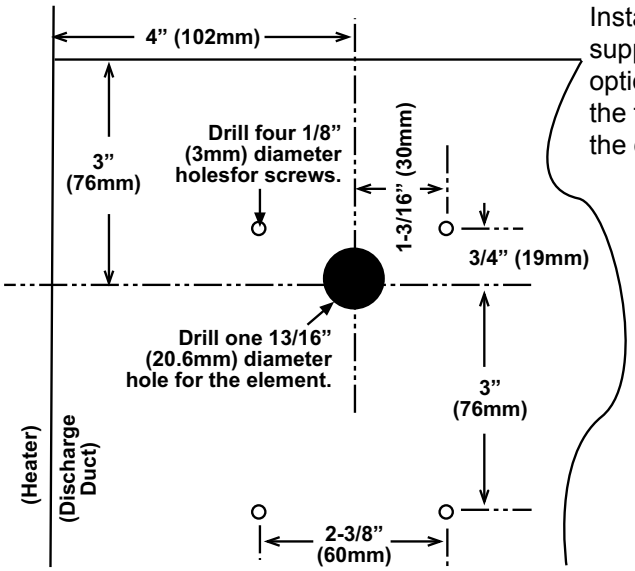
If you turn off the power supply, turn off the gas. See Hazard Intensity Levels, page 2.



8.0 Controls (cont'd)

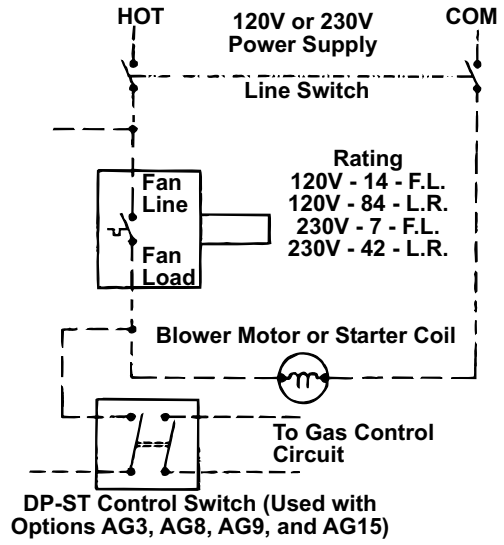
8.3 Fan Control (cont'd)

FIGURE 20B - Location of Fan Control Mounting Holes



Install the gasket supplied in the option kit between the fan control and the duct.

FIGURE 20C - Typical Fan Control Wiring (W.D. 145977)



3. To be sure that the fan can continue to operate, the power supply to the heater MUST NOT be interrupted except when servicing the heater.
4. If the customer wants the heater off at night, the gas valve circuit SHOULD BE OPENED by a single pole switch wired in series with the thermostat. Some thermostats are provided with this feature. Multiple units controlled from a single thermostat are shut off in the same manner. For proper operation, be sure fan control wiring is observed. See **FIGURES 20 A, B, & C** for installation and wiring.

8.4 Gas Controls

8.4.1 Gas Valve

All furnaces are equipped with a 24-volt combination valve which includes the automatic electric on-off valve controlled by the room thermostat, the pressure regulator, and the manual shutoff valve. The standard gas valve allows for single-stage control from a single-stage, 24-volt thermostat.

WARNING

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

8.4.2 Optional Two-Stage Operation - Heating Only

NOTE: Not available on Size 75 using propane.

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

8.4.3 Optional Two-Stage Operation - Makeup Air

NOTES: Makeup air option requires field installed fan control, see Paragraph 8.3. This option is not available on Size 75 using propane gas.

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, **FIGURES 21)**, or electrically connected to a remote electronic remote temperature selector (Option AG15, **FIGURE 22**).

FIGURE 21 - Ductstat and Parts, Option AG3

Ductstat, P/N 41700

FIGURE 22 - (A) Remote Temperature Selector and (B) Stage-Adder Module - Option AG15

Optional Ductstat with Capillary Tubing (Option AG3) - 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 (See **FIGURE 16A**). See **Paragraph 6.3.5** for instructions on re-locating 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 Ductstat with Electronic Remote Setpoint Module (Option AG15) - The remote modules in **FIGURE 22** and a required transformer are shipped separately for field installation. (Do not wire the remote module to the control transformer on the furnace.)

The sensor is shipped separately for installation in the discharge duct (See instructions in Paragraph 6.3.5).

Follow the wiring diagram 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 as illustrated in **FIGURE 22.** 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 cool position. To function properly, set switch to heat position.

8.4.4 Optional Electronic Modulation

NOTE: Requires field-installed fan control (Option CQ1). See Paragraph 8.3.

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

FIGURE 23A - Amplifier in Options AG7, AG8, and AG9

Electronic Modulation between 50% and 100% Firing Rate (Options AG7, AG8, AG9) - Depending on the heat requirements as established by the thermistor sensor, the burner modulates between 100% and 50% firing. The thermistor is a resistor that is temperature sensitive in that as the surrounding temperature changes, the Ohms resistance changes through the thermistor. This change is monitored by the solid state control center (amplifier) which furnishes varying DC current to the modulating valve to adjust the gas input. 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" w.c. 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 (See Paragraph 6.3.5.) and temperature selector (55-90°F) are identified as either Option AG8 or Option 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.

Refer to the wiring diagram supplied with the furnace for proper wiring connections.

FIGURE 23B - Signal Conditioner in Option AG21

Computer Controlled Electronic Modulation between 50% and 100% Firing Rate (Option AG21) - With this option the furnace is equipped with a Maxitrol signal conditioner which 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 to 20 volt DC current required to control the modulating valve.

The conditioner, the conditioner relay, the 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.

8.5 Pilot and Ignition Systems

A gas-fired intermittent pilot is standard. 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. (See Paragraph 10.2.2) Pilot is target type with lint-free feature. Pilot gas pressure should be the same as supply line pressure. (See Paragraph 6.1) If required, adjust the pilot flame length to approximately 1-1/4" with the pilot adjustment screw in the control valve body.

Intermittent Spark Ignition Safety Pilot Systems -- There are two types of intermittent spark pilots -- one type shuts off the pilot gas flow between the cycles and the other not only shuts off the pilot gas flow between cycles but also has a lockout device that stops the gas flow to the pilot if the pilot fails to light in 120 seconds. The lockout feature has a 1-hour retry or requires manual reset by interruption of the control circuit. Propane units require the spark ignition with lockout.

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

Ignition Controller -- 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. After ignition of the pilot gas, the ignition controller electronically senses the pilot flame. A low voltage DC electrical signal is imposed on the separate metal probe in the pilot assembly. The metal probe is electrically insulated from ground. The pilot flame acts as a conduction path to ground completing the DC circuit and proving pilot flame. With pilot flame proven, the ignition controller energizes the main gas valve.

FIGURE 24 - Ignition Controllers

Ignition Controller with Lockout, UTEC 1003-514, P/N 257010, for Option AH3 Gas Control

Recycling Ignition Controller, UTEC 1003-638A, P/N 257009, for Option AH2 Gas Control

NOTE: 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 no spark, check the following:

a) Voltage between Terminals TH and 7 should be at least 20 volts and no higher than 32 volts. Refer to troubleshooting (Paragraph 10.3) 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".

If the above conditions are normal and no spark occurs, replace the ignition controller (See **Service NOTE** on the left above).

8.6 Burner Carryover System and Air Adjustment

8.6.1 Burner Carryover

These duct furnaces have individually formed steel burners with accurately die-formed ports to give controlled flame stability without lifting or flashback with either natural or propane gas. The burners are lightweight and factory mounted in an assembly which 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. During regular service, check the main burner ports, the carryover assemblies, and the orifices for cleanliness.

8.6.2 Burner Air Adjustment

DANGER

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

Burner air shutters are not normally required on natural gas furnaces. Air shutters are supplied on propane gas units and may require adjustment.

Before making any adjustments to the air shutters, allow the heater to operate for about fifteen minutes with the air shutters open. The slotted screw on the end manifold bracket moves the air shutters and adjusts all burners simultaneously. Turning the screw clockwise opens the shutters; counterclockwise closes the shutters. After the furnace has been in operation for 15 minutes, close the air shutters observing the flame for yellow-tipping. Open the shutters until the yellow disappears. A limited amount of yellow-tipping is permissible for propane gas. Other fuels should not display any yellow-tipping.

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

9.0 Commissioning and Startup

9.1 Check the installation prior to startup:

- ☐ Check suspension. Unit must be secure and level.
- ☐ Be certain the electrical supply matches voltage rating of the furnace. (Refer to the rating plate.)
- ☐ Check all field wiring against the wiring diagram. Be sure wire gauges are as required for the electrical load. Verify that fuses or circuit breakers are in place and sized correctly.
- ☐ Check clearances from combustibles. Requirements are shown in Paragraph 4.2.
- ☐ If installed in a confined space, verify that the furnace has adequate combustion air supply. See Paragraph 2.2.
- ☐ Check vent system to be sure that it is installed according to the instructions in Paragraph 6.2.
- ☐ Check piping for leaks and proper gas line pressure. Bleed gas lines of trapped air. See Paragraph 6.1.
  - a) Turn manual shutoff valve to off position.
  - b) Turn gas supply on.
  - c) Observe gas meter for movement, or
  - d) Attach pressure gauge readable to .1" w.c. and after turning gas on for ten seconds, turn gas supply off. No change in pressure should occur over a three-minute period.
  - e) If either c) or d) above indicate a leak, locate leak by brushing a leak-detecting solution on all fittings. Bubbles will appear at a leak. Repair and repeat tests.

9.2 Startup:

- ☐ Turn electric and gas supply on to the furnace. Adjust the thermostat or ductstat so that a call for heat exists. Observe for complete sequencing of safety pilot and ignition.

Operating Sequence

1. Set thermostat at lowest setting
2. Turn on the power to the unit.
3. Turn on main and pilot manual gas valve.
4. Set thermostat at desired setting.
5. Thermostat calls for heat energizing the venter motor.
6. Pressure switch closes, energizing the pilot gas valve and spark gap to produce a pilot flame on each operating cycle. The sensing probe proves the presence of pilot flame and energizes the safety switch portion of the control. The switch action de-energizes the spark gap and energizes the main gas valve.
7. Fan control (Optional) senses heat exchanger temperature energizing the fan or blower motor of the air handler.
8. If the pilot flame is extinguished during main burner operation, the sensing probe detects the absence of the flame and causes the safety switch to close the main valve. On units with standard intermittent spark pilot systems, the spark gap recycles. On units with optional spark ignition with lockout, if the pilot is not established within the timing cycle (approximately 120 seconds), the unit locks out and must be reset by interrupting power to the control circuit.

9.3 Check installation after startup:

- ☐ With the unit in operation, measure manifold gas pressure. Manifold pressure for natural gas should be 3.5" w.c. and 10" w.c. for propane gas. See Paragraph 6.1.
- ☐ Turn the unit off and on, pausing two minutes between each cycle. Observe for smooth ignition. On two-stage or modulating burner systems, manipulate temperature adjustment slowly up and down to see if control is sequencing or modulating properly. 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" in height with blue coloring. Propane gas flame should be approximately the same length with blue coloring. Yellow tipping may appear on propane gas. If yellow extends beyond 1/2 to 3/4", adjust air shutters. See Paragraph 8.6.2 .
- ☐ Checked the limit control. With the heater on, completely block off distribution air. The limit control should open within a few minutes, shutting off the gas supply to the main burners.
- ☐ Place "Owner's Envelope" containing Limited Warranty Card, this booklet, and any optional information in an accessible location near the heater. Follow the instructions on the envelope.

9.0 Commissioning and Startup (cont'd)
9.3 Check installation after startup (cont'd)

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 which vents all flue products to the outside atmosphere. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH. Always comply with the combustion air requirements in the installation codes and in Paragraph 2.2. 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 Paragraph 2.2 of this heater installation manual. MAINTAIN THE VENT SYSTEM IN STRUCTURALLY SOUND AND PROPERLY OPERATING CONDITION.

10.0 Maintenance and Service

WARNING

If you turn off the power supply, turn off the gas. See Hazard Intensity Levels, page 2.

10.1 Maintenance Schedule

Maintenance Requirements - This unit will operate with a minimum of maintenance. However, to ensure long life and satisfactory performance, the following service schedule is recommended. When servicing, follow standard safety procedures and those specific instructions and warnings in this manual.

Furnaces should be inspected at the beginning of each heating season and then once every four (4) months where the equipment is working under normal conditions. If the furnace is located where an unusual amount of dust or soot or other impurities are contained in the air, more frequent inspection is recommended. Clean the heat exchanger (inside and outside) annually.

The following procedures should be carried out at least annually (See Paragraphs 10.2.1 - 10.2.4 for specific instructions.):

- ☐ Clean all dirt and grease from the primary and secondary combustion air openings.
- ☐ Check the gas valve to ensure that gas flow is being shutoff completely.
- ☐ Clean the heat exchanger both internally and externally.
- ☐ Check the pilot burner and main burners for scale, dust, or lint accumulation. Clean as needed.
- ☐ Check the vent system for soundness. Replace any parts that do not appear sound.
- ☐ Check the wiring for any damaged wire. Replace damaged wiring. (See Paragraph 7.0 for replacement wiring requirements.)

CAUTION: When cleaning, wearing eye protection is recommended.

NOTE: Use only factory-authorized replacement parts.

10.2 Maintenance Procedures

10.2.1 Operating Gas Valve

WARNING

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

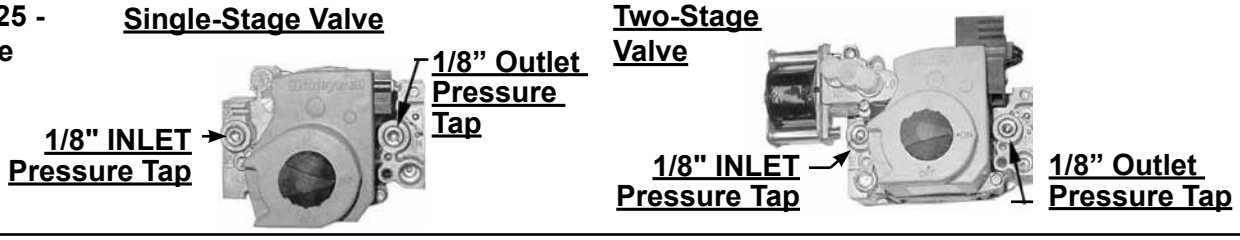
Remove external dirt accumulation and check wiring connections.

The combination gas valve must be checked annually to ensure that the valve is shutting off gas flow completely.

Instructions for Required Gas Valve Check:

1) Locate the 1/8” FPT **INLET** pressure tap on the combination valve (**FIGURE 25**).

FIGURE 25 - Gas Valve Shutoff Check



2) With the manual valve turned off to prevent flow to the gas valve, connect a manometer to the 1/8” inlet pressure tap in the valve. **NOTE:** A manometer (fluid-filled gauge) with an inches water column scale is recommended.

3) With the field-installed manual valve remaining closed, observe the manometer for two to three minutes for an indication of gas pressure. No pressure should be indicated on the manometer.

If the manometer indicates a gas pressure, the field-installed manual gas valve must be replaced or repaired before the combination gas valve can be checked.

4) If the manometer does not indicate gas pressure, slowly open the field-installed manual gas valve. After the manometer's indicated gas pressure has reached equilibrium, close the manual shutoff valve. Observe the gas pressure. There should be no loss of gas pressure on the manometer. If the manometer indicates a loss of pressure, replace the combination gas valve before placing the heater in operation.

NOTE: Operational pressure settings and instructions for checking pressure settings are in Paragraph 6.1.

10.2.2 Burner Rack and Pilot

Burner Rack Removal Instructions

1. Turn off the gas supply.
2. Turn off the electric supply.
3. Remove bottom rear panel (located on the manifold side of the furnace) by removing the two screws from each side.
4. Mark and disconnect electric valve leads.
6. Uncouple the union in the gas supply.
7. Remove two sheetmetal screws in the bottom of the burner rack assembly.
8. Pull "drawer-type" burner rack out of the furnace.

To disassemble the burner rack:

1. Remove flash carryover system (screws located at rear of burner drawer).
2. Remove burner hold down clamp (located inside burner drawer under the pilot).
3. Pull main burners horizontally away from injection opening and lift out.

Follow the instructions below to clean. To re-assemble and replace, reverse the above procedures being careful not to create any unsafe conditions.

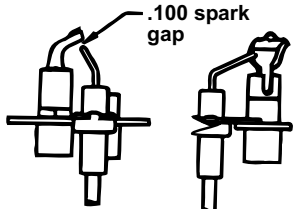


FIGURE 26 - Pilot Burner Spark Gap

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

Cleaning Pilot and Burners

Pilot - The pilot is located under the aeration panel on the control end of the burner tray and is accessible only after the burner rack assembly has been removed. In the event the pilot flame is short and/or yellow, check the pilot orifice for blockage caused by lint or dust accumulation. Remove the pilot orifice and clean with air pressure. DO NOT REAM THE ORIFICE. Check and clean the aeration slot in the pilot burner.

Clean the metal sensing probe and the pilot hood with an emery cloth and wipe off the ceramic insulator. Check the spark gap; spark gap should be maintained to .100". After the pilot is cleaned, blow any dirt away with compressed air. The combination valve includes a pilot adjustment screw. To adjust, remove cap screw and adjust the pilot flame to approximately 1-1/4".

Pilot System - 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.

10.0 Maintenance and Service (cont'd)

10.2 Maintenance Procedures (cont'd)

10.2.2 Burner Rack and Pilot (cont'd)

FIGURE 27A - Vertical Spark Pilot
When re-installing the pilot, be sure to include the pilot hole cover plate.

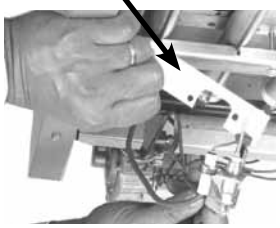
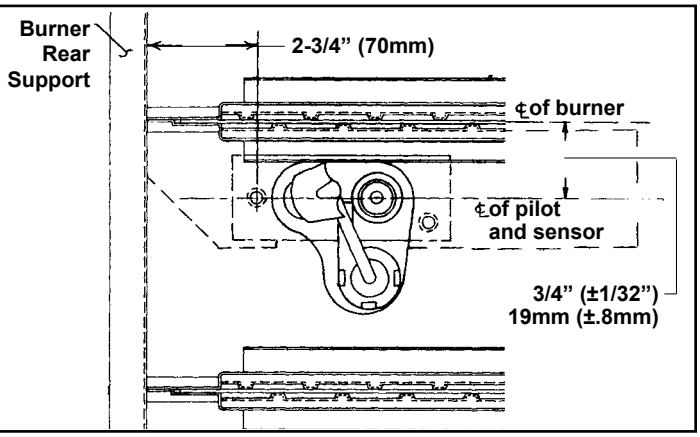


FIGURE 27B - Pilot Location



Burners - Normally it is unnecessary 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. Main burners may be cleaned using air pressure. Use an air nozzle to blow out scale and dust accumulation from the burner ports. Alternately blow through the burner ports and the venturi. Use a fine wire to dislodge any stubborn particles. Do not use anything that might change the port size.
Clean the burner rack flash carryover systems with air pressure.

Burner Orifices

Size	75	100	125	140	170	200	225	250	300	350	400
Qty	4	4	5	5	6	7	8	9	11	13	15
Burner Orifices for Sea Level Operation - Natural Gas											
Drill Size (**P/N**)	45 (**38678**)	41 (**11792**)		38 (**45870**)				39 (**45871**)			
Burner Orifices for Sea Level Operation - Propane											
Drill Size/ (**P/N**)	1.2mm (**63003**)	1.45mm (**61652**)		1.55mm (**61653**)					53 (**9789**)		

10.2.3 Cleaning the Heat Exchanger

Outer Surfaces (circulating air side) - To clean the outer surfaces of the heat exchanger, gain access by removing the inspection panels in the ductwork or remove the ductwork.
Remove the baffles between the heat exchanger tubes; see. **FIGURE 2B**, page 5. (**NOTE**: If the heater has been converted to high CFM (see **APPENDIX,** page 30, and Label on the unit), these baffles will have already been removed.) To remove the baffles, remove the screws marked "A" in **FIGURE 2B**, and slide each baffle forward. Use a brush and/or an air hose to remove accumulated dust and grease deposits from the heat exchanger tubes and the baffles. Re-install the baffles by sliding them into the slot in the other end of the heat exchanger and replacing the screws. Secure ductwork as necessary.
Inner Surfaces (combustion gas side) - The inner surfaces of the heat exchanger can be reached for cleaning with the burner rack removed (See Paragraph 10.2.2.) An air hose; a long (18 to 24-inch), 1/2" diameter stiff brush; a flashlight; and a mirror are needed. The required procedure depends on the size of the furnace and the date of manufacture. Follow these instructions to clean the inner surfaces of the heat exchanger.
All Sizes 75, 100 and 125 (do not have heat exchanger "V" baffles) and Sizes 140-400 manufactured prior to 11/95 (do not have heat exchanger "V" baffles)
-- Remove the burner rack assembly. Use a furnace brush (or a piece of heavy wire to which a piece of steel wool is attached). Brush up and down within the tubes until all soot is removed. With an air hose or brush, clean the outside space between the lower portions of the heat exchanger tubes to remove any accumulated dust or light deposits.
Sizes 140 - 400 manufactured beginning 11/95 (have heat exchanger "V" baffles)
-- Remove the burner rack assembly. Make sure that the flue pipe is supported. Remove the three screws that attach the venter housing to the outlet duct (pipe from furnace to venter). The venter assembly will remain in place. Remove the six screws used to attach the flue collection box to the top of the furnace. Remove the flue collection box exposing the heat exchanger tubes. The V-shaped tube baffles on the top of the heat exchanger can now be removed.

All Sizes -- After cleaning is complete, reverse the procedure to re-assemble the furnace. Use extreme care so that no unsafe conditions are created. **Check the furnace for proper operation.**

10.2.4 Venter

Motor - Remove dirt from the outer surface. The venter motor is permanently lubricated; no oiling is required.

Venter Relay - The venter relay controls the venter motor. If relay contacts fail to "make", the venter motor will not run. If relay contacts fail to "open, the venter motor will not shut off.

10.3 Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Venter motor will not start	**1.** No power to unit.	**1.** Turn on power, check supply fuses, or circuit breaker.
	2. No 24 volt power to venter relay.	**2.** Turn up thermostat; check control transformer output. Check for loose wire connections.
	3. Venter relay defective.	**3.** Replace relay.
	4. Defective motor or capacitor.	**4.** Replace motor or capacitor.
Pilot will not light (venter operating)	**1.** Manual valve not open.	**1.** Open manual valve.
	2. Air in gas line.	**2.** Bleed gas line.
	3. Dirt in pilot orifice.	**3.** Remove and clean with compressed air or solvent (do not ream).
	4. Gas pressure too high or too low.	**4.** Adjust supply pressure. (See Paragraph 6.1).
	5. Kinked pilot tubing.	**5.** Replace tubing.
	6. Pilot valve does not open.	**6.** If 24 volt available at valve, replace valve.
	7. No spark:	**7.**
	a) Loose wire connections	**a)** Be certain all wires connections are solid.
	b) Transformer failure.	**b)** Be certain 24 volts is available.
	c) Incorrect spark gap.	**c)** Maintain spark gap at .100".
	d) Spark cable shorted to ground.	**d)** Replace worn or grounded spark cable.
	e) Spark electrode shorted to ground.	**e)** Replace pilot if ceramic spark electrode is cracked or grounded.
	f) Drafts affecting pilot.	**f)** Make sure all panels are in place and tightly secured to prevent drafts at pilot.
	g) Ignition control not grounded.	**g)** Make certain ignition control is grounded to furnace chassis
	h) Faulty ignition controller.	**h)** If 24 volt 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.	**8.** Reset lockout by interrupting control at thermostat.
	9. Faulty combustion air proving switch.	**9.** Replace combustion air proving switch.
Pilot lights, main valve will not open	**1.** Manual valve not open.	**1.** Open manual valve.
	2. Main valve not operating.	**2.**
	a) Defective valve.	**a)** If 24 volt is measured at valve connections and valve remains closed, replace valve.
	b) Loose wire connections.	**b)** Check and tighten all wiring connections.
	3. Ignition control does not power main valve.	**3.**
	a) Loose wire connections.	**a)** Check and tighten all wiring connections.
	b) Flame sensor grounded. (Pilot lights - spark continues)	**b)** Be certain flame sensor lead is not grounded or insulation or ceramic is not cracked. Replace as required.
	c) Gas pressure incorrect.	**c)** Set supply pressure at 5" w.c. to 14" w.c. for natural gas and 11" w.c. to 14" w.c. for propane.
	d) Cracked ceramic at sensor.	**d)** Replace sensor.
	e) Faulty ignition controller.	**e)** If all checks indicate no other cause, replace ignition controller. Do not attempt to repair ignition controller; it has no field replaceable components.
No heat (Heater Operating)	**1.** Dirty Filters	**1.** Clean or replace filters.
	2. Incorrect manifold pressure or orifices.	**2.** Check manifold pressure (See Paragraph 6.1).
	3. Cycling on limit control.	**3.** Check air throughput (See Paragraph 6.3).
	4. Improper thermostat location or adjustment.	**4.** See thermostat manufacturer's instructions.
	5. Belt slipping on blower.	**5.** Adjust belt tension.
Cold air delivered On Start-up During Operation	**1.** Fan control improperly located or adjusted.	**1.** Relocate or adjust fan control (See Paragraph 8.3).
	2. Defective fan control.	**2.** Replace fan control.
	3. Blower set for too low temperature rise.	**3.** Slow down blower or increase static pressure.
	4. Incorrect manifold pressure.	**4.** Check manifold line pressure (See Paragraph 6.1).
Motor will not run	**1.** Circuit open.	**1.** Check wiring and connections.
	2. Fan control inoperative.	**2.** Replace fan control.
	3. Defective motor or capacitor.	**3.** Replace motor or capacitor.
Motor turns on and off while burner is operating (See "Motor... " below)	**1.** Fan control improperly located or adjusted.	**1.** Relocate or adjust fan control (See Paragraph 8.3).
	2. Defective fan control.	**2.** Replace fan control.
	3. Motor overload device cycling on and off.	**3.** Check motor load against motor rating plate. Replace motor if needed.
	4. 3 phase motor rotating in opposite direction.	**4.** Interchange 2 legs on supply connections.
Blower motor cuts out on overload	**1.** Improper motor pulley and/or adjustment.	**1.** See instructions on air throughput. (See Paragraph 6.3)
	2. Improper static pressure in the duct system.	**2.** Adjust duct system dampers.
	3. Low voltage.	**3.** Check power supply.

APPENDIX — Converting Model EEDU Duct Furnace for Lower Temperature Rise and Higher CFM Application

WARNING

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, explosion or production of carbon monoxide may result causing 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.

WARNING

The instructions in this sheet are designed to prepare duct furnace for increased air throughput conversion prior to installation. If your duct furnace is installed, for your safety, turn off the gas and the electric before servicing.

Description/Application

This duct furnace was factory assembled with the air throughput range listed on the rating plate. The conversion in these instructions will change the air throughput range as specified in the table below.

NOTE: If airflow is being reversed or other field-installed options apply, refer to the other information in Paragraph 3.2 before performing this conversion.

Model and Size	High Air Throughput (CFM)	
	MAXIMUM	MINIMUM
EEDU 75-6	2778	855
EEDU 100-6	3704	1140
EEDU 125-6	4630	1425
EEDU 140-6	5185	1595
EEDU 170-6	6296	1937
EEDU 200-6	7407	2279
EEDU 225-6	8333	2564
EEDU 250-6	9259	2849
EEDU 300-6	11111	3175
EEDU 350-6	12963	3704
EEDU 400-6	14815	4233

Verify the size on the heater rating plate. After confirming that this conversion is correct for the unit, follow the instructions below.

1. **Fill in the Field Conversion Label** - Remove the conversion label, **P/N 263310**, from the literature bag. Complete the information.

FIGURE 28 - Fill in the information on the Conversion Label

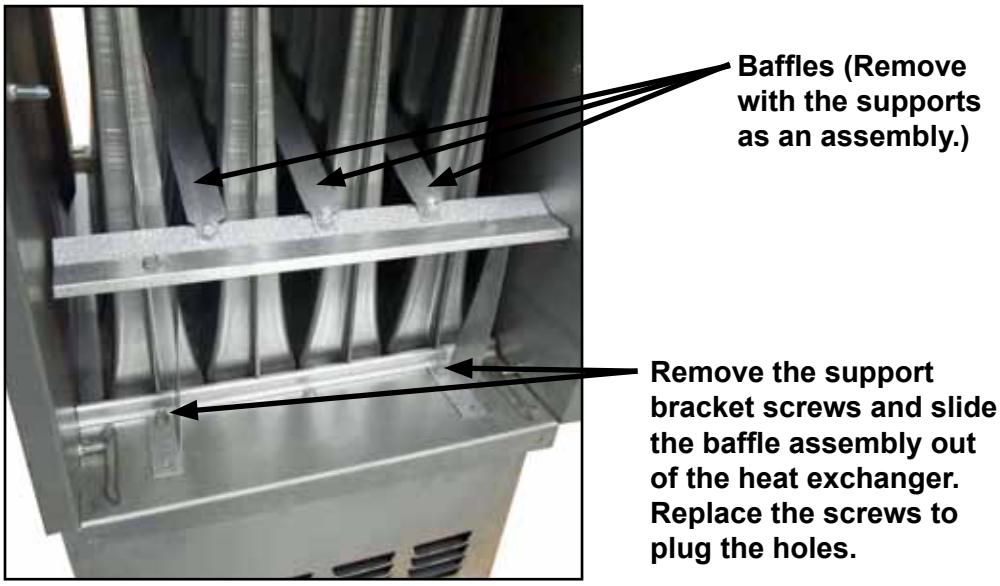
IMPORTANT

This appliance has been converted on
Cet appareil a été converti _____*(date)*_____
to _____ cfm maximum throughput
au _____ pi^3/min consommation maximum
to _____ cfm minimum throughput
au _____ pi^3/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

2. **Remove the Heat Exchanger Baffles** - Refer to **FIGURE 29** and identify the air baffles to be removed. Remove the screws from the support brackets and slide the entire baffle assembly out of the heat exchanger. Reinstall the screws to plug the holes.

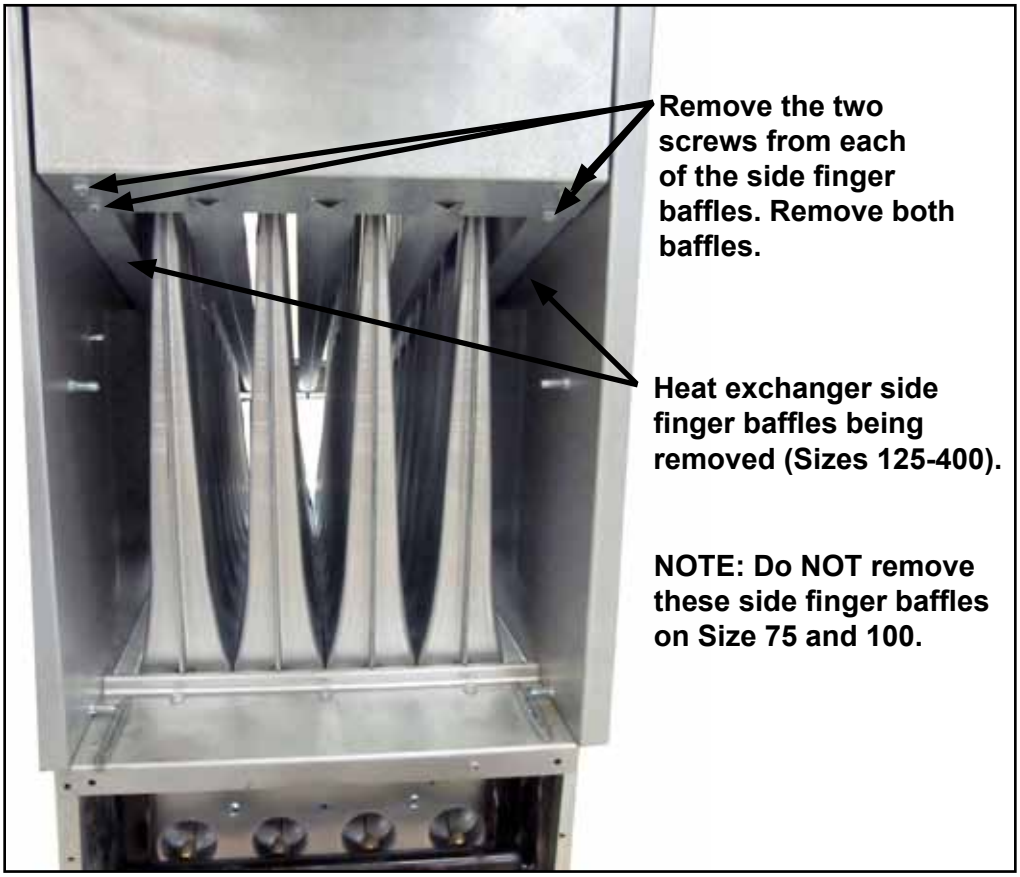
FIGURE 29 - Discharge Air End of the Heat Exchanger showing the Baffle Assembly to be Removed



Conversion is complete for Sizes 75-100; skip to Step 4.

3. **Sizes 125-400 only - Remove the Side Finger Baffles** – Refer to **FIGURE 30 showing the entering air side of the heat exchanger (baffles shown in FIGURE 29 have already been removed).** Identify the side finger baffles. Remove both side baffles; each baffle is attached with two screws.

FIGURE 30 - Entering Air End of the Heat Exchanger showing the Side Finger Baffles to be Removed



Conversion is complete for Sizes 125-400; continue to Step 4.

4. Select a location adjacent to the rating plate for the conversion label. Being sure the surface is clean and dry, adhere the conversion label that was completed in Step 1.

Test for proper operation. Be sure to comply with the air throughputs in the table on page 30.

INDEX

INSTALLATION RECORD - to be completed by the 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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