



REZTOR *Thomas & Betts*

Model Series X Indoor Duct Furnaces

INSTALLATION FORM RZ 422

APPLIES TO: Installation/Operation/Service

Table of Contents

	Paragraph No.	Page No.
Installation and Operation	1-27	1-16
Check Installation and Start-Up	28	17
Service/Maintenance/Troubleshooting	29-32	18-20

Index by Page Number

Air Flow Requirements	8	Dimensions	3	Mounting the Furnace	4
Blocked Vent Switch	12	Disconnect Switch	11	Pilot and Ignition Systems	16
Blower Connections	8	Duct Connections	7	Reversing Air Flow	3
Burner Air Adjustment	16	Optional Ductstat	14	SERVICE	18
Burner Rack Removal	18	ECO Control	11	Start-Up	17
Burners	16	Electrical Supply and Connections	11	Suspending the Furnace	4
Bypass Duct	9	Optional Electronic Modulation	15	Thermostat	11
Carryover System	16	Optional Fan Control	12	Troubleshooting	19
Check Installation and Start-Up	17	Gas Piping and Pressures	9	Optional Two-Stage Operation	14
CHLORINE	4	GENERAL	1	Uncratering	2
Cleaning Pilot and Main Burners	18	HAZARD INTENSITY LEVELS	1	Valve	14
Cleaning the Heat Exchanger	18	Installation Codes	2	Power Venting (Option CA)	6
Clearances	2	Limit Control	11	Venting Requirements	5
Combustion Air Requirements	4	MAINTENANCE	18	Warranty	2
Condensate Drain, Option CS1	6	Optional Mechanical Modulation	15	WIRING DIAGRAMS	12-14

References: Replacement Parts, Form RZ 705; Gas Conversion, Form RZ 703

FOR YOUR SAFETY

If you smell gas:

1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

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 Levels, below.

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

HAZARD INTENSITY LEVELS

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

GENERAL

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 to the duct furnace models listed below.

Model	Characteristics
X	Indoor, Gravity-Vented, Standard CFM, 80% Thermal Efficient
HX	Indoor, Gravity-Vented, High CFM, 80% Thermal Efficient

1. Installation Codes

The duct furnaces covered in this manual are design-certified by the Canadian Standards Association to ANSI Z83.8a and CAN/CGA 2.6 for use with either natural or propane gas. The type of gas for which the furnace is equipped and the correct firing rate are shown on the rating plate attached to the unit. 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 (latest edition). A Canadian installation must be in accordance with the CAN/CGA B149.1 and B149.2 Installation Code for Gas Burning Appliances and Equipment. 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.

Special Installations (Aircraft Hangars/Garages)

Installations in aircraft hangars should be in accordance with ANSI/NFPA No. 409 (latest edition), Standard for Aircraft Hangars; in public garages in accordance with ANSI/NFPA No. 88A (latest edition), Standard for Parking Structures; and for repair garages in accordance with ANSI/NFPA No. 88B (latest edition), Standard for Repair Garages. ANSI/NFPA-88 (latest edition) specifies overhead heaters must be installed at least eight feet above the floor. In Canada, installations in aircraft hangars should be in accordance with the requirements of the enforcing authorities, and in public garages in accordance with CAN/CGA B149 codes.

WARNING: These duct furnaces are not certified or approved for use in drying or process applications. If a duct furnace is to be used in a drying or process application, contact the factory for application guidelines and manufacturer's authorization. Without factory authorization, the warranty is void, and the manufacturer disclaims any responsibility for the duct furnace and/or the application.

WARNING: To ensure safety, follow lighting instructions located on outlet box cover. See Hazard Levels, Page 1.

2. Warranty

Refer to limited warranty information on the warranty card in the "Owner's Envelope".

WARRANTY: 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 on furnaces equipped with optional spark pilot.
- 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 4 and 7.)
- d. Furnace air throughput is not adjusted within the range specified on the rating plate.
- e. Duct furnace is installed in a process or drying application without factory authorization. (Any use in a process or drying application voids CSA certification.)

3. Uncrating and Preparation

This furnace was test operated and inspected at the factory prior to crating and was in operating condition. If the furnace has incurred any damage in shipment, document the damage with the transporting agency and immediately contact your Reznor distributor.

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 listed below, be sure these parts are available at the job site.

Heating - Gas Control Option	Option AG7 Thermostat, P/N 48033
Makeup Air - Gas Control Options	Option AG3, AG6, AG8 Control Switch, P/N 29054
	Option AG9 Remote Temperature Selector, P/N 48042 Control Switch, P/N 29054
	Option AG15 Remote Temperature Selector, P/N 115848 Stage Adder Module, P/N 115849 Control Switch, P/N 29054
	Option AG16 Remote Temperature Selector, P/N 115848 Stage Adder Module, P/N 115849 Remote Display Module, P/N 115852 Control Switch, P/N 29054

Other shipped-separate options could include a power venter, a gas shutoff valve, a condensate drain fitting, a thermostat, a different control switch, or a disconnect switch.

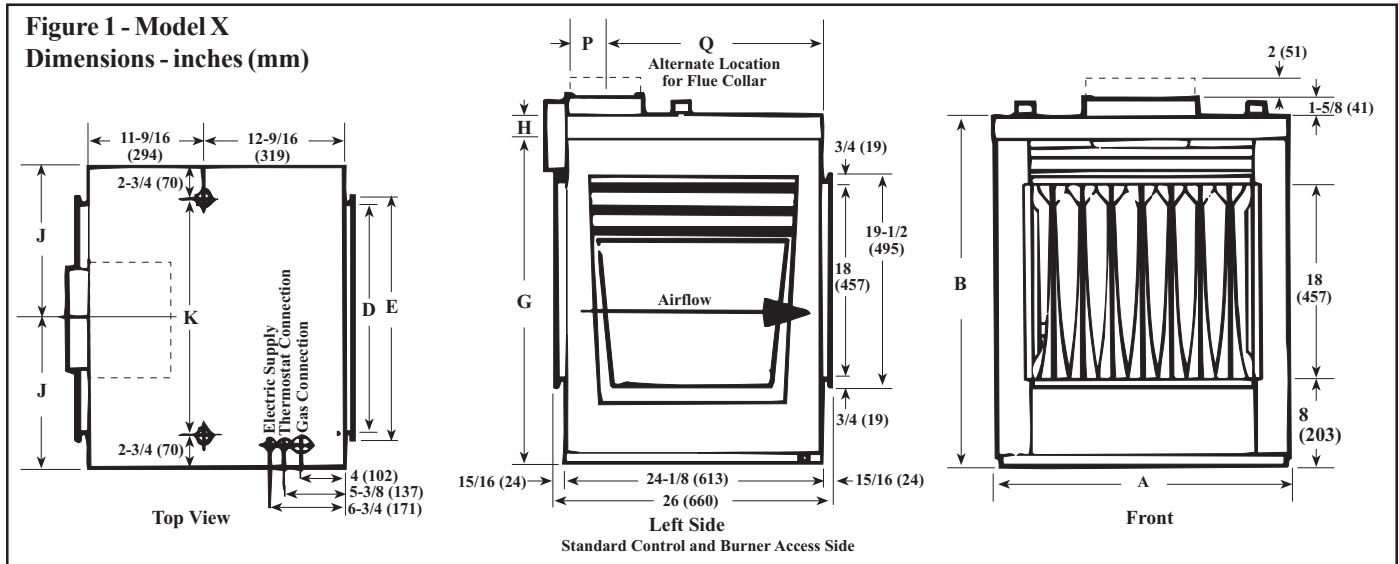
4. Clearances

Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. Clearance is also required to sides of furnace for combustion air space and for convenient installation and burner control service.

Required Clearances				
Top	Sides		Bottom	
	Control	Opposite	To Combustibles	To Non-Combustibles
6" (152mm)	See Note	6" (152mm)	3" (76mm)	0

NOTE: To have sufficient space to remove the drawer-type burner rack, the clearance on the control side of the furnace must be the width of the furnace plus 6" (152mm).

5. Dimensions



Dimensions (inches)

Size	A	B	D	E	G	H	J	K	P	Q	Flue
75	19-1/4	32-1/4	12-1/2	14	30-1/4	2	9-5/8	13-3/4	3-1/2	20-3/4	5" Round
100	19-1/4	32-1/4	12-1/2	14	30-1/4	2	9-5/8	13-3/4	3-1/2	20-3/4	6" Round
125	22	32-1/4	15-1/4	16-3/4	30-1/4	2	11	16-1/2	3-1/2	20-3/4	7" Oval
150, 175	27-1/2	32-1/4	20-3/4	22-1/4	30-1/4	2	13-3/4	22	3-1/2	20-3/4	8" Oval
200, 225	33	35-1/4	26-1/4	27-3/4	31-3/4	3-1/2	16-1/2	27-1/2	5	19-1/4	8" Round
250, 300	41-1/4	35-1/4	34-1/2	36	31-3/4	3-1/2	20-5/8	35-3/4	5	19-1/4	10" Oval
350	46-3/4	35-1/4	40	41-1/2	31-3/4	3-1/2	23-5/8	41-1/4	5	19-1/4	12" Oval
400	52-1/4	35-1/4	45-1/2	47	31-3/4	3-1/2	26-1/8	46-3/4	5	19-1/4	12" Oval

Dimensions (mm)

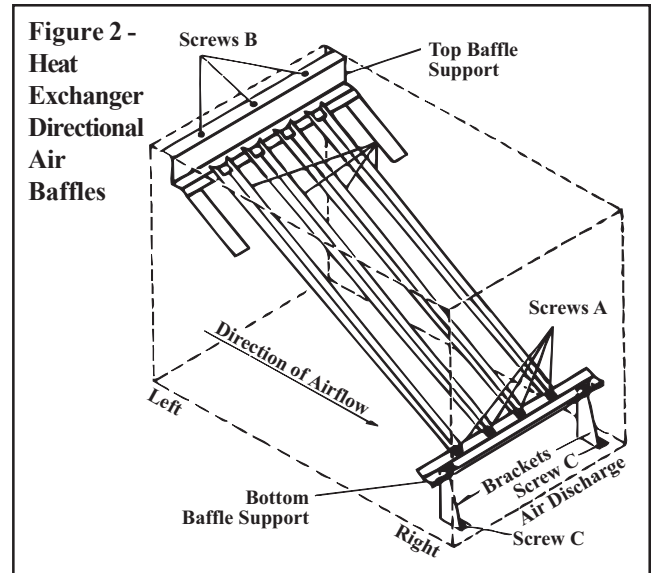
Size	A	B	D	E	G	H	J	K	P	Q	Flue
75	489	819	318	356	768	51	244	349	89	527	127 Round
100	489	819	318	356	768	51	244	349	89	527	152 Round
125	559	819	387	425	768	51	279	419	89	527	178 Oval
150, 175	699	819	527	565	768	51	349	559	89	527	203 Oval
200, 225	838	895	667	705	806	89	419	699	127	489	203 Round
250, 300	1048	895	876	914	806	89	524	908	127	489	254 Oval
350	1188	895	1016	1054	806	89	600	1048	127	489	305 Oval
400	1327	895	1156	1194	806	89	664	1187	127	489	305 Oval

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

Duct furnaces (for high CFM units, see note below) are equipped with directional air baffles between the heater exchanger tubes. Facing the control compartment of the furnace, the standard direction of airflow is from left to right. Installations requiring direction of airflow from right to left when facing the control compartment will require repositioning of the directional air baffles at the installation site. Change the position of baffles as follows (See Figure 2):

- 1) Remove Screws "A".
- 2) Lift each baffle slightly and slide forward removing each individual baffle completely from the heat exchanger.
- 3) Remove the top baffle support. Re-use screws "B" and install the top baffle support on the opposite end of the heat exchanger.
- 4) Re-install the bottom baffle support and brackets on the opposite end of the heat exchanger.
- 5) Reverse Steps 1 and 2 - re-installing all of the baffles.

NOTE: Models factory-built for high CFM capability contain only the top baffle support shown in Figure 2. To reverse air flow, move the top baffle support. The top baffle support **must** always be on the entering air side of the unit.



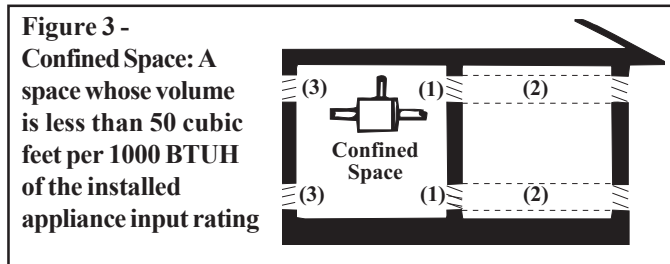
7. Combustion Air Requirements

These duct furnaces are 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 through wall openings or ducts.

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.

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 3, 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 3.
- 2. Air from outside through duct** -- openings 1 square inch free area per 2000 BTUH. See (2) in Figure 3.
- 3. Air direct from outside** -- openings 1 square inch free area per 4000 BTUH. See (3) in Figure 3.

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

WARNING: These furnaces are designed to take combustion air from the space in which the unit is installed and are not designed for connection to outside combustion air intake ducts. Connecting outside air ducts voids the warranty and could cause hazardous operation. See Hazard Levels, Page 1.

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.

8. Suspending or Mounting the Furnace

Location

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.

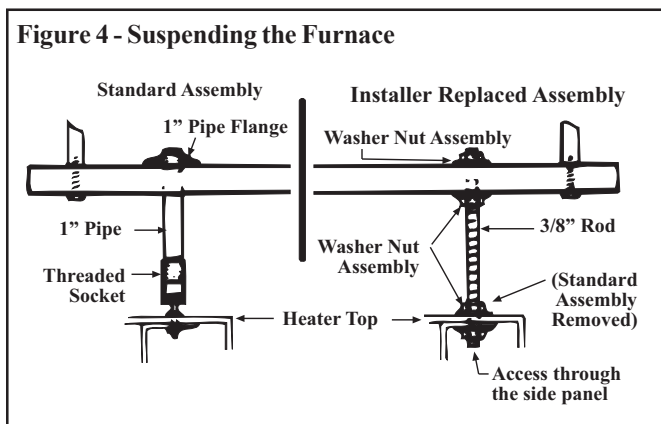
Net Weight		75	100	125	150	175	200	225	250	300	350	400
lbs		150	150	163	182	186	224	231	276	286	320	355
kg		68	68	74	83	84	102	105	125	130	145	161

WARNING: Avoid installing a furnace in extremely drafty areas. Extreme drafts can shorten the life of the heat exchanger and/or cause safety problems.

Suspending the Furnace

These duct furnaces have two-point suspension. See hanger centerline dimensions in Paragraph 5, page 3.

At each suspension point, the furnace is factory-equipped with a free-turning, female, 1" (NPT), pipe hanger. Suspend by connecting the pipe hanger to a 1" threaded pipe. See Figure 4 (left side). As an alternative method, the factory-installed pipe hanger may be removed and the heater suspended as illustrated on the right in Figure 4.



Mounting the Furnace

A minimum of 3" (76mm) clearance is required from the bottom of the unit to a combustible surface. See Figure 5 for illustration of available support feet (P/N 10680 - 4 required) or Figure 6 for an illustration of field-fabricated supports.

Figure 5 - Support Feet, P/N 10680 (4 required)

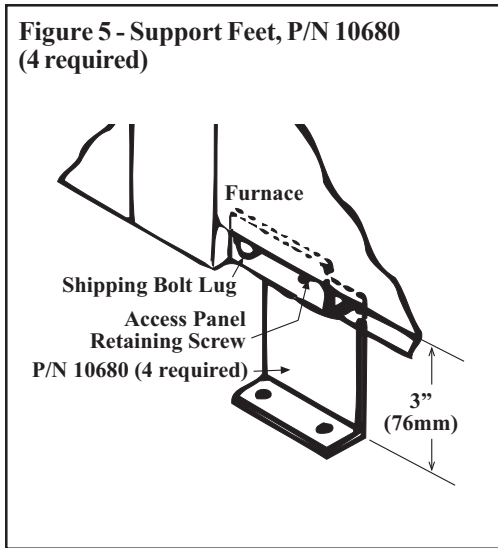
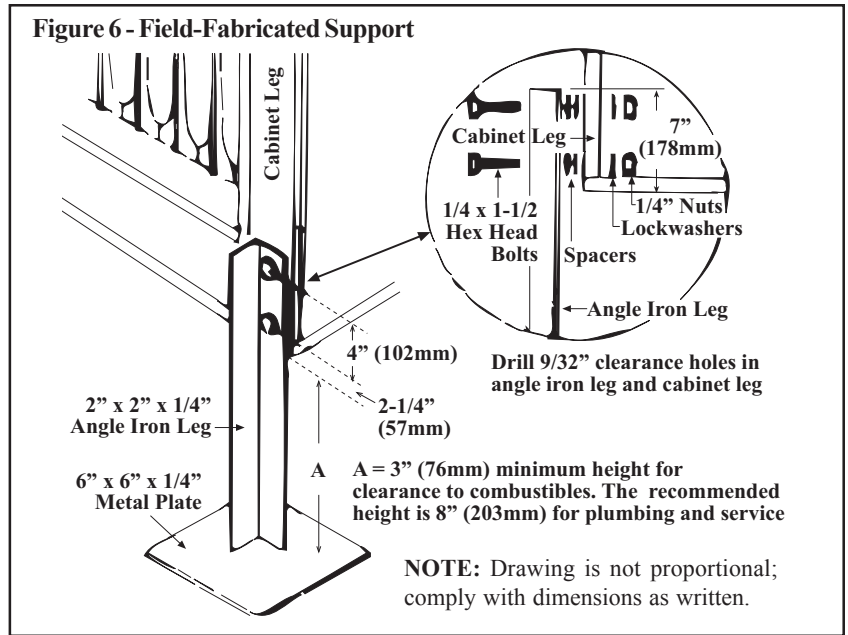


Figure 6 - Field-Fabricated Support

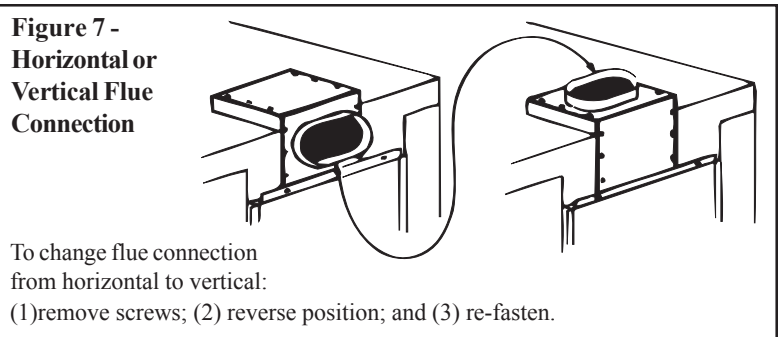


9. Venting

Furnaces have the following vent outlet sizes:

Model Size	Size and Configuration of Horizontal/Vertical Vent Outlet
75	5" Round
100	6" Round
125	7" Oval
150, 175	8" Oval
200, 225	8" Round
250, 300	10" Oval
350, 400	12" Oval

Figure 7 - Horizontal or Vertical Flue Connection



DANGER: Failure to provide proper venting could result in death, serious injury, and/or property damage. This furnace must be installed with a vent connection and proper vent to the outside of the building. Install vent in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1 (latest edition) or applicable provision of national, state or local codes. A Canadian installation must be in accordance with the CAN/CGA B149.1 and B149.2, Installation Code for Gas Burning Appliances and Equipment, and applicable local codes. Also, follow venting recommendations listed below.

Safe operation of any gravity-vented gas-fired equipment requires a properly operating vent system, correct provision for the combustion air (See Paragraph 7) and regular maintenance and inspection (See page 18). See Hazard Levels, Page 1.

Venting Requirements

1. Provide a minimum clearance of 18" between the drafthood relief opening and any obstruction. Do not expose the relief opening to wind drafts from any source such as from an overhead door or adjacent air handling equipment.
2. The unit is equipped with a built-in draft diverter, consequently an external draft diverter **MUST NOT** be installed in the vent connector or any internal alterations made. Do not install a manual damper or other fixed restriction in the vent connector.
3. Vent pipe should be a minimum of 24 gauge galvanized steel or other non-corrosive material. Double wall, Type B vent such as Metalbestos or Amerivent is recommended. (NOTE: Double-wall pipe is not available in 9" diameter.) Where it is necessary to run the vent pipe through an exterior wall of combustible materials, a suitable thimble must be used. The vent pipe shall have a clearance of at least six inches (152mm) from combustible materials, or as is specified by the double-wall vent pipe manufacturer.
4. With the outlet on the heater in the horizontal position, it is recommended that a 12-18" (305-457mm) piece of straight pipe be connected to the flue collar before installing an elbow. The horizontal vent pipe run should have a uniform rise of at least 1/4" per foot of horizontal run in the direction of discharge. The length of the lateral run must not exceed lengths shown in the vent tables of the National Fuel Gas Code or the Canadian Installation Code for Gas Burning Appliances (See Tables 1 and 2, page 6).
5. Lateral runs should be supported every six feet using a non-combustible material, such as strap steel or chain. Do not rely on the drafthood or heater for support of either horizontal or vertical vent pipe.

9. Venting (cont'd)

Venting Requirements (cont'd)

Vertical Height of Vent	Vent Diameter											
	5"		6"		7"		8"		10"		12"	
	ft	M	ft	M	ft	M	ft	M	ft	M	ft	M
6' (1.8M)	6	1.8	6	1.8	6	1.8	6	1.8	6	1.8	6	1.8
8' (2.4M)	8	2.4	8	2.4	16	4.9	16	4.9	16	4.9	16	4.9
10' (3.0M)	10	3	16	4.9	20	6.1	20	6.1	20	6.1	20	6.1
15' (4.6M)	16	4.9	16	4.9	30	9.1	30	9.1	30	9.1	30	9.1
20' (6.1M)	20	6.1	30	9.1	30	9.1	30	9.1	30	9.1	30	9.1
30' (9.1M)	20	6.1	40	12.2	40	12.2	40	12.2	40	12.2	40	12.2

Vertical Height of Vent	Vent Diameter													
	5"		6"		7"		8"		9"		10"		12"	
	ft	M	ft	M	ft	M	ft	M	ft	M	ft	M	ft	M
6' (1.8M)	2	.6M)	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6
8' (2.4M)	5	7.6M)	5	7.6	10	3	10	3	10	3	10	3	10	3
10' (3.0M)	5	7.6M)	10	3	15	4.6	15	4.6	15	4.6	15	4.6	15	4.6
15' (4.6M)	5	7.6M)	10	3	15	4.6	20	6.1	20	6.1	20	6.1	20	6.1
20' (6.1M)	-		10	3	15	4.6	20	6.1	20	6.1	20	6.1	20	6.1

- Vent connectors serving Category I heaters shall not be connected into any portion of a mechanical draft system operating under positive pressure.
- Where it is necessary to use a long run of vent pipe, or where the vent pipe is exposed to cold air, condensation within the pipe may occur. There are two ways to overcome or eliminate this problem.
 - Prevent condensation by insulating the pipe so that the temperature of the flue products never drops below 250°F.
 - Use double-wall, Type B vent pipe which is recommended for the reduction or elimination of condensate problems. Where extreme conditions are present and condensate is anticipated, install a trap for collecting condensate.
- The vent connection may be made into a suitable permanent chimney or into a gas vent. The effective area of the vent connector, gas vent or chimney when connected to a single appliance shall not be less than the area of the appliance drafthood outlet or in accordance with approved venting methods. The effective area of the gas vent or chimney when connected to more than one appliance shall not be less than the area of the largest vent connector plus 50% of the areas of additional vent connectors or in accordance with approved venting methods.

Minimum permissible height of the vertical vent is five feet providing no horizontal vent pipe connector is used. If a horizontal vent connector is necessary, consult Tables 1 and 2 above or the National Fuel Gas Code or the Canadian Installation Code for Gas Burning Appliances, for the maximum permissible length of a horizontal pipe run (vent connector) for a given vertical height of gas vent.

The gas vent or chimney should extend at least three feet (1M) above the highest point where it passes through a roof of a building and at least two feet (.6M) higher than any portion of a building or obstruction within a horizontal distance of ten feet (3M). Install a suitable weather cap on the end of the vent pipe to prevent rain or snow from entering the open end.

- If the heater is installed in a space served by a large exhaust fan, be sure that the exhaust fan does not affect the operation of the heater or the satisfactory venting of its products of combustion.

If a negative pressure exists, as evidenced by a downdraft, a factory-designed mechanical motor drive venter (Option CA) should be installed. In severe negative pressure conditions, makeup air equipment may be necessary.

Optional Power Venting (Option CA)

To install a gravity-vented furnace in an area where horizontal venting is required or where negative building pressure inhibits gravity venting, include an optional power venter in the application. Use only a power venter provided by the furnace manufacturer and carefully follow the instructions included in the optional venter package. Use the venter adapter provided to connect the power venter to the heater. **DO NOT INSTALL THE POWER VENTER WITHOUT THE VENTER ADAPTER.**

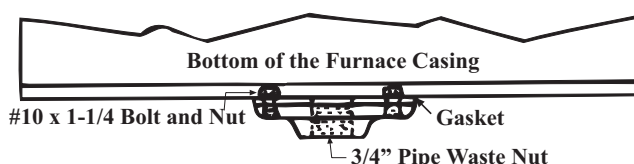
With an Option CA power venter installed, the furnace may be vented either horizontally or vertically. Do not exceed the maximum vent lengths shown in Table 3.

Vent Pipe Diameter	TABLE 3 - Maximum Vent Length (ft or M) for Furnace with Optional Power Venter								
		75 - 150	175	200	225	250	300	350	400
4"	ft	100	75	50	35	30	15		
	M	30	23	15	11	9	4.6		
6"	ft					100	100	100	92
	M					30	30	30	

10. Condensate Drain, Option CS1

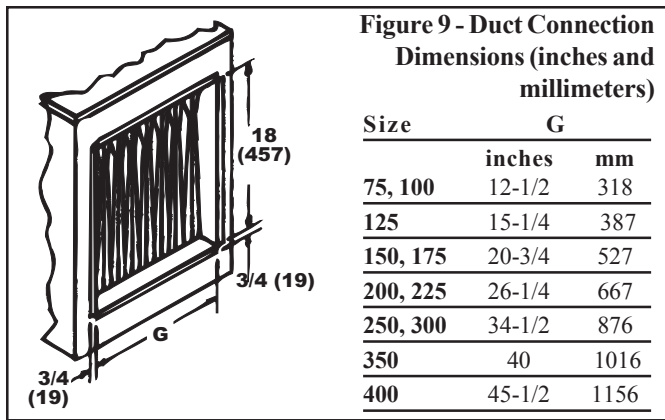
Condensate can form in the heat exchanger of furnaces installed as makeup air units or when installed downstream from a cooling coil. Under these conditions, a drain flange, Option CS1, may be installed on the furnace bottom as shown in Figure 8. When using Option CS1, seal all corners and the four square holes in the bottom pan edge.

Figure 8 - Condensate Drain, Option CS1 (P/N 31765)



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

11. Duct Connections



NOTE: A minimum horizontal duct length of 18 (457mm) inches is required at the furnace discharge before any vertical rise is made in front of the drafhood relief opening. This is required to prevent interference with the built-in drafhood.

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, steelbar joist, steel truss, pre-cast concrete) and the ceiling (whether hung, flush, etc.).
- **Ductwork Material** - Rectangular duct should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B & S gauge aluminum.
- **Ductwork Structure** - All duct sections 24 inches or wider, and over 48 inches 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 building 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, 1228 17th Street N.W., Washington, D.C. 20036. 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 10.
- **Horizontal Discharge Duct Length** - A minimum horizontal duct run of 18" (457mm) is **required** before turns or branches are made in the duct system to prevent interference with the built-in drafhood..
- **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 10 and 11.

- **Return Air Duct/Furnace Connection** - All return air ducts should be attached and sealed to return air flanges to provide airtight connection.
- **Return Air Duct/Grill Size** - Make certain that return air ducting or grills have a free area equal to the return duct size connection.

CAUTION: Joints where ducts attach to furnace must be sealed securely to prevent air leakage into drafhood or burner rack area. Leakage can cause poor combustion, pilot problems, shorten heat exchanger life and cause poor performance. See Hazard levels, Page 1.

Figure 10 - Connecting Supply Air Duct to the Furnace

(1) Flanges on the furnace (heat exchanger) turn out as shown. (2) Shape duct connection as shown -- "U" on top and bottom; "L" on sides. (3) Slide "U" channels over furnace top and bottom flanges making connection. (4) Form "U" channels to seal sides. **Drill and lock with sheetmetal screws.**

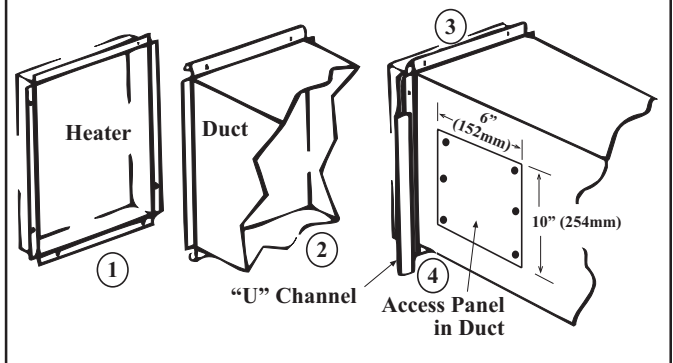
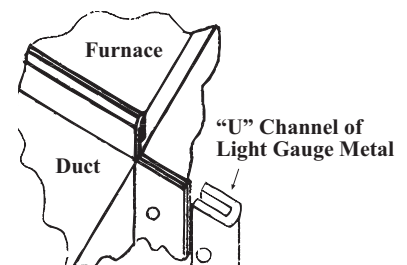


Figure 11 - Install "U" Channel on Sides of Duct Connection



12. Duct Furnace Air Flow Requirements

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 used in elbows or turns in the air inlet to ensure proper air distribution (See Paragraph 13). If it is determined that the blower CFM is greater than allowed or desirable, see Paragraph 14 for instructions on determining the correct size of bypass duct required. 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 following charts (on page 8) show the approved temperature rise range with the required CFM and the internal pressure drop for each size of unit.

Pressure Drop Table for 80% Thermal Efficient Duct Furnace with Standard CFM Capability

Size	75		100		125		150		175		200		225		250		300		350		400	
Temp 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.
50°F	1105	0.23	1475	0.43	1840	0.50	2210	0.38	2580	0.52	2945	0.42	3315	0.53	3685	0.40	4420	0.58	5160	0.65	5895	0.67
60°F	920	0.15	1225	0.29	1535	0.33	1840	0.26	2150	0.35	2455	0.28	2765	0.36	3070	0.28	3685	0.39	4300	0.44	4915	0.45
70°F	790	0.10	1050	0.21	1315	0.25	1580	0.19	1840	0.26	2105	0.22	2370	0.27	2630	0.23	3160	0.29	3685	0.31	4210	0.32
80°F	690	0.06	920	0.15	1150	0.21	1380	0.15	1610	0.19	1840	0.17	2070	0.22	2300	0.22	2765	0.25	3225	0.25	3685	0.25
90°F	610	0.04	815	0.11	1020	0.18	1225	0.12	1430	0.16	1635	0.14	1840	0.17	2045	0.21	2455	0.22	2865	0.23	3275	0.19

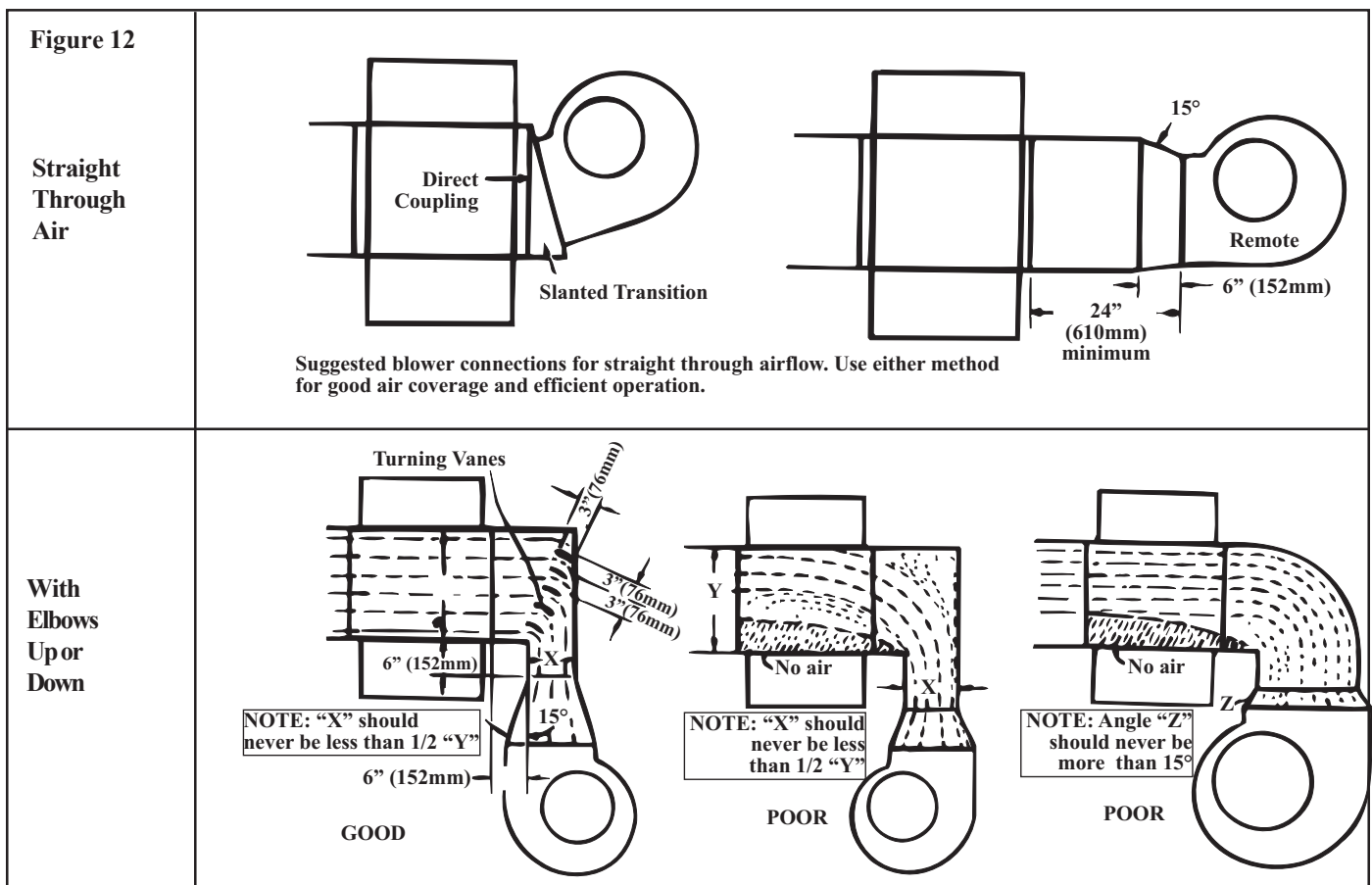
Pressure Drop Table for 80% Thermal Efficient Duct Furnace with Higher CFM Capability (Model Prefix "H")

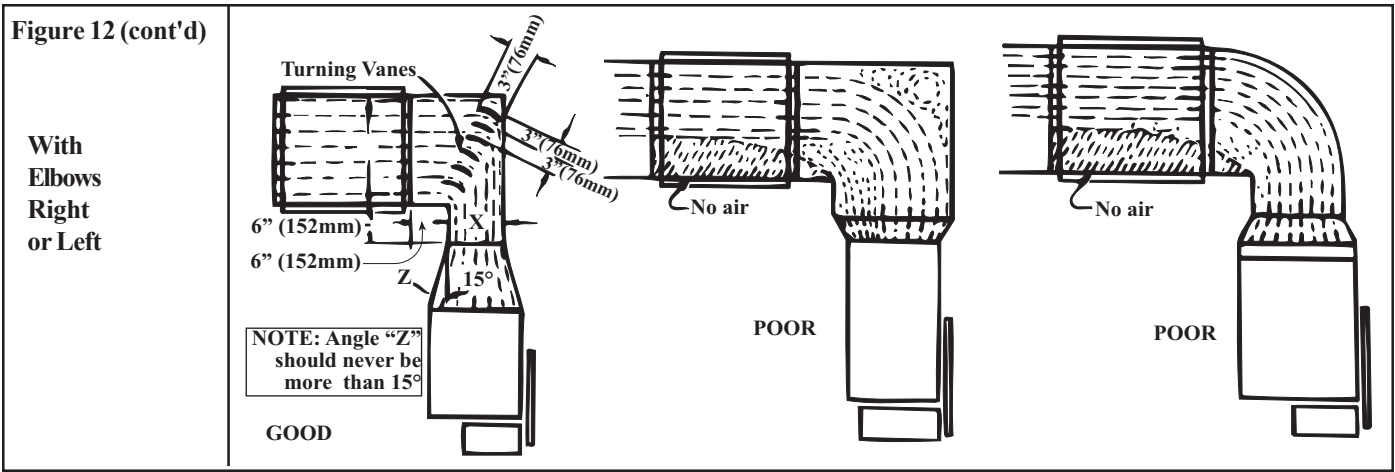
Size	75		100		125		150		175		200		225		250		300		350		400	
Temp Rise	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.	CFM	P.D.
20°F	2765	0.62	3685	1.08	4605	1.16	5530	0.85	6450	1.19	7370	1.00	8295	1.28	9215	0.90	11060	1.26	12900	1.23	14745	1.23
30°F	1840	0.28	2455	0.50	3070	0.53	3685	0.39	4300	0.54	4915	0.45	5530	0.58	6140	0.41	7370	0.57	8600	0.56	9830	0.56
40°F	1380	0.16	1840	0.28	2300	0.28	2765	0.21	3225	0.29	3685	0.25	4145	0.31	4605	0.22	5530	0.32	6450	0.31	7370	0.31
50°F	1105	0.12	1475	0.16	1840	0.21	2210	0.15	2580	0.18	2945	0.16	3315	0.21	3685	0.15	4420	0.21	5160	0.19	5895	0.19
60°F	920	0.10	1225	0.14	1535	0.15	1840	0.12	2150	0.15	2455	0.12	2765	0.15	3070	0.11	3685	0.15	4300	0.14	4915	0.15
75°F	735	0.10	980	0.12	1225	0.12	1475	0.11	1720	0.12	1965	0.11	2210	0.12	2455	0.08	2945	0.11	3440	0.11	3930	0.11

13. Duct Furnace Blower Connections

Requirements: 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.

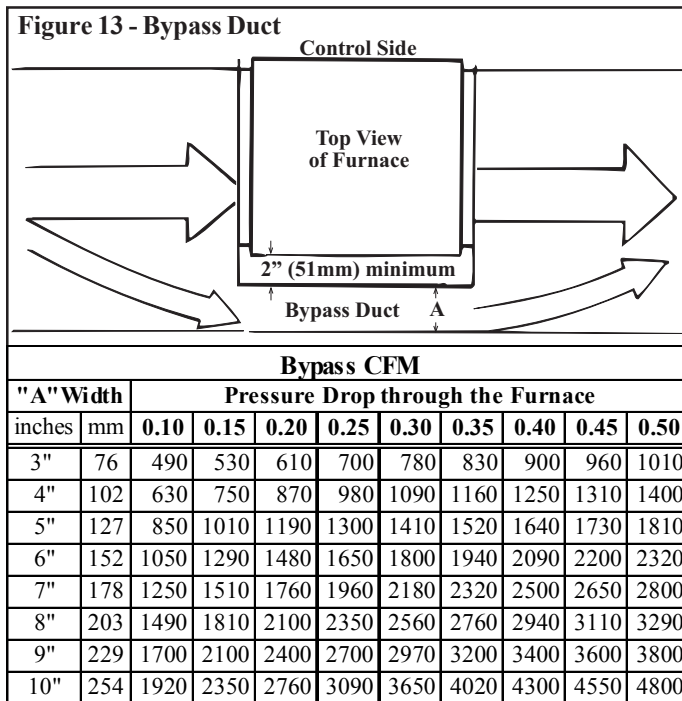
WARNING: The furnace must be installed on the positive pressure side of the air-circulating blower. See Hazard Levels, Page 1.





14. 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.



Directions for Sizing Bypass Duct

- From the tables in Paragraph 12, find the pressure drop (P.D.) and the allowable CFM for the furnace that is being installed.

Example: Standard Size 150 @ 50°F temperature rise
P.D. .38
CFM 2210
- 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 -2210
Bypass CFM 790
- 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 CFM closest to the answer in Step 2).

Example: P.D. .40
Bypass CFM 900
- Move to the left column to find out the required size of the bypass duct.

Example: Bypass Duct Size is 3" (76mm)

Depth of the bypass duct is 18" (457mm) on both inlet and outlet ends. Bypass duct must be located on side opposite controls and 2" from the heat exchanger side panel.

NOTE: Not all capacities are covered in this chart. If your installation is not covered, the correct size may be determined by consulting the factory representative.

15. Gas Piping and Pressures

WARNING: This appliance is equipped for a maximum gas supply pressure of 1/2 pound, 8 ounces, or 14 inches water column. Supply pressure higher than 1/2 pound 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.

All piping must be in accordance with requirements outlined in the National Fuel Gas Code ANSI/Z223.1a (latest edition), published by the American Gas Association or CAN/CGA-B149.1 and B149.2, published by the Canadian Gas Association (See Paragraph 1). 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 (+ or - 50) BTUH 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 15. 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").

Gas connection sizes are included in the Dimensional Tables in Paragraph 5. 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.

15. Gas Piping and Pressures (cont'd)

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.

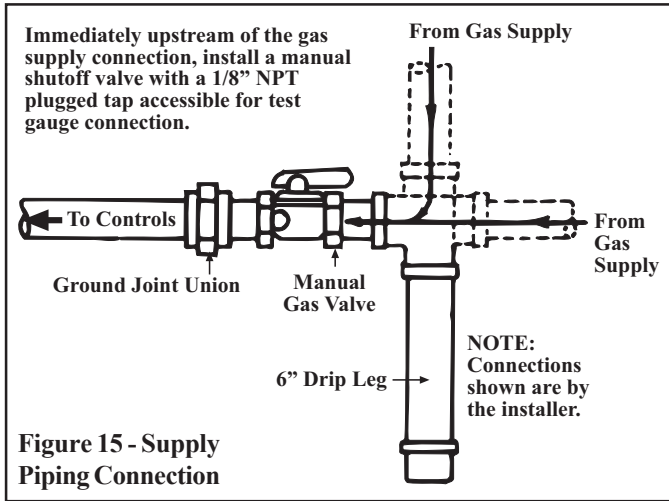


Figure 15 - Supply Piping Connection

Manifold or Orifice 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 28. The following warnings and instructions apply.

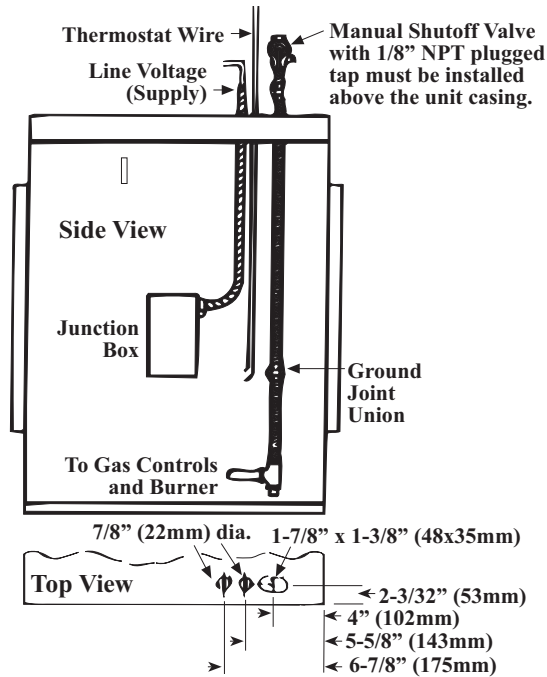
WARNING: Manifold gas pressure must never exceed 3.5" w.c. for natural gas and 10" w.c. for propane gas.

For Natural Gas: Manifold gas pressure is regulated by the combination valve to 3.5" w.c. Inlet 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 Sizes 350 and 400 with electronic modulation require a minimum of 6" w.c. natural gas supply pressure. Sizes 300 and 350 with mechanical modulation require 7" w.c.

For Propane Gas: Manifold gas pressure is regulated by the combination valve to 10" w.c. Inlet pressure to the valve must be a minimum of 11" w.c. and a maximum of 14" w.c.

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

Figure 14 - Gas Connections



Sizing Gas Supply Lines

Length of Pipe	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)											
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.

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:

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. 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.

16. Electrical Supply and Connections

All electrical wiring and connections, including electrical grounding MUST be made in accordance with the National Electric Code ANSI/NFPA No. 70 (latest edition) or, in Canada, the Canadian Electrical Code, Part I-C.S.A. Standard C22.1. In addition, the installer should be aware of any local ordinances or gas company requirements that might apply.

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 of 60°C. Conduit from the disconnect switch must be run so as not to interfere with the service panels of the furnace.

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 limit control, energy cutoff, and sensor lead wires which must be 150°C. See Hazard Levels, Page 1.

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

Specific wiring diagrams that include standard and factory-installed options are included with the heater. **Typical wiring diagrams are on the pages 12-14.**

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 providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size according to 1.25 times the maximum total input amps.

When installing, be careful that the conduit and switch housing are clear of furnace panels and inspection plates. Allow at least four feet of service room between the disconnect switch and removable panels.

Control Thermostat

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.

Wiring between the thermostat and the heater must be suitable for a temperature rise of 60°C. Labeled thermostat leads are provided in the heater junction box for connection of thermostat wiring.

Thermostats should be located five feet above the floor on an inside wall, not in the path of warm or cold air currents and not in corners where air may be pocketed. Do NOT install on cold air walls. For specific connection details, refer to the instructions with the thermostat.

If more than one unit is cycled from one thermostat, separately activated relays must be substituted at unit thermostat connections.

CAUTION: Make sure the thermostat has an adequate VA rating for the total requirements. Add coil rating of all relays and match thermostat rating. See Hazard Levels, Page 1.

Low voltage (24 volt) thermostats are equipped with heat anticipators which level out unit cycling for optimum temperature control. Set anticipator at full load control AMPS.

24 Volt Controls - Maximum Amps

(24 volt Transformer has 20 VA capacity)

Single-Stage Valve	.6
Two-Stage Valve	.6
Maxitrol System	.5
Spark Ignition System	.1
Fan Control Heater	.12
Time Delay Relay Heater	.1
Relay Coil	.12

WARNING: If you turn off the power supply, turn off the gas. See Hazard Levels, Page 1.

17. Limit and Energy Cutoff Controls

The heater is equipped with a non-adjustable high limit switch which shuts off the gas in the event of motor failure, lack of air due to dirty filters, or restrictions at the inlet or outlet of the unit. See Paragraph 28 for limit control check.

The ECO control is calibrated to open at a much higher temperature than the limit control, acting as a super high limit and providing redundant safety control.

WARNING: An ECO circuit interruption is a major failure caused by a malfunction of the primary safety control or miswiring, and will require correction of the cause of failure and the replacement of the limit control and wiring and the optional fan control (if equipped) before the furnace can be returned to service.

17. Energy Cutoff Control (cont'd)

An ECO interruption can be caused by the failure of the automatic reset limit in combination with the following:

- 1) Automatic gas valve stuck in the open position.
- 2) Restricted airflow over the heat exchanger due to motor failure, loose fan blade, broken blower belt, or defective fan control.
- 3) Failed or ruptured gas pressure regulator.
- 4) Improper wiring.

18. Optional Fan Control

1. An optional fan control provides the following:
 - (a) A 45-second delay of blower operation to prevent the discharge of cold air.
 - (b) Blower operation as long as the unit is hot.
2. The fan control provides additional safety by keeping the blower in operation in the event that the gas valve fails to close when the thermostat is satisfied.
3. To be sure that the blower can continue to operate, the power supply to the furnace **MUST NOT** be interrupted **except** when servicing the unit.
4. If the customer wants the furnace off at night, the gas valve circuit **SHOULD BE OPENED** by a single pole switch wired in series with the thermostat. Some thermostats are provided with this feature. Multiple units controlled from a single thermostat are shut off in the same manner. For proper operation, be sure the fan control wiring is observed.

19. Blocked Vent Switch

The blocked vent switch is a heat-activated, manually reset, safety device that interrupts the electric supply to the gas valve when the vent is 100% blocked. The sensor is located near the relief opening of the draft hood. The reset button is located inside the control compartment by the draft hood side.

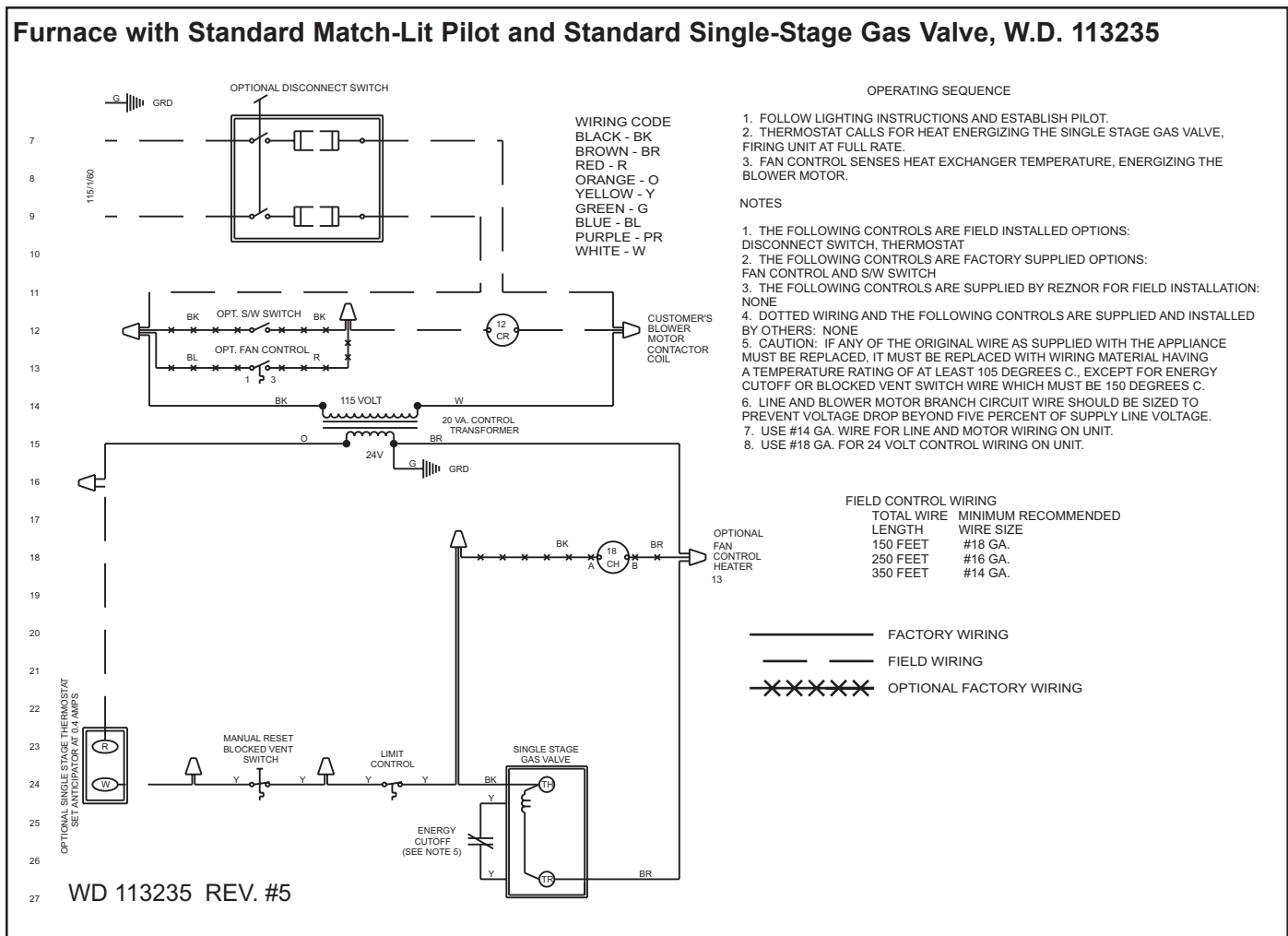
If the sensor detects heated flue gases in the draft hood relief opening area, the blocked vent safety device will activate to shut down the furnace. The cause of the switch shutting down the furnace must be determined and corrected. The blocked vent switch is designed to activate when the vent is blocked but may also be affected by a negative building pressure or an inadequate vent system.

After the problem has been corrected, remove the furnace control compartment panel and push the manual reset button on the blocked vent switch to restart the heater. Replace the panel.

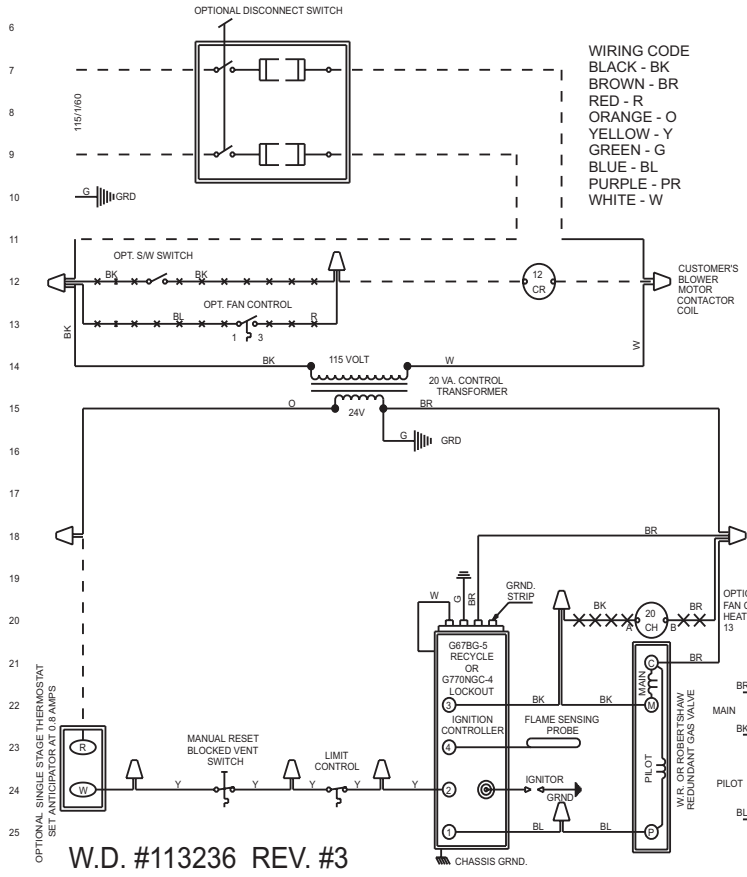
NOTE: Effective April 1991, gravity-vented duct furnaces are equipped with a blocked vent shutoff system. Duct furnaces manufactured prior to April 1991 do not include a blocked vent switch.

WARNING: In the event the blocked vent sensor causes the heater to shutoff, determine the correct the cause. Failure to do so could result in personal injury or death.

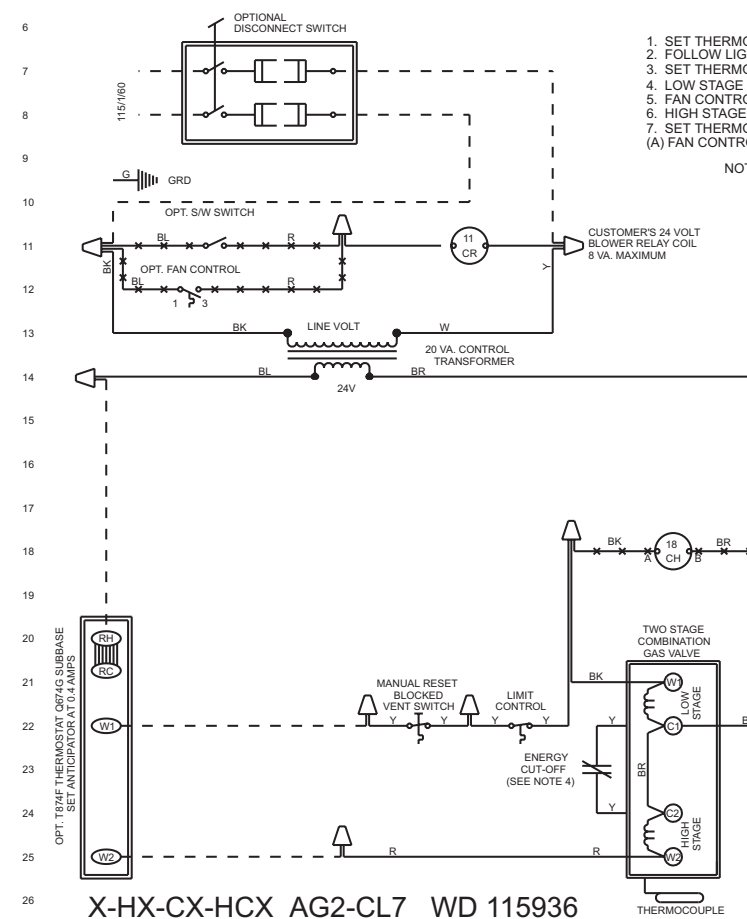
TYPICAL WIRING DIAGRAMS



Furnace with Optional Spark Pilot and Standard Single-Stage Gas Valve, W.D. 113236

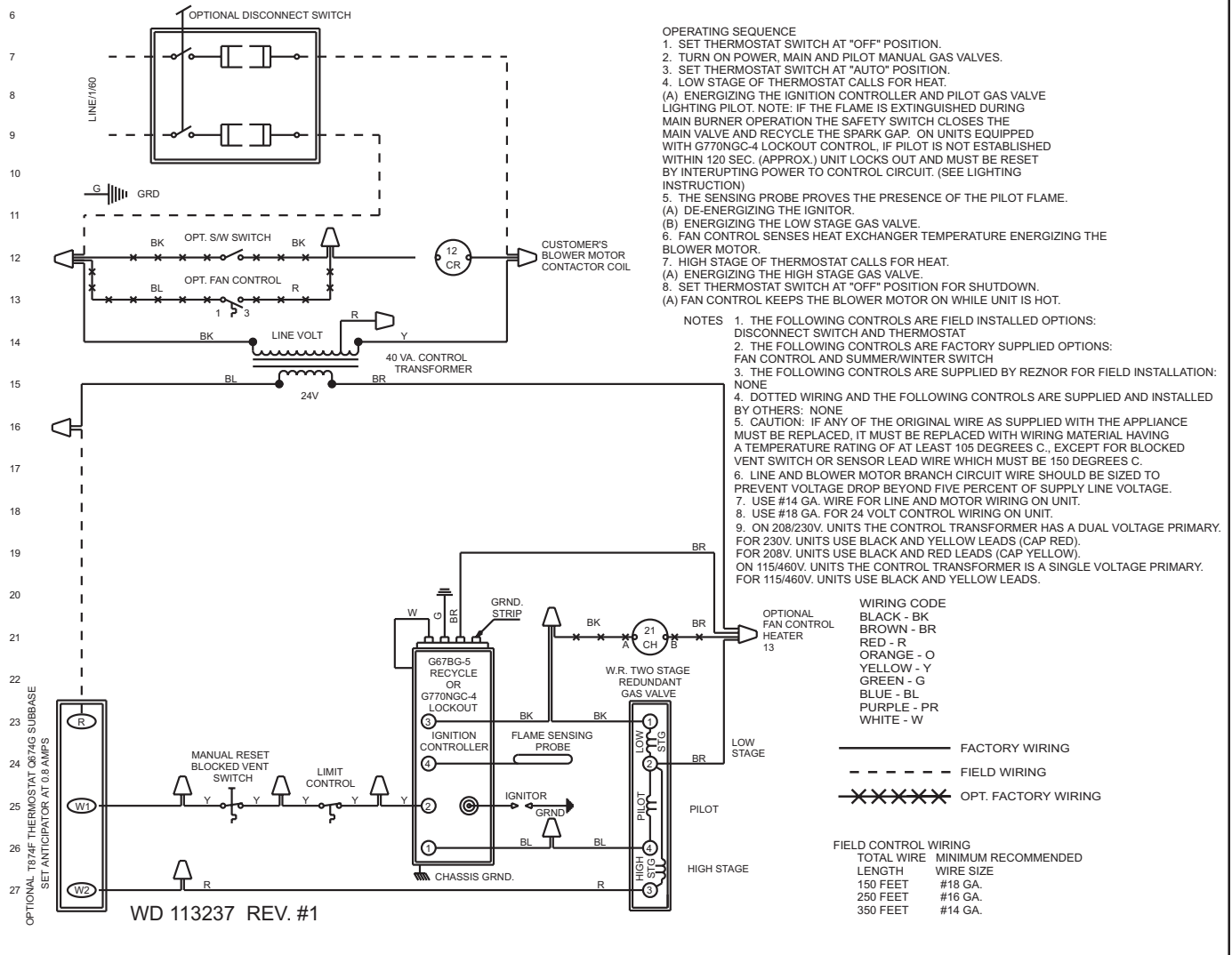


Furnace with Standard Match-Lit Pilot and Optional Two-Stage Gas Valve, W.D. 115936



TYPICAL WIRING DIAGRAMS (cont'd)

Furnace with Optional Spark Pilot and Optional Two-Stage Gas Valve, W.D. 113237



20. 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, the safety pilot valve, 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 Levels, Page 1.

21. Optional Two-Stage Operation for Heating Only

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 packed with the unit for specific gas valve specifications, wiring, and operating instructions.

22. Optional Two-Stage Operation for Makeup Air

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 (Figure 16) or electrically connected to a remote electronic temperature selector (Figure 17). The remote temperature selector is available with or without a display module.

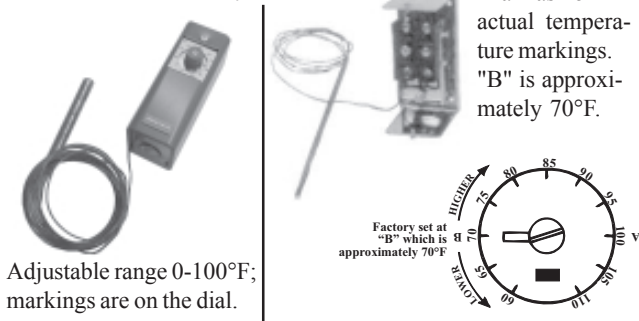
See Figure 18 for a general location of the factory-installed sensor with either the factory-mounted or the remote ductstat selector option.

Optional Ductstat with Capillary Tubing (Option AG3) - Either of the controls illustrated in Figure 16 is used with Option AG3. The

control is set to 70°F and has an adjustable range with a fixed differential of 2-1/2°F. Due to different CFM settings and outside air temperature, the average downstream outlet temperature may not match the ductstat setting exactly. After the installation is complete, adjust the setpoint of the ductstat to achieve the desired average outlet air temperature.

Figure 16 - Ductstat Control in Option AG3

Unit could be equipped with either control. Both are factory set at 70°F.



Optional Ductstat with Electronic Remote Setpoint Module (Options AG15 and AG16) - The field-installed sensing probe is field-wired to a remote temperature selector with a temperature operating range to 130°F. The remote modules and sensing probe are shipped separately for field installation. 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. The digital display module is optional. See Figure 17.

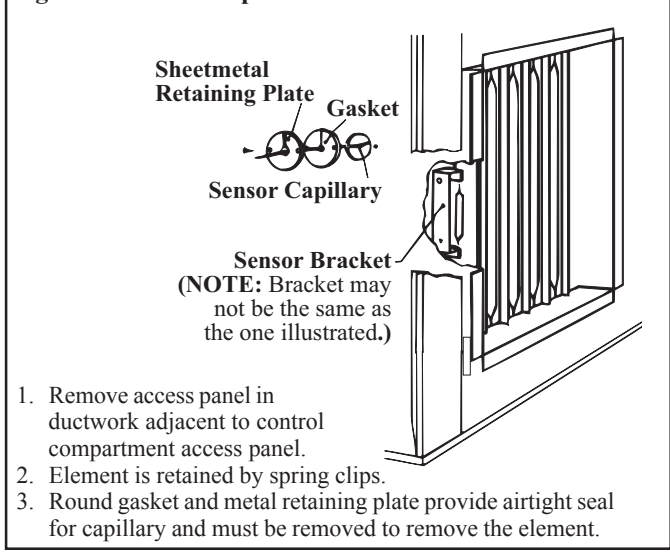
Figure 17 - Remote Temperature Selector, Stage-Adder Module, and Optional Display Module for Ductstat in Two-Stage Makeup Air Control Options (Option AG15 or AG16)



23. Optional Mechanical Modulation for Makeup Air Application

The mechanical modulation valve regulates the flow of gas to the main burner, depending on the demands of the sensing bulb which is located in the airstream adjacent to the heat exchanger. Inputs are varied from 50% through 100% of full rate in direct response to the modulating control sensing element and depending on the temperature of outside air being forced through the furnace. Outlet air or return air temperature can be maintained within a range of 50°F to 100°F (Option AG6) and is adjustable at the mechanical modulating valve. Valve manufacturer's specifications and operating instructions for mechanical modulating valve may be found in the heater instruction envelope accompanying the furnace. (See Figure 18 for a general location of the factory-installed sensor.)

Figure 18 - Duct Temperature Sensor Location



24. Optional Electronic Modulation

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.

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.

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

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

Computer Controlled Electronic Modulation between 50% and 100% Firing Rate (Option AG21) - With this option the furnace is equipped with a Maxitrol A200 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.



25. Pilot and Ignition Systems

These indoor duct furnaces are equipped with a match-lit thermocouple system as standard or an optional intermittent spark pilot system. The horizontal pilot is located in the control end of the burner rack and is accessible after the control compartment panel has been removed. All pilots are target type with lint-free feature. Pilot gas pressure should be the same as supply line pressure. (See Paragraph 15.) If required, adjust the pilot flame length to approximately 1-1/4" with pilot adjustment screw in control valve body.

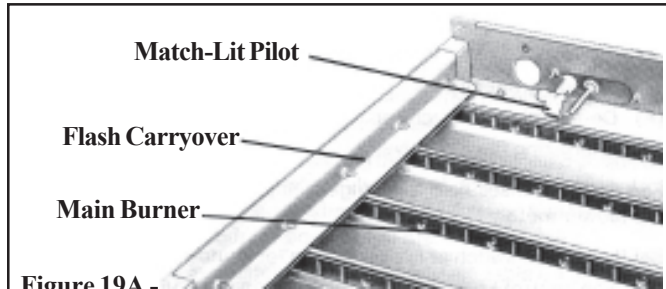


Figure 19A - Burner Rack with Standard Match-Lit Pilot

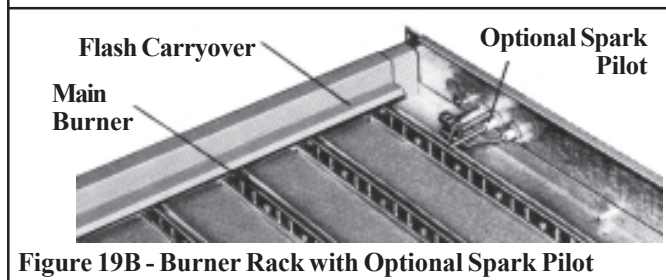


Figure 19B - Burner Rack with Optional Spark Pilot

Optional Intermittent Spark Ignition Safety Pilot Systems - There are two types of intermittent spark pilots -- one type shuts off the pilot gas flow between the cycles and the other not only shuts off the pilot gas flow between cycles but also has a lockout device that stops the gas flow to the pilot if the pilot fails to light in 120 seconds. This lockout feature requires manual reset by interruption of the thermostat circuit. Propane units require the spark ignition system with the lockout device. Refer to the wiring diagram supplied with the heater for pilot system identification and proper wiring. Spark pilot without lockout is designated as Option AH2; with lockout is Option AH3.

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.

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

See Hazard Levels, Page 1.

If no spark occurs, check the following:

- Voltage between blue and white terminals (non-lockout type pilot) and Terminals 2 and 5 (lockout type pilot) on the ignition controller should be at least 20 volts and no higher than 32 volts. Refer to Troubleshooting (Paragraph 32) if no voltage is observed.
- Short to ground in the high tension lead and/or ceramic insulator.
- Pilot spark gap should be approximately 7/64".

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

Form 422, Page 16

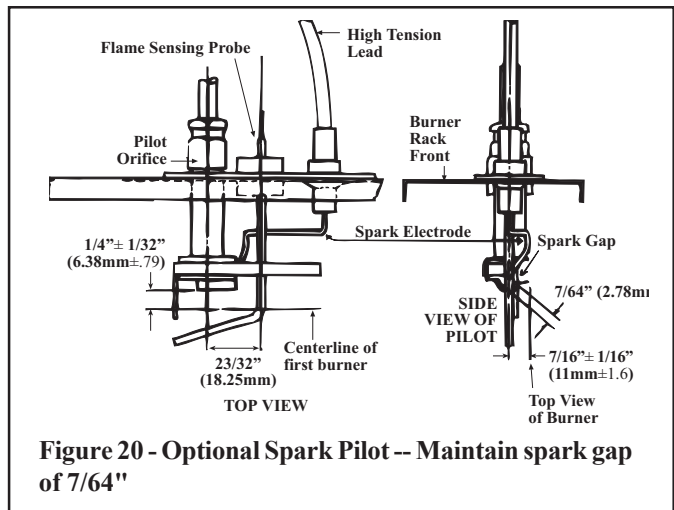


Figure 20 - Optional Spark Pilot -- Maintain spark gap of 7/64"

If the above conditions are normal and no spark occurs, replace the ignition controller.

If the main gas valve fails to open with a normal full size pilot flame established, check for the following:

- Voltage between black and brown leads on the main gas valve is 20 to 32 VAC and there is no main gas flow with the built-in manual valve in FULL OPEN position -- the main valve is defective.
- No voltage between black and brown leads on the main gas valve -- check for disconnected or shorted flame sensor lead or flame sensor probe.

When the above conditions are normal and the main gas flow is still off, the ignition controller is probably defective.

26. Burners & Carryover System

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 natural gas burners are equipped with two flash carryover systems that receive a supply of gas simultaneously with the main burner. All propane gas burners are equipped with one flash carryover and a regulated gas lighter tube system. During regular service, check the main burner ports, the carryover assemblies, and the orifices for cleanliness.

27. Burner Air Adjustment

Burner air shutters are not normally required on natural gas furnaces. Air shutters are required 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 liquefied petroleum gases. Natural gas should not display any yellow-tipping.

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

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

28. Check Installation & Start-Up

Check the installation prior to start-up:

- ❑ 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 clearances from combustibles. Requirements are shown in Paragraph 4.
- ❑ Check vent system to be sure that it is installed according to the instructions in Paragraph 9. Be sure that flue discharge openings are free from obstructions.
- ❑ Check piping for leaks and proper gas line pressure. Bleed gas lines of trapped air. See Paragraph 15.
 - 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 soapy solution on all fittings. Bubbles will appear at a leak. Repair and repeat tests.

Start-Up

- ❑ 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 with Standard Match-Lit Pilot:

- 1) Follow lighting instructions and establish pilot.
- 2) Thermostat calls for heat, energizing the single-stage gas valve, firing unit at full rate.
- 3) Optional fan control senses heat exchanger temperature, energizing the motor on the attached blower.

Operating Sequence for Optional Intermittent Spark Pilot System with or without 100% Lockout

- 1) Set the thermostat switch at its lowest setting.
- 2) Follow lighting instructions.
- 3) Set thermostat switch at desired setting.
- 4) Thermostat calls for heat, energizing the ignition controller and the pilot gas valve, lighting the pilot. NOTE: If the flame is extinguished during main burner operation, the safety switch closes the main valve and recycles the spark gap. On unit equipped with a G770NGC-4 controller which includes lockout control, if the pilot is not established within 120 seconds (approximately), the unit locks out and must be reset by interrupting the power to the control circuit (See Lighting Instructions).
- 5) The sensing probe proves the presence of the pilot flame.
 - (a) De-energizing the ignitor.
 - (b) Energizing the gas valve.
- 6) Optional fan control senses heat exchanger temperature, energizing the motor on the attached blower.
- 7) Set the thermostat switch at lowest setting for shutdown. Optional fan control keeps the blower motor on while unit is hot.

Check installation after start-up:

- ❑ 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 15.
- ❑ 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 27.
- ❑ Close all panels tightly. With the heater on, check limit control by completely blocking 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.

DANGER: The gas burner in this gas-fired equipment is designed and equipped to provide safe and economically controlled complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion which produces carbon monoxide, a poisonous gas that can cause death. Safe operation of indirect-fired gas burning equipment requires a properly operating vent system 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 7. 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 7 of this heater installation manual. MAINTAIN THE VENT SYSTEM IN STRUCTURALLY SOUND AND PROPERLY OPERATING CONDITION.

SERVICE AND MAINTENANCE

WARNING: If you turn off the power supply, turn off the gas. See Hazard Levels, Page 1.

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

The following procedures should be carried out at least annually (See Paragraphs 29-31 for specific instructions.):

- Clean all dirt and grease from the primary and secondary combustion air openings.
- 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 16 for replacement wiring requirements.)

CAUTION: When cleaning, wearing eye protection is recommended.

NOTE: Use only factory-authorized replacement parts.

29. Burner Rack Removal Instructions

1. Turn off the gas supply.
2. Turn off the electric supply.
3. Remove control access side panel.
4. Disconnect the pilot tubing and thermocouple or flame sensor lead.
5. Mark and disconnect electric valve leads.
6. Uncouple the union in the gas supply.
7. Remove sheetmetal screws in the top corners of the burner rack assembly.
8. Pull "drawer-type" burner rack out of the furnace.

To disassemble the burner rack:

1. Remove Carryover System --
Natural Gas - remove the flash carryover system from the "manifold end" of the burner rack
Propane Gas - break the lighter tube connection at the regulator and remove the lighter tube orifice supply tubing; remove the retaining screws in the drip shield and the shield; remove the retaining screws and slide out the lighter tube.
2. Pull main burners horizontally away from injection opening and lift out.
3. Remove manifold bracket screws and remove manifold.
4. Change main burner orifices, if necessary.
5. Remove screws and lift out pilot burner.

Follow the instructions in Paragraph 30 to clean. To re-assemble and replace, reverse the above procedures being careful not to create any unsafe conditions.

30. Cleaning Pilot and Main Burners

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.

If the furnace is equipped with an optional spark pilot, 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 7/64". After the pilot is cleaned, blow any dirt away with compressed air.

Main burners may be cleaned using air pressure. Use an air nozzle to blow out scale and dust accumulation from the burner ports. Alter-

nately 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 carryover systems with air pressure.

31. Cleaning the Heat Exchanger

To clean the outer surfaces (circulating air side) of the heat exchanger, gain access by removing the inspection panels in the ductwork or remove the ductwork. Depending on whether or not the furnace is designed for high CFM (Model prefix "H"), there may be directional baffles between the heat exchanger tubes. The standard furnace has baffles between the heat exchanger tubes as shown in Figure 21. (High CFM furnaces have only the top baffle support which does not need to be removed for cleaning.) To remove the baffles, remove the screws marked "A" in Figure 21, 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 rear slot and replacing the screw.

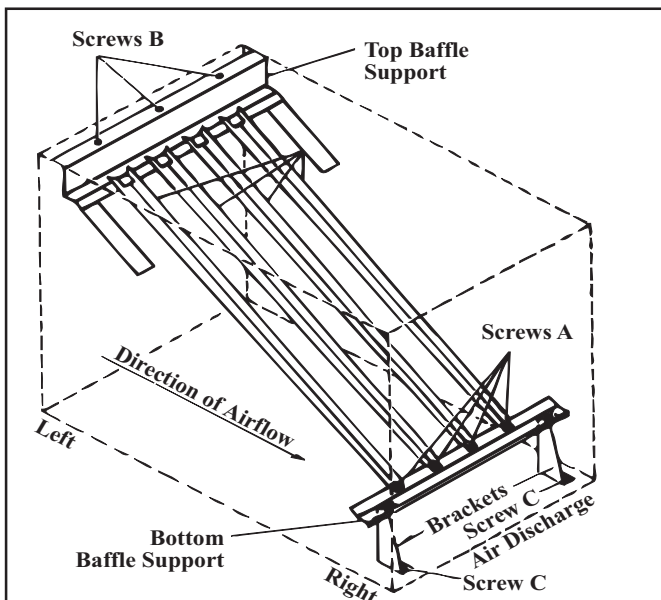


Figure 21 - When cleaning outer heat exchanger surface remove directional air baffles. Remove Screws "A" and slide baffles out. Clean and replace all baffles.
NOTE: High CFM furnaces do not have directional air baffles.

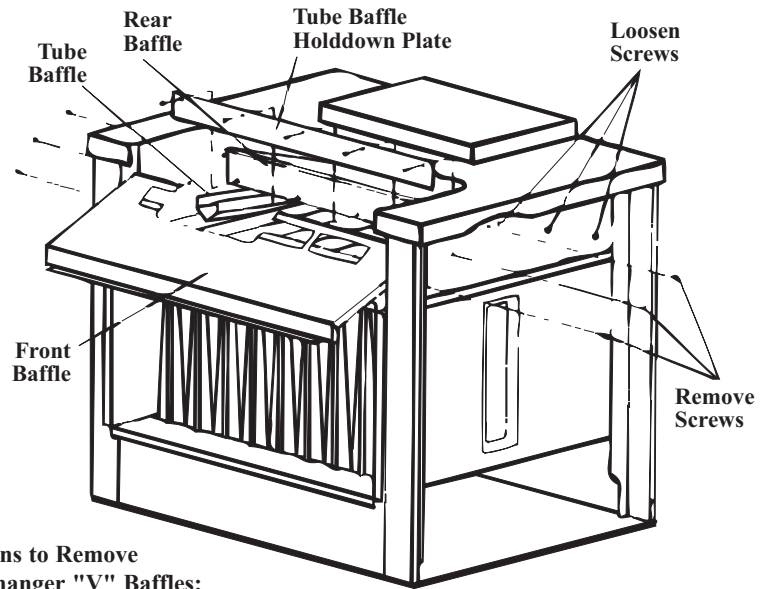
The inner surfaces (combustion air side) of the heat exchanger can be reached for cleaning with the burner rack removed. (See Paragraph 29.) An air hose, an 18-24" long, 1/2" diameter furnace brush (or heavy wire with steel wool securely attached), a flashlight, and a mirror are needed. The required procedure depends on the date of manufacture and whether or not the furnace is rated for high (80%) efficiency. Furnaces designed to provide high efficiency heating have "V" shaped baffles in the top of each heat exchanger tube. Follow the instructions in Figure 22 to remove the baffles when cleaning the inner surfaces of the heat exchanger.

NOTE: High efficiency furnaces manufactured prior to 3/95 have a "C" prefix in their model designation. **All furnaces manufactured beginning 3/95 are designed for high efficiency and include the heat exchanger "V" baffles.**

Clean the inner surfaces of the heat exchanger from beneath using the brush to "scrub" the tube walls to remove any accumulated dust, rust and/or soot. Clean the "V" tubes and re-assemble the heat exchanger and the furnace.

Check the furnace for proper operation.

Figure 22 - Remove "V" Baffles to Clean Inner Surface of Heat Exchanger Tubes



Instructions to Remove Heat Exchanger "V" Baffles:

- 1) Remove the screws (the number varies depending on unit size) along the bottom of the front baffle and the three on each end. Slide the front baffle out of the furnace.
- 1) Remove the screws that attach the tube baffle hold-down plate to the rear flue baffle.
- 3) Pull the "V" baffles out of the heat exchanger.

32. Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Pilot will not light (match-lit system)	<ol style="list-style-type: none"> 1. Manual valve not open. 2. Air in gas line. 3. Dirt in pilot orifice. 4. Gas pressure too high or too low. 5. Bent or kinked pilot tubing. 6. Failed E.C.O. device 	<ol style="list-style-type: none"> 1. Open manual valve. 2. Bleed gas line. 3. Remove and clean with compressed air or solvent (do not ream). 4. Adjust supply pressure. (See Paragraph 15). 5. Replace tubing. 6. Replace E.C.O. device.
Pilot lights, main valve will not open (Match-lit system)	<ol style="list-style-type: none"> 1. Manual valve not open. 2. Power not turned on or thermostat not calling for heat. 3. Circuit to valve open. 4. Faulty transformer. 5. Faulty or dirty thermorouple or safety pilot switch; or failed E.C.O. device 6. Faulty thermostat (see manufacturer's instructions) 7. Faulty valve. 8. High gas pressure. 9. Activated blocked vent switch. 	<ol style="list-style-type: none"> 1. Open manual valve. 2. Turn on power; check fuses; turn on thermostat. 3. Check wiring and connections at transformer and thermostat. 4. Replace the transformer. 5. Clean and test with millivolt member or test. Replace defective part. 6. Replace thermostat. 7. Replace valve or magnetic head. 8. Maximum supply gas pressure 8 oz. or 14" w.c. 9. Correct venting problem. Reset switch.
Pilot will not light (spark ignition system)	<ol style="list-style-type: none"> 1. Manual valve not open. 2. Air in gas line. 3. Dirt in pilot orifice. 4. Gas pressure too high or too low. 5. Kinked pilot tubing. 6. Pilot valve does not open. 7. No spark: <ol style="list-style-type: none"> a) Loose wire connections b) Transformer failure. c) Incorrect spark gap. d) Spark cable shorted to ground. e) Spark electrode shorted to ground. f) Drafts affecting pilot. g) Ignition control not grounded. 	<ol style="list-style-type: none"> 1. Open manual valve. 2. Bleed gas line. 3. Remove and clean with compressed air or solvent (do not ream). 4. Adjust supply pressure. (See Paragraph 15). 5. Replace tubing. 6. If 24 volt available at valve, replace valve. 7. <ol style="list-style-type: none"> a) Be certain all wires connections are solid. b) Be certain 24 volts is available. c) Maintain spark gap at 7/64". d) Replace worn or grounded spark cable. e) Replace pilot if ceramic spark electrode is cracked or grounded. f) Make sure all panels are in place and tightly secured to prevent drafts at pilot. g) Make certain ignition control is grounded to furnace chassis

32. Troubleshooting (cont'd)

TROUBLE (cont'd)	PROBABLE CAUSE (cont'd)	REMEDY (cont'd)
Spark Pilot will not light (cont'd)	h) Faulty ignition controller. 8. Optional lockout device interrupting control 9. Faulty combustion air proving switch.	h) If 24 volt is available to ignition controller and all other causes have been eliminated, replace ignition control. 8. Reset lockout by interrupting control at thermostat. 9. Replace combustion air proving switch.
Pilot lights, main valve will not open (Spark Ignition system)	1. Manual valve not open. 2. Main valve not operating. a) Defective valve. b) Loose wire connections. 3. Ignition control does not power main valve. a) Loose wire connections. b) Flame sensor grounded. (Pilot lights - spark continues) c) Gas pressure incorrect. d) Cracked ceramic at sensor. e) Faulty ignition controller.	1. Open manual valve. 2. a) If 24 volt is measured at valve connections and valve remains closed, replace valve. b) Check and tighten all wiring connections. 3. a) Check and tighten all wiring connections. b) Be certain flame sensor lead is not grounded or insulation or ceramic is not cracked. Replace as required. c) Set supply pressure at 5" w.c. to 8" w.c. for natural gas and 11" w.c. for propane gas. d) Replace sensor. e) See Paragraph 25. If all checks indicate no other cause, replace ignition controller. DO NOT ATTEMPT TO REPAIR IGNITION CONTROLLER. THIS DEVICE HAS NO FIELD REPLACEABLE PARTS.
No heat (Heater Operating)	1. Dirty filters in blower system.. 2. Incorrect manifold pressure or orifices. 3. Cycling on limit control. 4. Improper thermostat location or adjustment. 5. Belt slipping on blower	1. Clean or replace filters. 2. Check manifold pressure (See Paragraph 15). 3. Check air throughput (See Paragraph 12). 4. See thermostat manufacturer's instructions. 5. Adjust belt tension
Cold air delivered On Start-up	1. Fan control improperly wired 2. Defective fan control.	1. Connect as per wiring diagram. 2. Replace fan control.
During Operation	3. Incorrect manifold pressure. 4. Blower set for too low temperature rise.	3. Check manifold line pressure (See Paragraph 15). 4. Slow down blower or increase static pressure.

FOR SERVICE OR REPAIR, FOLLOW THESE STEPS IN ORDER:

FIRST: Contact the installer.

Name _____

Address _____

Phone _____

SECOND: Contact the nearest distributor (See Yellow Pages). If no listing, contact Authorized Factory Representative, 1-800-695-1901 (Press 1).

THIRD: Contact: REZNOR®/ Thomas & Betts Corporation
 150 McKinley Avenue
 Mercer, PA 16137
 Phone: (724) 662-4400

Model No. _____

Unit Serial No. _____

Date of Installation _____



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