INSTALLATION INSTRUCTIONS

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CAUTION: READ ALL SAFETY GUIDES BEFORE YOU START TO INSTALL YOUR FURNACE.

SAVE THIS MANUAL

TWO-STAGE *ULTRA*HIGH-EFFICIENCY GAS-FIRED VARIABLE SPEED FURNACES

MODELS UPFLOW - P*XU - "V" / G9V-UP 60 To 120 MBH Input

DOWNFLOW/HORIZONTAL - P*XD-V / G9V-DH 80 To 120 MBH Input











AWARNING

IMPROPER INSTALLATION MAY CREATE A CON-DITION WHERE THE OPERATION OF THE PRODUCT COULD CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE INJURY OR PROPERTY DAMAGE. REFER TO THIS MANUAL FOR ASSISTANCE OR ADDITIONAL INFORMATION, CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

A CAUTION

THIS PRODUCT MUST BE INSTALLED IN STRICT COMPLIANCE WITH THE ENCLOSED INSTALLATION INSTRUCTIONS AND ANY APPLICABLE LOCAL, STATE, AND NATIONAL CODES INCLUDING BUT NOT LIMITED TO, BUILDING, ELECTRICAL AND MECHANICAL CODES.

AWARNING

The furnace area must not be used as a broom closet or for any other storage purposes, as a fire hazard may be created. Never store items such as the following on, near or in contact with the furnace.

- 1. Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners or other cleaning tools.
- Soap powders, bleaches, waxes or other cleaning compounds; plastic items or containers; gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids or other volatile fluid.
- 3. Paint thinners and other painting compounds.
- 4. Paper bags, boxes or other paper products

Never operate the furnace with the blower door removed. To do so could result in serious personal injury and/or equipment damage.

GENERAL INFORMATION

DESCRIPTION

This Category IV, dual certified direct vent and 1-pipe vent furnace is designed for residential or commercial application. It may be installed without modification to the condensate system in a basement, garage, equipment room, alcove, attic or any other indoor location provided the space temperature is 32 °F or higher and where all required clearance to combustibles and other restrictions are met. If the furnace is being installed where the space temperature is below 32°F, refer to BELOW FREEZING LOCATIONS on Page 4.

This furnace is constructed at the factory for natural gas-fired operation from 0 - 4,500 ft. above sea level, but may be converted to operate on propane (LP) gas and at altitudes up to 10,000 ft. For applications at altitudes between 2,000 - 4,500 ft., see COMBUSTION AIR/VENT PIPE SIZING on Page 14, for required vent length reductions. For application at altitudes greater than 4,500 feet, see high altitude instructions 035-14460-000.

High altitude and propane (LP) changes or conversions required in order for the appliance to satisfactory meet the application must be made by an authorized distributor or dealer. In Canada, a certified conversion station or other qualified agency, using factory specified and/or approved parts, must perform the conversion.

The blower in this furnace is programmed to supply a constant volume of airflow to compensate for duct system static.

INSPECTION

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill.

A separate request for inspection by the carrier's agent should be made in writing. Also, before installation the unit should be checked for screws or bolts which may have loosened in transit. There are no shipping or spacer brackets which need to be removed.

NOTES, CAUTIONS & WARNINGS

The installer should pay particular attention to the words:

NOTE, CAUTION and WARNING. NOTES are intended to clarify or make the installation easier. CAUTIONS are given to prevent equipment damage. WARNINGS are given to alert the installer that personal injury and/or equipment or property damage may occur if installation procedures are not handled properly.



The cooling coil must be installed in the supply air duct. Cooled air may not be passed over the heat exchanger.

VENT SAFETY CHECK PROCEDURE

A CAUTION

This furnace may not be common vented with any other appliance, since it requires separate, properly-sized vent lines. The furnace shall not be connected to any type of B, BW or L vent or vent connector, and not connected to any portion of a factory-built or masonry chimney.

If this furnace is replacing a common-vented furnace, it may be necessary to resize the existing vent line and chimney to prevent oversizing problems for the new combination of units. Refer to the National Gas Code (ANSI Z223.1) or CAN/CGA B149.1 or.2 Installation Code (latest editions).

The following steps shall be followed with each appliance connected to the venting system placed in operation, while any other appliances connected to the venting system are not in operation:

- 1. Seal any unused openings in the venting system.
- Inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code, ANSI Z223.1, or the CAN/CGA B149 Installation Codes and these instructions. Determine that there is no blockage or restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.
- 3. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliance(s) is located and other spaces of the building. Turn on clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
- Test for draft hood equipped appliance spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
- After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
- 7. If improper venting is observed during any of the above tests, the venting system must be corrected.
- 8. Any corrections to the common venting system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1 or.2 Installation Code (latest editions). If the common vent system must be resized, it should be resized to approach the minimum size as determined using the appropriate tables in Appendix G of the above codes.

SPECIFIC UNIT INFORMATION

LIMITATIONS & LOCATION

This furnace should be installed in accordance with all national and local building/safety codes and requirements, or in the absence of local codes, with the National Fuel Gas Code ANSI Z223.1 or CAN/CGA B149.1 or .2 Installation Code (latest editions), local plumbing or waste water codes, and other applicable codes.

CLEARANCES FOR ACCESS

Ample clearances should be provided to permit easy access to the unit. The following minimum clearances are recommended:

- Twenty-four (24) inches between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
- Eighteen (18) inches at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

NOTE: In all cases, accessibility clearances shall take precedence over clearances for combustible materials where accessibility clearances are greater.

AWARNING

Do not install the furnace in an unconditioned space or garage that could experience ambient temperatures of 32° F (0° C) or lower. For application in below freezing locations, See "BELOW FREEZING LOCATIONS" on page 4.

The furnace is not to be used for temporary heating of buildings or structures under construction.

This unit must be installed in a level (1/4") position side-to-side and front-to-back to provide proper condensate drainage.

Do not allow return air temperature to be below 55°F for extended periods. To do so may cause condensation to occur in the maim fired heat exchanger.

Only use natural gas in furnaces designed for natural gas. Only use propane (LP) gas for furnaces that have been properly converted to use propane (LP) gas. Do not use this furnace with butane. Using wrong gas could create a hazard, resulting in damage, injury or death.

A CAUTION

Furnaces shall not be installed directly on carpeting, tile or other combustible material other than wood flooring. An accessory combustible floor base is available to allow direct installation of downflow models on combustible flooring.

Furnace shall be installed so the electrical components are protected from water.

The size of the unit should be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods may be used.

Refer to furnace rating plate for the type of gas approved for this furnace - only use those approved gases.

Check the rating plate and power supply to be sure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase, 60 Hertz power supply.

For installations above 2,000 feet, reduce input 4% for each 1,000 feet above sea level.

For installation between 2000 and 4500 feet, it is not required that the pressure switch be changed, provided the maximum vent/intake pipe lengths are adjusted as shown in the Note from Tables 5 & 6 on Pages 15 & 19. For altitudes above 4,500 feet, refer to instructions 035-14460-000 for correct pressure switch/orifice or other required conversion information.

The furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

A furnace installed in a residential garage shall be located so that all burners and burner ignition devices are located not less that 18" above the garage floor, and located or protected to prevent damage by vehicles.

Allow clearances from combustible materials as listed under Clearances to Combustibles, ensuring that service access is allowed for both the burners and blower.

When the furnace is used in conjunction with a cooling coil, the coil must be installed parallel with or in the supply air side of the furnace to avoid condensation in the primary heat exchanger.

When a parallel flow arrangement is used, the dampers or other means used to control air flow shall be adequate to prevent chilled air from entering the furnace, and if manually operated, must be equipped with means to prevent operation of either unit unless the damper is in the full heat or cool position

The furnace shall be located using these guidelines:

- Where a minimum amount of air intake/vent piping and elbows will be required.
- As centralized with the air distribution system as possible.
- Where adequate combustion air will be available (particularly when installing as 1-pipe system).
- 4. In an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures must not fall below 32°F (0°C) unless the condensate system is protected from freezing (Refer to BELOW FREEZING LOCATIONS below).
- 5. Where it will not interfere with proper air circulation in the confined space.
- Where the outdoor combustion air/vent terminal will not be blocked or restricted.

CLEARANCES TO COMBUSTIBLES

Minimum clearances from combustible construction are shown in Table 3, "UNIT CLEARANCES TO COMBUSTIBLES," on Page 6. These minimum clearances must be maintained in the installation.

BELOW FREEZING LOCATIONS

If this furnace is installed in any area where the ambient temperature may drop below 32° F, a UL listed self regulated heat tape must be installed on any condensate drain lines. It is recommended that self regulating heat tape rated at 3 watts per foot be used. This must be installed around the condensate drain lines in the unconditioned space. Always install the heat tape per the manufacturer's instructions. Cover the self-regulating heat tape with fiberglass or other heat resistant, insulating material.

A CAUTION

If this unit is installed in an unconditioned space and an extended power failure occurs, there could be potential damage to the condensate trap, drain lines and internal unit components. Following a power failure situation, Do Not Operate the Unit Until Inspection and Repair Are Performed.

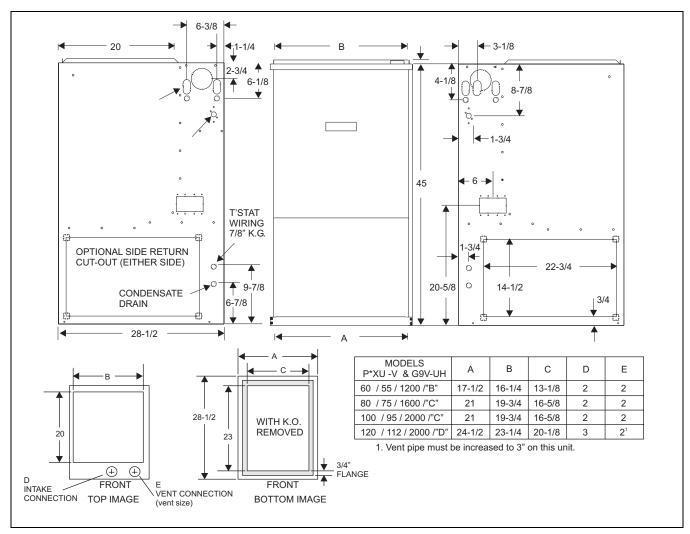


FIGURE 1: Dimensions - Upflow models

Table 1: RATINGS & PHYSICAL / ELECTRICAL DATA - UPFLOW MODELS

P*X	P*XU-V/G9V—UH		LOW		-		BLOWER			TOTAL	MAX.	MIN WIRE SIZE
INPU MBH H/L	OUTPUT MBH H/L	NOM. CFM	AFUE ¹	FIRE TEMP. RISE °F	TEMP. AIR	OUTLET AIR TEMP. °F	HP	AMPS	SIZE	UNIT AMPS	OVER-CURRENT PROTECT ²	(AWG) @ 75 FT. ONE WAY ²
60/39	55/36	1200	93.5	45 - 75	45 - 75	175	1/2	1.7	11x8	9.6	20	14
80/52	75/48	1600	93.5	30 - 60	30 - 60	165	3/4	3.6	11x8	12.0	20	14
100/65	95/60	2000	94.0	30 - 60	30 - 60	160	1	4.3	11x10	14.5	20	12
120/78	112/72	2000	94.0	45 - 75	45 - 75	175	1	4.4	11x10	14.5	20	12

^{1.} AFUE numbers are determined in accordance with DOE test procedures

^{2.} Wire size and overcurrent protection must comply with the National Electrical Code (NFPA-70-latest edition).

For altitudes above 2,000 ft., reduce capacity 4% for each 1,000 ft. above sea level. Refer to instructions 035-14460-000.

[·] Wire size based on copper conductors, 60°C, 3% voltage drop.

Continuous return air temperature must not be below 55°F.

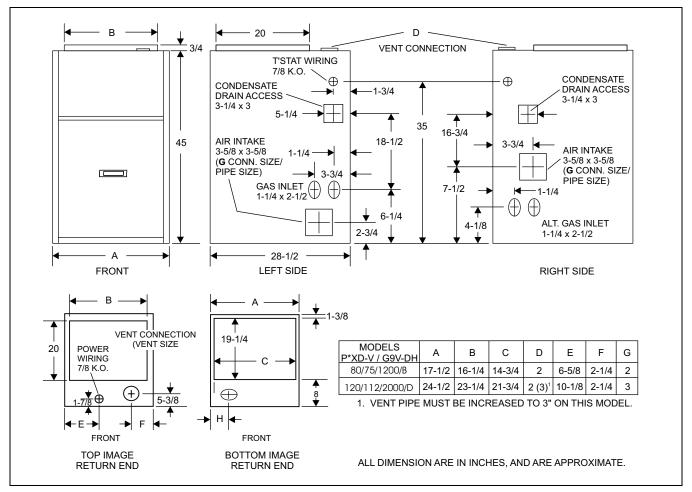


FIGURE 2: Dimensions - Downflow/Horizontal Models

Table 2: RATINGS & PHYSICAL / ELECTRICAL DATA - DOWNFLOW/HORIZONTAL MODELS

P*X	D-V/G9V-I	DH	CABINET	CABINET	CARINET	CABINET	CARINET	CABINET		LOW	HIGH	MAX.		BLOW	ER	TOTAL	MAX.	MIN WIRE SIZE	
INPU MBH H/L	OUTPUT MBH H/L	NOM.		AFUE ¹	FIRE TEMP. RISE °F	FIRE OUTLET TEMP. AIR RISE °F TEMP. °F	НР	AMPS	SIZE	UNIT	OVER-CURRENT PROTECT ²	(AWG) @ 75 FT. ONE WAY ²	OPERATING WT. (LBS)						
80/52	75/48	1200	17-1/2	92.0	35-65	35-65	165	1/2	1.7	11 x 8	12.0	20	14	128					
120/78	112/72	2000	24-1/2	92.0	40-70	40-70	170	1	4.4	11 x 10	14.5	20	12	184					

- 1. AFUE numbers are determined in accordance with DOE test procedures
- 2. Wire size and overcurrent protection must comply with the National Electrical Code (NFPA-70-latest edition).
- For altitudes above 2,000 ft., reduce capacity 4% for each 1,000 ft. above sea level. Refer to Form 035-14460-000.
- Wire size based on copper conductors, 60°C, 3% voltage drop.
- Continuous return air temperature must not be below 55°F.

Table 3: UNIT CLEARANCES TO COMBUSTIBLES

APPLICATION	ТОР	FRONT	REAR	LEFT SIDE	RIGHT SIDE	FLUE	FLOOR/BOTTOM	CLOSET	ALCOVE	ATTIC	LINE CONTACT	
	UPFLOW MODELS (P*XU-V / G9V-UP)											
UPFLOW	1	3	0	0	0	0	COMBUSTIBLE	YES	YES	YES	NO	
	DOWNFLOW / HORIZONTAL MODELS (P*XD-V / G9V-DH)											
DOWNFLOW	1	3	0	0	0	0	COMBUSTIBLE ¹	YES	YES	YES	NO	
HORIZONTAL	1	3	0	0	0+	0	COMBUSTIBLE ²	NO	YES	YES	YES ³	

- Special floor base or air conditioning coil required for use on combustible floor.
- Minimum of 8" clearance required to install condensate removal system.
- 3. Line contact only permitted between lines formed by the intersection of the rear panel and side panel (top in horizontal position) of the furnace jacket and building joists, studs or framing.

DUCTWORK

The duct system's design and installation must:

- Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
- Be installed in accordance with standards of NFPA (National Fire Protection Association) as outlined in NFPA pamphlets 90A and 90B (latest editions) or applicable national, provincial, local fire and safety codes.
- Create a closed duct system. The supply duct system
 must be connected to the furnace outlet and the return
 duct system must be connected to the furnace inlet. Both
 supply and return duct systems must terminate outside
 the space containing the furnace.
- Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.



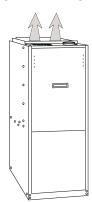
The cooling coil must be installed in the supply air duct. Cooled air must not be passed over the heat exchanger.

When the furnace is used in conjunction with a cooling coil, the coil must be installed parallel with, or in the supply air side of the furnace to avoid condensation in the primary heat exchanger.

When a parallel flow arrangement is used, the dampers or other means used to control air flow must be adequate to prevent chilled air from entering the furnace, and if manually operated, must be equipped with means to prevent operating of either unit unless the damper is in the full heat or cool position.

UPFLOW MODELS

SUPPLY PLENUM CONNECTION



Attach the supply plenum to the furnace outlet duct connection flanges. This is typically through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. This connection should be sealed to prevent air leakage.

If a matching cooling coil is used, it may be placed directly on the furnace outlet and sealed to prevent leakage. Follow the coil instructions for installing the supply plenum.

On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

RETURN DUCT CONNECTION

Return air may enter the furnace through the side(s) or bottom depending on the type of application. Return air may not be connected into the rear panel of the unit. Refer to the "Filter Installation" section of this instruction for the type of application desired for specific installation details.

NOTE: In order to achieve the airflow indicated in the table, it is recommended those applications over 1800 CFM use return air from two sides, one side and the bottom or bottom only. For single return application, see data and notes on blower performance data tables in this manual.

UPFLOW FILTER INSTALLATION

All applications require the use of a filter. A high velocity filter and retainer are provided for field installation.

Internal Installation

- Select desired filter position (left/right side, and/or bottom). Remove the corresponding cabinet cut-outs per instructions provided.
- Install snap-in retainer clips into the corresponding slots from the outside rear of the cabinet (Refer to Figure 3.)
 To prevent cabinet air leaks, install snap-in plugs (provided) into the unused slots at the outside rear of the cabinet.
- Install the wire retainer inside the cabinet. Insert the open ends of the wire retainer into the clip loops at the rear of the blower compartment. The retainer wire should pivot freely like a hinge, on the clips at the rear of the cabinet. See Figure 4.

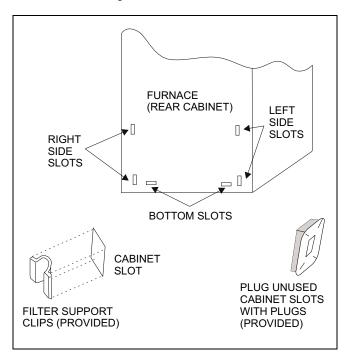


FIGURE 3: Furnace Filter Slot Locations

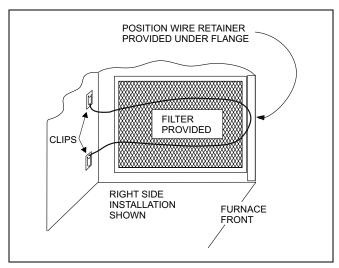


FIGURE 4: Side Filter Retainer Placement

- 4. Install the filter(s) provided. Cut filter if necessary to match air opening in cabinet. Filter should extend beyond opening edge as much as possible to prevent air from bypassing the filter. DO NOT remove stiffening rods from inside the filter. Shorten the rods, if necessary, to match final filter size.
- 5. Position the filter between the wire retainer and the cabinet wall (or floor) so it completely covers the cabinet air opening and secure the filter in place at the front of the cabinet by fastening the closed (looped) end of the retainer wire under the flanged edge of the cabinet. When properly installed the filter should fit flush with all four sides of the cabinet wall.

NOTE: Air velocity through throw-away type filters may not exceed 300 feet per minute. All velocities over this require the use of high velocity filters.

Side Return - External Filter

Locate and knock out the square corner locators. These indicate the size of the cutout to be made in the furnace side panel, See Figure 5.

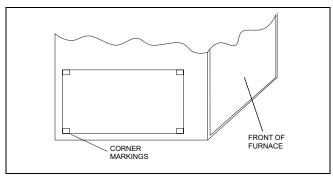


FIGURE 5: Side Return Cutout Markings

Install the side filter rack following the instructions provided with that accessory. If a filter(s) is provided at another location in the return air system, the ductwork may be directly attached to the furnace side panel.

NOTE: Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with the accessory for side opening requirements.

A CAUTION

All installations must have a filter installed.

The return duct may be attached to the furnace by S-cleat, bend tabs or other approved methods. Be sure to seal the duct to the furnace to prevent air leakage.

Where the return duct system is not complete, the return connection must run full size to a location outside the utility room or basement. For further details, consult Section 5.3 (Air for Combustion and Ventilation) of the National Fuel Gas Code, ANSI Z223.1, or CAN/CGA B149.1 or.2, Installation Code latest editions.

Bottom Return

Bottom return applications normally pull return air through a base platform or return air plenum. Be sure the return platform structure is suitable to support the weight of the furnace. Be sure to seal the furnace to plenum connection to prevent air leakage.

The bottom panel is equipped with a perforated opening for easy removal. Tabs must be cut with sheet metal snips to allow removing knock-out. Scribe marks are included for forming flanges for attachment of the return air ductwork.

NOTE: If an external mounted filter rack is being used, see the instructions provided with that accessory for proper hole cut size.

Upflow attic installations must meet all minimum clearances to combustibles and have floor support with required service accessibility.

DOWNFLOW/HORIZONTAL MODELS COOLING COIL TRANSITION

These furnace models are equipped with perforations in the supply air wrapper flanges that allow for easy application of air conditioning coil to the furnace without the use of sheet metal transition pieces, These perforations can be bent in either direction depending on the type of application - either downflow or horizontal left and right. Refer to either the "Downflow Application" or "Horizontal Application" section below for specific instructions on how to install the coil.

Downflow Installations

For installation of air conditioning coil in a downflow application, the perforations in the wrapper flanges must be bent in towards the heat exchanger to allow for the coil duct flange to recess into the furnace. Refer to the installation instructions supplied with the air conditioning coil for additional information and completion of the coil installation.

NOTE: Duct pliers or other suitable tool can be used to bend perforations. To help bend flanges in a straight line, scribe a line between the perforations prior to bending.

Horizontal Installations

For installation of an air conditioning coil in a horizontal application, the perforations in the wrapper flanges must be bent away from the heat exchanger to create duct flanges so the air conditioning coil can be properly seated on the furnace. Refer to the installation instructions supplied with the air conditioning coil for additional information and completion of the coil installation.

NOTE: Duct pliers or other suitable tool can be used to bend perforations. To help bend flanges in a straight line, scribe a line between the perforations prior to bending.

DOWNFLOW APPLICATION

DOWNFLOW FILTERS



A top return filter rack is supplied with the furnace. Two 14" x 20" permanent washable filters are supplied with each unit.

Downflow furnaces typically are installed with the filters located above the furnace, extending into the return air duct. See Figure 6.

Any branch duct must attach to the vertical ductwork above the filter height (FH).

The filter rack (provided) should be secured to the center of the front and rear flanges at the furnace top. Drill a hole through the front and rear duct flange into the filter rack and secure it with a sheet metal screw.

Refer to the unit rating plate for furnace model then see the dimensions page of this instruction for return air plenum dimensions. Install the plenum following instructions under Ductwork in this instruction

SUPPLY AIR DUCTS

Installations on combustible material or floors must use a combustible floor base (shown in Figure 7 - 1CB0317 or 1CB0324) as specified on the rating plate or a matching cooling coil. Follow the instructions supplied with the combustible floor base accessory.

This base can be replaced with a matching cooling coil, properly sealed to prevent leaks. Follow the cooling coil instructions for installing the plenum.

All downflow application supply duct systems must be designed and installed in accordance with the standards of NFPA 90A and 90B, and/or all local codes.

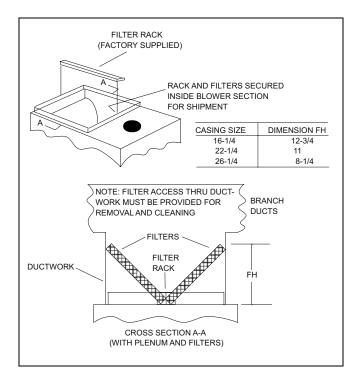


FIGURE 6: DOWNFLOW FILTERS

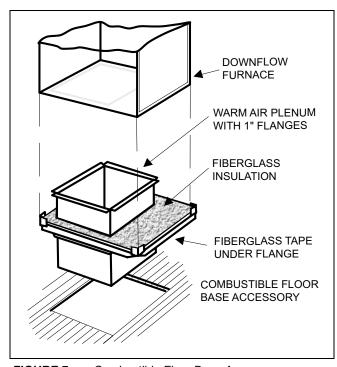
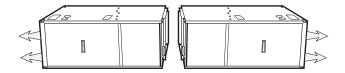


FIGURE 7: Combustible Floor Base Accessory

DOWNFLOW / HORIZONTAL MODELS - HORIZONTAL APPLICATION



Downflow furnaces may be installed horizontally with the supply airflow toward the left or right by laying the unit on the left or right side panel.



Do not install the unit on the rear panel.

After determining the best orientation, lay the unit on top of the shipping carton to protect the finish. The appropriate electrical knock-outs for power wiring, control wiring and gas piping should be removed at this time.

For horizontal application, return air may enter through the bottom, left side or right side panel or any combination of these openings. Return air may not be connected into the rear panel of the unit.

HORIZONTAL FILTERS

All filters and mounting provision must be field supplied. Filter(s) may be located in the duct system external to the furnace or in a return filter grille(s). Refer to furnace accessories on Page 30 for External Filter Kit options.

ATTIC INSTALLATION

This appliance is design certified for line contact for furnaces installed horizontally. The intersection of the furnace top and sides form a line. This line may be in contact with combustible material. Refer to Figure 8.

Secure a platform constructed of plywood or other building material to the floor joists. Sheet metal, 12" in front of the furnace combustion air openings is recommended. (Refer to Figure 8).

NOTE: The unit must be elevated to allow clearance to the condensate trap and drain pipe. A minimum of 8" clearance is required for this purpose.



If this furnace is installed over a finished space, a condensate safety pan must be installed.

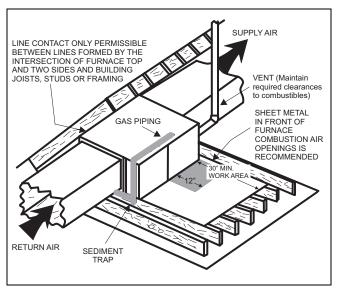


FIGURE 8: Typical Attic Installation

AWARNING

When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12" away from furnace and burner combustion air openings.

NOTE: See crawl space installation for suspending the furnace in attic installations.

CRAWL SPACE INSTALLATION

The furnace can be hung from floor hoists or installed on suitable blocks or pad. Blocks or pad installations shall provide adequate height to ensure the unit will not be subject to water damage.

When suspending the furnace from rafters or floor joists using rod, pipe or straps, refer to Physical Data and, Table 3, "UNIT CLEARANCES TO COMBUSTIBLES," on Page 6, for furnace weights to determine suitable means of suspension.

Angle supports should be placed at the supply air end and near the blower deck. (Refer to Figure 9.) **Do not support at return air end of unit.**

Units may also be suspended by using straps or other material at the same location. All four suspension points must be level to ensure quiet furnace operation

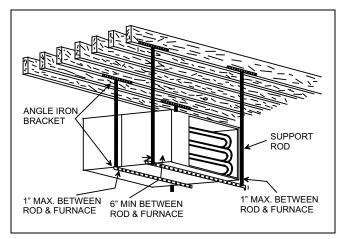


FIGURE 9: Typical Furnace Installation Using Suspension Materials

A CAUTION

In any application where temperatures below freezing are possible, See "BELOW FREEZING LOCATIONS" on page 4.

GAS PIPING

The gas supply should be a separate line and must be installed in accordance with the National Fuel Gas Code, ANSI Z223.1 (latest edition), or the CAN/CGA B149.1 or .2 Installation Codes (latest edition) and all applicable local and utility requirements.

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. Properly sized wrought iron, approved flexible or steel pipe must be used when making gas connections to the unit. The installation of a drop leg and ground union is required (Refer to Figure 10).

Gas piping may be connected from either side of the furnace using any of the gas pipe entry knockouts on both sides of the furnace (Refer to Figure 1 for locations and dimensions).

NOTE: Plan your combustion air piping before determining the correct gas pipe entry. Use 90 degree service elbow(s), or short nipples and conventional 90 degree elbow(s) to enter through the cabinet access holes.

INLET GAS PRESSURE RANGE								
NATURAL GAS PROPANE (LP)								
Minimum	4.5 In. W.C.	11 In. W.C.						
Maximum	13.8 ln. W.C.	13.8 In. W.C.						

NOTE: An accessible manual shutoff valve must be installed upstream of the furnace gas controls and within 6 feet of the furnace.

AWARNING

An overpressure protection device, such as a pressure regulator, which conforms to the National Fuel Gas Code, ANSI Z223.1 (U.S.) or CAN-B149.1 or .2 (Canada) and acts to limit the downstream pressure to a value that does not exceed 0.5 PSI (14" w.c.), must be installed in the gas piping system upstream of the furnace. Failure to do so may result in a fire or explosion or cause damage to the furnace or some of its components.

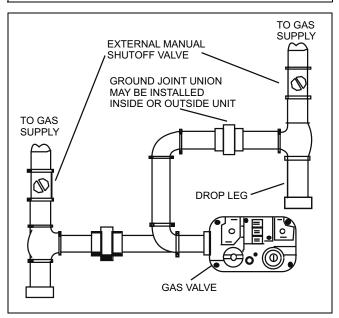


FIGURE 10: Gas Piping

NOTE: A 1/8" NPT plug is included in the inlet side of the gas valve for measuring incoming gas pressure.

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (3.48 kpa).

The furnace and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.48 kpa).

A CAUTION

Never apply a pipe wrench to the body of the combination automatic gas valve. A wrench must be placed on the projection or wrench boss of the valve when installing piping to it.

A CAUTION

Compounds used on threaded joints of gas piping must be resistant to the action of liquefied petroleum LP gases. After connections are made, leak-test all pipe connections.

After all gas piping connections are completed, leak test all joints, fittings and furnace connections with rich soap and water solution, commercially available bubble type leak detection fluid, or other approved means.

Do not use an open flame or other source of ignition for leak testing.

ELECTRICAL POWER CONNECTION

Field wiring to the unit must conform to and be grounded in accordance with the provisions of the National Electrical Code ANSI/NFPA No. 70-latest edition, Canadian Electric Code C22.1 Part 1 - (latest edition) and/or local codes. Electric wires which are field installed shall conform with the temperature limitation for 63°F / 35°C rise wire when installed in accordance with instructions. Specific electrical data is given for the furnace on its rating plate and in Table 1 on Page 5 or Table 2 on Page 6.

Provide a power supply separate from all other circuits. Install overcurrent protection and disconnect switch per local/national electrical codes. The switch should be close to the unit for convenience in servicing. With the disconnect switch in the OFF position, check all wiring against the unit wiring label. Also, see the wiring diagrams in this instruction.

NOTE: The furnace's control system depends on correct polarity of the power supply and a proper ground connection. Refer to FURNACE CONTROL DIAGNOSTICS on Page 37, for symptoms of reversed power supply polarity.

A CAUTION

Use copper conductors only.

Connect the power supply as shown on the unit wiring label on the inside of the blower compartment door and Figure 11 or 12 on Page 12. The black furnace lead must be connected to the L1 (hot) wire from the power supply. The white furnace lead must be connected to neutral. Also, the green equipment ground wire must be connected to the power supply ground.

Remove the screws retaining the wiring box cover. Route the power wiring through the opening in the unit into the junction box with a conduit connector or other proper connection. Make wiring connections referring to Figure 11 or 12 and replace the junction box cover and screws.

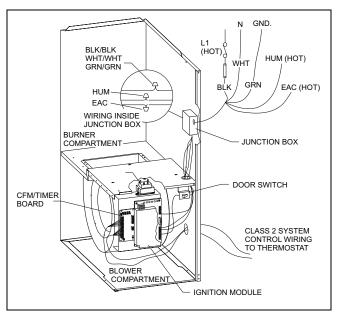


FIGURE 11: Electrical Wiring - Upflow Models

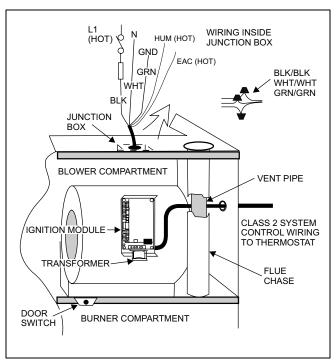
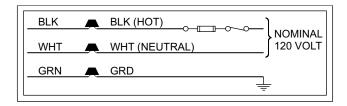


FIGURE 12: Electrical Wiring - Downflow / Horizontal Models

An alternate wiring method is to use a field provided 2 x 4 box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel.

NOTE: The power connection leads and wiring box on upflow units may be relocated to the left side of the furnace. Remove the screws and cut wire tie holding excess wiring. Reposition on the left side of the furnace and fasten using holes provided.



ELECTRICAL CONTROL CONNECTIONS

Install the field-supplied thermostat. The thermostat instructions for wiring are packed with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, complete the low-voltage wiring from the thermostat to the terminal strip on the cfm timer board. Connect Class 2 control wiring for single stage thermostat (refer to (Refer to Figure 13 on Page 13)) or for two stage thermostat (refer to (Refer to Figure 14 on Page 13).

Set the heat anticipator in the room thermostat as shown below. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the setpoint.

Two-Stage Thermostat	First Stage	.4 Amps
Two-olage Thermostat	Second Stage	.1 Amps
Single Stage Thermostat		.4 Amps

NOTE: Some electronic thermostats do not have adjustable heat anticipators. They may have other type cycle rate adjustments. Follow the thermostat manufacturer's instructions.

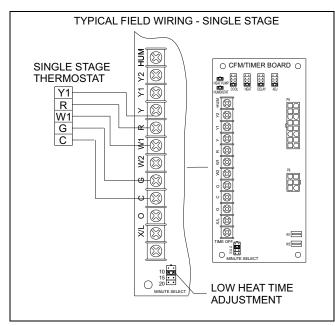


FIGURE 13: Field Wiring for Single Stage Thermostat

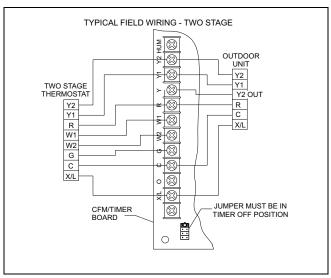


FIGURE 14: Field Wiring for Two Stage Thermostat

The 24-volt, 40 VA transformer is sized for the furnace components only, and should not be connected to power auxiliary devices such as humidifiers, air cleaners, etc. The transformer may provide power for an air conditioning unit contactor.

NOTE: Apply strain relief to thermostat lines passing through cabinet.

ACCESSORY CONNECTIONS



The furnace control will allow power switching control of various accessories. Refer to Figure 15 for connection details.

ELECTRONIC AIR CLEANER CONNECTION

The junction box contains a clearly marked wire for connection to an electronic air cleaner. This wire provides 120 VAC (1.0 amp maximum) during circulating blower operation.

HUMIDIFIER CONNECTION

The junction box contains a clearly marked wire for connection to a humidifier. This wire provides 120 VAC (1.0 amp maximum) during heat speed operation of the circulating blower

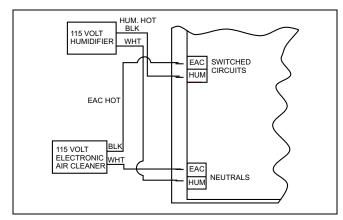


FIGURE 15: Accessory Connections

COMBUSTION AIR AND VENT SYSTEM

This furnace is certified to be installed with one of three possible intake/vent configurations.

- Two-pipe with a sealed combustion intake/vent system using outdoor combustion air.
- 2. Single pipe vent system using combustion air from the area surrounding the furnace.
- Two-pipe intake/vent system using combustion air from a ventilated attic space and a vent pipe to the outside.

Be sure to follow the appropriate venting section details, related information and limitations for your type of installation.

Furnace Intake / Vent Connection Size (All Models)							
	60 - 100 MBH 120 MBH						
Intake	2"	3"					
Vent	2"	2" ¹					

- 1. Vent must be increased to 3" on this model.
- Note 1:Any vent pipe size change must be made outside furnace casing in a vertical pipe section to allow proper drainage of condensate.
- Note 2: An offset using two 45 degree elbows will be required for plenum clearance when the vent is increased to 3".

METHOD ONE: TWO PIPE SEALED COMBUSTION AIR & VENT SYSTEM

COMBUSTION AIR INTAKE/VENT CONNECTIONS

This type installation requires outdoor combustion air. Two separate, properly-sized pipes must be used. One bringing air from the outdoors to the furnace combustion air intake collar on the burner box, and a second pipe from the furnace vent connection (top right of unit) back to the outdoors. Refer to Figure 16 or 17.

The intake/vent should be located either through the wall (horizontal or side vent) or through the roof (vertical vent). Care should be taken to locate side vented systems where trees or shrubs will not block or restrict supply air from entering or combustion products from leaving the terminal.

Also, the terminal assembly should be located as far as possible from a swimming pool or a location where swimming pool chemicals might be stored. Be sure the terminal assembly follows the outdoor clearances listed in Table 3 for U.S. installations: In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition-Venting Systems and Air Supply).

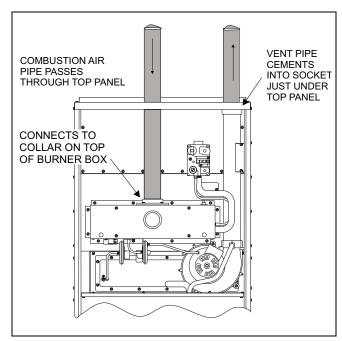


FIGURE 16: Air Intake and Vent Locations - Upflow

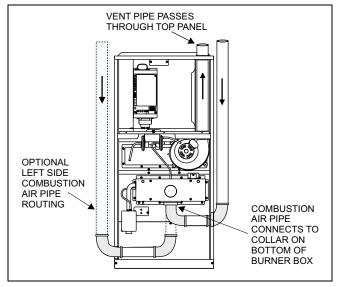


FIGURE 17: Air Intake and Vent Locations - Downflow/Horizontal

COMBUSTION AIR/VENT PIPE SIZING

To select the proper size piping for combustion air intake and venting refer to Table 6 on Page 19. The size will be determined by a combination of furnace model, total length of run, and the number of elbows required. The following rules must also be observed.

Table 4: INTAKE/VENT PIPING - 2 PIPE SYSTEM

Upflow Models	Pipe Size	Max. Elbows vs. One Way Vent Length (Ft.) ¹					
	0.20	5 - 40	45	50	75		
60 / 55 / 1200 / B			5				
80 / 75 / 1600 / C	2"	6		4	N/A		
100 / 95 / 2000 / C							
60 / 55 / 1200 / B					5		
80 / 75 / 1600 / C	3"	8	7	6			
100 / 95 / 2000 / C							
120 / 112 / 2000 / D	3" Only	6	5	4	N/A		

Elbow count does not include the elbows required for the termination. See Step 4 under Combustion Air/Vent Pipe Sizing

Table 5: INTAKE/VENT PIPING - 2 PIPE SYSTEM

Downflow/Horizontal Models	Pipe Size	Max. Elbows vs. One Way Vent Length (Ft.) ¹						
Modelo	CILO	5 - 30	35	40	60			
80 / 75 / 1200 / B	2"	6	5	4	N/A			
80 / 75 / 1200 / B	3"	8	7	6	5			
120 / 112 / 2000 / D	3" Only	6	5	4	N/A			

 Elbow count does not include the elbows required for the termination. See Step 4 under Combustion Air/Vent Pipe Sizing

NOTE: If installing furnace at altitudes between 2000 - 4500 ft., the maximum allowable intake and vent pipe length must be reduced by 10 ft. If the installation requires the maximum allowable intake and vent pipe length, the furnace must be converted for high altitude operation. Refer to the proper high altitude application instruction for details.

- 1. Long radius elbows are required for all units.
- 2. Elbows are assumed to be 90 degrees. Two 45 degree elbows count as one 90 degree elbow.
- Elbow count refers to combustion air piping and vent piping separately. For example, if the table allows for 5 elbows, this will allow a maximum of 5 elbows in the combustion air piping and a maximum of 5 elbows in the vent piping.
- Three vent terminal elbows (two for vent pipe and one for air intake pipe) are already accounted for and should not be counted in the allowable total indicated in the table. See section on vent terminal. These parts are shown shaded.
- Combustion air and vent piping must be of the same diameter.
- All combustion air/vent pipe and fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), F891 (PVC-DWV Cellular Core). D2241 (SDR-21 and SDR-26 PVC), D2261 (ABS-DWV), or F628 (Schedule 40 ABS. Pipe cement and primer must conform to ASTM Standards D2564 (PVC) or D2235 (ABS).

 The use of flexible connectors or no hub connectors in the vent system is not allowed. This type connection is allowed in the combustion air pipe near the furnace for air conditioning coil accessibility.

VENT TERMINATION (2-PIPE)

Side wall horizontal vent terminals and roof mounted vertical terminals may be field fabricated. Standard PVC/SRD fittings may be used. Terminal configuration must comply as detailed in this section.

NOTE: Combustion air and vent pipes must terminate together in the same atmospheric zone, either through a roof or sidewall.

NOTE: Accessory concentric intake/vent terminations, models 1CT0302 and 1CT0303 are available and approved for use with these furnaces. Refer to instructions 035-14287-000 for installation details.

When selecting the location for combustion air/vent termination the following should be considered:

- 1. Comply with all clearance requirements as listed below.
- Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
- Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
- Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
- Termination should be positioned where vent vapors are not objectionable.

VENT CLEARANCES (2-PIPE) U.S. ONLY

Dryer Vent
Plumbing Vent Stack
Gas Appliance Vent Terminal
From any mechanical fresh air intake 1 ft.
From any door, window or non-mechanical fresh air or combustion air intake 1 ft.
Above grade and anticipated snow depth \hdots 1 ft.
Above grade when adjacent to public walkway $\ldots\ldots$ 7 ft.
From electric, gas meters, regulators and relief equipment - min. horizontal distance 4 ft.

* Does not apply to multiple installations of this furnace model. Refer to multi-unit vent terminations.

In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition - Venting Systems and Air Supply)

NOTE: Consideration must be given for degradation of building materials by flue gases.

NOTE: Shaded components of the combustion air/vent system shown in the following figures are considered to be part of the vent terminal. These components should not be counted when determining piping limitations. Refer to Figure 18 thru Figure 20. Sidewall termination may require sealing or shielding of building surfaces with a corrosive resistance material to protect against combustion product corrosion.

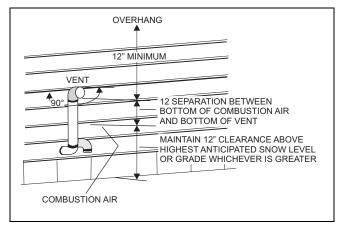


FIGURE 18: Horizontal Termination Configuration with 12" Minimum Clearance

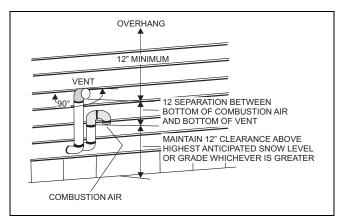


FIGURE 19: Horizontal Termination Raised
Configuration for Additional Clearance

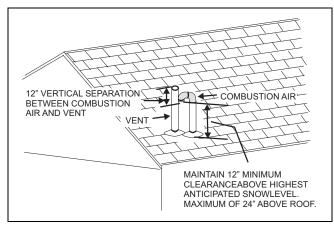


FIGURE 21: Vertical Termination

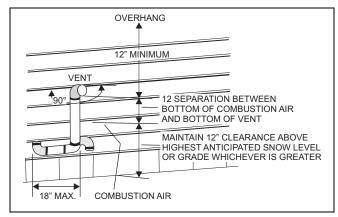


FIGURE 20: Horizontal Termination Configuration with Horizontal Extension

VENTING MULTIPLE UNITS

Each unit must have its own intake/vent piping and termination. Do not use common pipes for combustion air or venting. The vent terminals must be located as shown in refer to Figure 22 thru Figure 23.

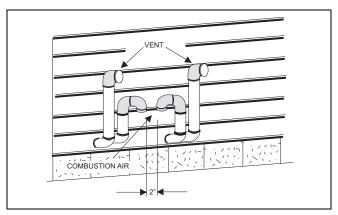


FIGURE 22: Double Sidewall Termination

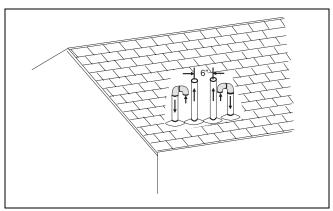


FIGURE 23: Double Rooftop Termination

PIPING ASSEMBLY

The final assembly procedure for the vent/combustion air piping is as follows:

- 1. Cut piping to the proper length, beginning at the furnace.
- 2. Deburr the piping inside and outside.
- 3. Chamfer the outer edges of the piping.
- 4. Dry-fit the entire vent/combustion air piping assembly.
- Disassemble the piping and apply cement primer and cement per the cement manufacturer's instructions.
 Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.

A CAUTION

Solvent cements are flammable and must be used in well-ventilated areas only. Keep them away from heat, sparks and open flames (including pilots). Do not breathe vapors and avoid contact with skin and eyes.

- All joints must be made to provide a permanent, air-tight, water-tight seal.
- 7. Support the combustion air and vent piping such that it is angled 1/4" per linear foot so that condensate will flow back toward the furnace. Piping should be supported with pipe hangers to prevent sagging. Maximum spacing between hangers is five (5) feet, except SDR-PVC piping, where maximum spacing is three (3) feet.
- 8. Seal around the openings where the combustion air and vent piping pass through the roof of side wall.

A CAUTION

Vent piping must be insulated with 1/2" Armaflex insulation if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.

When combustion air pipe is installed above a suspended ceiling, the pipe must be insulated with 1/2" Armaflex type insulation. The combustion air pipe should also be insulated when it passes through a warm, humid space.

NOTE: Vent pipe must be sloped 1/4" per foot to allow condensate to flow back to the furnace.

METHOD TWO: ONE PIPE SYSTEM

This type installation will use combustion air from within the space surrounding the furnace. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors. It is not directly ducted into the furnace. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided.

For upflow models combustion air is brought into the furnace through the unit top panel opening. Do not install a pipe into the intake collar on top of the burner box. Refer to Figure 24.

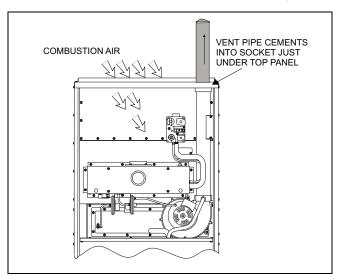


FIGURE 24: Vent Pipe Connection - Upflow

For downflow/horizontal models combustion air is brought into the furnace through the unit side panel openings.

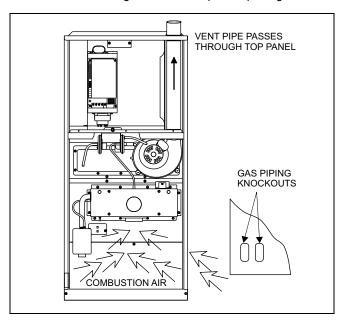


FIGURE 25 : Vent Pipe Connection - Downflow/Horizontal

For downflow/horizontal models, remove a minimum of two gas piping knockouts for combustion air access. Do not install a pipe into the intake collar on bottom of the burner box. For details, refer to Figure 25.

COMBUSTION AIR

All installations must comply with Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149.1 or .2 Installation Code - latest editions.

An unconfined space is not less than 50 cubic feet per 1000 Btu/hr input rating for all appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are not furnished with doors.

A confined space is an area with less than 50 cubic feet per 1000 Btu/hr input rating for all appliances installed in that area

The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Air Source from Inside the Building

Two permanent openings, one within 12 inches of the top of the confined space and one within 12 inches of the bottom, shall each have a free area of not less than one square inch per 1,000 Btuh of total input rating of all appliances located in the space. The openings shall communicate freely with interior areas having adequate infiltration from the outside.

NOTE: At least 100 square inches free area shall be used for each opening.

Air Source from Outdoors

- Two permanent openings, one within 12 inches of the top of the confined space and one within 12 inches of the bottom, shall communicate directly, or by means of ducts, with the outdoors or to such crawl or attic spaces that freely communicate with the outdoors.
 - a. Vertical Ducts Each opening must have a free area of not less than one square inch per 4,000 Btuh of total input of all appliances located in the space.

EXAMPLE:

Total Input of All Appliances = Square Inches Free Area

b. **Horizontal Ducts** - Each opening must have a free area of not less than one square inch per 2,000 Btuh of total input of all appliances located in the space.

NOTE: Ducts must have the same cross-sectional area as the free area in the opening to which they are connected. The minimum dimension of rectangular ducts shall be three inches.

2. One permanent opening, commencing within 12 inches of the top of the enclosure shall be permitted where the equipment has clearances of at least 1 inch from the sides and back and 6 inches from the front of the appliance. The opening shall communicate through a vertical or horizontal duct to the outdoors, or spaces (crawl or attic) that freely communicate with the outdoors and shall have a minimum free area of:

- a. 1 sq. in. per 3000 Btu per hr of the total input rating of all equipment located in the enclosure.
- Not less than the sum of the areas of all vent connectors in the confined space.
- 3. Louvers, Grilles and Screens
 - In calculating free area, consideration must be given to the blocking effects of louvers, grilles and screens.
 - b. If the free area of a specific louver or grille is not known, refer to the Table below, to estimate free area.

Wood or Metal	Wood 20-25% ¹
Louvers or Grilles	Metal 60-70% ¹
Screens ²	1/4 in. mesh or larger 100%

- 1. Do not use less than 1/4 in. mesh
- Free area or louvers an grilles varies widely; installer should follow louver or grille manufacturer's instructions

NOTE: If mechanically operated louvers are used, a means to prevent main burner ignition and operation must be provided should louvers close during startup or operation.

Special Combustion and Ventilation Considerations

Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances.

Specially Engineered Installations

The above requirements shall be permitted to be waived where special engineering, approved by the authority having jurisdiction, provides an adequate supply of air for combustion, ventilation and dilution of flue gases.

Combustion Air Quality

The recommended source of combustion air is to use the outdoor air supply. Excessive exposure to contaminated combustion air will result in safety and performance related problems. However, the use of indoor air in most applications is acceptable, except as described below.

- If the furnace is installed in a confined space it is recommended that the necessary combustion air come from the outdoors by way of attic, crawl space, air duct or direct opening.
- If indoor combustion air is used, there must be no exposure to the installations or substances listed below.

- The following types of installations may require OUT-DOOR AIR for combustion, due to chemical exposure.
 - a. Commercial buildings
 - b. Buildings with indoor pools
 - c. Furnaces installed in laundry rooms
 - d. Furnaces installed in hobby or craft rooms
 - e. Furnaces installed near chemical storage areas
 - f. Permanent wave solutions
 - g. Chlorinated waxes and cleaners
 - h. Chlorine based swimming pool chemicals
 - i. Water softening chemicals
 - j. De-icing salts or chemicals
 - k. Carbon tetrachloride
 - Halogen type refrigerants
 - m. Cleaning solvents (such as perchloroethylene)
 - n. Printing inks, paint removers, varnishes, etc.
 - o. Hydrochloric acids
 - p. Cements and glues
 - q. Antistatic fabric softeners for clothes dryers
 - r. Masonry acid washing chemicals

VENT PIPE SIZING (1-PIPE SYSTEM)

Refer to Table 6 to select the proper size piping for venting. The size will be determined by a combination of furnace model, total length of run, and the number of elbows required. The following rules must also be observed.

NOTE: Furnace vent pipe connections are sized for 2-in. pipe. Any pipe size change must be made outside the furnace casing in a vertical pipe section to allow proper drainage of vent connections.

NOTE: An offset using two 45 degree elbows may be required for plenum clearance when the vent is increased to 3".

- 1. Long radius elbows are required for all units.
- 2. Elbows are assumed to be 90 degrees. Two 45 degree elbows count as one 90 degree elbow.
- 3. One Vent terminal elbow is already accounted for and should not be counted in the allowable total indicated in the table. Refer to the section of this manual on vent terminal. This part is shown shaded.
- All vent pipe and fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), F891 (PVC-DWV Cellular Core), D2241 (SDR-21 and SDR-26 PVC), D2261 (ABS-DWV), or F628 (Schedule 40 ABS. Pipe cement and primer must conform to ASTM Standards D2564 (PVC) or D2235 (ABS).
- 5. The use of flexible connectors or no hub connectors in the vent system is not allowed.

Table 6: VENT PIPING / 1-PIPE SYSTEM - ALL MODELS

Model	Pipe Size	Max. Elbows vs. One Way Vent Length (Ft.)				
eue.	po oo	5-40	45	50	75	
All Models Except: 120 / 112 / 2000 / D	2"	6	5	4	N/A	
All Models Except: 120 / 112 / 2000 / D	3"	8	7	6	5	
120 / 112 / 2000 / D	3" Only	6	5	4	N/A	

NOTE: If installing furnace at altitudes between 2000 - 4500 ft., intake and vent pipe length must be reduced by 10 ft. If the installation requires the maximum allowable intake and vent pipe length, the furnace must be converted for high altitude operation. Refer to the proper high altitude application instruction for details.

VENT TERMINATION (1-PIPE SYSTEM)

Side wall horizontal vent terminals and roof mounted vertical terminals may be field fabricated. Standard PVC/SRD fittings may be used. Terminal configuration must comply as detailed in this section.

When selecting the locations for vent termination, the following should be considered:

- Comply with all clearance requirements. Refer to Figure 26.
- Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
- Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
- 4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
- 5. Termination should be positioned where vent vapors are not objectionable.

In Canada, refer to CAN/CGA-B149.1 or.2 Installation Code (latest edition - Venting Systems and Air Supply)

VENT TERMINAL LOCATION CLEARANCES

The vent must be installed with the following minimum clearances, (Figure 26), and complying with local codes or utility requirements or other authority having jurisdiction.

- 1. 1 foot above grade and above normal snow levels.
- 2. Not above any walkway.
- 4 feet below, 4 feet horizontally from, or 1 foot above any door/window or gravity air inlet to the building, or from gas or electric meters.
- 6 feet from any inside corner formed by two exterior walls. 10 feet is recommended where possible.
- At least 4 feet horizontally from any soffit or undereave vent.

- 10 feet from any forced air inlet to the building. Any fresh air or make up inlet as for a dryer or furnace area is considered to be a forced air inlet.
- 7. Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

NOTE: Consideration must be given for degradation of building materials by flue gases.

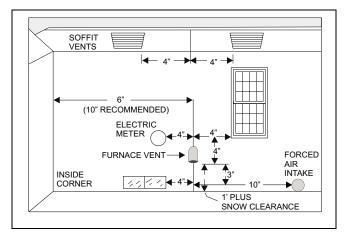


FIGURE 26: Minimum Vent Terminal Clearances (1-Pipe System) - U.S. Only

NOTE: Shaded components of the vent system shown in Figures 27 & 28 are considered to be terminations. These components should not be counted when determining piping limitations. Sidewall termination may require sealing or shielding of building surfaces with a corrosive resistant material due to vent system corrosive combustion products.

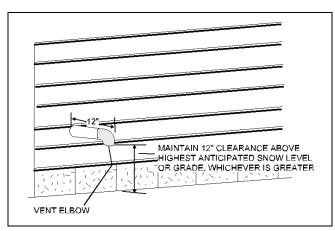


FIGURE 27: Horizontal Termination Configuration with 12"
Minimum Clearance

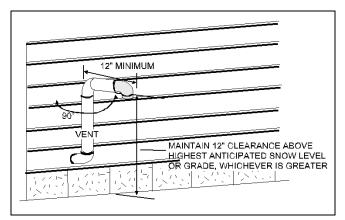


FIGURE 28: Horizontal Termination Raised Configuration for Additional Clearance

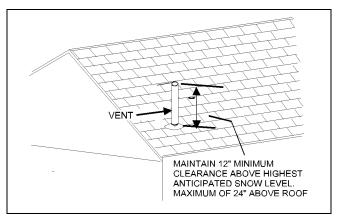


FIGURE 29: \Rooftop Termination

PIPING ASSEMBLY

The final assembly procedure for the vent piping is as follows:

- 1. Cut piping to the proper length, beginning at the furnace.
- 2. Deburr the piping inside and outside.
- 3. Chamfer the outer edges of the piping.
- 4. Dry-fit the entire vent piping system.
- Disassemble the piping and apply cement primer and cement per the cement manufacturer's instructions.
 Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.

A CAUTION

Solvent cements are flammable and must be used in well-ventilated areas only. Keep them away from heat, sparks and open flames (including pilots). Do not breathe vapors and avoid contact with skin and eyes.

- All joints must be made to provide a permanent, air tight. water tight seal.
- 7. Support the vent piping such that it is angled 1/4" per linear foot so that condensate will flow back towards the furnace. Piping should be supported with pipe hangers to prevent sagging. Maximum spacing between hangers is 5 feet, except SDR-PVC piping, where maximum spacing is 3 feet.
- 8. Seal around the openings where the vent piping passes through the roof or side wall.

A CAUTION

Vent piping must be insulated with 1/2" Armaflex insulation if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.

When combustion air pipe is installed above a suspended ceiling, the pipe must be insulated with 1/2" Armaflex type insulation. The combustion air pipe should also be insulated when it passes through a warm, humid space.

NOTE: Vent pipe must be sloped 1/4" per foot to allow condensate to flow back to the furnace.

METHOD THREE: TWO PIPE SYSTEM USING COMBUSTION AIR FROM A VENTILATED ATTIC SPACE

This type installation requires two properly sized pipes. One brings combustion air from a properly ventilated attic space and a second pipe from the furnace vent connection (top right of unit) exits to the outdoors.

In Canada, refer to CAN/CGA-B149.1 or.2 Installation Code (latest edition - Venting Systems and Air Supply)

COMBUSTION AIR INTAKE

Refer to Tables 4 or 5 on Page 14 or 15, for intake pipe sizing, allowable length and elbow usage. Follow all notes, procedures and required materials in the Two-Pipe Sealed Combustion section (Method 1) when installing the combustion air pipe within the unit and into the ventilated attic space.

COMBUSTION AIR TERMINATION

Refer to Figure 30, for required termination method and configuration for the intake pipe. For attic termination, use two 90 elbows with the open end in a downward position. Be sure to maintain 12" clearance above any insulation, flooring or other

AWARNING

Be sure to instruct the owner not to block this intake

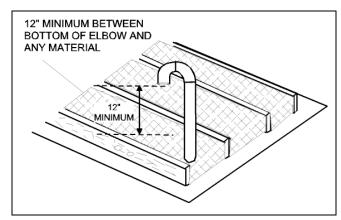


FIGURE 30: Attic Combustion Air Termination

COMBUSTION AIR REQUIREMENTS

The ventilated attic space from which the combustion air is taken must comply with the requirements shown on page 13 in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (current edition).

VENT PIPE

For vent pipe sizing, allowable length and elbow usage, see Tables 4 or 5 on Page 14 or 15. Follow all notes, installation procedures and required materials in the **METHOD TWO: ONE PIPE SYSTEM on Page 17** to install the vent pipe from the unit to the outdoors.

VENT TERMINATION

The vent pipe termination must be installed within the allowable locations, (Refer to Figure 26 on Page 20) and Section 7.8 in the National Fuel Gas Code, ANSI Z223.1 (current edition). Follow all local agency and utility requirements if more restrictive than those shown. For vent termination, refer to Figure 27 thru Figure 29.

HORIZONTAL VENT APPLICATIONS

If installing a horizontal venting system, it is recommended that a vent drain be added to the vent pipe to prevent the accumulation of excess condensate in the inducer motor during operational cycles. Refer to Figure 31.

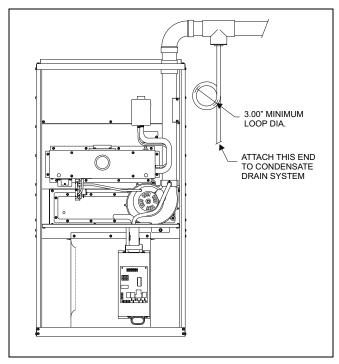


FIGURE 31: Horizontal Vent Drain - Upflow Models

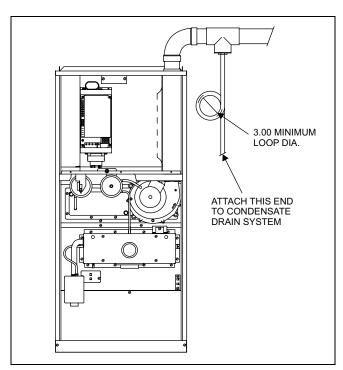


FIGURE 32 : Horizontal Vent Drain - Downflow/Horizontal Models

To install the vent drain, complete the following steps:

- Place a tee of the proper diameter for the vent system being installed (2" or 3") in the horizontal run closest to the furnace.
- Place a reducer bushing of proper diameter in the stem portion of the tee. The recommended size for the reducer is 5/8".
- 3. Place a piece of 5/8" diameter or other selected size pipe a minimum of 3" long into the reducer to serve as a nipple.

NOTE: Tee, reducer and nipple must be properly cemented together using the appropriate method and materials specified in the Combustion Air Intake/Vent Connections section of these instructions.

- Connect a piece of flexible drain tubing such as EPDM rubber, Vinyl or PVC to the nipple.
- 5. Loop the drain tubing to provide a trap.
- Connect the discharge end of the drain tube to the condensate disposal system externally to the furnace.

CONDENSATE PIPING

The condensate drain connection is packed in the furnace for field installation. It consists of a formed hose with a 1/2" NPT male connection. A 1/2" FM x 3/4" PVC slip coupling is provided.

This drain hose may be installed to allow left or right side condensate drain connection. Refer to Figure 33. Cut the hose to allow for proper fit for left or right exit.

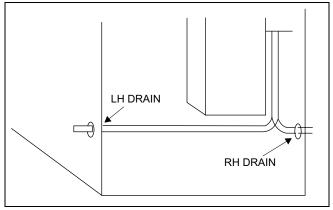


FIGURE 33: Condensate Piping - Upflow Models

To install the drain hose assembly, remove the 7/8" knockout in the side panel. Remove the conduit nut from the 1/2" male fitting. Push the male fitting through the hole and reinstall the nut. The use of the 3/4" PVC coupling is optional.

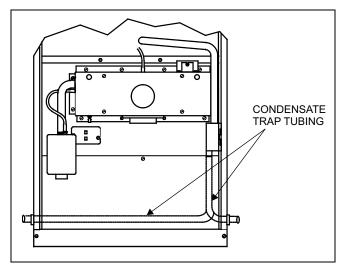


FIGURE 34: Downflow/Horizontal Models

CONVERSION FOR HORIZONTAL APPLICATIONS

Remove the condensate trap and its mounting bracket from the unit side panel. Remove all drain hoses.

Reinstall the trap/bracket on the side panel which will be on the bottom when the unit is located horizontally. Use the original mounting screws.

Refer to Figure 35 for hose locations and Table 7 on Page 23 for hose cut lengths. All hoses are identified as shown in Figure 35.

For horizontal left airflow (inducer and vent low) or horizontal right airflow (inducer and vent high), install condensate drain hoses as follows:

RIGHT AIRFLOW (Inducer High) - Three hoses are required. Hoses are supplied with furnace. Refer to Figure 35 and Table 7 on Page 23 for application.

LEFT AIRFLOW (Inducer Low) - Two hoses are required. Inducer outlet to trap is supplied. Condensate pan to trap must be field supplied using 5/8" I.D. hose material. Refer to Figure 35 and Table 7 on Page 23, for hose placement and sizing.

Table 7: HORIZONTAL CONDENSATE DRAIN HOSE SIZES - MODELS P*DH / FG9-DH / G9T-DH

	CABINET SIZE (IN.)					
DIM.	RIGHT AIRFLOW (INDUCER HIGH)					
	14-1/2 17-1/2 21 24-1/2					
Α	4-1/2	4-3/4	3-1/2	5-1/4		
В	7-1/2	10-1/2	14	17-1/2		
С	13-1/2	16-1/2	20	23-1/2		
	LEFT AIRFLOW (INDUCER LOW)					
D	3-3/8	3-1/4	3-1/4	3-1/4		

A CAUTION

Plug all unused condensate trap, condensate pan and inducer drain connection points using plugs provided.

Drain Connection: The following steps apply to all models.

- It is recommended that either 1/2" or 3/4" PVC or equivalent pipe be field installed as drain pipe. The condensate piping may be tied together with the air conditioning condensate drain if the air conditioning condensate drain line is trapped upstream of the tie-in and the combined drains are constructed of the same material.
- 2. All pipe joints must be cleaned, de-burred and cemented using PVC primer and cement.
- The furnace contains an internal trap. Therefore, no external trap should be used.
- If a condensate pump is used, it must be suitable for use with acidic water.
- 5. Where required, a field-supplied neutralizer can be installed in the drain line, external to the furnace.

NOTE: The condensate drain from the furnace may be connected in common with the drain from an air conditioning coil if allowed by local code. Follow the instructions with the coil for trapping the drain.

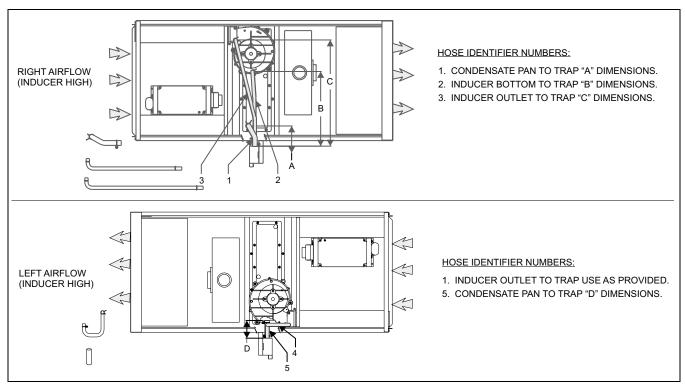


FIGURE 35: Horizontal Application Condensate Drain Connection

SAFETY CONTROLS

<u>Control Circuit Fuse:</u> A 3 amp. fuse is provided to protect the 24 volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located in the unit wiring harness between the control transformer and the furnace control.

<u>Blower Door Safety Switch:</u> This unit is equipped with an Electrical Interlock Switch mounted in the blower compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.



Blower and burner must never be operated without the blower panel in place.

Electrical supply to this unit is dependent upon the panel that covers the blower compartment being in place and properly positioned.



Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. Do not rely upon the interlock switch as a main power disconnect.

Rollout Switch Controls: This control is mounted on the burner box assembly. If the temperature in the burner compartment exceeds its set point, the igniter control and the gas valve are de-energized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. This is a manual reset control and must be reset before operation can continue.

<u>Pressure Switches:</u> This furnace is supplied with pressure switches which monitor the flow through the combustion air/vent piping system. These switches de-energize the ignition control module and the gas valve if any of the following conditions are present.

- Blockage of combustion air piping or terminal:
 - Low fire (1LP)
 - High fire (2 LP)
- 2. Blockage of vent piping or terminal:
 - Low fire (1LP)
 - High fire (2 LP)
- 3. Failure of combustion air blower motor:
 - Low fire (1LP)
 - High fire (2 LP)
- 4. Blockage of condensate drain piping:
 - Low fire (1LP)
 - High fire (2 LP)
- 5. Blockage of condensate drain piping (horizontal right installations only).
 - Low fire (3 LP)
 - High fire (3 LP)

LIMIT CONTROL

There are high temperature limit control(s) located on the furnace vestibule panel near the gas valve. These are automatic reset controls and provide over temperature protection due to reduced airflow, such as a dirty filter.

START-UP AND ADJUSTMENTS

The initial start-up of the furnace requires the following additional procedures:

 When the gas supply is initially connected to the furnace, the gas piping may be full of air. In order to purge this air, it is recommended that the ground union be loosened until the odor of gas is detected. When gas is detected, immediately retighten the union and check for leaks. Allow five minutes for any gas to dissipate before continuing with the start-up procedure.

A CAUTION

Be sure proper ventilation is available to dilute and carry away any vented gas.

A CAUTION

Perform the following procedures only after the condensate trap has been properly piped to a drain connection using the procedure in this instruction.

- The condensate trap must be filled with water before putting the furnace into operation. The recommended procedure is as follows:
 - a. Disconnect the condensate drain hose from the induced draft blower discharge.
 - b. Elevate this hose and fill with water using a funnel.
 - c. Replace the condensate drain hose and clamps.

NOTE: If this procedure is not followed, the unit may not properly drain on initial start up.

All electrical connections made in the field and in the factory should be checked for proper tightness.

IGNITION SYSTEM SEQUENCE

- Turn the gas supply ON at external valve and main gas valve.
- Set the thermostat above room temperature to call for heat.
- 3. System start-up will occur as follows:
 - a. The induced draft blower motor will start at high speed and wait for low pressure switch contacts to close, then switch to low speed and the hot surface ignitor will glow for approximately 17 seconds.

- b. The ignition module will energize (open) the main gas valve on low fire for seven seconds.
- After flame is established, the supply air blower will start in about 30 seconds.

NOTE: Burner ignition may not be satisfactory on first startup due to residual air in the gas line or until gas manifold pressure is adjusted. The ignition control will make 3 attempts to light before locking out.

4. With furnace in operation, paint the pipe joints and valve gasket lines with a rich soap and water solution. Bubbles indicate a gas leak. Take appropriate steps to stop the leak. If the leak persists, replace the component.

A CAUTION

DO NOT omit this test! Never use a flame to check for gas leaks.

GAS VALVE OPERATION

The electronic switch is a two-position (ON-OFF) type. To turn the valve ON, flip the switch to line up the word ON on the switch housing, Refer to Figure 36.

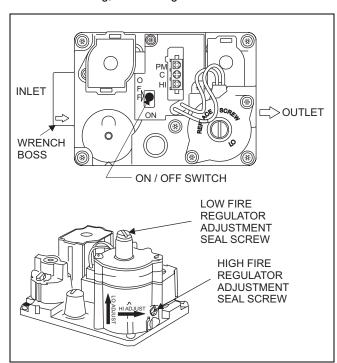


FIGURE 36: Gas Valve (Top) Manual Control Knob (Bottom) Regulator Adjustments

CHECKING GAS INPUT (NATURAL GAS)

NOTE: Front door of burner box must be secured when checking gas input.

- 1. Turn off all other gas appliances connected to gas meter.
- With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical domestic gas meter usually has a 1/2 or 1 cubic foot test dial.
- Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour from Table 4 on page 15.

NOTE: To find the Btuh input, multiply the number of cubic feet of gas consumed per hour by the BTU content of the gas in your particular locality. Contract your gas company for this information, as it varies widely from city to city.

EXAMPLE: It is found by measurement that it takes 26 seconds for the hand to turn on the 1 cubic foot dial to make a revolution with only a 120,000 Btuh furnace running. Using this information, locate 26 seconds in the first column of.

Read across to the column headed **1 Cubic Foot** where you will see that 138 cubic feet of gas per hour are consumed by the furnace at that rate. Multiply 138 by 850 (the BTU rating of the gas obtained from the local gas company). The result is 117,300 Btuh, which is close to the 120,000 Btuh rating of the furnace.

If the actual input is not within $\pm 2\%$ of the furnace rating, with allowance being made for the permissible range of the regulator setting (0.3 inches W.C.), replace the orifice spuds with spuds of the proper size.



Be sure to relight any gas appliances that were turned off at the start of this input check.

SECONDS FOR	SIZE OF TEST DIAL				
ONE REVOLUTION	1/2 CUBIC FOOT	1 CUBIC FOOT			
10	180	360			
12	150	300			
14	129	257			
16	113	225			
18	100	200			
20	90	180			
22	82	164			
24	75	150			
26	69	138			
28	64	129			
30	60	120			
32	56	113			
34	53	106			
36	50	100			
38	47	95			
40	45	90			
42	43	86			
44	41	82			
46	39	78			
48	37	75			
50	36	72			
52	35	69			
54	34	67			
56	32	64			
58	31	62			
60	30	60			

ADJUSTMENT OF MANIFOLD GAS PRESSURE

Manifold gas pressure may be measured by two different procedures. It may be measured with the burner box cover in place or it may be measured with the burner box cover removed. Follow the appropriate section, 1a or 1b in the instructions below.

- Read the inlet gas pressure using either of the two methods below.
 - Reading the gas pressure with the burner box cover in place - Disconnect the pressure reference hose from the right side of the burner box. Using a tee fitting and a short piece of hose, connect the negative side of the manometer to the burner box pressure reference port. Connect the positive side of the manometer to the adapter previously installed in the gas valve, See Figure 37 or 38.
 - Reading the gas pressure with the burner box cover removed - Remove the screws securing the burner box front cover plate. Remove the cover. It is gasketed and may stick in place. Connect the positive side of the manometer to the adapter previously installed in the gas valve as shown in Figure 37 or 38. There will be no second connection to the manometer as it will reference atmospheric pres-

The regulated outlet pressures, both low and high, have been calibrated at the factory. Additional pressure adjustment should not be necessary. If adjustment is necessary, set to the following specifications. After adjustment, check for gas leakage.

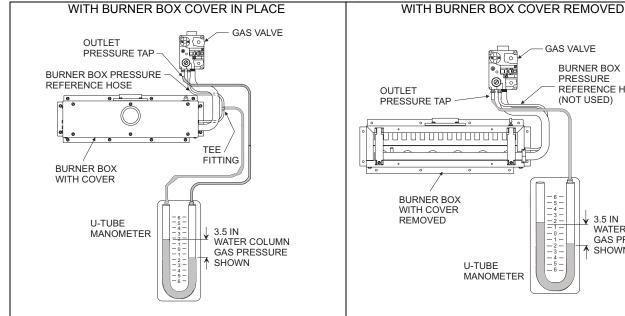
Natural Gas			
Low Fire 1.6 IWG			
High Fire	3.5 IWG		

High Outlet Pressure Adjustment

- Turn off all electrical power to the system at main fuse or circuit breaker.
- 2. Attach a manometer to the outlet pressure tap of the valve
- 3. Turn on power and energize main and redundant (P.M.) solenoids as well as the HI terminal.
- 4. Remove high adjustment seal screw to expose the 3/32" set screw (Refer to Figure 36).
- To increase outlet pressure, turn the 3/32" set screw clockwise. To decrease outlet pressure, turn the set screw counterclockwise. Adjust regulator until pressure shown on manometer matches the pressure specified on the appliance rating plate.
- 6. Replace low adjustment seal screw and tighten securely. Cycle the valve several times to verify regulator setting.
- Remove manometer and replace the outlet pressure tap

Low Outlet Pressure Adjustment

- Turn off all electrical power to the system at main fuse or circuit breaker.
- 2. Attach a manometer to the outlet pressure tap of the valve
- Turn on power and energize main and redundant (P.M.) solenoids. Do not energize HI terminal.
- Remove low adjustment seal screw, See Figure 36.
- To **increase** outlet pressure, turn the 3/32" set screw below the low adjustment seal screw clockwise. To decrease outlet pressure, turn the set screw counterclockwise. Adjust regulator until pressure shown on manometer matches the pressure specified on the appliance rating plate.
- Replace high adjustment seal screw and tighten securely. Cycle the valve two or three times to verify regulator setting.
- Remove manometer and replace the outlet pressure tap plug.



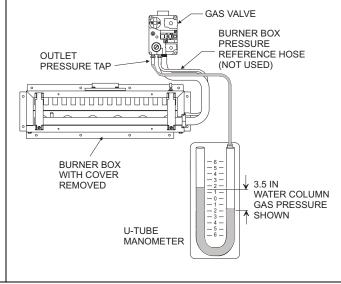


FIGURE 37: Reading Gas Pressure - Upflow Models

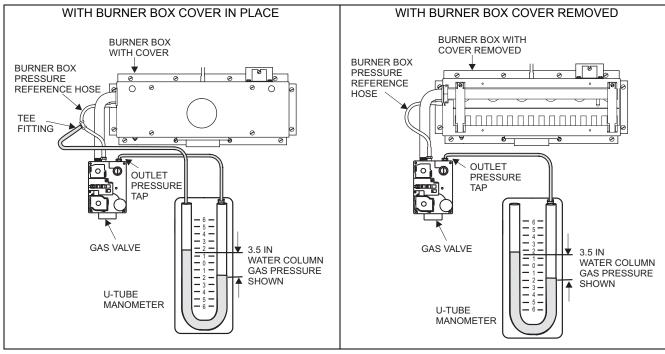


FIGURE 38: Reading Gas Pressure - Downflow/Horizontal Models

A CAUTION

The manifold pressure must be checked with the screw-off cap for the gas valve pressure regulator in place. If not, the nominal manifold pressure setting will result in an over-fire condition.

If manifold pressure is too high, an over-fire condition exists which could cause heat exchanger failure. If the manifold pressure is too low, sooting and eventual clogging of the heat exchanger could occur.

Be sure that gas valve regulator cap is replaced and burner box to gas valve pressure reference hose is reconnected.

Once the correct gas pressure to the burners has been established, turn the gas valve switch to OFF and turn the electrical supply switch to OFF; then remove the pressure tap at the gas valve and re-install the plug, using a compound (on the threads) resistant to the action of LP gases. Replace the burner box front cover or the pressure reference hose.

Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the plug with a soap and water solution.

ADJUSTMENT OF TEMPERATURE RISE DIRECT DRIVE MOTORS (ONLY APPLIES TO PSC REPLACEMENT)

The temperature rise, or temperature difference between the return air and the heated air from the furnace, must be within the range shown on the furnace rating plate. Application limitations are shown in Table 1 or 2. After the temperature rise has been determined, the cfm can be calculated.

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts, about six feet from the furnace where they will not be affected by radiant heat.

Increase the blower speed to decrease the temperature rise; decrease the blower speed to increase the rise.

All direct-drive blowers have multi-speed motors. The blower motor speed taps are located in the control box in the blower compartment.

You may select a heating speed and a cooling speed. They may be the same speed or a different speed.

To use the same speed tap for heating and cooling, the heat terminal and cool terminal must be connected using a jumper wire and connected to the desired motor lead. Place all unused motor leads on Park terminals. Two Park terminals are provided.



Do not energize more than one motor speed at a time or damage to the motor will result.

VARIABLE SPEED MOTORS

The temperature rise, or temperature difference between the return air and the heated air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 1 on Page 5 or Table 2 on Page 6.

FURNACE ACCESSORIES

ELECTRICAL	
*ET03700324	Thermostat, One-stage Heat/One-stage Cool, non-programmable
*ET03700124	Thermostat, One-stage Heat/One-stage Cool, Deluxe programmable
*ET03770010124	Thermostat, Two-stage Heat/Two-stage Cool, non-programmable
*ET03700024	Programmable Thermostat, Two-stage Heat/Two-stage Cool, Deluxe programmable
Non-electrical	
1NP0480	Propane Conversion Kit
1SR0302BK	External Side Filter Rack (6-Pack)
1BR0317	External Bottom or Horizontal Filter Rack - Cabinet "B"
1BR0321	External Bottom Filter Rack - Cabinet "C"
1BR0324	External Bottom or Horizontal Filter Rack - Cabinet "D"
1NK0301	Condensate Neutralizer Kit
1PS0315	High Altitude Pressure Switch Kit - 60 / 55 / 1200 "B"
1PS0316	High Altitude Pressure Switch Kit - 80 / 75 / 1600 "C"
1PS0317	High Altitude Pressure Switch Kit - 100 / 95 / 2000 "C"
1PS0318	High Altitude Pressure Switch Kit - 120 / 112 / 2000 "D"
1CT0302	Concentric Vent Kit - 2"
1CT0303	Concentric Vent Kit - 3"
1CT0317	Combustible Floor Base - Cabinet "B"
1CT0324	Combustible Floor Base - Cabinet "D"

^{*} Substitute 2 for York brands and 6 for non York brands.

AIRFLOW

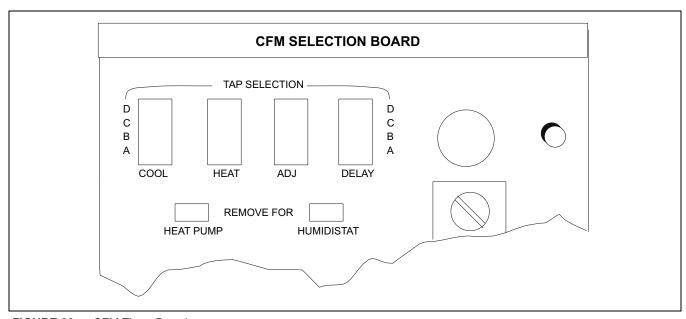


FIGURE 39: CFM Timer Board

HEATING AIRFLOW

The heating airflow has been preset at the factory to provide maximum CFM. If a lesser CFM is required for a specific HVAC system the "JUMPER" on the HEAT selection pins on the CFM-Timer Board may be moved to tap "B", "C", or "D". Pin "A" will provide the highest CFM and "D" the lowest CFM (Refer to Tables 9 or 10).

NOTE: When changing jumper positions, make sure that the jumper is pushed all the way on the pins. If the jumper is not making good contact or is left off completely, the blower will operate as if the jumper were in the "A" position.

NOTE: Power to the blower must be removed for at least 4 seconds after a heat or cool tap selection change, in order for the motor to recognize an adjustment.

The fixed blower on delay and adjustable blower-off delay will function as described in the "OPERATION AND MAINTENANCE" Section on Page 32 of this instruction.

COOLING AIRFLOW

The cooling airflow is preset at the factory to provide approximately 90 percent of the maximum CFM and must be field adjusted to match the HVAC system at installation. Refer to the outdoor unit installation instruction for the recommended airflow for the cooling system.

The "DELAY" Tap should be set in the "B" position for a two-stage condenser. This results in a 45 second off delay at 82% of the programmed cooling airflow with a 15-second coast to stop. It should be set in the "C" position for a system with a TXV or solenoid valve. This results in a 45 second off delay at 75% of the programmed cooling airflow with a 15-second coast to stop. It should be set in the "D" position for a system without a TXV or solenoid valve. This results in a 60 second off delay at 82% of the programmed cooling airflow with a 15-second coast to stop. The "A" position is the factory setting and is used for test purposes. With the delay set in the "A" position, the blower will operate at 100% of the programed cooling air flow for 60 seconds, with a 15 second coast to stop.

ADJUSTMENT OF FAN-OFF CONTROL SETTINGS

This furnace is equipped with a time-on/time-off heating fan control. The fan-on is fixed at 30 seconds. The fan-off delay is factory set to 60 seconds (refer to Table 8 and Figure 40), however, it is field-adjustable to 90, 120 or 180 seconds. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space.

The continuous fan speed dip switch (switch 3) on the ignition control has no affect on setting and should be left in the off position, as continuous fan speed is determined by the vari-

Table 8: FAN CONTROL SETTINGS

IGNITION CONTROL					
To Delay Fan-Off By:	Set Switch 1-2				
60 Sec.	On-On				
90 Sec.	Off-On				
120 Sec.	On-Off				
180 Sec.	Off-Off				

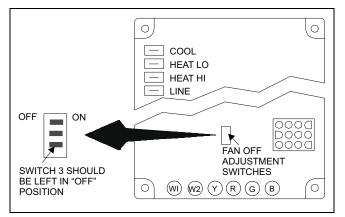


FIGURE 40 : Typical Heat/Cool Speed Tap Connections (PSC Motor)

CONTINUOUS BLOWER

There are two modes of continuous blower operation. In one mode the blower is controlled directly through the blower motor. In the second mode the blower is controlled through the ignition control. In the first mode, when the thermostat fan-switch is set to the ON position a circuit is completed between terminals "R" and "G" of the thermostat. The continuous fan speed will be 63% of the high cool speed. If more air is desirable the green wire labeled (G Cool Speed) may be connected to the "G" terminal of the ignition control to achieve HIGH COOL speed (DIP switch number 3 on the ignition control must be in the OFF position). The air cleaner and the blower motor are energized through the ignition control or directly through the motor.

INTERMITTENT BLOWER COOLING

On cooling/heating thermostats with fan switch, when the fan switch is set in the auto position and the thermostat calls for cooling, a circuit is completed between the R, Y and G terminals. The motor is energized through the Y1 cool terminal and runs on the speed selected on the CFM Timer board. The fan off setting is fixed at 60 seconds for SEER enhancement.

Table 9: AIRFLOW DATA - UPFLOW MODELS

	HIGH/LOW SPEED COOLING AND HEAT PUMP CFM								
_	2V05501 12UPB11	P1XUC1 G9V0801			20V09501 20UPC11	P1XUD20V11201 G9V12020UPD11		JUMPER SETTINGS	
High	Low	High	Low	High	Low	High	Low	COOL TAP	ADJ TAP
1315	720	1655	930	2030	1090	2180	1210	Α	В
1095	610	1555	855	1780	945	1760	970	В	В
1200	655	1510	830	1890	1000	2000	1100	Α	Α
1010	545	1440	790	1630	850	1600	910	В	Α
1065	595	1375	755	1685	895	1780	990	Α	С
870	500	1350	745	1555	830	1540	860	С	В
885	505	1280	700	1430	785	1410	820	В	С
655	450	1150	620	1310	740	1300	770	D	В
870	460	1230	670	1400	770	1400	800	С	Α
610	445	1030	555	1220	665	1220	710	D	Α
715	450	1120	600	1245	700	1230	740	С	С
545	450	915	495	1075	605	1060	660	D	С
				HIGH/LOW	HEAT CFM		•		
	P1XUB12V05501 P1XUC16V07501 P1XUC20V09501 G9V06012UPB11 G9V08016UPC11 G9V10020UPC11			P1XUD2 G9V1202		JUMPER SETTINGS			
High	Low	High	Low	High	Low	High	Low	HEAT TAP	ADJ TAP
1020	665	1635	1065	1940	1225	1870	1205	Α	Any
925	610	1540	990	1745	1105	1715	1105	В	Any
850	555	1400	890	1595	1010	1590	1020	С	Any
785	515	1265	805	1475	930	1480	950	D	Any

Table 10: AIRFLOW DATA - DOWNFLOW/HORIZONTAL MODELS

	HIGH	/LOW SPEED CO	OLING AND HEAT P	UMP CFM		
P1XDB12V07501 G9V08012DHB11		P1XDD20V11201 G9V12020DHD11		JUMPER SETTINGS		
High	Low	High	Low	COOL TAP	ADJ TAP	
1345	740	2230	1290	А	В	
1120	620	1810	1025	В	В	
1225	675	2100	1150	А	Α	
1020	560	1680	950	В	Α	
1100	605	1850	1045	А	С	
880	490	1600	900	С	В	
920	505	1500	840	В	С	
660	450	1410	770	D	В	
800	450	1510	825	С	Α	
600	420	1265	700	D	Α	
720	440	1320	740	С	С	
545	420	1120	625	D	С	
		HEATIN	NG AIRFLOW	•		
	P1XDB12V07501 G9V08012DHB11		20V11201 20DHD11	JUMPER SETTINGS		
High	Low	High	Low	COOL TAP	ADJ TAP	
1380	900	1925	1260	A	Any	
1260	820	1750	1165	В	Any	
1150	750	1600	1055	С	Any	
1075	700	1475	985	D	Any	

All CFM's are shown at 0.5" w.c. external static pressure. These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. From 0.6" to 1.0" static pressure, CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. external static pressure is not recommended.

NOTE: At some settings, LOW COOL and/or LOW HEAT air flow may be lower that what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

OPERATION AND MAINTENANCE

SEQUENCE OF OPERATION

The following describes the sequence of operation of the furnace as it relates to a furnace equipped with a variable speed blower. Refer to the schematic wiring diagram for component location on Page 39 or 40.

HEATING OPERATIONAL SEQUENCE

TWO STAGE THERMOSTAT

The ignition control in this furnace is unique to this product. The control allows for a 24 volt or a 115 volt circulator input/output. This allows for the replacement of the variable speed motor with a multi-speed PSC motor in the event a variable speed motor is not available at the time of servicing.

In a typical system, a call for first stage heat is initiated by closing the W1 thermostat contacts. The inducer blower is energized at high speed and the control waits for the low pressure switch contacts to close. The inducer blower is energized at low speed and the 120 VAC silicon carbide ignitor is powered.

At the end of the ignitor warm-up time, the first stage of the two stage gas valve is energized (low fire). Flame must be detected within 7 seconds. If flame is detected, the delay-to-fan-on period begins. After the delay-to-fan-on period ends, the circulator fan is energized at low heat speed and the air cleaner and humidifier are energized.

A call for second stage heat (W1 and W2) after a call for first stage heat will energize the inducer at high speed and energize the circulator at high heat speed. The circulator will energize at high heat speed after 30 seconds with a call for second stage heat. If the furnace has been operating in first stage heat for more than 30 seconds and the control receives a call for second stage heat, the blower will immediately switch to high speed. The second stage pressure switch contacts will close and energize the second stage gas valve (high fire).

If a call for second stage heat occurs at the same time as a call for first stage heat, the second stage heat is energized immediately after flame rectification is sensed on first stage.

When the second stage of the thermostat is satisfied, the inducer motor is reduced to low speed and the 2nd stage gas valve is de-energized to 1st stage. The circulator remains on high heat speed for 30 seconds then de-energizes to low heat speed.

When the first stage of the thermostat is satisfied, the gas valve is de-energized and the heat delay to fan off begins timing. The inducer will postpurge for an additional 15 seconds, then the inducer and humidifier will de-energize. Upon completion of the heat delay-to-fan-off, the circulator and air cleaner are de-energized. Control timing, refer to (Refer to Figure 41 on Page 33).

If flame is not detected during the trial for ignition period, the gas valve is de-energized, the ignitor is turned off and the ignition control goes into the "re-try" sequence.

The "re-try" sequence provides a 60 second wait with inducer interpurge following an unsuccessful ignition attempt (flame not detected). After this wait, the ignition sequence is restarted with an additional 10 seconds of ignitor warm-up time. Two retries will be attempted before the control goes into system lockout. If flame is established for more than 10 seconds after ignition, the ignition controller will clear the ignition attempt (or retry) counter.

If flame is detected, then lost, the ignition control will repeat the initial ignition sequence. After 5 attempts to sustain flame, the control will go into system lockout.

During burner operation, a momentary loss of power of 50 milliseconds or longer will de-energize the main gas valve. When power is restored, the gas valve will remain

de-energized and a restart of the ignition sequence will begin immediately.

A momentary loss of gas supply, flame blowout, or a shorted or open condition in the flame probe circuit will be sensed within 0.8 seconds. The gas valve will de-energize and the control will restart the ignition sequence.

Recycles will begin and the burner will operate normally if the gas supply returns, or the fault condition is corrected, before the last ignition attempt. Otherwise, the control will go into system lockout.

If the control has gone into system lockout, it may be possible to reset the control by a momentary power interruption of one second or longer. Refer to the FURNACE CONTROL DIAGNOSTICS on Page 37 of this instruction for reset information.

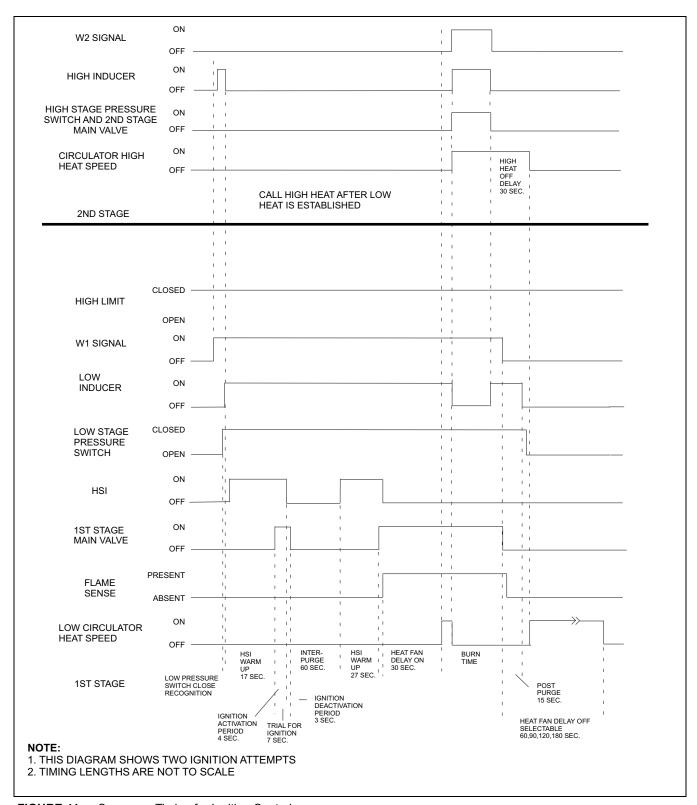


FIGURE 41: Sequence Timing for Ignition Control

SINGLE STAGE THERMOSTAT

If a single stage thermostat is used the unit will be controlled through the CFM Timer board timer adjustment pins (Refer to Figure 13 on Page 13.). For the furnace to operate on High Fire the timer jumper must be placed on the 10, 15 or 20 minute adjustment terminals. On a call for heat the unit will operate on low fire as detailed above. If the heating requirements cause the cycle to exceed the jumper settings, the high fire timer will energize the second stage heat. The second stage operation will function as detailed above. The heating cycle will be completed in high fire operation. If the timer jumper is in the "TIME OFF" position with a single-stage thermostat, the unit will stay in low fire operation.

HOT SURFACE IGNITION SYSTEM



Do not attempt to light this furnace by hand (with a match or any other means). There may be a potential shock hazard from the components of the hot surface ignition system. The furnace can only be lit automatically by its hot surface ignition system.

MAINTENANCE

AIR FILTERS

The filters should be checked periodically for dirt accumulation. Dirty filters greatly restrict the flow of air and overburden the system.

Clean the filters at least every three months. On new construction, check the filters every week for the first four weeks. Inspect the filters every three weeks after that, especially if the system is running constantly.

All filters used with the furnace are the high velocity, cleanable type. Clean these filters by washing in warm water. Make sure to shake all the water out of the filter and have it reasonably dry before installing it in the furnace. When replacing filters, be sure to use the same size and type as originally supplied.

UPFLOW FILTER REMOVAL AND REPLACEMENT

- Turn off electrical power supply to the furnace at disconnect switch. Remove access doors.
- In the blower compartment disengage the looped end of the filter retainer wire from the front edge of the cabinet. The wire will now pivot on the hinged ends at the rear of the cabinet. (Refer to Figure 4 on Page 8)
- Remove the filter and follow the cleaning instructions above. DO NOT remove the filter stiffener rods, if provided.
- When reinstalling the filter, be sure the filter completely covers the cabinet opening and is secured in place by the wire retainer.

LUBRICATION

Blower and ventor motors in these furnaces are permanently lubricated and do not require periodic oiling.

BLOWER CARE



Label all wires prior to disconnecting when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

Even with good filters properly in place, blower wheels and motors will become dust laden after long months of operation. The entire blower assembly should be inspected annually. If the motor and wheel are heavily coated with dust, they can be brushed and cleaned with a vacuum cleaner.

The procedure for removing the direct drive blower assembly for cleaning is as follows:

- Disconnect the electrical supply to the furnace and remove the access doors.
- Remove blower assembly mounting screws and slide the blower assembly out of the slots in the deck. If the two shipping screws were not previously removed, also remove and discard these two screws located on each front corner of the blower assembly.
- 3. To reassemble, reverse the procedure, restore power to the furnace and verify operation.

BURNER AND FLAME SENSOR REMOVAL/CLEANING

The main burners and flame sensor should be checked periodically for dirt accumulation or oxidation.

If cleaning is required, follow this procedure:

- 1. Turn off the electrical power to the unit.
- 2. Turn off the gas supply at the external manual shutoff valve and loosen the ground union joint.
- Remove the upper access panel and remove the burner box cover.
- 4. Remove the screws that hold the burner box assembly to the vest panel and remove the assembly.
- 5. Remove burners from the burner assembly.
- 6. Burners may be cleaned by rinsing in hot water.
- 7. Reassemble the burners in the reverse order.
- 8. Remove the retaining screw to the flame sensor and remove the sensor from the burner box. Clean the flame sense rod with steel wool and replace.

CLEANING THE HEAT EXCHANGER

- Turn off the main manual gas valve external to the furnace.
- 2. Turn off electrical power to the furnace.
- Remove the upper access panel and remove the burner box cover.
- Disconnect wires from flame sensor, rollout switch and HSI igniter. Remove igniter carefully, as it is easily broken.

AWARNING

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

- Remove the screws that hold the burner box assembly to the vestibule panel and remove the assembly. The lower portion of the heat exchanger will now be exposed.
- Remove the upper cover plate at the top of the furnace. Remove the internal baffle.
- The upper portion of the heat exchanger is now exposed.
- With a long flexible wire brush, clean inside each tube at both the top and bottom. The brush must pass around the rear heat exchanger tubes. Vacuum loose scale and dirt from each tube.
- 9. Clean vacuum all burners.
- Replace all components in reverse order. Reconnect all wiring.
- 11. Restore electrical power and gas supply to the furnace.
- 12. Check furnace operation.

CLEANING THE SECONDARY HEAT EXCHANGER

- Follow steps 1 thru 10 under Cleaning the Primary Heat Exchanger.
- Remove the vent piping from the venter housing. Disconnect the drain lines from the venter and from the condensate drain pan. Remove the venter blower and the condensate pan. The turbulators can then be gently removed from the secondary heat exchanger.
- 3. With a stiff wire brush, brush out loose scale or soot.
- 4. Vacuum the secondary heat exchanger.
- 5. Finish the cleaning procedure by following steps 10 thru 12 under Cleaning the Primary Heat Exchanger.

VENT/AIR INTAKE

Should it be necessary to service the vent/air intake system, the manufacturer recommends this service be conducted by a qualified service agency.

The operation of this appliance requires the reassembly and resealing of the vent/air intake system.

TROUBLESHOOTING

The following visual checks should be made before troubleshooting:

- Check to see that the power to the furnace and the ignition control module is ON.
- The manual shutoff valves in the gas line to the furnace must be open.
- 3. Make sure all wiring connections are secure.
- 4. Review the sequence of operation.

Start the system by setting the thermostat above the room temperature. Observe the system's response. Then use the troubleshooting section in this manual to check the system's operation.

TROUBLESHOOTING THE BLOWER ASSEMBLY

Check to see that there is power to the furnace and the ignition circuit module by turning the furnace power OFF for 5 seconds then ON. The red ignition control LED should light for an instant then go out.

NO AIRFLOW OR MOTOR DOESN'T RUN

- Verify that the blower wheel is properly tightened on the motor shaft.
- Verify 115 Volts AC at the power connector at the motor.
- Be sure the connectors at the motor, ignition control and CFM Selection Board are properly connected and fully seated.
- Switch the thermostat to CONTINUOUS FAN mode. If the motor does not run, verify 24 VAC on the R to C lines. If there is no voltage correct the cable/wiring, transformer fault. If there is voltage at the connector, the motor has failed.
- Check High Heat, Low Heat or Cool output terminals for 24 volts.
- · Check motor for tight shaft.
- Perform Moisture Check. Be sure motor connectors are facing down. Arrange the wire harness to create a drip loop under the motor. Check for plugged condensate drain. Check for low airflow. Check and plug leaks in return ducts.

MOTOR ROCKS BUT WON'T START

- Check for loose or compliant motor mount.
- Perform motor/control replacement check.

MOTOR OPERATION IS INTERMITTENT

Verify that all connectors are firmly seated. Gently pull
the motor connector wires at both ends of the cables
individually to be sure they are properly crimped into the
housings.

MOTOR RUNS WHEN IS SUPPOSED TO BE OFF

 Allow a few minutes for the motor to shut off. Motor-off delays are controlled by the ignition control.

MOTOR STARTS BUT: RUNS ERRATICALLY

- Check the line voltage for variation.
- Check low voltage connections at motor, unseated pins in motor harness connectors.
- Check "Bk" for erratic CFM command.

MOTOR HUNTS OR "PUFFS"

Excessive restriction in duct system or filter. Reduce maximum air flow.

STAYS AT LOW CFM DESPITE SYSTEM CALL FOR COOL OR HEAT CFM

- Check low voltage wires and connections.
- Verify fan is not in delay mode wait until delay is complete.
- "R" missing /not connected at motor or terminal strip.
- · Perform motor/control replacement check.

STAYS AT HIGH CFM

- "R" missing/not connected at motor or terminal strip.
- Is fan in delay mode? Wait until delay is complete.
- Perform motor/control replacement check.

BLOWER WON'T SHUT OFF

 Current leakage from controls into G, Y, or W? Check for Triac switched thermostat or solid state relay.

EXCESSIVE NOISE

Determine if it's air noise, cabinet, duct, or motor noise.

AIR NOISE

- Check for loose blower housing, panels, etc.
- High static creating high blower speed.

REPLACEMENT OF FAILED MOTOR CONTROL MODULE

NOTE: The motor control module may be removed and replaced without voiding the GE warranty.



You must have the correct replacement control module for the furnace being serviced. The controls are factory programmed for specific operating modes. Consult the parts list supplied with this furnace to obtain the correct part number before ordering the part.

Using the wrong control module voids all product warranties and may produce unexpected results.

BLOWER REMOVAL FOR CONTROLLER REPLACEMENT

- Refer to BLOWER CARE on Page 34 of this manual for blower removal instructions.
- Rest the blower on its side so the end of the motor is accessible and facing up.
- Wait at least 5 minutes after disconnecting AC power from the furnace before opening the motor.]
- Remove the 2-1/4" Hex head bolts from the motor while holding the control module.

A CAUTION

When the hex bolts are removed from the control module, the module is free from the motor but still connected by a plug and cable. Carefully rotate the control so as to gain access the plug on the end of cable. Squeeze the release latch and gently pull the plug out of the control module. Do not pull on the wires.

- Verify with an ohmmeter that the resistance of each motor lead is greater than 100K ohms by connecting one meter lead to the motor lead and the other to an unpainted portion of the motor housing. If any one of the leads fails this test THE MOTOR IS DEFECTIVE AND MUST BE REPLACED.
- Verify that the replacement control module is the correct one and carefully orient the control module close to the motor so the cable can be plugged into the module. BE SURE THE PLUG LATCHES WITH A CLICK.
- Carefully align the locating pin of the control module with the matching motor hole. Replace the 2-1/4" hex head bolts and tighten snugly. DO NOT OVERTIGHTEN.

REPLACEMENT OF THE VARIABLE SPEED MOTOR WITH A PSC DIRECT DRIVE MOTOR

NOTE: A failed variable speed motor should always be replaced with a variable speed motor suitable for the furnace model being serviced. However, if one is not available, a 3 speed direct drive motor may be used in the interim.

REMOVAL OF THE VARIABLE SPEED BLOWER ASSEMBLY AND MOTOR

Follow the Blower Removal Instructions in the Maintenance section of this instruction under, BLOWER CARE on Page 34.

 Loosen the blower wheel set screw and the motor mount bolt, and slide the variable speed motor out of the blower housing.

INSTALLATION OF PSC MOTOR

- Install the PSC direct drive motor into motor mount.
- Slide motor in motor mount insuring there is no interference between moving and stationary parts. Position wire leads downward. Tighten motor mount band screw to 30 in. lbs.
- Center the blower wheel in the blower housing and align the shaft flat with the blower wheel set screw. Tighten set screw to 30 in. lbs.
- Replace blower assembly and fasten with 5 screws
- Strap motor capacitor to electric panel. Refer to Table 11 on page 37, for proper capacitor selection.
- 6. Fasten electric panel to blower housing.
- Remove red wire from Circ. input terminal. Plug jumper wire (attach to motor power harness) on 120 volt line terminal on ignition control and jumper to Circ. Input. Connect brown door switch wire to jumper.

- 8. Connect white main harness lead to Line neutral.
- Connect motor leads to cool, heat lo and heat high per electrical wire diagram table in the Installation manual.
- Connect brown capacitor leads from motor to capacitor and cover terminals with boot supplied.

POWER SUPPLY POLARITY - Ignition Control

If the power supply polarity is reversed, the following unit operation will occur. On a call for heat, the inducer will run, the HSI will glow and the gas valve will energize and the burners will ignite. The burners will immediately extinguish and the unit will recycle. This will occur 3 times and then the unit will lockout. A "7" flash code will be displayed. This code means the flame could not be established. This occurs because the control cannot sense flame with the power supply polarity reversed.

Table 11: PSC MOTOR SELECTION

UPFLOW MODELS						
Model Number	Motor Part Number	Motor Horsepower	Capacitor Part Number	Capacitor Rating MF		
60 / 55 / 1200 / B	024-23271-000	1/2	024-20045-000	7.5		
80 / 75 / 1600 / C	024-26002-000	3/4	024-20046-000	10.0		
100 / 95 / 2000 / C	024-23288-001	1	024-20446-000	15.0		
120 / 112 / 2000 / D	024-23238-001	1	024-20446-000	15.0		
DOWNFLOW/HORIZONTAL MODELS						
Model Number	Motor Part Number	Motor Horsepower	Capacitor Part Number	Capacitor Rating MF		
80 / 75 / 1200 / B	024-23271-000	1/2	024-20045-000	7.5		
120 / 112 / 2000 / D	024-23238-001	1	024-20446-000	15.0		

FURNACE CONTROL DIAGNOSTICS

The furnace has built-in, self diagnostic capability. If a system problem occurs, a fault code is shown by a blinking LED. It is located behind a clear view port in the blower compartment door. DO NOT remove the furnace blower compartment panel OR turn off furnace power as either action will clear the control's memory of the fault.

The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED will indicate the failure code. If the failure is internal to the control, the light will stay on continuously. In this case, the entire control should be replaced as the control is not field repairable.

If the sensed failure is in the system (external to the control), the LED will flash in the following flash-pause sequences to indicate failure status.

Flash sequence codes 1 thru 4 are as follows. LED will turn on for 1/4 second and off for 1/4 second. This pattern will be repeated the number of times equal to the code. For example, two on flashes equals a number 2" fault code.

All flash code sequences are broken by a 2 second off period.

IGNITION CONTROL (P/N 031-01909-000)

Normal flame sense current is approximately

2.4 microamps DC (μa)

Low flame signal control lockout point is

0.15 microamps (DC (μa)

CONTINUOUS FLASH (1 sec on - 1 sec off): This indicates that flame was sensed when there was not a call for heat. With this fault code the control will also turn on both the inducer motor and supply air blower. This fault would typically be caused by a gas valve that leaks through or is slow closing.

2 FLASH: This indicates that the normally open pressure switch contacts are stuck in the closed position. The control confirms these contacts are open at the beginning of each heat cycle. This would indicate a faulty pressure switch or mis-wiring.

<u>3 FLASH:</u> This indicates the normally open pressure switch contact did not close at the beginning of the heat cycle. This could be caused by a number of problems; faulty inducer, blocked vent pipe, high winds at vent terminal, broken pressure switch hose or faulty pressure switch.

4 FLASH: This indicates that a primary limit, or auxiliary limit, or rollout limit switch has opened its normally closed contacts. With this fault code the control will operate the supply air blower and the ventor. This condition may be caused by: dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate or faulty blower motor. The rollout control is manually reset. If it has opened, check for proper combustion air, proper inducer operation, primary heat exchanger failure or burner problem. Be sure to reset the switch after correcting the failure condition.

6 FLASH: This indicates that after the unit was operating, the pressure switch opened 5 times during the call for heat. This could be caused by a number of problems; blocked vent or chimney, faulty inducer, cracked pressure switch hose. The ignition control will lock-out after the pressure switch opens 5 times.

<u>7 FLASH:</u> This fault code indicates that flame could not be established. This no-light condition occurred 3 times during the call for heat before locking out. This may be caused by low gas pressure, faulty gas valve, faulty hot surface igniter, reversed line polarity, or burner problem.

<u>8 FLASH:</u> This fault is indicated if the flame is lost 5 times during the heating cycle. This could be caused by low gas pressure or faulty gas valve. The ignition control will lock-out if the flame is lost 5 times.

<u>LED ON CONSTANTLY:</u> This indicates an internal fault in the furnace control discovered during its self-check procedure. Replace the control.

60 MINUTE AUTOMATIC RESET FROM LOCKOUT: This control includes a watchdog type circuit that will reset from a lockout condition after 60 minutes. This provides protection to an unoccupied structure if a temporary conditions exists causing a unit malfunction. An example would be a low incoming gas supply pressure condition preventing unit operation. When the gas pressure was restored, at some point the watchdog would restart the unit and provide heat for the house.

NOTE: The control will blink one time when initially powered. This is normal and not an indication of any malfunction.

RESET FROM LOCKOUT: To reset the control from any lockout condition break the line voltage supply or 24 volt signal from the thermostat for 30 seconds.

AWARNING

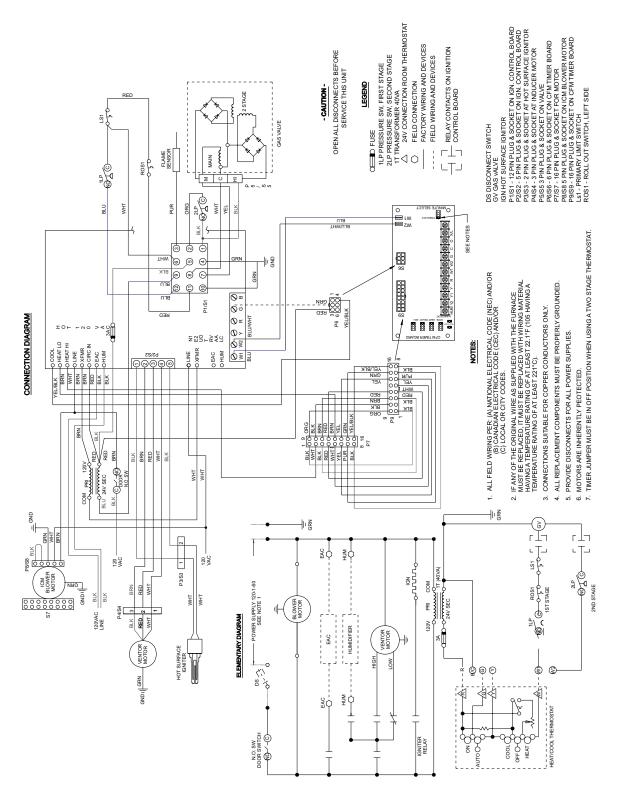
Do not try to repair controls. Replace defective controls with Source 1 Parts.

Never adjust pressure switch to allow furnace operation

Never jump pressure switch or rewire in an attempt to allow furnace operation. To do so will allow furnace to operate under potentially hazardous conditions.

WIRING DIAGRAM - UPFLOW MODELS

NOTE: The furnace's control system requires correct polarity of the power supply.



90% UPFLOW TWO-STAGE FURNACE - VARIABLE SPEED

FIGURE 42: Upflow Models

WIRING DIAGRAM - DOWNFLOW/HORIZONTAL MODELS

NOTE: The furnace's control system requires correct polarity of the power supply.

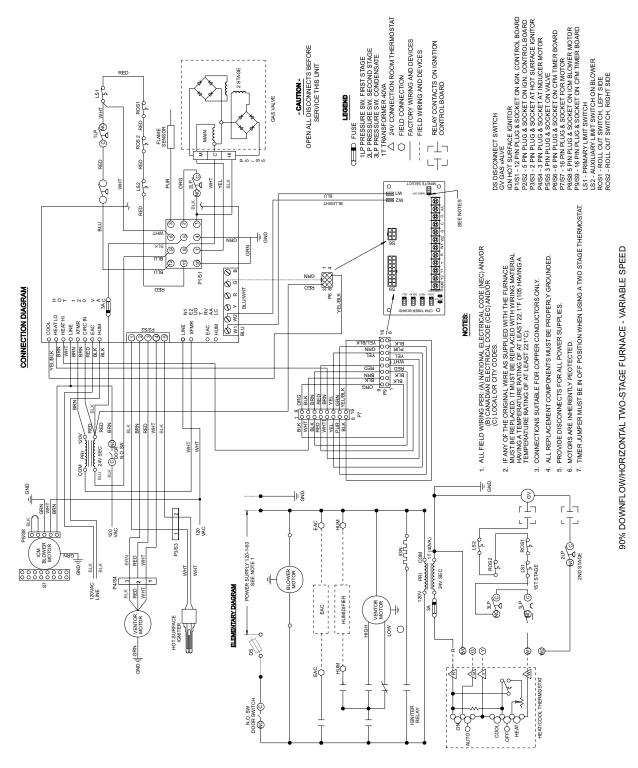


FIGURE 43: Downflow/Horizontal Models

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