

# INSTALLATION MANUAL

## HIGH EFFICIENCY TUBULAR HEAT EXCHANGER SERIES

(Two Stage Variable Speed Upflow / Horizontal / LoNOx)

80 - 120 MBH INPUT  
(23.45 - 35.17 kW) INPUT



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## SECTION I: SAFETY



This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention to the signal words **DANGER**, **WARNING**, or **CAUTION**.

**DANGER** indicates an **imminently hazardous** situation, which, if not avoided, **will result in death or serious injury**.

**WARNING** indicates a **potentially hazardous** situation, which, if not avoided, **could result in death or serious injury**.

**CAUTION** indicates a **potentially hazardous** situation, which, if not avoided **may result in minor or moderate injury**. It is also used to alert against unsafe practices and hazards involving only property damage.

### WARNING

*Improper installation may create a condition 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 for additional information, consult a qualified contractor, installer or service agency.*

### CAUTION

*This product must be installed in strict compliance with the installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.*

## SPECIFIC SAFETY RULES AND PRECAUTIONS

1. Only Natural gas or Propane (LP) gas are approved for use with this furnace. Refer to the furnace rating plate or Section IV of these instructions.
2. Install this furnace only in a location and position as specified in SECTION I of these instructions.
3. A gas-fired furnace for installation in a residential garage must be installed as specified in SECTION I of these instructions.
4. Provide adequate combustion and ventilation air to the furnace space as specified in SECTION VII of these instructions.
5. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in SECTION VII of these instructions.

### WARNING

#### FIRE OR EXPLOSION HAZARD

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

*Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.*

6. Test for gas leaks as specified in SECTION VIII of these instructions.
7. Always install the furnace to operate within the furnace's intended temperature rise range. Only connect the furnace to a duct system which has an external static pressure within the allowable range, as specified on the furnace rating plate.
8. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
9. The furnace is not to be used for temporary heating of buildings or structures under construction.
10. When installed in a Modular Home or building constructed on-site, combustion air shall not be supplied from occupied spaces.
11. 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.

## SAFETY REQUIREMENTS

- This furnace should be installed in accordance with all national and local building/safety codes and requirements, local plumbing or wastewater codes, and other applicable codes. In the absence of local codes, install in accordance with the National Fuel Gas Code ANSI Z223.1/NFPA 54, National Fuel Gas Code, and/or CAN/CGA B149.1 Natural Gas and Propane Installation Code (latest editions). Furnaces have been certified to the latest edition of standard ANSI Z21-47 • CSA 2.3.
- Refer to the unit rating plate for the furnace model number, and then see the dimensions page of this instruction for return air plenum dimensions in Figure 1. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed under Clearances to Combustibles.
- Provide clearances for servicing ensuring that service access is allowed for both the burners and blower.

- These models **ARE NOT** CSA listed or approved for installation into a **Manufactured (Mobile) Home**.
- This furnace is not approved for installation in trailers or recreational vehicles.
- **Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, death, personal injury and/or property damage.**
- Furnaces for installation on combustible flooring shall not be installed directly on carpeting, tile or other combustible material other than wood flooring.
- 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. **DO NOT CONNECT THIS APPLIANCE TO A 50 HZ POWER SUPPLY OR A VOLTAGE ABOVE 130 VOLTS.**
- Furnace shall be installed so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas fired components. Only trained and qualified personnel should install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
- These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances these instructions exceed certain local codes and ordinances, especially those who have not kept up with changing residential and modular home construction practices. These instructions are required as a minimum for a safe installation.

## COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in any of the following environments.

- Restricted Environments
- Commercial buildings
- Buildings with indoor pools
- Furnaces installed in laundry rooms
- Furnaces installed in hobby or craft rooms
- Furnaces installed near chemical storage areas
- Chemical Exposure

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in an area where the furnace is being exposed to the following substances and / or chemicals.

- Permanent wave solutions
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- De-icing salts or chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- Hydrochloric acid
- Cements and glues
- Antistatic fabric softeners for clothes dryers
- Masonry acid washing materials

When outdoor air is used for combustion, the combustion air intake duct system termination must be located external to the building and in an area where there will be no exposure to the substances listed above.

**⚠ WARNING**

*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.
2. 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.*

**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.

**FURNACE LOCATION AND CLEARANCES**

The furnace shall be located using the following guidelines:

1. Where a minimum amount of air intake/vent piping and elbows will be required.
2. As centralized with the air distribution as possible.
3. Where adequate combustion air will be available (particularly when the appliance is not using outdoor combustion air).
4. Where it will not interfere with proper air circulation in the confined space.
5. Where the outdoor vent terminal will not be blocked or restricted. Refer to "VENT CLEARANCES" located in SECTION VII of these instructions. These minimum clearances must be maintained in the installation.
6. Where the unit will be installed in a level position with no more than 1/4" (6.4 mm) slope side-to-side and front-to-back to provide proper condensate drainage.

**TABLE 1: Unit Clearances to Combustibles**

APPLICATION	TOP	FRONT	REAR	LEFT SIDE	RIGHT SIDE	FLUE	FLOOR/ BOTTOM	CLOSET	ALCOVE	ATTIC	LINE CONTACT
	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)					
UPFLOW	1 (25.4)	6 (15.24)	0 (0.0)	0 (0.0)	3 (7.62) <sup>1</sup>	6 (15.24)	COMBUSTIBLE	YES	YES	YES	NO
UPFLOW B-VENT	1 (25.4)	3 (7.62)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.4)	COMBUSTIBLE	YES	YES	YES	NO
HORIZONTAL	3 <sup>2</sup>	6 (15.24)	0 (0.0)	1 (25.4)	0 (0.0)	6 (15.24)	COMBUSTIBLE	NO	YES	YES	YES <sup>3</sup>
HORIZONTAL B-VENT	0 (0.0)	3 (7.62)	0 (0.0)	1 (25.4)	0 (0.0)	1 (25.4)	COMBUSTIBLE	NO	YES	YES	YES <sup>3</sup>

1. 14-1/2" cabinet models only. All other units "0" clearance.

2. 14-1/2" cabinet left airflow applications only. All other units and right hand airflow applications "0" clearance.

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.

**SECTION II: DUCTWORK****DUCTWORK GENERAL INFORMATION**

The duct system's design and installation must:

1. Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
2. 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, or state, and local fire and safety codes.
3. Create a closed duct system. For residential and Modular Home installations, when a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space con-

**Installation in freezing temperatures:**

1. Furnace shall be installed in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures may fall below 32° F (0° C) providing the flue temperature does not fall below 260° F (127° C) at any point in the flue pipe between the furnace and the chimney or a B-Vent. The flue products will condense in the vent pipe if the flue temperature falls below 260° F (127° C) causing the vent pipe to deteriorate rapidly.
2. Do not allow return air temperature to be below 55° F (13° C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.

**⚠ WARNING**

*Improper installation in an ambient below 32°F (0.0° C) could create a hazard, resulting in damage, injury or death.*

3. If this furnace is installed in an unconditioned space and an extended power failure occurs, there will be potential damage to the internal components. Following a power failure situation, do not operate the unit until inspection and repairs are performed.

**Clearances for access:**

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

1. Twenty-four (24) inches (61 cm) between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
2. Eighteen (18) inches (46 cm) at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

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

**Installation in a residential garage:**

1. A gas-fired furnace for installation in a residential garage must be installed so the burner(s) and the ignition source are located not less than 18 inches (46 cm) above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

taining the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

4. Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.

**⚠ CAUTION**

*The cooling coil must be installed in the supply air duct, downstream of the furnace. Cooled air may 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, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position.

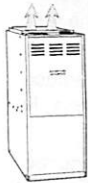
## WARNING

*The duct system must be properly sized to obtain the correct airflow for the furnace size that is being installed.*

*Refer to Table 8 and the furnace rating plate for the correct rise range and static pressures*

*If the ducts are undersized, the result will be high duct static pressures and/or high temperature rises which can result in a heat exchanger OVERHEATING CONDITION. This condition can result in premature heat exchanger failure, which can result in personal injury, property damage, or death.*

## DUCTWORK INSTALLATION AND 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. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace. If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all.

The duct system is a very important part of the installation. **If the duct system is improperly sized the furnace will not operate properly.** The ducts attached to the furnace plenum, should be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Table 2 is a guide for determining whether the rectangular duct system that the furnace is being connected to be of sufficient size for proper furnace operation.

Use the Example below to help you in calculating the duct area to determine whether the ducts have sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Ex. The furnace input is 80,000 BTUH and 1,200 CFM. The recommended duct area is 280 sq.in, there are two 8 x 14 rectangular ducts attached to the plenum and there are two 7 inch round ducts attached to the furnace.

1. Take 8 x 14, which equals 112 sq.in. X 2, which equals 224 square inch then go to round duct size located in Table 3.
2. The square inch area for 7 inch round pipe is 38.4, multiply by 2 for two round ducts which equals 76.8 square inch,
3. Then take the 224 square inch from the rectangular duct and add it to the 76.8 sq.in. of round duct. The total square inch of duct attached to the furnace plenum is 300.8 square inch. This exceeds the recommended 280 square inch of duct.

In this example, the duct system attached to the plenum has a sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

TABLE 2: Minimum Duct Sizing For Proper Airflow

Input	Airflow	Return <sup>1</sup>	Rectangular <sup>2</sup>	Round <sup>2</sup>	Supply <sup>3</sup>
BTU/H (kW)	CFM(m <sup>3</sup> )	In <sup>2</sup> (cm <sup>2</sup> )	in. x in. (cm x cm)	in. (cm)dia.	In <sup>2</sup> (cm <sup>2</sup> )
80,000 (23.44)	1,200 (33.98)	280 (711)	14 x 20 (35.6 x 50.8)	18 (45.7)	216(549)
100,000 (29.31)	1,600 (45.31)	360 (914)	18 x 20 (45.7 x 50.8)	22 (55.8)	280 (711)
100,000 (29.31)	2,000 (56.63)	440 (1,118)	20 x 22 (50.8 x 55.8)	24 (60.9)	390 (991)
120,000 (35.17)	2,000 (56.63)	440 (1,118)	20 x 22 (50.8 x 55.8)	24 (60.9)	390 (991)

NOTE: This chart does not replace proper duct sizing calculations or take into account static pressure drop for run length and fittings. Watch out for the temperature rise and static pressures.

1. Maximum return air velocity in rigid duct @ 700 feet per minute (19.82 m<sup>3</sup> / minute).
2. Example return main trunk duct minimum dimensions.
3. Maximum supply air velocity in rigid duct @ 900 feet per minute (25.49 m<sup>3</sup> / minute).

TABLE 3: Round Duct Size

Round Duct Size	Calculated Area For Each Round Duct Size
inches (cm)	Sq.in (cm <sup>2</sup> )
5 (13)	19.6 (126)
6 (15)	28.2 (182)
7 (18)	38.4 (248)
8 (20)	50.2 (324)
9 (23)	63.6 (410)
10 (25)	78.5 (506)
11 (28)	95 (613)
12 (30)	113.1 (730)
13 (33)	132.7 (856)
14 (36)	153.9 (993)

1. The Air Temperature Rise is determined by subtracting the Return Air Temperature Reading from the Supply Air Temperature Reading.
2. The External Static Pressure is determined by adding the Supply Duct Static Pressure reading to the Return Duct Static Pressure reading and adding the pressure drop across any applied a-coil and return air filter.

Tables 2 & 3 is to be used as a guide only to help the installer determine if the duct sizes are large enough to obtain the proper air flow (CFM) through the furnace. Tables 2 & 3 IS NOT to be used to design ductwork for the building where the furnace is being installed. There are several variables associated with proper duct sizing that are not included in the tables. To properly design the ductwork for the building, refer to the ASHRAE Fundamentals Handbook, Chapter on "DUCT DESIGN" or a company that specializes in Residential and Modular Home duct designs.

**IMPORTANT:** The minimum plenum height is 12" (30.5 cm). The furnace will not operate properly on a shorter plenum height. The minimum recommended rectangular duct height is 4 inches (10 cm) attached to the plenum.

**IMPORTANT:** The air temperature rise should be taken only after the furnace has been operating for at least 15 minutes. Temperatures and external static pressures should be taken 6" (15 cm) past the first bend from the furnace in the supply duct and the return duct. If an external filter box or an electronic air cleaner is installed, take the return air readings before the filter box or air cleaner.

## ⚠ WARNING

The supply air temperature **MUST NEVER** exceed the **Maximum Supply Air Temperature**, specified on the nameplate.

Operating the furnace above the maximum supply air temperature will cause the heat exchanger to overheat, causing premature heat exchanger failure. Improper duct sizing, dirty air filters, incorrect manifold pressure, incorrect gas orifice and/or a faulty limit switch can cause the furnace to operate above the maximum supply air temperature. Refer to sections II, III and VIII for additional information on correcting the problem.

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.

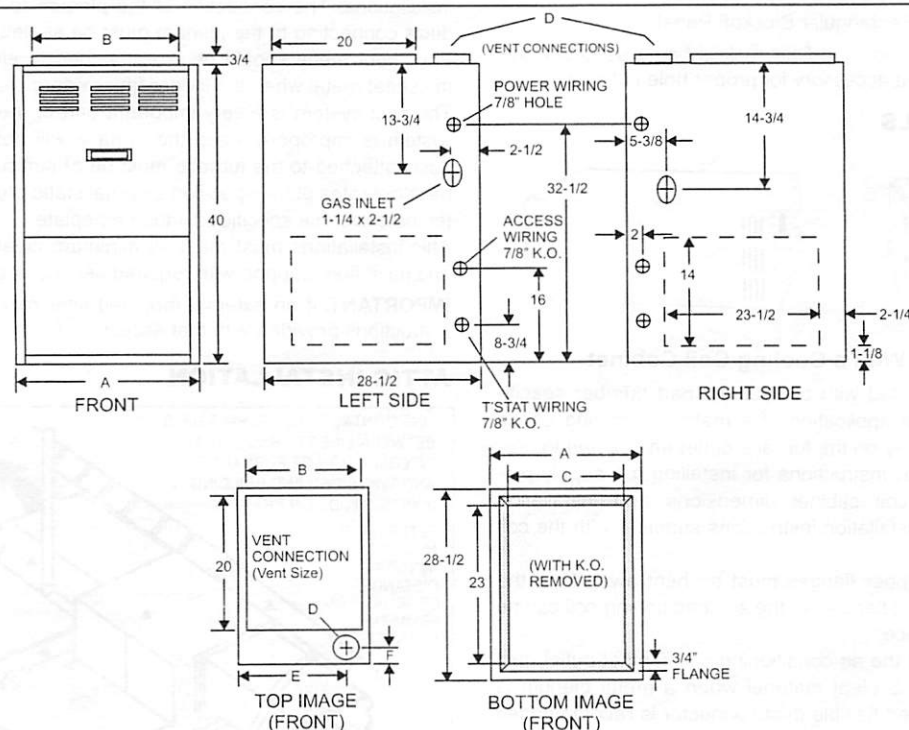


FIGURE 1: Dimensions

TABLE 4: Cabinet and Duct Dimensions

BTUH (kW) High/Low Fire Input	BTUH (kW) High/Low Fire Output	CFM (m <sup>3</sup> /min)	Cabinet Size	Cabinet Dimension											
				A	A (cm)	B	B (cm)	C	C (cm)	D	D (cm)	E	E (cm)	F	F (cm)
80/59 (23.4/17.3)	64/48 (18.8/14.1)	1200 (33.98)	A	14 1/2	36.8	13 1/4	33.7	10 1/8	25.7	4.0	10.2	10 1/8	25.7	3 3/4	9.53
100/65 (29.3/19.1)	80/53 (23.4/15.5)	1600 (45.31)	B	17 1/2	44.4	16 1/4	41.3	15 1/4	38.7	4.0	10.2	11 5/8	29.5	3 3/4	9.53
100/65 (29.3/19.1)	80/53 (23.4/15.5)	2000 (56.63)	C	21	53.3	19 3/4	50.2	16 5/8	42.2	4.0	10.2	13 3/8	34.0	3 3/4	9.53
120/78 (35.1/22.9)	96/64 (28.1/18.8)	2000 (56.63)	C	21	53.3	19 3/4	50.2	16 5/8	42.2	4.0	10.2	13 3/8	34.0	3 3/4	9.53

### RESIDENTIAL AND MODULAR HOME UPFLOW RETURN PLENUM 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. In order to achieve the airflow indicated, it is recommended those applications over 1800 CFM (57 m<sup>3</sup>/min) 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.

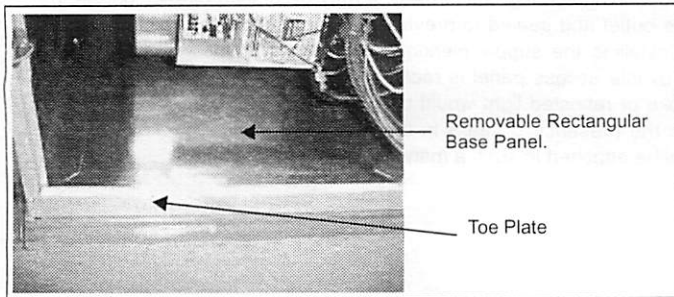
### BOTTOM RETURN AND ATTIC INSTALLATIONS

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

The furnace base is equipped with a rectangular blockoff panel that can be removed by performing the following steps:

1. Lay the furnace on its back.
2. Remove the toe plate. See Figure 2.
3. Slide the blockoff panel out and then replace the toe plate.
4. Bend the 3/4" flanges that will be used to attach the return air plenum using the scribe marks in the furnace base. Refer to Figure 2 "Bottom Image Return End".
5. Be sure to seal the furnace to plenum connections to prevent air leakage. Refer to Figure 1 for unit and plenum dimensions.

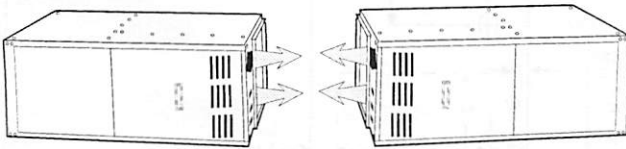
Attic installations must meet all minimum clearances to combustibles and have floor support with required service accessibility.



**FIGURE 2:** Furnace Base Rectangular Blockoff Panel

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

## HORIZONTAL MODELS



### Horizontal Installations With a Cooling Coil Cabinet

The furnace should be installed with coil cabinet part number specifically intended for Horizontal application. 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. For details of the coil cabinet dimensions and installation requirements, refer to the installation instructions supplied with the coil cabinet.

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.

Attach the supply plenum to the air conditioning coil cabinet outlet duct flanges 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. The connection to the furnace, air conditioning coil cabinet and the supply plenum should be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

The minimum plenum height is 12" (30.5 cm). If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all. Also the plastic drain pan in the air conditioning coil can overheat and melt. Refer to the installation instructions supplied with the air conditioning coil for additional information.

### Horizontal Installations Without a Cooling Coil Cabinet

When installing this appliance, the furnace must be installed so as to create a closed duct system, the supply duct system must be connected to the furnace outlet and the supply duct system must terminate outside the space containing the furnace. When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

Attach the supply plenum to the furnace outlet duct flanges 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. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized. 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.

## Residential and Modular Home Horizontal Return Plenum Connections

The return duct system must be connected to the furnace inlet and the return duct system must terminate outside the space containing the furnace. When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

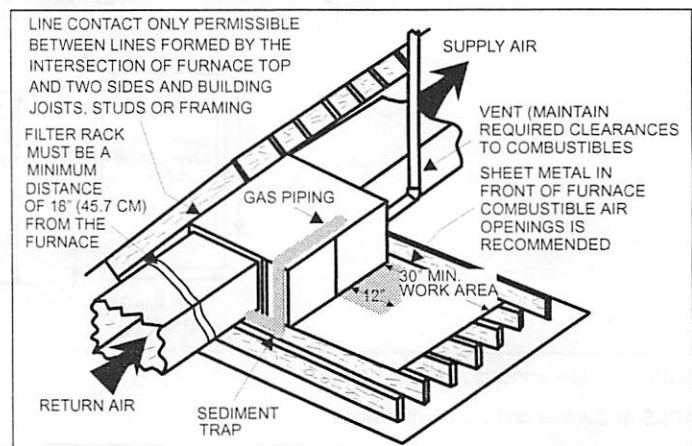
Attach the return plenum to the furnace inlet duct flanges. This is typically through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. The connection of the plenum to the furnace and all the ducts connecting to the plenum must be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

The duct system is a very important part of the installation. If the duct system is improperly sized the furnace will not operate properly. The ducts attached to the furnace must be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

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

**IMPORTANT:** if an external mounted filter rack is being used see the instructions provided with that accessory for proper hole cut size.

## ATTIC INSTALLATION



**FIGURE 3:** Typical Attic Installation

This appliance is design certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs or framing. This line may be in contact with combustible material.

## WARNING

*When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12 inches (30.5 cm) away from furnace and burner combustion air openings.*

## SUSPENDED FURNACE / CRAWL SPACE INSTALLATION

The furnace can be hung from floor joists 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. Units may also be suspended from rafters or floor joists using rods, pipe angle supports or straps. Angle supports should be placed at the supply air end and near the blower deck. Do not support at return air end of unit. All four suspension points must be level to ensure quiet furnace operation. When suspending the furnace use a secure platform constructed of plywood or other building material secured to the floor joists. Refer to Figure 4 for typical crawl space installation.



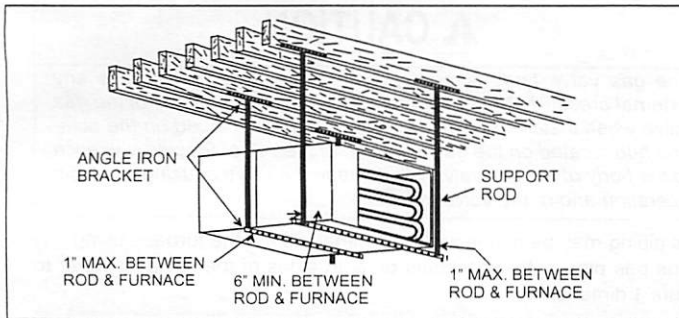


FIGURE 4: Typical Suspended Furnace / Crawl Space Installation

## CAUTION

In any application where temperatures below freezing are possible, see installation

## SECTION III: FILTERS

### FILTER INSTALLATION

All applications require the use of an internal or external filter. Filter(s) and the filter retainer are not provided on all models. Some models are shipped with a high velocity filter that must be field installed. A field-supplied internal or external filter and filter retainer hardware must be provided if the filter and the filter retainer are not shipped with the furnace. Refer to Table 5 for the recommended filter size.

TABLE 5: Filter Sizes

Cabinet Size	Side (in)	Side (cm)	Bottom (in)	Bottom (cm)
A	16 x 26	40.6 x 66.0	14 x 26	35.6 x 66.0
B	16 x 26	40.6 x 66.0	16 x 26	40.6 x 66.0
C	(2) 16 x 26	(2) 40.6 x 66.0	20 x 26	50.8 x 66.0
D	(2) 16 x 26	(2) 40.6 x 66.0	20 x 26	50.8 x 66.0

### SIDE RETURN - EXTERNAL INSTALLATION

Locate and knock out the square corner locators. These indicate the size of the cutout to be made in the furnace side panel. Refer to Figure 7.

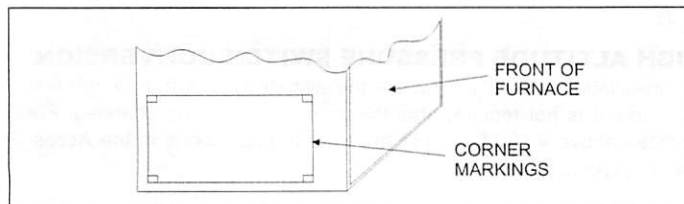


FIGURE 5: Side Return Cutout Markings

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.

**IMPORTANT:** Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with that accessory for side opening requirements. Do not cut the opening larger than the dimensions shown in Figure 1.

## HORIZONTAL APPLICATION

### 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). Filter(s) may be located in the duct system using an external duct filter box attached to the furnace plenum. Filters must be a minimum distance of 18" (45.7 cm) from the furnace. Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum above the filter height. The use of straps and / or supports is required to support the weight of the external filter box.

**IMPORTANT:** Air velocity through throwaway type filters must not exceed 300 feet per minute (1.52 m/m). All velocities over this require the use of high velocity filters. Refer to Table 17.

## CAUTION

All installations must have a filter installed.

## SECTION IV: GAS PIPING

### GAS SAFETY

## DANGER

An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 PSI (14" w.c. (3.48 kPa). Pressures exceeding 0.5 PSI (14" w.c. (3.48 kPa) at the gas valve will cause damage to the gas valve, resulting in a fire or explosion or cause damage to the furnace or some of its components that will result in property damage and loss of life.

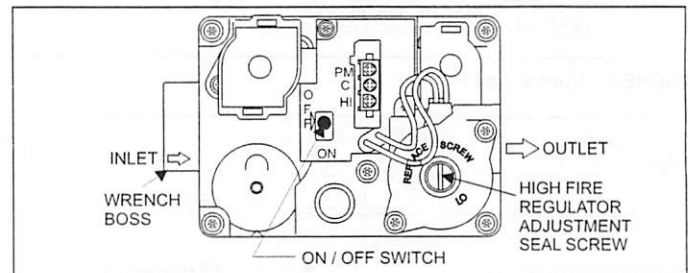


FIGURE 6: Gas Valve

**IMPORTANT:** Plan your gas supply 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.

### CHECKING THE GAS PRESSURES

- The pressure ports on the gas valve are marked OUT P and IN P.
- The manifold pressure must be taken at the port marked OUT P.
- The inlet gas supply pressure must be taken at the port marked IN P.
- Using a 3/32" (0.2 cm) Allen wrench, loosen the set screw by turning it 1 turn counter clockwise. **DO NOT REMOVE THE SET SCREW FROM THE PRESSURE PORT.**
- Push one end the 3/8" (0.9 cm) ID flexible tubing over the pressure port so that the body of the port is inside the tubing.
- Use a reducer connector to connect the 3/8" (0.9 cm) ID flexible tube to a 1/4" (0.6 cm) ID flexible tube that is connected to a "U" tube manometer or digital pressure measuring equipment.

TABLE 6: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5" W.C. (1.12 kPa)	8.0" W.C. (1.99 kPa)
Maximum	10.5" W.C. (2.61 kPa)	13.0" (3.24 kPa) W.C.

**IMPORTANT:** The inlet gas pressure operating range table specifies what the minimum and maximum gas line pressures must be for the furnace to operate safely. The gas line pressure **MUST BE** a minimum of:

- 7" W.C. (1.74 kPa) for Natural Gas
- 11" W.C. (2.74 kPa) for Propane (LP) Gas

in order to obtain the BTU input specified on the rating plate and/or the nominal manifold pressure specified in these instructions and on the rating plate.

## GAS PIPING INSTALLATION

Properly sized wrought iron, approved flexible or steel pipe must be used when making gas connections to the unit. If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. Refer to Figure 9.

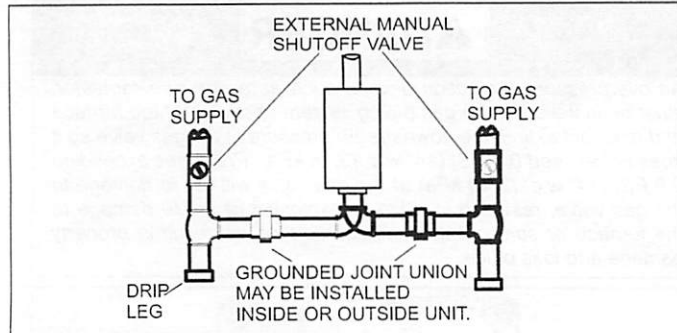


FIGURE 7: Upflow Gas Piping

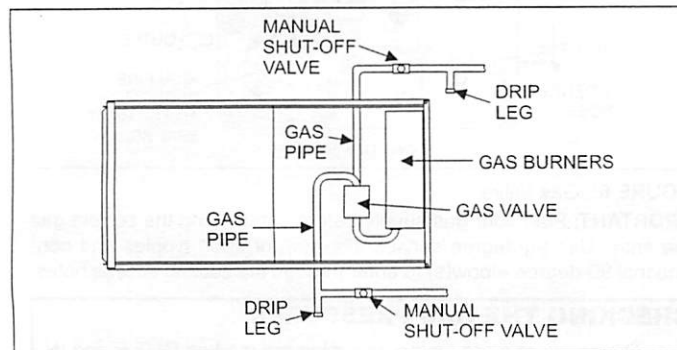


FIGURE 8: Horizontal Gas Piping

**IMPORTANT:** An accessible manual shutoff valve must be installed upstream of the furnace gas controls and within 6 feet (1.8 m) of the furnace.

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 (3.5 kPa).

TABLE 7: High Altitude Conversion

Type Of Gas	Orifice at Sea Level	2,000 ft. (610 m)	3,000 ft. (914 m)	4,000 ft. (1219 m)	5,000 ft. (1524 m)	6,000 ft. (1829 m)	7,000 ft. (2134 m)	8,000 ft. (2438 m)	9,000 ft. (2743 m)	10,000 ft. (3048 m)
Natural	#45	#46	#47	#47	#47	#48	#48	#49	#49	#50
Propane	#55	#55	#55	#55	#56	#56	#56	#56	#56	#57

## CAUTION

The gas valve body is a very thin casting that cannot take any external pressure. Never apply a pipe wrench to the body of the gas valve when installing piping. A wrench must be placed on the octagon hub located on the gas inlet side of the valve. Placing a wrench to the body of the gas valve will damage the valve causing improper operation and/or the valve to leak.

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 dimensions.

## GAS ORIFICE CONVERSION FOR PROPANE (LP)

This furnace is constructed at the factory for natural gas-fired operation, but may be converted to operate on propane (LP) gas by using a factory-supplied LP conversion kit. Follow the instructions supplied with the LP kit. Refer to Table 7 or the instructions in the propane (LP) conversion kit for the proper gas orifice size.

## WARNING

LoNOx furnaces requiring propane (LP) gas must have the LoNOx screens removed prior to installation and operation. See propane instructions 035-14445-000 or the start up procedure at the back of these instructions on proper removal of the NOx screens.

## HIGH ALTITUDE GAS ORIFICE CONVERSION

This furnace is constructed at the factory for natural gas-fired operation at 0 – 2,000 ft. (0 m – 610 m) above sea level.

The gas orifices on this furnace must be changed in order to maintain proper and safe operation, when the furnace is installed in a location where the altitude is greater than 2,000 ft. (610 m) above sea level on natural gas or the altitude is greater than 4,000 ft. (1219 m) above sea level on propane (LP) gas. Refer to Table 7 or the instructions in the high altitude conversion kit for the proper gas orifice size.

The unit may also be converted for altitudes up to 10,000 ft. (3048 m) on natural and propane (LP) gas with additional derate as shown in Table 7 or refer to ANSI Z223.1 NFPA 54 National Fuel Gas Code or in Canada CAN/CGA-B149.1-00 Natural Gas and Propane Installation Code.

## HIGH ALTITUDE PRESSURE SWITCH CONVERSION

For installation in locations where the altitude is less than 4,500 feet (1372 m), it is not required that the pressure switch be changed. For altitudes above 4,500 feet (137 m), refer to Instructions in the Accessory High Altitude Kit.



**▲ DANGER****PROPANE AND HIGH ALTITUDE CONVERSION KITS**

*It is very important to choose the correct kit and/or gas orifices for the altitude and the type of gas for which the furnace is being installed.*

*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 gas.*

*Incorrect gas orifices or a furnace that has been improperly converted will create an extremely dangerous condition resulting in premature heat exchanger failure, excessive sooting, high levels of carbon monoxide, personal injury, property damage, a fire hazard and/or death.*

*High altitude and propane (LP) conversions are required in order for the appliance to satisfactorily meet the application.*

*An authorized distributor or dealer must make all gas conversions.*

*In Canada, a certified conversion station or other qualified agency, using factory specified and/or approved parts, must perform the conversion. The installer must take every precaution to insure that the furnace has been converted to the proper gas orifice size when the furnace is installed. Do not attempt to drill out any orifices to obtain the proper orifice size. Drilling out a gas orifice will cause misalignment of the burner flames, causing premature heat exchanger burnout, high levels of carbon monoxide, excessive sooting, a fire hazard, personal injury, property damage and/or death.*

**SECTION V: ELECTRICAL POWER****Electrical Power Connections**

Field wiring to the unit must be grounded. Electric wires that are field installed shall conform to the temperature limitation for 63°F (35°C) rise wire when installed in accordance with instructions. Refer to Table 8 in these instructions for specific furnace electrical data.

**TABLE 8: Ratings & Physical / Electrical Data**

Input BTU/H High/Low (kW)	Output BTU/H High/Low (kW)	Airflow		Cabinet Width		AFUE	Low Fire Air Temp. Rise		High Fire Air Temp. Rise			
		CFM	m3mm	In	cm		°F	°C	°F	°C		
80/59 (23.4/17.3)	64/48 (18.8/14.1)	1200	34.0	14 1/2	36.8	80.0	40-70	22-39	40-70	22-39		
100/65 (29.3/19.1)	80/53 (23.4/15.5)	1600	45.3	17 1/2	44.5	80.0	40-70	22-39	40-70	22-39		
100/65 (29.3/19.1)	80/53 (23.4/15.5)	2000	56.6	21	53.3	80.0	40-70	22-39	40-70	22-39		
120/78 (35.1/22.9)	96/64 (28.1/18.8)	2000	56.6	21	53.3	80.0	35-65	19-36	35-65	19-36		
Input BTU/H High/Low (kW)	Output BTU/H High/Low (kW)	Max. Outlet Air Temp		Blower		Blower Size		Unit Amps	Max Fuse Size	Min Wire Size	Operation Weight	
		°F	°C	Hp	Amps	In	cm				Lbs	Kg
80/59 (23.4/17.3)	64/48 (18.8/14.1)	175	79.4	1/2	7.7	10 x 8	25.4 x 20.3	9.0	20	14	117	43.67
100/65 (29.3/19.1)	80/53 (23.4/15.5)	170	76.7	3/4	9.6	10 x 10	25.4 x 25.4	12.0	20	14	128	47.77
100/65 (29.3/19.1)	80/53 (23.4/15.5)	170	76.7	1	12.8	11 x 10	27.9 x 25.4	14.0	20	12	145	54.12
120/78 (35.1/22.9)	96/64 (28.1/18.8)	170	76.7	1	12.8	11 x 10	27.9 x 25.4	14.0	20	12	147	54.87

1. Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE Test procedures.
2. Field wiring and over-current protection (Max Fuse Size) must conform to and be grounded in accordance ANSI/NFPA No. 70-latest edition or the Canadian Electrical Code C22.1 Part 1-latest edition and / or local codes.  
Wire size based on copper conductors, 60° C, 3% voltage drop. "Unit Amps" refers to the full load current.
3. Min wire size (awg) @ 75 ft. one way refers to the minimum recommended field installed wire size.
4. Electric wires that are field installed shall conform with the temperature limitation for 63°F / 35°C rise wire when installed
5. in accordance with the instructions.

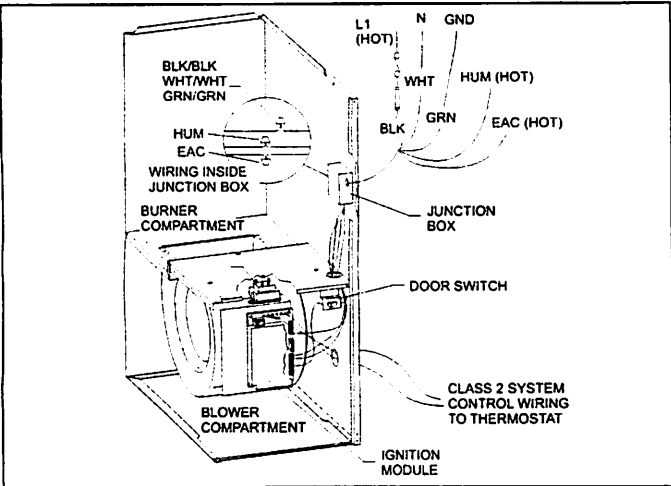
**SUPPLY VOLTAGE CONNECTIONS**

1. 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 or fused switch in the OFF position, check all wiring against the unit wiring label. Refer to the wiring diagram in this instruction.
2. 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. In the junction box there will be three wires, a Black Wire, a White Wire and a Green Wire. Connect the power supply as shown on the unit-wiring label on the inside of the blower compartment door or the wiring schematic in this section. 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. Connect the green fur-

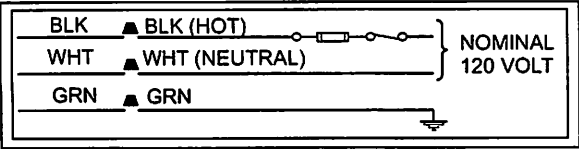
nace lead (equipment ground) to the power supply ground. An alternate wiring method is to use a field provided 2" (51 mm) x 4" (102 mm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel. After making the wiring connections replace the wiring box cover and screws. Refer to Figure 11.

3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. Refer to Figure 12 or "FURNACE CONTROL DIAGNOSTICS" for symptoms of reversed power supply polarity.

**IMPORTANT:** The power connection leads and wiring box 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.



**FIGURE 9: Electrical Wiring**  
**POWER SUPPLY POLARITY - Ignition Control:** If the power supply polarity is reversed, the control board will flash 9 times. The furnace will not operate until the polarity is corrected.

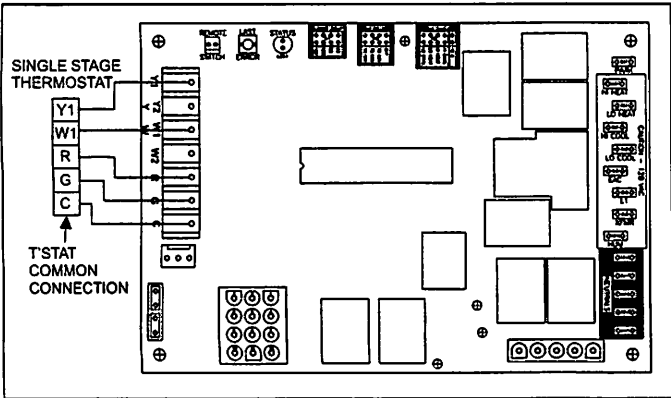


**FIGURE 10: Line Wiring Connections**

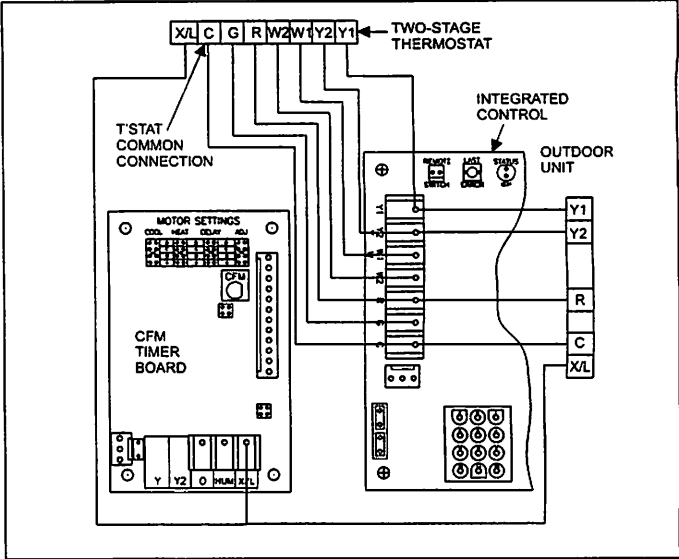
**LOW VOLTAGE CONTROL WIRING CONNECTIONS**

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the terminal strip on the cfm timer board, as shown in Figure 14 for single stage or Figure 13 for two stage. Electronic thermostats may require the common wire to be connected to the "C" terminal as shown in Figures 13 & 14. Apply strain relief to thermostat wires passing through cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the cfm timer board to the yellow and brown wires on the condensing unit (unit out side) as shown in Figure 14.

**IMPORTANT:** Set the heat anticipator in the room thermostat to 0.10 amps. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the set points.



**FIGURE 11: Field Wiring for Single Stage Thermostat**



**FIGURE 12: Field Wiring for Two Stage Thermostat**

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
	Second Stage	.1 Amps
Single Stage Thermostat		.4 Amps

**CAUTION**

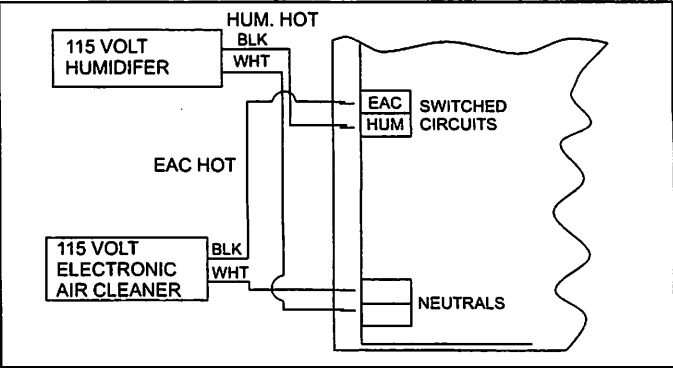
Do not exceed 1.0 amp loading.

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

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.

**ACCESSORY CONNECTIONS**

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



**FIGURE 13: Accessory Connections**

**ELECTRONIC AIR CLEANER CONNECTION**

Two 1/4" (0.64 cm) spade terminals (EAC and NEUTRAL) for electronic air cleaner connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during circulating blower operation.

## HUMIDIFIER CONNECTION

Two 1/4" (0.64 cm) spade terminals (HUM and NEUTRAL) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during heating system operation.

## TWINNING

These furnaces are not to be twinned. If more than one furnace is needed in an application, each furnace must have its own completed duct system and its own wall thermostat.

## SECTION VI: VENT SYSTEM

### VENT SAFETY

This Category I, furnace is designed for residential application. It may be installed without modification in a basement, garage, equipment room, alcove, attic or any other indoor location where all required clearance to combustibles and other restrictions are met.

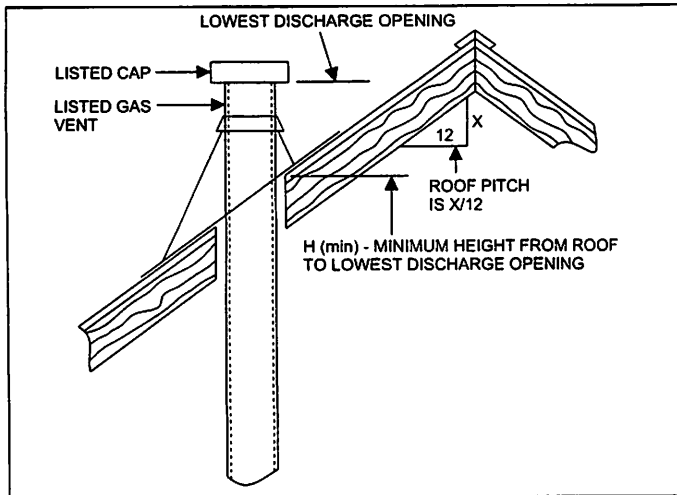


FIGURE 14: Vent Termination

TABLE 9: Roof Pitch

ROOF PITCH	H(min) ft	m
Flat to 6/12	1.0	0.30
6/12 to 7/12	1.25	0.38
Over 7/12 to 8/12	1.5	0.46
Over 8/12 to 9/12	2.0	0.61
Over 9/12 to 10/12	2.5	0.76
Over 10/12 to 11/12	3.25	0.99
Over 11/12 to 12/12	4.0	1.22
Over 12/12 to 14/12	5.0	1.52
Over 14/12 to 16/12	6.0	1.83
Over 16/12 to 18/12	7.0	2.13
Over 18/12 to 20/12	7.5	2.27
Over 20/12 to 21/12	8.0	2.44

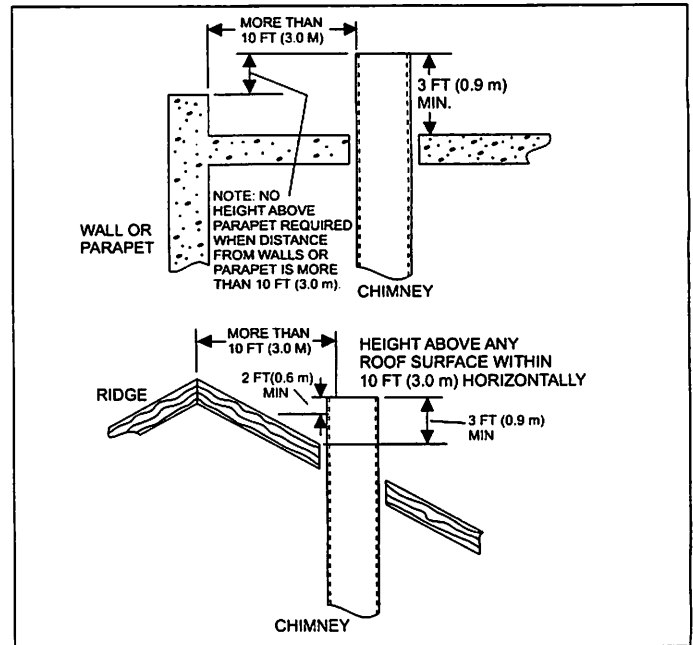


FIGURE 15: Vent Termination

### CATEGORY 1 - 450 F. MAX. VENT TEMP.

The venting system must be installed in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition), or Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition) or applicable provisions of the local building code and these instructions.

The furnace shall be connected to any type of B, BW or L vent connector, and shall be connected to a factory-built or masonry chimney. **The furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.**

The furnace rating plate lists the maximum vent gas temperature. This temperature must be used to select the appropriate venting materials and clearances.

It is recommended that the appliance is installed in a location where the space temperature is 32 °F (0°C) or higher. If the appliance is installed in a location where the ambient temperature is below 32 °F (0°C), the combustion byproducts could condense causing damage to the appliance heat exchanger.

**IMPORTANT:** The "VENT SYSTEM" must be installed as specified in these instructions for Residential and Modular Homes.

This appliance may be common vented with another gas appliance for residential installations as allowed by the codes and standards listed in these instructions.

Approved Modular Homes must be vented with an approved roof jack and may not be common vented with other appliances.



## VENTING

Category I venting consists of vertically venting one or more appliances in B-vent or masonry chimney (as allowed), using single wall metal pipe or B-vent connectors. Type B-vent system extends in a general vertical direction and does not contain offsets exceeding 45 degrees. A vent system having not more than one 60 degree offset is permitted. If installing furnace at altitudes between 2000 - 4500 ft. (610 - 1372 m), vent pipe length must be reduced by 10 ft. (3.05 m). If the installation requires the maximum allowable vent pipe length, the furnace must be converted for high altitude operation. Refer to SECTION IV "GAS PIPING" of these instructions and the proper high altitude application instruction for details.

### VENTING INTO AN EXISTING CHIMNEY

For Category I installations, the furnace shall be connected to a factory built chimney or vent complying with a recognized standard, or a masonry or concrete chimney lined with a material acceptable to the authority having jurisdiction. Venting into an unlined masonry chimney or concrete chimney is prohibited.

Whenever possible, B-1 metal pipe should be used for venting. Where use of an existing chimney is unavoidable, the following rules must be followed:

1. The masonry chimney must be built and installed in accordance with nationally recognized building codes or standards and must be lined with approved fire clay tile flue liners or other approved liner material that will resist corrosion, softening, or cracking from flue gases. **THIS FURNACE IS NOT TO BE VENTED INTO AN UNLINED MASONRY CHIMNEY.**
2. This furnace must be vented into a fire clay tile lined masonry chimney only if a source of dilution air is provided, such as by common venting with a draft hood equipped water heater. If no source of dilution air is available, Type B vent must be used, or masonry chimney vent kit 1CK0603 or 1CK0604 must be used. Refer to the instructions with the kit to properly apply these masonry chimney kits.
3. The chimney must extend at least 3 ft (0.91 m) above the highest point where it passes through a roof of a building and at least two feet higher than any portion of the building with a horizontal distance of ten feet.
4. The chimney must extend at least 5 ft (1.5 m) above the highest equipment draft hood or flue collar.

### HORIZONTAL SIDEWALL VENTING

For applications where vertical venting is not possible, the only approved method of horizontal venting is the use of an auxiliary power vent. Approved power venters are Fields Controls Model SWG-4Y or Tjernlund Model GPAK-JT. Follow all application and installation details provided by the manufacturer of the power vent.

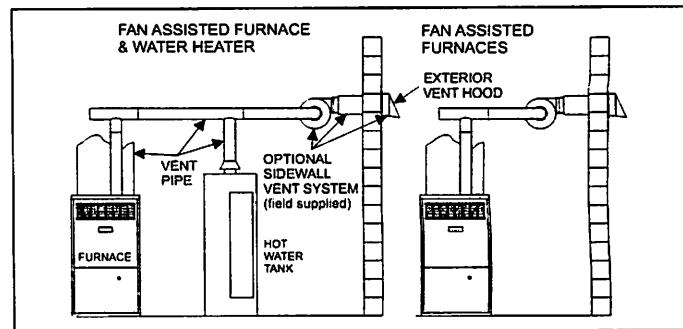


FIGURE 16: Typical Sidewall Vent Application

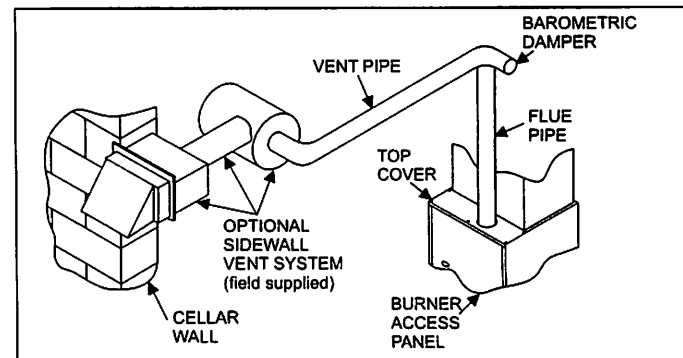


FIGURE 17: Typical Sidewall Vent and Termination Configuration

### VENT 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. Dry-fit the vent piping assembly from the furnace to the termination checking for proper fit support and slope. Piping should be supported with pipe hangers to prevent sagging. The maximum spacing between hangers is 4 feet (1.22 m).
4. Assemble the vent piping from the furnace to the termination securing the pipe connections with screws.

### VENT CLEARANCES

**IMPORTANT:** The vent must be installed with the following minimum clearances as shown in Figure 20, and must comply with local codes and requirements.

TABLE 10: Horizontal Venting

						Horizontal Vent Length Ft (m) with 4 Elbows					
Heating	Heating	Heating	Heating	Furnace	Furnace	Pipe Size		Min. Vent Length		Max. Vent Length	
Input	Input	Input	Output	Airflow	Airflow	Inches	cm				
BTU/H	kW	BTU/H	kW	CFM	cm/m			Feet	meters	Feet	meters
80,000	23.44	64,000	18.76	1200	33.98	4	10.16	4.5	1.37	34.5	10.82
100,000	29.31	80,000	23.45	1600	45.31	4	10.16	4.5	1.37	34.5	10.82
100,000	29.31	80,000	23.45	2000	56.63	4	10.16	4.5	1.37	34.5	10.82
120,000	35.17	104,000	30.48	2000	56.63	4	10.16	4.5	1.37	34.5	10.82

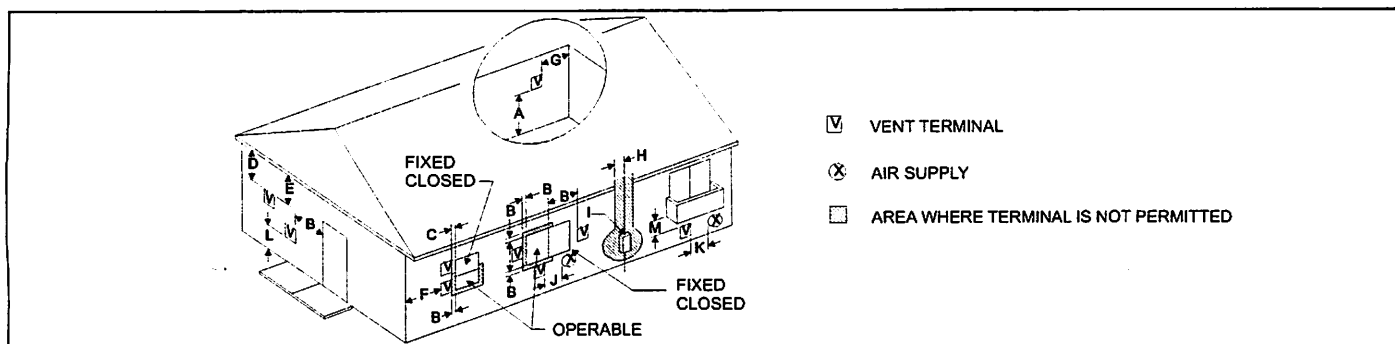


FIGURE 18: Home Layout

	Canadian Installations <sup>1</sup>	US Installation <sup>2</sup>
A. Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm)	12 inches (30 cm)
B. Clearance to window or door that may be opened	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and ≤ 100,000 Btuh (30kW), 36 inches (91 cm) for appliances > 100,000 Btuh (30kW)	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 9 inches (23 cm) for appliances > 10,000 Btuh (3kW) and ≤ 50,000 Btuh (15kW), 12 inches (30 cm) for appliances > 50,000 Btuh (30kW)
C. Clearance to permanently closed window	-	-
D. Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	-	-
E. Clearance to unventilated soffit	-	-
F. Clearance to outside corner	-	-
G. Clearance to inside corner	-	-
H. Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator assembly	-
I. Clearance to service regulator vent outlet	3 feet (91 cm)	-
J. Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and ≤ 100,000 Btuh (30kW), 36 inches (91 cm) for appliances > 100,000 Btuh (30kW)	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 9 inches (23 cm) for appliances > 10,000 Btuh (3kW) and ≤ 50,000 Btuh (15kW), 12 inches (30 cm) for appliances > 50,000 Btuh (30kW)
K. Clearance to a mechanical supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 cm) horizontally
L. Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m) †	-
M. Clearance under veranda, porch, deck, or balcony	12 inches (30 cm) ‡	-
Dryer Vent	3 ft (91.44 cm)	3 ft (91.44 cm)
Plumbing Vent Stack	3 ft (91.44 cm)	3 ft (91.44 cm)
Gas Appliance Vent Terminal	3 ft (91.44 cm) *	3 ft (91.44 cm) *
Vent Termination from any Building Surface	12" (30.4 cm)	12" (30.4 cm)
Above Any Grade Level	12" (30.4 cm)	12" (30.4 cm)
Above anticipated snow depth	12" (30.4 cm)	12" (30.4 cm)
Any forced air inlet to the building.	10 ft (304.8 cm)	10 ft (304.8 cm)
The vent shall extend above the highest point where it passes through the roof, not less than	18" (46 cm)	18" (46 cm)
Any obstruction within a horizontal distance	Not less than 18" (46 cm)	Not less than 18" (46 cm)

1. In accordance with the current CSA B149.1-00, Natural Gas and Propane Installation Code.

2. In accordance with the current ANSI Z223.1 / NFPA 54, National Gas Code.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor. For clearance not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1-00.

Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's Installation Manual.

Any fresh air or make up inlet for dryer or furnace area is considered to be forced air inlet.

Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

A terminus of a vent shall be either:

Fitted with a cap in accordance with the vent manufacturer's installation instructions, or In accordance with the installation instructions for a special venting system.

\* Does not apply to multiple installations of this furnace model. Refer to "VENTING MULTIPLE UNITS" in this section of these instructions.

IMPORTANT: Consideration must be given for degradation of building materials by flue gases. Sidewall termination may require sealing or shielding of building surfaces with a corrosion resistant material to protect against combustion product corrosion. Consideration must be given to wind direction in order to prevent flue products and/or condensate from being blown against the building surfaces. If a metal shield is used it must be a stainless steel material at a minimum dimension of 20 inches. It is recommended that a retaining type collar be used that is attached to the building surface to prevent movement of the vent pipe.

Responsibility for the provision of proper adequate venting and air supply for application shall rest with the installer.

Vent shall extend high enough above building, or a neighboring obstruction, so that wind from any direction will not create a positive pressure in the vicinity of the vent.

## HORIZONTAL VENT APPLICATIONS AND TERMINATION

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

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
3. 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.
6. Horizontal portions of the vent system must slope upwards and be supported to prevent sagging. The vent system may be supported by the use of clamps or hangers secured to a permanent part of the structure every 4 ft. (1.22 m).

## FAN-ASSISTED COMBUSTION SYSTEM

An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger.

### Ambient Combustion Air Supply

This type installation will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. 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.

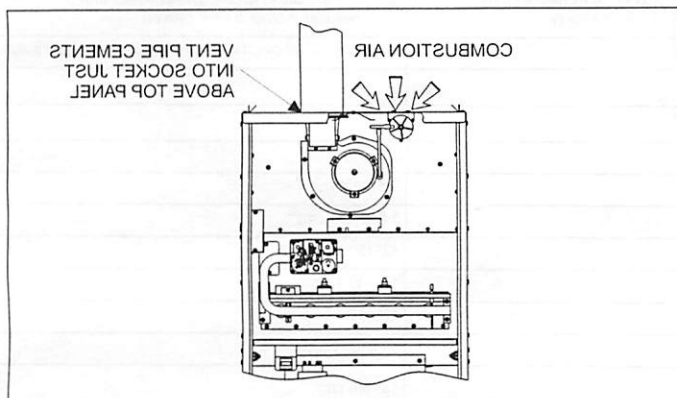


FIGURE 19: Combustion Airflow Path Through The Furnace Casing to the Burner Box

## WARNING

*This type of installation requires that the supply air to the appliance(s) be of a sufficient amount to support all of the appliance(s) in the area. 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. A venting problem or a lack of supply air will result in a hazardous condition, which can cause the appliance to soot and generate dangerous levels of CARBON MONOXIDE, which can lead to serious injury, property damage and / or death.*

An **unconfined space** is not less than 50 cu.ft (1.42 m<sup>3</sup>) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are furnished with doors.

A **confined space** is an area with less than 50 cu.ft (1.42 m<sup>3</sup>) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

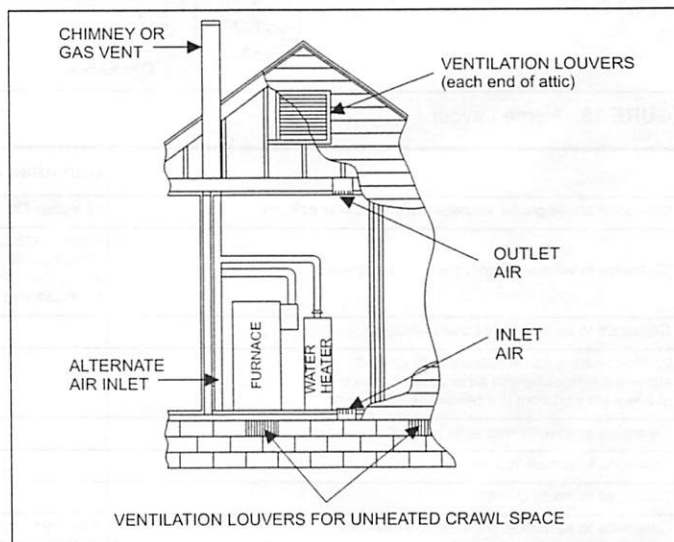


FIGURE 20: Alternate Air Intake, Air Outlet and Chimney Connections

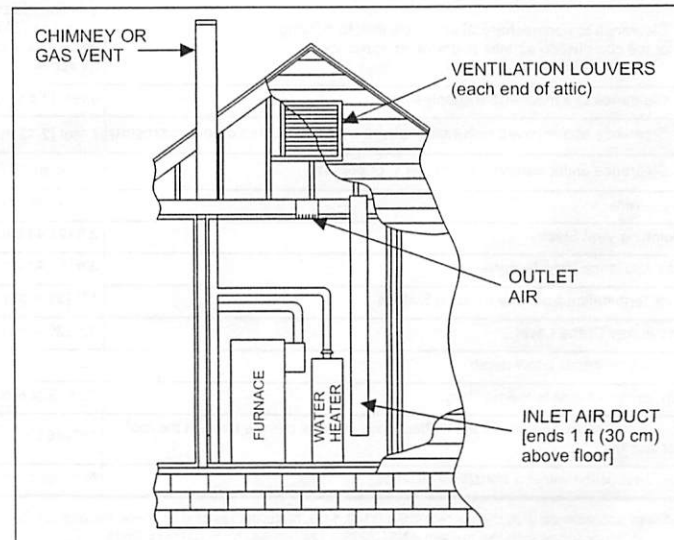


FIGURE 21: Air Inlet, Outlet and Chimney Connections

### Combustion Air Source From Outdoors

The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, refer to Table 11, to estimate free area.

TABLE 11: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20-25%* Metal 60-70%*
Screens+	1/4" (0.635 cm) mesh or larger 100%

\* Do not use less than 1/4" mesh

+ Free area of louvers and grille varies widely; the installer should follow louver or grille



### Dampers, Louvers and Grilles (Canada Only)

1. The free area of a supply air opening shall be calculated by subtracting the blockage area of all fixed louvers grilles or screens from the gross area of the opening.
2. Apertures in a fixed louver, a grille, or screen shall have no dimension smaller than 0.25" (6.4 mm).
3. A manually operated damper or manually adjustable louvers are not permitted for use.
4. A automatically operated damper or automatically adjustable louvers shall be interlocked so that the main burner cannot operate unless either the damper or the louver is in the fully open position.

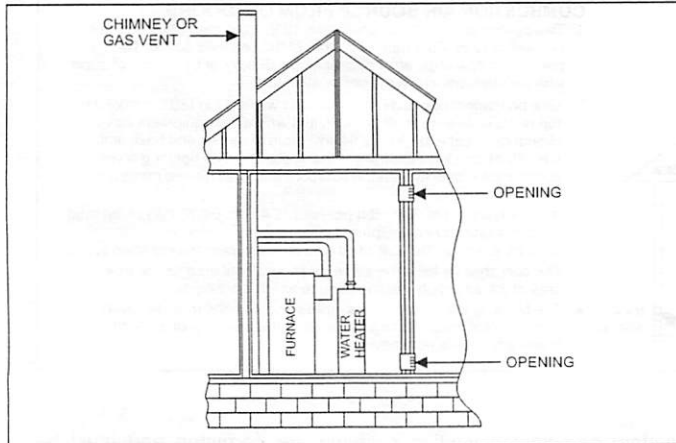


FIGURE 22: Typical Chimney Connections

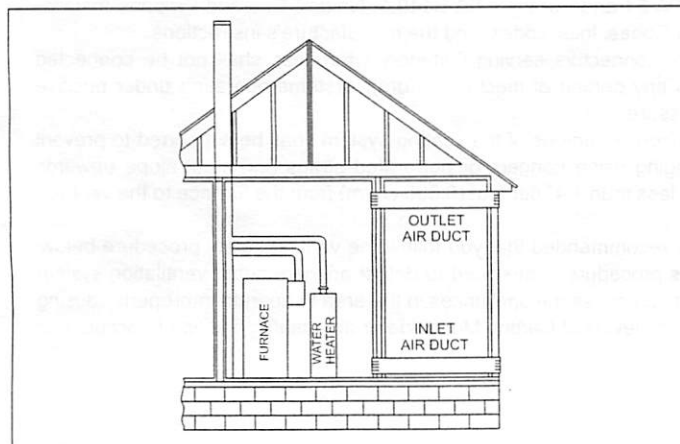


FIGURE 23: Horizontal Air Inlet, Outlet and Chimney Connections

TABLE 12: Free Area

BTUH Input Rating	Minimum Free Area Required for Each Opening		
	Horizontal Duct (2,000 BTUH)	Vertical Duct or Opening to Outside (4,000 BTUH)	Round Duct (4,000 BTUH)
80,000	40 in <sup>2</sup> (258 cm <sup>2</sup> )	20 in <sup>2</sup> (129 cm <sup>2</sup> )	5" (13 cm)
100,000	50 in <sup>2</sup> (322 cm <sup>2</sup> )	25 in <sup>2</sup> (161 cm <sup>2</sup> )	6" (15 cm)
120,000	60 in <sup>2</sup> (387 cm <sup>2</sup> )	30 in <sup>2</sup> (193 cm <sup>2</sup> )	7" (18 cm)

EXAMPLE: Determining Free Area.

Appliance 1Appliance 2Total Input  
 100,000 + 30,000 = (130,000 ÷ 4,000) = 32.5 Sq. In. Vertical  
 Appliance 1Appliance 2Total Input  
 100,000 + 30,000 = (130,000 ÷ 2,000) = 65 Sq. In. Horizontal

TABLE 13: Unconfined Space Minimum Area in Square Inch

BTUH Input Rating	Minimum Free Area in Square Feet Required for Each Opening
80,000	500 (46.45 m <sup>2</sup> )
100,000	625 (58.06 m <sup>2</sup> )
120,000	750 (69.68 m <sup>2</sup> )

EXAMPLE: Square feet is based on 8 foot ceilings.

$\frac{28,000 \text{ BTUH}}{1,000} \times 50 \text{ Cubic Ft.} = \frac{1,400}{8' \text{ Ceiling Height}} = 175 \text{ Sq. Ft.}$

### WARNING

*When a Category I furnace is removed or replaced, the original venting system may no longer be correctly sized to properly vent the attached appliances.*

*An improperly sized vent system can cause CARBON MONOXIDE to spill into the living space causing personal injury, and or death.*

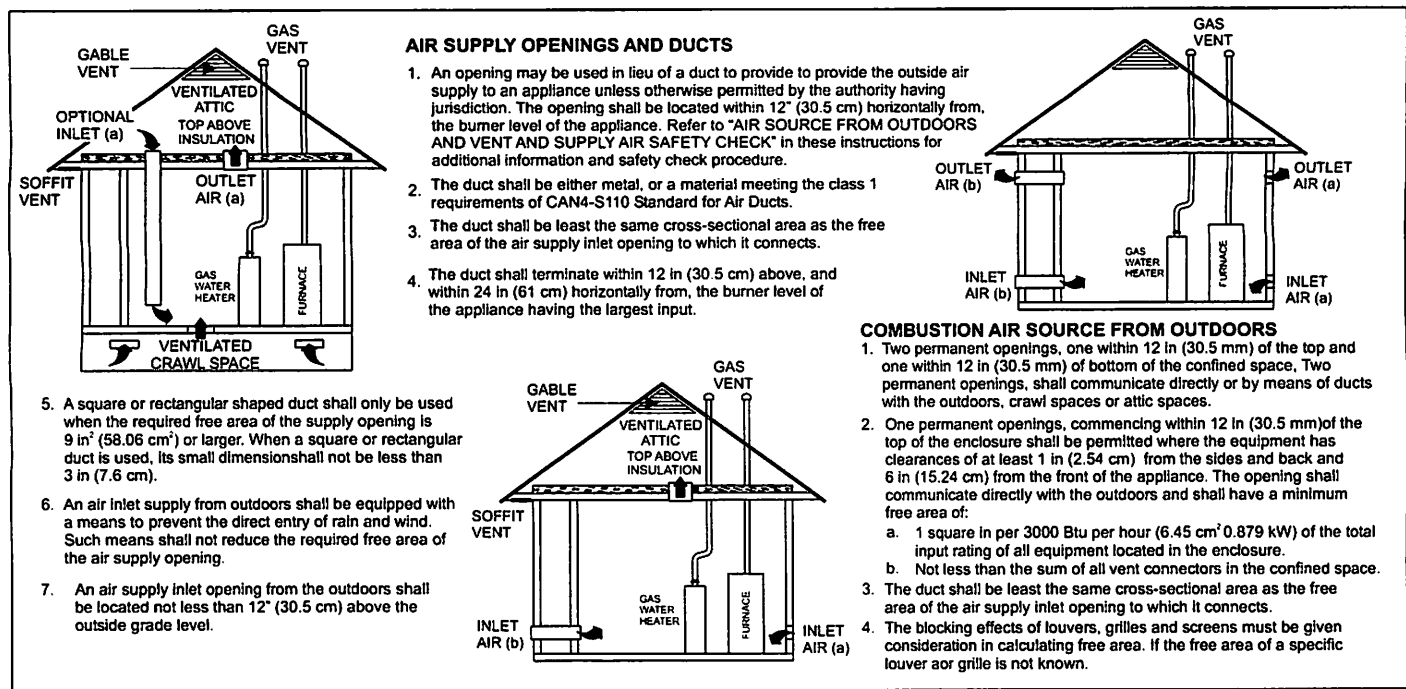


FIGURE 24: Outside and Ambient Combustion Air

### Ventilated Combustion Air

The ventilated attic space or a crawl space from which the combustion air is taken must comply with the requirements specified in "AIR SOURCE FROM OUTDOORS" in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type installation requires two properly sized pipes. One brings combustion air from a properly ventilated attic space or crawl space and a second pipe that extends from the furnace vent connection (top right of unit) to the exterior of the building.

### Vent and Supply (Outside) Air Safety Check Procedure

For Category I furnaces, vent installations shall be in accordance with Parts 7 and 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, and or Section 7 and Appendix B of the CSA B149.1, Natural Gas and Propane Installation Codes, the local building codes, furnace and vent manufacture's instructions.

Multi-story or common venting systems are permitted and must be installed in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and / or the CSA B149.1, Natural Gas and Propane Installation Codes, local codes, and the manufacture's instructions.

Vent connectors serving Category I furnaces shall not be connected into any portion of mechanical draft systems operating under positive pressure.

Horizontal portions of the venting system shall be supported to prevent sagging using hangers or perforated straps and must slope upwards not less than 1/4" per foot (0.635 cm/m) from the furnace to the vent terminal.

It is recommended that you follow the venting safety procedure below. This procedure is designed to detect an inadequate ventilation system that can cause the appliances in the area to operate improperly causing unsafe levels of Carbon Monoxide or an unsafe condition to occur.

## ▲ WARNING

### CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon-monoxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows and all doors.
3. Turn on clothes dryers and TURN ON any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Open the fireplace dampers. Do not operate a summer exhaust fan.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test each appliance (such as a water heater) equipped with a draft hood for spillage (down-draft or no draft) at the draft hood relief opening after 5 minutes of main burner operation. Appliances that do not have draft hoods need to be checked at the vent pipe as close to the appliance as possible. Use a combustion analyzer to check the CO<sub>2</sub> and CO levels of each appliance. Use a draft gauge to check for a downdraft or inadequate draft condition.
6. After it has been determined that each appliance properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their normal condition.
7. If improper venting is observed during any of the above tests, a problem exists with either the venting system or the appliance does not have enough combustion air (Supply Air from outside) to complete combustion. This condition must be corrected before the appliance can function safely.

**NOTE:** An unsafe condition exists when the CO reading at the furnace vent exceeds 40 ppm and the draft reading is not in excess of - 0.1 in. W.C. (-25 kPa) with all of the appliance(s) operating at the same time.

8. Any corrections to the venting system and / or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1-00 Natural Gas and Propane Installation Code (latest editions). If the vent system must be resized, follow the appropriate tables in Appendix G of the above codes or for this appliance.

## SECTION VII: SAFETY CONTROLS

### CONTROL CIRCUIT FUSE

A 3-amp fuse is provided on the control circuit board 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 on the control board.

### BLOWER DOOR SAFETY SWITCH

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.

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

## ▲ CAUTION

*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.*

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

### ROLLOUT SWITCH CONTROLS

These controls are mounted on the burner box assembly. If the temperature in the burner box exceeds its set point, the ignition 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. These are manual reset controls that must be reset before operation can continue.

### PRESSURE SWITCHES

This furnace is supplied with two pressure switches, which monitor the flow through the combustion air/vent piping system. This switches de-energize the ignition control module and the gas valve if any of the following conditions are present. Refer to Figure 27 for tubing connections.

1. Blockage of vent piping or terminal.

2. Failure of combustion air blower motor.

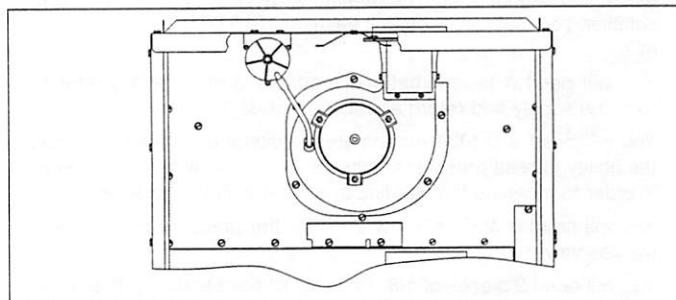


FIGURE 25: Pressure Switch Tubing Routing

### LIMIT CONTROLS

There is a high temperature limit control located on the furnace vestibule panel near the gas valve. This is an automatic reset control that provides over temperature protection due to reduced airflow, that may be caused by a dirty filter, or if the indoor fan motor should fail. The control module will lockout if the limit trips 5 consecutive times. Control will reset & try ignition again after 1 hour. Control will reset and try ignition again after 1 hour.

## SECTION VIII: START-UP AND ADJUSTMENTS

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

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

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



**NOx SCREEN REMOVAL (Lo-NOx Models Only)**

If the furnace is equipped with NOx screens and is to be used with LP (propane) gas, the screens must be removed prior to startup.

1. Make sure that the electrical power to the unit is turned off and that the gas supply is turned off at the shutoff valve.
2. Remove the blower compartment and burner compartment access doors.
3. Disconnect the gas supply piping at the union to permit removal of the entire burner and gas control assembly from the vestibule panel. Use the wrench boss on the gas valve when removing or installing the piping.
4. Unplug the ignitor from the wire harness. Disconnect the flame sensor wires located on top of the air shield. Unplug the gas valve from the wiring harness.
5. Remove the ignitor and ignitor bracket. Handle the ignitor very carefully since it is fragile and easily broken.
6. Remove the screws holding the burner assembly to the vestibule panel. It may be necessary to remove the rollout switch bracket(s) to gain access to one or more of these screws.
7. Remove the burner assembly. It should be possible to swing the burner assembly out of the way without disconnecting the remaining wires.
8. With the burner assembly out of the way, simply slide the NOx screens out of the heat exchanger tubes and discard the screens.
9. Replace all components in reverse order. Reconnect all wiring.

**TOOLS AND INFORMATION THAT WILL BE REQUIRED IN ORDER TO PROPERLY PERFORM THE FURNACE STARTUP PROCEDURE.**

1. Call the local gas supplier to obtain heating value of the natural gas. If you cannot obtain the heating value of the gas from the gas supplier, you may use a default value of 1030 BTU/SCF (38.8 MJ / m<sup>3</sup>).
2. You will need a thermometer or portable digital thermometer to read the supply and return air temperatures.
3. You will need a U-tube manometer or digital equipment that has the ability to read pressures between 0 – 15" in.w.c (0 - 3.73 kPa) in order to measure the gas line and the manifold pressures.
4. You will need a 3/32" Allen wrench for the pressure port plugs in the gas valve.
5. You will need 2 pieces of 1/8" (0.3 cm) ID flexible tubing that is 12" (30 cm) in length, 2 – pieces of 1/8" (0.3 cm) tubing that are 4" (10.0 cm) in length, a 1/8" (0.3 cm) tee and a 1/8" (0.3 cm) adapter to connect the U-tube manometer or the digital pressure measuring equipment to the gas valve pressure ports.

There is an accessory kit (1PK0601) available from Source 1, which has the following items:

- 1 - 12" (30 cm) length x 1/8" (0.3 cm) diameter tubing
- 2 – pieces of 4" (10 cm) length x 1/8" (0.3 cm) diameter tubing
- 1 - 5/16" (0.8 cm) tee
- 1 – 5/16" (0.8 cm) x 1/8" (3.175 mm) reducing coupling
- 1 – 1/8" (0.3 cm) adapter

There is a accessory kit (1PK0602) available from Source 1, which has the following items:

- 12" (30 cm) length x 1/8" (0.3 cm) diameter tubing
- 2 – pieces of 4" (10 cm) length x 1/8" (0.3 cm) diameter tubing
- 1 - 5/16" (0.8 cm) tee

- 1 – 5/16" (0.8 cm) x 1/8" (0.3 cm) reducing coupling
- 1 – 1/8" (0.3 cm) adapter
- 1 - Dwyer – Manometer

These items are required in order to properly perform the required startup procedure.

**IGNITION SYSTEM SEQUENCE**

1. Turn the gas supply ON at external valve and main gas valve.
2. 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 and come up to speed. Shortly after inducer start-up, the hot surface igniter will glow for about 17 seconds.
  - b. After this warm up, the ignition module will energize (open) the main gas valve.
  - c. After flame is established, the supply air blower will start in about 30 seconds.

## ▲ WARNING

**FIRE OR EXPLOSION HAZARD**

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

*Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.*

**IMPORTANT:** 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.

With furnace in operation, check all of the pipe joints, gas valve connections and manual valve connections for leakage using an approved gas detector, a non-corrosive leak detection fluid, or other leak detection methods. Take appropriate steps to stop any leak. If a leak persists, replace the component.

The furnace and its equipment 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 PSI (3.45 kPa).

The furnace must be isolated from the gas supply piping system by closing the equipment shutoff valve during any pressure testing of the gas supply piping system.

## **CALCULATING THE FURNACE INPUT (NATURAL GAS)**

**NOTE:** Burner orifices are sized to provide proper input rate using natural gas with a heating value of 1050 BTU/Ft<sup>3</sup> (39.12 MJ/m<sup>3</sup>). If the heating value of your gas is significantly different, it may be necessary to replace the orifices.

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

1. Turn off all other gas appliances connected to the gas meter.
2. At the gas meter, measure the time (with a stop watch) it takes to use 2 cubic ft. (0.0566 m<sup>3</sup>.) of gas.
3. Calculate the furnace input by using one of the following equations.

**In the USA use the following formula to calculate the furnace input.**

For natural gas multiply the heat content of the gas BTU/SCF (or Default 1030 BTU/SCF, times 2 cubic ft. of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 2 cubic ft. of gas from the gas meter.

For propane (LP) gas multiply the heat content of the gas BTU/SCF (or Default 2500 BTU/SCF, times 1 cubic ft. of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 1 cubic ft. of gas from the gas meter.

**The formula for US input calculation using a cubic foot gas meter:**

$\frac{\text{BTU/}^3 \times 2 \text{ cu.ft.} \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	BTUH/H	$\frac{\text{BTU/}^3 \times 2 \text{ cu.ft.} \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	BTUH/H
<b>NATURAL GAS INPUT CALCULATION</b>					
<b>EXAMPLE:</b>					
$\frac{1030 \times 2 \times 0.960 \times 3600}{90.5}$	=	79,997.38	$\frac{2500 \times 1 \times 0.960 \times 3600}{108}$	=	80,000.00
Natural Gas			Propane Gas		
BTU/SCF 1030			BTU/SCF 2500		

**In Canada you will use the following formula to calculate the furnace input if you are using a cubic foot gas meter.**

For Natural Gas multiply the Heat content of the gas MJ/m<sup>3</sup> (or Default 39.2), times 2 cu. ft. of gas x 0.02831 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 2 cu.ft. of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m<sup>3</sup> (or Default 93.14), times 1 cu. ft. of gas x 0.02831 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 1 cu.ft. of gas from the gas meter.

**The formula for metric input calculation using a cubic foot gas meter:**

$\frac{\text{MJ/m}^3 \times (2 \text{ cu.ft.} \times \text{Conv}) \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTUH/H
<b>NATURAL GAS INPUT CALCULATION</b>										
<b>EXAMPLE:</b>										
$\frac{39.2 \times 2 \times 0.960 \times 3600}{90.5}$	=	84.76	x	0.2777	=	23.54	x	3412.14	=	80,312.62
Natural Gas										
BTU/SCF 1030 = 39.2 MJ/m <sup>3</sup>										
<b>PROPANE (LP) GAS INPUT CALCULATION</b>										
<b>EXAMPLE:</b>										
$\frac{93.15 \times 1 \times 0.960 \times 3600}{108}$	=	84.41	x	0.2777	=	23.45	x	3412.14	=	80,000.00
Propane Gas										
BTU/SCF 2500+93.15 MJ/m <sup>3</sup>										

**In Canada use the following formula to calculate the furnace input if you are using a gas meter that measures cubic meters.**

For Natural Gas multiply the Heat content of the gas MJ/m<sup>3</sup> (or Default 39.2), times 0.0566 m<sup>3</sup> of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.0566 m<sup>3</sup> of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m<sup>3</sup> (or Default 93.14), times 0.00283 m<sup>3</sup> of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.0283 cm of gas from the gas meter.

**The formula for metric input calculation using a cubic foot gas meter:**

$\frac{\text{MJ/m}^3 \times (2 \text{ cu.ft.} \times \text{Conv}) \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTUH/H
<b>NATURAL GAS INPUT CALCULATION</b>										
<b>EXAMPLE:</b>										
$\frac{39.2 \times 2 \times 0.960 \times 3600}{90.5}$	=	84.76	x	0.2777	=	23.54	x	3412.14	=	80,312.62
Natural Gas										
BTU/SCF 1030 = 39.2 MJ/m <sup>3</sup>										
<b>PROPANE (LP) GAS INPUT CALCULATION</b>										
<b>EXAMPLE:</b>										
$\frac{93.15 \times 1 \times 0.960 \times 3600}{108}$	=	84.41	x	0.2777	=	23.45	x	3412.14	=	80,000.00
Propane Gas										
BTU/SCF 2500+93.15 MJ/m <sup>3</sup>										

DO NOT ADJUST the manifold pressure regulator if the actual input is equal to or within 8% less than the furnace input specified on the rating plate or if the furnace rise is above the specified rise range on the rating plate.

If the actual input is significantly higher than the furnace input specified on the rating plate then replace the gas orifice spuds with the gas orifice spuds of the proper size for the type of gas you are using.

For altitudes above 2,000 ft. (610 m) the furnace input MUST BE DERATED. Refer to the GAS CONVERSION FOR PROPANE (LP) AND HIGH ALTITUDES IN SECTION IV for information on high altitude conversions.

## ⚠ CAUTION

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

**TABLE 14: Inlet Gas Pressure Range**

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5" W.C. (1.12 kPa)	8.0" W.C. (1.99 kPa)
Maximum	10.5" W.C. (2.61 kPa)	13.0" (3.24 kPa) W.C.

**IMPORTANT:** The inlet gas pressure operating range table specifies what the minimum and maximum gas line pressures must be for the furnace to operate safely. The gas line pressure **MUST BE**

- 7" W.C. (1.74 kPa) for Natural Gas
- 11" W.C. (2.74 kPa) for Propane (LP) Gas

in order to obtain the BTU input specified on the rating plate and/or the nominal manifold pressure specified in these instructions and on the rating plate.

### ADJUSTMENT OF MANIFOLD GAS PRESSURE

Manifold gas pressure may be measured by connecting the "U" tube manometer to the gas valve with a piece of tubing and on an adapter. Follow the appropriate section in the instructions below. Refer to Figure 28 for a drawing of the locations of the pressure ports on the gas valve.

**Turn gas off at the ball valve or gas cock on gas supply line before the gas valve. Find the pressure ports on the gas valve marked Out Pressure Tap and Inlet Pressure Tap.**

1. The manifold pressure must be taken at the port marked OUT Pressure Tap.
2. The gas line pressure must be taken at the port marked Inlet Pressure Tap.

Using a screw driver, remove the cap that covers the manifold pressure set screw.

### Read the inlet gas pressure

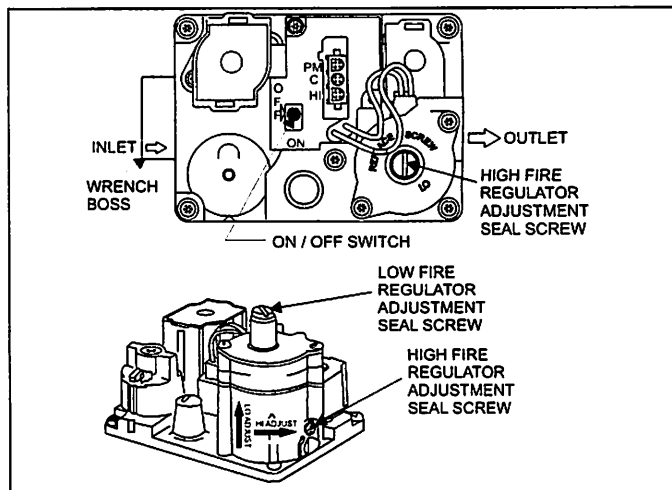
Connect the positive side of the manometer to the adapter previously installed in the Out pressure Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. Refer to Figure 29 for connection details.

**IMPORTANT:** The cap for the pressure regulator must be removed entirely to gain access to the adjustment screw. Loosening or tightening the cap does not adjust the flow of gas.

**NOTE:** 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.

**TABLE 15: Nominal Manifold Pressure**

NOMINAL MANIFOLD PRESSURE	
Natural Gas (High Fire)	3.5" w.c. (0.87 kPa)
Natural Gas (Low Fire)	1.6" w.c. (0.40 kPa)
Propane (LP) Gas (High Fire)	10.0" w.c. (2.488 kPa)
Propane (LP) Gas (Low Fire)	4.0" w.c. (0.99 kPa)



**FIGURE 26: Gas Valve**

### High Outlet Pressure Adjustment

1. 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". See Figure 28.
5. 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.
7. Remove manometer and replace the outlet pressure tap plug.

### Low Outlet Pressure Adjustment

1. 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. Do not energize HI terminal.
4. Remove low adjustment seal screw. See Figure 28.
5. 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.
6. Replace high adjustment seal screw and tighten securely. Cycle the valve two and three times to verify regulator setting.
7. Remove manometer and replace the outlet pressure tap.

**IMPORTANT:** If gas valve regulator is turned in (clockwise), manifold pressure is increased. If screw is turned out (counterclockwise), manifold pressure will decrease.

8. After the manifold pressure has been adjusted, re-calculate the furnace input to make sure you have not exceeded the specified input on the rating plate. Refer to "CALCULATING THE FURNACE INPUT (NATURAL GAS)".
9. Once the correct BTU (kW) input has been established, turn the gas valve to OFF and turn the electrical supply switch to OFF; then remove the flexible tubing and fittings from the gas valve pressure tap and re-install the plug in the Out Pressure Port using a compound (on the threads) resistant to the action of LP gases. Replace the burner box front cover (if it was removed) and replace the pressure reference hose.



10. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved non-corrosive gas leak detection fluid, or other non-flammable leak detection methods.

## WARNING

The manifold pressure must be checked with the screw-off cap for the gas valve pressure regulator in place. If not, the manifold pressure setting could result in an over-fire condition. A high manifold pressure will cause an over-fire condition, which could cause premature 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 in place and burner box to gas valve pressure reference hose is connected.

### MAINFOLD PRESSURE "U" TUBE CONNECTION

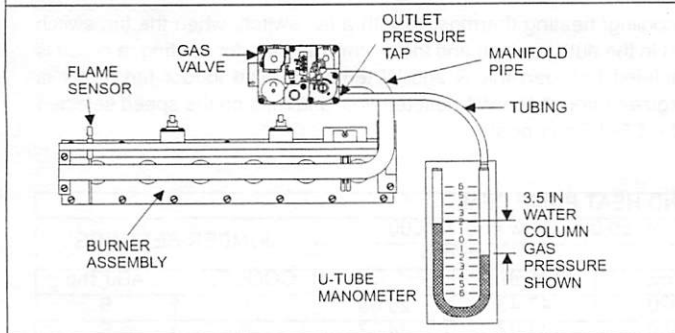


FIGURE 27: Reading Gas Pressure

## ADJUSTMENT OF TEMPERATURE RISE

## DANGER

The temperature rise, or temperature difference between the return air and the supply (heated) air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 8 "ELECTRICAL AND PERFORMANCE DATA".

The supply air temperature cannot exceed the "Maximum Supply Air Temperature" specified in these instructions and on the furnace rating plate. Under NO circumstances can the furnace be allowed to operate above the Maximum Supply Air Temperature. Operating the furnace above the Maximum Supply Air Temperature will cause premature heat exchanger failure, high levels of Carbon Monoxide, a fire hazard, personal injury, property damage, and/or death.

The temperature rise, or temperature difference between the return air and the heated supply air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations as shown in Table 8.

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 (1.83 m) 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.

## DIRECT DRIVE MOTORS

### 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; 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.

## VARIABLE SPEED MOTORS

The variable speed motor CFM / Timer Control Board must be configured so the blower will provide a sufficient airflow so that the furnace operates within the temperature rise range on the rating plate and within the application limitations shown in Table 8 in these Instructions.

## ADJUSTMENT OF FAN CONTROL SETTINGS

This furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 seconds. The fan off delay has 4 settings (60, 90, 120 and 180 seconds). The fan off delay is factory set to 120 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 living space. The fan-off timing may be adjusted by positioning the jumper on two of the four pins as shown in Figure 30.

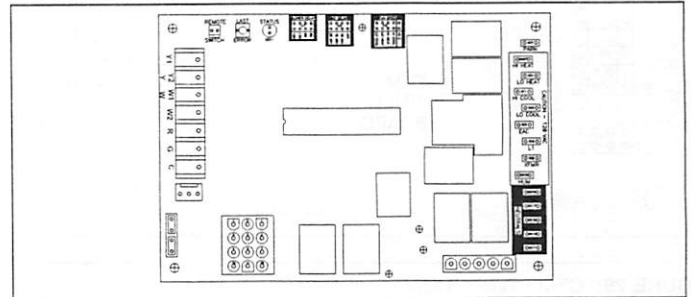


FIGURE 28: Furnace Control Board

### Heating Indoor Fan Off Delay

The jumper pins are located on the main control board. Refer to Figure 30 for the jumper settings to obtain the desired fan OFF delay. The blower off delay must be long enough to adequately cool the furnace, but not so long that cold air is blown into the living space.

The blower on delay is fixed at 30 seconds and can not be adjusted.

### Heating and Cooling Airflow

The heating and the cooling airflows are preset at the factory. The heating airflow is set to the maximum CFM. The cooling airflow is set to provide 90 percent of the maximum CFM. The heating and cooling airflows must be field adjusted to match the HVAC system at installation. See Table 16 for the HEAT, COOL and ADJ jumper settings to use for specific airflows.

### CFM Board - Delay Taps Selection

The set of jumper pins on the CFM board labeled "DELAY" are used to set the delay profiles for the furnace. These can be chosen so as to maximize the comfort and sound levels for various regions of the country.

**Tap A** is the default profile. It provides a 15-second ramp-up from zero airflow to full capacity and a 15-second ramp-down from full capacity back to zero airflow. Whenever there is a change in airflow mode, such as from low heat to high heat, the motor will take 15 seconds to ramp from one speed to the other.

**Tap B** is the humid profile. This profile is best-suited for installations where the humidity is frequently very high during cooling season, such as in the southern part of the country. On a call for cooling, the blower will ramp up to 50% of full capacity and will stay there for two minutes, then will ramp up to 82% of full capacity and will stay there for five minutes, and then will ramp up to full capacity, where it will stay until the wall thermostat is satisfied. In every case, it will take the motor 15 seconds to ramp from one speed to another.

**Tap C** is the dry profile. This profile is best suited to parts of the country where excessive humidity is not generally a problem, where the summer months are usually dry. On a call for cooling the motor will ramp up to full capacity and will stay there until the thermostat is satisfied. At the end of the cooling cycle, the blower will ramp down to 50% of full capacity where it will stay for 60 seconds. Then it will ramp down to zero. Any ramp up to a higher speed will take 30 seconds and any ramp down to a lower speed (or off) will take 60 seconds.

**Tap D** is the normal profile, best suited for most of the country, where neither excessive humidity nor extremely dry conditions are the norm. On a call for cooling, the motor will ramp up to 63% of full capacity and will stay there for 90 seconds, then will ramp up to full capacity. At the end of the cooling cycle, the motor will ramp down to 63% of full capacity and will stay there for 30 seconds, then will ramp down to zero. In every case, it will take the motor 15 seconds to ramp from one speed to another.

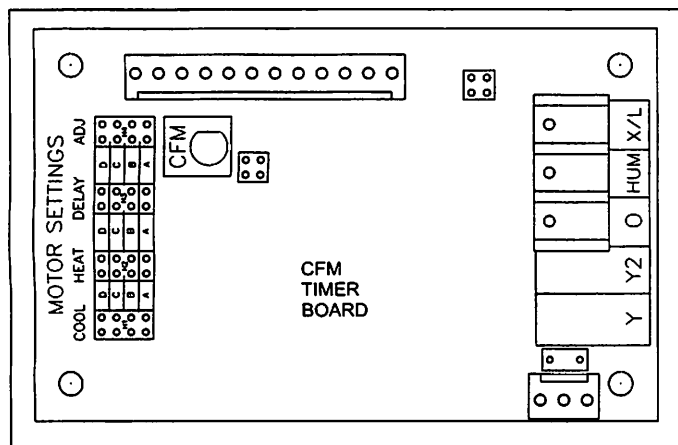


FIGURE 29: CFM / Timer Board

### Continuous Blower Operation

The blower will run continuously whenever the wall thermostat fan switch is in the "ON" position. The furnace blower will run at the speed selected on the "FAN SPEED" jumpers on the main control board (HI COOL, LO COOL, HI HEAT or LO HEAT). When the jumper is in the "VS G" position, the blower will run at 50% of the high cool speed.

### Intermittent Blower Cooling

On cooling/ heating thermostats with a 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.

### Intermittent Blower Heating

On cooling/ heating thermostats with a fan switch, when the fan switch is set in the auto position and the thermostat calls for heating, a circuit is completed between the R and W terminals. The indoor fan motor is energized through the W1 heat terminal and runs on the speed selected on the CFM Timer board.

TABLE 16: Air Flow Data

HIGH / LOW SPEED COOLING AND HEAT PUMP CFM									
INPUT High Fire: 60,000 / Low Fire: 39,000				INPUT High Fire: 80,000 / Low Fire: 52,000				JUMPER SETTINGS	
CFM		m³/min		CFM		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap
1340	740	37.94	20.95	1675	920	47.43	26.05	A	B
1155	635	32.71	17.98	1555	850	44.03	24.07	B	B
1220	671	34.55	19.00	1525	830	43.18	23.50	A	A
1050	578	29.73	16.37	1410	795	39.93	22.51	B	A
1100	605	31.15	17.13	1355	760	38.37	21.52	A	C
913	502	25.85	14.22	1330	750	37.66	21.24	C	B
945	520	26.76	14.72	1280	710	36.25	20.10	B	C
726	400	20.56	11.33	1145	625	32.42	17.70	D	B
830	456	23.50	12.91	1235	680	34.97	19.26	C	A
660	400	18.69	11.33	1035	555	29.31	15.72	D	A
747	411	21.15	11.64	1105	600	31.29	16.99	C	C
594	400	16.82	11.33	920	495	26.05	14.02	D	C
INPUT High Fire: 100,000 / Low Fire: 65,000				INPUT High Fire: 120,000 / Low Fire: 78,000				JUMPER SETTINGS	
CFM		m³/min		CFM		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap*
2050	1135	58.05	32.14	2020	1130	57.20	32.00	A	B
1860	980	52.67	27.75	1855	960	52.53	27.18	B	B
1945	1035	55.08	29.31	1920	1010	54.37	28.60	A	A
1665	910	47.15	25.77	1680	850	47.57	24.07	B	A
1740	950	49.27	26.90	1765	910	49.98	25.77	A	C
1575	880	44.60	24.92	1630	820	46.16	23.22	C	B
1440	830	40.78	23.50	1485	760	42.05	21.52	B	C
1325	760	37.52	21.52	1355	720	38.37	20.39	D	B
1410	820	39.93	23.22	1465	745	41.48	21.10	C	A
1190	725	33.70	20.53	1210	650	34.26	18.41	D	A
1245	745	35.25	21.10	1260	695	35.68	19.68	C	C
1065	690	30.16	19.54	1080	595	30.58	16.85	D	C
HIGH / LOW HEAT CFM									
INPUT High Fire: 60,000 / Low Fire: 39,000				INPUT High Fire: 80,000 / Low Fire: 52,000				JUMPER SETTINGS	
CFM		m³/min		CFM		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap*
1315	880	37.24	24.92	1490	990	42.19	28.03	A	Any
1185	795	33.56	22.51	1350	900	38.23	25.49	B	Any
1075	720	30.44	20.39	1240	820	35.11	23.22	C	Any
990	665	28.03	18.83	1140	760	32.28	21.52	D	Any
INPUT High Fire: 100,000 / Low Fire: 65,000				INPUT High Fire: 120,000 / Low Fire: 78,000				JUMPER SETTINGS	
CFM		m³/min		CFM		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap*
1480	975	41.91	27.61	1950	1330	55.22	37.66	A	Any
1350	900	38.23	25.49	1840	1165	52.10	32.99	B	Any
1235	815	34.97	23.08	1705	1055	48.28	29.87	C	Any
1140	770	32.28	21.80	1535	960	43.47	27.18	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 airflow may be lower than 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.

NOTE - The ADJ "D" tap should not be used.

## FILTER PERFORMANCE

The airflow capacity data published in Table 16 represents blower performance **WITHOUT** filters. To determine the approximate blower performance of the system, apply the filter drop value for the filter being used or select an appropriate value from the Table 17.

**NOTE:** The filter pressure drop values in Table 17 are typical values for the type of filter listed and should only be used as a guideline. Actual pressure drop ratings for each filter type vary between filter manufacturers.

**TABLE 17: Filter Performance - Pressure Drop Inches W.C. and (kPa)**

AIRFLOW RANGE	MINIMUM OPENING SIZE				FILTER TYPE											
					DISPOSABLE				WASHABLE FIBER*				PLEATED			
	1 Opening		2 Openings		1 Opening		2 Opening		1 Opening		2 Opening		1 Opening		2 Opening	
	Sq. in.	m <sup>2</sup>	Sq. in.	m <sup>2</sup>	In w.c.	Pa	In w.c.	Pa	In w.c.	Pa	In w.c.	Pa	In w.c.	Pa	In w.c.	Pa
0 - 750	230	.15			0.01	2.5			0.01	2.5			0.15	37		
751 - 1000	330	.21			0.04	10			0.03	7.5			0.20	50		
1001 - 1250	330	.21			0.08	20			0.07	17			0.20	50		
1251 - 1500	330	.21			0.08	20			0.07	17			0.25	62		
1501 - 1750	380	.25	658	.42	0.14	35	0.08	20	0.13	32	0.06	15	0.30	75	0.17	42
1751 - 2000	380	.25	658	.42	0.17	42	0.09	22	0.15	37	0.07	17	0.30	75	0.17	42
2001 & Above	463	.30	658	.42	0.17	42	0.09	22	0.15	37	0.07	17	0.30	75	0.17	42

\* Hogs Hair Filters are the type supplied with furnace (if supplied).

## APPLYING FILTER PRESSURE DROP TO DETERMINE SYSTEM AIRFLOW

To determine the approximate airflow of the unit with a filter in place, follow the steps below:

1. Select the filter type.
2. Select the number of return air openings or calculate the return opening size in square inches to determine the proper filter pressure drop.
3. Determine the External System Static Pressure (ESP) without the filter.
4. Select a filter pressure drop from the table based upon the number of return air openings or return air opening size and add to the ESP from Step 3 to determine the total system static.
5. If total system static matches a ESP value in the airflow table (i.e. 0.20 w.c. (50 Pa), 0.60 w.c. (150 Pa), etc.) the system airflow corresponds to the intersection of the ESP column and Model/Blower Speed row.
6. If the total system static falls between ESP values in the table (i.e. 0.58 w.c. (144 Pa), 0.75 w.c. (187 Pa), etc.), the static pressure may be rounded to the nearest value in the table determining the airflow using Step 5 or calculate the airflow by using the following example.

Example: For a 130,000 BTUH (38.06 kW) furnace with 2 return openings and operating on high-speed blower, it is found that total system static is 0.58" w.c. To determine the system airflow, complete the following steps:

Obtain the airflow values at 0.50 w.c. (125 Pa) & 0.60 w.c. (150 Pa) ESP.

Airflow @ 0.50": 2125 CFM (60.17 m<sup>3</sup>/min)

Airflow @ 0.60": 2035 CFM (57.62 m<sup>3</sup>/min)

Subtract the airflow @ 0.50 w.c. (125 Pa) from the airflow @ 0.60 w.c. (150 Pa) to obtain airflow difference.

2035 - 2125 = -90 CFM (2.55 m<sup>3</sup>/min)

Subtract the total system static from 0.50 w.c. (125 Pa) and divide this difference by the difference in ESP values in the table, 0.60 w.c. (150 Pa) - 0.50 w.c. (125 Pa), to obtain a percentage.

$(0.58 - 0.50) / (0.60 - 0.50) = 0.8$

Multiply percentage by airflow difference to obtain airflow reduction.

$(0.8) \times (-90) = -72$

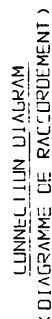
Subtract airflow reduction value to airflow @ 0.50 w.c. (125 Pa) to obtain actual airflow @ 0.58 inwc (144 Pa) ESP.

2125 - 72 = 2053

**TABLE 18: Field Installed Accessories - Non Electrical**

MODEL NO.	DESCRIPTION	USED WITH
1NP0480	PROPANE (LP) CONVERSION KIT	ALL MODELS
1SR0302	EXTERNAL SIDE FILTER RACK (6-PACK)	ALL MODELS
1BR0314	EXTERNAL BOTTOM RETURN FILTER RACK WITH HIGH VELOCITY FILTER	ALL 14-1/2" ("A") UNITS
1BR0317		ALL 17-1/2" ("B") UNITS
1BR0321		ALL 21" ("C") UNITS
1PS0313	HIGH ALTITUDE PRESSURE SWITCH KIT (DOES NOT INCLUDE ORIFICES)	FOR APPLICATION INFORMATION SEE FORM 650.78-N1.1V
1PS0314		

**FIGURE 30: Wiring Diagram**



- |    |   |                   |   |  |
|----|---|-------------------|---|--|
| 1  | 1   | FILED WIRING PER: | 63) NATIONAL FILE<br>64) CANADIAN FILE<br>(C) LOCAL OR CITY CODES | LOCAL (CITY) AND/OR<br>CITY CODES AND/OR<br>CITY |
| 2  | IF ANY OF THE ORIGINAL WIRE<br>MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL<br>HAVING A TEMPERATURE RATING OF AT LEAST: 201°F (105°C) |                   |   |  |
| 3  | CONNECTORS SUITABLE FOR COPPER CONDUCTORS ONLY.   |                   |   |  |
| 4  | ALL REPLACEMENT COMPONENTS MUST BE PROPERLY GROUNDED  |                   |   |  |
| 5  | PROVIDED: WIRING SHALL BE AS PER SUPPLIES.  |                   |   |  |
| 6  | WIRING IS IN EXCELLENT PROTECTED  |                   |   |  |
| 7  | REPAIRS MAY BE AT ANY TIME WHEN USING: A 2 5/16"  |                   |   |  |
| 8  | TEMPERATURE MUST BE IN THE PERMITTED WHEN USING A   |                   |   |  |
| 9  | IND. STABLE TEMPERATURE   |                   |   |  |
| 10 | SSS IN SERIES WITH LSI AND RDS3   |                   |   |  |

## NOTES

- [illegible]

WIRE COLOR KEY  
CODE OF CONFLIPS

BLACK (N° 1)	RED (N° 1)	WHITE (N° 1)	GREEN (N° 1)	YELLOW (N° 1)	BLUE (N° 1)	PURPLE (N° 1)	BROWN (N° 1)	ORANGE (N° 1)	PINK (N° 1)	GRAY (N° 1)
BLACK (N° 2)	RED (N° 2)	WHITE (N° 2)	GREEN (N° 2)	YELLOW (N° 2)	BLUE (N° 2)	PURPLE (N° 2)	BROWN (N° 2)	ORANGE (N° 2)	PINK (N° 2)	GRAY (N° 2)
BLACK (N° 3)	RED (N° 3)	WHITE (N° 3)	GREEN (N° 3)	YELLOW (N° 3)	BLUE (N° 3)	PURPLE (N° 3)	BROWN (N° 3)	ORANGE (N° 3)	PINK (N° 3)	GRAY (N° 3)
BLACK (N° 4)	RED (N° 4)	WHITE (N° 4)	GREEN (N° 4)	YELLOW (N° 4)	BLUE (N° 4)	PURPLE (N° 4)	BROWN (N° 4)	ORANGE (N° 4)	PINK (N° 4)	GRAY (N° 4)
BLACK (N° 5)	RED (N° 5)	WHITE (N° 5)	GREEN (N° 5)	YELLOW (N° 5)	BLUE (N° 5)	PURPLE (N° 5)	BROWN (N° 5)	ORANGE (N° 5)	PINK (N° 5)	GRAY (N° 5)
BLACK (N° 6)	RED (N° 6)	WHITE (N° 6)	GREEN (N° 6)	YELLOW (N° 6)	BLUE (N° 6)	PURPLE (N° 6)	BROWN (N° 6)	ORANGE (N° 6)	PINK (N° 6)	GRAY (N° 6)
BLACK (N° 7)	RED (N° 7)	WHITE (N° 7)	GREEN (N° 7)	YELLOW (N° 7)	BLUE (N° 7)	PURPLE (N° 7)	BROWN (N° 7)	ORANGE (N° 7)	PINK (N° 7)	GRAY (N° 7)
BLACK (N° 8)	RED (N° 8)	WHITE (N° 8)	GREEN (N° 8)	YELLOW (N° 8)	BLUE (N° 8)	PURPLE (N° 8)	BROWN (N° 8)	ORANGE (N° 8)	PINK (N° 8)	GRAY (N° 8)
BLACK (N° 9)	RED (N° 9)	WHITE (N° 9)	GREEN (N° 9)	YELLOW (N° 9)	BLUE (N° 9)	PURPLE (N° 9)	BROWN (N° 9)	ORANGE (N° 9)	PINK (N° 9)	GRAY (N° 9)
BLACK (N° 10)	RED (N° 10)	WHITE (N° 10)	GREEN (N° 10)	YELLOW (N° 10)	BLUE (N° 10)	PURPLE (N° 10)	BROWN (N° 10)	ORANGE (N° 10)	PINK (N° 10)	GRAY (N° 10)

## LEGEND

- [illegible]

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- 10 COMMISSAIRE DES DOSSONS  
 11 CHAIRS DE GAY  
 12 CHAIRS DE L'IMP  
 13 CHAIRS DE L'IMP  
 14 CHAIRS DE L'IMP  
 15 CHAIRS DE L'IMP  
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