

**Installation Instructions**

**Two-Stage Condensing Furnaces With Fixed and Variable Speed Blowers**



**\*TC Upflow/Horizontal Model**



**\*TL Downflow Model**

**⚠ WARNING:**

- **PROPOSITION 65 WARNING:** This product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.
- **This furnace is not approved for installation in mobile homes. Installing this furnace in a mobile home could cause fire, property damage, and/or personal injury.**

**ATTENTION INSTALLERS:**

It is your responsibility to know this product better than your customer. This includes being able to install the product according to strict safety guidelines and instructing the customer on how to operate and maintain the equipment for the life of the product. Safety should always be the deciding factor when installing this product and using common sense plays an important role as well. Pay attention to all safety warnings and any other special notes highlighted in the manual. Improper installation of the furnace or failure to follow safety warnings could result in serious injury, death, or property damage.

These instructions are primarily intended to assist qualified individuals experienced in the proper installation of this appliance. Some local codes require licensed installation/service personnel for this type of equipment. Please read all instructions carefully before starting the installation. Return these instructions to the customer's package for future reference.

**⚠ WARNING:**

**FIRE OR EXPLOSION HAZARD**

- **Failure to follow safety warnings exactly could result in serious injury or property damage.**
- **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**
- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

**WHAT TO DO IF YOU SMELL GAS**

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Leave the building immediately.**
- **Immediately call your gas supplier from a neighbors phone. Follow the gas suppliers instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

**DO NOT DESTROY.**

**KEEP IN A SAFE PLACE FOR FUTURE REFERENCE.**

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## SAFETY INFORMATION

Safety markings are used frequently throughout this manual to designate a degree or level of seriousness and should not be ignored. **WARNING** indicates a potentially hazardous situation that if not avoided, could result in personal injury or death. **CAUTION** indicates a potentially hazardous situation that if not avoided, may result in minor or moderate injury or property damage.

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### **WARNING:**

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**The safety information listed below must be followed during the installation, service, and operation of this furnace. Failure to follow safety recommendations could result in possible damage to the equipment, serious personal injury or death.**

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- Use only with type of gas approved for this furnace. Refer to the furnace rating plate.
- Install this furnace only in a location and position as specified in Table 1 (page 7).
- Provide adequate combustion and ventilation air to the furnace space as specified on pages 8 - 10.
- Provide adequate clearances around the vent air intake terminal as specified in Figures 6 - 9 (pages 12 - 13).
- Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified on pages 10 - 14.
- Never test for gas leaks with an open flame. Use a commercially available soap solution to check all connections. See page 20.
- This furnace is designed to operate with a maximum external pressure rise of 0.5 inches of water column. Consult Tables 8 - 10 (pages 35 - 37), and the rating plate for the proper circulating air flow and temperature rise. It is important that the duct system be designed to provide the correct flow rates and external pressure rise. An improperly designed duct system can result in nuisance shutdowns, and comfort or noise issues.
- When 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 in the conditioned space. See page 14.
- A gas-fired furnace for installation in a residential garage must be installed as specified on page 6.
- This furnace may be used for temporary heating of buildings or structures under construction. See the guidelines listed on pages 5 - 6.

## REQUIREMENTS and CODES

**This furnace must be installed in accordance with these instructions, all applicable local building codes and the current revision of the National Fuel Gas Code (NFPA54/ANSI Z223.1) or the Natural Gas and Propane Installation Code, CAN/CGA B149.1.**

The Commonwealth of Massachusetts requires compliance with regulation 248 CMR 4.00 and 5.00 for installation of through – the – wall vented gas appliances as follows:

1. For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment, where the bottom of the vent terminal and the air intake is installed below four feet above grade the following requirements must be satisfied:
  - a.) A carbon monoxide (CO) detector and alarm shall be placed on each floor level where there are bedrooms. The detector shall comply with NFPA 720 (2005 Edition) and be mounted in the living area outside the bedroom(s).
  - b.) A (CO) detector shall be located in the room that houses the appliance or equipment and shall:
    - Be powered by the same electrical circuit as the appliance or equipment. Only one service switch shall power the appliance and the (CO) detector;
    - Have battery back-up power;
    - Meet ANSI/UL 2034 Standards and comply with NFPA 720 (2005 Edition); and Approved and listed by a Nationally Recognized Testing Laboratory as recognized under 527 CMR.
  - c.) A Product-approved vent terminal must be used, and if applicable, a product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.
  - d.) A metal or plastic identification plate shall be mounted at the exterior of the building, four feet directly above the location of vent terminal. The plate shall be of sufficient size, easily read from a distance of eight feet away, and read "Gas Vent Directly Below".
2. For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment where the bottom of the vent terminal and the air intake is installed above four feet above grade the following requirements must be satisfied:
  - a.) A (CO) detector and alarm shall be placed on each floor level where there are bedrooms. The detector shall comply with NFPA 720 (2005 Edition) and be mounted in the living area outside the bedroom(s).

- b.) The (CO) detector shall:
- Be located in the room that houses the appliance or equipment;
  - Be hard-wired or battery powered or both.
  - Shall comply with NFPA 720 (2005 Edition).
- c.) A product-approved vent terminal must be used, and if applicable, a product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.

**Additional information listed below is for reference purposes only and does not necessarily have jurisdiction over local or state codes. Always consult with local authorities before installing any gas appliance.**

**Combustion and Ventilation Air**

- US: National Fuel Gas Code (NFGC), Air for Combustion and Ventilation
- CANADA: Natural Gas and Propane Installation Codes (NSCNGPIC), Venting Systems and Air Supply for Appliances

**Duct Systems**

- US and CANADA: Air Conditioning Contractors Association (ACCA) Manual D, Sheet Metal and Air Conditioning Contractors National Association (SMACNA), or American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Fundamentals Handbook

**Electrical Connections**

- US: National Electrical Code (NEC) ANSI/NFPA 70
- CANADA: Canadian Electrical Code CSA C22.1

**Gas Piping and Gas Pipe Pressure Testing**

- US: NFGC and National Plumbing Codes
- CANADA: NSCNGPIC

**General Installation**

- US: Current edition of the NFGC and the NFPA 90B. For copies, contact the National Fire Protection Association Inc., Batterymarch Park, Quincy, MA 02269; or American Gas Association, 400 N. Capitol, N.W., Washington DC 20001 or www.NFPA.org
- CANADA: NSCNGPIC. For a copy, contact Standard Sales, CSA International, 178 Rexdale Boulevard, Etobicoke (Toronto), Ontario, M9W 1R3 Canada

**Safety**

- US: (NFGC) NFPA 54–1999/ANSI Z223.1 and the Installation Standards, Warm Air Heating and Air Conditioning Systems ANSI/NFPA 90B.
- CANADA: CAN/CGA-B149.1 and .2–M00 National Standard of Canada. (NSCNGPIC)

**GENERAL INSTRUCTIONS**

**Combustion Air Quality**



**Combustion air must not be drawn from a corrosive atmosphere.**

To maximize heat exchanger life, the combustion air must be free of chemicals that can form corrosive acidic compounds in the combustion gases. The recommended source of combustion air is to use outdoor air. However, the use of indoor air in most applications is acceptable except as listed:

- If the furnace is installed as a single pipe installation in a confined space, it is required that the necessary combustion air come from the outdoors by way of attic, crawl space, air duct, or direct opening. For Installations in confined spaces, see pages 8 - 10 for combustion air requirements.
- Installations in these locations may require outdoor air for combustion, due to chemical exposures:
  - Commercial buildings
  - Buildings with indoor pools
  - Furnaces installed in laundry rooms
  - Furnaces installed in hobby or craft rooms
  - Furnaces installed near chemical storage areas
- Exposure to the following substances in the combustion air supply may require outdoor air for combustion:
  - 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 (perchloroethylene)
  - Printing inks, paint removers, varnishes, etc.
  - Hydrochloric Acid
  - Cements and glues
  - Antistatic fabric softeners
  - Masonry acid washing materials

**Operation of Furnace During Construction**



**Failure to follow these instructions will void the factory warranty and may significantly reduce the life or the performance of the furnace, and/or result in other unsafe conditions. It is the responsibility of the installing contractor to insure these provisions are met.**

Operating gas furnaces in construction environments can cause a variety of problems with the furnace. Proper use of commercial portable space heating equipment during construction is recommended. This gas furnace may be used during construction if it is not in violation of any applicable codes and the following criteria are met:

- The installation must meet all applicable codes. The furnace must be permanently installed according to the instructions supplied with the furnace including electrical supply, gas supply, duct work and venting. The furnace must be controlled by a thermostat properly installed according to the instructions supplied with the furnace and thermostat. The installation must include a properly installed filter in the return air system with no by-pass air. The filter must be inspected frequently and replaced when necessary.
- Combustion air must be supplied from outside the structure and located such that dust and gases from construction activity are not introduced into the combustion system.
- Provisions must be made to insure that condensate does not freeze in the furnace or condensate drain lines during operation and during idle times; for example, overnight if turned off. (Condensing furnaces only)
- Before occupying the structure: The filter must be replaced or cleaned, the duct work must be inspected and cleaned of any construction debris, and the furnace must be cleaned and/or repaired if found to be dirty, damaged, or malfunctioning in any way by a qualified HVAC technician. The furnace shall be inspected and approved by applicable local authority even if this requires redundant inspections.
- Serial numbers for furnaces used during construction must be submitted in writing (fax and email also acceptable). This information will be used to track the long-term affects of the use during construction on furnaces. Proof of this submittal shall be available for the final inspection of the furnace prior to occupancy.
- This furnace is designed to operate with return air temperatures in ranges normally found in occupied residences, including setbacks. Minimum continuous return temperature must not be below 60° F (15° C). Occasionally a temporary return temperature of 55° F (12° C) is acceptable. However, operation with a return temperature below 55° F (12° C) is not allowed.

### Heating Load

This furnace should be sized to provide the design heating load requirement. Heating load estimates can be made using approved methods available from Air Conditioning Contractors of America (Manual J); American Society of Heating, Refrigerating, and Air Conditioning Engineers; or other approved engineering methods. **Excessive oversizing of the furnace could cause the furnace and/or vent to fail prematurely.** The ductwork should be appropriately sized to the capacity of the furnace to ensure its proper airflow rating.

For installations above 2,000 ft., the furnace should have a sea level input rating large enough that it will meet the heating load after deration for altitude.

Two-stage furnaces operate at two input rates to better meet heating loads. The lower heating rate (low fire) is 65% of the high fire rate. The greatest degree of control over the furnace can be gained by controlling it with a two stage thermostat. This allows the thermostat to directly request either high or low fire. However, it is possible to operate the furnace using a single stage thermostat. In this application the furnace control can be set to increase from low to high fire, based on a timer. See Autostaging for Single Stage Thermostats (page 23).

Furnaces are properly sized to meet the expected maximum heating load. But this load occurs infrequently. So, during more moderate weather, the furnace is likely to use low fire a considerable part of the time. This is normal and has the benefit of quieter and more efficient operation.

### Installation in a Garage



## WARNING:

### FIRE AND EXPLOSION HAZARD

**Can result in serious injury or death.**

**Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance. Storage of or use of gasoline or other flammable vapors or liquids in the vicinity of this or any appliance can result in serious injury or death.**

This Gas-fired furnace may be installed in a residential garage with the provision that the burners and igniter are located no less than 18 inches (457mm) above the floor. The furnace must be located or protected to prevent physical damage by vehicles.

### Clearances to Combustible Materials

This furnace is Design Certified in the U.S. and Canada by CSA International for the minimum clearances to combustible material listed in Table 1 (page 7). To obtain model number and specific clearance information, refer to the furnace rating plate, located inside of the furnace cabinet.

Access for positioning and servicing the unit must be considered when locating unit. The need to provide clearance for access to panels or doors may require clearance distances over and above the requirements. **Allow 24 inches minimum clearance from the front of the unit. However 36 inches is strongly recommended.**

INSTALLATION CLEARANCES to COMBUSTIBLE MATERIALS For UPFLOW, HORIZONTAL & DOWNFLOW FURNACES		
Left Side.....0 Inches	Vent..... 1 Inch	Top.....1 Inches
Right Side .....0 Inches	Back.....0 Inches	Front..... 4 Inches <sup>†</sup>
<b>UPFLOW APPLICATION</b>	<b>HORIZONTAL APPLICATION</b>	<b>DOWNFLOW APPLICATION</b>
<p>TOP</p> <p>LEFT SIDE</p> <p>RIGHT SIDE</p> <p>BOTTOM</p>	<p>TOP</p> <p>SIDE</p> <p>BOTTOM</p> <p>SIDE</p>	<p>TOP</p> <p>LEFT SIDE</p> <p>RIGHT SIDE</p> <p>BOTTOM</p>
<sup>†</sup> Allow 24 in. minimum clearance for servicing. Recommended clearance is 36 in.		
<b>NOTE:</b> The furnace is listed for installation on combustible or non-combustible flooring. However, wood is the only combustible flooring allowed for installation. Downflow models must use the appropriate subbase kit when installing over a wood floor.		

Table 1. Minimum Clearances to Combustible Materials

## 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 with each individual appliance connected to the venting system being placed in operation, while all other appliances connected to the venting system are not in operation:

1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* or the *CSA B149.1, Natural Gas and Propane Installation Codes* and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. As far as practical, close all building doors and windows and all doors between the space in which the appliance(s) connected to the venting system are located and other spaces of the building.
4. Close fireplace dampers.
5. Turn on clothes dryers and any appliance not connected to the venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they are operating at maximum speed. Do not operate a summer exhaust fan.
6. Follow the lighting instructions. Place the appliance being inspected into operation. Adjust the thermostat so appliance is operating continuously.
7. Test for spillage from draft hood equipped appliances at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
8. If improper venting is observed during any of the above tests, the venting system must be corrected in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* and/or *CSA B149.1, Natural Gas and Propane Installation Codes*.
9. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-fired burning appliance to their previous conditions of use.

## COMBUSTION AIR REQUIREMENTS

### General Information

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**WARNING:**

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**Furnace installation using methods other than those described in the following sections must comply with the National Fuel Gas Code (NFGC) and all applicable local codes.**

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- Instructions for determining the adequacy of combustion air for an installation can be found in the current revision of the NFGC (ANSI Z223.1 / NFPA54). **Consult local codes for special requirements.** These requirements are for US installations as found in the NFGC.
- The requirements in Canada (B149.1) are structured differently. Consult with B149.1 and local code officials for Canadian installations.

This condensing furnace is certified for installation either as a Direct Vent (2-pipe) or Conventional (1-pipe) appliance. Direct Vent appliances draw combustion air from the outdoors and vent combustion products back outside. Installation with air taken from around the furnace is often referred to as Conventional installation - i.e. only the vent (exhaust) pipe is provided.

Provisions must be made during the installation of this furnace that provide an adequate supply of air for combustion. The combustion air from the outside needs to be clear of chemicals that can cause corrosion. The inlet pipe should not be placed near corrosive chemicals such as those listed on page 6.

Another important consideration when selecting one or two pipe installation is the quality of the Indoor air which can sometimes be contaminated with various household chemicals. These chemicals can cause severe corrosion in the furnace combustion system. A 2-pipe installation has the additional advantage that it isolates the system from the effects of negative pressure in the house.

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**CAUTION:**

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**Exhaust fans, clothes dryers, fireplaces and other appliances that force air from the house to the outdoors can create a negative pressure inside the house, resulting in improper furnace operation or unsafe conditions such as flame roll out. It is imperative that sufficient air exchange with the outdoors is provided to prevent depressurization. Additional information about how to test for negative pressure problems can be found in the NFGC.**

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**NOTE:** Air openings on top of the furnace and openings in closet doors or walls must never be restricted. If the furnace is operated without adequate air for combustion,

the flame roll-out switch will open, turning off the gas supply to the burners. This safety device is a manually reset switch. **DO NOT install jumper wires across these switches to defeat their function or reset a switch without identifying and correcting the fault condition.** If a switch must be replaced, use only the correct sized part specified in the Replacement Parts List provided online.

#### Direct Vent Furnaces

Direct Vent (2-pipe) furnaces draw combustion air directly from the outdoors and then vent the combustion products back outside, isolating the entire system from the indoor space. It is important to make sure that the whole system is sealed and clearances to combustibles are maintained regardless of the installation being in a confined or unconfined space.

#### Conventional Furnaces - Confined Spaces

A confined space is an area with volume less than 50 cubic feet per 1,000 Btuh of the combined input rates of all appliances drawing combustion air from that space. Furnace closets, small equipment rooms and garages are confined spaces. Furnaces installed in a confined space which supply heated air to areas outside the space must draw return air from outside the space and must have the return air ducts tightly sealed to the furnace. Ducts must have cross - sectional area at least as large as the free area of their respective openings to the furnace space. Attics or crawl spaces must connect freely with the outdoors if they are the source of air for combustion and ventilation.

The required sizing of these openings is determined by whether inside or outside air is used to support combustion, the method by which the air is brought to the space, and by the total input rate of all appliances in the space. In all cases, the minimum dimension of any combustion air opening is 3 inches.

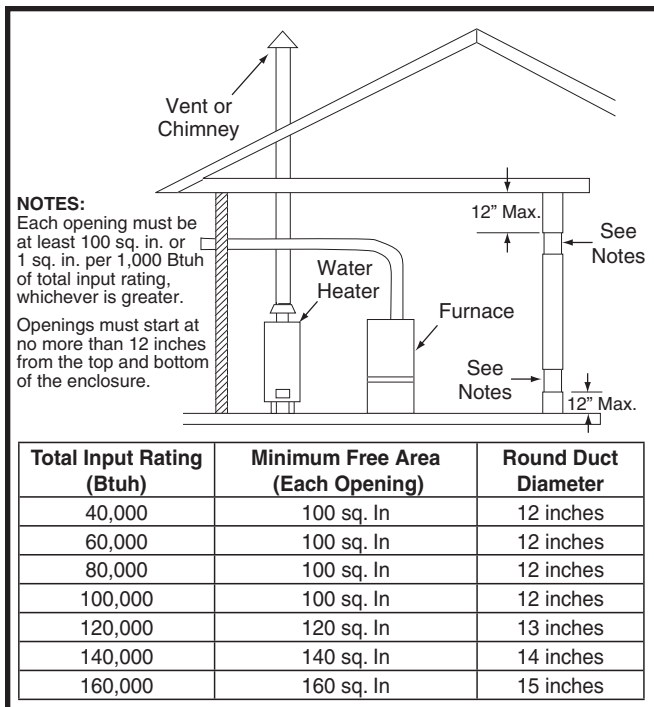
#### Air From Inside

If combustion air is taken from the heated space, the two openings must each have a free area of at least one square inch per 1,000 Btuh of total input of all appliances in the confined space, but **not less than** 100 square inches of free area (Figure 1, page 10).

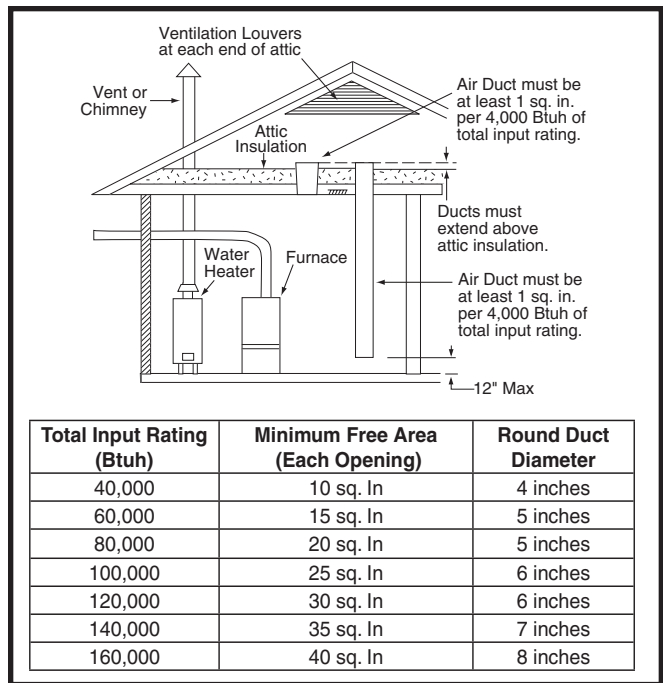
#### **Example:**

If the combined input rate of all appliances is less than or equal to 100,000 Btuh, each opening must have a free area of at least 100 square inches. If the combined input rate of all appliances is 120,000 Btuh, each opening must have a free area of at least 120 square inches.





**Figure 1. Combustion Air Drawn from Inside**



**Figure 3. Combustion Air Drawn from Outside Through Vertical Ducts**

Outdoor Air from a Crawl Space or Vented Attic

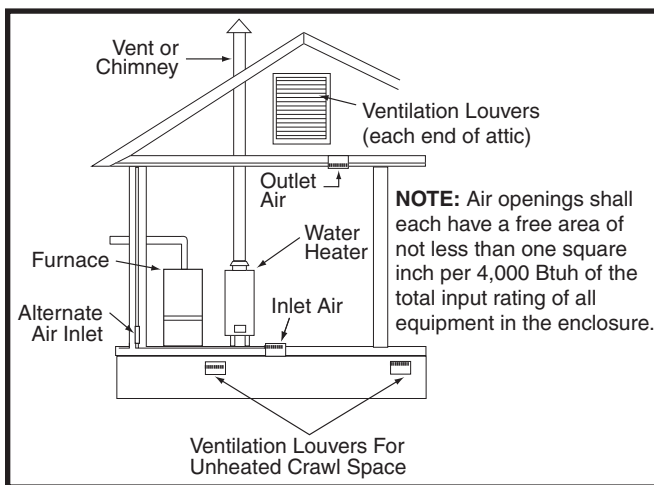
When the openings can freely exchange air with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 Btuh of total appliance input. The openings shall exchange directly, or by ducts, with the outdoor spaces (crawl or attic) that freely exchange with the outdoors (Figure 2).

Outdoor Air Using Vertical Ducts

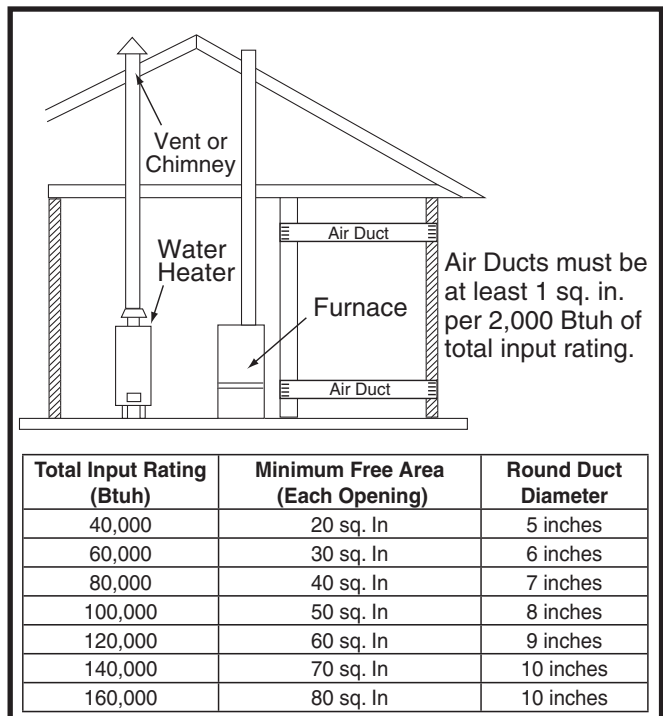
If combustion air is taken from outdoors through vertical ducts, the openings and ducts must have a minimum free area of one square inch per 4,000 Btuh of total appliance input (Figure 3).

Outdoor Air Using Horizontal Ducts

If combustion air is taken from outdoors through horizontal ducts, the openings and ducts must have a minimum free area of one square inch per 2,000 Btuh of total appliance input (Figure 4). Ducts must have cross-sectional area at least as large as the free area of their respective openings to the furnace space.



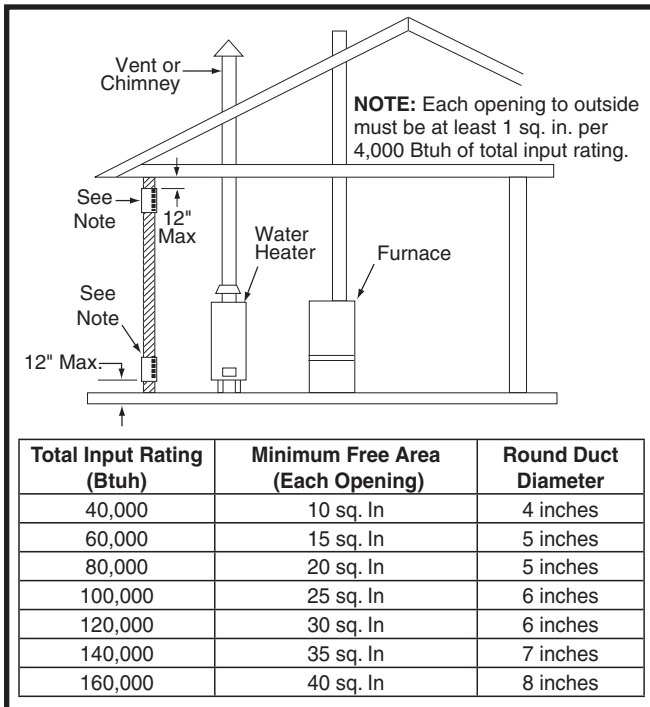
**Figure 2. Combustion Air Drawn from a Crawl Space or Vented Attic**



**Figure 4. Combustion Air Drawn from Outside Through Horizontal Ducts**

### Air Directly Through an Exterior Wall

If combustion air is provided directly through an exterior wall, the two openings must each have free area of at least one square inch per 4,000 Btuh of total appliance input (Figure 5).



**Figure 5. Combustion Air Drawn from Outside Through an Exterior Wall**

#### Alternate Method of Providing Air from Outside:

If acceptable under local Codes, it is permitted to provide outside air using one opening (See NFGC).

Generally, confined spaces must have two openings in the space for combustion air. One opening must be within 12 inches of the ceiling, and the other must be within 12 inches of the floor. However, an alternative method recently adopted by the NFGC uses one opening within 12 inches of the top of the space. This method may be used if it is acceptable to the local codes.

#### The following conditions must be met:

1. The opening must start within 12" of the top of the structure and connect with the out of doors through vertical or horizontal ducts or be ducted to a crawl or attic space that connects with the out of doors.
2. The opening must have a minimum free area of 1 sq. in. per 3,000 Btu per hour of the total input rating of all equipment located in the enclosure.
3. The free area must not be less than the sum of all the areas of the vent connectors in the enclosure.

### Conventional Furnaces - Unconfined Spaces

An unconfined space is an area including all rooms not separated by doors with a volume greater than 50 cubic feet per 1,000 Btuh of the combined input rates of all appliances which draw combustion air from that space.

In general, a furnace installed in an unconfined space will not require outside air for combustion. However, in homes built for energy efficiency (low air change rates), it may be necessary to provide outside air to ensure adequate combustion and venting, even though the furnace is located in an unconfined space. See example.

#### Example:

A space with a water heater rated at 45,000 Btuh input and a furnace rated at 75,000 Btuh requires a volume of 6,000 cubic feet [ $50 \times (45 + 75) = 6,000$ ] to be considered unconfined. If the space has an 8 foot ceiling, the floor area of the space must be 750 square feet ( $6,000 / 8 = 750$ ).

### VENTING REQUIREMENTS

- This furnace must be vented in compliance with the current revision of the National Fuel Gas Code (ANSI-Z223.1/NFPA54) and the instructions provided below. **Consult local codes for special requirements.**
- In Canada, venting shall conform to the requirements of the current (CAN/CGA B149.1 or .2) installation codes. **Consult local codes for special requirements.**

### WARNING:

**This furnace must not be vented with other appliances, even if that appliance is of the condensing type. Common venting can result in severe corrosion of other appliances or their venting and can allow combustion gases to escape through such appliances or vents. Do not vent the furnace to a fireplace chimney or building chase.**

### WARNING:

**Upon completion of the furnace installation, carefully inspect the entire flue system both inside and outside the furnace to assure it is properly sealed. Leaks in the flue system can result in serious personal injury or death due to exposure of flue products, including carbon monoxide.**

This furnace is classified as a "Category IV" appliance, which requires special venting materials and installation procedures.

This section specifies installation requirements for Conventional (1-pipe) and Direct Vent (2-pipe) piping. For 1- pipe installations, install vent piping as described in this section and provide air for combustion and ventilation according to pages 8 - 10. Table 2 contains the maximum length of vent and combustion air piping for either type of installation.

Category IV appliances operate with positive vent pressure and therefore require vent systems which are thoroughly sealed. They also produce liquid condensate, which is slightly acidic and can cause severe corrosion of ordinary venting materials. Furnace operation can be adversely affected by restrictive vent and combustion air piping.

The inducer assembly on this furnace can be rotated to vent the flue products out of the left or right side of the furnace. This increases the flexibility of which direction the vent pipe can exit the furnace.

### Vent Pipe Material

Vent and combustion air pipe and fittings must be one of the following materials in the list and must conform to the indicated ANSI/ASTM standards. Cement must conform to ASTM Standard D2564 for PVC and Standard D2235 for ABS. PVC primer must meet standard ASTM F656. When joining PVC piping to ABS, use PVC solvent cement. (See procedure specified in ASTM Standard D3138)

<b>Material</b>	<b>Standard</b>
Schedule 40PVC	D1785
PVC-DWV	D2665
SDR-21 & SDR-26	D2241
ABS-DWV	D2661
Schedule 40 ABS	F628
Foam/Cellular Core PVC	F891

In Canada, all plastic vent pipes and fittings including any cement, cleaners, or primers must be certified as a system to ULC S636. However this requirement does not apply to the finish flanges or piping internal to the furnace.

### Vent Pipe Length and Diameter

In order for the furnace to operate properly, the combustion air and vent piping must not be excessively restrictive.

- The venting system should be designed to have the minimum number of elbows or turns.
- All horizontal runs must slope upwards from the furnace at 1/4 inch minimum per running foot of vent.
- Transition to the final vent diameter should be done as close to the furnace outlet as practical.
- Always use the same size or a larger pipe for combustion air that is used for the exhaust vent.

Table 2 indicates the maximum allowable pipe length for a furnace of known input rate, when installed with piping

FURNACE MODELS (BTU)	FURNACE INSTALLATION	SINGLE VENT PIPE LENGTH (FT.) with 1 long radius elbow**		DUAL VENT PIPE LENGTH (ft.) with 1 long radius elbow on each pipe**	
		OUTLET 2" Diameter	OUTLET 3" Diameter	INLET/OUTLET 2" Diameter	INLET/OUTLET 3" Diameter
60,000	Upflow	90	90	90	90
	Horizontal	50	90	50	90
	Downflow	30	90	30	90
80,000	Upflow	90	90	90	90
	Horizontal	30	90	30	90
	Downflow	30	90	30	90
100,000	Upflow	60	90	60	90
	Horizontal	30	90	30	90
	Downflow	30	90	25	90
120,000	Upflow	N/A	90	N/A	90
	Horizontal	N/A	90	N/A	90
	Downflow	N/A	90	N/A	90

**\*NOTES:**

1. Subtract 2.5 ft. for each additional 2 inch long radius elbow, 5 ft. for each additional 2 inch short radius elbow, 3.5 ft. for each additional 3 inch long radius elbow, and 7 ft. for each additional 3 inch short radius elbow. Subtract 5 ft for each 2" tee and 8 ft for each 3" tee. Two 45 degree elbows are equivalent to one 90 degree elbow.
2. The length of pipe needed between the inducer and the finish flange on downflow models is 15".
3. This table applies for elevations from sea level to 2,000 ft. For higher elevations, decrease pipe lengths by 8% per 1,000 ft of altitude.

**Table 2. Vent Pipe Lengths**

of selected diameter and number of elbows. To use the table, the furnace input rate, the centerline length and the number of elbows on each pipe must be known.

When estimating the length of vent runs, consideration must be made to the effect of elbows and other fittings. This is conveniently handled using the idea of “equivalent length”. This means the fittings are assigned a linear length that accounts for the pressure drop they will cause. For example: a 2” diameter, long radius elbow is worth the equivalent of 2.5 feet of linear run. A 90 degree tee is worth 7 ft.

The equivalent lengths of tees and various elbows are listed in Table 2. Measure the linear length of the vent run and then add in the equivalent length of each fitting. The total length, including the equivalent fitting lengths, must be less than the maximum length specified in Table 2.

Condensing furnace combustion products have very little buoyancy, so Table 2 is to be used without consideration of any vertical rise in the piping.

### Vent Pipe Installation

## ! CAUTION:

**Combustion air must not be drawn from a corrosive atmosphere.**

This furnace has been certified for installation with zero clearance between vent piping and combustible surfaces. However, it is good practice to allow space for convenience in installation and service.

- The quality of outdoor air must also be considered. Be sure that the combustion air intake is not located near a source of solvent fumes or other chemicals which can cause corrosion of the furnace combustion system. (See list of substances on page 5).
- Route piping as direct as possible between the furnace and the outdoors. Longer vent runs require larger diameters. Vent piping must be sloped upwards 1/4” per foot in the direction from the furnace to the terminal. This is to ensure that any condensate flows back to the condensate disposal system.
- If a Direct Vent (2-pipe) system is used, the combustion air intake and the vent exhaust must be located in the same atmospheric pressure zone. This means both pipes must exit the building through the same portion of exterior wall or roof as shown in Figures 6 - 9 (pages 12 - 13) and Figure 36 (page 47).
- Piping must be mechanically supported so that its weight does not bear on the furnace. Pipe supports must be installed a minimum of every 5 feet along the vent run to ensure no displacement after installation. Supports may be at shorter intervals if necessary to ensure that there are no sagging sections that can trap condensate. It is recommended to install couplings along the vent pipe,

on either side of the exterior wall (Figure 36). These couplings may be required by local code.

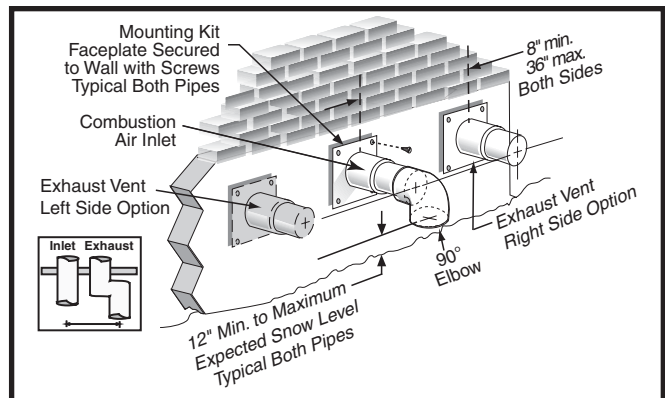
- If breakable connections are required in the combustion air inlet pipe (if present) and exhaust vent piping, then straight neoprene couplings for 2” or 3” piping with hose clamps can be used. These couplings can be ordered through your local furnace distributor. To install a coupling:

1. Slide the rubber coupling over the end of the pipe that is attached to the furnace and secure it with one of the hose clamps.
2. Slide the other end of the rubber coupling onto the other pipe from the vent.
3. Secure the coupling with the second hose clamp, ensuring that the connection is tight and leak free.

### Outdoor Terminations - Horizontal Venting

Vent and combustion air intake terminations shall be installed as depicted in Figures 6 & 7 (page 13) and in accordance with these instructions:

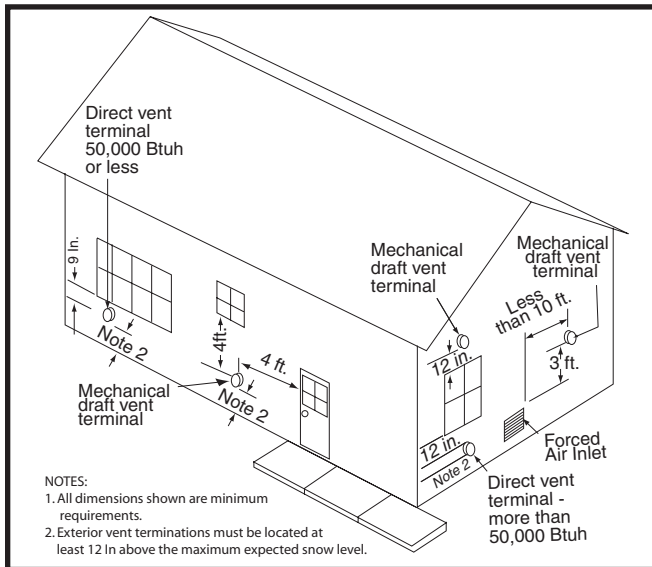
- Vent termination clearances must be consistent with the NFGC, ANSI 2223.1/NFPA 54 and/or the CSA B149.1, Natural Gas and Propane Installation Code. Table 15 (page 44) lists the necessary distances from the vent termination to windows and building air intakes.
- All minimum clearances must be maintained to protect building materials from degradation by flue gases as shown in Figure 7.
- Vent and combustion air intake terminations must be located to ensure proper furnace operation and conformance to applicable codes. A vent terminal must be located at least 3 feet above any forced air inlet located within 10 feet. This does not apply to the combustion air inlet of a direct vent (two pipe) appliance. In Canada, CSA B149.1, takes precedence over these instructions. See Table 17 (page 46).
- For optimal performance, vent the furnace through a wall that experiences the least exposure to winter winds.
- The vent termination shall be located at least 3 ft. horizontally from any electric meter, gas meter, regulator and any relief equipment. These distances apply ONLY



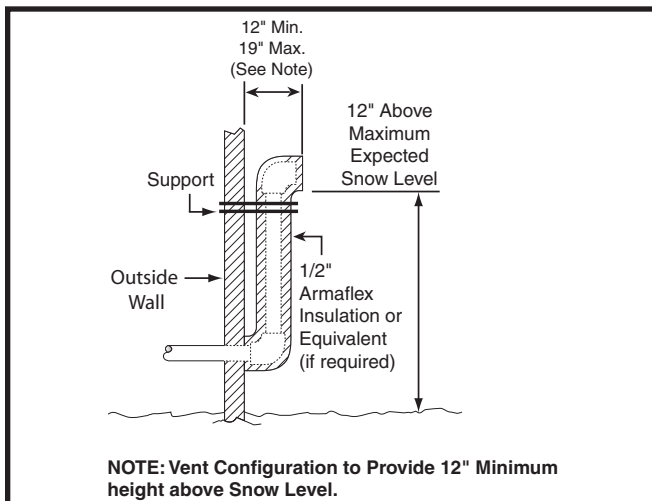
**Figure 6. Inlet and Exhaust Pipe Clearances**

to U.S. installations. In Canada, CSA B149.1, takes precedence over these instructions.

- Do not install the vent terminal such that exhaust is directed into window wells, stairwells, under decks or into alcoves or similar recessed areas, and do not terminate above any public walkways.
- If venting horizontally, a side wall vent kit is available according to the pipe diameter size of the installation. For 2 inch pipe use side wall vent kit #904617, and for 3 inch pipe use kit #904347. **Please follow the instructions provided with the kit.**
- Concentric vent termination kits are available for use with these furnaces. For 2 Inch pipe use kit #904177 and for 3 inch pipe use kit # 904176. **Please follow the instructions provided with the kit.**
- When the vent pipe must exit an exterior wall close to the grade or expected snow level where it is not possible to obtain clearances shown in Figure 6, a riser may be provided as shown in Figure 8. Insulation is required to prevent freezing of this section of pipe. See Table 3 for vent freezing protection.



**Figure 7 Vent Locations**

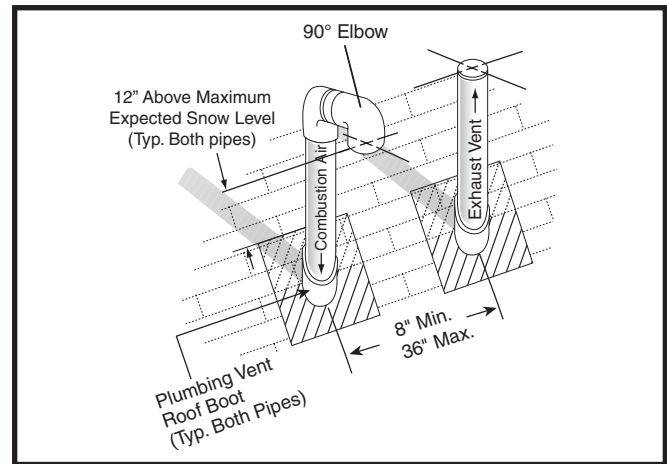


**Figure 8. Alternate Horizontal Vent Installation**

**Outdoor Terminations - Vertical Venting**

Termination spacing requirements from the roof and from each other are shown in Figure 9. The roof penetration must be properly flashed and waterproofed with a plumbing roof boot or equivalent flashing. Vent and combustion air piping may be installed in an existing chimney which is not in use provided that:

- Both the exhaust vent and air intake run the length of the chimney.
- The top of the chimney is sealed and weatherproofed.
- The termination clearances shown in Figure 9 are maintained.
- No other gas fired or fuel-burning equipment is vented through the chimney.



**Figure 9. Vertical Vent Termination**

**Vent Freezing Protection**

- When the vent pipe is exposed to temperatures below freezing (i.e., when it passes through unheated spaces, chimneys, etc.) the pipe must be insulated with 1/2 inch thick sponge rubber insulation, Armaflex-type insulation or equivalent. Insulating pipe is important to avoid condensate icing.
- Table 3 lists the maximum length of flue pipe that can travel through an unconditioned space or an exterior space. The total vent length must not exceed the lengths noted in Table 2 (page 11). For Canadian installations, please refer to the Canadian Installation Code (CAN/CGA-B149.1 or 2) and/or local codes.

Winter Design Temperature	Maximum Flue Pipe Length in Unconditioned and Exterior Spaces	
	Without Insulation (feet)	With Insulation (feet)*
20	45	70
0	20	70
-20	10	60

\* = Insulation thickness greater than 3/8 inch, based on an R value of 3.5 (ft x F x hr) / (BTU x in.)

**Table 3. Vent Protection**

- For extremely cold climates or for conditions of short furnace cycles (i.e. set back thermostat conditions) the last 18 inches of vent pipe can be reduced. It is acceptable to reduce from 3" to 2-1/2", 3" to 2", or 2" to 1-1/2" if the total vent length is at least 15 feet in length, the vent length is within the parameters specified in Table 2 (page 11). The restriction should be counted as 3 equivalent feet. Smaller vent pipes are less susceptible to freezing, but must not be excessively restrictive. The length of the 2 inch pipe must not be longer than 18 inches.
- If furnace is installed horizontally, make sure the drainage port on the in-line drain assembly is pointed downward to ensure proper drainage of condensate. See Figure 33 - 34 on pages 44- 45.
- To prevent debris or creatures from entering the combustion system, a protective screen may be installed over the combustion air intake opening. The screens hole size must be large enough to prevent air restriction.

### Condensate Disposal

The method for disposing of condensate varies according to local codes. Consult your local code or authority having jurisdiction.

Each of the condensate drain lines must be J-trapped using field supplied parts. After the condensate lines are J-trapped, they may be combined together into a single run to the drain. The drain lines must be routed downward to ensure proper drainage from furnace.

Neutralizer kit P/N 902377 is available for use with this furnace. **Please follow the instructions provided with the kit.**

### Existing Installations

When an existing furnace is removed from a vent system serving other appliances, the existing vent system may not be sized properly to vent the remaining appliances (For example: water heater). An improperly sized venting system can result in the formation of condensate, leakage, or spillage. The existing vent system should be checked to make sure it is in compliance with NFGC and must be brought into compliance before installing the furnace.

**NOTE:** If replacing an existing furnace, it is possible you will encounter an existing plastic venting system that is subject to a Consumer Product Safety Commission recall. The pipes involved in the recall are High Temperature Plastic Vent (HTPV). **If your venting system contains these pipes DO NOT reuse this venting system!** This recall does not apply to other plastic vent pipes, such as white PVC or CPVC. Check for details on the CPSC website or call their toll-free number (800) 758-3688.

## CIRCULATING AIR REQUIREMENTS



**Do not allow combustion products to enter the circulating air supply. Failure to prevent the circulation of combustion products into the living space can create potentially hazardous conditions including carbon monoxide poisoning that could result in personal injury or death.**

**All return ductwork must be secured to the furnace with sheet metal screws. For installations in confined spaces, all return ductwork must be adequately sealed. When return air is provided through the bottom of the furnace, the joint between the furnace and the return air plenum must be air tight.**

**The surface that the furnace is mounted on must provide sound physical support of the furnace with no gaps, cracks or sagging between the furnace and the floor or platform.**

**Return air and circulating air ductwork must not be connected to any other heat producing device such as a fireplace insert, stove, etc. This may result in fire, explosion, carbon monoxide poisoning, personal injury, or property damage.**

### Plenums and Air Ducts

- Plenums and air ducts must be installed in accordance with the Standard for the Installation of Air Conditioning and Ventilating Systems (NFPA No. 90A) or the Standard for the Installation of Warm Air Heating and Air Conditioning Systems (NFPA No. 90B).
- Tables 8 - 10 (pages 35 - 37) contain the maximum airflow and temperature rise data for fixed and variable speed motors. If the maximum airflow is 1,600 CFM or more, it is recommended that two openings be used for return air on upflow furnaces. Downflow furnaces can only use one return opening.
- It is recommended that the outlet duct contain a removable access panel. The opening should be accessible when the furnace is installed in service and shall be of a size that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The cover for the opening shall be attached in such a way as to prevent leaks.
- If outside air is used as return air to the furnace for ventilation or to improve indoor air quality, the system must be designed so that the return air is not less than 60° F (15° C) during operation. If a combination of indoor and outdoor air is used, the ducts and damper

system must be designed so that the return air supply to the furnace is equal to the return air supply under normal, indoor return air applications.

- When a cooling system is installed which uses the furnace blower to provide airflow over the indoor coil, the coil must be installed downstream (on the outlet side) of the furnace or in parallel with the furnace.
- If a cooling system is installed in parallel with the furnace, a damper must be installed to prevent chilled air from entering the furnace and condensing on the heat exchanger. If a manually operated damper is installed, it must be designed so that operation of the furnace is prevented when the damper is in the cooling position and operation of the cooling system is prevented when the damper is in the heating position.
- It is good practice to seal all connections and joints with industrial grade sealing tape or liquid sealant. Requirements for sealing ductwork vary from region to region. Consult with local codes for requirements specific to your area.

### Supply Air Connections

The supply air must be delivered to the heated space by duct(s) secured to the furnace casing, running full size and without interruption.

#### Upflow and Horizontal Furnaces

To attach the supply air duct to the furnace, bend the furnace flanges (Figure 28, page 34) upward 90° with a pair of wide duct pliers. Position the duct on top of the furnace and secure together with sheet metal screws. The screws must penetrate the sheet metal casing and furnace flange. Tape or seal all seams if required by local code.

#### Downflow Furnaces

To attach the supply air duct to the downflow furnace, position the furnace over the duct and secure together with sheet metal screws. The screws must penetrate the duct and furnace cabinet.

### Return Air Connections

In applications where the supply ducts carry heated air to areas outside the space where the furnace is installed, the return air must be delivered to the furnace by duct(s) secured to the furnace casing, running full size and without interruption.

#### Upflow Horizontal Furnaces

For upflow installations, the return air ductwork may be connected to the left side, right side, or bottom. The bottom panel (Figure 28) must be installed for left or right return air. **NOTE: Do not use the back of the furnace for return air.**

#### *Side Return Installations*

To attach the return air duct to the left or right side of the furnace, punch out the four knockouts (Figure 28) from the preferred side of the furnace. Using sharp metal cutters, cut an opening between all four knockouts to expose

the blower assembly. Position the return air duct over the opening in the side and secure together with sheet metal screws. The screws must penetrate the duct and furnace cabinet.



## WARNING:

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**The solid base of the furnace must be in position when the furnace is installed with side return air ducts. Removal of all or part of the base could cause circulation of combustible products into the living space and create potentially hazardous conditions, including carbon monoxide poisoning that could result in personal injury or death.**

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#### *Bottom Return Installations*

The bottom panel (Figure 28) must be removed from the bottom of the furnace for bottom return air. If bottom panel is installed, go to page 15 for removal instructions. Position the furnace over the return air duct and secure together with sheet metal screws. The screws must penetrate the duct and furnace cabinet.

#### Downflow Furnaces

To attach the return air duct to the furnace, bend the furnace flanges (Figure 28, page 34) upward 90° with a pair of wide duct pliers. Position the duct on top of the furnace and secure together with sheet metal screws. The screws must penetrate the sheet metal cabinet and furnace flange. Tape or seal all seams if required by local code.

### Acoustical Treatments

Damping ducts, flexible vibration isolators, or pleated media-style filters on the return air inlet of the furnace may be used to reduce the transmission of equipment noise emanating from the furnace. These treatments can produce a quieter installation, particularly in the heated space. However, they can increase the pressure drop in the duct system. Care must be taken to maintain the proper maximum pressure rise across the furnace, temperature rise and flow rate. This may mean increasing the duct size and/or reducing the blower speed. These treatments must be constructed and installed in accordance with NFPA and SMACNA construction standards. Consult with local codes for special requirements. For best sound performance, be sure to install all the needed gaskets and grommets around penetrations into the furnace, such as for electrical wiring

## FURNACE INSTALLATION

\*TC series gas furnaces offer a wide range of installation options, including installation in the upflow or horizontal positions with either right, left, or upflow return air. The \*TL series gas furnaces may only be installed as a down flow application.

### General Requirements

- The furnace must be leveled at installation and attached to a properly installed duct system. See Table 1 (page 7) for the required clearances needed to move the furnace to its installation point (hallways, doorways, stairs, etc).
- The furnace must be installed so that all electrical components are protected from water.
- The furnace must be installed upstream from a refrigeration system. (If applicable)
- The cabinet plug must always be used to close the hole in the side of the furnace when rotating the inducer.
- The furnace requires special venting materials and installation procedures. See pages 10 -14 for venting guidelines and specifications.

### Direct Vent (2-Pipe) Applications

It is important that Direct Vent (2-pipe) systems maintain an airtight flow path from the air inlet to the flue gas outlet. The furnace ships from the factory with two holes in the cabinet for the air inlet and flue gas outlet. In certain configurations, it is necessary to remove and relocate a plastic cap in the furnace cabinet. If changing the position of the air inlet and flue gas outlet, it is required that the previous hole be closed off with the plastic cap to maintain air tightness in the furnace. The hole locations for \*TC and \*TL furnaces are shown in Figure 28 (page 34).

### Upflow Installation

**! WARNING:**

**The furnace must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.**

#### Side Return Air Inlet

\*TC series gas furnaces are shipped with the bottom panel installed (Figure 28). If the upflow furnace is installed using both side return air inlets, the bottom panel must not be removed. The bottom panel must be in place if the bottom of the furnace is not being used as a return.

#### Bottom Return Air Inlet

If the \*TC series gas furnace is installed using the bottom as a return air inlet and 1 side return, the bottom panel (Figure 28) must be removed.

### Downflow Installation

**! WARNING:**

**The furnace must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.**

**! WARNING:**

**Failure to install the downflow sub-base kit may result in fire, property damage or personal injury.**

To install the furnace on combustible flooring, a special sub-base is required. Downflow sub-base kits are factory supplied accessories and are listed according to the cabinet letter of the furnace. For 'B', 'C', and 'D' size cabinets use Kit #904911. **Please follow the instructions provided with the kit.**

A downflow sub-base kit is not necessary if the furnace is installed on a factory or site-built cased air conditioning coil. However, the plenum attached to the coil casing must be installed so that its surfaces are at least 1" from combustible construction.

#### Installation on a concrete slab.

1. Create an opening in the floor according to the dimensions in Figure 10.
2. Position the plenum and the furnace as shown in Figure 11 (page 17).

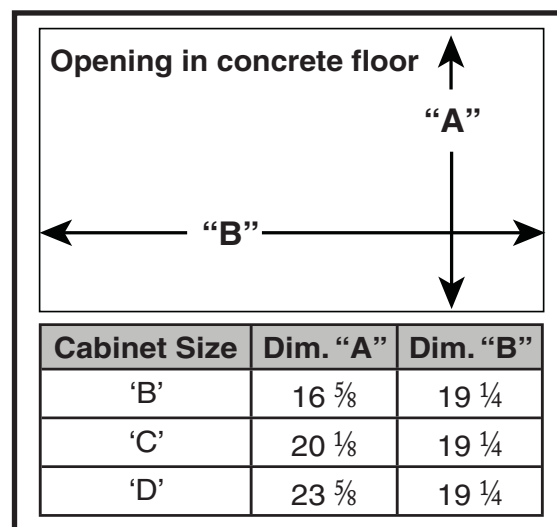


Figure 10. Cutout Dimensions



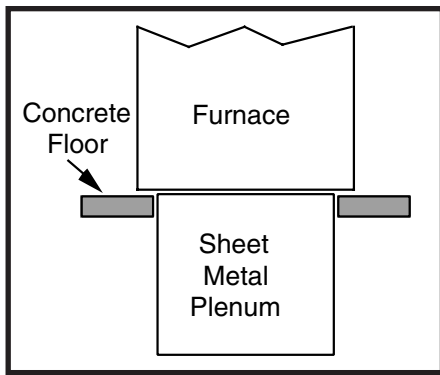


Figure 11. Furnace on a Concrete Slab

**Horizontal Installation**

**! WARNING:**

The furnace must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.

The \*TC series gas furnace can be installed horizontally (Figure 12) in an attic, basement, crawl space or alcove. It can also be suspended from a ceiling in a basement or utility room in either a right to left airflow or left to right airflow as shown in Figure 13.

\*TC series furnaces are shipped with the bottom panel installed. If furnace is installed horizontally, remove the bottom panel from the furnace before attaching the duct system. See Bottom Panel Removal section.

If installing the furnace in an attic, it is required that a drip pan be placed under the furnace. If the installation is on a combustible platform (Figure 12), it is recommended that the drip pan extend at least 12 inches past the top and front of the furnace.

If the furnace will be suspended from the ceiling, assemble a support frame (Figure 13) using slotted iron channel and full threaded rod. Fasten the frame together with nuts,

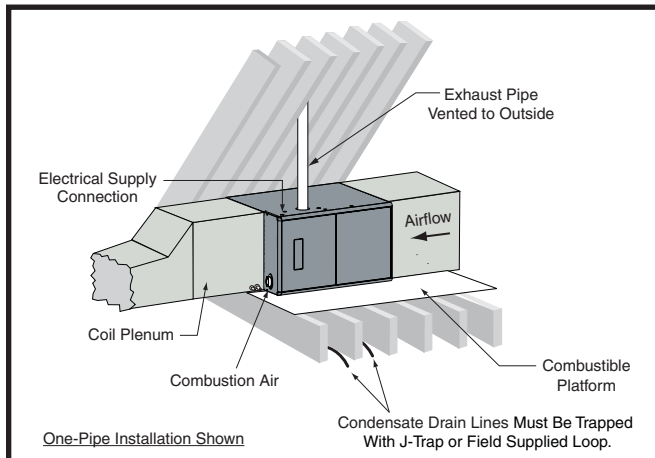


Figure 12. \*TC Horizontal installation on a Platform

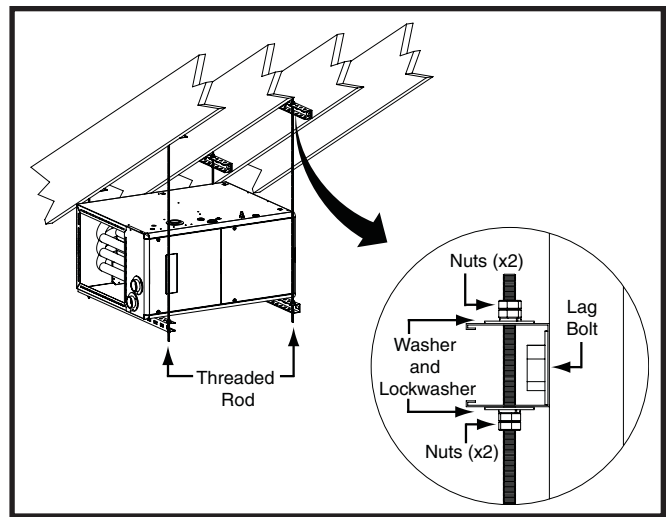


Figure 13. \*TC Horizontally Suspended in Attic or Crawl Space

washers, and lockwashers. Secure the support frame to the rafters with lag bolts. The furnace can also be suspended using steel straps around each end of the furnace. The straps should be attached to the furnace with sheet metal screws and to the rafters with bolts.

It is recommended for further reduction of fire hazard that cement board or sheet metal be placed between the furnace and the combustible floor and extend 12 inches beyond the front of the door and top of the furnace.

**Bottom Panel Removal**

The steps listed below describe how to remove the bottom panel from the furnace. See Figure 14.

1. Remove the door (1) from the blower compartment.
2. Disconnect the blower motor wiring harness (2) from the control board.
3. Remove two screws (3) securing the blower assembly (4) to the furnace.
4. Carefully pull the blower assembly (4) out thru the front of the furnace.

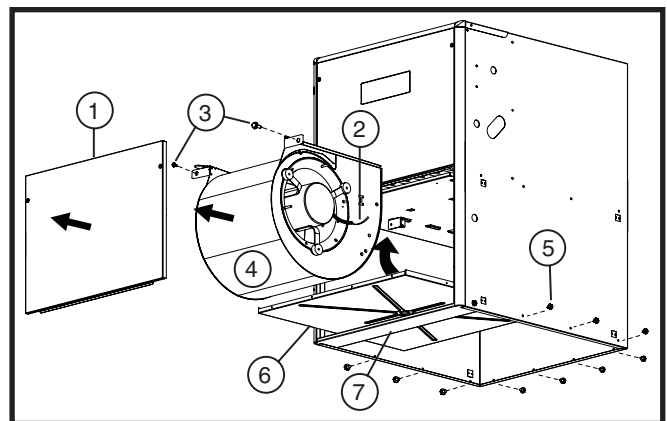


Figure 14. Bottom Panel Removal

- Remove all screws (5) securing bottom panel (6) to bottom of furnace and front brace (7).
- Lift up and slide bottom panel (6) out through front of furnace.
- Reinstall the blower assembly (4) in reverse order.

#### Alternate Bottom Panel Removal

If the bottom panel cannot be removed using the previous instructions, the steps below are an alternate method for removing the bottom panel. (See Figure 15).

- Remove the door (1) from the blower compartment
- Remove all screws securing the bottom panel (2) to the front brace (3).
- Remove two screws (4) securing the furnace cabinet to the blower deck (5).
- Remove all screws (6) securing the furnace cabinet to the bottom panel (2).
- Remove the screw (7) securing the bottom corner of the furnace cabinet to the front brace (3).
- Carefully spread the bottom corner of the furnace cabinet outwards while sliding the bottom panel (2) out through the front of the furnace.
- Reassemble the furnace in reverse order.

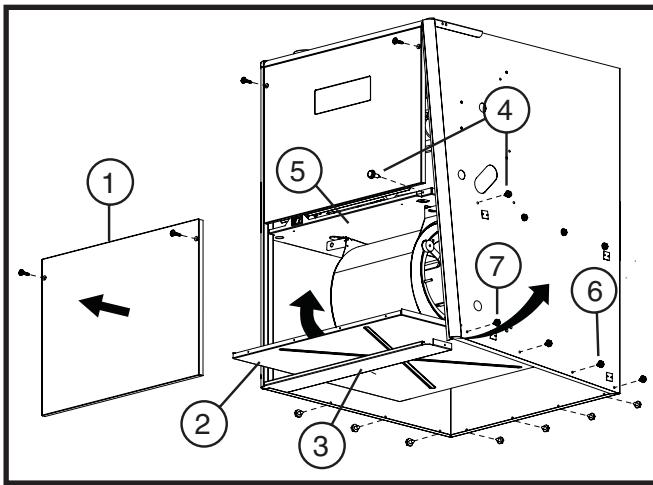


Figure 15. Alternate Removal Method

#### Vent and Inducer Assembly Options

To increase installation flexibility, the inducer assembly can be rotated to 2 different positions. Each variation has slightly different requirements with regard to condensate disposal and, in some cases, the need to seal the furnace cabinet. **IMPORTANT NOTE: The Inducer Assembly must never be positioned to vent downwards on horizontal installs.**

Before using Table 4 (page 19) the number of pipes (1-pipe or 2-pipe) connected to the furnace must be known. Find the proper furnace style (upflow, horizontal, or downflow) and then the side that the pipes will exit from the furnace. Finally select the option that properly matches your installation type from Figures 37 - 39 (pages 48 - 50).I

Conventional (1 Pipe)				
Vent	Upflow	Horiz. Right	Horiz. Left	Downflow
Right	Option 1	N/A	N/A	Option 9†
Up	N/A	Option 5	Option 6	Option 10
Left	Option 2	N/A	N/A	Option 11†
Direct Vent (2-pipe)				
Vent	Upflow	Horiz. Right	Horiz. Left	Downflow
Right	Option 3	N/A	N/A	Option 12†
Up	N/A	Option 7	Option 8	Option 13
Left	Option 4	N/A	N/A	Option 14†

† Requires a 2 inch PVC endcap.

Table 4. Vent and Inducer Blower Options

#### Inducer Assembly Rotation

### ! WARNING:

**Inducer rotation must be completed before the furnace is connected to gas and electric. If both utilities have been connected, follow the shutdown procedures printed on the furnace label and disconnect the electrical supply.**

### ! CAUTION:

**It is good practice to label all wires prior to disconnection. Wiring errors can cause improper and dangerous operation.**

- Disconnect the electrical harness (1) from the inducer assembly (2). See Figure 16.
- Remove the inducer assembly ground wire (3) from the blower deck (4) or door.
- Remove four screws (5) securing the inducer assembly (2) to the header box (6).
- Remove drain tube from inline drain assembly.
- Rotate the inducer assembly (2) to its new position.

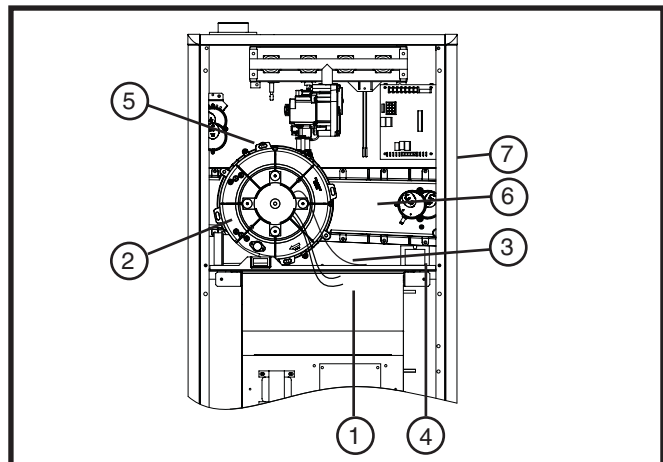


Figure 16. Inducer Assembly Rotation

6. Secure the inducer assembly (2) to the header box (6) by reinstalling the four screws (5) and the extra screw provided in the parts package.
7. Remove the cabinet plug (7) from side of furnace and reinstall in hole on opposite side of cabinet.
8. If applicable, install condensate drain on the in-line drain assembly. See Figures 37-39 (pages 48 - 50).
9. Reconnect the electrical harness (1) to the inducer assembly (2).
10. Reconnect the inducer assembly ground wire (3) to the blower deck (4) or door.
11. Verify proper operation as detailed on the furnace label.

### Accessories

The components in Figures 17 - 19 are included in the extra parts bag supplied with the purchase of \*TC/\*TL furnaces. Depending on your particular installation, some of these components are optional and may not be used. Please refer to the descriptions and accompanying figures when installing these items.

#### Finish Flange (Fig. 17)

The finish flange must be installed to vent the combustion air pipe through the top of the furnace. **NOTE:** For proper installation it is important that the pipe and screw holes in the finish flange, gasket, and cabinet are aligned.

1. Position flange gasket over hole in the furnace cabinet.
2. Position finish flange on top of the flange gasket.
3. Secure flange and gasket to cabinet with three field supplied sheet metal screws.

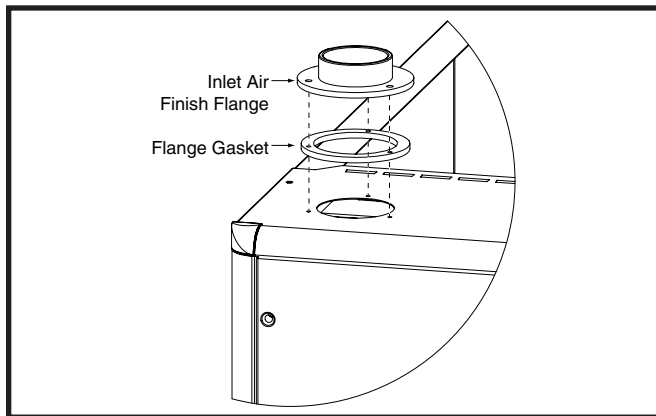


Figure 17. Finish Flanges

#### Rubber Grommets (Fig. 18)

The 2 1/4" rubber grommet is used to seal the opening between the furnace cabinet and the 2" PVC vent pipe. The rubber grommet should be installed in the 3" hole prior to running the vent pipe out of cabinet. No sealants are required.

The 7/8" rubber grommet is used to seal the opening between the furnace cabinet and the gas pipe. The

rubber grommet should be installed in the 1 5/8" hole prior to running the gas pipe into the cabinet. No sealants are required.

The 3/4" rubber grommet is used if venting out the left side of the cabinet and the drain tube is routed through the blower deck. Remove the plastic plug from the hole and install the grommet before routing the drain tube.

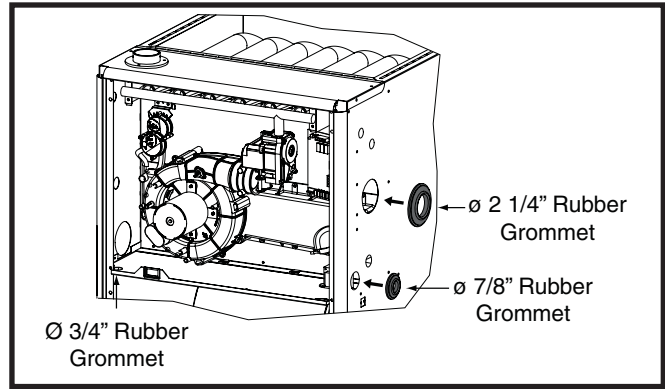


Figure 18. Rubber Grommets

#### PVC TEE, Reducer, and Hose Barbs (Fig. 19)

##### IMPORTANT NOTES:

**Before permanently installing these components, it is recommended you dry-fit them first to ensure proper fit and alignment with other vent pipes.**

**The PVC items shown in Figure 19 (page 20) are not supplied with \*TL furnaces.**

The 2" PVC tee, reducer, and hose barb are used when the inducer is rotated to vent out thru the left or right side of the furnace cabinet.

The 1/2" x 3/4" hose barb can be used to route the condensate drain to the outside of the cabinet. It must be installed from inside the cabinet with the threaded end inserted thru the 1 1/16" hole. See Figure 28

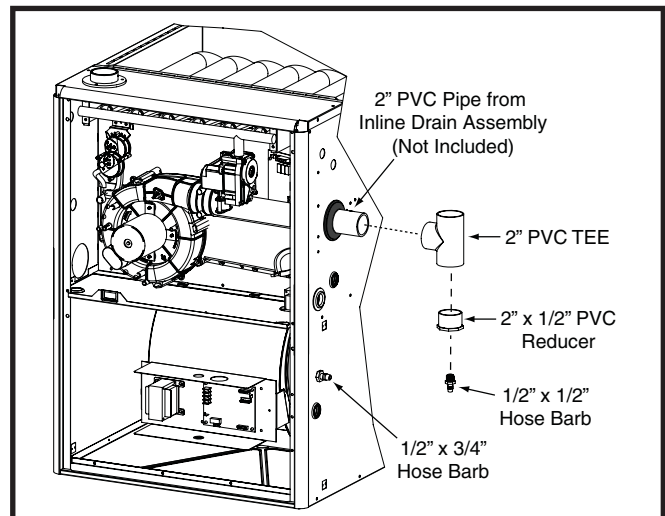


Figure 19. PVC Tee (2"), Reducer and Hose Barb

(page 34) for hole location The condensate drain should be connected to the barbed end. Attach 1" PVC drain line to the threaded end.

1. Install the 1/2" x 1/2" hose barb on the 2" PVC reducer. Do not over tighten! NOTE: Use an adequate amount of Teflon tape on the threads. Do not use liquid sealants.
2. Install the reducer on one end of the PVC tee. Use appropriate primer and cement to permanently bond the reducer and tee together.
3. Install the tee on the 2" vent pipe that is extending out the side of the cabinet. Use appropriate primer and cement to permanently bond them together.
4. Verify all connections and joints for tight fit and proper alignment with other vent pipes.

#### Condensate Drain Lines

The placement of the condensate drain lines will depend on the configuration selected in Table 4 (page 18). The drain lines can be routed out the left or right side of the furnace, but must maintain a downward slope to ensure proper condensate drainage. The J-trap may need to be rotated to the side that matches your setup in Figures 37 - 39 (pages 48 - 50). To rotate the J-trap, loosen the clamp on the drain tube, rotate the J-trap to either side, and retighten the clamp.

#### **Four general rules apply:**

- Each condensate drain line must be separately trapped using a J-Trap or field supplied loop.
- There must always be a drain attached to the collector at the outlet of the secondary heat exchanger.
- There must always be a drain at the outlet of the inducer assembly.
- There must always be a drain at the lowest point of the venting system.

#### **Exceptions and clarifications to the general rules:**

- In some cases, the lowest point in the vent system is where it connects to the inducer (Options 6 & 8). In this case one drain at this location is sufficient.
- If the vent exits the furnace horizontally, the vent may be turned vertically with a tee. **The drip leg formed by the tee must include a drain** (Options 1-4, 9, 11, 12, 14).
- In certain cases, it is permitted to drain the inducer back into the top drain of the collector (Options 1, 3, 5, 7, 9, 10, 12, & 13). To ensure proper drainage of condensate, make sure the drain line does not sag or becomes twisted. The drain tube supplied with the furnace may need to be trimmed.

**IMPORTANT NOTE:** If the furnace is installed in an area where temperatures fall below freezing, special precautions must be made for insulating condensate drain lines that drain to the outdoors. If condensate freezes in the lines, this will cause improper operation or damage to the furnace. It is recommended that all

**drain lines on the outside of the residence be wrapped with an industry approved insulation or material allowed by local code.**

#### **GAS SUPPLY AND PIPING**

All gas piping must be installed in compliance with local codes and utility regulations. In the absence of local codes the gas line installation must comply with the latest edition of the National Fuel Gas Code (ANSI Z223.1) or (CAN/CGA B149.1 or .2) Installation Codes.

#### **IMPORTANT NOTES:**

- **Some local regulations require the installation of a manual main shut-off valve and ground joint union external to the furnace as depicted in Figure 20. The shut-off valve should be readily accessible for service and/or emergency use. Consult the local utility or gas supplier for additional requirements regarding placement of the manual main gas shut-off.**
- **Gas piping must never run in or through air ducts, chimneys, gas vents, or elevator shafts.**
- **Compounds used on threaded joints of gas piping must be resistant to the actions of liquefied petroleum gases.**
- **The main gas valve and main power disconnect to the furnace must be properly labeled by the installer in case emergency shutdown is required.**
- **Flexible gas connectors are not recommended for this type of furnace but may be used if allowed by local jurisdiction. Only new flexible connectors may be used. Do not reuse old flexible gas connectors.**
- **A drip leg should be installed in the vertical pipe run to the unit as shown in Figure 20.**

Table 12 (page 38) lists gas flow capacities for standard pipe sizes as a function of length in typical applications based on nominal pressure drop in the line.

The furnace may be installed for either left or right side gas entry. When connecting the gas supply, provide clearance between the gas supply line and the entry hole in the furnace casing to avoid unwanted noise and/or damage to the furnace. Typical gas hookups are shown in Figure 20 (page 21).

#### **Leak Check**

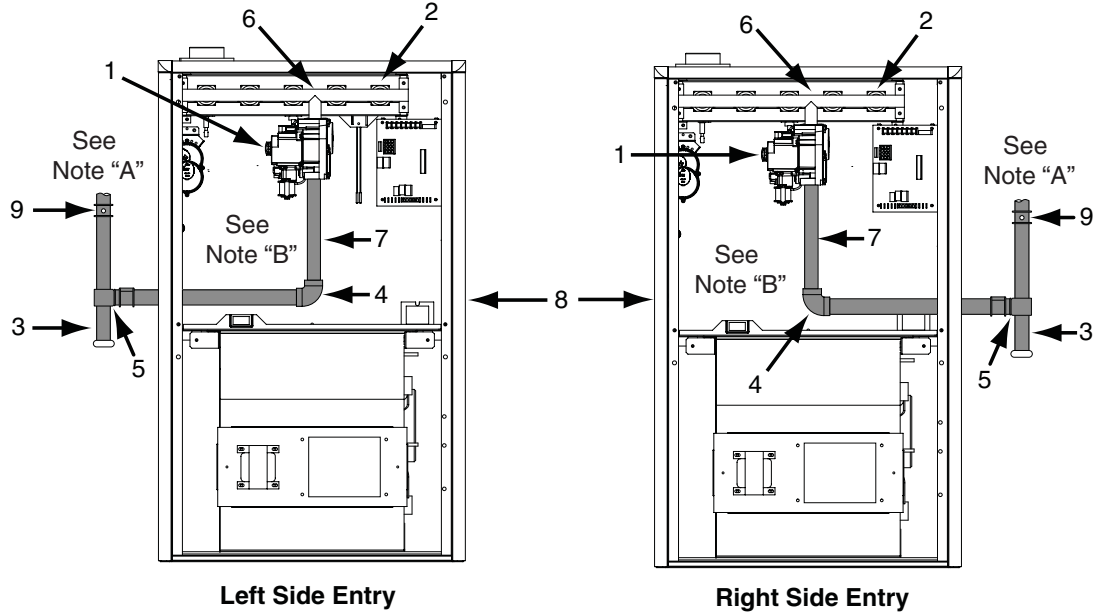


### **WARNING:**

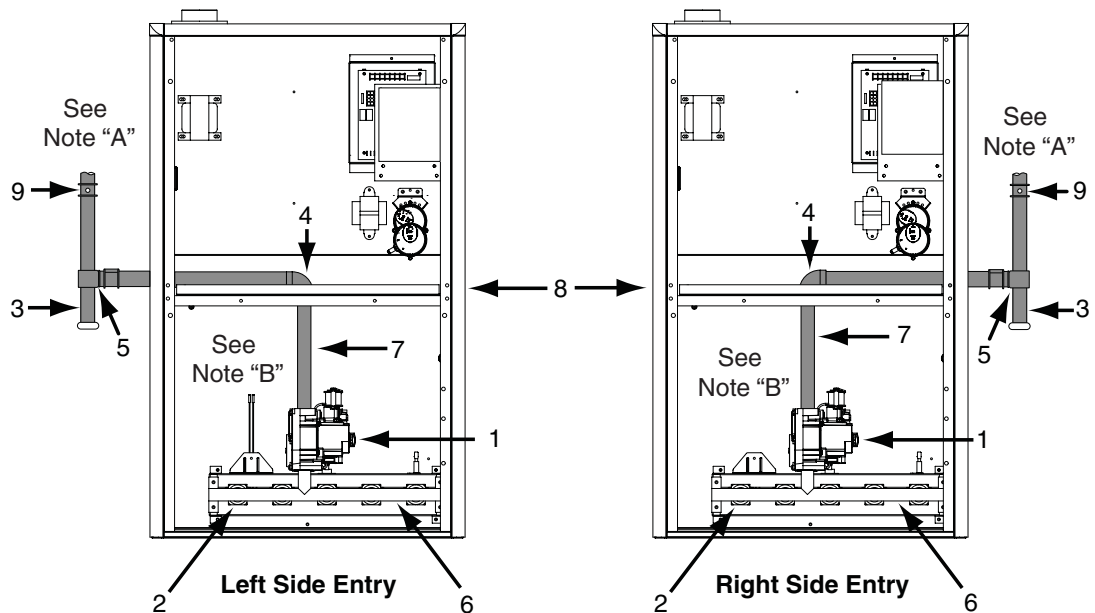
#### **FIRE OR EXPLOSION HAZARD**

**Never test for gas leaks with an open flame. Check all connections using a commercially available soap solution. A fire or explosion may result causing property damage, personal injury or loss of life. Failure to follow the safety warnings exactly could result in serious injury, death or property damage.**

**UPFLOW MODELS**



**DOWNFLOW MODELS**



**ITEM # and COMPONENT**

- |   |                        |                      |
|---|------------------------|----------------------|
| (1) Automatic Gas Valve<br>(w/ manual shut-off) | (2) Burner Assembly    | (3) Dripleg          |
| (4) Elbow                                       | (5) Ground Joint Union | (6) Manifold         |
| (7) Pipe Nipple (8 inch)                        | (8) Plug               | (9) Shut - Off Valve |

**NOTE A:** Some utilities require Shut- Off Valve to be 4 to 5 feet above floor.  
**NOTE B:** Inducer assembly omitted for clarity of pipe installation.

**Figure 20. Typical Gas Connections**

After the gas piping to the furnace is complete, all connections must be tested for gas leaks. This includes pipe connections at the main gas valve, emergency shutoff valve and flexible gas connectors (if applicable). The soap and water solution can be applied on each joint or union using a small paintbrush. If any bubbling is observed, the connection is not sealed adequately and must be retightened. Repeat the tightening and soap check process until bubbling ceases.

**IMPORTANT NOTE: When pressure testing gas supply lines at pressures greater than 1/2 psig (14 inch W.C.), the gas supply piping system must be disconnected from the furnace to prevent damage to the gas control valve. If the test pressure is less than or equal to 1/2 psig (14 inch W.C.), close the manual shut-off valve.**

**High Altitude Application**

The installation of this furnace at altitudes above 2,000 feet must meet the requirements of the National Fuel Gas Code or local jurisdiction. In Canada, the requirements for high altitude are different and governed by CGA B149.1. Please consult your local code authority.

 **WARNING:**

**The reduction of input rating necessary for high altitude installation may only be accomplished with factory supplied orifices. Do not attempt to drill out orifices in the field. Improperly drilled orifices may cause fire, explosion, carbon monoxide poisoning, personal injury or death.**

The furnaces are shipped from the factory with orifices and gas regulator settings for natural gas operation at sea level altitudes. At 2000 feet, the NFGC requires that this appliance be derated 4% for each 1000 feet of altitude. For example, the input needs to be reduced 8% at 2,000 feet, 12% at 3,000 feet, etc. This deration is in reference to the input rate and gas heating value at sea level.

To derate the furnace requires knowing the heating value of the gas at the installation site. Heating values at particular job sites vary for two reasons:

1. The chemical mixture of the gas varies from region to region and is expressed as the “sea level heating value”.
2. The heating value varies by altitude. For this reason, particularly in high altitude areas, the local gas utility usually specifies the heating value at the residence’s gas meter as the “local value”.

For added flexibility, two tables have been provided for natural gas installations with high or low heating values at sea level. Tables 15 and 16 (page 40) contain the orifice sizes and manifold pressure to use at various altitudes. Table 15 (HIGH) is for natural gas installations with a

heating value of more than 1,000 Btu per cubic foot and Table 16 (LOW) is for less than 1,000 Btu per cubic foot. To determine which table to use:

1. Consult your local utility for the local heating value at your installation.
2. From Table 14 (page 39), find your local heating value as supplied by the utility company. Follow down the column and stop at your altitude level.
3. If your sea level heating value is HIGH, use Table 15 or if it’s LOW, use Table 16. See example.

**INSTALLATION EXAMPLE**

**Elevation:** .....5,000 feet  
**Type of Gas:** ..... Natural Gas  
**Local Heating Value of Gas:** .....750

---

From Table 14, find 750 and follow down the column, stop at the 5,000 feet row. The heating value listed is LOW. Table 16 will be used to determine orifice size and manifold pressure.

After changing the regulator pressure or changing the orifices, it is required that you measure the gas input rate. This may be accomplished in the usual way, by clocking the gas meter and using the local gas heating value. See Verifying and Adjusting the Input Rate section (page 27).

**IMPORTANT NOTE: Observe the action of the burners to make sure there is no yellowing, lifting or flashback of the flame.**

**Conversion to LP/Propane**

 **WARNING:**

**The furnace was shipped from the factory equipped to operate on natural gas. Conversion to LP/propane gas must be performed by qualified service personnel using a factory supplied conversion kit. Failure to use the proper conversion kit can cause fire, explosion, property damage, carbon monoxide poisoning, personal injury, or death.**

Conversion to LP/propane is detailed in the installation instructions provided with the conversion kit. Generally, this will require the replacement of the burner orifices and the spring/stem assembly in the pressure regulator.

Approved conversion kits are listed below. **Please follow the instructions provided with each kit.**

- The United States LP/Propane Gas Sea Level and High Altitude Conversion Kit (P/N 904914) is for LP/propane conversion in the United States at altitudes between 2,000 ft. and 10,000 ft. above sea level.

- The Canadian LP/Propane Gas Sea Level and High Altitude Conversion Kit (P/N 904915) is for LP/propane conversions in Canada at altitudes between zero and 4,500 ft. above sea level.

In the U.S., if installation is above 2,000 ft., refer to Table 13 (page 39) to determine the correct orifice size and regulator pressure. When conversion is complete, verify the manifold pressure and input rate are correct as listed in the tables.

## ELECTRICAL WIRING

### **WARNING:**

#### **ELECTRICAL SHOCK, FIRE OR EXPLOSION HAZARD**

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

**Improper servicing could result in dangerous operation, serious injury, death or property damage.**

- **Before servicing, disconnect all electrical power to furnace.**
- **When servicing controls, label all wires prior to disconnecting. Reconnect wires correctly.**
- **Verify proper operation after servicing.**

- Electrical connections must be in compliance with all applicable local codes, and the current revision of the National Electric Code (ANSI/NFPA 70).
- For Canadian installations the electrical connections and grounding shall comply with the current Canadian Electrical Code (CSA C22.1 and/or local codes).

**IMPORTANT NOTE: If replacing any of the original wires supplied with the furnace, the replacement wire must be copper wiring and have a temperature rating of at least 105°F (40°C). For electrical specifications, refer to the furnace nameplate or Table 5 (page 26).**

Two-stage furnaces use high efficiency circulating air motors that come in two variations and both are controlled differently. The fixed speed motor control board (Figure 29, page 41) controls the torque and the variable speed motor control board (Figure 30) controls the airflow at a constant CFM. Both boards use the same furnace control board (Figure 29).

## Fixed Speed Blower Applications

**NOTE:** This section applies only to furnaces with model numbers suffixed with two numbers, followed by a letter, such as 35C or 45D. If your model has suffix VA, VB, VC, or VD, please consult the Variable Speed Blower Application section.

The fixed speed motor control board (Figure 29) contains a set of dip switches for setting the blower speed. Use pins 1 to 4 to set the blower speed for heating and pins 5 to 8 to set the speed for cooling. To determine the appropriate switch settings for your installation, refer to Table 8 (page 35).

For thermostats with a dehumidifier output, use a field supplied wire to connect the thermostat's dehumidifier output to the terminal marked "DHUM". The thermostat should be set so that the DHUM output should be high (positive) when dehumidification is needed. See page 25 for additional dehumidification options.

### **CAUTION:**

**The terminal marked "Y1\_IN" on the variable speed motor control board is not an output to drive the outdoor unit. DO NOT connect Y1\_IN on the motor control board to the outdoor unit.**

## Variable Speed Blower Applications

**NOTE:** This section applies only to models ending with the suffixes VA, VB, VC, or VD.

The variable speed motor control board (Figure 30, page 41) has a set of dip switches for setting the base blower speed. Use pins 1 to 4 to set the blower speed for heating and pins 5 to 8 to set the speed for cooling. To determine the appropriate switch settings for your installation, see Table 9 (page 36) for heating or Table 10 (page 37) for cooling.

Use field supplied wire to connect the thermostat's dehumidifier output to the terminal marked "DHUM". The thermostat should be set so that the DHUM output is high (positive) when dehumidification is needed. See page 25 for additional dehumidification options.

### **CAUTION:**

**The variable speed control board is also used by other appliances. Many of the terminals and connections on the board are for other appliances and are not used in the two stage application. The only two-stage field connection to this board is the DHUM terminal, used to reduce the blower speed during cooling. See page 26.**

## Wiring Configurations

Depending on the type of air conditioning unit and thermostat used, both blower applications utilize three basic wiring configurations:

### Single Stage AC and Single Stage Thermostat (Fig. 21)

This option does not use the full two-stage control capability of the furnace, but the possibility of timed autostaging is available. See Autostaging for Single Stage Thermostats.

- Connect the thermostat's **W** output (Figure 21) to the furnace control boards **W1** terminal. This allows the furnace to always run in **low** output mode.
- Always connect the thermostat **C** and **R** to the furnace control board **C** and **R**.
- For cooling, connect the thermostats **Y** signal to the furnace control board **Y/Y2** terminal.
- Field supplied wires should also connect **Y/Y2** and **C** to the outdoor unit's **Y** and **C** terminals.

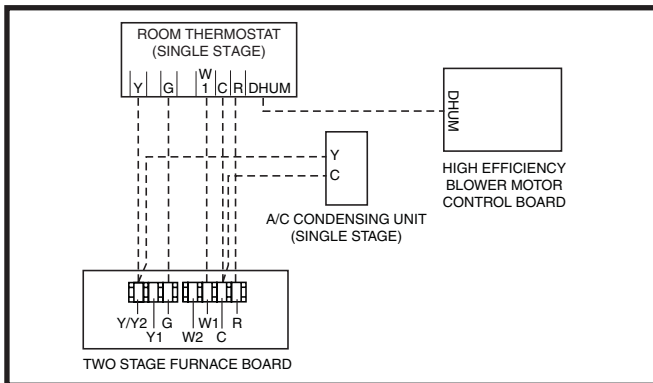


Figure 21. Wiring Configuration 1

### Single Stage AC and Two Stage Thermostat (Fig. 22)

This option uses the full two stage heating capability of the furnace with a single stage outdoor unit:

- Connect the thermostat's **W1** and **W2** outputs to the furnace control board's **W1** and **W2** terminals.
- Always connect the thermostat **C** and **R** to the furnace control board **C** and **R**
- For cooling, connect the thermostats **Y** signal to the furnace control board **Y/Y2** terminal.
- Field supplied wires should also connect **Y/Y2** and **C** to the outdoor unit's **Y** and **C** terminals.

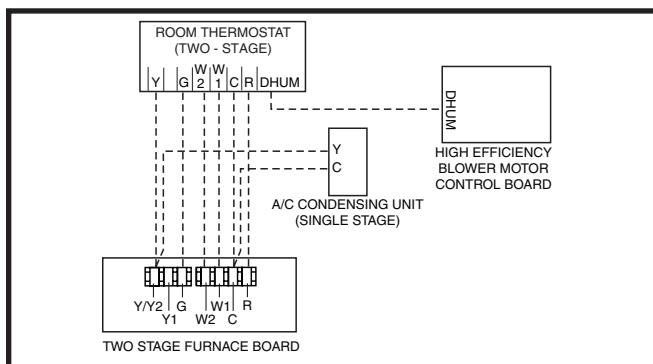


Figure 22. Wiring Configuration 2

### Two-Stage AC and Two-Stage Thermostat (Fig. 23)

This option uses the full two stage heating capability of the furnace with a two stage outdoor unit:

- Connect the thermostat's **W1** and **W2** outputs to the furnace control board's **W1** and **W2** terminals.
- Always connect the thermostat **C** and **R** to the furnace control board **C** and **R**.
- For cooling, connect the thermostat **Y** and **Y1** to the furnace control board's **Y/Y2** and **Y1** terminal's.
- Field supplied wires should also connect the **Y/Y2** and **Y1** signals to the outdoor unit's **Y** and **Y1** terminals.
- Connect terminal **C** to the outdoor unit's **C**.

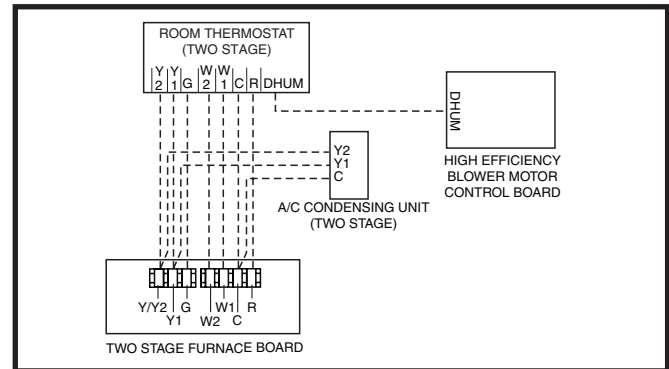


Figure 23. Wiring Configuration 3

### Autostaging for Single Stage Thermostats

The Autostaging feature included on all G7 2-stage furnaces makes it possible to use a single stage thermostat and still receive some of the benefits of 2-stage furnace operation. If Autostage is enabled, the furnace will start in **low** fire, but after a period of time jump to **high** fire, until the heating load is met. See Low Voltage Wiring (page 25).

Autostaging options are selected using the Autostage jumper (Figure 31, page 41) located near the thermostat screw terminal block. On the circuit board, Autostage jumper pins are electrically connected on the circuit board to **R**, **W1**, and **W2** such that:

1. When the Autostage jumper is in the "SHORT" position, **R** is connected to **W2**. Setting the Autostage jumper in the "SHORT" position is the same as jumping **R** to **W2**. This connection signals the control to utilize an 8 minute delay between low fire and high fire when a call for heat is supplied via 24V signal to **W1**.
2. When the Autostage jumper is in the "LONG" position, **W1** and **W2** are connected. Setting the Autostage jumper in the "LONG" position is the same as jumpering **W1** and **W2** together. The control board knows that Autostaging (at 12 minutes, the "LONG" setting) is active when 24vac inputs from both **W1** and **W2** are received at the same time.



### Autostaging for Two-Stage Thermostats

The Autostage setting on the furnace control board (Figure 31) is disabled when shipped from the factory. This feature will be not used when paired with a two-stage thermostat. The Autostage Jumper (P7) must be kept on the **NONE** setting to allow the thermostat to adjust stages.

Please note that on certain thermostats, even without the Autostage jumper in the “LONG” position, **W1** and **W2** may be energized at exactly the same time when a recovery from a set-back begins, the user adjusts the set point, or the system is powered on. If **W1** and **W2** are energized at exactly the same time for any reason, the control will operate in the Autostage “LONG” (12 minute) mode. If the Autostage jumper is in the “NONE” position and Autostaging is activated unexpectedly for any of the reasons listed, it will return to normal, staged operation after the completion of the heating cycle.

### Dehumidification Options

Both motor control boards (Figures 29 & 30, page 41) have a DHUM connection that causes the system to increase the amount of humidity that is removed from the circulating air. This is accomplished by reducing the CFM and allowing the cooling coil to become colder. This will only occur when there is a call for cooling.

There are many ways that this can be electrically wired:

1. If the room thermostat incorporates a humidity sensor and **DHUM** output, connect the **DHUM** on the thermostat to the **DHUM** terminal on the motor control board (Figure 24).
2. If using a separate humidistat, connect the **DHUM** and **R** terminals on the humidistat to the **DHUM** and **R** terminals on the motor control board. In this option, the **DHUM** output of the humidistat must be set to be normally open and closed when there is a call for humidification.
3. If a humidistat is not available, it is an acceptable option to connect the **R** and **DHUM** terminals on the motor control board together with a field supplied wire. This option causes the blower to run at a reduced CFM for 10 minutes after a call for cooling.

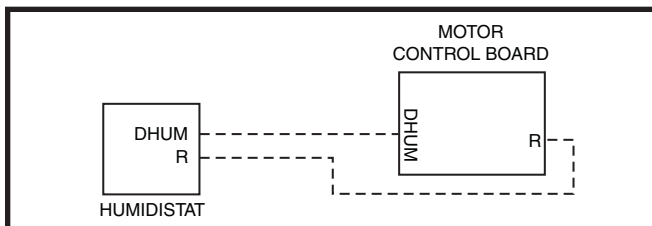


Figure 24. DHUM Wiring Configuration 7

### Line Voltage Wiring

It is recommended that the line voltage (115 VAC) to the furnace be supplied from a dedicated branch circuit containing the correct fuse or circuit breaker for the furnace (Table 5, page 26).

**IMPORTANT NOTE:** An electrical disconnect must be installed readily accessible from and located within sight of the furnace. See Figure 25 (page 26) or the wiring diagram label inside of the control door. Any other wiring methods must be acceptable to authority having jurisdiction.

### CAUTION:

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

**IMPORTANT NOTE:** Proper line voltage polarity must be maintained in order for the control system to operate correctly. Verify the incoming neutral line is connected to the white wire and the incoming “hot” line is connected to the black wire. The furnace will not operate unless the polarity and ground are properly connected as shown in Figure 25.

### Low Voltage Wiring

The thermostat must be installed according to the instructions supplied by the thermostat manufacturer. Low voltage connections (24 VAC) from the thermostat are wired to the terminal strip on the integrated control in the furnace. Recommended minimum wire gauge for thermostat wiring is shown in Table 5.

The thermostat must not be installed on an outside wall or any other location where its operation may be adversely affected by radiant heat from fireplaces, sunlight, or lighting fixtures, and convective heat from warm air registers or electrical appliances.

**IMPORTANT NOTE:** Set the heat anticipator according to the instructions supplied by the thermostat manufacturer.

To determine the heat anticipator setting:

1. Add the current draw of the system components; or
2. Measure the current flow on the thermostat **R-W** circuit after the circulating blower motor has started.

### Grounding

### WARNING:

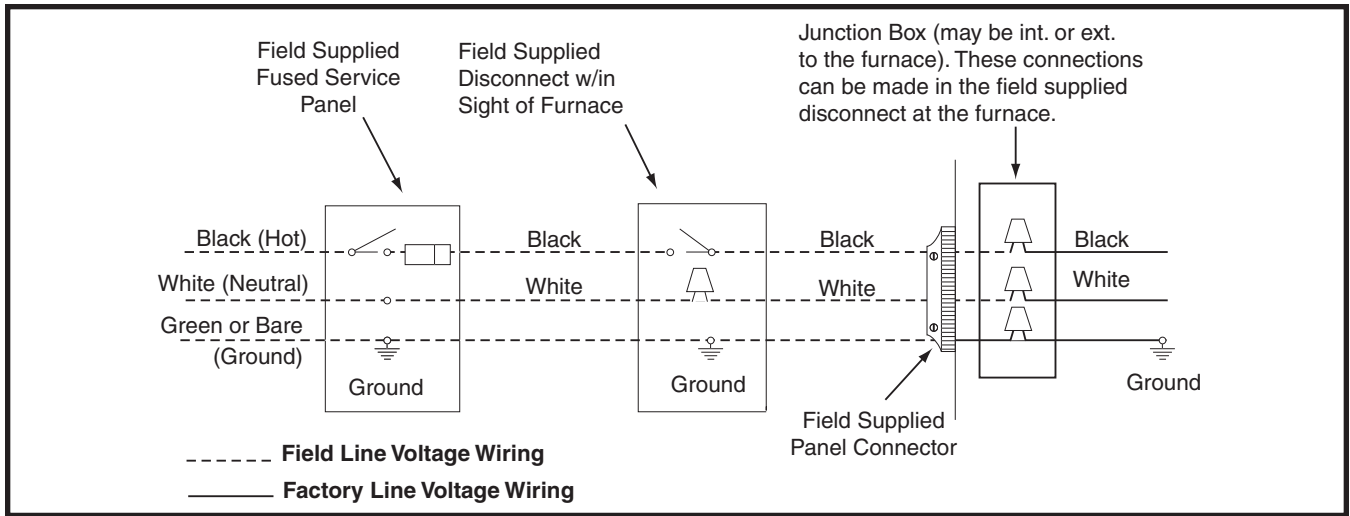
**To minimize personal injury, the furnace cabinet must have an uninterrupted or unbroken electrical ground. The controls used in this furnace require an earth ground to operate properly. Acceptable methods include electrical wire or conduit approved for ground service. Do not use gas piping as an electrical ground!**

Furnace Input (Btuh)	Cabinet Width (in.)	Nominal Electrical Supply	Maximum Operating Voltage	Minimum Operating Voltage	Maximum Furnace Amperes	Minimum Wire Gauge	Maximum Fuse or Circuit Breaker Amps**
60,000	17 ½	115-60-1	127	103	7.0	14	15
80,000	21	115-60-1	127	103	9.4	14	20
100,000	21	115-60-1	127	103	9.4	14	20
120,000	24 ½	115-60-1	127	103	12.5	14	25

\*\* Time-delay fuses or HACR-type circuit breakers are required.

Thermostat Wire Gauge	Recommended Thermostat Wire Length	
	2 - wire (Heating)	4 or 5 wire (Cooling)
24	55 ft.	25 ft.
22	90 ft.	45 ft.
20	140 ft.	70 ft.
18	225 ft.	110 ft.

**Table 5. Wire Length and Voltage Specifications**

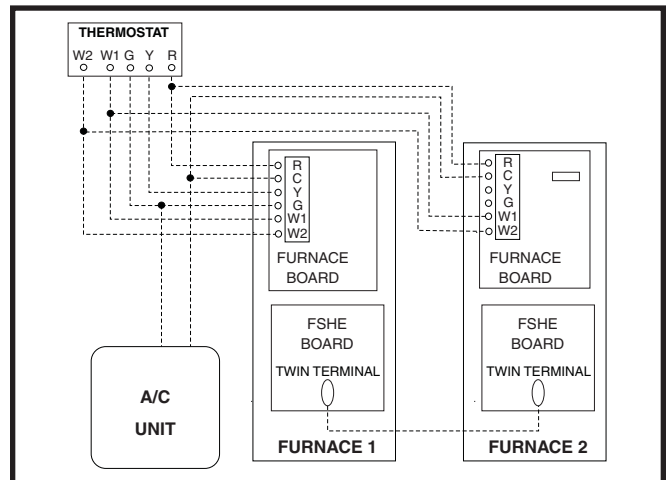


**Figure 25. Line Voltage Field Wiring**

**Twinning**

The control boards on fixed speed furnaces are capable of being twinned to other furnace of the same series, only if the following criteria are met:

- The circuit boards are the same.
- The thermostat wires and the 1/4 inch thick quick-connect terminals marked “TWIN” (Figure 26) on the furnace controls must be connected together.
- The fuses must remain installed on each board.
- Twinned furnaces must be properly grounded according to local codes.
- The autostage jumper must be set to the same pin setting on both furnace control boards.



**Figure 26. Twinning**

**Note:** Variable speed furnaces cannot be twinned.

## START-UP AND ADJUSTMENTS

### Pre-Start Check List

- √ Verify the polarity of the connections are correct, the line voltage power leads are securely connected and the furnace is properly grounded.
- √ Verify that all needed thermostat wires are securely connected to the correct leads on the terminal strip of the circuit board. See Figures 21 - 23 (page 24).
- √ Verify the gas line service pressure does not exceed 10.0 inches of water column, and is not less than 4.5 inches W.C. for natural gas. For LP gas the line service pressure must not exceed 14 in. W.C., and must not be less than 11.0 in. W.C..
- √ Verify the roll-out and manual reset switch is closed. If necessary, press the button to reset the switch. **DO NOT install a jumper wire across a switch to defeat its function.** If a switch reopens on start-up, **DO NOT** reset the switch without identifying and correcting the fault condition.
- √ Verify the blower door is in place, closing the door switch in the line voltage circuit.
- √ Verify the gas line has been purged and all connections are leak free.

### Start-up Procedures

Do not perform these steps until all of the checks in the previous steps have been completed:

1. Set the thermostat to the lowest setting.
2. Turn off all electrical power to the furnace.
3. Follow the Operating Instructions on the furnace label.
4. Set the thermostat above room temperature and verify the Operating Sequence. See page 28.
5. After 5 minutes of operation, set the thermostat below room temperature and verify steps 11 & 12 of the Operating Sequence.

### Verifying and Adjusting Input Rate

**IMPORTANT NOTE: The input rate must not exceed the rate shown on the furnace rating plate. At altitudes above 2,000 feet, it must not exceed that on the rating plate less 4% for each 1,000 feet.**

The input rate must be verified for each installation to prevent over-firing of the furnace. To determine the exact input rate, perform the following procedures:

1. Shut off all other gas fired appliances.
2. Start and run the furnace in high fire for at least 3 minutes.
3. Measure the time (in seconds) required for the gas meter to complete one revolution.
4. Convert the time per revolution to cubic feet of gas per hour using Table 11 (page 38).

5. Multiply the gas flow rate in cubic feet per hr by the heating value of the gas in Btu per cubic ft to obtain the input rate in Btuh. See example.

#### Example:

- Time for 1 revolution of a gas meter with a 1 cubic foot dial = 40 seconds.
- From Table 11 read 90 cubic ft gas per hr.
- Local heating value of the gas (obtained from gas supplier) = 1,040 Btu per cubic foot.
- Input rate = 1,040 x 90 = 93,600 Btuh.

6. The manifold pressure must be set to the appropriate value for each installation by a qualified installer, service agency or the gas supplier.



### WARNING:

**Do not attempt to drill the gas orifices. Use only factory supplied orifices. Improperly drilled orifices may cause fire, explosion, carbon monoxide poisoning, personal injury or death.**

- a.) Remove plastic cap from pressure regulator.
- b.) Obtain the manifold pressure setting required for this installation by referring to Table 13 (page 39) for Propane or Tables 15 or 16 for Natural Gas (page 40).
- c.) Using an Allen wrench, turn the the LO Input Adjusting Screw on the LO side of the regulator to adjust the reduced input setting or turn the HI Input Adjusting Screw (Figure 27) on the side of the regulator to adjust the full input setting. **IMPORTANT NOTE: Turning the adjusting screw clockwise increases the pressure and counterclockwise reduces the pressure.**
- d.) Reinstall plastic cap after adjustment is complete.

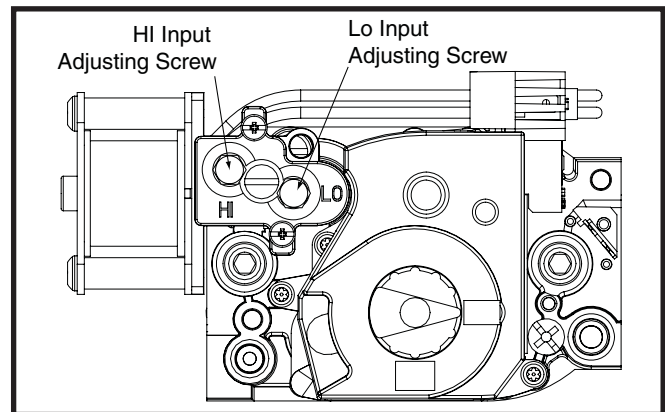


Figure 27. HI and LO Input Adjusting Screws

### Verifying and Adjusting Temperature Rise

Confirm the temperature rise through the furnace is within the limits specified on the furnace rating plate. Any temperature rise outside the specified limits could result in premature failure of the heat exchanger.

1. Place thermometers in the return and supply air stream as close to the furnace as possible. To avoid false readings, the thermometer on the supply air side must be shielded from direct radiation from the heat exchanger.
2. Adjust all registers and duct dampers to the desired position and run the furnace for 10 to 15 minutes on high fire before taking any temperature readings. The temperature rise is the difference between the supply and return air temperatures.

For typical duct systems, the temperature rise will fall within the limits specified on the rating plate with the blower speed at the factory recommended setting. If the measured temperature rise is outside the specified limits, it may be necessary to change the speed of the blower. **NOTE:** Lowering the blower speed increases the temperature rise and a higher blower speed will decrease the temperature rise.

The furnace is equipped with a multi-speed motor. Heating and cooling speed selection is made by moving the switches on the integrated control located in the furnace.

### Verifying Burner Operation



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**The door over the burners may only be open for inspection purposes only. The door must be installed during unattended operation.**

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1. Remove the burner compartment door.
2. Set the thermostat above room temperature and observe the ignition sequence. The burner flame should carry over immediately between all burners without lifting off, curling, or floating. The flames should be blue, without yellow tips.
3. After validating flame characteristics, change thermostat setting to below room temperature.
4. Verify burner flame is completely extinguished.
5. Replace the burner compartment door.

### Verifying Operation of the Supply Air Limit Switch

**Note:** A properly functioning limit switch should turn off the gas valve when the return is blocked (time depends on how well the return air is blocked). The circulating air and combustion blowers should continue to run when the limit switch opens.

1. Check the blower door and verify that it is securely mounted in place and that there is power to the furnace.

2. Block the return airflow to the furnace by installing a close-off plate in place of or upstream of the filter(s).
3. Set the thermostat above room temperature and observe the Operating Sequence.
4. Remove the close-off immediately after the limit switch opens. If the furnace continues to operate with no return air, set the thermostat to a temperature below room temperature, shut off the power to the furnace, and replace the limit switch.

### OPERATING SEQUENCE

The operating sequences for the heating, cooling, and fan modes are described below. Refer to the field and furnace wiring diagrams: (Figures 21 - 23, page 24), (Figures 32 - 35, pages 42 - 45) and (Figure 25, page 26).

#### Heating Cycle

1. The thermostat calls for heat by energizing the **W1** terminal with 24VAC.
2. The control checks to see the pressure switch is open. If the switch is closed, the furnace will shut down for 5 minutes before retrying
3. If the pressure switch is open, the control energizes the induced draft motor and waits for the pressure switch to close. The pressure switch must close within 12 seconds.
4. The control runs the inducer for a 30 second pre-purge time.
5. The control energizes the igniter output for the appropriate adaptive warm-up time limit.
6. The furnace always ignites the burners in high fire. If the call for heat is for low rate, the furnace will move down to low fire after the flames stabilize.
7. If the flame is proved and ignites the gas, the control de-energizes the igniter. The gas valve and inducer remains energized. The control goes to blower on delay.
8. The control energizes the blower on the selected HEAT speed 30 seconds after the gas valve opened. The gas valve and inducer remain energized.
9. If there is a call for high fire, the gas valve moves to the high fire position and the blower speeds are increased. The furnace will remain in high fire until the demand for heat is satisfied.
10. If autostaging is enabled (single stage thermostat) the demand for heat has lasted more than the selected time, the furnace automatically moves up to high fire. Autostage times are either **SHORT** (8 minutes), **LONG** (12 minutes) or **OFF**, depending on the Jumper (P7) setting on the Furnace Control Board.
11. When the thermostat demand for heat is satisfied, the control de-energizes the gas valve. The inducer output remains on for a 30 second post-purge period.

12. The circulating air blower will continue to run for the selected Blower Off Delay(P5). This may be 60, 90, or 120 seconds depending on the Jumper setting on the Furnace Control Board.

### Cooling Cycle

1. The thermostat calls for cooling by energizing the **Y/Y2** or **Y1** terminal with 24VAC.
2. The control energizes the blower in the cooling speed and sends 24VAC to the contactor in the condensing unit.
3. When the thermostat removes the call for cooling, the contactor in the outdoor condensing unit is de-energized and the control continues to run the fan for a period of 60 seconds.

### Fan Mode

- When the thermostat energizes the **G** terminal for continuous fan (without calling for heat or cooling), the indoor fan is energized on the selected FAN speed.
- If a call for cooling occurs during continuous fan, the blower will switch over to the selected COOL speed.
- If the **W** terminal receives a call for heat during continuous fan, the blower will de energize.
- A call for fan is ignored while in lockout.
- The blower will operate at 50% of the selected high cooling speed for continuous fan operation.

## TROUBLESHOOTING

### If the furnace fails to operate check the following:

- Is the thermostat operating properly?
- Are the blower compartment door(s) in place?
- Is the furnace disconnect closed?
- Has the circuit breaker tripped or the control board fuse burned open?
- Is the gas turned on?
- Are any manual reset switches open?
- Is the filter dirty or plugged?
- Is the flame sensor coated? (Remove and clean with steel wool. **Do not use emery cloth or sandpaper!**)
- Is there blockage in the condensate drain switch? Also verify that there is no double trapping of condensate.
- Is the secondary heat exchanger free of debris and clogs?
- Is evaporator coil clean and free of debris (If applicable).

- Are all the LED's on the furnace and motor control boards constantly ON? If not, refer to Tables 6 - 7 to determine fault condition.

### IMPORTANT NOTE: The furnace will lock out after 5 failed attempts for ignition and will try again every hour if the call for heat remains.

- If the Inducer Blower is operating, and items above have been verified, check the Blower Limit Switch (Figure 40 or 41, page 51) and reset if necessary.
- If the furnace operates when the Blower Limit Switch is reset, contact a qualified service technician to identify and repair the problem.
- If the furnace still doesn't operate, check the Flame Roll-out Switches (Figure 40 or 41) and reset if necessary.
- If the furnace operates when the Flame Rollout Switch is reset, contact a qualified service technician to identify and repair the problem.

Diagnostic Description	Green LED	Red LED
Control Fault (No Power)	Off	Off
L1/Neutral Polarity Fault	Flash	Flash
1 Hour Lockout	Alternating Flash	
Normal Operation	On	On
Pressure Switch Closed Fault	On	Flash
Pressure Switch Open Fault	Flash	On
Open Limit Switch Fault	Flash	Off
Motor Fault	On	Off
Diagnostic Description	Yellow LED	
Low Flame Sensor Signal	Continuous Flash	
Flame Present	On	

Table 6. Furnace Control Board Fault Conditions

	Diagnostic Description	Green LED	Red LED
<b>Fixed Speed Furnaces</b>	Control Fault (No Power)	Off	Off
	Normal Operation	On	On
	Motor Fault	On	Flash
	Twin Fault (no motor fault)	Flash	On
	Communications Fault	Flash	Flash
<b>Variable Speed Furnaces</b>	Control Fault (No Power)	Off	Off
	Normal Operation	On	On
	Motor Fault	On	Flash
	Communications Fault	Flash	Flash

Table 7. Motor Control Board Fault Conditions

## DESCRIPTION OF COMPONENTS

The descriptions below are various functional components that affect the operation and shutting down of this furnace. Some of these components and their locations are shown in Figures 40 and 41 (page 51). If any component of the furnace must be replaced, use only factory authorized replacement parts specified in the Replacement Parts List provided online.

### Blower Limit Switch

The Blower switch prevents furnace operation when blower is not operational.

### Condensate Drain Switch

The Condensate Drain Switch will shut down the furnace if the condensate drain from the Collector Pan becomes clogged.

### Flame Sensor

The flame sensor verifies when a flame has carried over from the igniter to the opposite end burner. If no flame is detected, the furnace will shut down within 4 seconds.

### Flame Roll-Out Switch

The flame roll-out switch verifies that the burner flames are drawn into the heat exchanger tubes. If the burner flames are not properly drawn into the heat exchanger, the flame roll-out switch will close the gas valve and initiate the shutdown cycle.

### Gas Valve

The gas valve controls the flow of gas to the burners. When the gas valve is energized it automatically opens and regulates the gas pressure in the manifold.

### Inducer Assembly

The inducer assembly vents products of combustion to the outside.

### Pressure Switch

The pressure switch verifies that the inducer is drawing the combustion gases through the heat exchanger. If the flame is not properly drawn into the heat exchanger tube, the rollout switch or the flame sensor will shut the furnace down.

### Supply Air Limit Switch

The supply air limit switch prevents the air temperature leaving the furnace from exceeding the maximum allowable outlet air temperature.

## MAINTENANCE



### WARNING:

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**These maintenance instructions are primarily intended to assist qualified technicians experienced in the proper maintenance and operation of this appliance.**

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Proper maintenance is most important to achieve the best performance from a furnace. Follow these instructions for years of safe, trouble free operation.

- Always reinstall the doors on the furnace after servicing or cleaning/changing the filters. Do not operate the furnace without all doors and covers in place.
- Verify that the thermostat is properly installed and is not affected by drafts or heat from lamps or other appliances.
- To achieve the best performance and minimize equipment failure it is recommended that a yearly maintenance checkup be performed. At a minimum, this check should include the following items:

### Air Filter(s)



### WARNING:

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**Never operate the furnace without a filter in place. Dust and lint in the return air can build up on internal components, resulting in loss of efficiency, equipment damage, and possible fire.**

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**Note:** Air filter(s) are not supplied with the furnace as shipped from the factory. The installer must provide a high velocity filter and rack for a filter in the return air duct adjacent to the furnace, or in a return air grill to the furnace. It is recommended that filters be cleaned or replaced monthly. New or newly renovated homes may require more frequent changing until the construction dust has minimized.

Filters designed to remove smaller particles such as pollen, may require additional maintenance. Filters for side return and bottom return applications are available from most local distributors.

### Blower Compartment

Dirt and lint can create excessive loads on the motor resulting in higher than normal operating temperatures and shortened service life. It is recommended that the blower compartment be cleaned of dirt or lint that may have accumulated in the compartment or on the blower and motor as part of the annual inspection.

## Cleaning of Burners

If the burners must be cleaned, follow the steps below and see Figure 40 or 41 (page 51) for component location.

1. Shut off gas supply to the furnace either at the meter or at a manual valve in the supply piping.
2. Turn off all power to the furnace and set the thermostat to its lowest setting.
3. Remove the burner door from the furnace.
4. Turn the gas control switch to the OFF position.
5. Disconnect the wires from the gas valve, igniter, flame sensor, and flame rollout switch.
6. Using two wrenches, separate the ground-joint union in the gas supply piping at the furnace.
7. Remove the piping between the Gas Valve and the ground-joint union. (If applicable).
8. Remove all screws securing the Manifold Assembly to the Burner Box.
9. Carefully remove the burner assembly from the furnace. **DO NOT DAMAGE THE IGNITER WHILE REMOVING THE BURNER ASSEMBLY.**
10. Inspect the burners for accumulated dust or debris. If necessary carefully clean them with a soft wire brush and a vacuum cleaner. **DO NOT DAMAGE THE IGNITER WHILE CLEANING THE BURNER.**
11. Replace all the parts in reverse order from which they were removed.
12. Follow the lighting instructions found on the furnace door to return the furnace to operation. Verify proper operation after servicing.

## Heat Exchanger and Burner Maintenance

The furnace should operate for many years without soot buildup in the flue passageways, however, the flue, vent system, and burners should be inspected and cleaned (if required) by a qualified service technician annually to ensure continued safe operation. Pay attention to any deterioration from corrosion or other sources.



### **WARNING:**

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**Holes in the vent pipe or heat exchanger can cause combustion products to enter the home. Replace the vent pipe or heat exchanger if leaks are found. Failure to prevent the circulation of combustion products into the living space can create potentially hazardous conditions including carbon monoxide poisoning that could result in personal injury or death.**

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## Lubrication

The bearings in the blower motor and inducer blower used in these furnaces are pre-lubricated and sealed by the manufacturer. No further oiling of the bearings is required for the life of the motor.

## Vent System

Check the inlet pipe (if applicable) and outlet pipe to ensure they are not blocked by debris. Any damaged section of vent pipe must be replaced, and any obstruction or blockage must be removed prior to operating the furnace.

## FRENCH TRANSLATIONS

The following are French translations of important warning statements found within this manual.



### **AVERTISSEMENT:**

#### **RISQUE D'EMPOISONNEMENT AU MONOXYDE DE CARBONÉ**

**Le non-respect des consignes suivantes portant sur chacun des appareils raccordés au système**

**d'évacuation mis en service pourrait entraîner l'empoisonnement au monoxyde de carbone ou la mort. Les consignes suivantes doivent être observées pour chaque appareil raccordé au système d'évacuation mis en service si les autres appareils raccordés au système ne sont pas en service:**

- 1. Sceller toute ouverture non utilisée de la système d'évacuation;**
- 2. S'assurer que la système d'évacuation présente des dimensions et une pente horizontale conformes à la norme ANSI Z223.1/NFPA 54, intitulée National Fuel Gas Code ou aux codes d'installation CSA-B149.1, ainsi qu'aux présentes instructions. S'assurer que la système d'évacuation n'est pas bloquée, restreinte, corrodée, qu'elle ne fuit pas et qu'elle ne présente aucun autre défaut potentiellement dangereux;**
- 3. Dans la mesure du possible, fermer toutes les portes et fenêtres du bâtiment, et toutes les portes entre la pièce où se trouve l'appareil raccordé à la système d'évacuation et les autres pièces du bâtiment.**
- 4. Fermer les registres des foyers;**
- 5. Mettre en service les sècheuses et tout autre appareil qui n'est pas raccordé à la système d'évacuation. Faire fonctionner à régime maximal tout ventilateur d'évacuation, tel que les hottes de cuisinière et les ventilateurs de salles de bains. Ne pas mettre en service les ventilateurs d'été.**
- 6. Respecter les instructions d'allumage. Mettre en service l'appareil à l'essai. Régler le thermostat de manière à ce que l'appareil fonctionne sans interruption;**
- 7. Vérifier s'il y a débordement à l'orifice d'évacuation du coupe tirage des appareils dotés d'un coupe tirage 5 minutes après l'allumage du brûleur principal. Utiliser la flamme d'une allumette ou d'une chandelle.**
- 8. Si l'on constate, au cours de l'un des essais qui précèdent, que l'évacuation est déficiente, corriger le système d'évacuation conformément à la norm ANSI Z223.1/NFPA 54, National Fuel Gas Code, et (ou) aux codes d'installation CSA B149.1.**
- 9. Après avoir déterminé que tous les appareils raccordés à la système d'évacuation évacuent correctement tel que prescrit ci-dessus, rouvrir les portes et les fenêtres et remettre les ventilateurs d'évacuation, les registres de foyers et tout autre appareil fonctionnant au gaz à leur état de fonctionnement initial.**





## **AVERTISSEMENT:**

### **RISQUE D'INCENDIE OU D'EXPLOSION**

- Le non-respect des avertissements de sécurité pourrait entraîner des blessures graves, la mort ou des dommages matériels.
- L'installation et l'entretien doivent être effectués par un installateur qualifié, un organisme de service ou le fournisseur de gazstaller, service agency or the gas supplier.
- Ne pas entreposer ni utiliser de l'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil, ni de tout autre appareil.

### **QUE FAIRE S'IL Y A UNE ODEUR DE GAZ**

- Ne pas tenter d'allumer aucun appareil.
  - Ne toucher à aucun interrupteur électrique; n'utiliser aucun téléphone dans le bâtiment.
  - Évacuer l'immeuble immédiatement.
  - Appeler immédiatement le fournisseur de gaz en employant le téléphone d'un voisin. Respecter à la lettre les instructions du fournisseur de gaz.
  - Si personne ne répond, appeler le service des incendies.
- 



## **AVERTISSEMENT:**

### **RISQUE D'INCENDIE ET D'EXPLOSION**

Risque de blessures graves ou de mort.

Ne pas entreposer ni utiliser de l'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil, ni de tout autre appareil. Le fait d'entreposer ou d'utiliser de l'essence ou d'autres liquides ou vapeurs inflammables à proximité de cet appareil ou de tout autre appareil peut causer des blessures graves ou la mort.

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## **AVERTISSEMENT:**

### **RISQUE DE CHOC ÉLECTRIQUE, D'INCENDIE OU D'EXPLOSION**

Le non-respect des avertissements de sécurité pourrait entraîner un fonctionnement dangereux de l'appareil, des blessures graves, la mort ou des dommages matériels.

Un entreteïn incorrect pourrait entraîner un fonctionnement dangereux de l'appareil, des blessures graves, la mort ou des dommages matériels.

- Couper toute alimentation électrique au générateur d'air chaud avant de prodéder aux travaux d'entretein.
  - Au moment de l'entretien des commandes, étiquetez tous les fils avant de les débrancher. S'assurer de les raccorder correctement.
  - S'assurer que l'appareil fonctionne adéquatement après l'entretien.
- 



## **AVERTISSEMENT:**

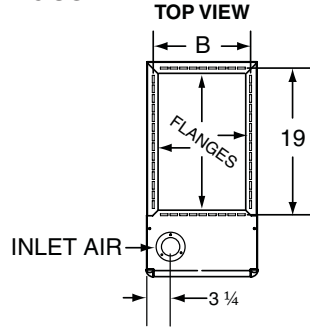
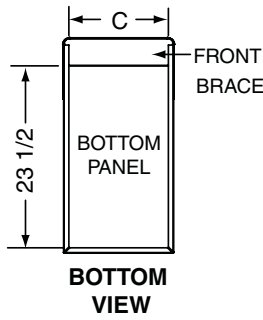
Ne jamais utiliser une flamme nue por vérifier la présence des fuites de gaz. Pour la vérification de tous les joints, utiliser plutôt une solution savonneuse commerciale fabriquée spécifiquement pur la détection des fuites de gaz. Un incendie ou une explosion peut entraîner des dommages matériels, des blessures ou la mort.

Le non-respect des avertissements de sécurité pourrait d'entraîner des blessures graves, la mort ou des dommages matériels.

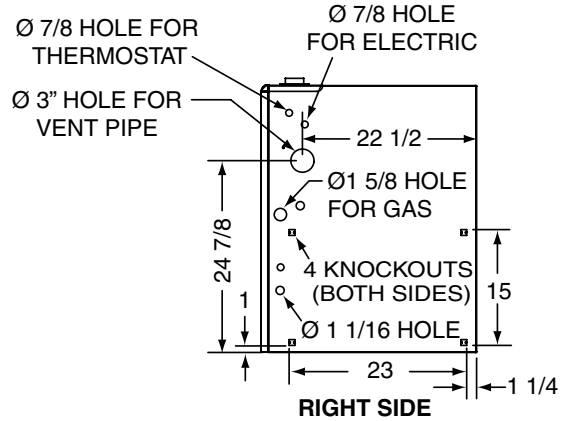
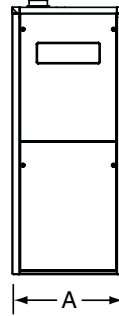
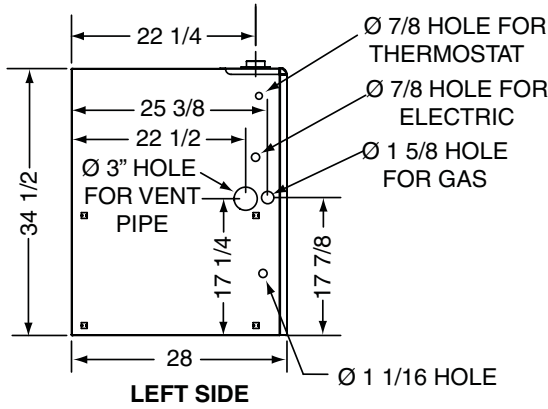
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## FIGURES AND TABLES

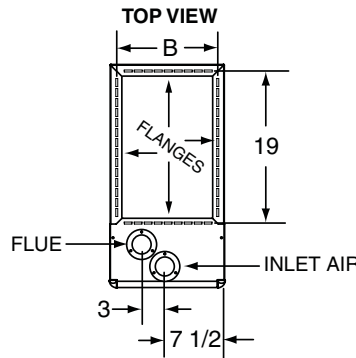
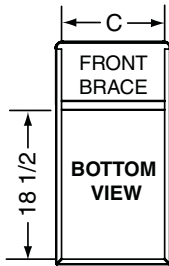
### \*TC 95.1% Upflow/Horizontal Furnace



Upflow/Horz. Cabinets	Dim. "A"	Dim. "B"	Dim. "C"
'B' Cabinet	17 1/2	15 7/8	16 1/8
'C' Cabinet	21	19 3/8	19 5/8
'D' Cabinet	24 1/2	22 7/8	23 1/8
<b>NOTES:</b>			
Dimensions shown in inches.			



### \*TL 95.1% Downflow Furnace



Downflow Cabinets	Dim. "A"	Dim. "B"	Dim. "C"
'B' Cabinet	17 1/2	15 7/8	16 1/8
'C' Cabinet	21	19 3/8	19 5/8
'D' Cabinet	24 1/2	22 7/8	23 1/8
<b>NOTES:</b>			
Dimensions shown in inches.			

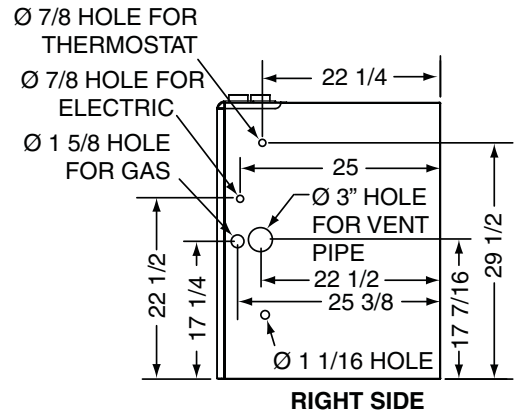
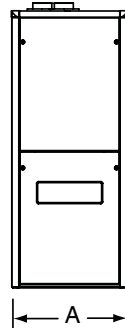
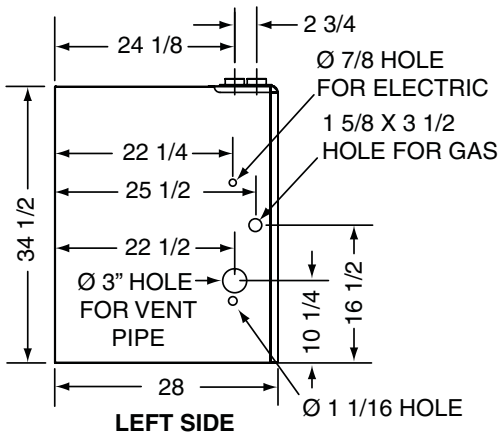


Figure 28. Furnace Dimensions



*TC/TL FURNACES WITH VARIABLE SPEED BLOWERS						
"B" CABINET	Switch Settings For Heat (0 = OFF, 1 = ON)				*TC/TL-060D-*B Input (BTU) 60,000	
	1	2	3	4	CFM	Temp Rise (°F)
	1	0	0	0	1,000	53
	1	0	0	1	1,100	48
	1	0	1	0	1,200	44
	1	0	1	1	1,300	41
	1	1	0	0	1,400	38
	1	1	0	1	1,500	35
	1	1	1	0	1,600	33
1	1	1	1	1,700	31	

"C" CABINET	Switch Settings For Heat (0 = OFF, 1 = ON)				*TC/TL-080D-*C Input (BTU) 80,000		*TC/TL-100D-*C Input (BTU) 100,000	
	1	2	3	4	CFM	Temp Rise (°F)	CFM	Temp Rise (°F)
	#	0	0	0	1,000	70	1,000	88
	#	0	0	1	1,115	63	1,115	79
	#	0	1	0	1,230	57	1,230	72
	#	0	1	1	1,345	52	1,345	65
	#	1	0	0	1,460	48	1,460	60
	#	1	0	1	1,575	45	1,575	56
	#	1	1	0	1,690	42	1,690	52
#	1	1	1	1,805	39	1,805	49	

"D" CABINET	Switch Settings For Heat (0 = OFF, 1 = ON)				*TC/TL-120D-*D Input (BTU) 120,000	
	1	2	3	4	CFM	Temp Rise (°F)
	#	0	0	0	1,500	70
	#	0	0	1	1,615	65
	#	0	1	0	1,730	61
	#	0	1	1	1,845	57
	#	1	0	0	1,960	54
	#	1	0	1	2,075	51
	#	1	1	0	2,190	48
#	1	1	1	2,305	46	

**Notes:**

1. Two openings are recommended for airflows above 1,600 CFM if the filter(s) is (are) adjacent to the furnace.
  2. Temperature rises in the table are approximate. Actual temperature rises may vary.
  3. Temperature rises shaded in grey are for reference only. These conditions are not recommended.
- # Switch not used- can be 0 or 1.

**Table 9. Nominal Heating Airflows (CFM) and Temperature Rises (°F)**

*TC/TL FURNACES WITH VARIABLE SPEED BLOWERS "B" CABINET								
Switch Settings (0 = OFF, 1 = ON)					CFM		Nominal A/C and HP Capacity	
HEAT		COOL			LOW	HIGH		
1-4	5	6	7	8				
1	0	0	0	0	485	700	3.5 TON 3 TON 2.5 TON 2 TON	
1	0	0	0	1	525	760		
1	0	0	1	0	565	820		
1	0	0	1	1	605	880		
1	0	1	0	0	650	940		
1	0	1	0	1	690	1,000		
1	0	1	1	0	730	1,060		
1	0	1	1	1	775	1,120		
1	1	0	0	0	815	1,180		
1	1	0	0	1	855	1,240		
1	1	0	1	0	895	1,300		
1	1	0	1	1	940	1,360		
1	1	1	0	0	980	1,420		
1	1	1	0	1	1,020	1,480		
1	1	1	1	0	1,065	1,540		
1	1	1	1	1	1,105	1,600		

*TC/TL FURNACES WITH VARIABLE SPEED BLOWERS "C" CABINET								
Switch Settings (0 = OFF, 1 = ON)					CFM		Nominal A/C and HP Capacity	
HEAT		COOL			LOW	HIGH		
1-4	5	6	7	8				
#	0	0	0	0	705	1,025	5 TON 4 TON 3.5 TON 3 TON 2.5 TON	
#	0	0	0	1	750	1,090		
#	0	0	1	0	795	1,155		
#	0	0	1	1	840	1,220		
#	0	1	0	0	885	1,285		
#	0	1	0	1	930	1,350		
#	0	1	1	0	975	1,415		
#	0	1	1	1	1,020	1,480		
#	1	0	0	0	1,065	1,545		
#	1	0	0	1	1,110	1,610		
#	1	0	1	0	1,155	1,675		
#	1	0	1	1	1,200	1,740		
#	1	1	0	0	1,245	1,805		
#	1	1	0	1	1,290	1,870		
#	1	1	1	0	1,335	1,935		
#	1	1	1	1	1,380	2,000		

*TC/TL FURNACES WITH VARIABLE SPEED BLOWERS "D" CABINET								
Switch Settings (0 = OFF, 1 = ON)					CFM		Nominal A/C and HP Capacity	
HEAT		COOL			LOW	HIGH		
1-4	5	6	7	8				
#	0	0	0	0	965	1,400	5 TON 4 TON 3.5 TON	
#	0	0	0	1	995	1,440		
#	0	0	1	0	1,020	1,480		
#	0	0	1	1	1,050	1,520		
#	0	1	0	0	1,075	1,560		
#	0	1	0	1	1,105	1,600		
#	0	1	1	0	1,130	1,640		
#	0	1	1	1	1,160	1,680		
#	1	0	0	0	1,185	1,720		
#	1	0	0	1	1,215	1,760		
#	1	0	1	0	1,240	1,800		
#	1	0	1	1	1,270	1,840		
#	1	1	0	0	1,295	1,880		
#	1	1	0	1	1,325	1,920		
#	1	1	1	0	1,350	1,960		
#	1	1	1	1	1,380	2,000		

# Switch not used - can be 0 or 1

Table 10. Nominal Cooling/Heat Pump Airflows (CFM) for Variable Speed Furnaces

## GAS INFORMATION

GAS FLOW RATES (CUBIC FEET PER HOUR)							
TIME FOR ONE REVOLUTION (SECONDS)	CUBIC FEET PER REVOLUTION OF GAS METER			TIME FOR ONE REVOLUTION (SECONDS)	CUBIC FEET PER REVOLUTION OF GAS METER		
	1	5	10		1	5	10
10	360	1,800	3,600	66	55	273	545
12	300	1,500	3,000	68	53	265	529
14	257	1,286	2,571	70	51	257	514
16	225	1,125	2,250	72	50	250	500
18	200	1,000	2,000	74	49	243	486
20	180	900	1,800	76	47	237	474
22	164	818	1,636	78	46	231	462
24	150	750	1,500	80	45	225	450
26	138	692	1,385	82	44	220	439
28	129	643	1,286	84	43	214	429
30	120	600	1,200	86	42	209	419
32	113	563	1,125	88	41	205	409
34	106	529	1,059	90	40	200	400
36	100	500	1,000	92	39	196	391
38	95	474	947	94	38	191	383
40	90	450	900	96	38	188	375
42	86	429	857	98	37	184	367
44	82	409	818	100	36	180	360
46	78	391	783	102	35	176	353
48	75	375	750	104	35	173	346
50	72	360	720	106	34	170	340
52	69	346	692	108	33	167	333
54	67	333	667	110	33	164	327
56	64	321	643	112	32	161	321
58	62	310	621	114	32	158	316
60	60	300	600	116	31	155	310
62	58	290	581	118	31	153	305
64	56	281	563	120	30	150	300

**Table 11. Gas Flow Rates**

CAPACITY OF BLACK IRON GAS PIPE (CU. FT. PER HOUR) FOR NATURAL GAS (SPECIFIC GRAVITY - 0.60)								
NOMINAL BLACK IRON PIPE DIAMETER (IN.)	LENGTH OF PIPE RUN (FT)							
	10	20	30	40	50	60	70	80
½	130	90	75	65	55	50	45	40
¾	280	190	150	130	115	105	95	90
1	520	350	285	245	215	195	180	170
1 ¼	1,050	730	590	500	440	400	370	350
1 ½	1,600	1,100	890	760	670	610		

**NOTES**

The cubic feet per hour listed in the table above must be greater than the cubic feet per hour of gas flow required by the furnace. To determine the cubic feet per hour of gas flow required by the furnace, divide the input rate of the furnace by the heating value (from gas supplier) of the gas.

$$\text{Cubic Feet Per Hour Required} = \frac{\text{Input To Furnace (Btu/hr)}}{\text{Heating Value of Gas (Btu/Cu. Ft.)}}$$

**Table 12. Black Iron Gas Pipe Capacities**

PROPANE GAS									
ALTITUDE ABOVE SEA LEVEL	INPUT (BTU) and STAGE								
	60,000		80,000		100,000		120,000		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
0 to 1,999 FT	55		55		55		55		ORIFICE SIZE
	4.2	10.0	4.2	10.0	4.2	10.0	4.2	10.0	MANIFOLD PRESSURE
2,000 to 2,999 FT	55		55		55		55		ORIFICE SIZE
	4.2	9.0	4.2	9.0	4.2	9.0	4.2	9.0	MANIFOLD PRESSURE
3,000 to 4,999 FT	55		55		55		55		ORIFICE SIZE
	4.2	8.5	4.2	8.5	4.2	8.5	4.2	8.5	MANIFOLD PRESSURE
5,000 to 5,999 FT	56		56		56		56		ORIFICE SIZE
	4.2	10.0	4.2	10.0	4.2	10.0	4.2	10.0	MANIFOLD PRESSURE
6,000 to 7,999 FT	56		56		56		56		ORIFICE SIZE
	4.2	9.0	4.2	9.0	4.2	9.0	4.2	9.0	MANIFOLD PRESSURE
8,000 to 10,000 FT	56		56		56		56		ORIFICE SIZE
	4.2	8.5	4.2	8.5	4.2	8.5	4.2	8.5	MANIFOLD PRESSURE

Table 13. High Altitude Deration Chart for Propane Gas

ALTITUDE ABOVE SEA LEVEL	LOCAL HEATING VALUE, BTU PER CUBIC FOOT								
	650	700	750	800	850	900	950	1,000	1,050
2,000	LOW	LOW	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH
3,000	LOW	LOW	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH
4,000	LOW	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH
5,000	LOW	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH
6,000	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
7,000	LOW	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
8,000	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
9,000	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
10,000	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH

Table 14. Natural Gas Heating Values

NATURAL GAS - HIGH HEATING VALUE									
ALTITUDE ABOVE SEA LEVEL	INPUT (BTU) and STAGE								
	60,000		80,000		100,000		120,000		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
0 to 1,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.5	1.7	3.5	1.7	3.5	1.7	3.5	MANIFOLD PRESSURE
2,000 to 2,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.3	1.7	3.3	1.7	3.3	1.7	3.3	MANIFOLD PRESSURE
3,000 to 3,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.1	1.7	3.1	1.7	3.1	1.7	3.1	MANIFOLD PRESSURE
4,000 to 4,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	2.9	1.7	2.9	1.7	2.9	1.7	2.9	MANIFOLD PRESSURE
5,000 to 5,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	2.8	1.7	2.8	1.7	2.8	1.7	2.8	MANIFOLD PRESSURE
6,000 to 6,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.5	1.7	3.5	1.7	3.5	1.7	3.5	MANIFOLD PRESSURE
7,000 to 7,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.3	1.7	3.3	1.7	3.3	1.7	3.3	MANIFOLD PRESSURE
8,000 to 8,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.0	1.7	3.0	1.7	3.0	1.7	3.0	MANIFOLD PRESSURE
9,000 to 9,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	2.8	1.7	2.8	1.7	2.8	1.7	2.8	MANIFOLD PRESSURE

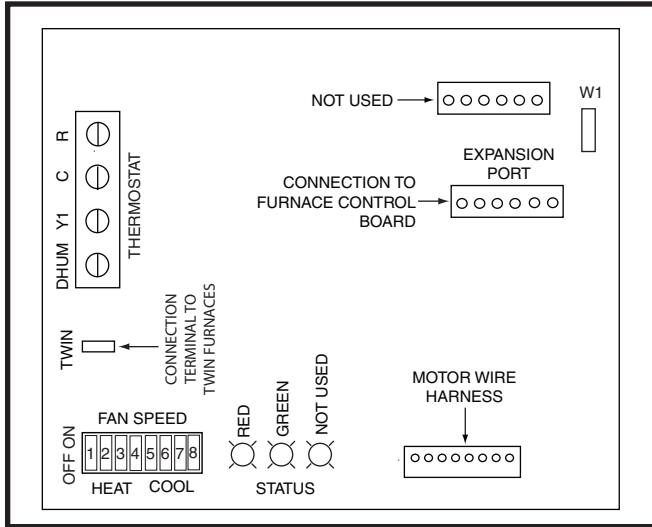
Table 15. High Altitude Deration Chart for Natural Gas - High Heating Value

NATURAL GAS - LOW HEATING VALUE									
ALTITUDE ABOVE SEA LEVEL	INPUT (BTU) and STAGE								
	60,000		80,000		100,000		120,000		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
0 to 1,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.5	1.7	3.5	1.7	3.5	1.7	3.5	MANIFOLD PRESSURE
2,000 to 2,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.5	1.7	3.5	1.7	3.5	1.7	3.5	MANIFOLD PRESSURE
3,000 to 3,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.4	1.7	3.4	1.7	3.4	1.7	3.4	MANIFOLD PRESSURE
4,000 to 4,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.2	1.7	3.2	1.7	3.2	1.7	3.2	MANIFOLD PRESSURE
5,000 to 5,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	3.1	1.7	3.1	1.7	3.1	1.7	3.1	MANIFOLD PRESSURE
6,000 to 6,999 FT	45		45		45		45		ORIFICE SIZE
	1.7	2.9	1.7	2.9	1.7	2.9	1.7	2.9	MANIFOLD PRESSURE
7,000 to 7,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.5	1.7	3.5	1.7	3.5	1.7	3.5	MANIFOLD PRESSURE
8,000 to 8,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.3	1.7	3.3	1.7	3.3	1.7	3.3	MANIFOLD PRESSURE
9,000 to 9,999 FT	48		48		48		48		ORIFICE SIZE
	1.7	3.1	1.7	3.1	1.7	3.1	1.7	3.1	MANIFOLD PRESSURE

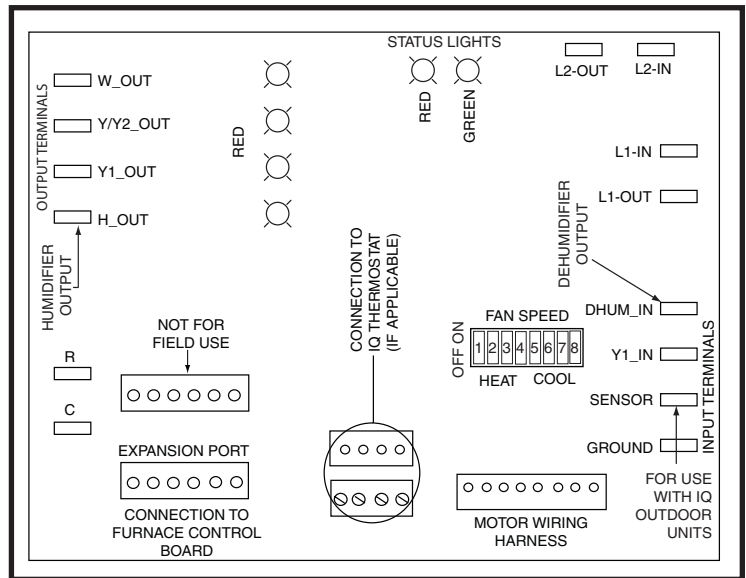
Table 16. High Altitude Deration Chart for Natural Gas - Low heating Value



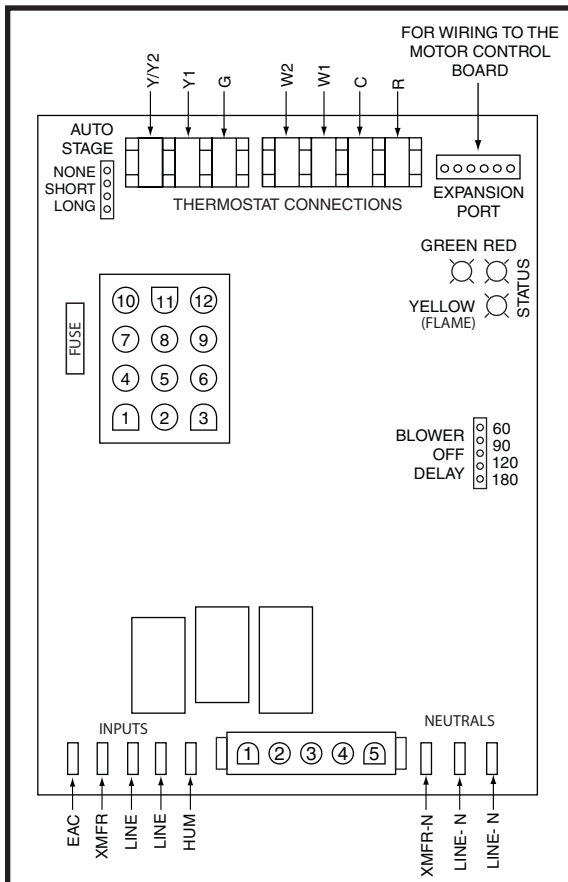
# ELECTRICAL INFORMATION



**Figure 29. Two-Stage Fixed Speed Motor Control Board**



**Figure 30. Two-Stage Variable Speed Motor Control Board**



**Figure 31. Two-Stage Furnace Control Board**

# WIRING DIAGRAM

## For 80+ and 90+ 2-Stage Fixed Speed Upflow Furnaces

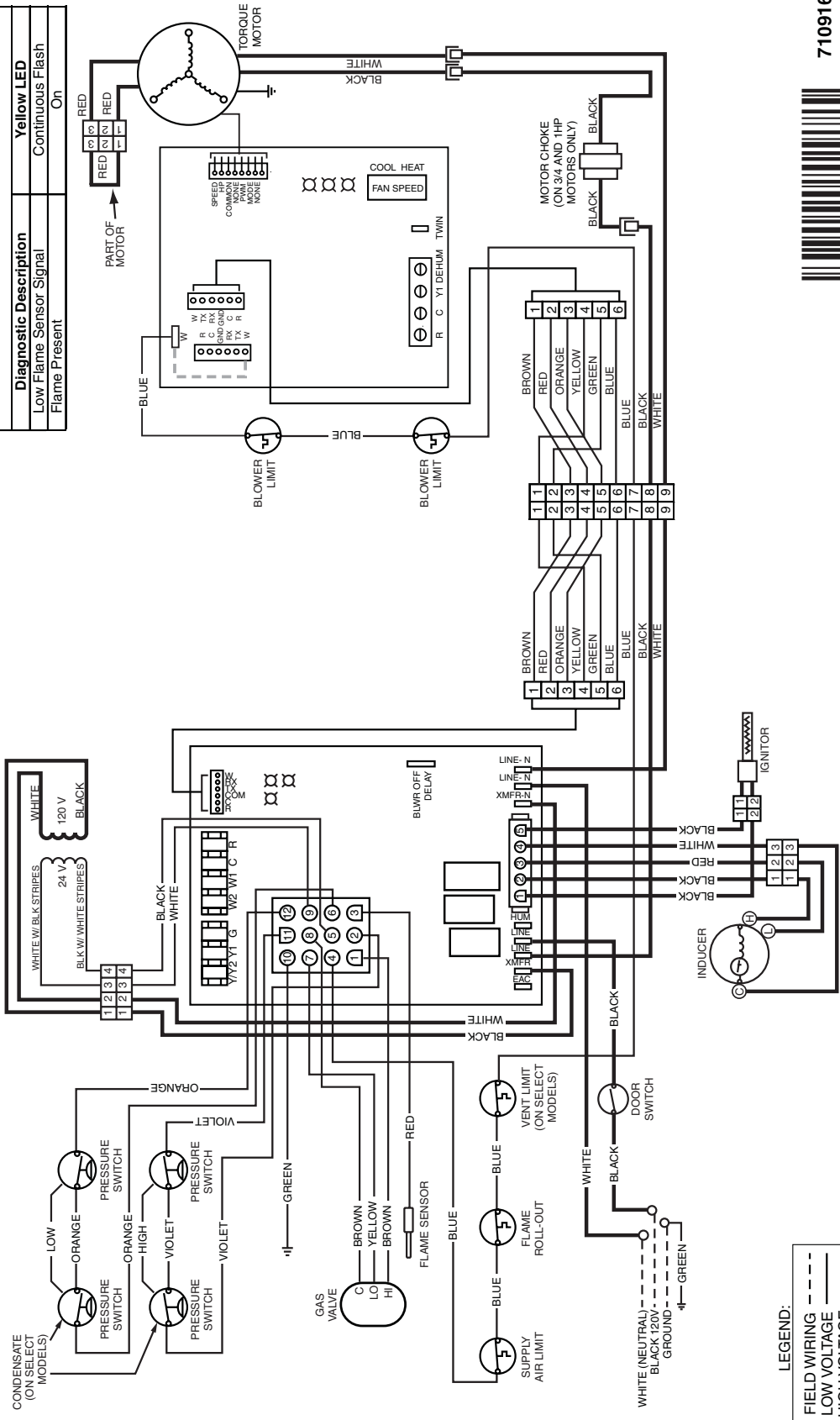
Refer to the Installation Instructions provided with the kit for the proper heating and cooling speeds for your application.

This wiring diagram shows connections and termination required for the blower kit only. Use in addition to the wiring diagram for the furnace.

If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 105° C.

Use copper conductors only.

FAULT CONDITIONS		
<b>Diagnostic Description</b>	<b>Green LED</b>	<b>Red LED</b>
Control Fault (No Power)	Off	Off
L1 / Neutral Polarity Fault	Flash	Flash
1 Hour Lockout	Alternating Flash	Flash
Normal Operation	On	On
Pressure Switch Closed Fault	On	Flash
Pressure Switch Open Fault	Flash	On
Open Limit Switch Fault	Flash	Off
Motor Fault	On	Off
Diagnostic Description		
Low Flame Sensor Signal	Continuous Flash	
Flame Present	On	



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Figure 32. Wiring Diagram for Two-Stage, Fixed Speed Upflow Furnaces

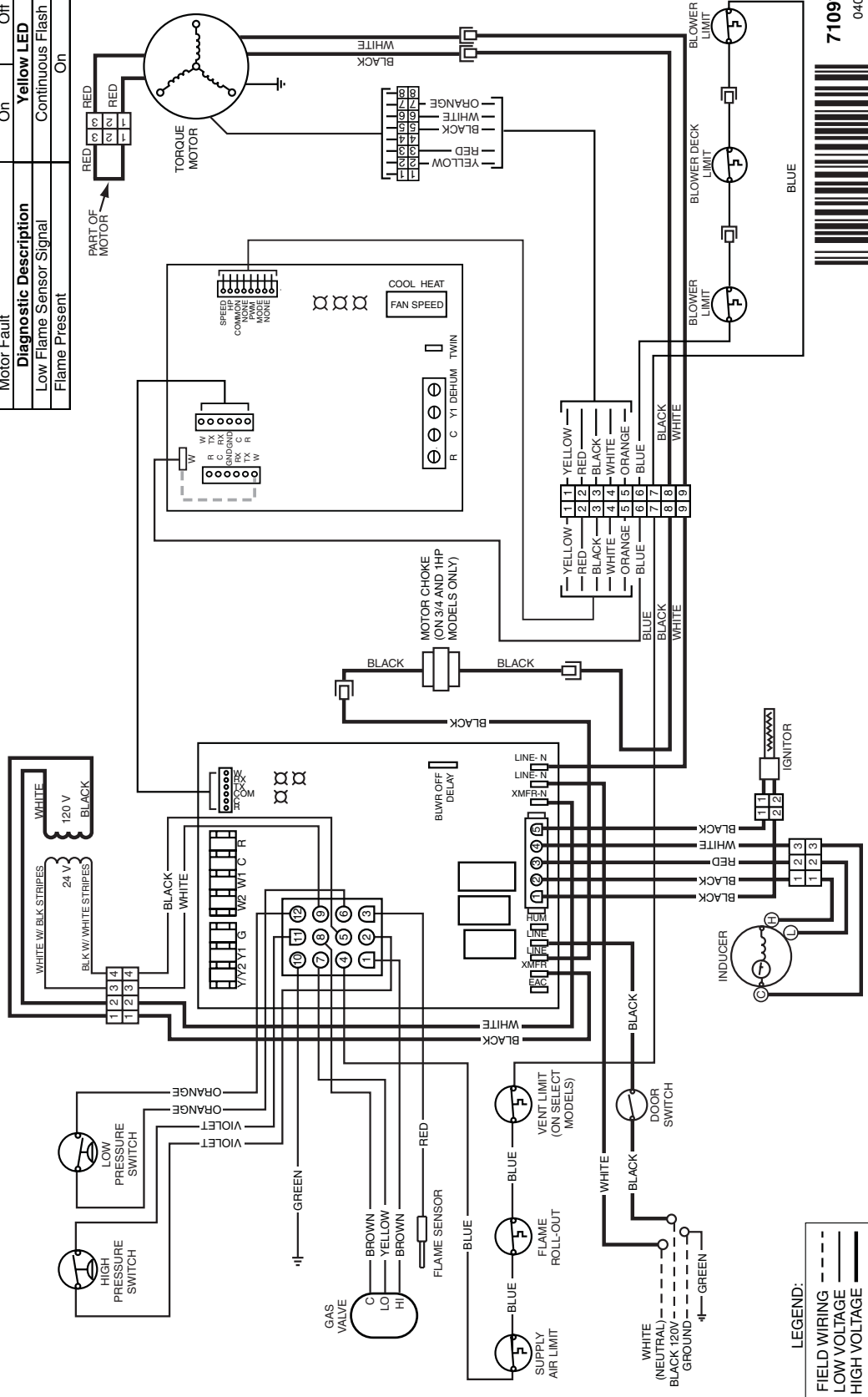
# WIRING DIAGRAM

## For 80+ and 90+ 2-Stage Fixed Speed Downflow Furnaces

Refer to the installation instructions provided with the kit for the proper heating and cooling speeds for your application. This wiring diagram shows connections and termination required for the blower kit only. Use in addition to the wiring diagram for the furnace.

Use copper conductors only.

FAULT CONDITIONS		
Diagnostic Description	Green LED	Red LED
Control Fault (No Power)	Off	Off
L1 / Neutral Polarity Fault	Flash	Flash
1 Hour Lockout	Alternating Flash	Flash
Normal Operation	On	On
Pressure Switch Closed Fault	On	Flash
Pressure Switch Open Fault	Flash	On
Open Limit Switch Fault	Flash	Off
Motor Fault	On	Off
Diagnostic Description		
Low Flame Sensor Signal	Yellow LED	
Flame Present	Continuous Flash	
Flame Present	On	



**LEGEND:**  
 FIELD WIRING (dashed line)  
 LOW VOLTAGE (solid line)  
 HIGH VOLTAGE (thick solid line)



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Figure 33. Wiring Diagram for Two-Stage, Fixed Speed Downflow Furnaces

# WIRING DIAGRAM

## For 80+ and 90+ 2-Stage Variable Speed Upflow Furnaces

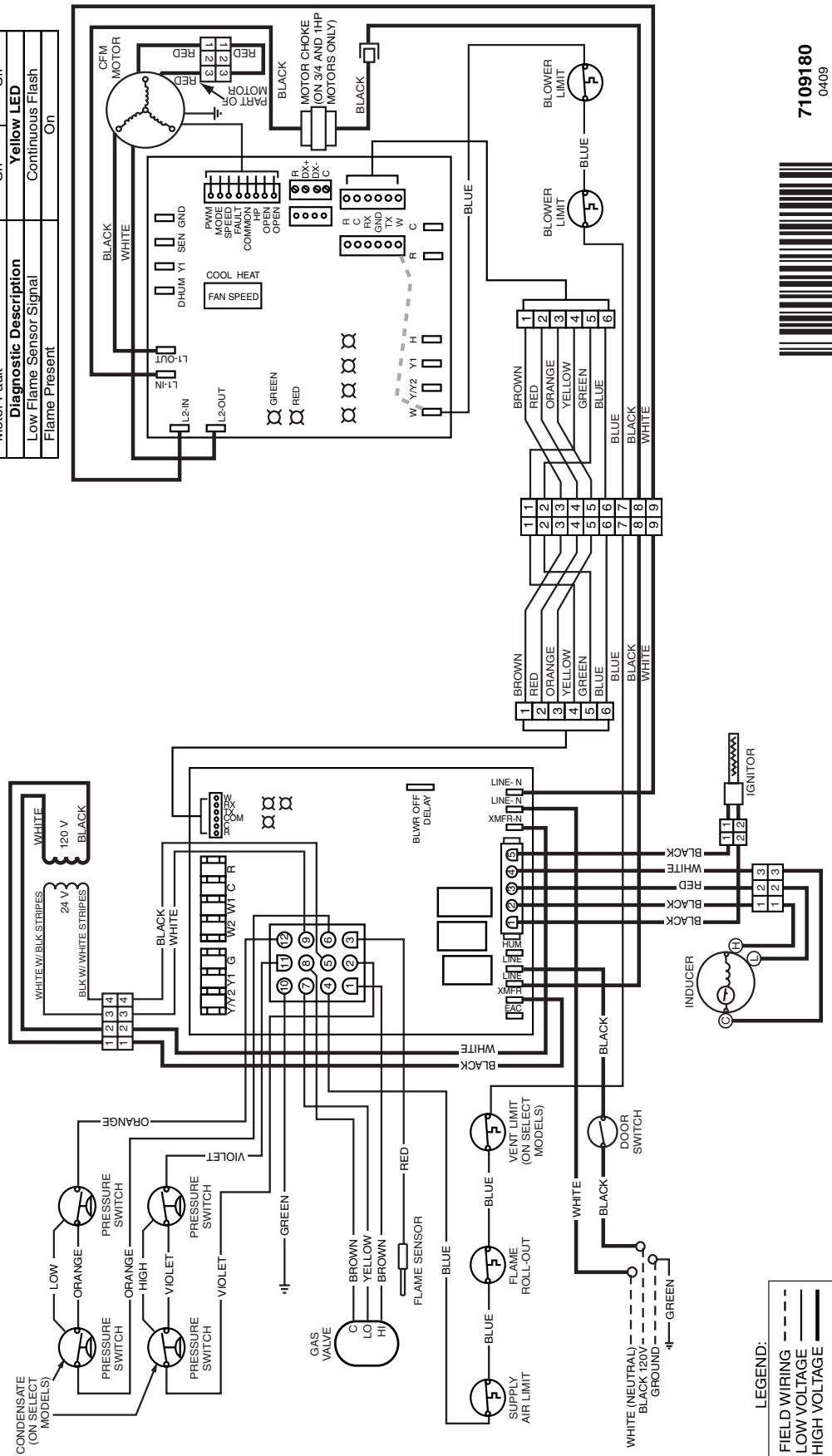
Refer to the installation instructions provided with the kit for the proper heating and cooling speeds for your application.

This wiring diagram shows connections and termination required for the blower kit only. Use in addition to the wiring diagram for the furnace.

If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 105° C.

Use copper conductors only.

FAULT CONDITIONS		
Diagnostic Description	Green LED	Red LED
Control Fault (No Power)	Off	Off
L1/Neutral Polarity Fault	Flash	Flash
1 Hour Lockout	Alternating Flash	Flash
Normal Operation	On	On
Pressure Switch Closed Fault	On	Flash
Pressure Switch Open Fault	Flash	On
Open Limit Switch Fault	Flash	Off
Motor Fault	On	Off
Diagnostic Description		
Low Flame Sensor Signal	Continuous Flash	Yellow LED
Flame Present	On	On



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Figure 34. Wiring Diagram for Two-Stage, Variable Speed Upflow Furnaces

# WIRING DIAGRAM

## For 80+ and 90+ 2-Stage Variable Speed Downflow Furnaces

Refer to the Installation Instructions provided with the kit for the proper heating and cooling speeds for your application.

This wiring diagram shows connections and termination required for the blower kit only. Use in addition to the wiring diagram for the furnace.

If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 105° C.

Use copper conductors only.

FAULT CONDITIONS			
Diagnostic Description	Green LED	Red LED	Red LED
Control Fault (No Power)	Off	Off	Off
L1 / Neutral Polarity Fault	Flash	Flash	Flash
1 Hour Lockout	Alternating Flash	Flash	Flash
Normal Operation	On	On	On
Pressure Switch Closed Fault	On	Flash	Flash
Pressure Switch Open Fault	Flash	Flash	Flash
Open Limit Switch Fault	Flash	Off	Off
Motor Fault	On	Off	Off
Diagnostic Description			
Low Flame Sensor Signal	Continuous Flash	Continuous Flash	Continuous Flash
Flame Present	On	On	On

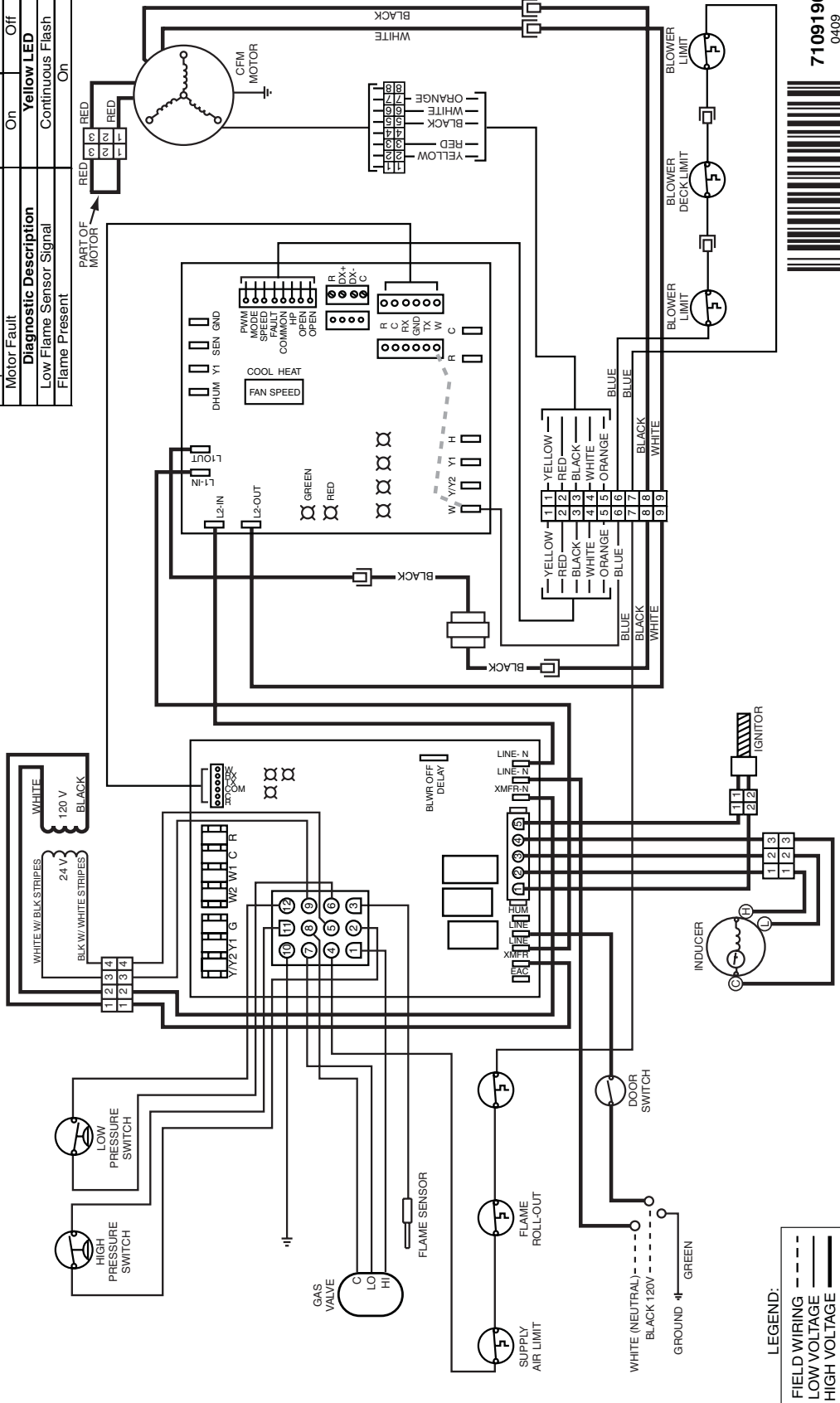
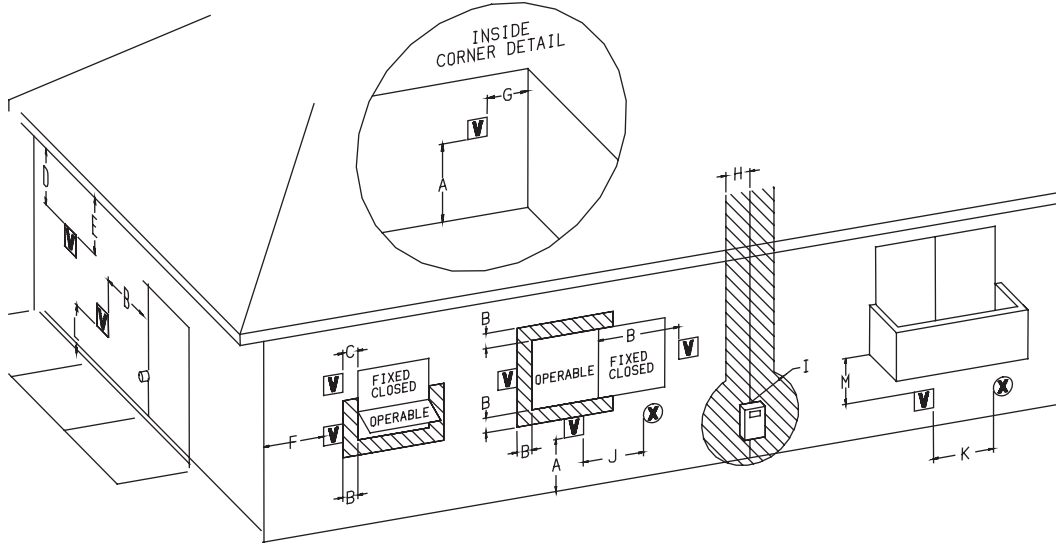


Figure 35. Wiring Diagram for Two-Stage, Variable Speed Downflow Furnaces

## VENTING INFORMATION



**V** VENT TERMINAL
**X** AIR SUPPLY INLET
**▨** AREA WHERE TERMINAL IS NOT PERMITTED

Clearance Location	CANADIAN INSTALLATIONS <sup>a</sup>		US INSTALLATIONS <sup>b</sup>	
	Direct Vent (2-pipe) & Conventional Vent (1-pipe) Furnaces	Direct Vent (2-pipe) Furnaces	Direct Vent (2-pipe) Furnaces	Conventional Vent (1-pipe) Furnaces
A = Clearance above grade, veranda, porch, deck, balcony, or maximum expected snow level.	12 inches (30cm)	12 inches (30cm)	12 inches (30cm)	12 inches (30cm)
B = Clearance to window or door that may be opened.	6 inches (15cm) for appliances < 10,000 Btuh (3kW) 12 inches (30cm) for appliances 10,000 Btuh - 100,000 Btuh (30kW) 36 inches (91cm) for appliances > 100,000 Btuh (30Kw)	6 inches (15cm) for appliances < 10,000 Btuh (3kW) 9 inches (23cm) for appliances 10,000 Btuh - 50,000 Btuh (30kW) 12 inches (30cm) for appliances > 50,000 Btuh (30Kw)	4 ft. (1.2m) below or to side of opening; 1 ft. (300mm) above opening	
C = Clearance to permanently closed window	*	*	*	*
D = Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61cm) 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 (91cm) within a height 15 feet above the meter/regulator assembly	*	*	*
I = Clearance to service regulator vent outlet.	3 feet (1.83m)	*	*	*
J = Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance.	6 inches (15cm) for appliances < 10,000 Btuh (3kW) 12 inches (30cm) for appliances 10,000 Btuh - 100,000 Btuh (30kW) 36 inches (91cm) for appliances > 100,000 Btuh (30Kw)	6 inches (15cm) for appliances < 10,000 Btuh (3kW) 9 inches (23cm) for appliances 10,000 Btuh - 50,000 Btuh (30kW) 12 inches (30cm) for appliances > 50,000 Btuh (30Kw)	4 ft. (1.2m) below or to side of opening; 1 ft. (300mm) above opening	
K = Clearance to mechanical air supply inlet.	6 feet (1.83m)	3 feet (91cm) above if within 10 feet (3m) horizontally	3 ft. (91cm) above if within 10 feet (3m) horizontally	3 ft. (91cm) above if within 10 feet (3m) horizontally
L = Clearance above paved sidewalk or driveway located on public property.	7 feet (2.13m) <sup>c</sup>	*	*	7 ft. (2.13m)
M = Clearance under veranda, porch, deck, or balcony.	12 inches (30cm) <sup>d</sup>	*	*	*
<b>NOTES:</b>				
a	In accordance with the current CSA B149.1 Natural Gas and Propane Installation Guide Code			
b	In accordance with the current ANSI Z223.1 / NFPA 54 Natural Fuel Gas Code			
c	A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.			
d	Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.			
*	For clearances not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1, the following statement shall be included: "Clearance in accordance with local installation codes, and the requirements of the gas supplier and the manufacturers installation instructions"			

**Table 17. Vent Termination Clearances**

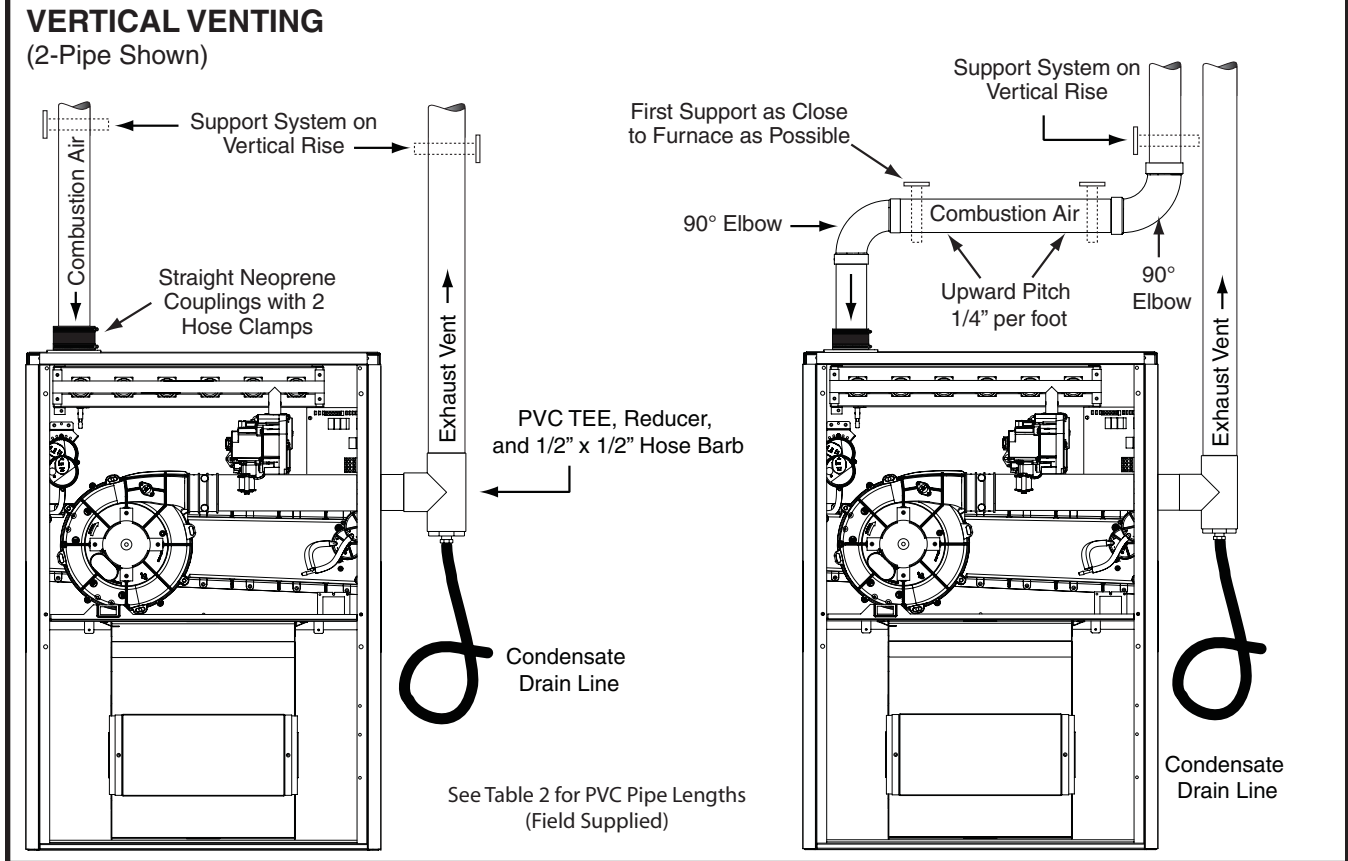
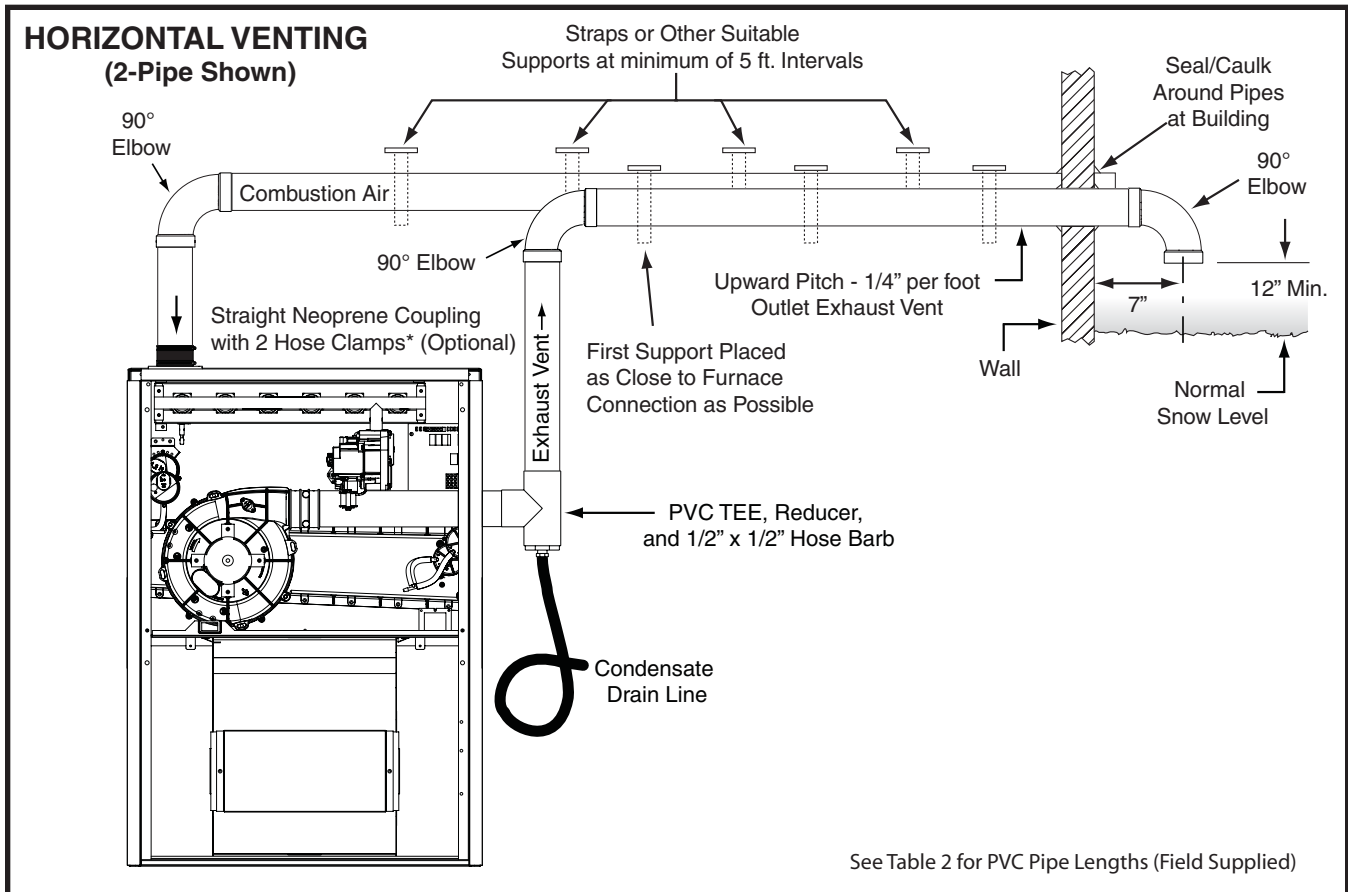
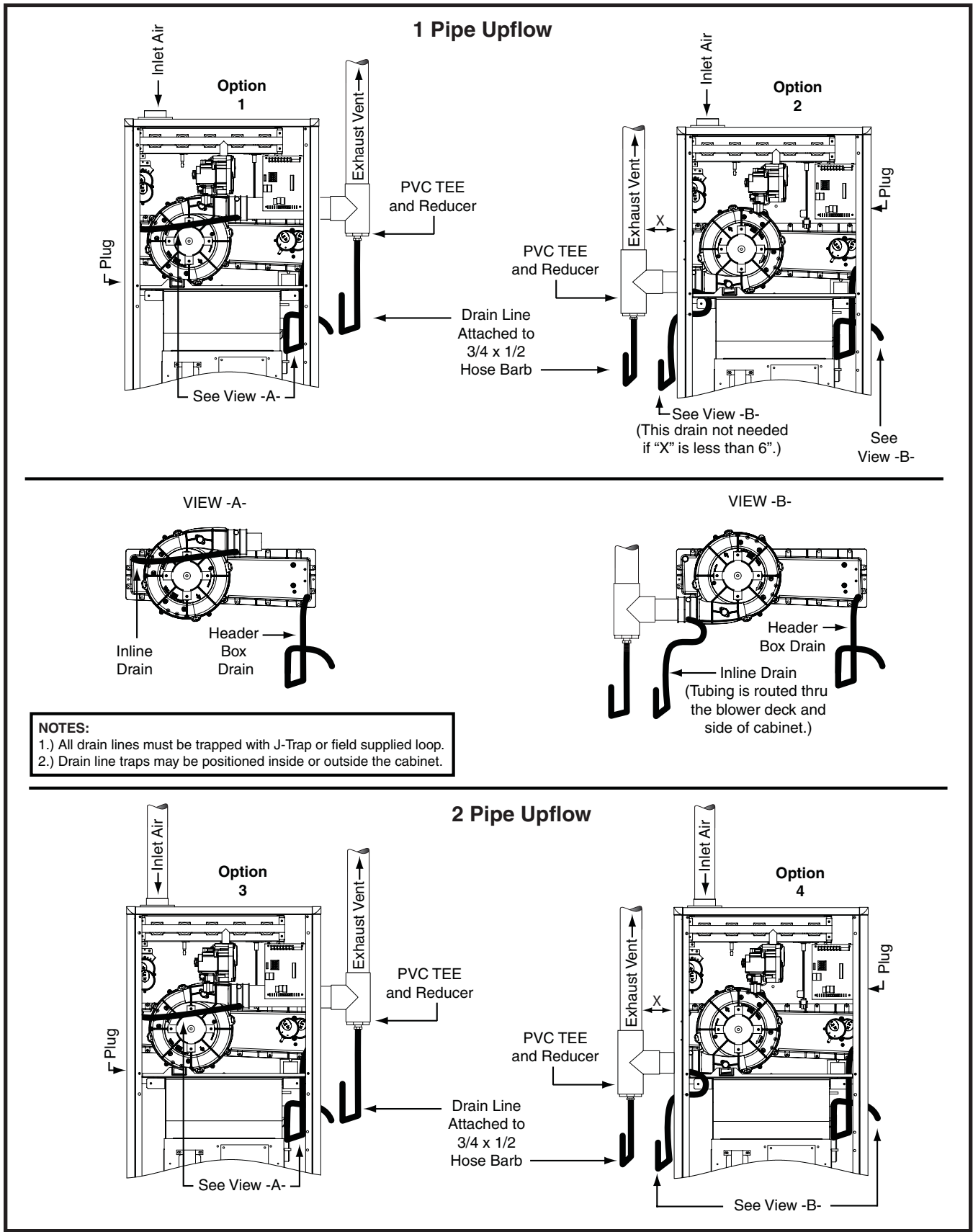


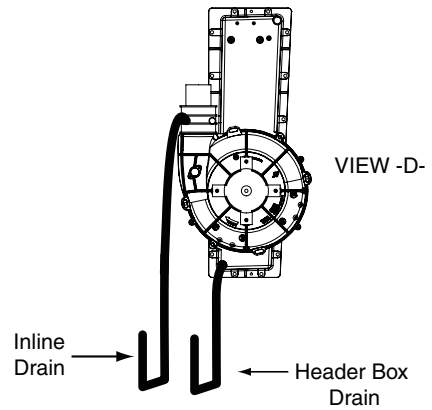
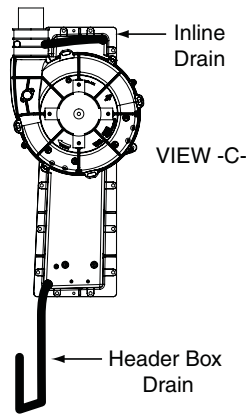
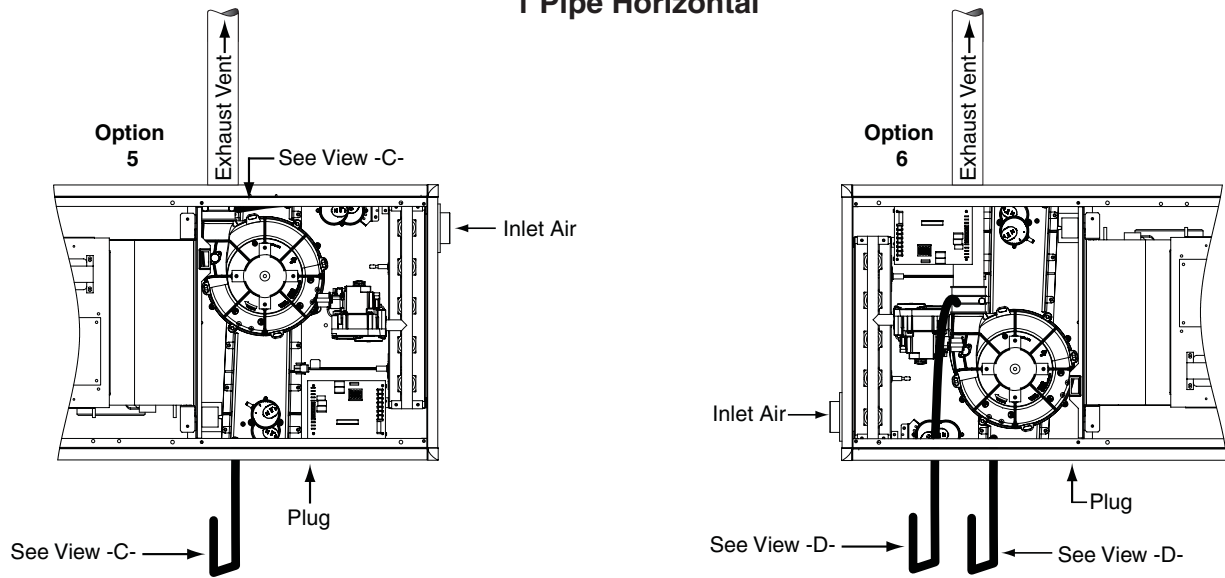
Figure 36. Horizontal and Vertical Venting



**Figure 37. Upflow Options**



### 1 Pipe Horizontal



All drain lines must be trapped with J-Trap or field supplied loop.

### 2 Pipe Horizontal

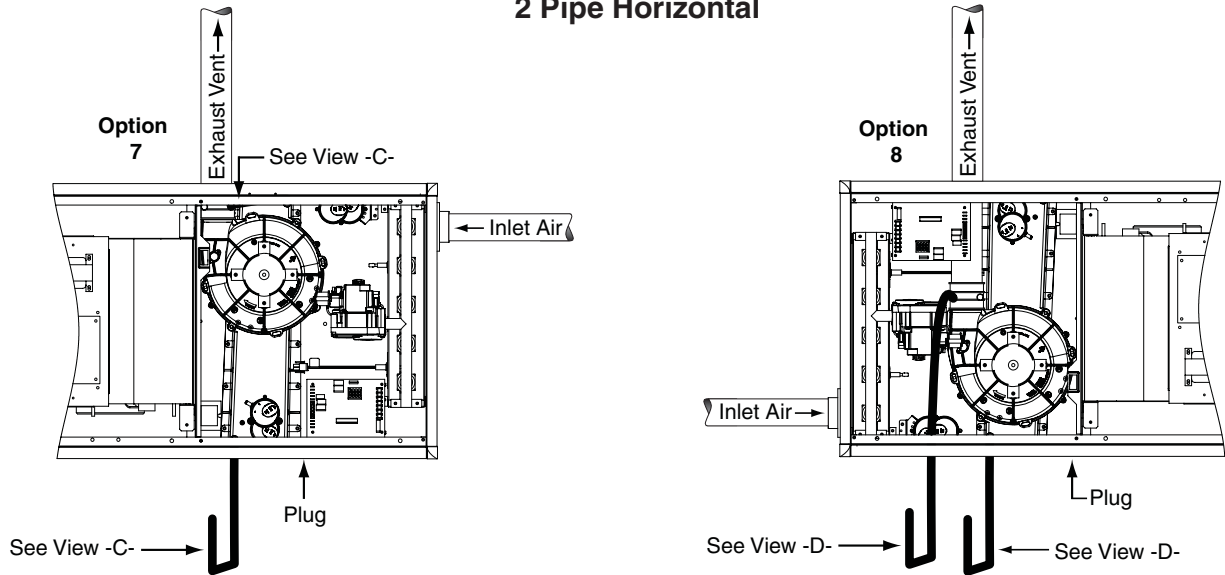
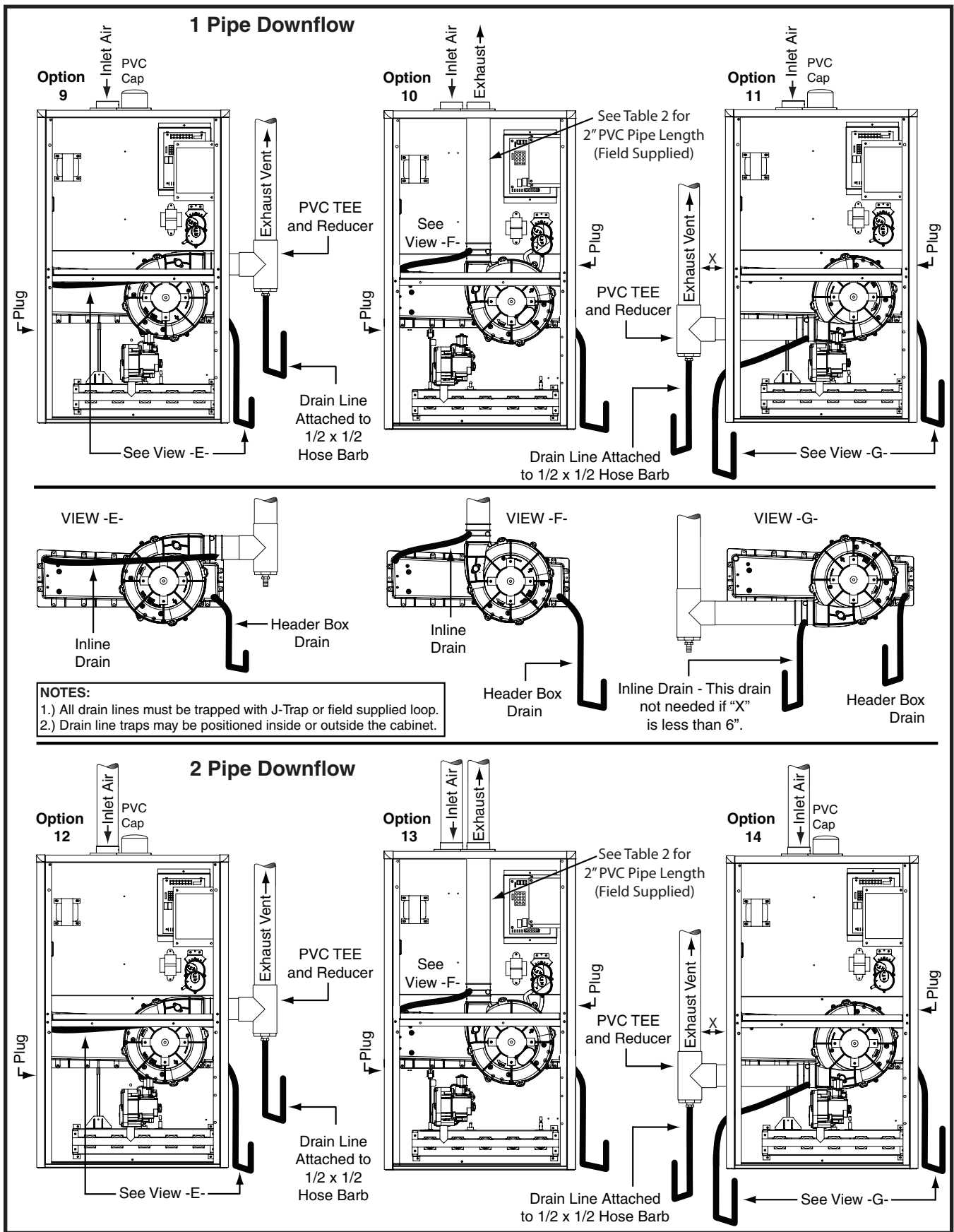
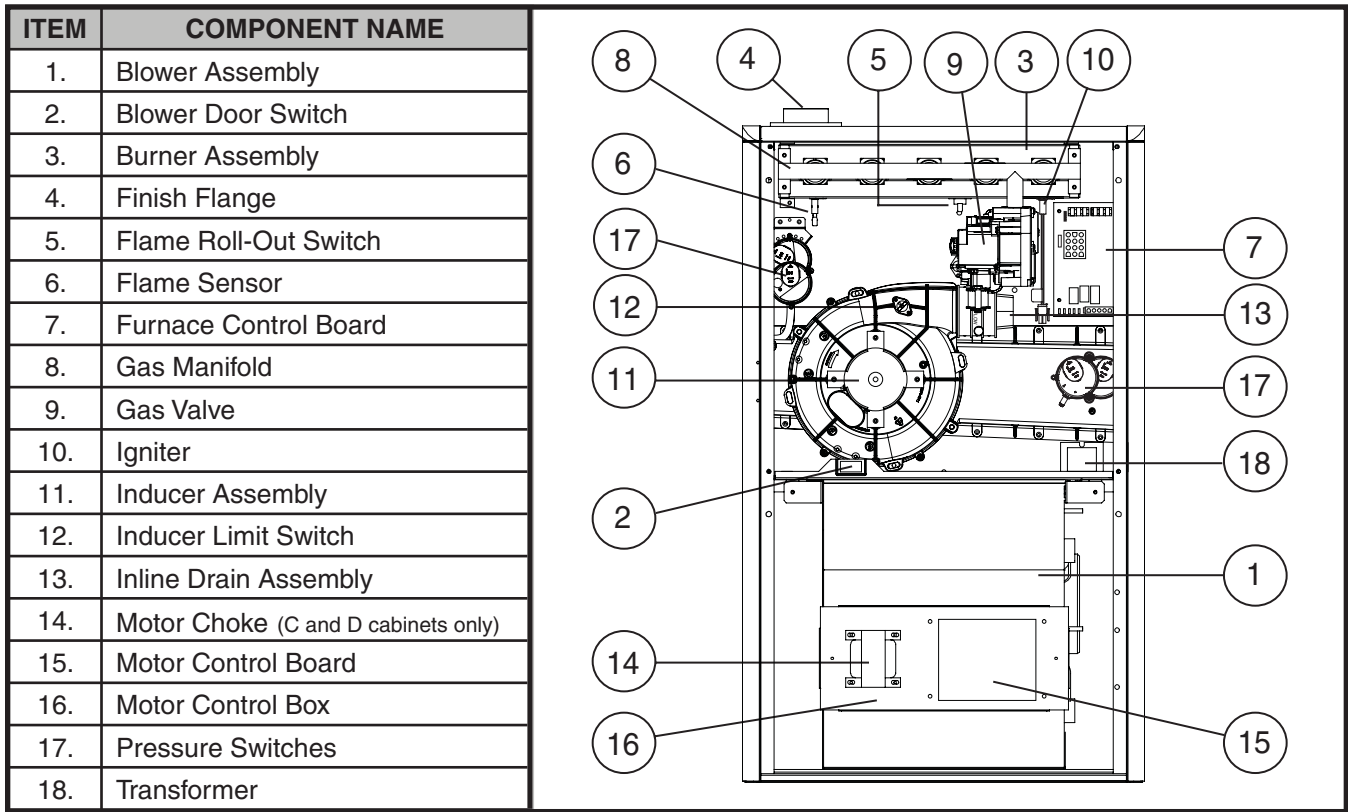


Figure 38. Horizontal Options

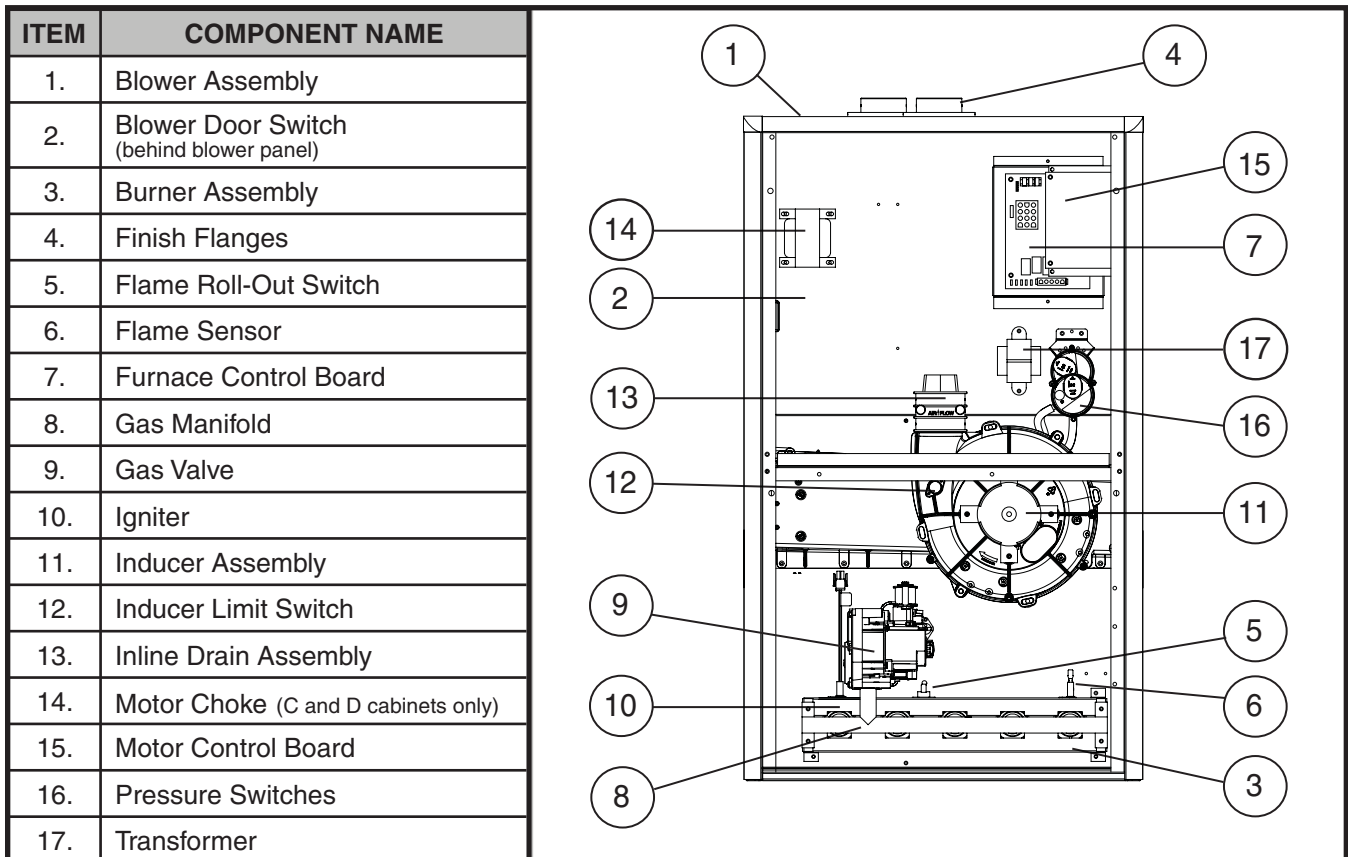


**Figure 39. Downflow Options**

## LOCATION OF FURNACE COMPONENTS



**Figure 40. Upflow/Horizontal Gas Furnace Components**



**Figure 41. Downflow Gas Furnace Components**

## INSTALLATION/PERFORMANCE CHECK LIST

<b>INSTALLER NAME:</b>	
CITY _____	STATE _____

<b>INSTALLATION ADDRESS:</b>	
CITY _____	STATE _____
UNIT MODEL # _____	
UNIT SERIAL # _____	

Minimum clearances per Table 1 (page 7)?	YES	NO
--	-----	----

Has the owner's information been reviewed with the home-owner?	YES	NO
--	-----	----

Has the literature package been left near the furnace?	YES	NO
--	-----	----

ELECTRICAL SYSTEM:		
Electrical connections tight?	YES	NO
Line voltage polarity correct?	YES	NO
Supply Voltage: _____ VOLTS		
Has the thermostat been calibrated?	YES	NO
Is the thermostat level?	YES	NO
Is the heat anticipator setting correct?	YES	NO

GAS SYSTEM:		
Gas Type: (circle one)	Natural Gas	Propane
Gas pipe connections leak-tested?	YES	NO
Gas Line Pressure: _____ (in - W.C.)		
Is there adequate fresh air supply for combustion and ventilation?	YES	NO
Installation Altitude: _____ (FT.)		
Deration Percentage: _____ (%)		
Furnace Input: _____ (Btuh)		
Supply Air Temperature: _____ (° F)		
Return Air Temperature: _____ (° F)		
Temperature Rise: _____ (° F)		

VENTING SYSTEM:		
Vent free from restrictions?	YES	NO
Filter(s) secured in place?	YES	NO
Filter(s) clean?	YES	NO
Flue connections tight?	YES	NO
Is there proper draft?	YES	NO

