GAS FURNACES **95.1% AFUE**

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.

⚠ WARNING:

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.

- 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 3 on page 29.
- Provide adequate combustion and ventilation air to the furnace space as specified on Pages 7 - 10.
- Provide adequate clearances around the vent air intake terminal as specified in Figures 6 thru 9 on page 13.
- Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified on Pages 11 - 14.
- Never test for gas leaks with an open flame. Use a commercially available soap solution to check all connections (Page 19).
- This furnace is designed to operate with a maximum external pressure rise of 0.5 inches of water column. Consult Tables 4 - 6 (pages 32 - 34), 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.
- 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 page 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.

Additional codes listed below are for reference purposes only and do 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

⚠ CAUTION:

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 - 9 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

⚠ CAUTION:

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.

Installation in a Garage
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**.**

⚠ WARNING:

Do not place combustible material on or against the furnace cabinet or within 6 inches of the vent pipe. Do not place combustible materials, including gasoline or any other flammable vapors and liquids, in the vicinity of the furnace.

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.** In addition, 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 pairing 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.

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 3 (page 29). 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 minimum required clearance from the front of the unit for servicing is 24 inches. The minimum required clearance for positioning is 30 inches from the front of the unit. **The recommended clearance from the front of the unit is 36 inches.** The need to provide clearance for access to panels or doors may require clearance distances over and above the requirements.

COMBUSTION AIR REQUIREMENTS
General Information

⚠ WARNING:

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.

- Instructions for determining the adequacy of 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.
- Additional reference information for US and Canadian installations can be found in the Combustion and Ventilation Air section (page 5).

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.

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.

⚠ CAUTION:

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.

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.

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.

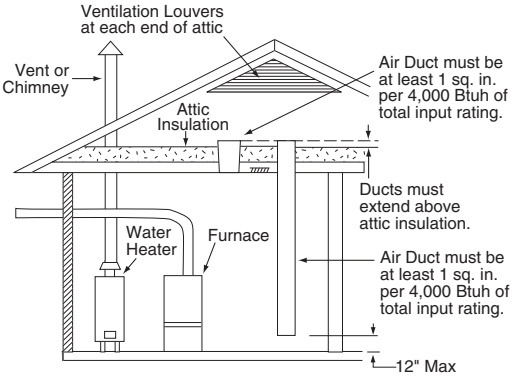
Outdoor Air Using Vertical Ducts

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 1).

Outdoor Air Using Horizontal Ducts

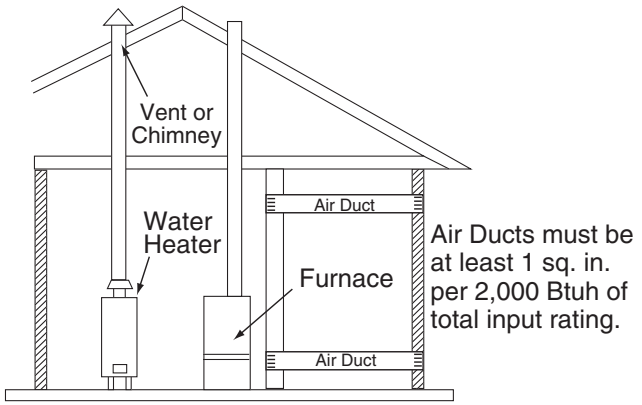
If combustion air is taken from outdoors through horizontal ducts, the openings and ducts must have a minimum free area of one square inch per 2,000 Btuh of total appliance input (Figure 2). Ducts must have cross - sectional area at least as large as the free area of their respective openings to the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

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.



Total Input Rating (Btuh)	Minimum Free Area (Each Opening)	Round Duct Diameter
40,000	10 sq. In	4 inches
60,000	15 sq. In	5 inches
80,000	20 sq. In	5 inches
100,000	25 sq. In	6 inches
120,000	30 sq. In	6 inches
140,000	35 sq. In	7 inches
160,000	40 sq. In	8 inches

Figure 1. Combustion Air Drawn from Outside Through Vertical Ducts



Total Input Rating (Btuh)	Minimum Free Area (Each Opening)	Round Duct Diameter
40,000	20 sq. In	5 inches
60,000	30 sq. In	6 inches
80,000	40 sq. In	7 inches
100,000	50 sq. In	8 inches
120,000	60 sq. In	9 inches
140,000	70 sq. In	10 inches
160,000	80 sq. In	10 inches

Figure 2. Combustion Air Drawn from Outside Through Horizontal 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 3, page 9).

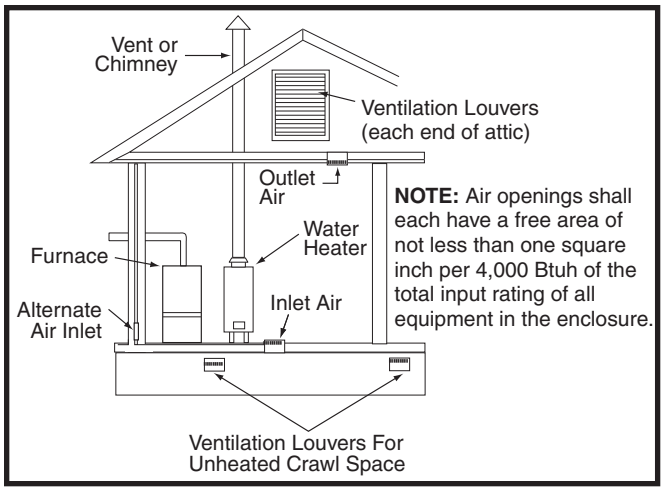
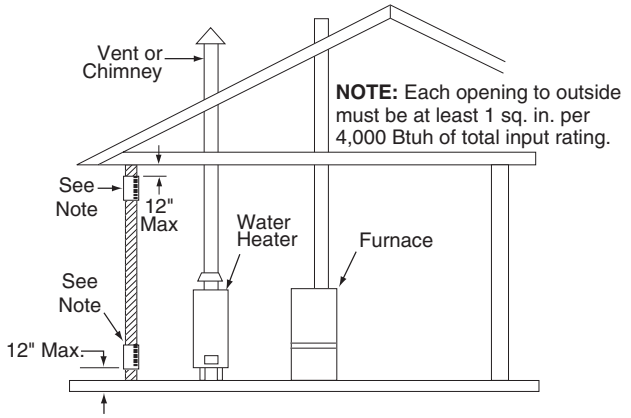


Figure 3. Combustion Air Drawn from a Crawl Space or Vented Attic

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 4).



Total Input Rating (Btuh)	Minimum Free Area (Each Opening)	Round Duct Diameter
40,000	10 sq. In	4 inches
60,000	15 sq. In	5 inches
80,000	20 sq. In	5 inches
100,000	25 sq. In	6 inches
120,000	30 sq. In	6 inches
140,000	35 sq. In	7 inches
160,000	40 sq. In	8 inches

Figure 4. 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).

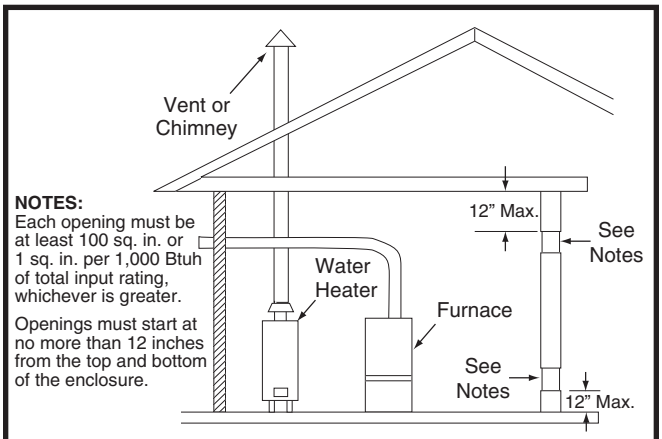
Generally, confined spaces must have two openings in the space for combustion air. One opening must be within 12 inches of the ceiling, and the other must be within 12 inches of the floor. However, an alternative method recently adopted by the NFGC uses one opening within 12 inches of the top of the 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.

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 5)**.** For example, if the combined input



Total Input Rating (Btuh)	Minimum Free Area (Each Opening)	Round Duct Diameter
40,000	100 sq. In	12 inches
60,000	100 sq. In	12 inches
80,000	100 sq. In	12 inches
100,000	100 sq. In	12 inches
120,000	120 sq. In	13 inches
140,000	140 sq. In	14 inches
160,000	160 sq. In	15 inches

Figure 5. Combustion Air Drawn from Inside

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.

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 x (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).

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.

⚠ 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.**

VENTING 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.

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

- 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.**
- Additional reference information for US and Canadian installations can be found in the Combustion and Ventilation Air section (page 5).

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 7-10. Table 18 (page 49) 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.

⚠ 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.

Vent Pipe Material

Vent and combustion air pipe and fittings must be one of the following materials and must conform to the indicated ANSI/ASTM standards. In Canada, all plastic vent pipes and fittings including any cement, cleaners, or primers must be certified as a system to ULC S636.

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

Cement and primer must conform to ATSM Standard D2564 for PVC and Standard D2235 for ABS. When joining PVC piping to ABS, use PVC solvent cement. (See procedure specified in ASTM Standard D3138.)

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

Using Table 18, measure the linear length of your 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 18.

Condensing furnace combustion products have very little buoyancy, so Table 18 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 6).
- Route piping as direct as possible between the furnace and the outdoors. Longer vent runs require larger diameters.
- 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 (page 13) and Figure 36 (page 45). 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.
- Piping must be mechanically supported so that its weight does not bear on the furnace. Pipe supports must be installed a minimum of every five 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.
- 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. Table 15 (page 44) lists the necessary distances from the vent termination to windows and building air intakes. In Canada, CSA B149.1, takes precedence over these instructions.
- 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 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 #904349. **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 (page 13). Insulation is required to prevent freezing of this section of pipe. See Table 1 (page 13) for vent freezing protection.

Outdoor Terminations - Vertical Venting

Termination spacing requirements from the roof and from each other are shown in Figure 9 (page 13). 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.

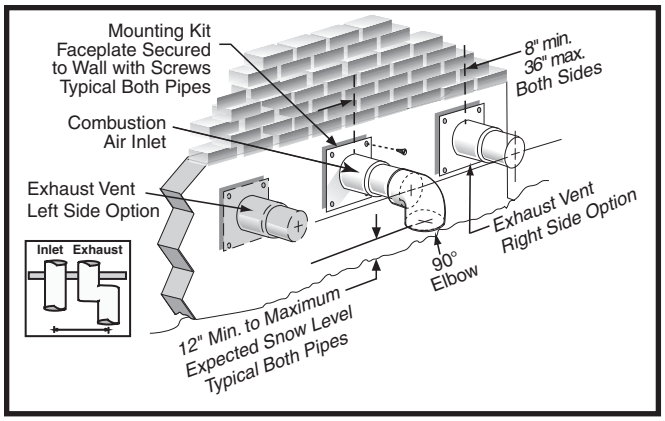


Figure 6. Exhaust and Combustion Air Pipe Clearances

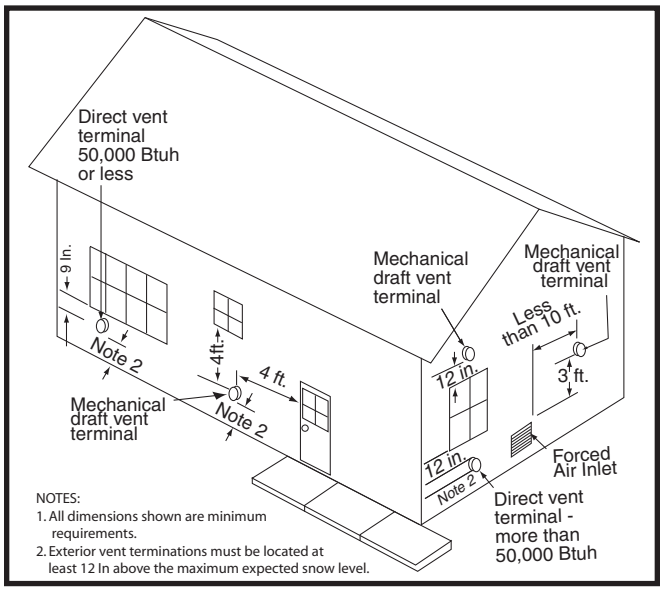


Figure 7 Vent Locations

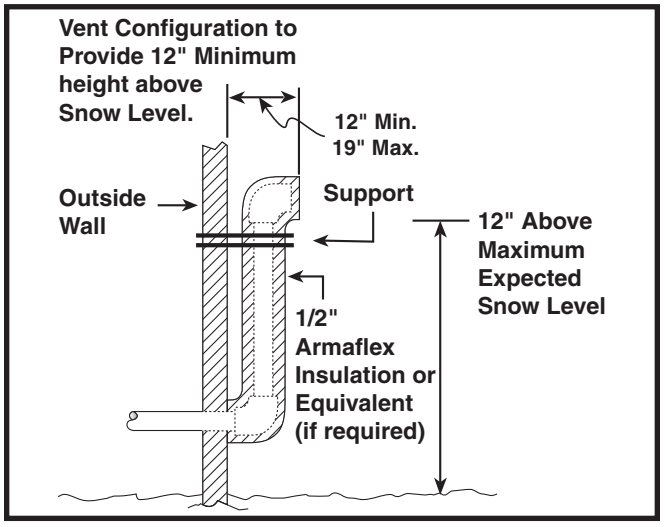


Figure 8. Alternate Horizontal Vent Installation

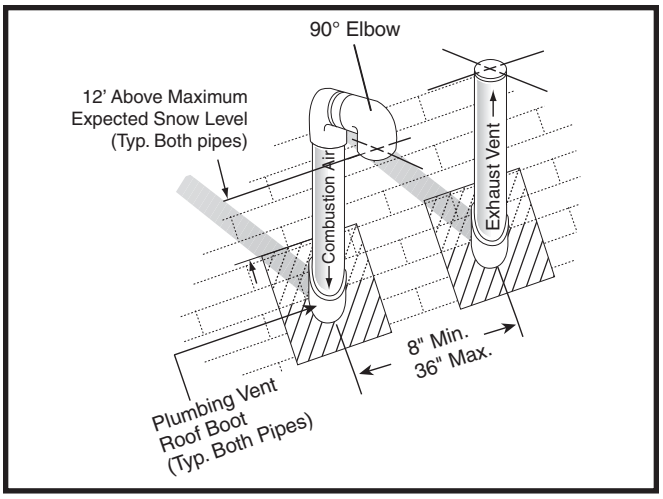


Figure 9. Vertical Vent Termination

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 1 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 16 (page 48). 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 1. Vent Protection

Condensate Disposal

The method for disposing of condensate varies according to local codes. Consult your local code or authority having jurisdiction. Neutralizer kit P/N 902377 is available for use with this furnace. **Please follow the instructions provided with the kit.**

This furnace has multiple options for positioning the vent pipe as described in the Vent and Inducer Assembly Options section (page 14). 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 to run to the drain.

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.

FURNACE INSTALLATION

General Requirements

*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.

- *TC series gas furnaces are shipped ready for installation in the upflow or horizontal right or left positions. Only the *TL series gas furnace may be used for downflow operation.
- The furnace must be leveled at installation and attached to a properly installed duct system. See Table 3 (page 29) 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.
- The cabinet plug must always be used to close the hole in the side of the furnace when rotating the inducer.
- Additional reference information for US and Canadian installations can be found in the General Installation section (page 5).

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 2, 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 46-48).

Conventional (1 Pipe)				
Vent	**Upflow**	**Horizontal Right**	**Horizontal Left**	**Downflow**
Right	Option 1	N/A	Option 6	Option 9
Left	Option 2	Option 5	N/A	Option 10
Direct Vent (2-pipe)				
Vent	**Upflow**	**Horizontal Right**	**Horizontal Left**	**Downflow**
Right	Option 3	N/A	Option 8	Option 11
Left	Option 4	Option 7	N/A	Option 12

Table 2. 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.

1. Disconnect the electrical harness (1) from the inducer assembly (2) as shown in Figure 10 (page 15).
2. Remove the inducer assembly ground wire (3) from the blower deck (4) or door.
3. Remove four screws (5) securing the inducer assembly (2) to the header box (6).
4. Rotate the inducer assembly (2) to its new position.
5. 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.
6. Remove the cabinet plug (7) from side of furnace and reinstall in hole on opposite side of cabinet.
7. Install in-line drain assembly and tubing (Figures 37-39).
8. If applicable, install the condensate drain (Figures 37-39).
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.

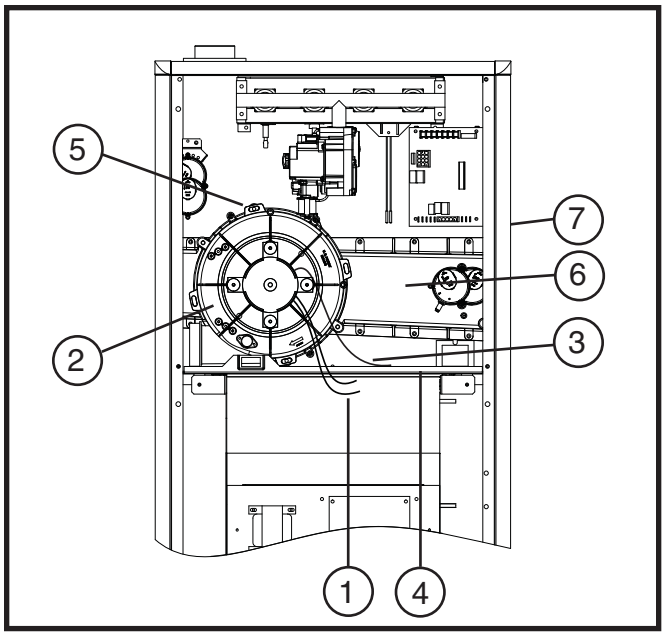


Figure 10. Inducer Assembly Rotation

Condensate Drain Lines
The methods for draining condensate out of the system depend on your particular installation. See Figures 37-39 (pages 46-48) to determine the configuration that is suitable for your setup.

Four general principles 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 & 9-12).
- In certain cases, it is permitted to drain the inducer back into the top drain of the collector (Options 1, 3, 5, & 7). Take care that this drain does not sag or becomes twisted. The drain tube supplied with the furnace may need to be trimmed.

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 series upflow/horizontal furnaces are indicated in Figure 27 (page 30). For *TL downflow installations, the hole locations are shown in Figure 28 (page 31).

Upflow 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 may be installed directly on combustible wood flooring or supports. Additional venting guidelines and specifications are listed in the Venting Requirements section (page 11).

Side Return Air Inlet
*TC series gas furnaces are shipped with the bottom panel installed (Figure 27). 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 27) must be removed.

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 in an attic, basement, crawl space or alcove (Figure 11, page 16). 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 12 (page 16).

*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 on page 16.

If the furnace is to be suspended from the ceiling, it will be necessary to use 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. The furnace could also be suspended by an angle iron frame bolted to the rafters (Figure 12).

Access for positioning and servicing must be considered when locating the unit. See Table 3 (page 29) for clearance specifications.

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 11), it is recommended that the drip pan extend at least 12 inches past the top and front of the furnace.

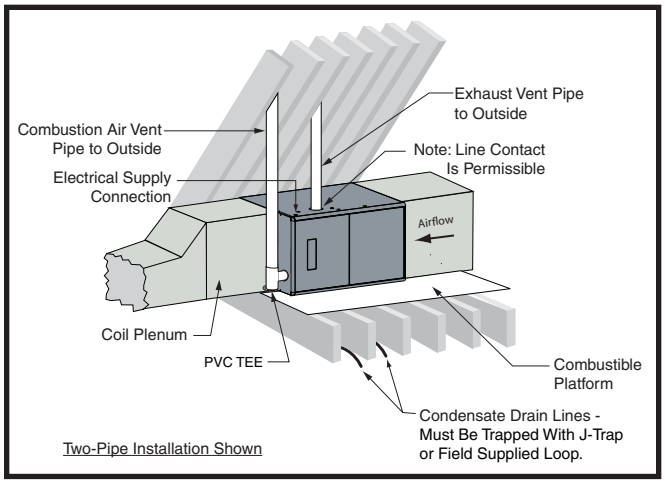


Figure 11. *TC Horizontal installation on a Platform

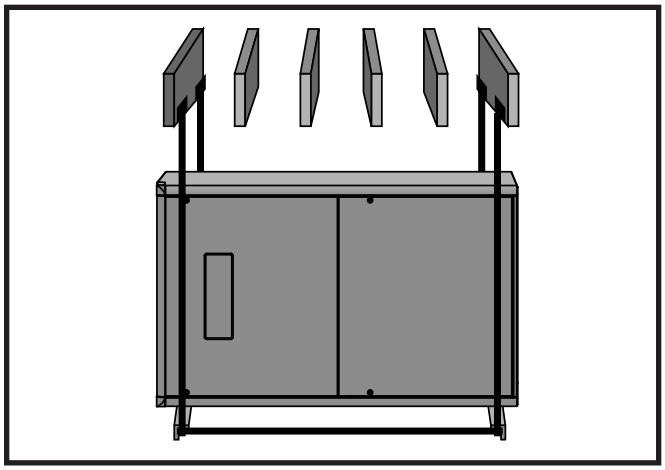


Figure 12. *TC Horizontal Installation Suspended in Attic or Crawl Space

Bottom Panel Removal

To remove the bottom panel (Figure 13) from the upflow furnace, perform the following steps:

1. Remove the blower door (1) from bottom of furnace.
2. Disconnect the wiring harness (2) from the connector.
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.
5. Remove all screws (5) securing bottom panel (6) to bottom of furnace and front brace (7).
6. Lift up and slide bottom panel (6) out through front of furnace.
7. Reinstall the blower assembly (4) in reverse order it was removed.

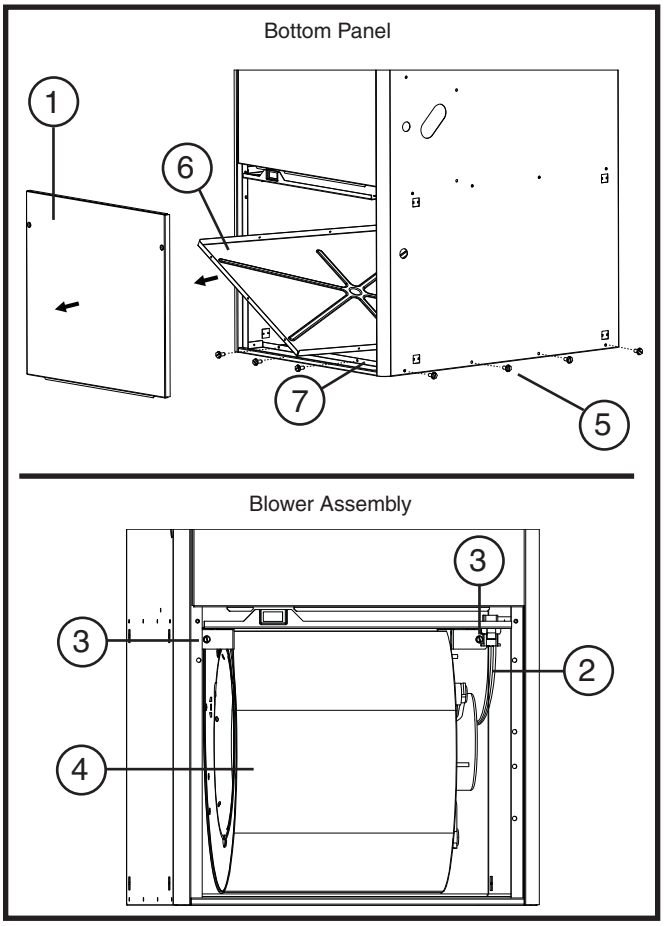


Figure 13. Removal of Bottom Panel

Downflow Installation

⚠ WARNING:

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

The *TL series gas furnace is certified for installation on combustible flooring. **This furnace must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.** Additional venting guidelines and specifications are listed on page 5.

⚠ WARNING:

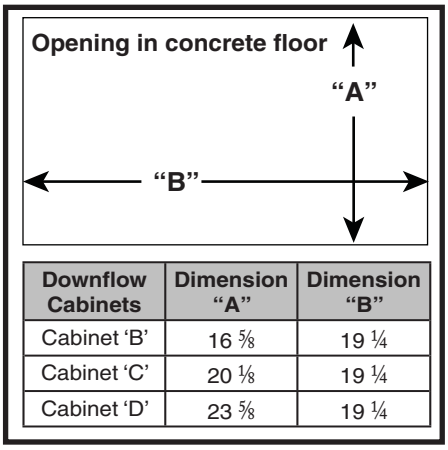
Failure to install the downflow sub-base kit may result in fire, property damage or personal injury.

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 14.
2. Position the plenum and the furnace as shown in Figure 15.



Downflow Cabinets	Dimension "A"	Dimension "B"
Cabinet 'B'	16 ⅝	19 ¼
Cabinet 'C'	20 ⅛	19 ¼
Cabinet 'D'	23 ⅝	19 ¼

Figure 14. Cutout Dimensions

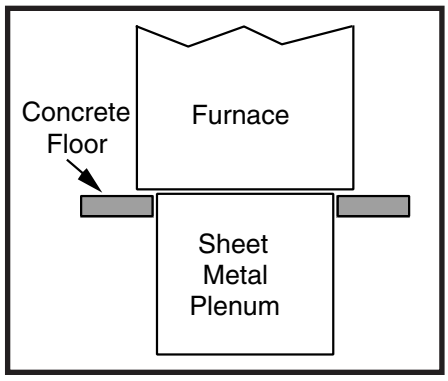


Figure 15. Furnace on a Concrete Slab

CIRCULATING AIR REQUIREMENTS

⚠ WARNING:

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). Additional reference information for US and Canadian installations can be found in the Duct Systems section (page 5).
- Tables 4-6 (pages 32-34) contain the 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.

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. 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.

Upflow and Horizontal Furnaces

To attach the supply air duct to the furnace, bend the furnace flanges (Figure 27, page 30) 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. 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.

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 27, page 30) 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 27) 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:

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.

Bottom Return Installations

The bottom panel (Figure 27) 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 31) 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 eminating 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

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. Additional reference information for US and Canadian installations can be found in the Gas Piping and Gas Pipe Pressure Testing section (page 5).

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 16. 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 16.

Table 8 (page 35) 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. A typical gas service hookup is shown in Figure 16.

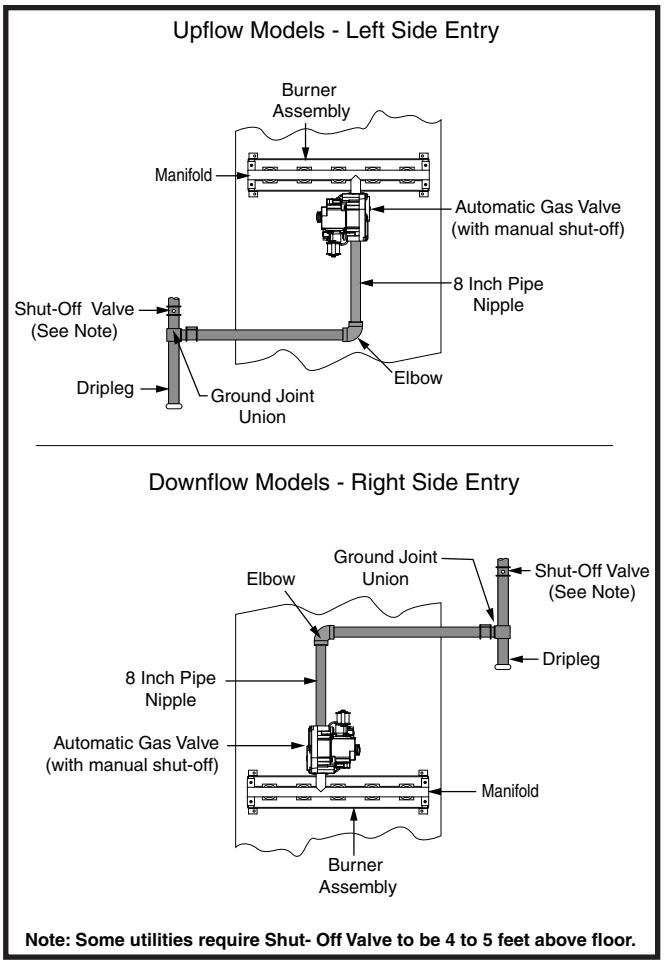


Figure 16. Typical Gas Connection

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.

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 and 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 11 and 12 (page 37) contain the orifice sizes and manifold pressure to use at various altitudes. Table 11 (HIGH) is for natural gas installations with a heating value of more than 1,000 Btu per cubic foot and Table 12 (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 10 (page 36), 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 11 or if it’s LOW, use Table 12.

INSTALLATION EXAMPLE

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

From Table 10, find 750 and follow down the column, stop at the 5,000 feet row. The heating value listed is LOW. Table 11 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 25).

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.

In the U.S., if installation is above 2,000 ft., refer to Table 9 (page 36) 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.
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.

ELECTRICAL WIRING

⚠ WARNING:

To avoid electric shock, personal injury, or death, turn off the electric power at the disconnect or the main service panel before making any electrical connections.

- 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).
- Additional reference information for US and Canadian installations can be found in the Electrical Connections section (page 5).

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 requirements, refer to the furnace nameplate or Table 13 (page 38).

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 39) 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 31).

Depending on the type of air conditioning unit and thermostat used, there are two applications containing six basic configurations:

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. Models with suffixes VA, VB, VC, or VD should consult the Variable Speed Blower Application section (page 22).

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 4 (page 32).

For thermostats with a dehumidifier output, use a field supplied wire to connect the thermostat's dehumidifier output to the terminal marked **"DEHUM"**. The thermostat should be set so that the **DEHUM** output should be high (positive) when dehumidification is needed.

⚠ 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_N on the motor control board to the outdoor unit.

Configuration 1: Single Stage AC and Single Stage Heat Thermostat (Figure 17)

NOTE: This option does not use the full two stage control capability of the furnace, but has many options.

- Connect the thermostat's **W** output to the furnace control boards **W1** terminal. This allows the furnace to always run in low output mode. However, the possibility of timed autostaging is also available. See Autostaging for Single Stage Thermostats (page 23).
- Always connect the thermostat **C** and **R** to the furnace control board **C** and **R**.
- For cooling, the thermostat's **Y** signal should be connected to the furnace control board's **Y/Y2** terminal.
- Field supplied wires should also connect **Y/Y2** and **C** to the outdoor unit's **Y** and **C** terminals.

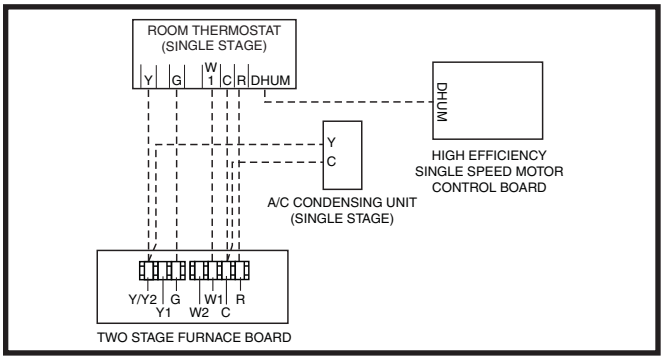


Figure 17. Wiring Configuration 1

Configuration 2: Single Stage AC and Two-Stage Heat Thermostat (Figure 18, page 22)

NOTE: 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, the thermostat's **Y** signal should be connected to the furnace control board's **Y/Y2** terminal.
- Field supplied wires should also connect **Y/Y2** and **C** to the outdoor unit's **Y** and **C** terminals.

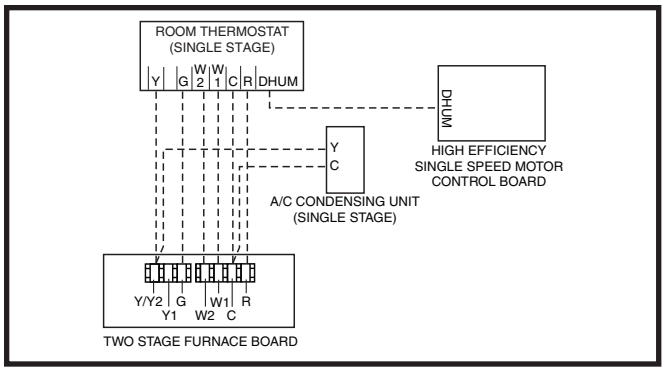


Figure 18. Wiring Configuration 2

Configuration 3: Two-Stage AC and Two-Stage Heat Thermostat (Figure 19)

NOTE: 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, the thermostat's **Y** and **Y1** signals should be connected to the furnace control board's **Y/Y2** and **Y1** terminal's.
- Field supplied wires should also connect the **Y** and **Y1** signals to the outdoor unit's **Y** and **Y1** terminals.
- Connect terminal **C** to the outdoor unit's **C**.

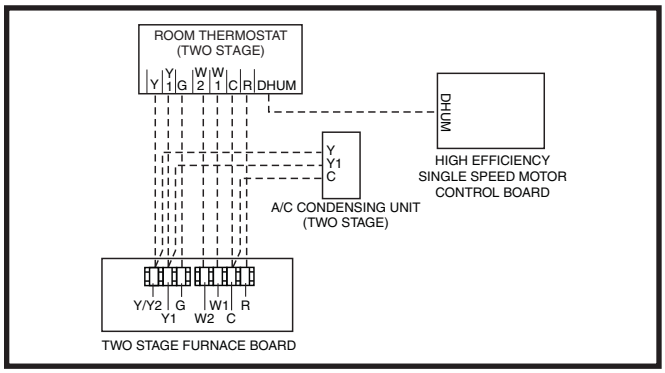


Figure 19. Wiring Configuration 3

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 39) 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 5 for heating or Table 6 (pages 34-35) for cooling.

Use field supplied wire to connect the thermostat's dehumidifier output to the terminal marked **"DEHUM"**. The thermostat should be set so that the **DEHUM** output is high (positive) when dehumidification is needed. For installations with separate humidistats or no humidistats at all, see the Dehumidification Options section (page 20).

⚠ 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 23.

Configuration 4: Single Stage AC and Single Stage Heat Thermostat (Figure 20)

NOTE: This option does not use the full two stage control capability of the furnace, but has many options:

- Connect the thermostat's **W** output to the furnace control boards **W1** terminal. This allows the furnace to always run in low output mode. However, the possibility of timed autostaging is available. See Autostaging for Single Stage Thermostats (page 23).
- Always connect the thermostat **C** and **R** to the furnace control board **C** and **R**.
- For cooling, connect the thermostat **Y** 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.

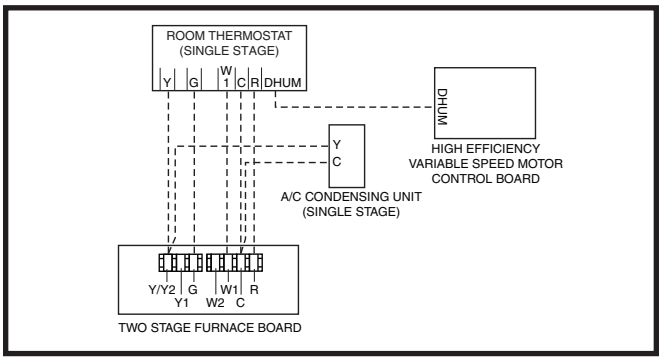


Figure 20. Wiring Configuration 4

Configuration 5: Single Stage AC and Two Stage Heat Thermostat (Figure 21)

NOTE: 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, the thermostat's **Y** signal should be connected to the furnace control board's **Y/Y2** terminal.
- Field supplied wires should also connect **Y/Y2** and **C** to the outdoor unit's **Y** and **C** terminals.

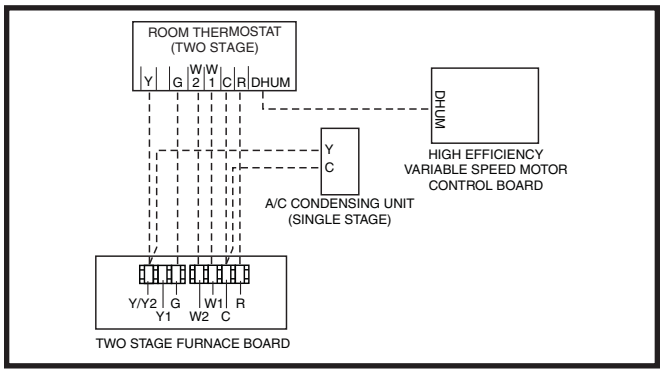


Figure 21. Wiring Configuration 5

Configuration 6: Two-Stage AC and Two-Stage Heat Thermostat (Figure 22, page 23)

NOTE: 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**.

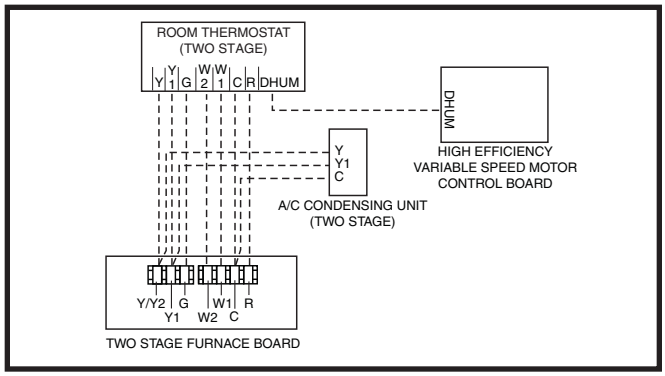


Figure 22. Wiring Configuration 6

Autostaging for Single Stage Thermostats

This furnace may be operated by a single stage thermostat by connecting to the **W** terminal. In this type of installation, the Autostage Jumper (P7) on the furnace control board (Figure 26, page 35) may be adjusted to **SHORT** (8 minutes) or **LONG** (12 minutes). 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 21).

Autostaging for Two-Stage Thermostats

The Autostage setting on the furnace control board (Figure 26, page 35) 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.

Dehumidification options

Both motor control boards (Figures 29 & 30, page 39) 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 23).
2. If there is 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.

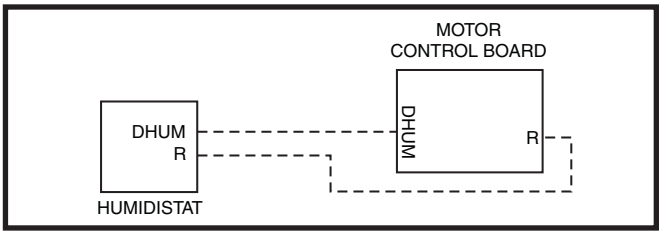


Figure 23. DHUM Wiring Configuration 7

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 13 (page 38).

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.

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 24) 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.

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

Off-the-shelf furnace twinning kits such as Johnson Controls (P/N 2TC03700124) may be used. Contact your furnace distributor for technical details.

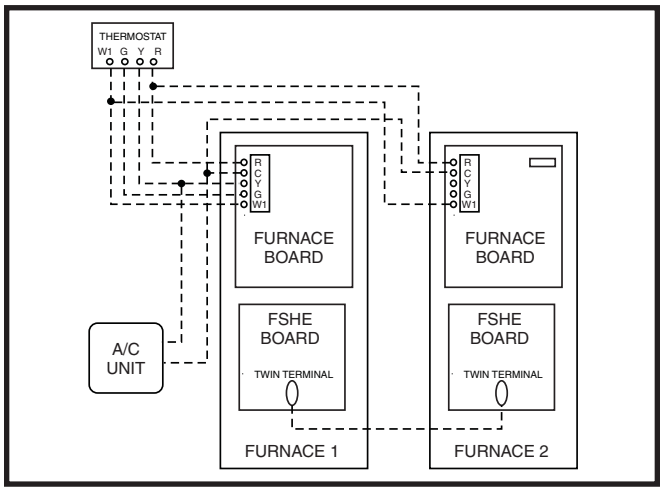


Figure 24. Twinning

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 13).

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

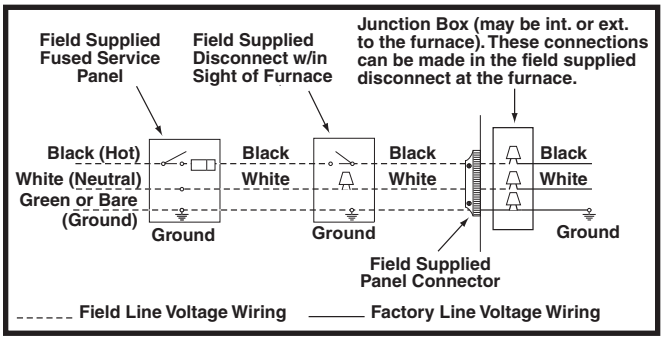


Figure 25. Line Voltage Field Wiring

⚠ 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.

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!

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 the thermostat wires (**R**, **W**, **Y**, and **G**) are securely connected to the correct leads on the terminal strip of the circuit board as shown in figures 17-22 (pages 21- 23).

√ 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. **Note: 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 (page 26).
5. After 5 minutes of operation, set the thermostat below room temperature and verify steps 11 &12 of the Operating Sequence (Page 26).

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 7 (page 35).
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 or see the example.

Example:

- Time for 1 revolution of a gas meter with a 1 cubic foot dial = 40 seconds.
- From Table 7 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 9 for Propane or Tables 11 or 12 for Natural Gas (pages 36-37).

c.) Using an allen wrench, turn the adjusting screw on the HI side of the regulator to adjust the full input setting or turn the adjusting screw on the LO side of the regulator to adjust the reduced input setting (See Figure 26). **IMPORTANT NOTE: Turning the adjusting screw clockwise increases the pressure and counterclockwise reduces the pressure.**

d.) Reinstall plastic cap after adjustment is complete.

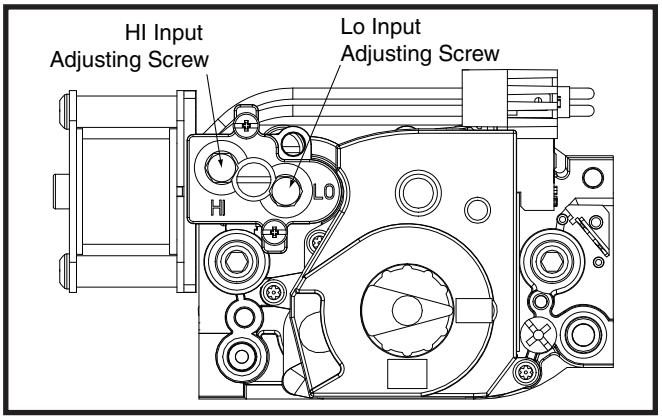


Figure 26. HI and LO Input Adjusting Screws

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

⚠ CAUTION:

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

1. Remove the burner compartment door.
2. Set the thermostat to a temperature 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 17-23, pages 21-23), (Figures 32-35, pages 39-42) and (Figure 24, page 24).

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. See Figure 31 (Page 38).
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. (Figure 31, page 38).

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.

MAINTENANCE

⚠ WARNING:

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

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

- Always replace 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:

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.

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 43 or 44 (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 it's 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:

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.

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.

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 14-16 (page 38) 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 43 or 44, 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 43 or 44) 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.

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 43 and 44. 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.

FIGURES AND TABLES

UPFLOW, DOWNFLOW & HORIZONTAL INSTALLATION CLEARANCES*	
Left Side	0 In.
Right Side	0 In.
Vent	1 In.
Back	0 In.
Top	1 In.
Front	4 In.**
* These are the listed clearances to combustible materials.	
** Allow 24 in. minimum clearance for servicing. Recommended clearance is 36 in.	
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 subase kit when installing over a wood floor.	

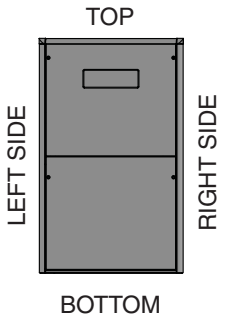
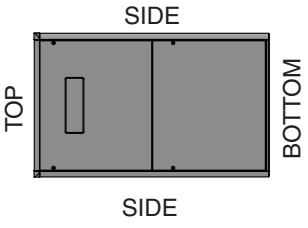
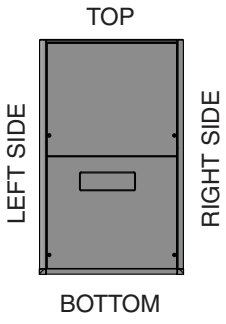
UPFLOW APPLICATION	HORIZONTAL APPLICATION	DOWNFLOW APPLICATION
		

Table 3. Minimum Clearances to Combustible Material

FURNACE DIMENSIONS

Upflow Cabinets	Dimension "A"	Dimension "B"	Dimension "C"
'B' Cabinet	17 ½	15 ⅞	16 ⅛
'C' Cabinet	21	19 ⅜	19 ⅝
'D' Cabinet	24 ½	22 ⅞	23 ⅛

NOTES:

Dimensions shown in inches.

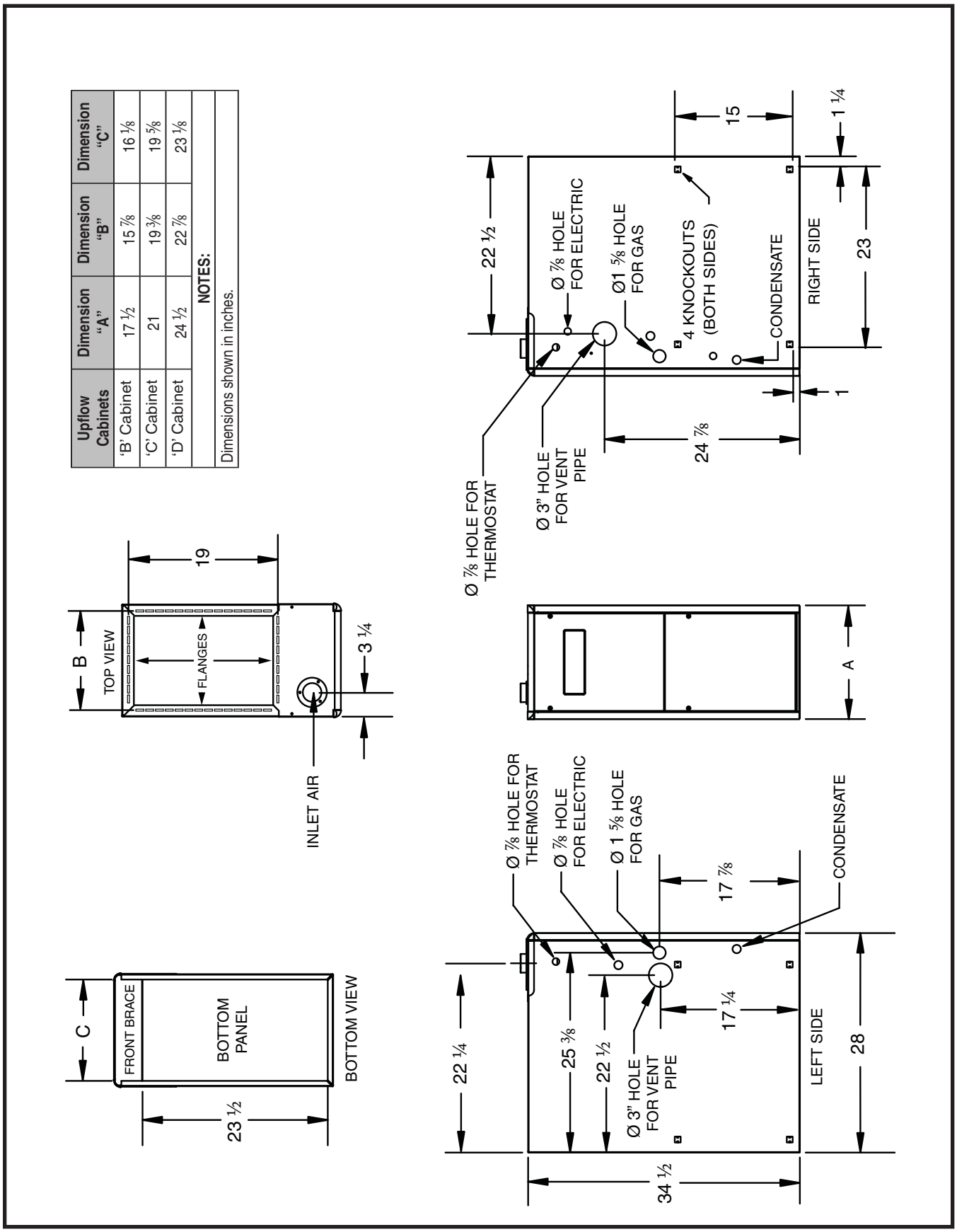
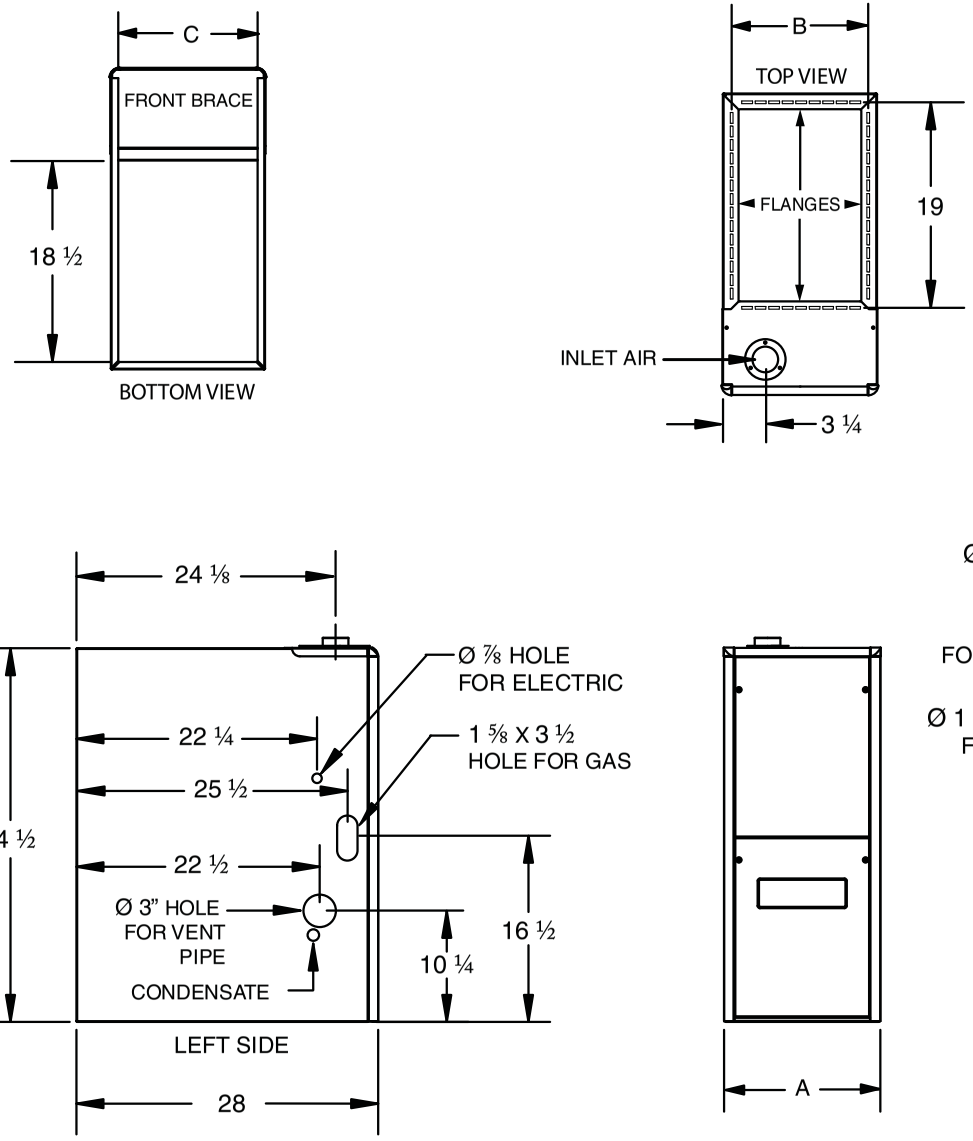


Figure 27. *TC 95.1% High Efficiency Upflow/Horizontal Furnaces



Downflow Cabinets	Dimension "A"	Dimension "B"	Dimension "C"
'B' Cabinet	17 ½	15 ⅞	16 ⅛
'C' Cabinet	21	19 ⅜	19 ⅝
'D' Cabinet	24 ½	22 ⅞	23 ⅛
NOTES:			
Dimensions shown in inches.			

Figure 28. *TL 95.1% High Efficiency Downflow Furnaces

AIRFLOW DATA

Model Number	Heating Input (Btuh)	Motor Switch Setting (See Note 1)				External Static Pressure (in.W.C.)															
						0.1		0.2		0.3		0.4		0.5		0.6		0.7		0.8	
		1/5	2/6	3/7	4/8	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise
*TC/TL-060D-*B	60,000	0	0	0	0																
		1	0	0	0																
		0	1	0	0																
		1	1	0	0	725	73														
		0	0	1	0	810	65														
		1	0	1	0	940	56	890	59	845	62	795	66	750	70	700	75				
		0	1	1	0	990	53	945	56	905	58	860	61	820	64	775	68	735	72	690	76
		1	1	1	0	1,055	50	1,015	52	970	54	930	57	890	59	845	62	805	66	760	69
		0	0	0	1	1,135	47	1,095	48	1,055	50	1,010	52	960	55	930	57	890	59	850	62
		1	0	0	1	1,185	45	1,145	46	1,105	48	1,065	50	1,030	51	990	53	950	56	910	58
		0	1	0	1	1,250	42	1,210	44	1,170	45	1,135	47	1,095	48	1,055	50	1,020	52	980	54
		1	1	0	1	1,290	41	1,255	42	1,220	43	1,180	45	1,145	46	1,110	48	1,075	49	1,040	51
		0	0	1	1	1,315	40	1,275	41	1,240	43	1,200	44	1,160	45	1,120	47	1,085	49	1,045	51
		1	0	1	1	1,350	39	1,315	40	1,280	41	1,245	42	1,205	44	1,170	45	1,135	47	1,100	48
		0	1	1	1	1,390	38	1,350	39	1,315	40	1,275	41	1,240	43	1,200	44	1,160	45	1,125	47
		1	1	1	1	1,420	37	1,380	38	1,345	39	1,310	40	1,270	42	1,235	43	1,200	44	1,160	45
*TC/TL-80D-*C	80,000	0	0	0	0	1,125	55	1,040	68	960	73	880	80	795	89						
		1	0	0	0	1,205	58	1,120	63	1,040	68	960	73	875	80	795	89				
		0	1	0	0	1,305	54	1,225	57	1,150	61	1,070	66	995	71	915	77	840	84		
		1	1	0	0	1,430	49	1,350	52	1,270	55	1,190	59	1,110	63	1,030	68	950	74	865	81
		0	0	1	0	1,525	46	1,450	49	1,375	51	1,300	54	1,225	57	1,150	61	1,075	65	1,000	70
		1	0	1	0	1,620	43	1,540	46	1,465	48	1,390	51	1,315	54	1,240	57	1,165	60	1,090	65
		0	1	1	0	1,695	42	1,620	43	1,545	46	1,465	48	1,390	51	1,315	54	1,235	57	1,160	61
		1	1	1	0	1,770	40	1,700	41	1,630	43	1,555	45	1,485	47	1,410	50	1,340	53	1,265	56
		0	0	0	1	1,875	38	1,805	39	1,730	41	1,655	43	1,580	45	1,510	47	1,435	49	1,340	53
		1	0	0	1	1,905	37	1,840	38	1,775	40	1,710	41	1,640	43	1,575	45	1,510	47	1,445	49
		0	1	0	1	1,980	36	1,910	37	1,845	38	1,780	40	1,715	41	1,650	43	1,580	45	1,515	46
		1	1	0	1	2,025	35	1,960	36	1,895	37	1,830	38	1,765	40	1,700	41	1,635	43	1,570	45
		0	0	1	1	2,085	34	2,025	35	1,960	36	1,900	37	1,840	38	1,775	40	1,715	41	1,655	43
		1	0	1	1	2,135	33	2,070	34	2,010	35	1,945	36	1,880	37	1,815	39	1,750	40	1,685	42
		0	1	1	1	2,200	32	2,145	33	2,090	34	2,035	35	1,980	36	1,925	37	1,870	38	1,820	39
		1	1	1	1	2,280	31	2,225	32	2,170	32	2,115	33	2,065	34	2,010	35	1,955	36	1,900	37
*TC/TL-100D-*C	100,000	0	0	0	0	1,125	78	1,040	85												
		1	0	0	0	1,205	73	1,120	79	1,040	85										
		0	1	0	0	1,305	67	1,225	72	1,150	76	1,070	82	995	88						
		1	1	0	0	1,430	62	1,350	65	1,270	69	1,190	74	1,110	79	1,030	85				
		0	0	1	0	1,525	58	1,450	61	1,375	64	1,300	68	1,225	72	1,150	76	1,075	82	1,000	88
		1	0	1	0	1,620	54	1,540	57	1,465	60	1,390	63	1,315	67	1,240	71	1,165	76	1,090	81
		0	1	1	0	1,695	52	1,620	54	1,545	57	1,465	60	1,390	63	1,315	67	1,235	71	1,160	76
		1	1	1	0	1,770	50	1,700	52	1,630	54	1,555	57	1,485	59	1,410	62	1,340	66	1,265	70
		0	0	0	1	1,875	47	1,805	49	1,730	51	1,655	53	1,580	56	1,510	58	1,435	61	1,340	66
		1	0	0	1	1,905	46	1,840	48	1,775	50	1,710	51	1,640	54	1,575	56	1,510	58	1,445	61
		0	1	0	1	1,980	44	1,910	46	1,845	48	1,780	49	1,715	51	1,650	53	1,580	56	1,515	58
		1	1	0	1	2,025	43	1,960	45	1,895	46	1,830	48	1,765	50	1,700	52	1,635	54	1,570	56
		0	0	1	1	2,085	42	2,025	43	1,960	45	1,900	46	1,840	48	1,775	50	1,715	51	1,655	53
		1	0	1	1	2,135	41	2,070	42	2,010	44	1,945	45	1,880	47	1,815	48	1,750	50	1,685	52
		0	1	1	1	2,200	40	2,145	41	2,090	42	2,035	43	1,980	44	1,925	46	1,870	47	1,820	48
		1	1	1	1	2,280	39	2,225	40	2,170	41	2,115	42	2,065	43	2,010	44	1,955	45	1,900	46
*TC/TL-120D-*D	120,000	0	0	0	0	1,395	76	1,350	78	1,305	81	1,260	84	1,210	87	1,165	91	1,120	94		
		1	0	0	0	1,465	72	1,420	74	1,375	77	1,330	79	1,290	82	1,245	85	1,200	88	1,155	91
		0	1	0	0	1,555	68	1,510	70	1,470	72	1,425	74	1,380	76	1,340	79	1,295	82	1,250	84
		1	1	0	0	1,625	65	1,585	67	1,540	69	1,500	70	1,460	72	1,415	75	1,375	77	1,335	79
		0	0	1	0	1,690	62	1,650	64	1,610	66	1,570	67	1,530	69	1,485	71	1,445	73	1,405	75
		1	0	1	0	1,760	60	1,715	62	1,670	63	1,625	65	1,575	67	1,530	69	1,485	71	1,440	73
		0	1	1	0	1,835	58	1,790	59	1,745	60	1,695	62	1,650	64	1,605	66	1,555	68	1,510	70
		1	1	1	0	1,885	56	1,840	57	1,790	59	1,745	60	1,700	62	1,655	64	1,610	66	1,565	67
		0	0	0	1	1,945	54	1,900	56	1,850	57	1,805	58	1,760	60	1,710	62	1,665	63	1,620	65
		1	0	0	1	1,950	54	1,905	55	1,860	57	1,820	58	1,775	59	1,735	61	1,690	62	1,650	64
		0	1	0	1	2,075	51	2,030	52	1,990	53	1,945	54	1,900	56	1,855	57	1,810	58	1,770	60
		1	1	0	1	2,125	50	2,085	51	2,040	52	2,000	53	1,955	54	1,910	55	1,870	56	1,825	58
		0	0	1	1	2,170	49	2,130	50	2,090	51	2,045	52	2,005	53	1,965	54	1,925	55	1,880	56
		1	0	1	1	2,215	48	2,180	48	2,140	49	2,105	50	2,070	51	2,035	52	2,000	53	1,965	54
		0	1	1	1									2,225	47	2,165	49	2,100	50	2,040	52
		1	1	1	1											2,170	49	2,120	50	2,065	51

Notes:

1. Motor Switch Settings are for heating speeds using HEAT switches 1, 2, 3, & 4 and cooling speeds using COOL switches 5, 6, 7, & 8.
2. Two openings are recommended for airflows above 1,600 CFM if the filter(s) is (are) adjacent to the furnace.
3. Data is shown without filter.
3. Temperature rises in the table are approximate. Actual temperature rises may vary.
4. Temperature rises that are shaded in grey are for reference only. These conditions are not recommended.

Table 4. Heating / Cooling Airflows (CFM) and Temperature Rises (°F) for Furnaces with Fixed Speed Blowers

"B" CABINET					
Switch Settings (HEAT)				*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 (HEAT)				*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 (HEAT)				*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

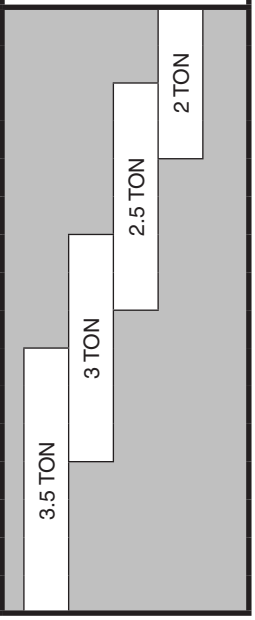
Notes:

Switch not used - can be 0 or 1

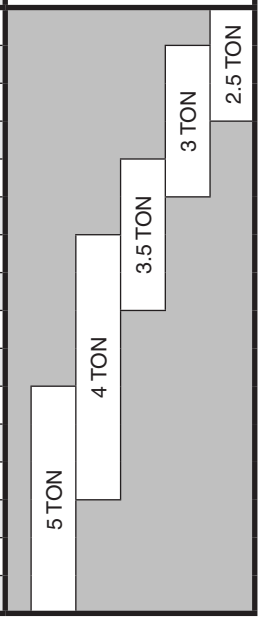
1. Two openings are recommended for airflows above 1,600 CFM if the filter(s) is (are) adjacent to the furnace.
2. Temperature rises in the table are approximate. Actual temperature rises may vary.
3. Temperature rises shaded in grey are for reference only. These conditions are not recommended.

Table 5. Nominal Heating Airflows (CFM) and Temperature Rises (°F) for Furnaces with - Variable Speed

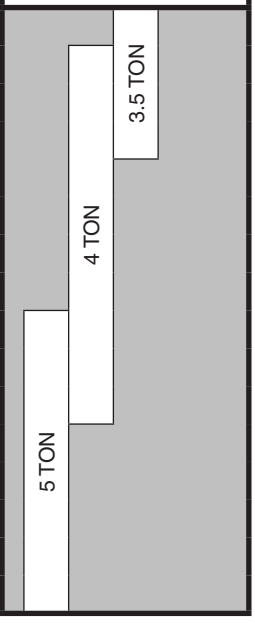
"B" CABINET							
Switch Settings					CFM		Nominal A/C and HP Capacity
HEAT	COOL						
1-4	5	6	7	8	LOW	HIGH	
1	0	0	0	0	485	700	
1	0	0	0	1	525	760	
1	0	0	1	0	565	820	
1	0	0	1	1	605	880	
1	0	1	0	0	650	940	
1	0	1	0	1	690	1,000	
1	0	1	1	0	730	1,060	
1	0	1	1	1	775	1,120	
1	1	0	0	0	815	1,180	
1	1	0	0	1	855	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	



"C" CABINET							
Switch Settings					CFM		Nominal A/C and HP Capacity
HEAT	COOL						
1-4	5	6	7	8	LOW	HIGH	
#	0	0	0	0	705	1,025	
#	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	



"D" CABINET							
Switch Settings					CFM		Nominal A/C and HP Capacity
HEAT	COOL						
1-4	5	6	7	8	LOW	HIGH	
#	0	0	0	0	965	1,400	
#	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 6. Nominal Cooling/Heat Pump Airflows (CFM) - Variable Speed

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 7. 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 8. 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 9. 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 10. 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 11. 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 12. High Altitude Deration Chart for Natural Gas - Low heating Value

ELECTRICAL INFORMATION

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 13. Wire Length and Voltage Specifications

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
Diagnostic Description	**Yellow LED**	
Low Flame Sensor Signal	Continuous Flash	
Flame Present	On	

Table 14. Furnace Control Board Fault Conditions

Diagnostic Description	Green LED	Red LED
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

Table 15. Motor Control Board Fault Conditions - Fixed Speed

Diagnostic Description	Green LED	Red LED
Control Fault (No Power)	Off	Off
Normal Operation	On	On
Motor Fault	On	Flash
Communications Fault	Flash	Flash

Table 16. Motor Control Board Fault Conditions - Variable Speed

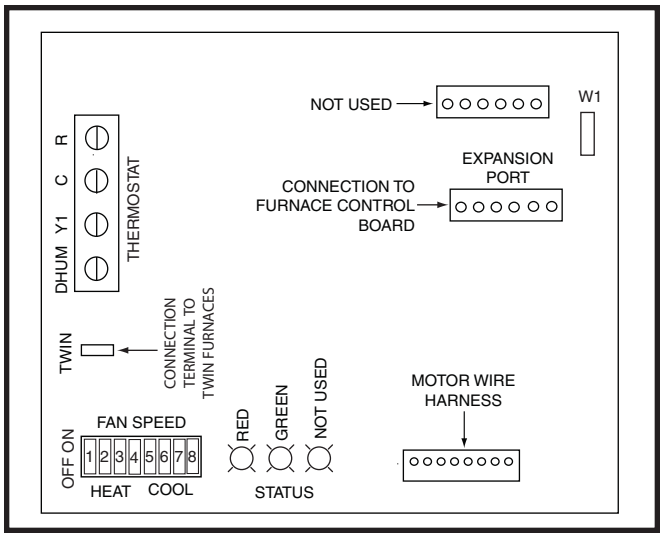


Figure 29. Two-Stage Fixed Speed Motor Control Board

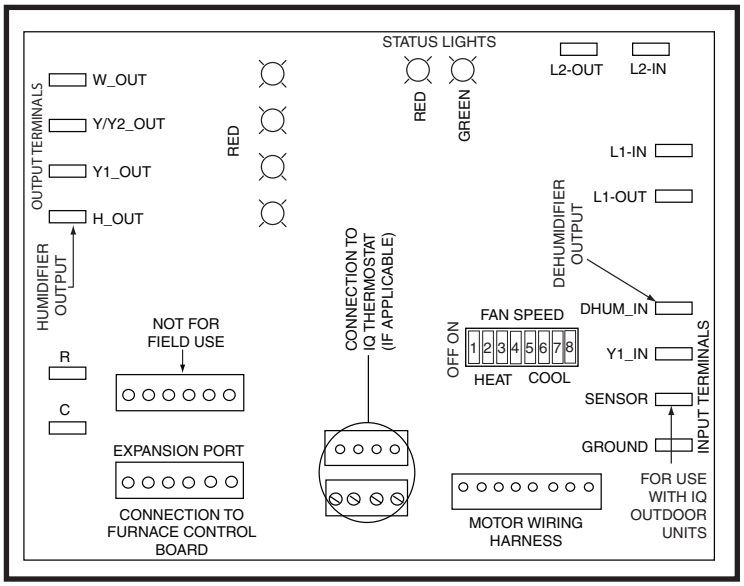


Figure 30. Two-Stage Variable Speed Motor Control Board

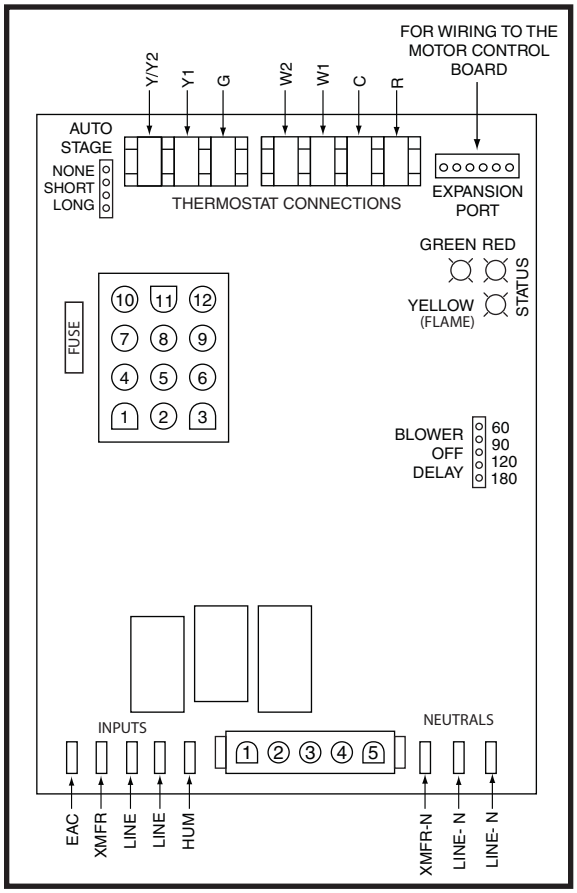


Figure 31. Two-Stage Furnace Control Board

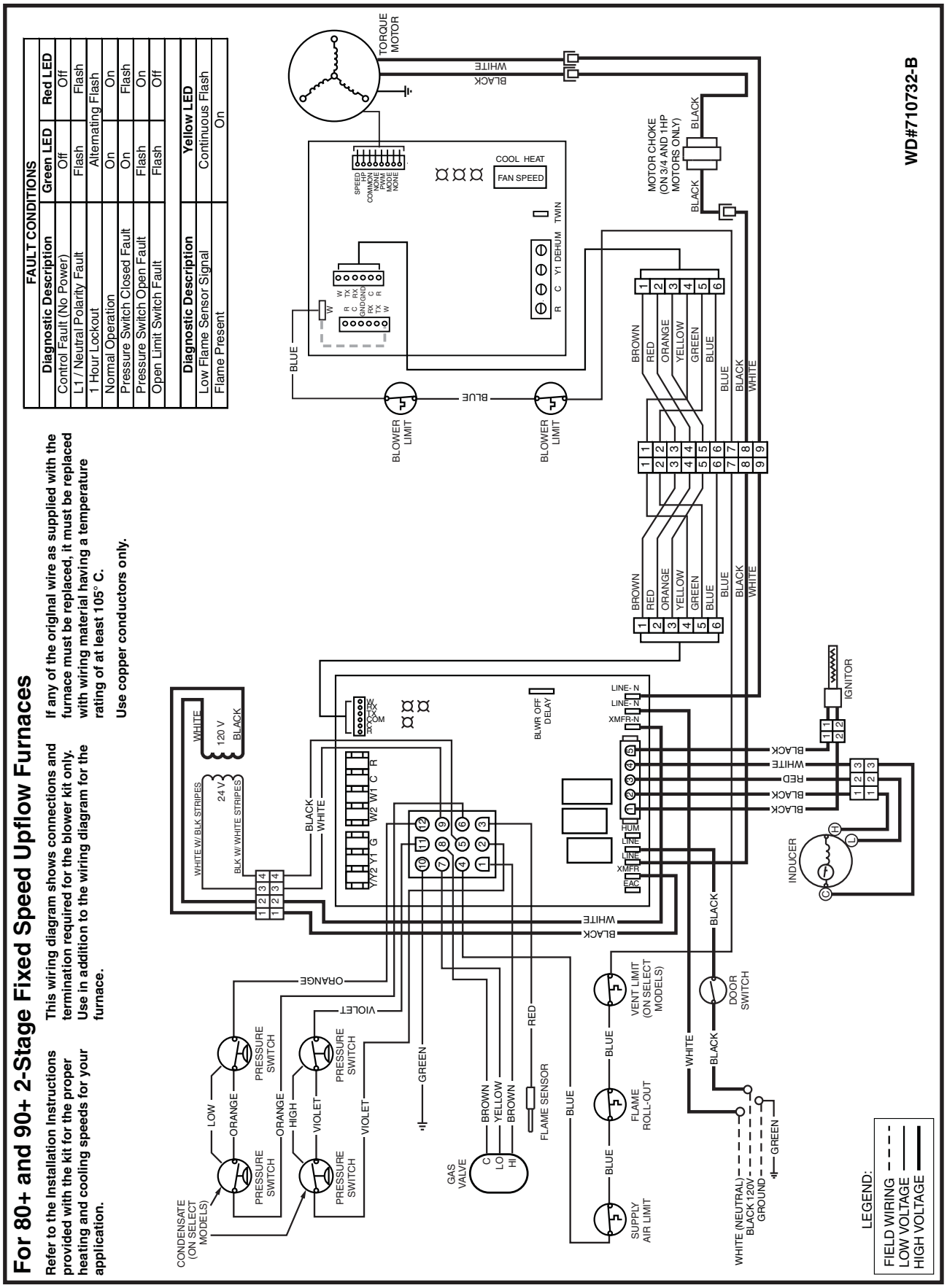


Figure 32. Wiring Diagram for Two-Stage, Fixed Speed Upflow Furnaces

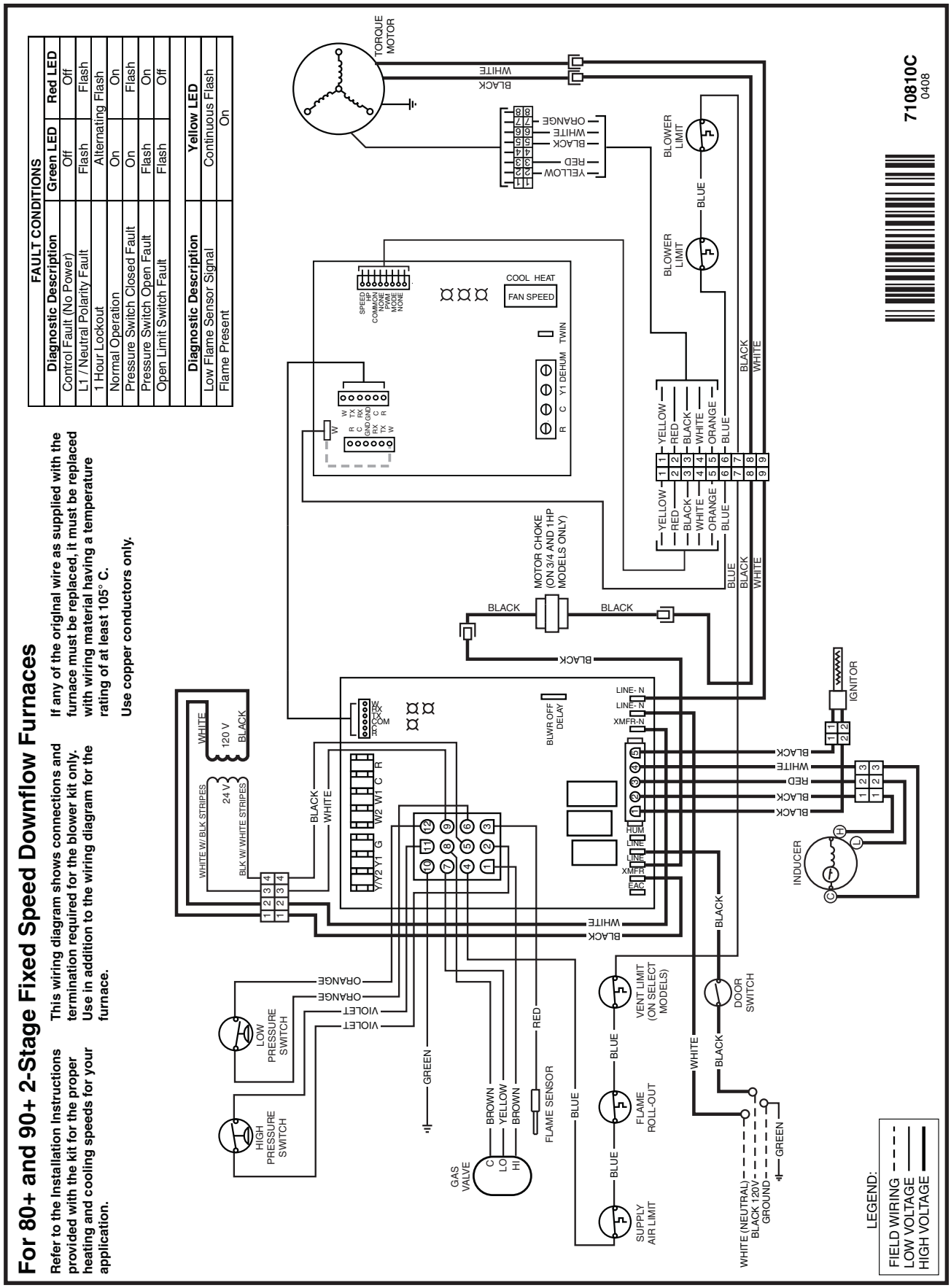


Figure 33. Wiring Diagram for Two-Stage, Fixed Speed Downflow Furnaces

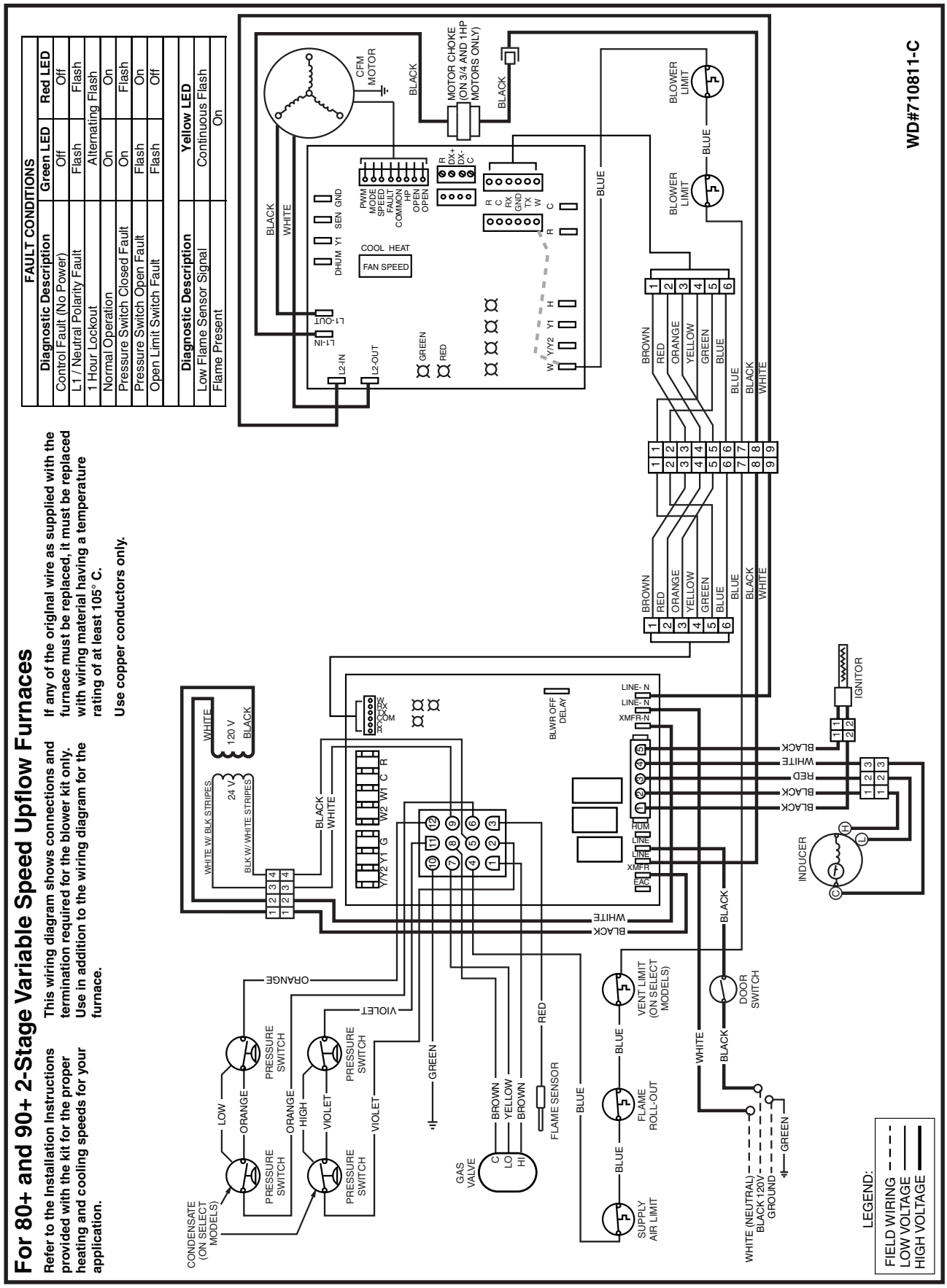


Figure 34. Wiring Diagram for Two-Stage, Variable Speed Upflow Furnaces

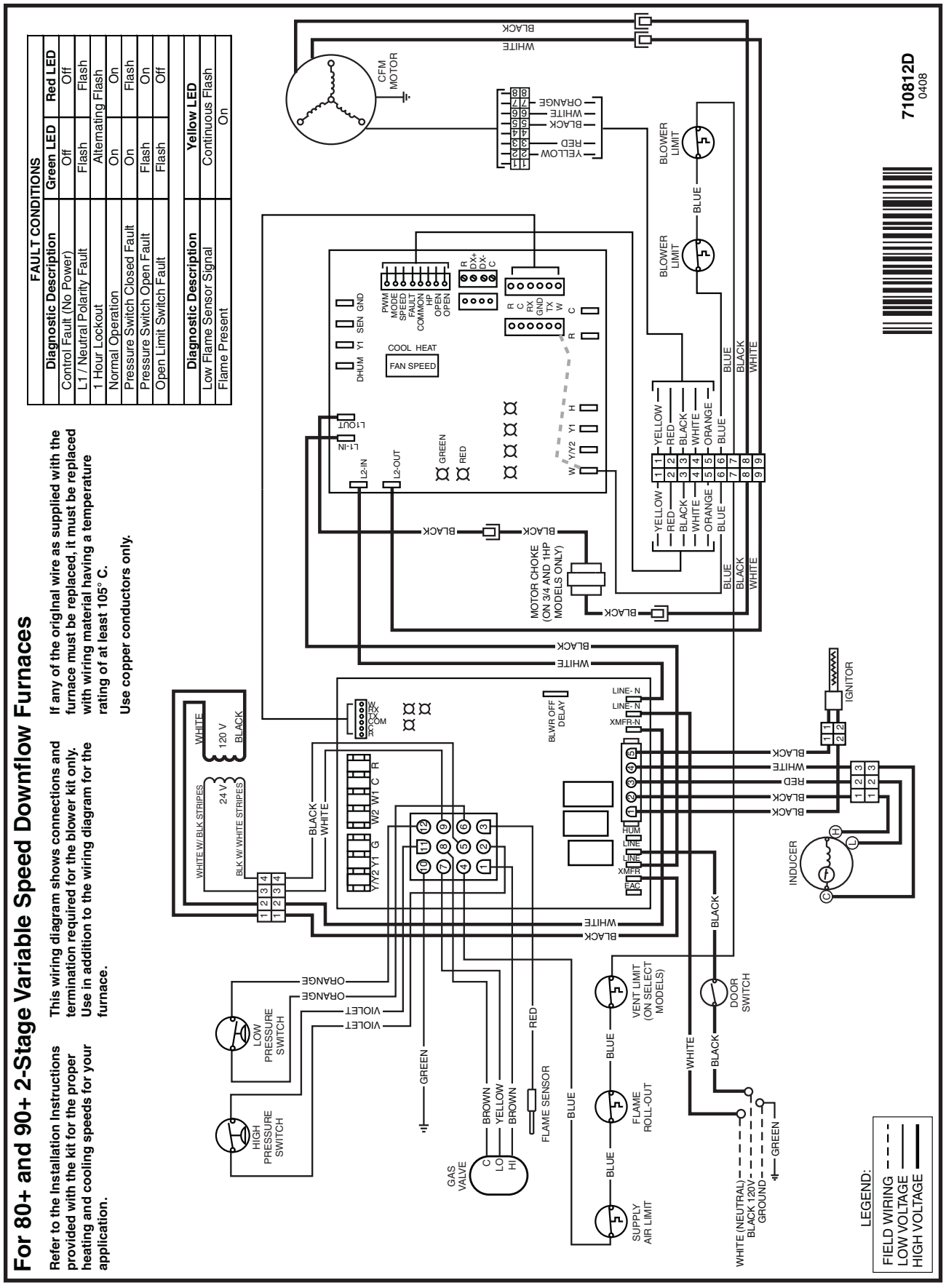
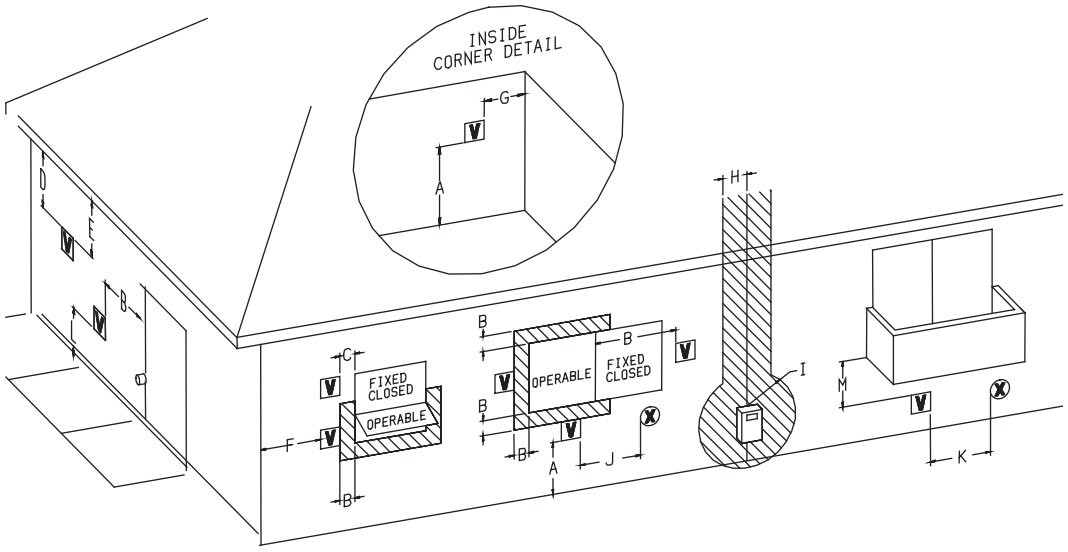


Figure 35. Wiring Diagram for Two-Stage, Variable Speed Downflow Furnaces

VENTING INFORMATION



VENT TERMINAL **AIR SUPPLY INLET** **AREA WHERE TERMINAL IS NOT PERMITTED**

Clearance Location		CANADIAN INSTALLATIONS [a]	US INSTALLATIONS [b]	
		Direct Vent (2-pipe) & Conventional Vent (1-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)
B =	Clearance to window or door that may be opened.	6 inches (15cm) for appliances < 10,000 Btuh (3kW)	6 inches (15cm) for appliances < 10,000 Btuh (3kW)	4 ft. (1.2m) below or to side of opening; 1 ft. (300mm) above opening
		12 inches (30cm) for appliances 10,000 Btuh - 100,000 Btuh (30kW)	9 inches (23cm) for appliances 10,000 Btuh - 50,000 Btuh (30kW)	
		36 inches (91cm) for appliances > 100,000 Btuh (30Kw)	12 inches (30cm) for appliances > 50,000 Btuh (30Kw)	
C =	Clearance to permanently closed window	*	*	*
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (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)	6 inches (15cm) for appliances < 10,000 Btuh (3kW)	4 ft. (1.2m) below or to side of opening; 1 ft. (300mm) above opening
		12 inches (30cm) for appliances 10,000 Btuh - 100,000 Btuh (30kW)	9 inches (23cm) for appliances 10,000 Btuh - 50,000 Btuh (30kW)	
		36 inches (91cm) for appliances > 100,000 Btuh (30Kw)	12 inches (30cm) for appliances > 50,000 Btuh (30Kw)	
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
L =	Clearance above paved sidewalk or driveway located on public property.	7 feet (2.13m) [c]	*	7 ft. (2.13m)
M =	Clearance under veranda, porch, deck, or balcony.	12 inches (30cm) [d]	*	*

NOTES:

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

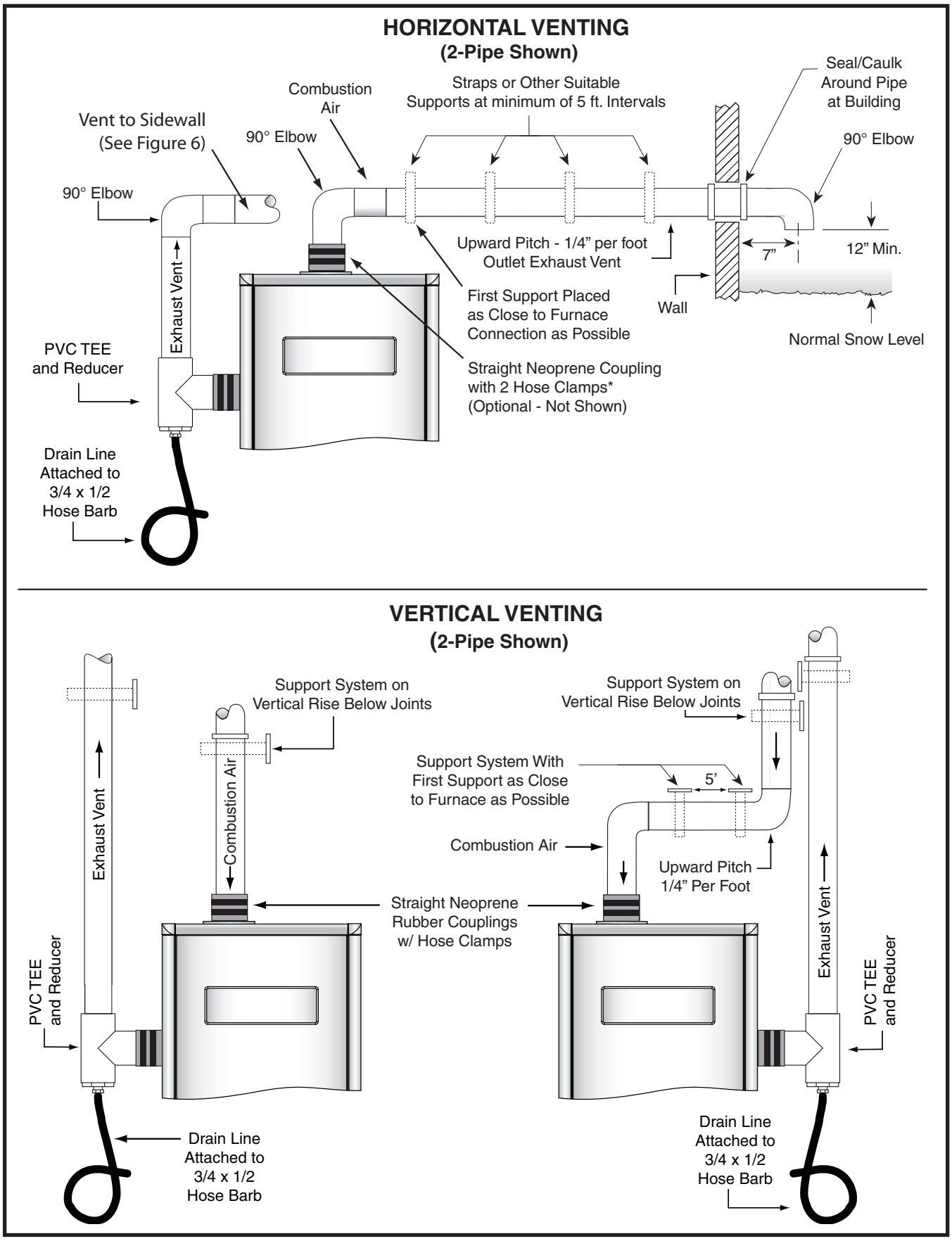


Figure 36. Horizontal and Vertical Venting

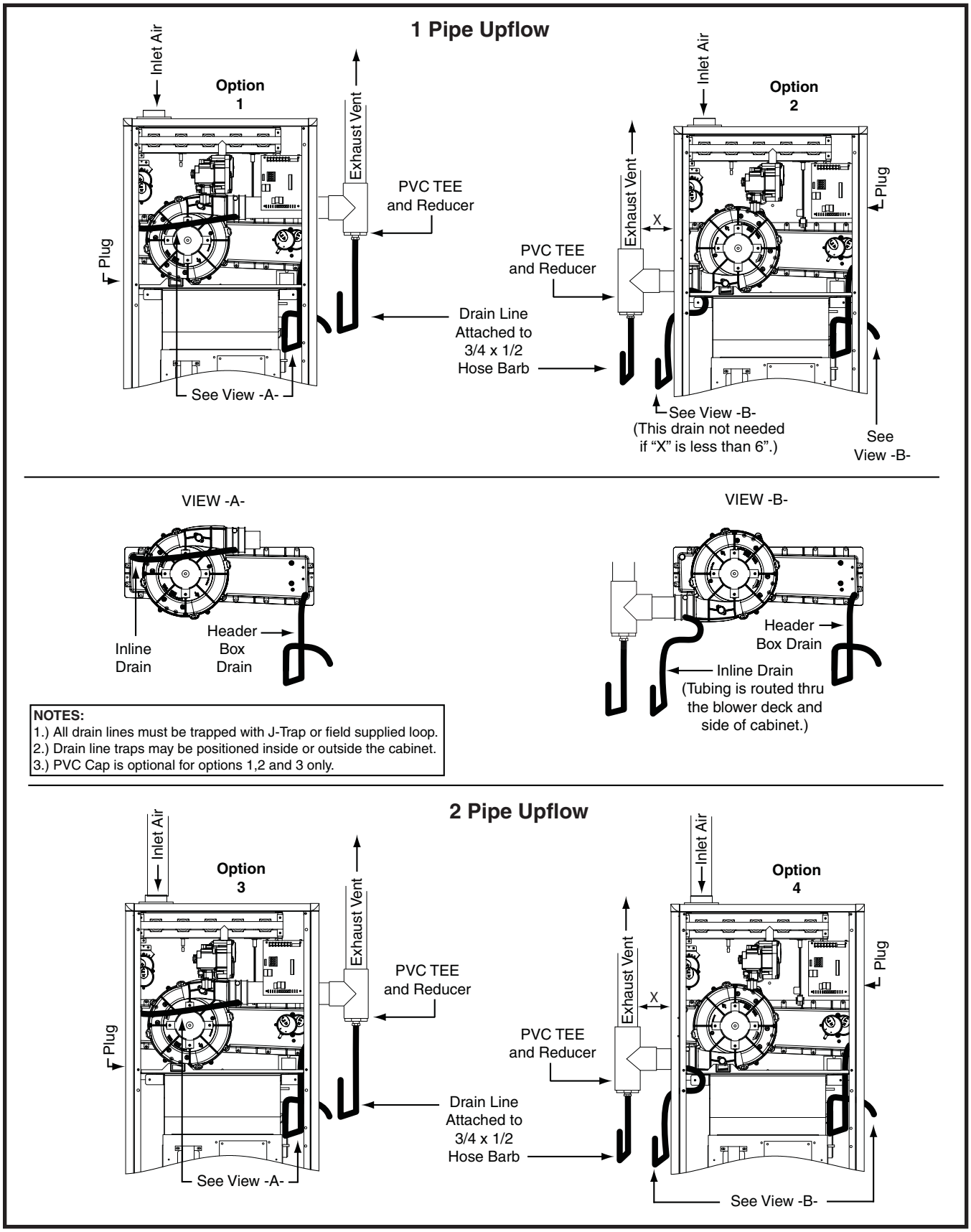


Figure 37. Upflow Options

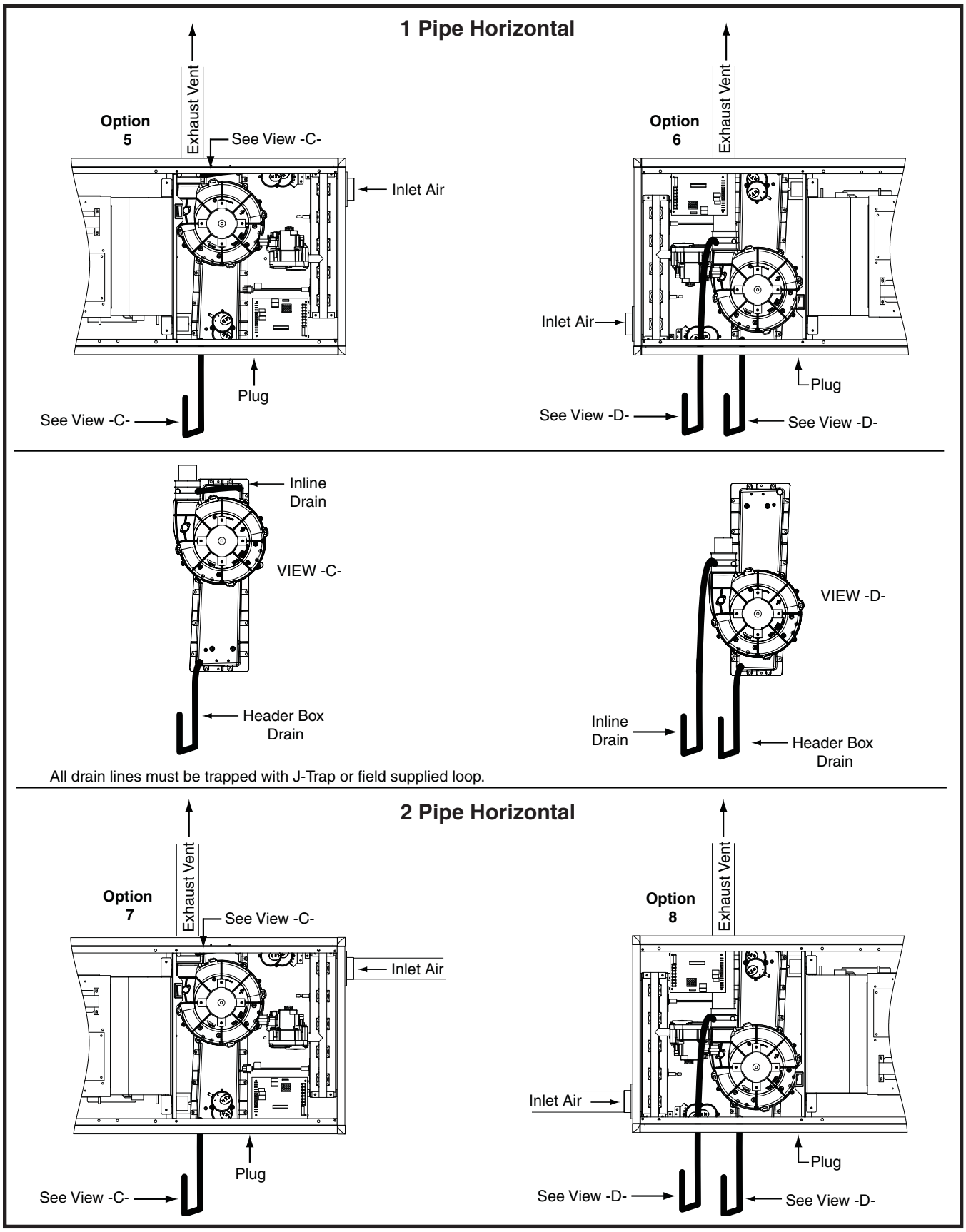


Figure 38. Horizontal Options

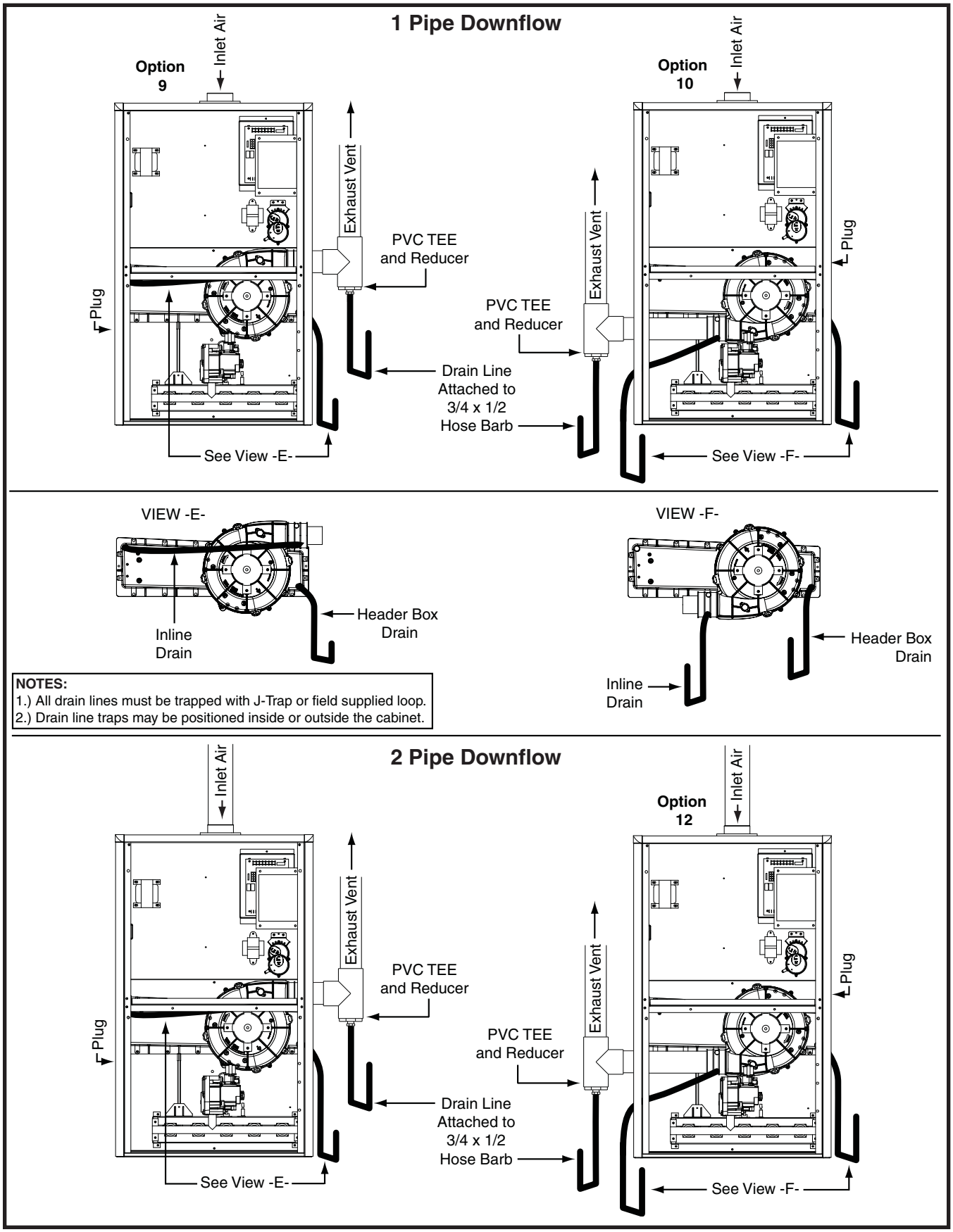


Figure 39. Downflow Options

FURNACE MODELS (BTU)	FURNACE INSTALLATION	SINGLE PIPE LENGTH (FT.) with 1 long radius elbow**		DIRECT VENT, DUAL 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 5ft for each 2" tee and 8ft for each 3" tee.

2. Two 45 degree elbows are equivalent to one 90 degree elbow.

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 18. Vent Pipe Lengths

ACCESSORIES

The components below are included in the extra parts bag that is supplied with the purchase of your furnace. 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.

1. Position a flange gasket (Figure 40) on a finish flange, aligning screw holes in the gasket and flange.
2. Position the flange (with gasket) on the furnace cabinet, aligning holes in gasket, flange and cabinet.
3. Secure flange and gasket to cabinet with three field supplied sheet metal screws..

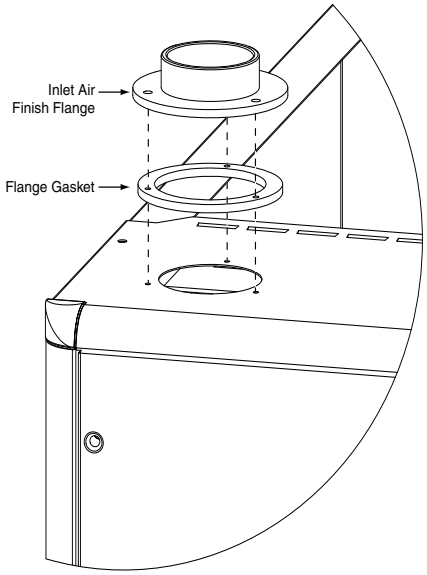


Figure 40. Finish Flanges

The 2 1/4" rubber grommet (Figure 41) 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 (Figure 41) 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.

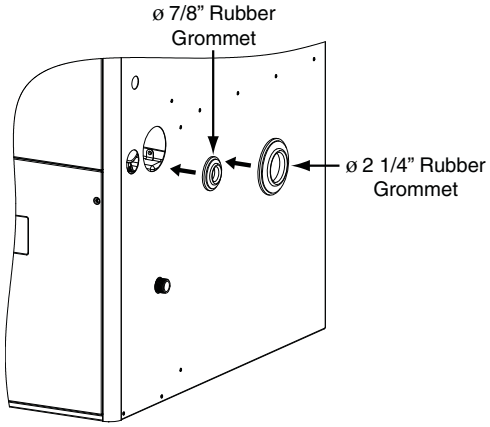


Figure 41. Rubber Grommets

The 2" PVC tee, reducer, and hose barb (Figure 42) 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. The Condensate drain should be connected to the barbed end. Attach 1" PVC drain line to the threaded end.

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

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 the tee to the 2" PVC pipe.
4. Verify all connections and joints for tight fit and proper alignment with other vent pipes.

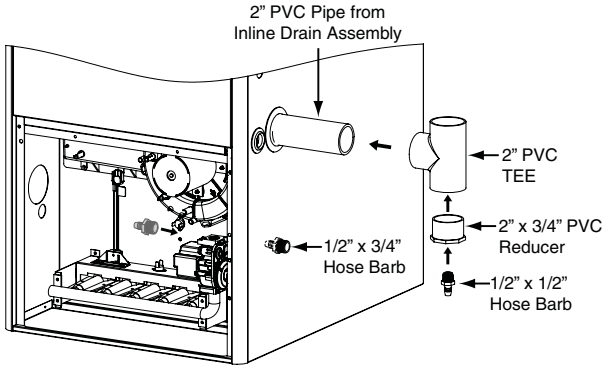


Figure 42. 2" PVC Tee, Reducer and Hose Barb

LOCATION OF FURNACE COMPONENTS

ITEM	COMPONENT NAME
1.	Blower Assembly
2.	Blower Door Switch
3.	Burner Assembly
4.	Finish Flange
5.	Flame Roll-Out Switch
6.	Flame Sensor
7.	Furnace Control Board
8.	Gas Manifold
9.	Gas Valve
10.	Igniter
11.	Inducer Assembly
12.	Inducer Limit Switch
13.	Motor Choke (C and D cabinets only)
14.	Motor Control Board
15.	Motor Control Box
16.	Pressure Switches
17.	Transformer

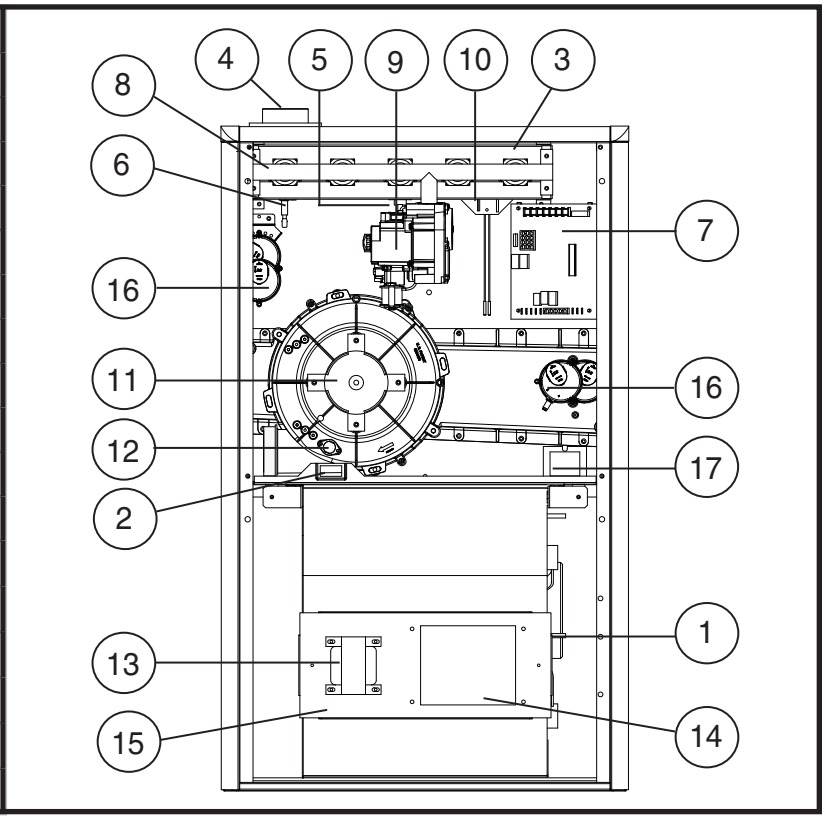


Figure 43. Upflow/Horizontal Gas Furnace Components

ITEM	COMPONENT NAME
1.	Blower Assembly
2.	Blower Door Switch
3.	Burner Assembly
4.	Finish Flange
5.	Flame Roll-Out Switch
6.	Flame Sensor
7.	Furnace Control Board
8.	Gas Manifold
9.	Gas Valve
10.	Igniter
11.	Inducer Assembly
12.	Inducer Limit Switch
13.	Motor Choke (C and D cabinets only)
14.	Motor Control Board
15.	Pressure Switches
16.	Transformer

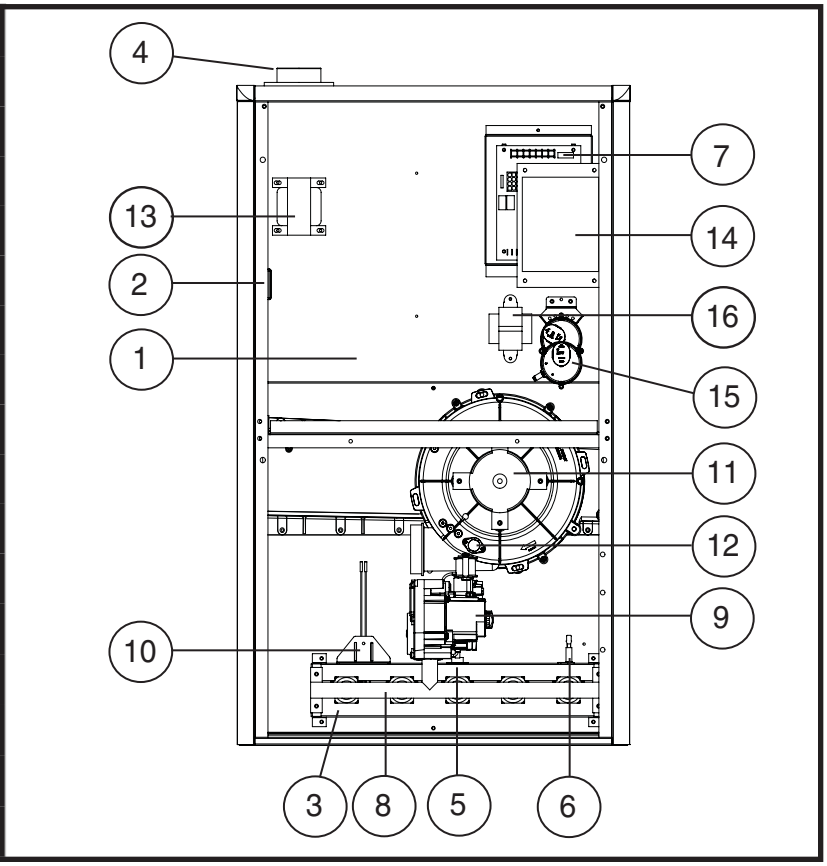


Figure 44. Downflow Gas Furnace Components

INSTALLATION/PERFORMANCE CHECK LIST

INSTALLER NAME:	
CITY _____	STATE _____

INSTALLATION ADDRESS:	
CITY _____	STATE _____
UNIT MODEL #_____	
UNIT SERIAL # _____	

Minimum clearances per Table 3 (page 29)?	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

ENERGY STAR

CERTIFIED

DESIGN CERTIFIED

EFFICIENCY RATING CERTIFIED Gama

NORDYNE
O'Fallon, MO

708810A

708810A (Replaces 7088100)