

INSTALLATION MANUAL

SINGLE STAGE ECM RESIDENTIAL GAS FURNACES MODELS: TM9E Series (95% AFUE Multi-Position)



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These high efficiency, compact units employ induced combustion reliable hot surface ignition and high heat transfer aluminized tubular heat exchangers. The units are factory shipped for installation in upflow or horizontal applications and can be converted for downflow applications.

These furnaces are designed for residential installation in a basement, closet, alcove, attic, recreation room, or garage, and are also ideal for commercial applications. All units are factory assembled, wired, and tested to ensure safe, dependable, and economical installation and operation.

These units are Category IV listed and can not be common vented with another gas appliance as allowed by the National Fuel Gas Code.

SECTION I: SAFETY



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

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

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

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

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

WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. **Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, death, personal injury and/or property damage.** Only a qualified contractor, installer or service agency should install this product.

SPECIFIC SAFETY RULES AND PRECAUTIONS

1. Only Natural gas or Propane (LP) gas are approved for use with this furnace.
2. Install this furnace only in a location and position specified in these instructions.
3. A gas-fired furnace for installation in a residential garage must be installed as specified in these instructions.
4. Provide adequate combustion and ventilation air to the furnace space as specified in these instructions.
5. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in SECTION VIII: COMBUSTION AIR AND VENT SYSTEM.
6. Test for gas leaks as specified in these instructions.

WARNING**FIRE OR EXPLOSION HAZARD**

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

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

7. Always install the furnace to operate within the furnace's intended temperature rise range. Only connect the furnace to a duct system which has an external static pressure within the allowable range, as specified on the furnace rating plate.
8. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air must also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
9. It is permitted to use the furnace for heating of buildings or structures under construction where the application and use comply with all manufacturer's installation instructions including the following:
 - Proper vent installation
 - Furnace operating under thermostatic control
 - Return air duct sealed to the furnace
 - Air filters in place
 - Set furnace input rate and temperature rise per rating plate marking

- Means for providing outdoor air required for combustion
- Return air temperature maintained between 55°F (13°C) and 80°F (27°C)
- The **air filter must be replaced** upon substantial completion of the construction process
- Clean furnace, duct work, and components upon substantial completion of the construction process, and verify furnace operating conditions including ignition, input rate, temperature rise, and venting according to the manufacturer's instructions.

10. When installed in a non-HUD-Approved Modular Home or building constructed on-site, combustion air must not be supplied from occupied spaces.
11. The size of the unit must be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods can be used.
12. When moving or handling this furnace prior to installation, always leave the doors on the furnace to provide support and prevent damage or warping of the cabinet. When lifting the furnace by the cabinet, support the ends of the furnace rather than lifting by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.
13. When lifting the furnace, it is acceptable to use the primary heat exchanger tubes as a lifting point, provided that the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel. Do not use the top return bend of the heat exchangers as lifting points as the tubes may shift out of position or their location brackets/baffles.

IMPORTANT: During installation, doors must remain on the furnace when moving or lifting the furnace.

SAFETY REQUIREMENTS

CAUTION

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

- Refer to the unit rating plate for the furnace model number, and then see the return air plenum dimensions in Figure 8. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed in Table 1.
- Provide clearances for servicing, ensuring that service access is allowed for both the burners and blower.
- These models **ARE NOT** CSA listed or approved for installation into a **HUD Approved Modular Home** or a **Manufactured (Mobile) Home**.
- This furnace is not approved for installation in trailers or recreational vehicles.
- Furnaces for installation on combustible flooring must not be installed directly on carpeting, tile or other combustible material other than wood flooring.
- Check the rating plate and power supply to ensure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase, 60 Hz power supply. **DO NOT CONNECT THIS APPLIANCE TO A 50 Hz POWER SUPPLY OR A VOLTAGE ABOVE 130 V.**
- The furnace must be installed so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas fired components. Only trained and qualified personnel must install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that apply.

COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

WARNING

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

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

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

The furnace requires **OUTDOOR AIR** for combustion when the furnace is located in any of the following environments:

- Buildings with indoor pools
- Chemical exposure
- Commercial buildings
- Hobby or craft rooms
- Laundry rooms
- Near chemical storage areas
- Restricted environments

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

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

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

CODES AND STANDARDS

Follow all national, local codes and standards in addition to this installation manual. The installation must comply with regulations of the serving gas supplier and local building, heating, plumbing, and other codes. In absence of local codes, the installation must comply with the national codes listed below and all authorities having jurisdiction.

In the United States and Canada, follow all codes and standards for the following, using the latest edition available.

STEP 1 - Safety

- US: National Fuel Gas Code (NFGC) NFPA 54/ANSI Z223.1 and the Installation Standards, Warm Air Heating and Air Conditioning Systems ANSI/NFPA 90B
- CANADA: CAN/CGA-B149.1 National Standard of Canada. Natural Gas and Propane Installation Codes (NSCNGPIC)

STEP 2 - General Installation

- US: Current edition of the NFGC and NFPA 90B. For copies, contact:

National Fire Protection Association Inc.
Batterymarch Park
Quincy, MA 02269

or for only the NFGC, contact:

American Gas Association,
400 N. Capital, 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 Canada M9W 1R5

STEP 3 - Combustion and Ventilation Air

- US: Section 5.3 of the NFGC, air for Combustion and Ventilation
- CANADA: Part 7 of NSCNGPIC, Venting Systems and Air Supply for Appliances

STEP 4 - Duct Systems

- US and CANADA: Air Conditioning Contractors Association (ACCA) Manual D, Sheet Metal and Air Conditioning Contractors Association National Association (SMACNA), or American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 1997 Fundamentals Handbook Chapter 32.

STEP 5 - Acoustical Lining and Fibrous Glass Duct

- US and CANADA: Current edition of SMACNA and NFPA 90B as tested by UL Standard 181 for Class 1 Rigid Air Ducts

STEP 6 - Gas Piping and Gas Pipe Pressure Testing

- US: NFGC; chapters 2, 3, 4, and 9 and National Plumbing Codes
- CANADA: NSCNGPIC Part 5

STEP 7 - Electrical Connections

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

These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances, these instructions exceed certain local codes and ordinances, especially those that do not reflect changing residential and non-HUD modular home construction practices. These instructions are required as a minimum for a safe installation.

INSPECTION

On receiving a unit, inspect the unit for possible damage during transit. If damage is evident, note the extent of the damage on the carrier's freight bill. Make a separate request for inspection by the carrier's agent in writing. Before installation, check the unit for screws or bolts that may have loosened in transit. There are no shipping or spacer brackets that need to be removed from the interior of this unit.

FURNACE LOCATION AND CLEARANCES

The furnace must be located using the following guidelines:

- Where a minimum amount of air intake/vent piping and elbows is required
- As centralized with the air distribution as possible
- Where adequate combustion air is available (particularly when the appliance is not using outdoor combustion air)
- Where it does not interfere with proper air circulation in the confined space

- Where the outdoor vent terminal is not blocked or restricted. See Vent Clearances in SECTION VIII: COMBUSTION AIR AND VENT SYSTEM. These minimum clearances must be maintained in the installation.
- Where the unit is installed in a level position with no more than 1/4 in. (6.4 mm) slope side-to-side and front-to-back to provide proper condensate drainage.

Installation in freezing temperatures:

- The furnace must be installed in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures must not fall below 32°F (0°C) unless the condensate system is protected from freezing.

FOR FURNACES INSTALLED IN THE COMMONWEALTH OF MASSACHUSETTS ONLY

For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

- 1. INSTALLATION OF CARBON MONOXIDE DETECTORS.** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors
 - a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
 - b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.
- 2. APPROVED CARBON MONOXIDE DETECTORS.** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.
- 3. SIGNAGE.** A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".
- 4. INSPECTION.** The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

⚠ WARNING

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

- Do not allow return air temperature to be below 55°F (13°C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.
- If this furnace is installed in an unconditioned space and an extended power failure occurs, there is potential for damage to the internal components. Following a power failure, do not operate the unit until inspection and repairs are performed.

⚠ WARNING

Liquid anti-freeze will cause damage to internal plastic parts of this furnace. **DO NOT attempt to winterize the furnace using liquid anti-freeze.**

Clearances for access/service:

Provide ample clearances to permit easy access to the unit. The following minimum clearances are recommended:

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

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

Installation in a residential garage:

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

Table 1: Unit Clearances to Combustibles

Application	Upflow	Downflow	Horizontal
Top	1 in.	0 in.	0 in.
Vent	0 in.	0 in.	0 in.
Rear	0 in.	0 in.	0 in.
Side	0 in.	0 in.	1 in.
Front ¹	0 in.	0 in.	0 in.
Floor	Combustible	Combustible ²	Combustible
Closet	Yes	Yes	Yes
Line Contact	No	No	Yes

1. 24 in. clearance in front and 18 in. on side is recommended for service access.
 2. A special sub-base is required for downflow applications on combustible floors.
Note: All furnaces are approved for alcove and attic installation.

SECTION II: DUCTWORK

DUCTWORK GENERAL INFORMATION

The duct system's design and installation must:

- Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
- Be installed in accordance with National Fire Protection Association as outlined in NFPA standard 90B (latest editions) or applicable national, provincial, state, and local fire and safety codes.
- Create a closed duct system. For residential and non-HUD Modular Home installations, when a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air must also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
- Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.

CAUTION

The indoor coil must be installed in the supply air duct, downstream of the furnace. Cooled air may not be passed over the heat exchanger.

When the furnace is used with an indoor coil, the coil must be installed parallel with, or in the supply air side of the furnace to avoid condensation in the primary heat exchanger. When a parallel flow arrangement is used, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position.

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

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

IMPORTANT: The minimum plenum height is 12 in. (30.5 cm). The furnace does not operate properly on a shorter plenum height. The minimum recommended rectangular duct height is 4 in. (10.1 cm) attached to the plenum.

If a matching cased indoor coil is used, it can be placed directly on the furnace outlet and sealed to prevent leakage. If an uncased indoor coil with a thermoplastic drain pan is installed in the upflow/horizontal configuration, an extra 2 in. minimum spacing may be needed to ensure against drain pan distortion.

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

WARNING

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

Refer to the furnace rating plate for the correct rise range and static pressures or to Table 5 for the correct rise range.

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

DUCT FLANGES

Four flanges are provided to attach ductwork to the furnace. These flanges are rotated down for shipment. To use the flanges:

1. Remove the screw holding an individual flange.
2. Rotate the flange so it is in the upward position.
3. Reinstall the screw.
4. Repeat steps 1 to 3 for all four flanges.

If the flanges are not used, they must remain in the rotated down position as shipped.

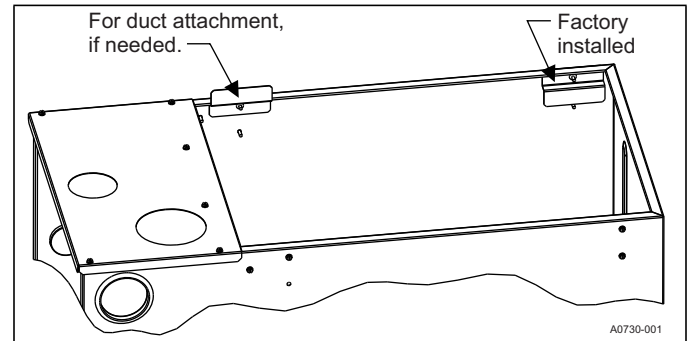
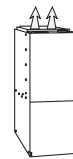


FIGURE 1: Duct Attachment

DUCTWORK INSTALLATION AND SUPPLY PLENUM CONNECTION - UPFLOW/HORIZONTAL



Attach the supply plenum to the furnace outlet. Use an approved flexible duct connector on all installations. Seal this connection to prevent air leakage. The sheet metal must be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

FLOOR BASE AND DUCTWORK INSTALLATION - DOWNFLOW



Installations on combustible material or directly on any floors must use a combustible floor base as shown in Figure 3. Follow the instructions supplied with the combustible floor base accessory. This combustible floor base can be replaced with a matching indoor coil, properly sealed to prevent leaks. Follow the instructions supplied with the indoor coil cabinet for installing the cabinet to the duct connector. Plug intake and vent pipe holes in bottom panel and move grommet to required vent side exit.

Downflow Air - Indoor Coil Cabinet

The furnace must be installed with coil cabinet part number specifically intended for downflow application. If a matching indoor coil is used, it can be placed directly on the furnace outlet and sealed to prevent leakage. For details of the coil cabinet dimensions and installation requirements, refer to the installation instructions supplied with the coil cabinet.

Attach the indoor coil cabinet to the duct connector, and then position the furnace on top of the coil cabinet. The connection to the furnace, indoor coil cabinet, duct connector, and supply air duct must be sealed to prevent air leakage.

COIL INSTALLATION

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

The indoor coil must be mounted on the supply side of the furnace as shown in Figure 2. Refer to the installation instructions provided with each indoor coil.

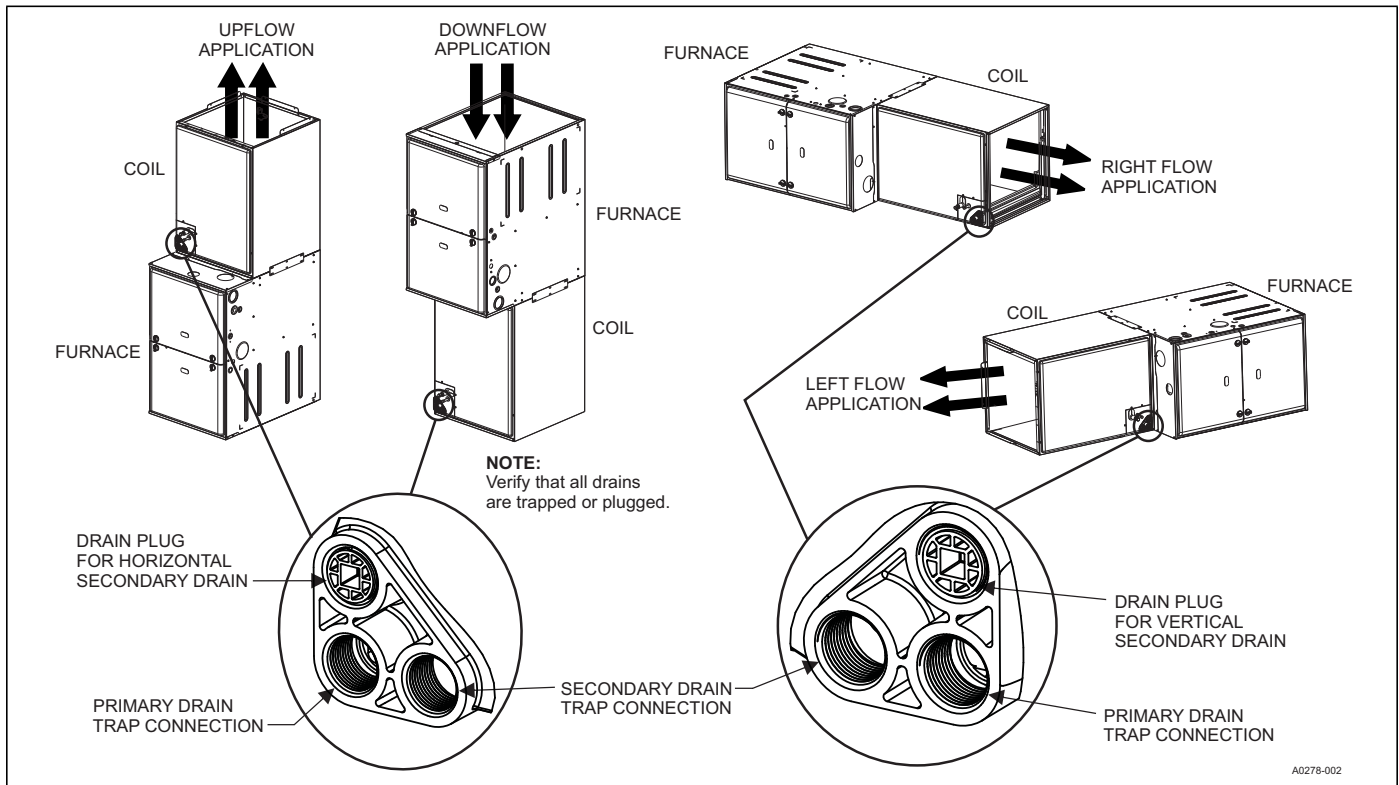


FIGURE 2: Furnace and Coil Attachment

DOWNFLOW DUCT CONNECTORS

All downflow installations must use a suitable duct connector approved by the furnace manufacturer for use with this furnace. The duct connectors are designed to be connected to the rectangular duct under the floor and sealed. Refer to the instructions supplied with the duct connector for proper installation. See the separate accessory parts list at the end of these instructions for the approved accessory duct connectors.

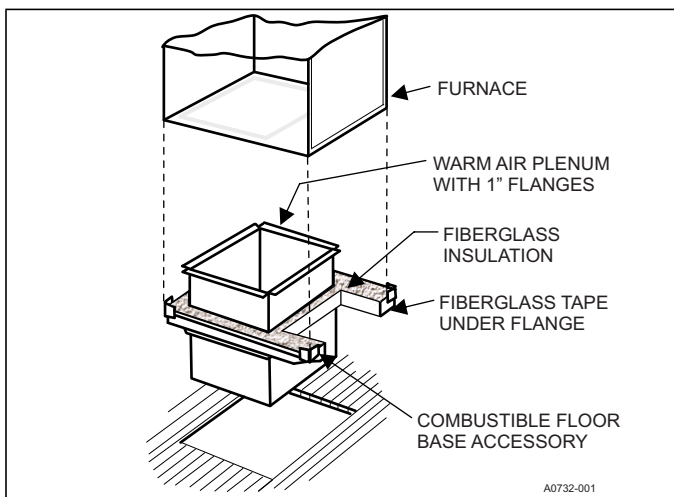


FIGURE 3: Combustible Floor Base Accessory

RESIDENTIAL AND MODULAR HOME UPFLOW RETURN PLENUM CONNECTION

Return air may enter the furnace through the side(s) or bottom depending on the type of application. Return air must not be connected into the rear panel of the unit.

SIDE RETURN APPLICATION

Side return applications pull return air through an opening cut in the side of the furnace casing. The furnace is supplied with a bottom block-off panel that must be left in place if a side return is used. If the furnace is installed on a flat, solid surface, this bottom panel provides an adequate seal to prevent air leakage through the unused bottom opening. However, if the furnace is installed on a surface that is uneven, or if it is installed on blocks or otherwise raised off the floor, **it is necessary to seal the edges of the bottom panel to the casing using tape or other appropriate gasket material to prevent air leakage.**

BOTTOM RETURN AND ATTIC INSTALLATIONS

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

The internal bottom panel must be removed for this application.

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

HORIZONTAL APPLICATION

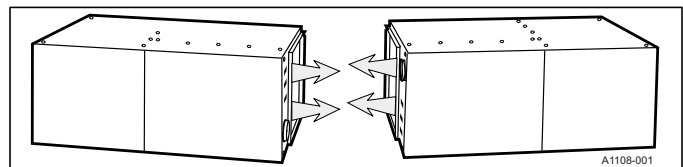


FIGURE 4: Horizontal Application

IMPORTANT: This furnace can be installed in a horizontal position on either side as shown above. **It must not be installed on its back.**

ATTIC INSTALLATION

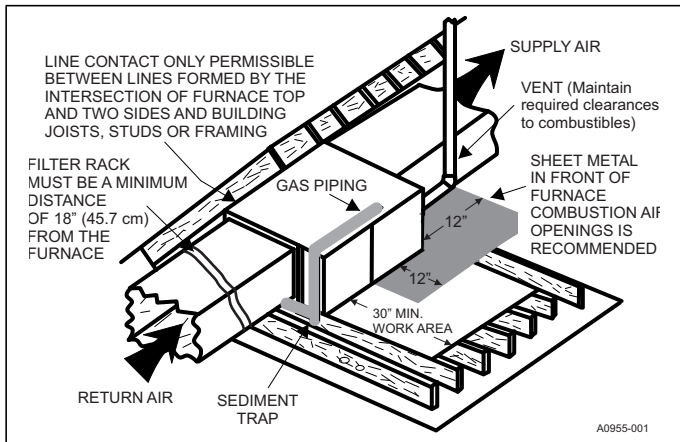


FIGURE 5: Typical Attic Installation

This appliance is certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs, or framing. This line can be in contact with combustible material. See Figure 5.

WARNING

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

IMPORTANT: During installation, doors must remain on the furnace when moving or lifting the furnace.

When moving or handling this furnace before installation, always leave the doors on the furnace to provide support and to prevent damage or warping of the cabinet. When lifting the furnace, support the ends of the furnace rather than lifting by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.

It is acceptable to use the primary heat exchanger tubes as a lifting point, provided that the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel. Do not use the top return bend of the heat exchangers as lifting points as the tubes may shift out of position or their location brackets/baffles.

SUSPENDED FURNACE/CRAWL SPACE INSTALLATION

The furnace can be hung from floor joists or installed on suitable blocks or pads. Blocks or pad installations must provide adequate height to ensure that the unit is not subject to water damage.

Units can also be suspended from rafters or floor joists using rods, pipe angle supports, or straps. In all cases, the furnace must be supported with rods, straps, or angle supports at three locations to properly support the furnace. Place one support at the supply end of the furnace, place one support located approximately in the center of the furnace near the blower shelf, and place one support at the return end of the furnace. Maintain a 6 in. (15.2 cm) minimum clearance between the front of the furnace and the support rods or straps.

All six suspension points must be level to ensure proper and quiet furnace operation. When suspending the furnace, use a secure platform constructed of plywood or other building materials secured to the floor or ceiling joists. See Figure 6 for details and additional information.

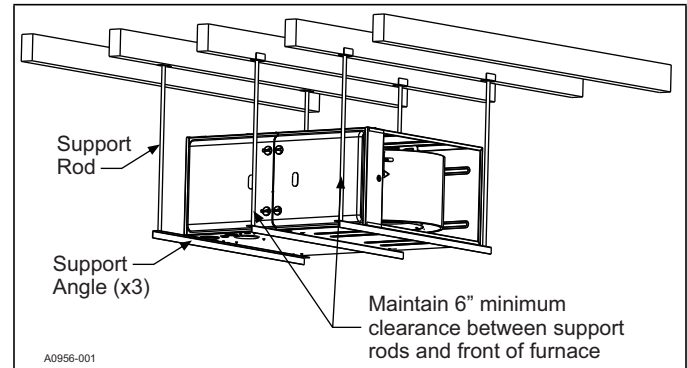


FIGURE 6: Typical Suspended Furnace/Crawl Space Installation

DOWNFLOW APPLICATION

To apply the furnace in a downflow position, it is necessary to rotate the vent blower 90° left or right so the vent pipe passes through the side of the furnace casing. See Figure 7.

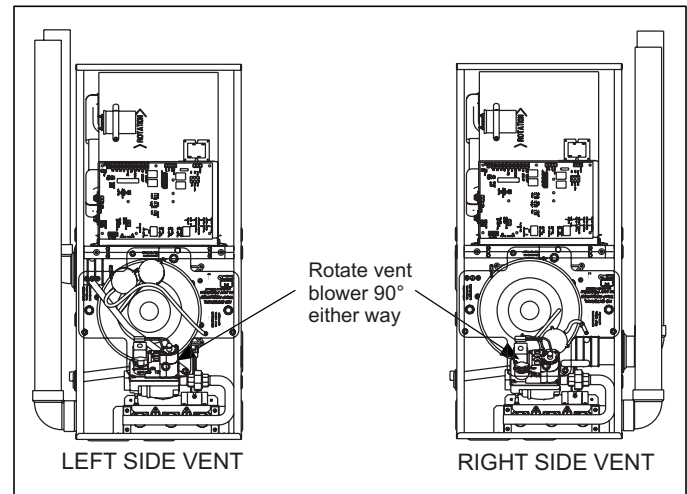


FIGURE 7: Downflow Venting

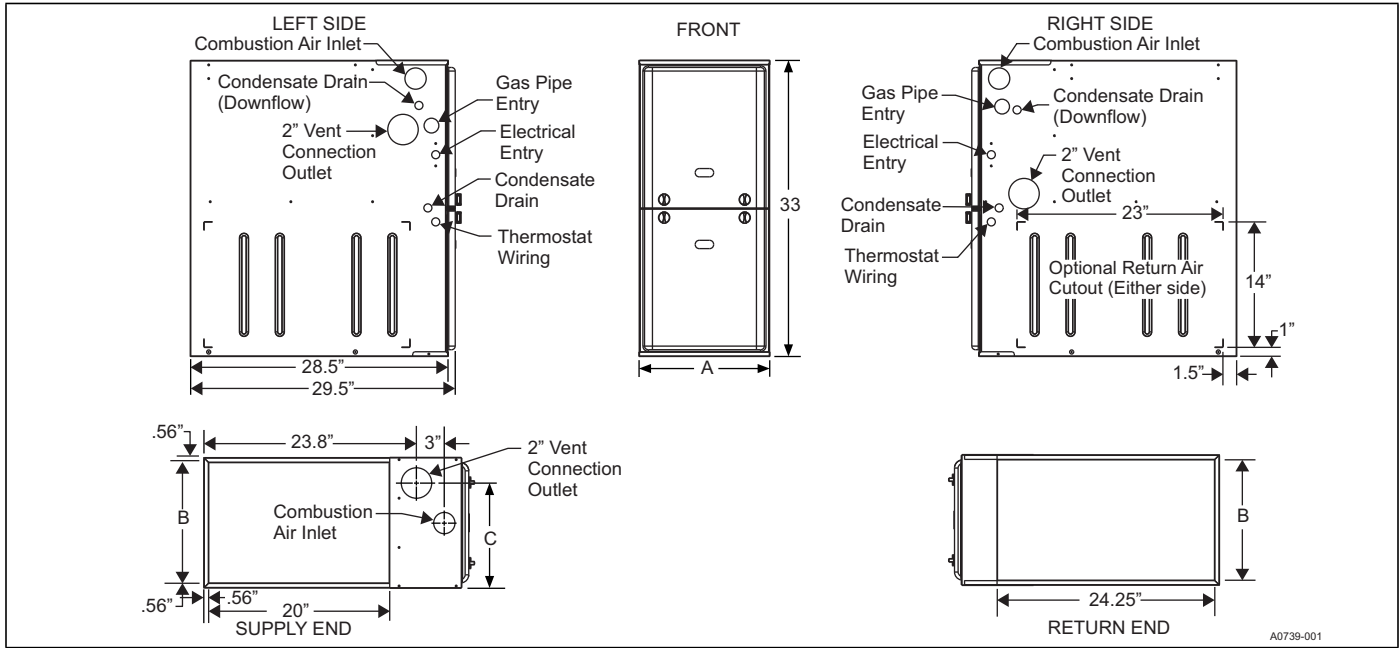


FIGURE 8: Dimensions

Table 2: Cabinet and Duct Dimensions - TM9E

BTUH (kW) Input	Nominal CFM (m ³ /min)	Cabinet Size	Cabinet Dimensions (in.) (Illustrated in Figure 8)						Approximate Operating Weights lb (kg)
			A (in)	A (cm)	B (in)	B (cm)	C (in)	C (cm)	
40 (11.7)	1000 (28.3)	A	14 1/2	36.8	13 3/8	34.0	11 3/4	29.8	113 (51)
60 (17.6)	1000 (28.3)	A	14 1/2	36.8	13 3/8	34.0	11 3/4	29.8	118 (54)
60 (17.6)	1200 (34.0)	B	17 1/2	44.4	16 3/8	41.6	13 1/4	33.7	122 (55)
80 (23.4)	1200 (34.0)	B	17 1/2	44.4	16 3/8	41.6	14 3/4	37.5	126 (57)
80 (23.4)	1600 (45.3)	C	21	53.3	19 7/8	50.5	16 1/2	41.9	136 (62)
80 (23.4)	2000 (56.6)	C	21	53.3	19 7/8	50.5	16 1/2	41.9	139 (63)
100 (29.3)	1600 (45.3)	C	21	53.3	19 7/8	50.5	18 1/4	46.4	142 (64)
100 (29.3)	2000 (56.6)	C	21	53.3	19 7/8	50.5	18 1/4	46.4	145 (66)
120 (35.1)	2000 (56.6)	D	24 1/2	62.2	23 3/8	59.4	21 3/4	55.2	156 (71)

SECTION III: FILTERS

FILTER INSTALLATION

CAUTION

All filters and mounting provision must be field supplied. All installations must have a filter installed.

All applications require the use of a field installed filter. All filters and mounting provision must be field supplied.

Filters must be installed external to the furnace cabinet. **DO NOT attempt to install filters inside the furnace.**

NOTICE

Single side return above 1800 CFM is approved as long as the filter velocity does not exceed filter manufacturer's recommendation and a transition is used to allow use of a 20 x 25 filter.

Table 3: Recommended Filter Sizes (High Velocity 600 FPM)

CFM (m ³ /min)	Cabinet Size	Side (in)	Bottom (in)
1000 (28.3)	A	16 x 25	14 x 25
1200 (34.0)	A	16 x 25	14 x 25
1200 (34.0)	B	16 x 25	16 x 25
1600 (45.3)	C	16 x 25	20 x 25
2000 (56.6)	C	(2) 16 x 25	20 x 25
2000 (56.6)	D	(2) 16 x 25	22 x 25

Notes:

Air velocity through throwaway filters must not exceed 300 ft/min (91.4 m/min). All velocities over this require the use of high velocity filters. Do not exceed 1800 CFM using a single side return and a 16 x 25 filter. For CFM greater than 1800, you can use two side returns, one side and the bottom, or one side return with a transition to allow use of a 20 x 25 filter.

SIDE RETURN

Locate the L-shaped corner locators. These indicate the size of the cutout to be made in the furnace side panel. See Figure 9.

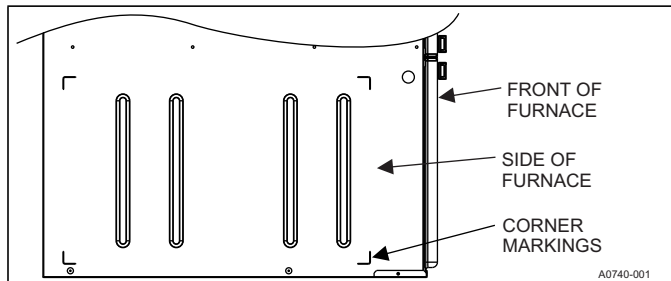


FIGURE 9: Side Return Cutout Markings

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

IMPORTANT: Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with that accessory for side opening requirements. Do not cut the opening larger than the dimensions for the "Optional Return Air Cutout" shown in Figure 8.

HORIZONTAL FILTERS

Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum before the filter. The use of straps and/or supports is required to support the weight of the external filter box.

DOWNFLOW FILTERS

Downflow furnaces are typically installed with the filters located above the furnace, extending into the return air plenum or duct. Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum above the filter height.

Filter(s) can be located in the duct system external to the furnace using an external duct filter box attached to the furnace plenum or at the end of the duct in a return filter grille(s). The use of straps and/or supports is required to support the weight of the external filter box.

SECTION IV: GAS PIPING

GAS SAFETY

⚠ DANGER

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

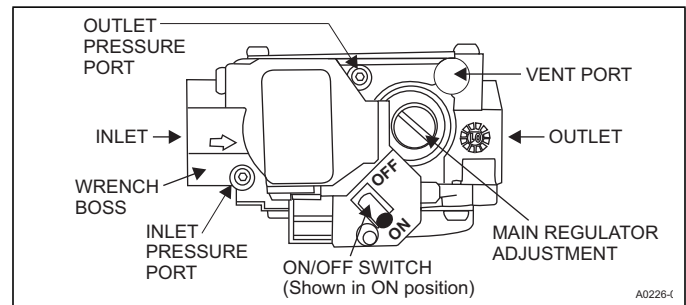


FIGURE 10: Gas Valve

IMPORTANT: Plan the gas supply routing before determining the correct gas pipe entry. Use 90° conventional elbow(s) and short pipe nipples to enter through the cabinet access holes.

GAS PIPING INSTALLATION

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

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. See Figure 12.

For left side supply gas pipe arrangement, two 1/2 in. elbows and two 1/2 in. x 1-1/2 in. pipe nipples must be used. The arrangement shown in Figure 11 aligns entrance hole in furnace casing with supply gas pipe. Furnace casing does not support installations completed using street-elbows.

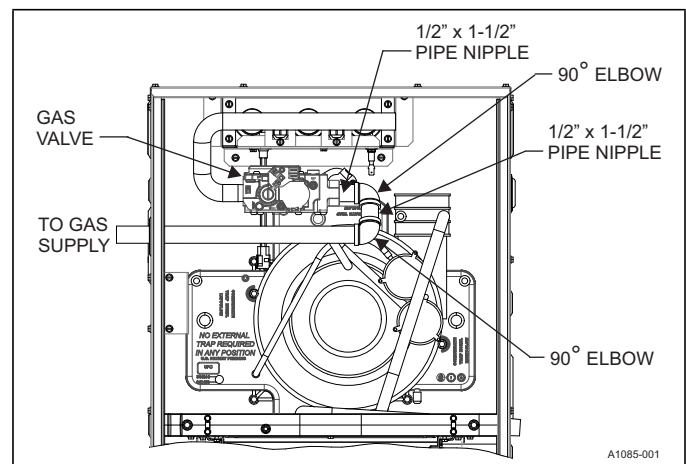


FIGURE 11: Left Side Supply Gas Pipe Arrangement

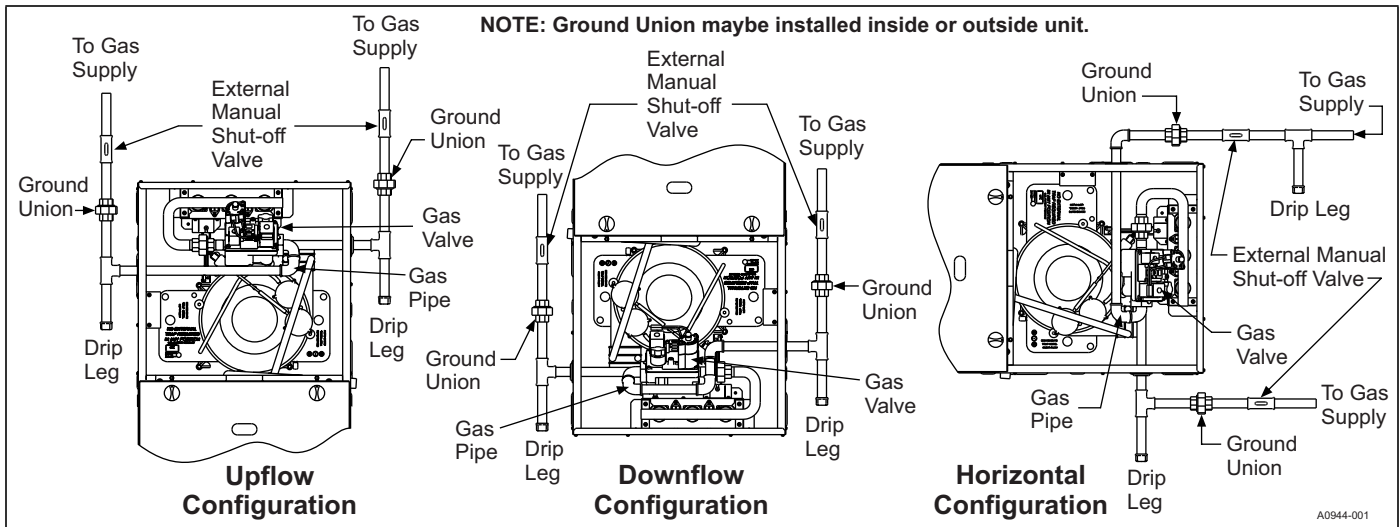


FIGURE 12: Gas Piping

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

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 0.5 psig (3.5 kPa).

⚠ CAUTION

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

Gas piping can be connected from either side of the furnace using any of the gas pipe entry knockouts on both sides of the furnace. See Figures 8 and 12.

Table 4: Nominal Manifold Pressure - High Fire

Gas Heating Value (BTU/cu ft.)	Manifold Pressures		
	Altitude (ft)		
	0-7999	8000-8999	9000-9999
	in. W.C.	in. W.C.	in. W.C.
800	3.5	3.5	3.5
850	3.5	3.5	3.5
900	3.5	3.5	3.5
950	3.5	3.5	3.3
1000	3.5	3.2	2.9
1050	3.5	2.9	2.7
1100	3.2	2.7	2.4
2500 (LP)	9.8	8.2	7.5

GAS ORIFICE CONVERSION FOR PROPANE (LP)

This furnace is constructed at the factory for natural gas-fired operation, but can be converted to operate on propane (LP) gas by using a factory-supplied LP conversion kit. Follow the instructions supplied with the LP kit.

HIGH ALTITUDE GAS ORIFICE CONVERSION

This furnace is constructed at the factory for natural gas-fired operation at 0 ft to 7,999 ft (0 m to 2,438 m) above sea level.

The manifold pressure must be changed in order to maintain proper and safe operation when the furnace is installed in a location where the altitude is greater than 7,999 ft (2,438 m) above sea level. See Table 4 for proper manifold pressure settings.

HIGH ALTITUDE PRESSURE SWITCH CONVERSION

For installation where the altitude is less than 5,000 ft (1,524 m), it is not required to change the pressure switch unless you are in an area subject to low pressure inversions.

Gas Heating Value (MJ/cu m)	Manifold Pressures		
	Altitude (m)		
	0-2437	2438-2742	2743-3048
	kPa	kPa	kPa
29.8	0.87	0.87	0.87
31.7	0.87	0.87	0.87
33.5	0.87	0.87	0.87
35.4	0.87	0.87	0.81
37.3	0.87	0.80	0.73
39.1	0.87	0.73	0.67
41.0	0.80	0.66	0.61
93.2 (LP)	2.44	2.03	1.86

⚠ DANGER

PROPANE AND HIGH ALTITUDE CONVERSION KITS

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

Only use natural gas in furnaces designed for natural gas. Only use propane (LP) gas for furnaces that have been properly converted to use propane (LP) gas. Do not use this furnace with butane gas.

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

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

An authorized distributor or dealer must make all gas conversions.

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

SECTION V: ELECTRICAL POWER

ELECTRICAL POWER CONNECTIONS

Field wiring to the unit must be grounded. Electric wires that are field installed must conform to the temperature limitation for 63°F (35°C) rise wire specified in these instructions. See Table 5 for specific furnace electrical data.

⚠ CAUTION

Use copper conductors only.

Table 5: Ratings and Physical/Electrical Data - TM9E

Input		Output		Nominal Airflow		AFUE	Air Temperature Rise		Maximum Outlet Air Temperature		Blower		Blower Size	Recommended Fuse or Circuit Breaker	Total Unit	Gas Pipe Connection, NPT
MBH	kW	MBH	kW	CFM	m ³ /min	%	°F	°C	°F	°C	HP	A	in.	A	A	in.
40	11.7	38	11.1	1000	28.3	95.0	30–60	17–33	190	88	1/2	6.8	11 x 8	15	10.4	1/2
60	17.6	57	16.7	1000	28.3	95.0	35–65	19–36	190	88	1/2	6.8	11 x 8	15	10.4	1/2
60	17.6	57	16.7	1200	34.0	95.0	30–60	17–33	190	88	1/2	6.8	11 x 8	15	10.4	1/2
80	23.4	76	22.3	1200	34.0	95.0	40–70	22–39	190	88	1/2	6.8	11 x 8	15	10.4	1/2
80	23.4	76	22.3	1600	45.3	95.0	40–70	19–36	190	88	5/8	8.0	11 x 10	15	11.6	1/2
80	23.4	76	22.3	2000	56.6	95.0	30–60	17–33	190	88	1	10.9	11 x 11	20	14.5	1/2
100	29.3	95	27.8	1600	45.3	95.0	40–70	22–39	190	88	5/8	8.0	11 x 10	15	11.6	1/2
100	29.3	95	27.8	2000	56.6	95.0	35–65	19–36	190	88	1	10.9	11 x 11	20	14.5	1/2
120	35.1	114	33.4	2000	56.6	95.0	45–75	25–42	190	88	1	10.9	11 x 11	20	14.5	1/2

Notes:

Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE Test procedures.

Wire size and overcurrent protection must comply with the National Electrical Code (NFPA-70-latest edition) and all local codes.

The furnace must be installed so the electrical components are protected from water.

SUPPLY VOLTAGE CONNECTIONS

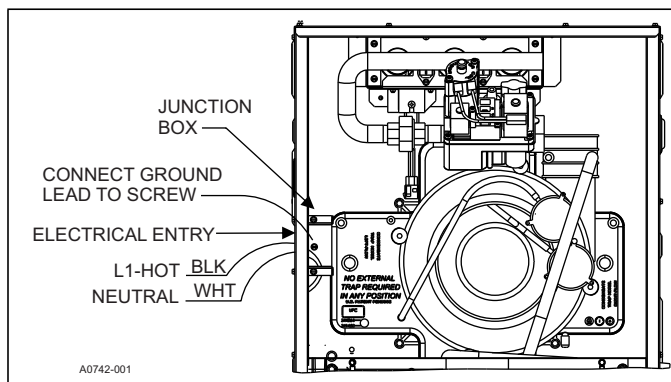


FIGURE 13: Electrical Wiring

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

2. Remove the wiring box cover screws. Route all power wiring through a conduit connector or other proper bushing that is field installed into the unit opening and the junction box. In the junction box, there is a black wire, a white wire, and a green ground screw. Connect the power supply as shown on the unit's wiring label located on the inside of the blower compartment door, or the wiring schematic in this section. Connect the black wire to L1 (hot) from the power supply. Connect the white wire to neutral. Connect the ground wire (installer-supplied) to the green (equipment ground) screw. An alternate wiring method is to use a field-provided 2 in. (5.1 cm) x 4 in. (10.2 cm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel. After making the wiring connections, replace the wiring box cover and screws. See Figure 13.
3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. See Figure 13.

IMPORTANT: The power connection leads and wiring box can be relocated to the opposite side of the furnace. Remove the screws and cut wire tie holding excess wiring. Reposition on the opposite side of the furnace and fasten using holes provided.

LOW VOLTAGE CONTROL WIRING CONNECTIONS

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the terminal board on the ignition module, as shown in Figures 14 and 15. Electronic thermostats require the common wire to be connected. Apply strain relief to thermostat wires passing through cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the furnace control board to the proper wires on the outdoor unit.

IMPORTANT: Set the heat anticipator in the room thermostat to 0.4 A. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the set points.

IMPORTANT: Some electronic thermostats do not have adjustable heat anticipators. They must be set to six cycles per hour. Follow the thermostat manufacturer's instructions.

The 24 V, 40 VA transformer is sized for the furnace components only, and must not be connected to power auxiliary devices such as humidifiers or air cleaners. The transformer can provide power for an outdoor heat pump or air conditioning unit.

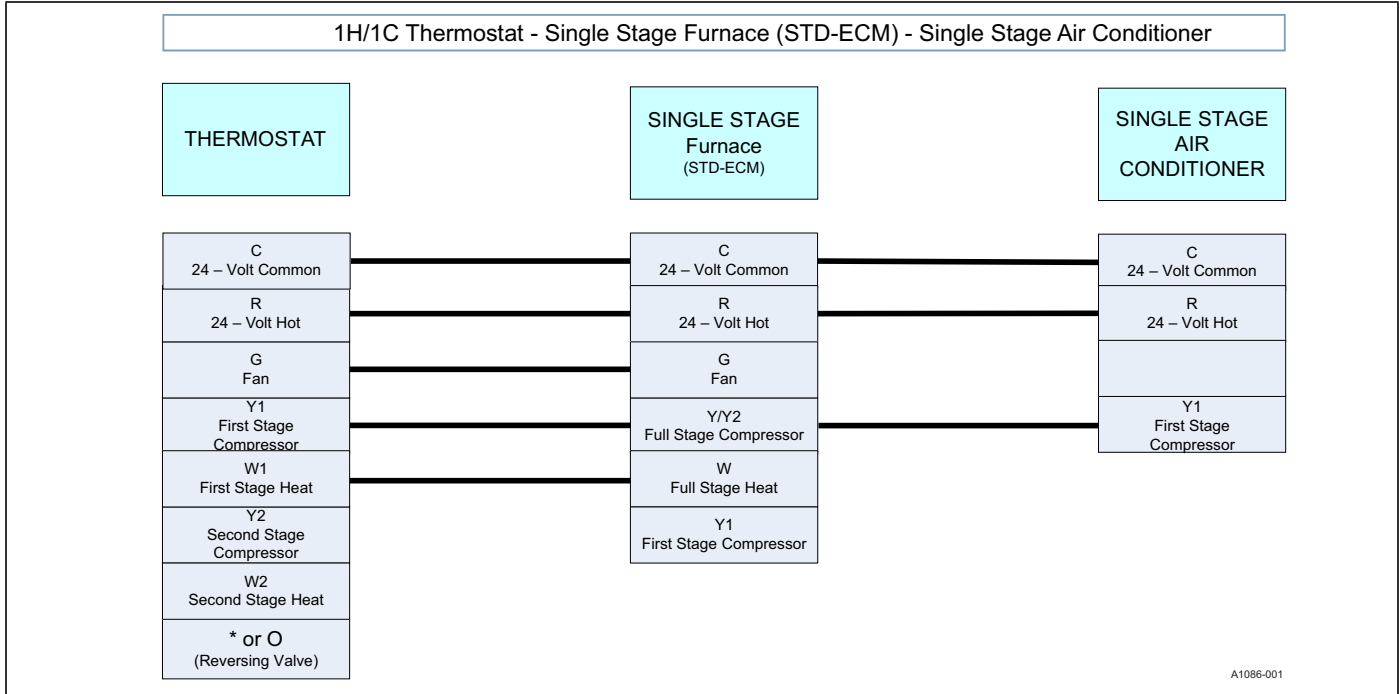


FIGURE 14: Thermostat Chart - 1H/1C - Single Stage Furnace (STD-ECM) - Single Stage Air Conditioner

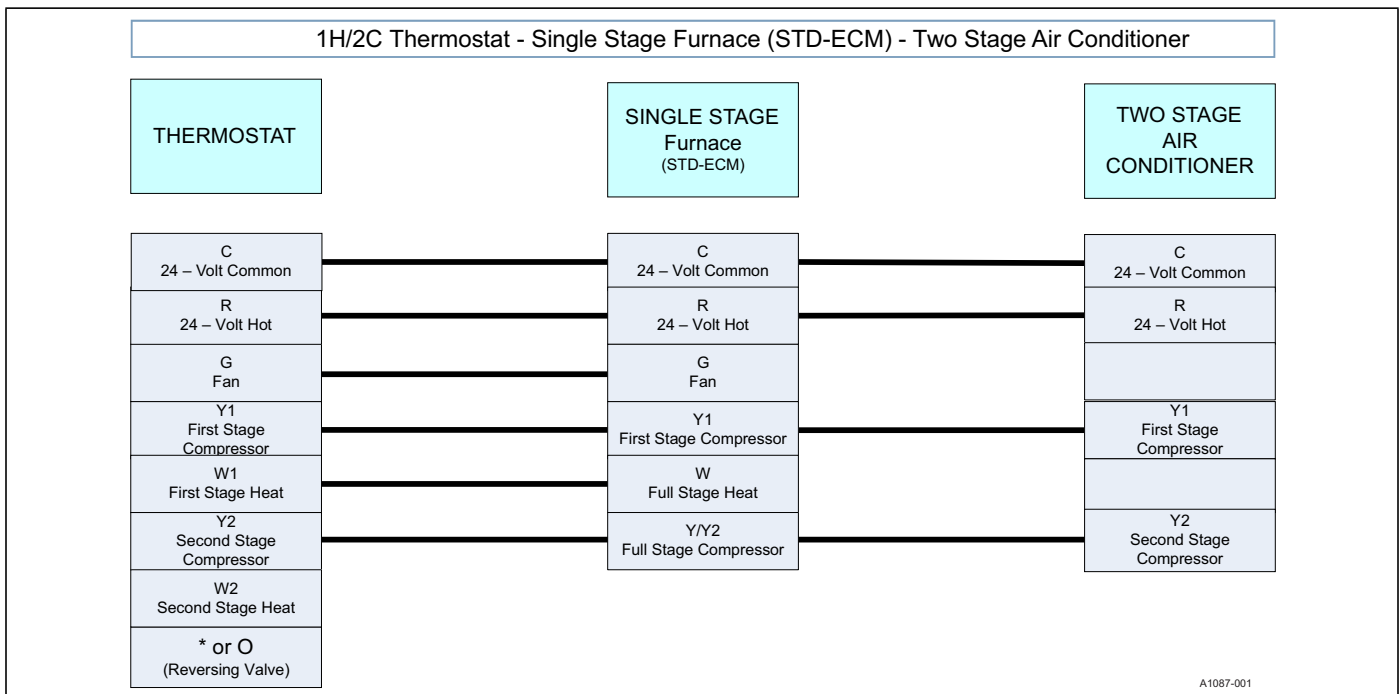


FIGURE 15: Thermostat Chart - 1H/2C - Single Stage Furnace (STD-ECM) - Two Stage Air Conditioner

ACCESSORY CONNECTIONS

The furnace control will allow power-switching control of various accessories.

ELECTRONIC AIR CLEANER CONNECTION

Two 1/4 in. (6.4 mm) spade terminals (EAC and NEUTRAL) for electronic air cleaner connections are located on the control board. The terminals provide 115 VAC (1.0 A maximum) during circulating blower operation.

HUMIDIFIER CONNECTION

Two 1/4 in. (6.4 mm) spade terminals (HUM and NEUTRAL) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 A maximum) during heating system operation.

A mounting hole is provided on the control panel next to the furnace control board for mounting a humidifier transformer if required.

SECTION VI: TWINNING AND STAGING

NOTICE

For twinning applications, Source 1 twinning kit S1-33103764000 MUST be used.

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem (as long as the two furnaces have the same model number). When two identical furnaces are installed using the same duct system, it is very important that the two furnace circulating air blowers operate simultaneously at all times. If one blower starts before the second blower, the duct system will become pressurized and the blower on the second furnace may turn backwards causing the second furnace to overheat, resulting in damage to the furnace. Twinning is used to make two furnaces operate in tandem, using one duct system and one room thermostat and causing both furnaces blowers to turn on and off simultaneously.

TWINNING DUCT SYSTEM

Twinning furnaces must only be applied on a common duct system. A single air supply plenum must be used for both furnaces and indoor coil(s). Separate plenums and supply ducts systems cannot be utilized. A single return air plenum, common to both furnaces, must be used. It is suggested that a return platform be utilized, with bottom air entrance into each furnace. If a side entrance return system is used, the common return duct must be divided equally so as to supply each furnace with an equal amount of return air.

Both furnaces must be identical models in both heating capacity and CFM capacity. Both furnaces must be operated on the same motor speed taps. Detailed and specific indoor blower motor wiring and control wiring information can be found in Source 1 twinning kit S1-33103764000 installation instructions. See Figure 16 for a typical application.

If furnace staging is required with two single stage furnaces on a common duct, where the gas burner on the first furnace operates on W1 and the gas burner on the second furnace operates on W2, the use of an air-mixing device in the plenum to mix the air from both furnaces is strongly recommended. The mixing device must be installed before any ducts that supply air to occupied spaces. Twinning causes both indoor fans to operate simultaneously. If a mixing device is not used, any ducts that are connected down stream from the furnace that is not operating in heat mode supply cold air to the occupied spaces.

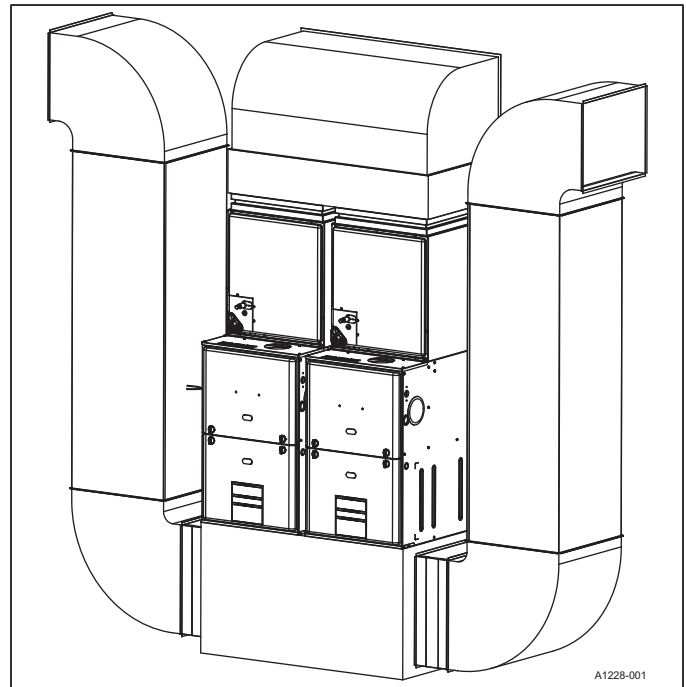


FIGURE 16: Twinning Furnaces

CAUTION

If a return duct is connected to only one furnace (with a connection between the two furnaces) an imbalance in the airflow will occur and the furnace furthest from the return plenum will overheat.

SECTION VII: CONDENSATE PIPING AND FURNACE VENTING CONFIGURATION

CONDENSATE DRAIN LOCATION

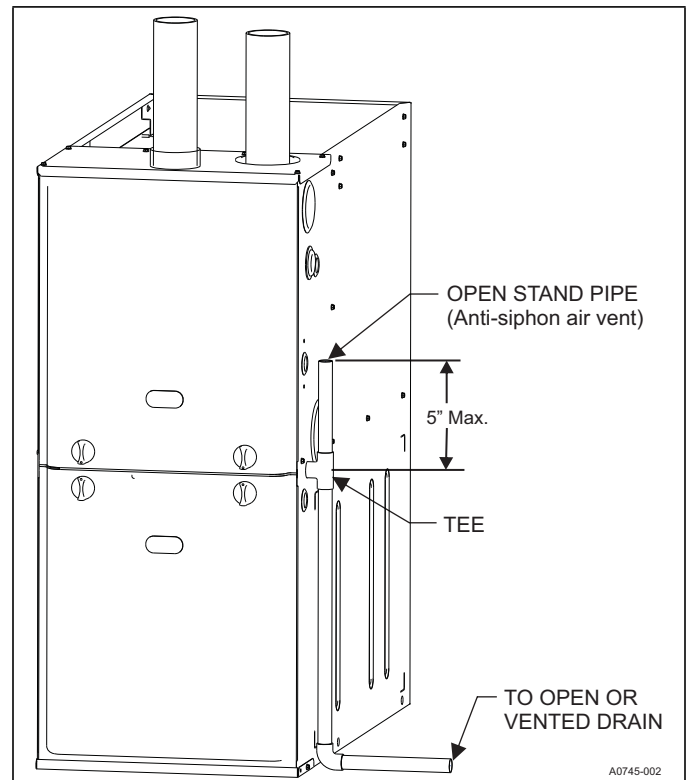


FIGURE 17: Typical - Condensate Drain, Vertical Installation

As shipped from the factory:

- For all 040K, 060K, and 080K input furnaces, the main drain is plumbed through the casing right-side opening when viewed from the front of the furnace.
- For all 100K and 120K input furnaces, the main drain is plumbed through the casing left-side opening when viewed from the front of the furnace.

NOTICE

Figures 18 to 21 show the condensate drain arrangement for the various possible furnace and vent blower positions.

The condensate hoses must slope downwards at all points.

⚠ CAUTION

The furnace condensate pan is self priming and contains an internal trap to prevent flue gas leaking. Do not install an external condensate trap.

When drain hose routing changes are required (shown in Figures 18 to 21), be sure to cap all unused openings.

If rerouting hoses, cut off excess length so no sagging loops collect and hold condensate, as this causes the furnace to not operate.

No hose clamps are needed for connecting to the condensate pan.

IMPORTANT: The furnace, indoor coil, and humidifier drains can be combined and drained together. The evaporator coil drain can have an external, field-supplied trap prior to the furnace drain connection to prevent conditioned air leakage. All drain connections (furnace, indoor coil, or humidifier) must be terminated into an open or vented drain as close to the respective equipment as possible. Regular maintenance is required on condensate drainage system.

IMPORTANT: Condensate must be disposed of properly. Follow local plumbing or wastewater codes. The drain line must maintain a 1/4 in. per foot (20 mm/m) downward slope to the drain.

IMPORTANT: If an external vent tee is being installed, then it must have its own condensate trap before it is disposed into an open or vented drain. **This is not to be considered as a second trap as referenced elsewhere in this document.**

The condensate will flow to the drain better if an open stand pipe is installed in the drain line. See Figure 17.

Do not drain other devices (for example, humidifier or indoor coil) into the top opening of the vent stand pipe. Instead, install a second tee in the vented drain tube below the furnace drain tee and route additional drainage through the new tee.

NOTICE

A loop has been added to the pressure switch vacuum hose. However, ensure that all pressure switch hoses are routed such that they prevent any condensate from entering the pressure switch.

⚠ CAUTION

It is possible for condensation to form inside the combustion air (intake) pipe in the summer months if significant length of combustion air pipe passes through conditioned space. This problem can be averted by installing the supplied vent drain and drain hose located in the loose parts bag. The intake drain hose is to be installed by connecting it to the inlet pipe coupling and to the collector box as shown in Figures 18, 20, and 21. The drain hose must not sag or droop after it is installed. If glue is used when connecting the intake pipe to the intake coupling, the drain opening in the vent drain must not be plugged. If the intake drain is used, the bird screen **cannot** be installed. This is only approved for upflow and horizontal applications when the intake pipe is located on the top of the furnace. This is true for all long horizontal venting in any furnace configuration. This will keep condensate from entering the furnace.

CONDENSATE DRAIN TERMINATION

A condensate sump pump **MUST** be used if required by local codes, or if no indoor floor drain is available. The condensate sump pump must be approved for use with acidic condensate.

⚠ WARNING

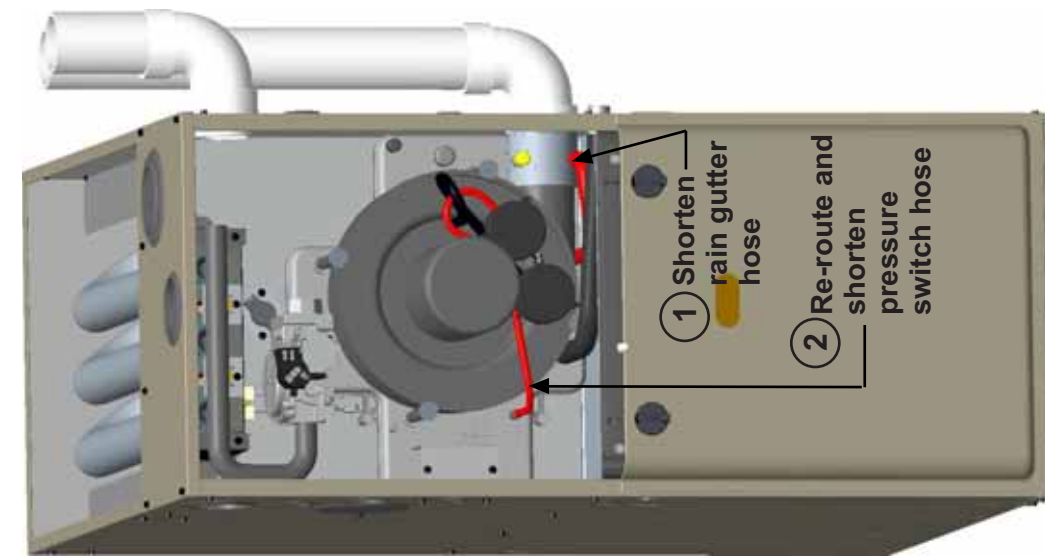
DO NOT terminate the condensate drain in a chimney, or where the drain line may freeze. If the drain line will be exposed to temperatures below freezing, adequate measures must be taken to prevent the drain line from freezing. Failure to provide proper protection from freezing can result in improper operation or damage to the equipment and possible property damage. When exposed to temperatures below freezing, use of a 3 to 6 watt per foot at 115 VAC, 40°F (4.4°C) self-regulating, shielded and waterproof heat tape is recommended on the drain line outside the furnace.

DO NOT trap the drain line at any location. The furnace has a condensate drain trap built into the drain pan.

⚠ WARNING

Liquid anti-freeze will cause damage to internal plastic parts of this furnace. **DO NOT attempt to winterize the furnace using liquid anti-freeze.**

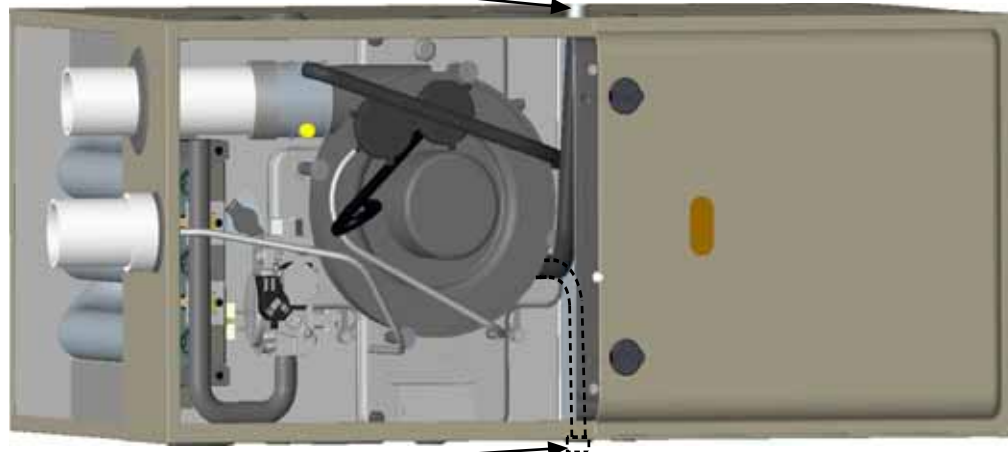
When drain hose routing changes are required, be sure to cap all un-used openings. If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.



INDUCER ROTATED FOR RIGHT SIDE VENTING

A0789-001

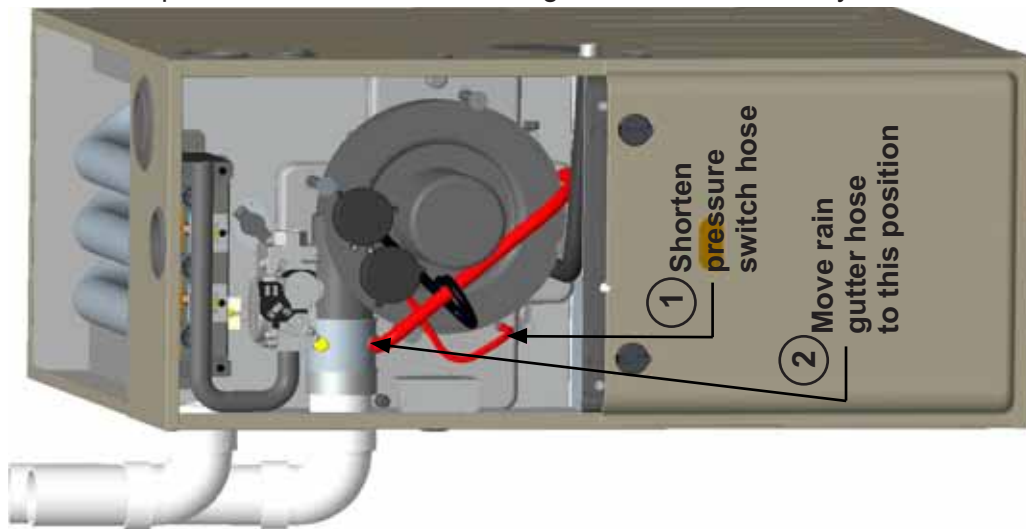
For 040, 060 & 080K input furnaces, the condensate drain is plumbed toward the right casing outlet from the factory.



UPFLOW AS RECEIVED

Condensate drain may exit cabinet on either side.

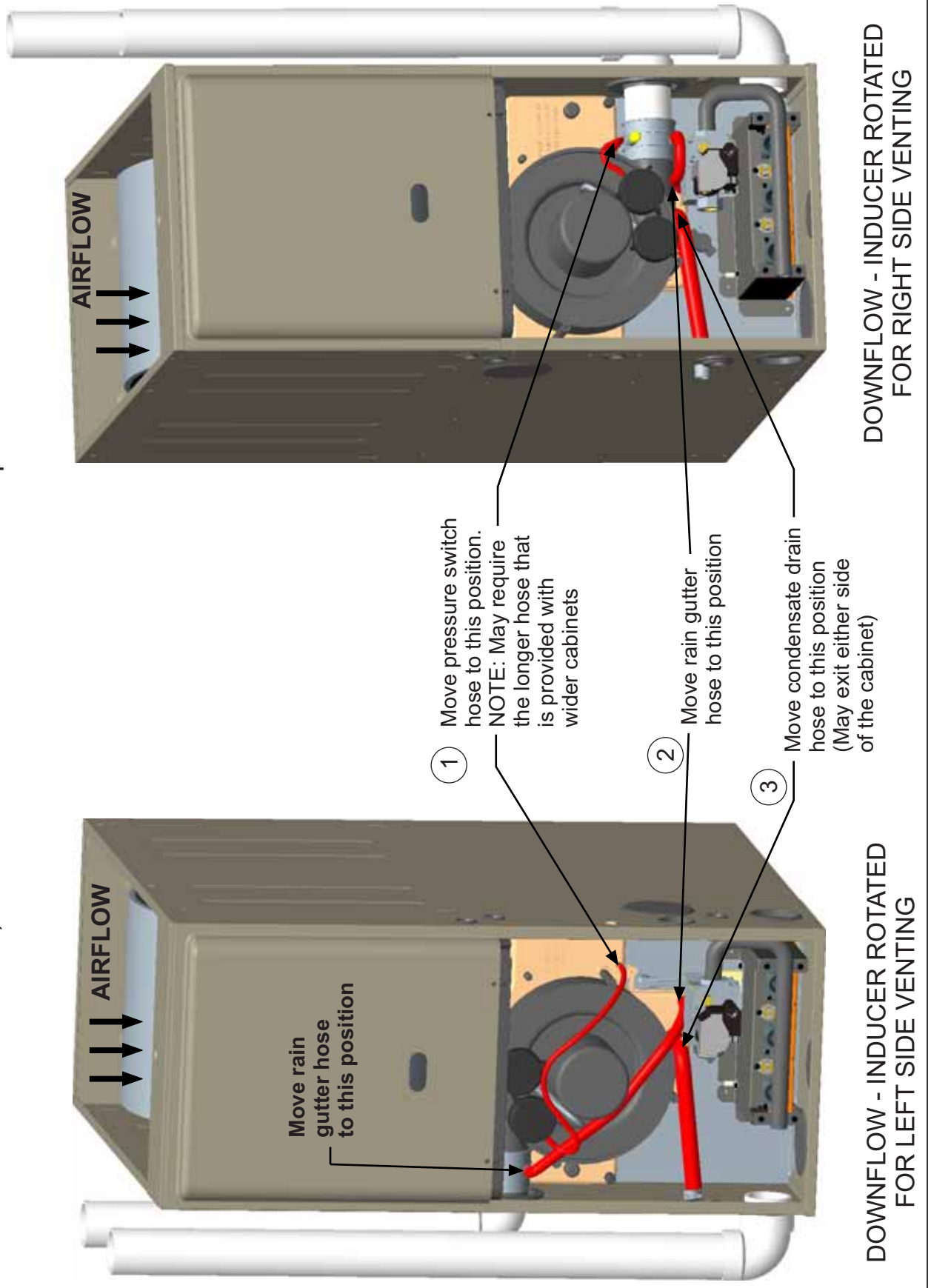
For 100 & 120 input furnaces, the condensate drain is plumbed toward the left casing outlet from the factory.



INDUCER ROTATED FOR LEFT SIDE VENTING

FIGURE 18: Upflow Configuration

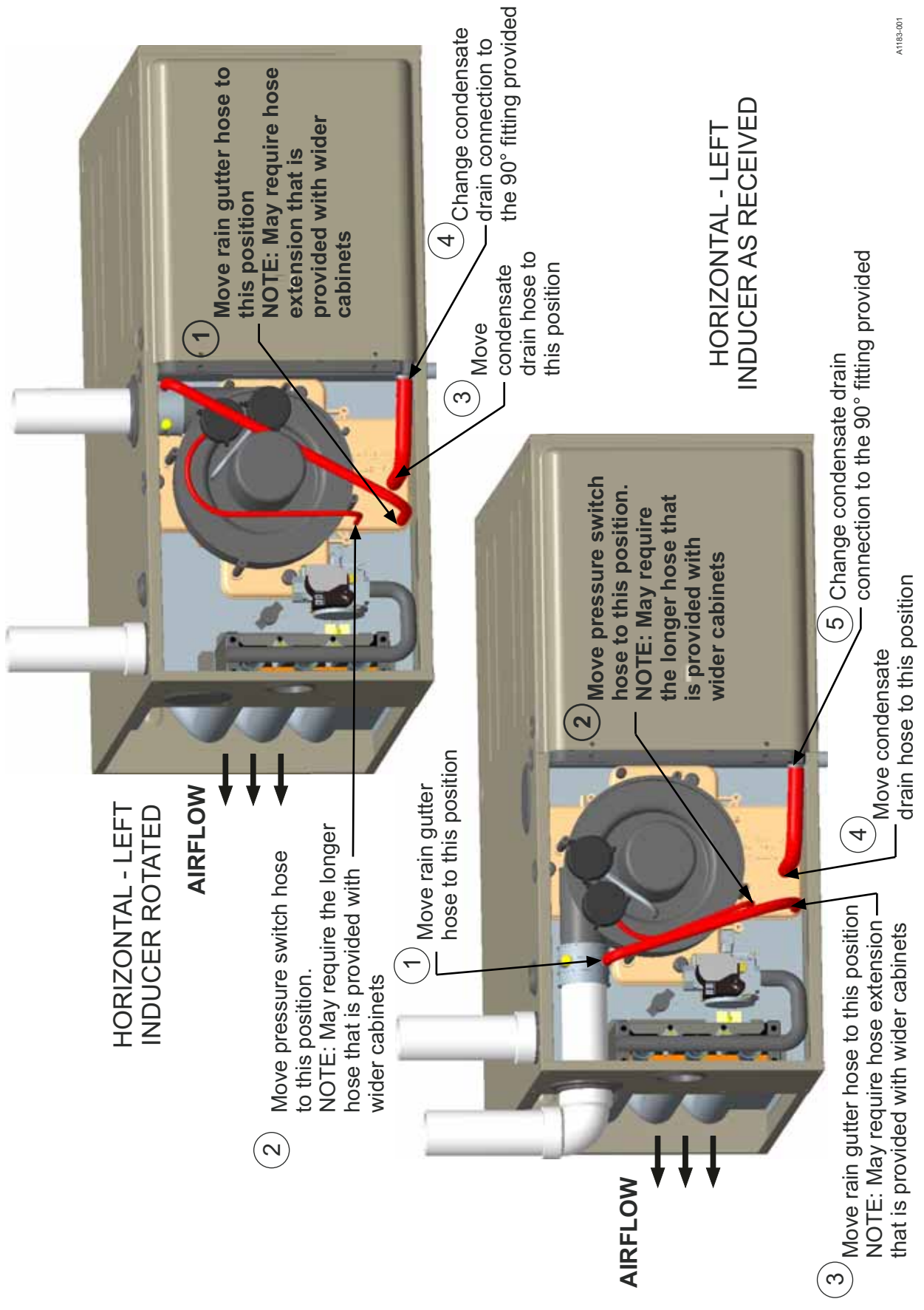
When drain hose routing changes are required, be sure to cap all un-used openings. If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.



A0747-001

FIGURE 19: Downflow Configuration

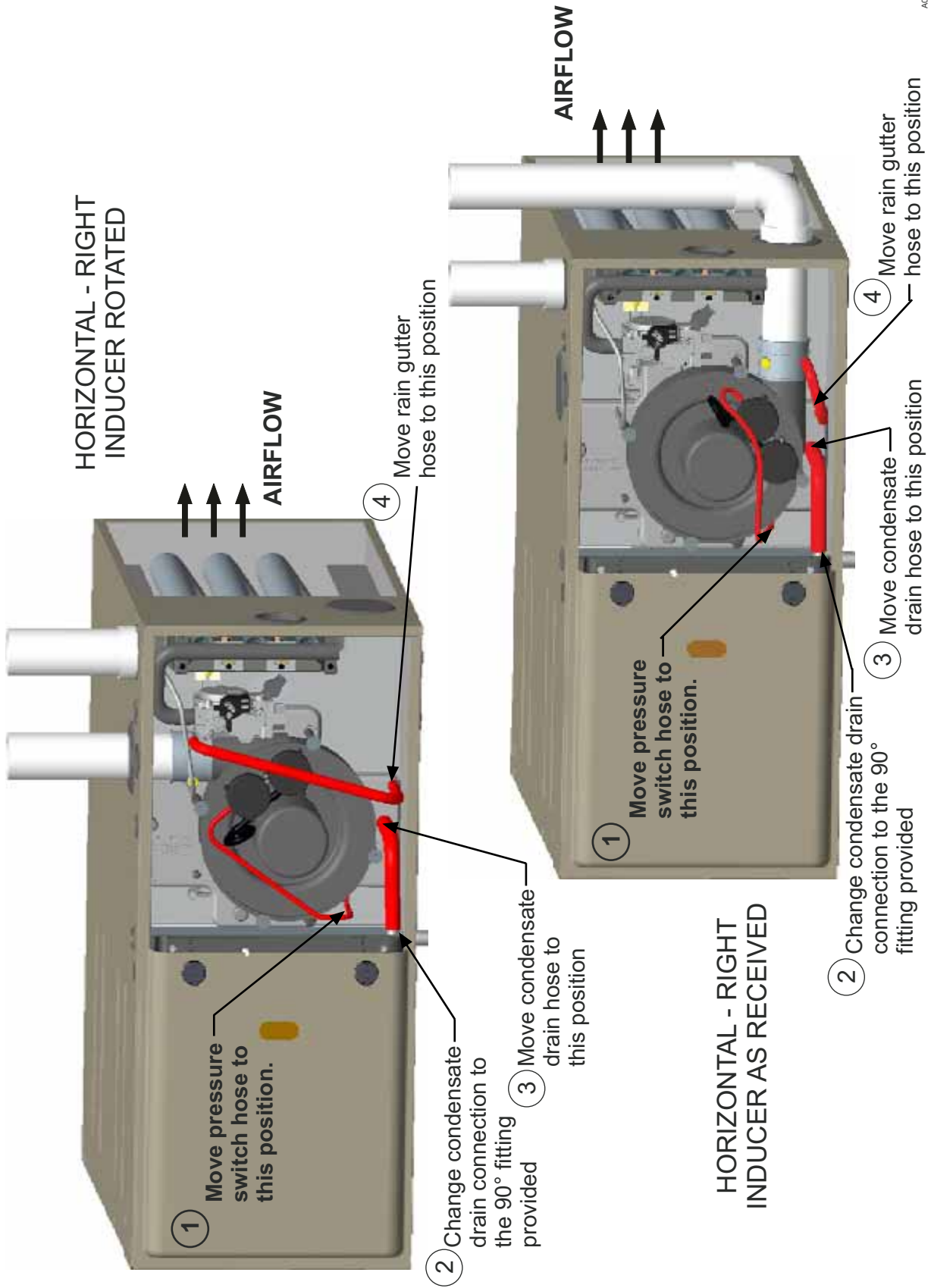
When drain hose routing changes are required, be sure to cap all un-used openings. If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.



A1183-001

FIGURE 20: Horizontal Left Configuration

When drain hose routing changes are required, be sure to cap all un-used openings. If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.



A0888-002

FIGURE 21: Horizontal Right Configuration

SECTION VIII: COMBUSTION AIR AND VENT SYSTEM

COMBUSTION AIR AND VENT SAFETY

This Category IV, dual certified direct vent furnace is designed for residential application. It can be installed without modification to the condensate system in a basement, garage, equipment room, alcove, attic, or any other indoor location where all required clearance to combustibles and other restrictions are met. The combustion air and the venting system must be installed in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition), or Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition), or applicable provisions of the local building code, and these instructions.

IMPORTANT: The "VENT SYSTEM" must be installed as specified in these instructions for Residential and non-HUD Modular Homes. The direct vent system is the only configuration that can be installed in a non-HUD Modular Home.

⚠ WARNING

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

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

⚠ CAUTION

When combustion air pipe is installed above a suspended ceiling or when it passes through a warm and humid space, the pipe may need insulated if two feet or more of pipe is exposed.

Vent piping must be insulated if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.

COMBUSTION AIR/VENT PIPE SIZING

The size of pipe required will be determined by the furnace model, the total length of pipe required and the number of elbows required.

Table 6 lists the maximum equivalent length of pipe allowed for each model of furnace. The equivalent length of pipe for each elbow installed is listed in Table 9. The equivalent length of the vent system is the total length of straight pipe PLUS the equivalent length of all of the elbows.

Adhere to the following rules:

- Drain, waste, and vent (DWV) elbows with a long radius (sweep) are recommended. Standard DWV elbows can be used, but since they have a longer equivalent length, they will reduce the total length of pipe that will be allowed. Short radius (plumbing or pressure) elbows are not allowed for venting. The standard dimensions of the acceptable elbows are shown in Figure 22.
- The maximum equivalent length listed in Table 6 is for the vent piping and the air intake piping separately. For example, if the table allows 65 equivalent ft for a particular model, the vent can have 65 equivalent ft of pipe, AND the combustion air intake can have another 65 equivalent ft of pipe.
- Three vent terminal elbows (two for the vent and one for the combustion air intake) are already accounted for and need not be included in the equivalent length calculation.

- All PVC or ABS combustion air and vent pipe must conform to American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), F891 (PVC-DWV Cellular Core), D2261 (ABS-DWV) or F628 (Schedule 40 ABS). Pipe cement and primer must conform to ASTM Standard D2546 (PVC) or D2235 (ABS). If ABS pipe is to be used, any joint where ABS pipe is joined to PVC pipe must be glued with cement that is approved for use with BOTH materials. Metallic materials must not be used for venting or air intake.
- If a flexible connector is used in the vent system, it must be made of a material that is resistant to acidic exposure and to at least 225°F (107°C) temperature. Flexible connectors are also allowed in the combustion air pipe.
- All models are supplied with 2 in. (5.1 cm) vent connections. When the pipe must be increased to 3 in. (7.6 cm) diameter, the transition from 2 in. to 3 in. must be done as close to the furnace as possible. The 2 in. to 3 in. increase must be installed in the vertical position to avoid creating an area that will pool water.
- In Canada, vents must be certified to ULC S636, Standard for Type BH Gas Venting Systems.
- In Canada, the first 3 ft (91.4 cm) of the vent must be readily accessible for inspection.
- For single pipe systems, it is best practice to install the combustion air coupling provided and install approximately 18 in. (46 cm) of PVC pipe on the furnace.
- Minimum vent length for all models is 5 ft (1.5 m).

POLYPROPYLENE VENT/INTAKE PIPING

The ULC S636 approved polypropylene (PP) vent piping materials listed below have been tested and approved for use with this furnace. DO NOT mix parts made by different manufacturers. The entire vent/air intake system must be made from pipe, fittings and termination made by the same manufacturer. Only single-wall rigid polypropylene pipe is approved for these furnaces. Use of flexible polypropylene pipe is not allowed.

Selkirk Polyflue (Hart & Cooley) part numbers

- Horizontal concentric termination - 2 in. - 2PF-HCT
- Horizontal concentric termination - 3 in. - 3PF-HCT
- Locking band - PF-LB

Consult the Polyflue installation instructions for assembly details.

For other Polyflue pipe and fitting part numbers, visit the website www.polyflue.com

Duravent Polypro part numbers

- Adapter to air intake coupling - 2PPS-ADL
- Adapter connector - PPS-PAC
- Twin pipe horizontal termination - 2 in. - 2PPS-HTPL
- Twin pipe horizontal termination - 3 in. - 3PPS-HTPL

Consult the Polypro installation instructions for assembly details.

For other Polypro pipe and fitting part numbers, visit the website www.duravent.com

Centrotherm Innoflue

- Adapter to air intake coupling - ISAGL0202
- Adapter to draft inducer blower - ISAAL0202
- Low profile wall termination - 2 in. - ISLPT0202
- Low profile wall termination - 3 in. - ISLPT0303

Consult the Innoflue installation instructions for assembly details.

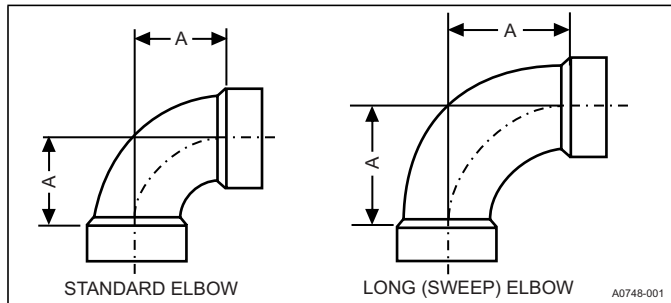
For other Innoflue pipe and fitting part numbers, visit the website www.centrotherm.us.com

Table 6: Maximum Equivalent Pipe Length - TM9E

Elevation Sea Level–2000			Elevation 6001–7000		
Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)	Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)
40,000	2	65	40,000	2	40
40,000	3	90	40,000	3	65
40,000	4	150	40,000	4	130
60,000	2	65	60,000	2	40
60,000	3	90	60,000	3	65
60,000	4	150	60,000	4	130
80,000	2	65	80,000	2	30
80,000	3	90	80,000	3	65
80,000	4	150	80,000	4	130
100,000	2	30	100,000	2	5
100,000	3	90	100,000	3	65
100,000	4	150	100,000	4	130
120,000	3	90	120,000	3	65
120,000	4	150	120,000	4	130
Elevation 2001–4000			Elevation 7001–8000		
Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)	Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)
40,000	2	55	40,000	2	35
40,000	3	80	40,000	3	60
40,000	4	145	40,000	4	125
60,000	2	55	60,000	2	35
60,000	3	80	60,000	3	60
60,000	4	145	60,000	4	125
80,000	2	55	80,000	2	25
80,000	3	80	80,000	3	60
80,000	4	145	80,000	4	125
100,000	2	20	100,000	2	NA
100,000	3	80	100,000	3	60
100,000	4	145	100,000	4	125
120,000	3	80	120,000	3	60
120,000	4	145	120,000	4	125
Elevation 4001–5000			Elevation 8001–9000		
Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)	Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)
40,000	2	50	40,000	2	30
40,000	3	75	40,000	3	55
40,000	4	140	40,000	4	120
60,000	2	50	60,000	2	30
60,000	3	75	60,000	3	55
60,000	4	140	60,000	4	120
80,000	2	50	80,000	2	20
80,000	3	75	80,000	3	55
80,000	4	140	80,000	4	120
100,000	2	15	100,000	2	NA
100,000	3	75	100,000	3	55
100,000	4	140	100,000	4	120
120,000	3	75	120,000	3	55
120,000	4	140	120,000	4	120
Elevation 5001–6000			Elevation 9001–10000		
Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)	Model Input (BTUH)	Pipe Size (in.)	Max. Equivalent Length (ft)
40,000	2	45	40,000	2	25
40,000	3	70	40,000	3	50
40,000	4	135	40,000	4	115
60,000	2	45	60,000	2	25
60,000	3	70	60,000	3	50
60,000	4	135	60,000	4	115
80,000	2	35	80,000	2	15
80,000	3	70	80,000	3	50
80,000	4	135	80,000	4	115
100,000	2	10	100,000	2	NA
100,000	3	70	100,000	3	50
100,000	4	135	100,000	4	115
120,000	3	70	120,000	3	50
120,000	4	135	120,000	4	115

Table 7: High Altitude Pressure Switches - TM9E

High Altitude Pressure Switches Required for all Installations Above 5000 ft	
Part Number	Models
S1-1PS3302	100k, 120k
S1-1PS3306	60k
S1-1PS3307	40k, 80k

**FIGURE 22:** Elbow Dimensions**TABLE 8:** Elbow Dimensions

Elbow	A Dimension (Illustrated in Figure 22)
2 in. standard	2-5/16 in.
3 in. standard	3-1/16 in.
2 in. sweep	3-1/4 in.
3 in. sweep	4-1/16 in.

Note: Dimensions are those required in Standard ASTM D-3311.

TABLE 9: Equivalent Length of Fittings

Fitting	Equivalent Length
2 in. 90° sweep elbow	5 ft of 2 in. pipe
2 in. 45° sweep elbow	2-1/2 ft of 2 in. pipe
2 in. 90° standard elbow	7 ft of 2 in. pipe
2 in. 45° standard elbow	3-1/2 ft of 2 in. pipe
3 in. 90° sweep elbow	5 ft of 3 in. pipe
3 in. 45° sweep elbow	2-1/2 ft of 3 in. pipe
3 in. 90° standard elbow	7 ft of 3 in. pipe
3 in. 45° standard elbow	3-1/2 ft of 3 in. pipe
4 in. 90° elbow (sweep or standard)	5 ft of 4 in. pipe
4 in. 45° elbow (sweep or standard)	2-1/2 ft of 4 in. pipe
2 in. corrugated connector	10 ft of 2 in. pipe
3 in. corrugated connector	10 ft of 3 in. pipe
4 in. corrugated connector	10 ft of 4 in. pipe

Example:

An 80,000 BTUH furnace requires 32 ft of pipe and five 90° elbows. Using 2 in. pipe and standard elbows, the total equivalent length is:

$$\begin{array}{r}
 32 \text{ ft of 2 in. pipe} = 32 \text{ equivalent ft} \\
 5 - 90^\circ \text{ standard 2 in. elbows} = (5 \times 7) = 35 \text{ equivalent ft} \\
 \hline
 \text{Total} = 67 \text{ equivalent ft of 2 in. pipe}
 \end{array}$$

This exceeds the 65 ft maximum equivalent length of 2 in. pipe allowed for that model and is not acceptable.

By using sweep elbows, the total equivalent length is:

$$\begin{array}{r}
 32 \text{ ft of 2 in. pipe} = 32 \text{ equivalent ft} \\
 5 - 90^\circ \text{ sweep 2 in. elbows} = (5 \times 5) = 25 \text{ equivalent ft} \\
 \hline
 \text{Total} = 57 \text{ equivalent ft of 2 in. pipe}
 \end{array}$$

This is less than the 65 ft maximum equivalent length of 2 in. pipe allowed for that model and is acceptable.

Alternatively, using 3 in. pipe and standard elbows, the total equivalent length is:

$$\begin{array}{r}
 32 \text{ ft of 3 in. pipe} = 32 \text{ equivalent ft} \\
 5 - 90^\circ \text{ standard 3 in. elbows} = (5 \times 7) = 35 \text{ equivalent ft} \\
 \hline
 \text{Total} = 67 \text{ equivalent ft of 3 in. pipe}
 \end{array}$$

This is less than the 90 ft maximum equivalent length of 3 in. pipe allowed for that model and is acceptable.

TABLE 10: Combustion Air Intake and Vent Connection Size at Furnace (All Models)

FURNACE VENT CONNECTION SIZES	
Furnace Input	All
Intake Pipe Size	2 in. (5.1 cm)
Vent Pipe Size	2 in. (5.1 cm)

IMPORTANT: Furnace vent pipe connections are sized for 2 in. (5.1 cm). pipe. Any pipe size change must be made outside the furnace casing in a vertical pipe section to allow proper drainage of condensate. An offset using two 45° (degree) elbows will be required for plenum clearance when the vent is increased to 3 in. (7.6 cm).

IMPORTANT: Accessory concentric vent / intake termination kits 1CT0302 and 1CT0303, and for Canadian applications 1CT0302-636 and 1CT0303-636 are available and approved for use with these furnaces. Horizontal sidewall vent terminations kits 1HT0901 and 1HT0902 are also approved for use with these furnaces.

COMBUSTION AIR AND VENT PIPING ASSEMBLY

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

1. Cut piping to the proper length beginning at the furnace.
2. Deburr the piping inside and outside.
3. Chamfer (bevel) the outer edges of the piping.
4. Dry-fit the vent piping assembly from the furnace to the outside termination checking for proper fit support and slope.
5. Dry-fit the combustion air piping assembly checking for proper fit, support, and slope on the following systems:
 - a. Sealed combustion air systems from the furnace to the outside termination.
 - b. Ventilated combustion air systems from the furnace to the attic or crawl space termination.

⚠ CAUTION

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

6. Disassemble the combustion air and vent piping, and apply cement primer and the cement per the manufacturer's instructions. Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.
7. All joints must provide a permanent airtight and watertight seal.
8. Install the combustion air and vent piping such that it has a 1/4 in. per foot (21 mm/m) grade so that condensate flows back toward the furnace. Support piping with pipe hangers to prevent sagging.
9. Seal around the openings where the combustion air and / or vent piping pass through the roof or sidewalls.

COMBUSTION AIR/VENTING

IMPORTANT: The vent must be installed with the minimum required clearances, and must comply with local codes and requirements.

VENT CLEARANCES

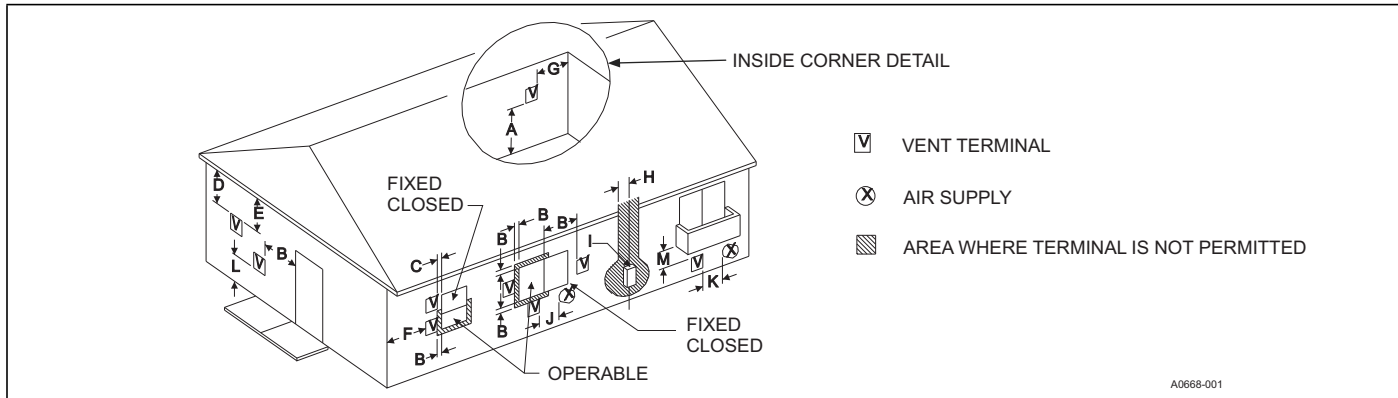


FIGURE 23: Home Layout

Direct Vent Terminal Clearances	Canadian Installations ^{1,3}	US Installation ^{2,3}
A. Clearance above grade, veranda, porch, deck, or balcony	12 in. (30.5 cm)	12 in. (30.5 cm)
B. Clearance to window or door that may be opened	12 in. (30.5 cm) for models ≤100,000 BTUH (30 kW) 36 in. (91.4 cm) for models >100,000 BTUH (30 kW)	Two-pipe (direct vent) applications: 12 in. (30.5 cm)†† Single-pipe applications: 4 ft (1.2 m)
C. Clearance to permanently closed window	12 in. (30.5 cm)	12 in. (30.5 cm)
D. Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier
E. Clearance to unventilated soffit	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier
F. Clearance to outside corner	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier
G. Clearance to inside corner	3 ft (91.4 cm)	3 ft (91.4 cm)
H. Clearance to each side of center line extended above meter/regulator assembly	Above a meter/regulator assembly within 3 ft (91.4 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m) above the meter/regulator assembly	Above a meter/regulator assembly within 3 ft (91.4 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m) above the meter/regulator assembly
I. Clearance to service regulator vent outlet	3 ft (91.4 cm)	3 ft (91.4 cm) or in accordance with local installation codes and the requirements of the gas supplier
J. Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	12 in. (30.5 cm) for models ≤100,000 BTUH (30 kW) 36 in. (91 cm) for models >100,000 BTUH (30 kW)	Two-pipe (direct vent) applications: 12 in. (30.5 cm) Single-pipe applications: 4 ft (1.2 m)
K. Clearance to a mechanical supply inlet	6 ft (1.83 m)	3 ft (91.4 cm) above if within 10 ft (3 m) horizontally.
L. Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) or in accordance with local installation codes and the requirements of the gas supplier
M. Clearance under veranda, porch, deck, or balcony	12 in. (30.5 cm)‡	12 in. (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier

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

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

3. In accordance with the current ANSI Z21.47 * CSA 2.3 American National Standard.

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

†† 12 in. (30.5 cm) up from the bottom edge of the structure for two-pipe (direct vent) applications per ANSI Z223.1 / NFPA 54, National Gas Code.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and the distance between the top of the vent termination and the underside of the veranda, porch, or deck is greater than 12 in. (30.5 cm) as specified in CSA B149.1-00.

A vent must not terminate less than 12 in. (30.5 cm) above a grade level.

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

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

A terminus of a vent must be fitted with a cap in accordance with the vent manufacturer's installation instructions, or in accordance with the installation instructions for a special venting system.

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

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

IMPORTANT: Consideration must be given for degradation of building materials by flue gases. Sidewall termination may require sealing or shielding of building surfaces with a corrosion resistant material to protect against combustion product corrosion. Consideration must be given to wind direction in order to prevent flue products and/or condensate from being blown against the building surfaces. If a metal shield is used it must be a stainless steel material at a minimum dimension of 20 inches (51 cm). It is recommended that a retaining type collar be used that is attached to the building surface to prevent movement of the vent pipe.

VENT SYSTEM

Install this furnace using one of the following vent configurations:

- Horizontal vent system. This vent system can be installed completely horizontal or combinations of horizontal, vertical, or offset using elbows.
- Vertical vent system. This vent system can be installed completely vertical or a combination of horizontal, vertical, or offset using elbows.

VENT APPLICATIONS AND TERMINATION

When selecting the location for a combustion air/vent termination, consider the following:

- Observe all clearances listed in vent clearances in these instructions.
- Termination must be positioned where vent vapors will not damage plants, shrubs, or air conditioning equipment.
- Termination must be located where it is not affected by wind gusts, light snow, or airborne leaves and does not allow recirculation of flue gases.
- Termination must be located where it will not be damaged or exposed to flying stones or balls, for example.
- Termination must be positioned where vent vapors are not objectionable.
- Horizontal portions of the vent system must slope upwards and be supported to prevent sagging.
- Direct vent systems must be installed so the vent and the combustion air pipes terminate in the same atmospheric zone. See Figures 25 and 26.

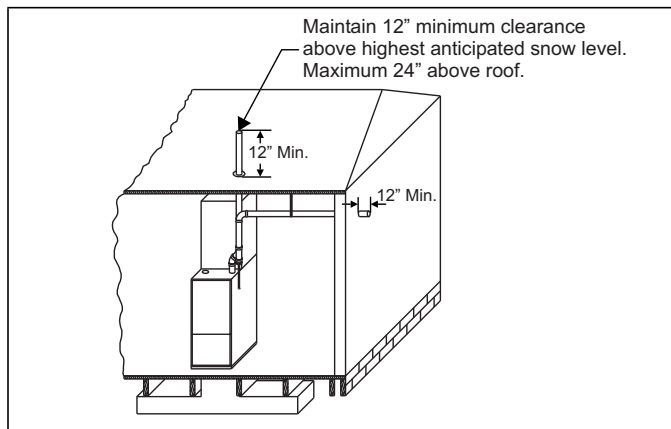


FIGURE 24: Termination Configuration - Single Pipe

⚠ WARNING

Condensation in Intake Pipe

Installations where the furnace and intake pipe are to be located in a conditioned space and in a region that may have hot, humid weather extending several consecutive days will have condensate form in the intake pipe. Use of the supplied intake drain will ensure that any condensate will be safely diverted away from the internal components of the furnace. Proper venting installation (of both intake and exhaust) and sealing any equipment air leaks that might contact the intake pipe will help reduce condensation.

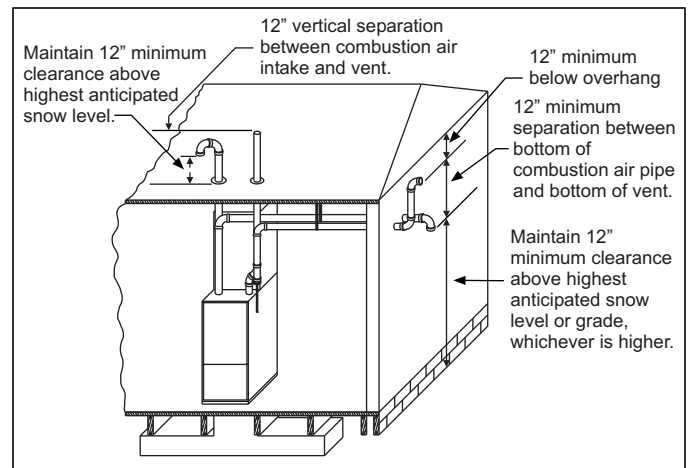


FIGURE 25: Termination Configuration - Two Pipe

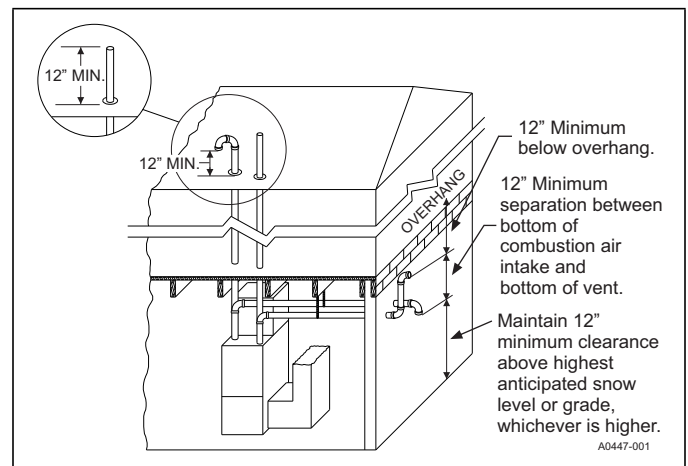


FIGURE 26: Termination Configuration - Two Pipe Basement

VENTING MULTIPLE UNITS

Multiple units can be installed in a space or structure as either a single-pipe configuration or a two-pipe configuration.

The combustion air side of the single-pipe configuration shown in Figures 24 and 31 is referred to in these instructions as ambient combustion air supply. Follow the instructions for ambient combustion air installations, paying particular attention to the Ambient Combustion Air Supply section. The vent for a single-pipe system must be installed as specified in the VENT APPLICATIONS AND TERMINATION section with both vents terminating as shown in Figures 27 and 28. Each furnace must have a separate vent pipe. Under NO circumstances can the two vent pipes be tied together.

The combustion air side of the two-pipe configuration shown in Figures 26 and 27 can be installed so the combustion air pipe terminates as described in the Outdoor Combustion Air or Ventilated Combustion Air sections. Follow the instructions for outdoor combustion air or ventilated combustion air and the instructions for installing the vent system with the vent terminating as shown in Figures 27 and 28. The two-pipe system must have a separate combustion air pipe and a separate vent pipe for each furnace. Under NO circumstances can the two combustion air or vent pipes be tied together. The combustion air and vent pipes must terminate in the same atmospheric zone.

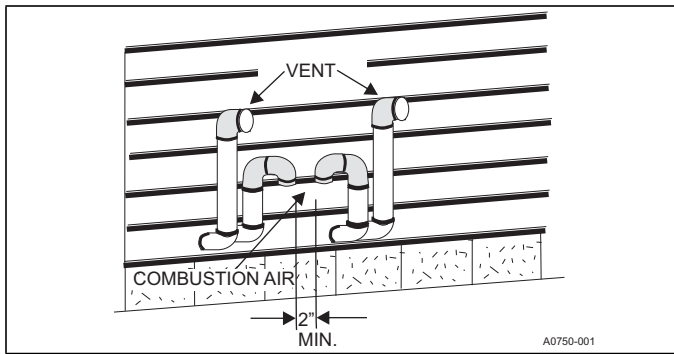


FIGURE 27: Double Horizontal Combustion Air Intake and Vent Termination

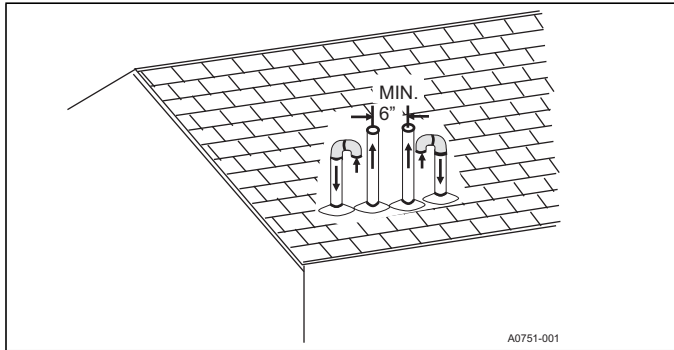


FIGURE 28: Double Vertical Combustion Air Intake and Vent Termination

DOWNWARD VENTING

In some applications, it may be necessary to run the vent pipe and air intake downwards. If this is to be done, adhere to the following rules:

- A condensate trap hose must be connected to both the air intake pipe and the vent pipe at the lowest part of the horizontal run.
- The condensate drain trap must have a trap of a minimum of six in.
- The total vertical downward distance must not exceed 16 ft.
- The condensate drain hose must be connected to a condensate drain pump or an open or vented drain or into the condensate drain line from the furnace.
- The condensate drain lines must not pass through unconditioned spaces where the temperature may fall below freezing.
- The condensate drain line must be primed at the initial start-up before the start of heating season.

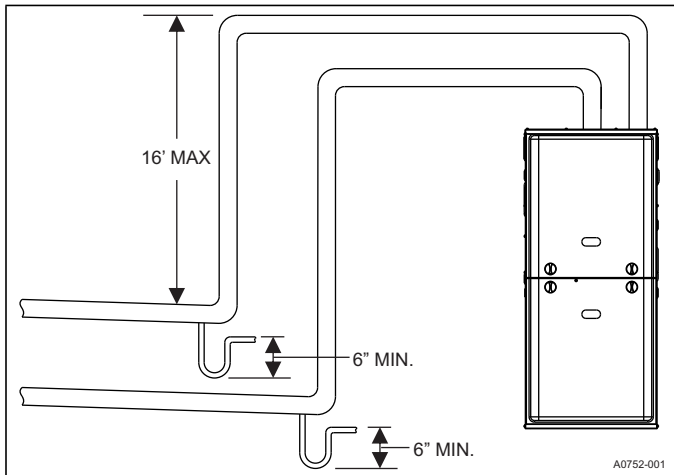


FIGURE 29: Downward Venting

COMBUSTION AIR SUPPLY

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

Install this furnace using one of the following combustion air intake configurations:

- **OUTDOOR COMBUSTION AIR:** This is a direct vent configuration where the combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the furnace and is terminated in the same atmospheric zone as the vent. This type of installation is approved on all models. See Figures 25 and 26.
- **AMBIENT COMBUSTION AIR:** Combustion air is supplied from the area surrounding the furnace through openings in the furnace casing. The combustion air and the vent pipes are not terminated in the same atmospheric zone. See Figure 23 for vent terminations. See the Ambient Combustion Air Supply section for proper installation. See Figure 31.
- **VENTILATED COMBUSTION AIR:** Combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the burner box and is terminated in a ventilated attic or crawl space. The combustion air and the vent pipes are not terminated in the same atmospheric zone. See Figure 33 for attic and crawl space termination. Only the combustion air intake can terminate in the attic. The vent must terminate outside.

Outdoor Combustion Air

Combustion Air Intake/Vent Connections

This installation requires combustion air to be brought in from outdoors. This requires a properly sized pipe (shown in Figure 30) that will bring air in from the outdoors to the furnace combustion air intake collar on the burner box. The second pipe (shown in Figure 30) is the furnace vent pipe.

NOTICE

An optional plastic birdscreen is shipped in the loose parts bag with every furnace. This may be installed in the intake collar to prevent any small objects from entering the furnace.

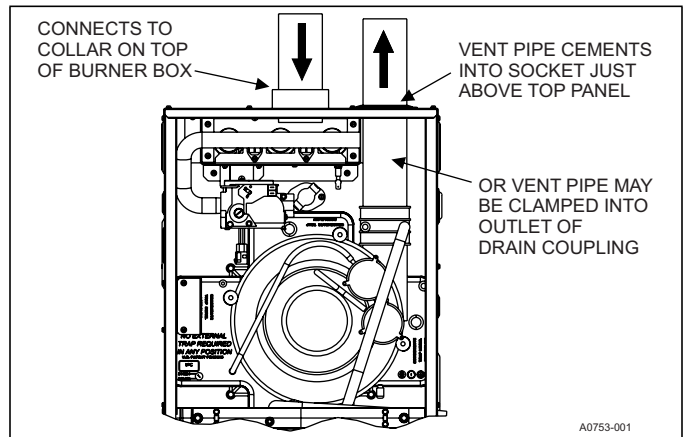


FIGURE 30: Direct Vent Air Intake Connection and Vent Connection

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

The terminal assembly must be located as far as possible from a swimming pool or a location where swimming pool chemicals might be stored. Ensure the terminal assembly follows the outdoor clearances listed in the VENT APPLICATIONS AND TERMINATION section.

Ambient Combustion Air Supply

This type of installation will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This can be from within the space in a non-confined location or it can be brought into the furnace area from outdoors through permanent openings or ducts. It is not piped directly into the furnace. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided. It is recommended that the supplied intake coupling and 18 in. of pipe be attached to the furnace to prevent accidental blockage of the combustion air intake.

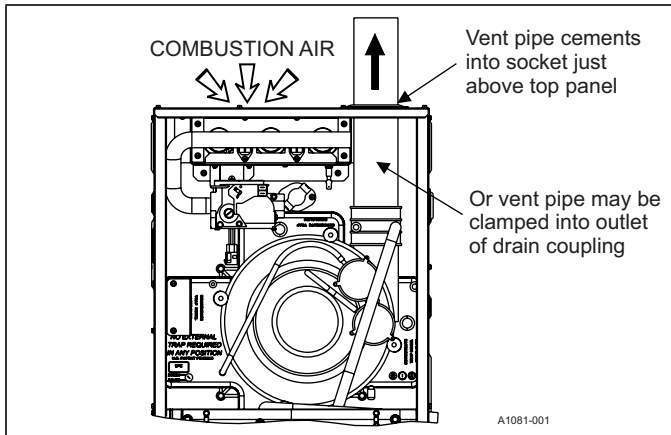


FIGURE 31: Combustion Airflow Path Through the Furnace Casing

⚠ WARNING

This type of installation requires that the supply air to the appliance(s) be of a sufficient amount to support all of the appliance(s) in the area. Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances. A venting problem or a lack of supply air will result in a hazardous condition, which can cause the appliance to soot and generate dangerous levels of CARBON MONOXIDE, which can lead to serious injury, property damage and / or death.

An **unconfined space** is not less than 50 cu.ft (1.42 m³) per 1,000 BTU/hr (0.293 kW/h) input rating for all of the appliances installed in that area.

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

A **confined space** is an area with less than 50 cu.ft (1.42 m³) per 1,000 BTU/hr (0.293 kW/h) input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Dampers, Louvers and Grilles

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

Table 11: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20-25%* Metal 60-70% *
Screens+	1/4 in. (6.4 mm) mesh or larger 100%

* Do not use less than 1/4 in. (6.4 mm) mesh

+ Free area of louvers and grille varies widely. The installer must follow louver or grille manufacturer's instructions.

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

⚠ WARNING

When a Category I furnace is removed or replaced, the original venting system may no longer be correctly sized to properly vent the attached appliances.
An improperly sized vent system can cause CARBON MONOXIDE to spill into the living space causing personal injury, and or death.

Table 12: Unconfined Space Minimum Area

BTUH Input Rating	Minimum Free Area Required for Each Opening
40,000	40 in ² (258 cm ²)
60,000	60 in ² (387 cm ²)
80,000	80 in ² (516 cm ²)
100,000	100 in ² (645 cm ²)
120,000	120 in ² (742 cm ²)

Table 13: Free Area

BTUH Input Rating	Minimum Free Area Required for Each Opening		
	Horizontal Duct (2,000 BTUH)	Vertical Duct or Opening to Outside (4,000 BTUH)	Round Duct (4,000 BTUH)
40,000	20 in ² (129 cm ²)	10 in ² (64 cm ²)	4 in. (10 cm)
60,000	30 in ² (193 cm ²)	15 in ² (97 cm ²)	5 in. (13 cm)
80,000	40 in ² (258 cm ²)	20 in ² (129 cm ²)	5 in. (13 cm)
100,000	50 in ² (322 cm ²)	25 in ² (161 cm ²)	6 in. (15 cm)
120,000	60 in ² (387 cm ²)	30 in ² (193 cm ²)	7 in. (18 cm)
130,000	65 in ² (419 cm ²)	33 in ² (213 cm ²)	7 in. (18 cm)

EXAMPLE: Determining Free Area

Appliance	1 Appliance	2 Total Input	
100,000	+ 30,000	= (130,000 ÷ 4,000)	= 32.5 sq in. vertical
Appliance	1 Appliance	2 Total Input	
100,000	+ 30,000	= (130,000 ÷ 2,000)	= 65 sq in. horizontal

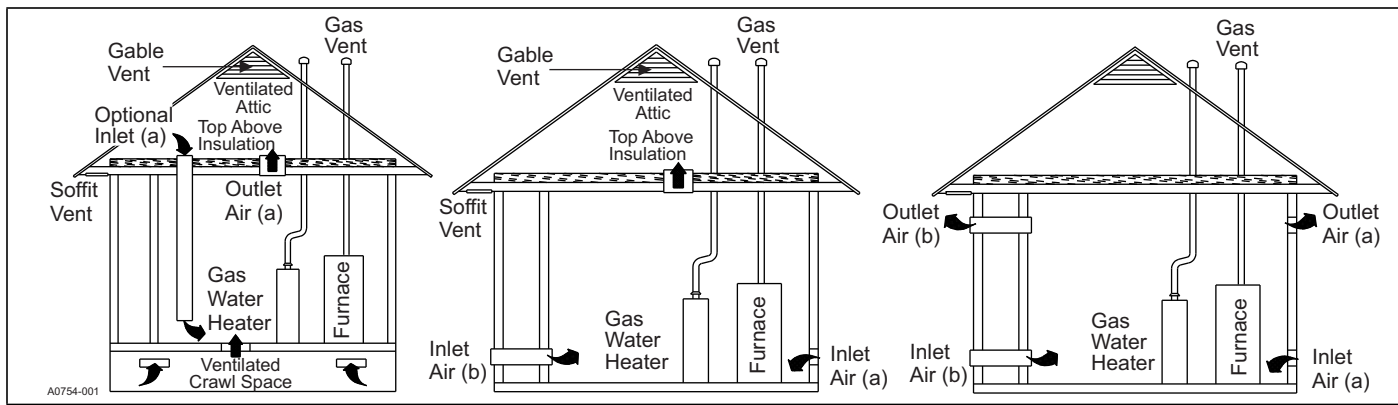


FIGURE 32: Ambient Combustion Air

Air Supply Openings and Ducts

1. An opening can be used in lieu of a duct to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening must be located within 12 in. (30.5 cm) horizontally from the burner level of the appliance. See the Combustion Air Source from Outdoors section and the COMBUSTION AIR AND VENT SAFETY section for additional information and the safety check procedure.
2. The duct must be either metal or a material meeting the class 1 requirements of CAN4-S110 Standard for Air Ducts.
3. The duct must be at least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The duct must terminate within 12 in. (30.5 cm) above and within 24 in. (61 cm) horizontally from the burner level of the appliance having the largest input.
5. A square or rectangular shaped duct must only be used when the required free area of the supply opening is 9 in² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimension must not be less than 3 in. (7.6 cm).
6. An air inlet supply from outdoors must be equipped with a means to prevent the direct entry of rain and wind. Such means must not reduce the required free area of the air supply opening.
7. An air supply inlet opening from the outdoors must be located not less than 12 in. (30.5 cm) above the outside grade level.

Combustion Air Source from Outdoors

1. Two permanent openings, one within 12 in. (30.5 cm) of the top and one within 12 in. (30.5 cm) of the bottom of the confined space, must communicate directly or by means of ducts with the outdoors, crawl spaces, or attic spaces.
2. One permanent opening commencing within 12 in. (30.5 cm) of the top of the enclosure is permitted where the equipment has clearances of at least 1 in. (2.54 cm) from the sides and back and 6 in. (15.2 cm) from the front of the appliance. The opening must communicate directly with the outdoors and must have a minimum free area of:
 - a. 1 in² per 3000 BTU per hour (322 cm² per 0.879 kW) of the total input rating of all equipment located in the enclosure
 - b. Not less than the sum of all vent connectors in the confined space

3. The duct must be at least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, see Table 11.

Ventilated Combustion Air

The ventilated attic space or crawl space from which the combustion air is taken must comply with the requirements specified for ventilated combustion air in the COMBUSTION AIR SUPPLY section or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type of installation requires two properly sized pipes. One pipe brings combustion air from a properly ventilated attic space or crawl space and the second pipe extends from the furnace vent connection (top right of unit) to the exterior of the building. See Table 6 for intake pipe sizing, allowable length and elbow usage. Follow all notes, procedures and required materials in the COMBUSTION AIR/VENT PIPE SIZING section when installing the combustion air pipe from the unit and into a ventilated attic space or crawl space. DO NOT terminate vent pipe in an attic or crawl space.

Ventilated Combustion Air Termination

See Figure 32 for required attic termination for the combustion air intake pipe. For attic termination, use two 90° elbows with the open end in a downward position. Ensure to maintain 12 in. (30.5 cm) clearance above any insulation, flooring or other material.

A crawl space combustion air installation consists of a straight pipe from the PVC coupling on the burner box that extends into the crawl space and terminates with a 1/4 in. (6.4 mm) mesh screen and no elbows.

⚠ WARNING

CARBON MONOXIDE POISONING HAZARD

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

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

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows and all doors.
3. Turn on clothes dryers and TURN ON any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Open the fireplace dampers. Do not operate a summer exhaust fan.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test each appliance (such as a water heater) equipped with a draft hood for spillage (down-draft or no draft) at the draft hood relief opening after 5 minutes of main burner operation. Appliances that do not have draft hoods need to be checked at the vent pipe as close to the appliance as possible. Use a combustion analyzer to check the CO₂ and CO levels of each appliance. Use a draft gauge to check for a downdraft or inadequate draft condition.
6. After it has been determined that each appliance properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their normal condition.
7. If improper venting is observed during any of the above tests, a problem exists with either the venting system or the appliance does not have enough combustion air (Supply Air from outside) to complete combustion. This condition must be corrected before the appliance can function safely.
8. Any corrections to the venting system and / or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1 Natural Gas and Propane Installation Code (latest editions). If the vent system must be resized, follow the appropriate tables in Appendix G of the above codes or for this appliance.

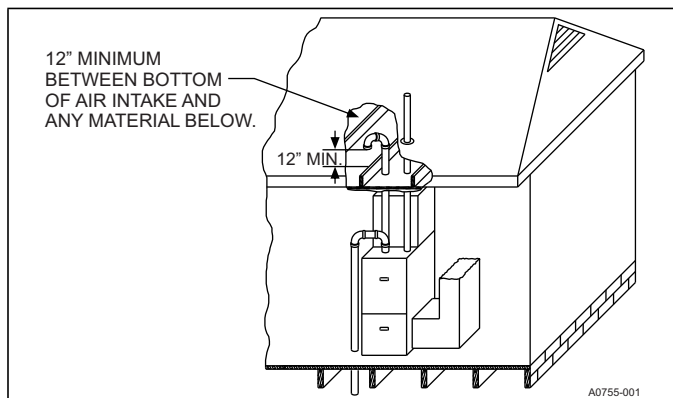


FIGURE 33: Attic and Crawl Space Combustion Air Termination

Specially Engineered Installations

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

⚠ WARNING

Be sure to instruct the owner not to block this intake pipe.

VENT BLOWER ROTATION

For ease of venting, the vent blower can be rotated 90° in either direction. For upflow installations the vent can exit through the top or either side of the cabinet. For downflow installations, the vent blower must be rotated so that the vent exits through either side of the cabinet. See Figures 18 to 21 for illustrations of different inducer rotation positions.

SECTION IX: START-UP AND ADJUSTMENTS

The following start-up checks **MUST** be performed by the furnace installer on every new furnace installation:

1. Gas piping leak check
2. Furnace input rate check
3. Air temperature rise check

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

When the gas supply is initially connected to the furnace, the gas piping may be full of air. In order to purge this air, it is recommended that the ground union be loosened until the odor of gas is detected. When gas is detected, immediately retighten the union and check for leaks. Allow 5 min for any gas to dissipate before continuing with the start-up procedure. Be sure proper ventilation is available to dilute and carry away any vented gas.

GAS PIPING LEAK CHECK

⚠ WARNING

FIRE OR EXPLOSION HAZARD

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

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

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

It is recommended that when the gas supply is first connected to the furnace, the ground union be loosened until the odor of gas is detected. When gas is detected, immediately tighten the union and check for gas leaks. Allow 5 min for any gas to dissipate before continuing with the startup procedure. Be sure that proper ventilation is available to dilute and carry away any vented gas.

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

The furnace and its equipment shutoff valve must be disconnected from the gas supply during any pressure testing of that system at test pressures in excess of 0.5 psig (3.45 kPa).

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

IGNITION SYSTEM SEQUENCE

1. Turn the gas supply ON at external valve and main gas valve.
2. Set the thermostat above room temperature to call for heat.
3. System start-up will occur as follows:
 - a. The induced draft blower motor will start and come up to speed. Shortly after inducer start-up, the hot surface igniter will glow for about 17 s.
 - b. After this warm up, the ignition module will energize (open) the main gas valve.
 - c. After flame is established, the supply air blower will start in about 30 s.

WARNING

HOT SURFACE IGNITION SYSTEM

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

CALCULATING THE FURNACE INPUT (NATURAL GAS)

Burner orifices are sized to provide proper input rate using natural gas with a heating value of 1030 BTU/ft³ (38.4 MJ/m³). If the heating value of your gas is significantly different, it may be necessary to replace the orifices.

NOTICE

DO NOT set manifold pressure less than 3.2 in. W.C. or more than 3.8 in. W.C. for natural gas at sea level. If manifold pressure is outside this range, change main burner orifices.

NOTICE

If orifice hole appears damaged or it is suspected to have been redrilled, check orifice hole with a numbered drill bit of correct size. Never redrill an orifice. A burr-free and squarely aligned orifice hole is essential for proper flame characteristics.

CAUTION

DO NOT bottom out gas valve regulator adjusting screw. This can result in unregulated manifold pressure and result in excess overfire and heat exchanger failures.

Verify natural gas input rate by clocking meter.

1. Turn off all other gas appliances and pilots.
2. Run furnace for a minimum of 3 min in heating operation.
3. Measure time (in seconds) for gas meter to complete one revolution and note reading. The 2 cubic feet dial provides a more accurate measurement of gas flow.
4. See Table 14 for cubic feet of gas per hour.
5. Multiply cubic feet per hour by heating value (BTU/cu ft) to obtain input.

If clocked rate does not match the input rate from the unit nameplate, follow the steps in the ADJUSTMENT OF MANIFOLD GAS PRESSURE AND INPUT RATE section to adjust the manifold pressure. Repeat steps 2 to 5 until correct input is achieved.

CAUTION

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

Table 14: Gas Rate (CU FT/HR) at Full Input

Seconds For One Revolution	Size of Test Dial			Seconds For One Revolution	Size of Test Dial		
	1 Cu Ft	2 Cu Ft	5 Cu Ft		1 Cu Ft	2 Cu Ft	5 Cu Ft
10	360	720	1800	55	65	131	327
11	327	655	1636	56	64	129	321
12	300	600	1500	57	63	126	316
13	277	555	1385	58	62	124	310
14	257	514	1286	59	61	122	305
15	240	480	1200	60	60	120	300
16	225	450	1125	62	58	116	290
17	212	424	1059	64	56	112	281
18	200	400	1000	66	54	109	273
19	189	379	947	68	53	106	265
20	180	360	900	70	51	103	257
21	171	343	857	72	50	100	250
22	164	327	818	74	48	97	243
23	157	313	783	76	47	95	237
24	150	300	750	78	46	92	231
25	144	288	720	80	45	90	225
26	138	277	692	82	44	88	220
27	133	267	667	84	43	86	214
28	129	257	643	86	42	84	209
29	124	248	621	88	41	82	205
30	120	240	600	90	40	80	200
31	116	232	581	92	39	78	196
32	113	225	563	94	38	76	192
33	109	218	545	96	38	75	188
34	106	212	529	98	37	74	184
35	103	206	514	100	36	72	180
36	100	200	500	102	35	71	178
37	97	195	486	104	35	69	173
38	95	189	474	106	34	68	170
39	92	185	462	108	33	67	167
40	90	180	450	110	33	65	164
41	88	176	439	112	32	64	161
42	86	172	429	116	31	62	155
43	84	167	419	120	30	60	150
44	82	164	409	124	29	58	145
45	80	160	400	128	28	56	141
46	78	157	391	133	27	54	135
47	76	153	383	138	26	52	130
48	75	150	375	144	25	50	125
49	73	147	367	150	24	48	120
50	72	144	360	157	23	46	115
51	71	141	355	164	22	44	110
52	69	138	346	171	21	42	105
53	68	136	340	180	20	40	100
54	67	133	333				

ADJUSTMENT OF MANIFOLD GAS PRESSURE AND INPUT RATE

Inlet and manifold gas pressure can be measured by connecting the U-tube manometer to the gas valve with a piece of tubing. Follow the appropriate section in the instructions below. See Figure 34 for the locations of the pressure ports on the gas valve.

Turn gas off at the ball valve or gas cock on gas supply line before the gas valve. Find the pressure ports on the gas valve marked Out P and In P.

1. The manifold pressure must be taken at the port marked OUT P.
2. The gas line pressure must be taken at the port marked IN P.
3. Using a 3/32 in. (2.4 mm) hex head wrench, loosen the set screw by turning it one turn counter clockwise. DO NOT REMOVE THE SET SCREW FROM THE PRESSURE PORT.

Read the inlet gas pressure

Connect the positive side of the manometer to the IN P Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. See Figures 34 and 35 for connection details.

1. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.

Table 15: Inlet Gas Pressure Range

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

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

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

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

2. Once the correct gas inlet pressure has been established (see Table 15), turn the gas valve to OFF and turn the electrical supply switch to OFF. Remove the flexible tubing from the gas valve pressure tap and tighten the pressure tap plug using the 3/32 in. (2.4 mm) hex head wrench.
3. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port using an approved noncorrosive gas leak detection fluid or other nonflammable leak detection methods.

Read the manifold gas pressure

Connect the positive side of the manometer to the OUT P Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. See Figures 34 and 35 for connection details.

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

1. See Figure 34 for location of pressure regulator adjustment cap and adjustment screws on main gas valve.
2. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.
3. Adjust manifold pressure by adjusting gas valve regulator screw for the appropriate gas per the following:

Table 16: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas	3.5 in. W.C. (0.87 kPa)
Propane (LP) Gas	10.0 in. W.C. (2.488 kPa)

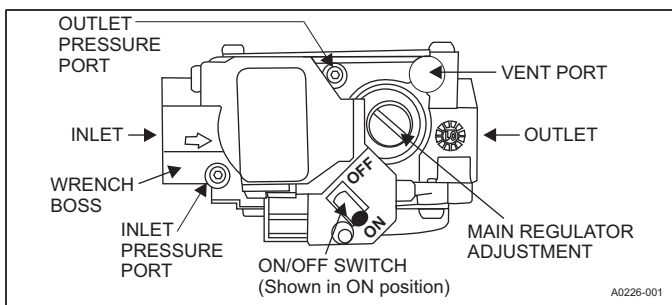


FIGURE 34: Gas Valve

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

4. After the manifold pressure has been adjusted, re-calculate the furnace input to make sure you have not exceeded the specified input on the rating plate. See the CALCULATING THE FURNACE INPUT (NATURAL GAS) section.
5. Once the correct BTU (kW) input has been established, turn the gas valve to OFF and turn the electrical supply switch to OFF. Remove the flexible tubing from the gas valve pressure tap and tighten the pressure tap plug using the 3/32 in. (2.4 mm) hex head wrench.
6. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port using an approved noncorrosive gas leak detection fluid or other nonflammable leak detection methods.

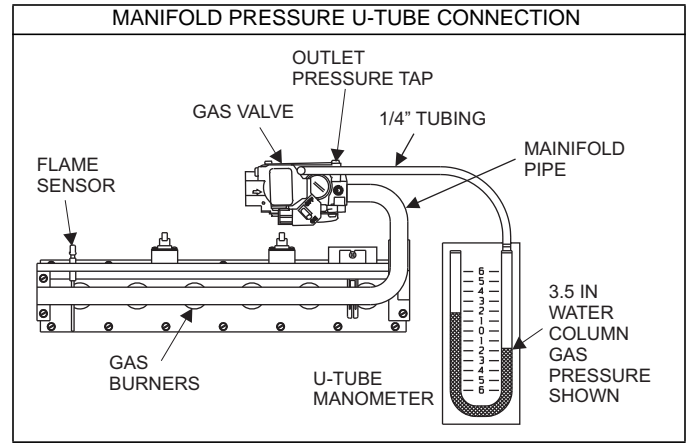


FIGURE 35: Reading Gas Pressure

AIRFLOW SETTINGS

Cooling Airflow Settings

This unit is equipped with a five-speed blower motor. The required cooling airflow can be selected by connecting the required motor speed tap wire to the HI COOL terminal on the control board. Select the speed to deliver approximately 350 CFM to 400 CFM per ton of AC cooling capacity. Use of airflow outside of this range may result in diminished air conditioning performance and may result in lower overall energy efficiency and higher electric utility bills. See Table 17 for default cooling blower settings.

Continuous Fan Airflow Default Setting

The default blower speed for continuous fan operation is LOW speed. The continuous fan speed is set at the factory to the default continuous fan blower speed.

In certain circumstances, it may be necessary to move the continuous fan speed to a different speed tap. However, doing so will result in higher than normal electrical energy usage and electric utility bills.

Table 17: Default Blower Speeds

Model Number	Default Blower Speeds		
	Heat	Cool	Continuous Fan
TM9E040A10	Low (5)	High (1)	Low (5)
TM9E060A10	Medium Low (4)	High (1)	Low (5)
TM9E060B12	Medium Low (4)	High (1)	Low (5)
TM9E080B12	Medium (3)	High (1)	Low (5)
TM9E080C16	Medium (3)	High (1)	Low (5)
TM9E080C20	Low (5)	High (1)	Low (5)
TM9E100C16	Medium High (2)	High (1)	Low (5)
TM9E100C20	Medium Low (4)	High (1)	Low (5)
TM9E120D20	Medium Low (4)	High (1)	Low (5)

Continuous Fan Jumpers

This furnace can be operated in continuous fan mode by setting the wall thermostat FAN switch to ON. To select the required continuous fan airflow, place the FAN SPEED jumper on the control board on the pins adjacent to the required speed. There are four options:

- With the FAN SPEED jumper in the G position, the blower will run during continuous fan operation at the motor speed connected to the G terminal on the control board.
- With the FAN SPEED jumper in the HI COOL position, the blower will run during continuous fan operation at the motor speed connected to the HI COOL terminal on the control board.
- With the FAN SPEED jumper in the LO COOL position, the blower will run during continuous fan operation at the motor speed connected to the LO COOL terminal on the control board.
- With the FAN SPEED jumper in the HEAT position, the blower will run during continuous fan operation at the motor speed connected to the HEAT terminal on the control board.

The default position is with the jumper in the G position and the LOW speed motor wire on the G terminal. In certain circumstances, it may be necessary to move the continuous fan speed to a different speed tap. However, doing so is not recommended because it will result in higher than normal electrical energy usage and electric utility bills.

Gas Heating Airflow Default Setting

This unit is equipped with a five-speed blower motor. The heating blower speed is set at the factory to the default blower speed, which is the blower speed that will deliver the correct airflow for proper heating operation in most applications. The default heating blower speed for each model is shown in Table 17. Use of a heating speed other than the default heating blower speed may result in reduced energy efficiency and higher electric utility bills.

In certain circumstances, it may be necessary to move the heating blower speed to a different motor speed tap. Not all five motor speeds are appropriate for gas heating operation. The use of heating airflow on a speed other than the default speed will result in diminished heating performance and may cause the furnace temperature limit controls to shut down the furnace.

Measurement of Temperature Rise

⚠ DANGER

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

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

After about 5 min of operation, determine the furnace temperature rise. Measure the temperature of both the return air and the heated air in the ducts, about 6 ft (1.83 m) from the furnace where they will not be affected by radiant heat. Increase the blower speed to decrease the temperature rise. Decrease the blower speed to increase the temperature rise.

The blower speed taps are located on the furnace control board in the blower compartment. See Figure 36 and refer to the unit-wiring label to change the blower speed. To use the same speed tap for heating and cooling, the heat terminal and cool terminal must be connected using a jumper wire and connected to the required motor lead. Place all unused motor leads on park terminals. Two park terminals are provided.

ADJUSTMENT OF FAN CONTROL SETTINGS

This furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 s. The fan off delay has 4 settings (60 s, 90 s, 120 s, and 180 s). The fan off delay is factory set to 120 s. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan-off timing can be adjusted by positioning the jumper on two of the four pins as shown in Figure 36.

TAKING A FLUE GAS SAMPLE

If it is necessary to obtain a flue gas sample for analysis, it is permissible to drill a small hole in the plastic flue pipe for a sample probe, provided that the vent piping is PVC and the hole is properly sealed afterwards. If using a polypropylene vent system, the vent system's manufacturer test port fitting must be used. **DO NOT** drill a test port hole in polypropylene piping. Use the following procedure:

1. Drill a 11/32 in. hole in the side wall of the PVC vent pipe. If the hole is in a horizontal section of the vent pipe, ensure that it is located away from the bottom where condensation may be flowing back toward the furnace.
2. Operate the furnace a minimum of (10 min) to ensure stable operation of the combustion process.
3. Sample the flue gas as necessary to obtain CO readings.
4. Using a 1/8 in. pipe tap, cut threads into the sampling hole of the PVC pipe.
5. Use high temp RTV as a sealant on the threads of a 1/8 in. brass MPT plug and insert it three turns into the hole to correctly seal it.

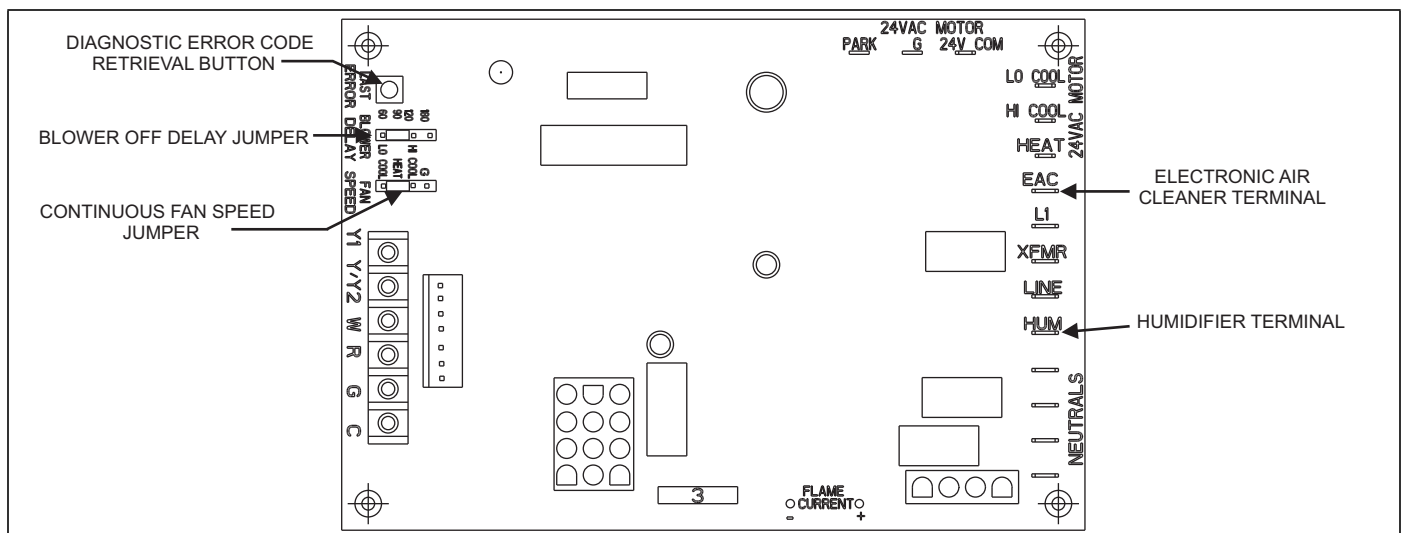


FIGURE 36: Furnace Control Board

Table 18: Blower Performance CFM - Any Position (Without Filter)

Model	Speed	Airflow Data (SCFM) ^{1,2}							
		External Static Pressure (in. H ₂ O)							
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
TM9E040A10	High	1172	1147	1116	1083	1035	984	933	870
	Medium High	952	919	896	865	839	809	780	765
	Medium	882	861	824	802	771	746	709	685
	Medium Low	754	716	688	650	610	588	551	523
	Low	688	648	619	584	541	518	481	446
TM9E060A10	High	1239	1209	1175	1143	1124	1095	1066	1019
	Medium High	1142	1102	1080	1050	1019	989	960	924
	Medium	971	935	909	869	839	805	761	731
	Medium Low	915	891	848	818	776	744	708	691
	Low	773	739	687	655	604	572	527	496
TM9E060B12	High	1342	1316	1290	1268	1243	1219	1172	1116
	Medium High	1297	1267	1247	1217	1189	1159	1129	1087
	Medium	1165	1139	1108	1080	1051	1020	983	948
	Medium Low	1027	995	965	936	894	862	825	778
	Low	822	775	740	687	649	605	566	512
TM9E080B12	High	1418	1390	1364	1333	1304	1281	1246	1205
	Medium High	1305	1281	1244	1217	1182	1149	1109	1066
	Medium	1139	1112	1071	1035	992	951	908	874
	Medium Low	1017	986	948	901	859	819	765	727
	Low	885	821	763	711	651	611	560	518
TM9E080C16	High	1706	1678	1649	1621	1602	1560	1505	1437
	Medium High	1390	1344	1313	1267	1235	1194	1150	1109
	Medium	1212	1167	1125	1086	1041	996	951	902
	Medium Low	1016	964	914	861	803	734	653	594
	Low	920	791	733	666	568	506	448	388
TM9E080C20	High	2130	2086	2065	2016	2001	1932	1863	1775
	Medium High	1922	1894	1835	1810	1771	1727	1688	1627
	Medium	1684	1648	1616	1559	1516	1471	1429	1382
	Medium Low	1563	1528	1474	1435	1392	1329	1291	1244
	Low	1371	1321	1281	1222	1173	1131	1076	1017
TM9E100C16	High	1762	1733	1688	1659	1625	1594	1565	1512
	Medium High	1428	1386	1337	1291	1245	1205	1161	1114
	Medium	1225	1178	1127	1083	1034	988	918	886
	Medium Low	1108	1059	1001	948	889	821	764	702
	Low	1022	867	799	732	660	579	521	496
TM9E100C20	High	2140	2100	2070	2038	2006	1932	1871	1786
	Medium High	1883	1854	1818	1777	1720	1676	1649	1590
	Medium	1671	1624	1595	1557	1498	1450	1407	1351
	Medium Low	1581	1525	1493	1443	1394	1346	1292	1253
	Low	1350	1311	1244	1202	1138	1098	1053	978
TM9E120D20	High	2159	2118	2089	2050	2005	1939	1856	1756
	Medium High	1941	1907	1864	1824	1779	1736	1688	1645
	Medium	1789	1749	1714	1677	1629	1586	1540	1494
	Medium Low	1643	1607	1555	1515	1468	1420	1380	1332
	Low	1396	1343	1302	1250	1190	1152	1095	1034

1. Airflow expressed in standard cubic feet per minute (SCFM).

2. Motor voltage at 115 V.


Note: Shaded conditions are not recommended for use as heating speeds.

SECTION X: SAFETY CONTROLS

CONTROL CIRCUIT FUSE

A 3 A fuse is provided on the control circuit board to protect the 24 V transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located on the control board.

BLOWER DOOR SAFETY SWITCH

 CAUTION
<p>Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. <u>Do not rely upon the interlock switch as a main power disconnect.</u></p> <p>Blower and burner must never be operated without the blower panel in place.</p>

This unit is equipped with an electrical interlock switch mounted in the burner compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.

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

ROLLOUT SWITCH CONTROLS

These controls are mounted on the burner assembly. If the temperature in the area surrounding burner exceeds its set point, the gas valve is de-energized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. These are manual reset controls that must be reset before operation can continue.

PRESSURE SWITCHES

This furnace is supplied with two pressure switches, which monitor the flow through the combustion air/vent piping and condensate drain system. These switches de-energize the gas valve if any of the following conditions are present:

1. Blockage of combustion air piping or terminals
2. Blockage of condensate drain piping
3. Blockage of vent piping or terminal
4. Failure of combustion air blower motor

See SECTION VII: CONDENSATE PIPING AND FURNACE VENTING CONFIGURATION for tubing connections.

LIMIT CONTROLS

There is a high temperature limit control located on the furnace vestibule panel near the gas valve. This is an automatic reset control that provides over temperature protection due to reduced airflow. This may be caused by the following:

- A dirty filter
- Indoor fan motor failure
- Too many supply or return registers closed or blocked off

The control module will lock out if the limit trips five consecutive times. If this occurs, control will reset and try ignition again after 1 h.

SECTION XI: NORMAL OPERATION AND DIAGNOSTICS

NORMAL OPERATION SEQUENCE

The following describes the sequence of operation of the furnace. Refer to Owners Manual for component location.

Continuous Blower

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the ON position the thermostat circuit is completed between terminals R and G. The motor will operate continuously on the speed tap wire that is connected to the G terminal on the furnace control board. To obtain a different constant air circulation, change the wire to another speed wire.

Intermittent Blower - Cooling

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the AUTO position the thermostat circuit is completed between terminals R and G when there is a call for cooling. The motor will operate on the speed tap wire that is connected to the HI COOL cooling terminal on the control board. The fan off setting is fixed at 60 s to improve cooling efficiency.

Heating Cycle

When the thermostat switch is set on HEAT and the fan is set on AUTO, and there is a call for heat, a circuit is completed between terminals R and W of the thermostat. When the proper amount of combustion air is being provided, the pressure switch will close and the ignition control provides a 17 s ignitor warm-up period. The gas valve then opens, the gas starts to flow, ignition occurs, and the flame sensor begins its sensing function. The blower motor will energize 30 s after the gas valve opens, if a flame is detected. Normal furnace operation will continue until the thermostat circuit between R and W is opened, which causes the ignition system and gas valve to de-energize and the burner flames to be extinguished. The vent motor will operate for 15 s and the blower motor will operate for the amount of time set by the fan-off delay jumper located on the control board. See Figure 36. The heating cycle is now complete, and ready for the start of the next heating cycle.

If the flame is not detected within 7 s of the gas valve opening, the gas valve is shut off and a retry operation begins. Also, if the flame is lost for 2 s during the 10 s stabilization period, the gas valve is shut off and a retry operation begins. During a retry operation, the vent motor starts a 15 s inter-purge and the ignitor warm-up time is extended to 27 s. If the flame is established for more than 10 s after ignition during a retry, the control will clear the ignition attempt (retry) counter. If three retries occur during a call for heat, the furnace will shut down for 1 h. If at the end of the 1 h shut down there is a call for heat, the furnace will initiate a normal start cycle. If the problem has not been corrected the furnace will lock out after three retries.


A momentary loss of gas supply, flame blowout, or a faulty flame probe circuit will result in a disruption in the flame and be sensed within 1.0 s. The gas valve will de-energize and the control will begin a recycle operation. A normal ignition sequence will begin after a 15 s inter-purge. If during the five recycles the gas supply does not return, or the fault condition is not corrected the ignition control will lock out for 60 min.

During burner operation, a momentary loss of power for 50 milliseconds or longer will de-energize the gas valve. When the power is restored, the gas valve will remain de-energized and the ignition sequence will immediately restart.

TROUBLESHOOTING

Make the following visual checks before troubleshooting:

1. Check to see that the power to the furnace and the ignition control module is ON.
2. The manual shut-off valves in the gas line to the furnace must be open.
3. Make sure all wiring connections are secure.
4. Review the sequence of operation. Start the system by setting the thermostat above the room temperature. Observe the system's response, then use the NORMAL OPERATION SEQUENCE section to check the system's operation.

 WARNING
<p>Never bypass any safety control to allow furnace operation. To do so will allow furnace to operate under potentially hazardous conditions.</p> <p>Do not try to repair controls. Replace defective controls with UPG Source 1 Parts.</p> <p>Never adjust pressure switch to allow furnace operation.</p>

FURNACE CONTROL DIAGNOSTICS

The furnace has built-in, self-diagnostic capability. A blinking LED light on the control board can flash red, green or amber to indicate various conditions. The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED light will indicate the failure code.

The SLOW flash speed is 2 s on and 2 s off.

The other flash codes listed below have the following timing: the LED light will turn on for 1/3 s and off for 1/3 s. This pattern will be repeated the number of times equal to the code. There will be a 2 s pause between codes. For example, the 6 Red Flashes code means the LED light flashes on and off six times, and is then off for 2 s. This pattern will repeat as long as the fault condition remains.

SLOW GREEN FLASH: Normal operation, no thermostat calls.

SLOW AMBER FLASH: Normal operation with call for heat.

LED STEADY OFF: If the LED light does not flash at all, check for power to the board and check for a blown fuse on the board. If the board is properly powered and the fuse is not blown, the control board may need to be replaced.

STEADY ON ANY COLOR: Control failure. Turn power to the furnace off and back on. If the fault code returns, the control board must be replaced. The control board is not field-repairable.

1 RED FLASH: This indicates that flame was sensed when there was not a call for heat. The control will turn on both the inducer motor and supply air blower. Check for a leaking or slow-closing gas valve.

2 RED FLASHES: This indicates that the pressure switch is closed when it should be open. The control confirms that the pressure switch contacts are open at the beginning of each heat cycle and will not let the ignition sequence continue if the pressure switch contacts are closed when they should be open. Check for a faulty pressure switch or miswiring.

3 RED FLASHES: This indicates the pressure switch contacts are open when they should be closed. Check for faulty inducer, blocked vent pipe, broken pressure switch hose, disconnected pressure switch or inducer wires or faulty pressure switch.

4 RED FLASHES: This indicates that the main limit switch has opened its normally closed contacts. The control will operate the supply air blower and inducer while the open limit condition exists. Check for a dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate, loose limit switch wiring or faulty blower motor.

If the limit switch has not closed within 5 min, the control will operate as if the blower is not functioning. The control will start a hard lockout and will begin to flash the 11 Red Flashes error code. Power will have to be cycled off and on to reset the control after the problem has been corrected. See the 11 Red Flashes description below.

If the main limit switch opens five times within a single call for heat, the control will also indicate 4 Red Flashes and enter a 1 h soft lockout.

5 RED FLASHES: This fault is indicated if the normally closed rollout switch opens. The rollout control is manually reset. Check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. The control will enter a hard lockout and power will have to be cycled off and on to reset the control after the problem has been corrected.

6 RED FLASHES: This indicates that while the unit was operating, the pressure switch opened four times during the call for heat. Check for faulty inducer, blocked vent pipe or faulty pressure switch. The furnace will lock out for 1 h and then restart.

7 RED FLASHES: This fault code indicates that the flame could not be established during three trials for ignition. Check that the gas valve switch is in the ON position. Check for low or no gas pressure, faulty gas valve, dirty or faulty flame sensor, faulty hot surface ignitor, loose wires or a burner problem. The furnace will lock out for 1 h and then restart.

8 RED FLASHES: This fault is indicated if the flame is lost five times (four recycles) during the heating cycle. Check for low gas pressure, dirty or faulty flame sensor or faulty gas valve. The furnace will lock out for 1 h and then restart.

9 RED FLASHES: Indicates reversed line voltage polarity, grounding problem or reversed low-voltage transformer wires. Both heating and cooling operations will be affected. Check polarity at furnace and branch. Check furnace grounding. Check that flame probe is not shorted to chassis. The furnace will not start the ignition sequence until this problem is corrected.

10 RED FLASHES: Gas valve energized with no call for heat. The main blower and inducer blower will run and no ignition sequence will be started as long as this condition exists. Check gas valve and gas valve wiring.

11 RED FLASHES: This indicates that the main limit switch has opened its normally-closed contacts and has remained open for more than 5 min. This condition is usually caused by a failed blower motor or blower wheel. The control will enter a hard lockout and power will have to be cycled off and on to reset the control after the problem has been corrected.

4 AMBER FLASHES: The control is receiving a Y signal from the thermostat without a G signal. The furnace will operate normally in both heating and cooling, but this fault code will be displayed in order to alert the user that there is a wiring problem. Verify that the G wire from the thermostat is connected properly.

SOFT LOCKOUT: This control includes a soft lockout that will reset automatically after 1 h. This provides protection to an unoccupied structure if a temporary condition exists causing a furnace malfunction. An example of this is a temporary interruption in gas supply that prevents the furnace from lighting. The control will keep trying to light each hour and will resume normal operation if the gas supply is restored.

HARD LOCKOUT: Some fault conditions result in a hard lockout, which requires power to the control to be turned off and then back on to reset the control. The control will not automatically restart.

IGNITION CONTROL FLAME SENSE LEVELS

Normal flame sense current is approximately
3.7 microamps DC (μa)
Low flame signal warning starts at 1.5 microamps.
Low flame signal control lockout point is
0.1 microamps DC (μa)

DIAGNOSTIC FAULT CODE STORAGE AND RETRIEVAL

The control in this furnace is equipped with memory that will store up to five error codes to allow a service technician to diagnose problems more easily. This memory will be retained even if power to the furnace is lost. **This feature must only be used by a qualified service technician.**

If more than five error codes have occurred since the last reset, only the five most recent will be retained. The furnace control board has a button labeled LAST ERROR that is used to retrieve error codes. This function will only work if there are no active thermostat signals, so any call for heating, cooling, or continuous fan must be terminated before attempting to retrieve error codes.

To retrieve the error codes, press the LAST ERROR button. The LED on the control will then flash the error codes that are in memory, starting with the most recent. There will be a 2 s pause between each flash code. After the error codes have all been displayed, the LED will resume the normal slow green flash after a 5 s pause. To repeat the series of error codes, press the button again.

If there are no error codes in memory, the LED will flash two green flashes. To clear the memory, press and hold the LAST ERROR button for more than 5 s. The LED will flash three green flashes when the memory has been cleared, then will resume the normal slow green flash after a 5 s pause.

SECTION XII: REPLACEMENT PARTS LIST

DESCRIPTION
MOTOR
BLOWER, COMBUSTION
MOTOR, DIRECT DRIVE BLOWER
ELECTRICAL
CONTROL, FURNACE
CONTROL, TEMPERATURE
IGNITER
SENSOR, FLAME
SWITCH, DOOR
SWITCH, LIMIT
SWITCHES, PRESSURE
TRANSFORMER
VALVE, GAS
AIR MOVING
HOUSING, BLOWER
WHEEL, BLOWER
FABRICATED PARTS
BRACKET, BLOWER TRACK (2 required)
BRACKET, IGNITER
BURNER, MAIN GAS
HEAT EXCHANGER ASSEMBLY
MANIFOLD, GAS
PANEL, BLOCKOFF
PAN, BOTTOM
PANEL, DOOR (2 required)

DESCRIPTION
FABRICATED PARTS Continued
PANEL, TOP
RAIL, BLOWER (2 required)
RESTRICTOR, COMBUSTION BLOWER
SHELF, BLOWER
MISCELLANEOUS
BAG, PARTS
BRACKET, DOOR
DIAGRAM, WIRING
FERRULE (3 req'd)
GASKET, FOAM (Door) (1.5 ft required)
GROMMET (3 req'd)
HARNESS, WIRING
HOSE, CONDENSATE
HOSE, RAIN GUTTER
KNOB, QUARTER TURN (4 required)
MOTOR MOUNT
ORIFICE, BURNER (Natural No. 45)
PAN, CONDENSATE
PLUG, SEAL, 7/8 in.
PLUG, SEAL, 2-3/8 in.
PLUG, VENT PIPE
SIGHT GLASS, OVAL (2 required)
TUBING, SILICON

REPLACEMENT PART CONTACT INFORMATION

This is a generic parts list. To request a complete parts list, refer to the contact information below.

Visit our website at www.source1parts.com to do the following:

- Search for a part or browse the catalog.
- Find a dealer or distributor.
- Access Customer Service contact information as follows:
 - a. Click the **Brand Links** button.
 - b. Click the **Customer Service** button.

You can contact us by mail. Send a written request to the following address:

**Johnson Controls Ducted Systems
Consumer Relations
5005 York Drive
Norman, OK 73069**

SECTION XIII: WIRING DIAGRAM

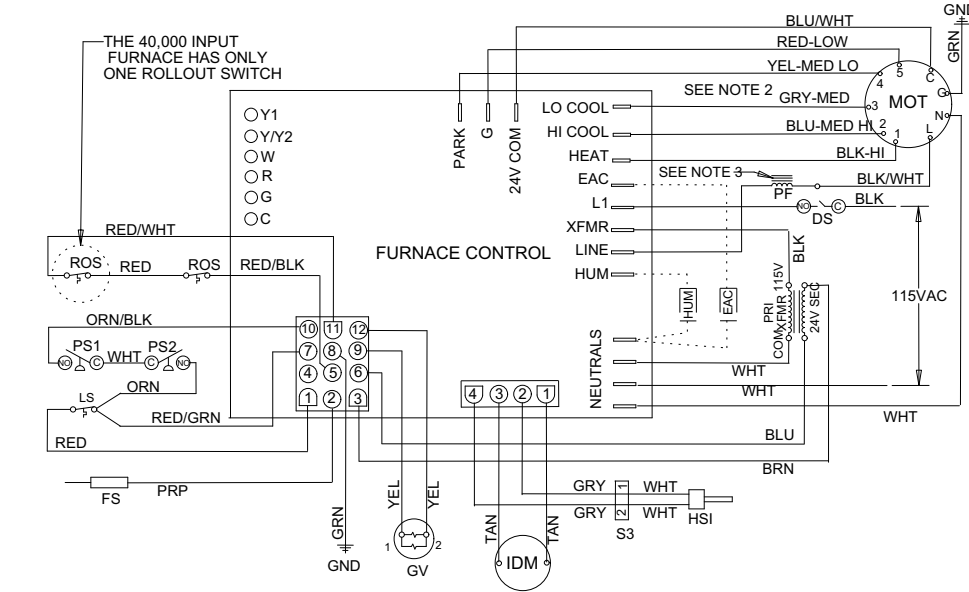
Wiring Diagram - 95% Standard ECM Furnace

CAUTION

OPEN ALL DISCONNECTS BEFORE SERVICING THIS UNIT

PRECAUTION

OUVREZ LES DISJONCTEURS AVANT DE PROCEDER AVEC LE SERVICE



Legend

- DS - Door switch
- ROS - Rollout switch
- FS - Flame sensor
- TST - Wall thermostat
- PS1 - Pressure switch
- PS2 - Condensate pressure switch
- MOT - Circulating motor
- IDM - Inducer motor
- HSI - Hot surface igniter
- EAC - Electronic air cleaner
- LS - Limit switch
- HUM - Humidifier
- XFMR - Transformer
- GV - Gas valve

Legende

- DS - Commutateur de porte
- ROS - Commutateur de roulement
- XFMR - Transformeur
- LS - Commutateur de limite
- HSI - Ignition de surface chaud
- PS1 - Commutateur de pression
- MOT - Moteur soufflerie
- IDM - D'induct moteur
- GV - Soupape de gaz
- HUM - Humidificateur
- PS2 - Commutateur de pression, condensation
- TST - Thermostat
- FS - Capteur de flamme
- HUM - Filtre électrique

Diagnostic Fault Codes

Flashes	Fault Condition
None	Power Off or blown fuse
Slow Green	Normal Operation
Slow Amber	Normal Operation with call for heat
4 Amber	No G from thermostat
Steady on Red	Control Failure
1 Red	Flame present with gas off
2 Red	Pressure switch stuck closed
3 Red	Vent, intake, or termination problem
4 Red	Airflow problem
5 Red	Flame Rollout
6 Red	Repeated 3 Red
7 Red	Failed to light burners
8 Red	Loss of flame during call for heat
9 Red	Hot/Neutral reversed OR poor ground/neutral
10 Red	Gas valve shorted "ON"
11 Red	Check blower motor/wiring

Refer to Installation Manual for more detailed information.

Fault Code Retrieval

Notice - Only a qualified service technician should use this feature.

Fault code retrieval functions will work only if there are no active thermostat signals.

To retrieve fault codes, push and release ERROR button on control board. The LED will flash the last five error codes, beginning with the most recent. If there are no fault codes in memory, the LED will give two green flashes. To clear the fault code memory, push and hold the ERROR button for at least five seconds. The LED will give three green flashes when the memory has been cleared.

NOTES:

1. If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 221 degrees F (105 degrees C).
2. Blower motor speed connections shown are typical, but may vary by model and application.
3. Power Factor Choke not installed on all models. (3/4 - 1HP motors only)

NOTES:

1. Si l'un des fils d'origine fourni avec ce four doit être remplacé, il doit être remplacé avec le fil ayant un degré de température d'au moins 221 degrés F (105 degrés C).
2. Les connexions à grande vitesse du moteur du ventilateur indiqués sont typiques, mais peuvent varier selon le modèle et par application.
3. Le starter de facteur de puissance n'est pas installé sur tous les modèles. (Moteurs 3/4 - 1 HP uniquement)

5594770-UWD-D-1119

FIGURE 37: Wiring Diagram

SECTION XIV: START UP SHEET

33" 95% AFUE ECM Single Stage Gas Furnace Start Up Sheet
 Proper furnace start up is critical to customer comfort and equipment longevity

Start-Up Date

Technician Performing Start-Up

Installing Contractor Name

Owner Information

Name

Address

City

State or Province

Zip or Postal Code

Equipment Data

Furnace Model

Furnace Serial

Indoor Coil Model

Indoor Coil Serial

Outdoor Unit Model

Outdoor Unit Serial

Furnace Configuration
 Upflow Downflow Horizontal Left Horizontal Right
Filter, Thermostat, Accessories

Filter Type

Filter Size

Filter Location(s)

Thermostat Type

Other System Equipment and Accessories

Connections -- All Per Installation Instructions and Local Code
 Unit is level Gas piping is connected (including drip leg) Supply plenum and return air are connected
 Vent system is connected
Condensate Management
 Condensate tubing is correctly installed for the furnace position Condensate drain is connected
Venting
 Intake Size # of 90 Degree Ells # of 45 Degree Ells Length

 Exhaust Size # of 90 Degree Ells # of 45 Degree Ells Length
 Venting system is the proper size, within the limitations of the chart in the installation instructions, properly connected to the furnace, and properly pitched
Electrical: Line Voltage
 Polarity is correct (black is L1 (hot), white is N (neutral)) Ground wire is connected

Line voltage value to furnace (volts AC)

Electrical: Low Voltage
 Thermostat wiring is complete Thermostat heat anticipator set to .40 (if present)

Low voltage value between "R" and "C" on furnace control board (volts AC)

Continued on next Page

Gas Side

Gas Type Natural Gas LP Gas (Requires LP conversion kit)

LP Gas Conversion Kit Part # Used LP Conversion Kit Installed By

Inlet Gas Pressure (in. w.c.) Manifold Gas Pressure (in. w.c.)

Calculated input in btuh - clock the gas meter (Nat Gas Only)

Burner flame inspected -- flames are blue and extending directly into the primary heat exchanger cells

Air Side: System External Static Pressure

Supply static before indoor coil (in w.c.) Supply static after indoor coil (in w.c.)

Return Static (in w.c.) before filter Return Static (in w.c.) after filter (furnace side)

Total External Static Pressure

Air Side: Heating

Heat Blower Speed Selected 5-Red (Low) 4-Yel (Med Lo) 3-Gray (Med) 2-Blue (Med High) 1-Black (High)

Temperature rise in degrees F

Air Side: Cooling

Low Cool Blower Speed Selected 5-Red (Low) 4-Yel (Med Lo) 3-Gray (Med) 2-Blue (Med High) 1-Black (High)

High Cool Blower Speed Selected 5-Red (Low) 4-Yel (Med Lo) 3-Gray (Med) 2-Blue (Med High) 1-Black (High)

Cooling CFM delivery (use Blower Performance Data Chart) Hi Low

Air Side: Continuous Fan

Blower Speed Selected 5-Red (Low) 4-Yel (Med Lo) 3-Gray (Med) 2-Blue (Med High) 1-Black (High)

Cycle Test

- Operate the furnace through several heating cycles from the thermostat, noting and correcting any problems
- Operate the furnace through continuous fan cycles from the thermostat, noting and correcting any problems
- Operate the furnace through cooling cycles (as applicable), noting and correcting any problems

Clean Up

Installation debris disposed of and furnace area cleaned up?

Owner Education

- Give owner the owner's manual provided
- Explain operation of system to equipment owner
- Explain the importance of regular filter replacement and equipment maintenance
- Explain thermostat use and programming (if applicable) to owner

Additional Job Detail