

Installation Manual: Z9ES Series - Condensing Single-Stage ECM Multi- Position Gas Furnace

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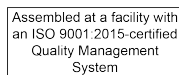
General

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 applications and can be converted for downflow or horizontal 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 cannot be common-vented with another gas appliance as prohibited by the *National Fuel Gas Code*.

Certification



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**, as well as the **NOTICE**, **Important**, and **Note** alerts.

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.

NOTICE indicates information considered important, but not hazard-related, such as messages relating to property damage.

Important indicates information that is essential to complete a task or may result in damage to the device if not followed.

Note indicates something of special interest or importance. Notes can contain any type of information except safety information.



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.



WARNING

Personnel must be qualified according to local, state, and national building and safety codes and regulations. Incorrect installation could cause leaks, electric shock, fire or explosion. Additionally, in N.A., the US EPA regulations (40 CFR Part 82, Subpart F) under Section 608 of the Clean Air Act requires that technicians who maintain, service, repair, or dispose of equipment that could release refrigerants into the atmosphere must be certified.



WARNING

Perform the test run in its entirety to ensure normal operation. Safety guards, shields, barriers, covers, and protective devices must be in place while the compressor/unit is operating. During the test run, keep fingers and clothing away from any moving parts. Clean up the site when finished, remembering to check that no metal scraps or bits of wiring have been left inside the unit being installed. After installation work for the system has been completed, explain the Safety Precautions, use, and maintenance of the unit to the customer according to the information in all manuals that accompanied the system. All manuals and warranty information must be given to the user or left near the Indoor Unit.



WARNING

- Check that the ground wire is securely connected. Do not connect ground wiring to gas piping, water piping, lighting conductor, or telephone ground wiring.
- If a circuit breaker, fuse or safety sensor is frequently activated, i.e. rapid red flashes, shut down the system and contact your service contractor. Please follow all instructions provided in this manual. Any disregard of the steps outlined in this manual is taken at the user's own risk.



WARNING

- Unauthorized modifications to Johnson Controls products are prohibited as they:
- may create hazards which could result in death, serious injury or equipment damage.
 - will void product warranties.
 - may invalidate product regulatory certifications.
 - may violate OSHA standards.



WARNING

Use appropriate personal protective equipment, such as gloves and protective goggles and, where appropriate, have a gas mask nearby. Also, use electrical protection equipment and tools suited for electrical operation purposes. Do not touch or adjust any safety devices inside the indoor or outdoor units. All safety features, disengagement, and interlocks must be in place and functioning correctly before the equipment is put into operation. If these devices are improperly adjusted or tampered with in any way, a serious accident can occur. Never bypass or wire around any safety device.

Safety rules and precautions

- Only use natural gas or propane (LP) gas with this furnace.
- Only install the furnace in a location and position as specified in this manual.
- Only install a gas-fired furnace in a residential garage as specified in this manual.
- Provide adequate combustion and ventilation air to the furnace space as specified in this manual.

- Only discharge combustion products outdoors. Only connect the furnace to an approved vent system, as specified in this manual.
- Test for gas leaks as specified in this manual.



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.

- Always install the furnace to operate within the intended temperature rise range of the furnace. Only connect the furnace to a duct system that has an external static pressure within the allowable range, as specified on the furnace rating plate.
- When installing a furnace so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, handle the return air with ducts that are sealed to the furnace casing and terminate outside the space containing the furnace.
- It is permitted to use the furnace to heat buildings or structures under construction where the application and use comply with all installation instructions in this manual, and the following conditions are met:
 - There is adequate vent installation.
 - The furnace is operating under thermostatic control.
 - The return air duct is sealed to the furnace.
 - The air filters are in place.
 - The furnace input rate and temperature rise are set according to the rating plate marking.
 - There is a means for providing the outside air required for combustion.
 - The return air temperature is maintained between 55°F (13°C) and 80°F (27°C).
 - The air filter is replaced after substantial completion of the construction process.
 - The furnace, ductwork, and components are cleaned after substantial completion of the construction process.
 - The furnace operating conditions are verified, including ignition, input rate, temperature rise, and venting.

- When installing the furnace in a non-HUD-Approved Modular Home or building constructed on-site, do not supply combustion air from occupied spaces.
- Base the size of the unit on an acceptable heat loss calculation for the structure. Use ACCA Manual J or another approved method.
- When moving or handling the furnace before 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 bottom or side return air openings or supply air opening.
- When lifting the furnace, you can use the primary heat exchanger tubes as a lifting point provided that you lift the tubes at the front of the heat exchangers where they are 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.

► **Important:** The doors must remain on the furnace when moving or lifting the furnace during installation.

Safety requirements

Consider the following safety requirements before installing the furnace:

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 [Figure 13](#) for return air plenum dimensions. You must install the plenum according to the instructions.
- Provide clearances from combustibile materials as listed in [Table 1](#).
- Provide clearances for servicing. Ensure to allow service access for both the burners and the blower.
- These models **are not** CSA listed or approved for installation in a **HUD approved modular home** or a **manufactured (mobile) home**.
- This furnace is not approved for installation in trailers or recreational vehicles.
- Do not install the furnace on combustibile flooring such as directly on carpeting, tile, or other combustibile material, with the exception of wood flooring.

- Check the rating plate and power supply to ensure that the electrical characteristics match. All models use a nominal 115 VAC, single-phase, 60 Hz power supply. **Do not connect this appliance to a 50 Hz power supply or a voltage above 130 V.**
- Install the furnace so that 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 licensed personnel must install, repair, or service gas heating equipment. Unlicensed 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 and 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:
Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners or other cleaning tools.

Soap powders, bleaches, waxes or other cleaning compounds, plastic items or containers, gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids or other volatile fluid.

Paint thinners and other painting compounds.

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 locating the furnace in any of the following environments:

- Buildings with indoor pools
- Areas where there is 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 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
- De-icing salts or chemicals
- Halogen type refrigerants
- Hydrochloric acid
- Masonry acid washing materials
- Permanent wave solutions
- Printing inks, paint removers, varnishes, and similar substances
- Water softening chemicals

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

Codes and standards

Follow all national, local codes, and standards in addition to these instructions.

The installation must comply with regulations of the serving gas supplier and local building, heating, plumbing, and other codes. In the 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 using the latest edition available.

In the United States, contact National Fire Protection Association Inc. Batterymarch Park Quincy, MA 02269. For the NFGC only, contact: American Gas Association, 400 N. Capital, N.W. Washington DC 20001 or <http://www.NFPA.org/>.

In Canada: NSCNGPIC.

For a copy, contact: Standard Sales, CSA International 178 Rexdale Boulevard Etobicoke, (Toronto) Ontario Canada M9W 1R3.

Combustion and ventilation air

- United States: Section 9.3 of the NFGC, air for Combustion and Ventilation
- Canada: Part 8 of NSCNGPIC, Venting Systems and Air Supply for Appliances

Duct systems

The following applies to the United States and Canada:

- Air Conditioning Contractors Association (ACCA) Manual D
- Sheet Metal and Air Conditioning Contractors Association National Association (SMACNA)
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 2021 Fundamentals Handbook

Acoustical lining and fibrous glass duct

In the United States and Canada consult the current edition of SMACNA and NFPA 90B as tested by UL Standard 181 for Class I Rigid Air Ducts.

Gas piping and gas pipe pressure testing

- United States: NFPA 54/ANSI Z223.1, NFGC; chapters 5, 6, 7 and 8 and National Plumbing Codes
- Canada: CAN/CSA-B149.1, Parts 4, 5, 6 and 9 NSCNGPIC Part 5

Electrical connections

- United States: 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.

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.

Inspection

Immediately after receiving the unit, inspect the unit for possible damage during transit. If damage is evident, perform the following steps:

- 1. Note the extent of the damage on the carrier's freight bill.
- 2. Make a separate request for inspection by the carrier's agent in writing.

Also, before installation, check the unit for any screws or bolts that loosened in transit. You do not need to remove any shipping or spacer brackets from the interior of this unit.

Location

Locate the furnace using the following guidelines:

- Choose a location that requires a minimum amount of air intake or vent piping and elbows.
- Choose a location that is as centralized with the air distribution as possible.
- Ensure that adequate combustion air is available, particularly when the appliance is not using outdoor combustion air.
- Make sure that the furnace does not interfere with adequate air circulation in the confined space.

- Be aware that the furnace is designed to be installed level. It is permissible to create up to 1/4 in. (6 mm) slope from back to front to assist in condensate drainage. Do this by shimming the back edge of the furnace in contact with the ground or platform.
- Install the furnace on a ground or platform with no more than 1/4 in. (6 mm) slope side to side and front to back.

Installation in freezing temperatures

- Install the furnace 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.

WARNING

Incorrect installation in an ambient below 32°F (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. This causes condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.
- Potential damage to the internal components can occur if the furnace is installed in an unconditioned space and an extended power failure occurs. 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 or service

Provide ample clearances so that there is easy access to the unit. Maintain the following minimum clearances:

- 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
- 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

You must ensure that the burners and the ignition source are located at least 18 in. (46 cm) above the floor when installing a gas-fired furnace in a residential garage. Locate or protect the furnace to avoid physical damage by vehicles.

Table 1: Unit clearances to combustibles

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

① Note:

1. Maintain a 24 in. clearance in front of the unit and 18 in. clearance on the side of the unit for service access. All furnaces are approved for alcove and attic installation.
2. Downflow application suitable for combustible floors only when used with a combustible floor base accessory.

Ductwork

Ductwork general information

The design and installation of the duct system must adhere to the following:

- The duct system must handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
- The duct system installation must be in accordance with the National Fire Protection Association as outlined in NFPA standard 90B (latest editions) or applicable national, provincial, state, and local fire and safety codes.

- The duct system must be a closed duct system. For residential and non-HUD modular home installations, when installing a furnace so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, handle the return air with ducts sealed to the furnace casing and terminating outside the space containing the furnace.
- The duct system must 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

You must install the indoor coil in the supply air duct, downstream of the furnace. Do not pass cooled air over the heat exchanger.

It is important to be aware of the following:

- When using the furnace with an indoor coil, install the coil parallel with or on the supply air side of the furnace to avoid condensation in the primary heat exchanger. When using a parallel flow arrangement, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, equip the damper 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 then remove the existing plenum and install a new plenum that is the correct size for the new furnace. If the plenum is shorter than 12 in. (30.5 cm), the turbulent airflow may cause the limit controls not to operate as designed or the limit controls may not operate at all.
- The duct system is a very important part of the installation.

- ① Note:** If the duct system is incorrectly sized, the furnace does not operate correctly.

The ducts attached to the furnace plenum must be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

- Important:** The minimum plenum height is 12 in. (30.5 cm). The furnace does not operate correctly on a shorter plenum height. The minimum rectangular duct height is 4 in. (10.2 cm) attached to the plenum.

- If using a matching cased indoor coil, it is possible to place it directly on the furnace outlet and seal it to prevent leakage. If installing an uncased indoor coil with a thermoplastic drain pan in the upflow/horizontal configuration, then provide an extra 2 in. (5.1 cm) minimum spacing to ensure against drain pan distortion.
- On all installations without a coil, use a removable access panel in the outlet duct so that smoke or reflected light are observable inside the casing, which indicates the presence of leaks in the heat exchanger. Ensure to attach this access panel securely to prevent leaks.



WARNING

The duct system must be correctly 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 6](#) 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.

Using the duct flanges

Three duct flanges are provided as part of the furnace casing.

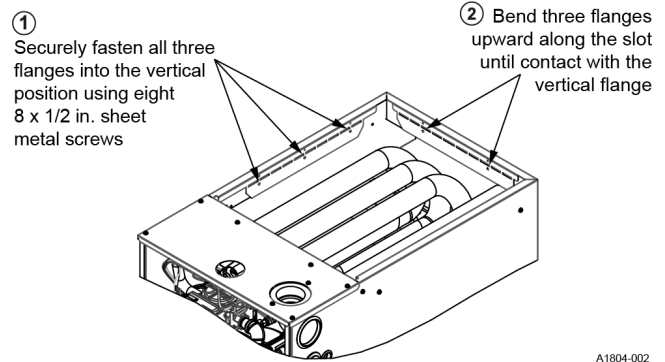
If not using flanges, they must remain in the rotated down position as shipped.

To use the duct flanges, follow the steps below:

1. Fold the flanges upward along the slots until the flanges come into contact the casing flange.
2. Secure each flange to the casing using eight 8 x 1/2 in. screws in the holes provided.

① **Note:** The screws are not provided.

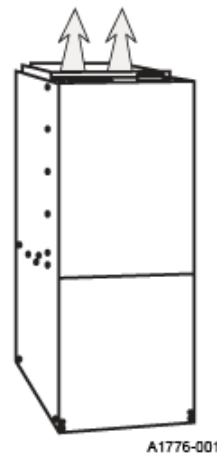
Figure 1: Duct attachment



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Ductwork installation and supply plenum connection - upflow/horizontal

Figure 2: Ductwork installation and supply plenum connection - upflow/horizontal

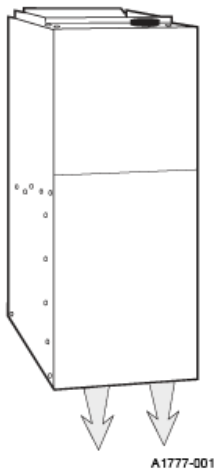


To install the ductwork and supply plenum connection in the upflow/horizontal configuration, follow the steps below:

1. Attach the supply plenum to the furnace outlet. Use an approved flexible duct connector on all installations.
2. Ensure that you seal the connection to prevent air leakage.
3. Use crosshatched sheet metal to eliminate any popping of the sheet metal when the indoor fan is energized.

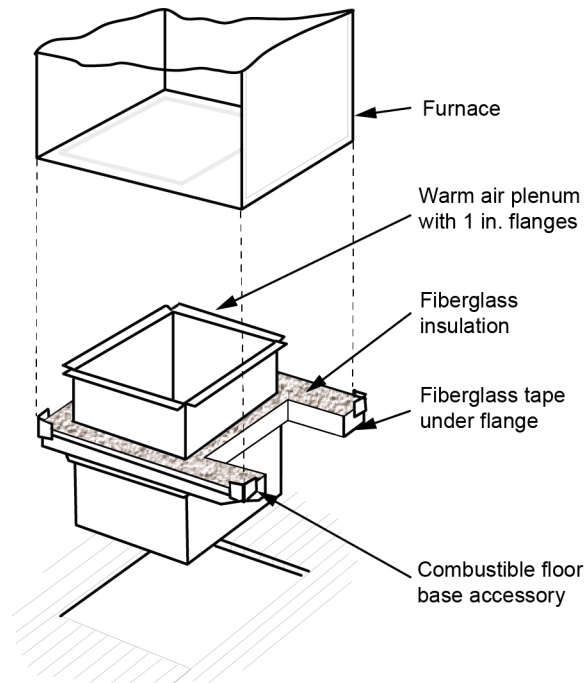
Floor base and ductwork installation - downflow

Figure 3: Floor base and ductwork installation - downflow



- Use a combustible floor base for installations on combustible material or directly on any floors, as shown in [Figure 4](#).
- Follow the instructions supplied with the combustible floor base accessory.
- It is possible to replace this combustible floor base with a matching indoor coil, correctly 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 the bottom panel and move the grommet to the required vent side exit.

Figure 4: Combustible floor base accessory



Downflow air applications - indoor coil cabinet

Note: Install the furnace with the coil cabinet specifically intended for downflow application. Make sure that the coil cabinet part number is the correct one. If a matching indoor coil is used, place it directly on the furnace outlet and seal it to prevent leakage. For details of the coil cabinet dimensions and installation requirements, refer to the installation instructions supplied with the coil cabinet.

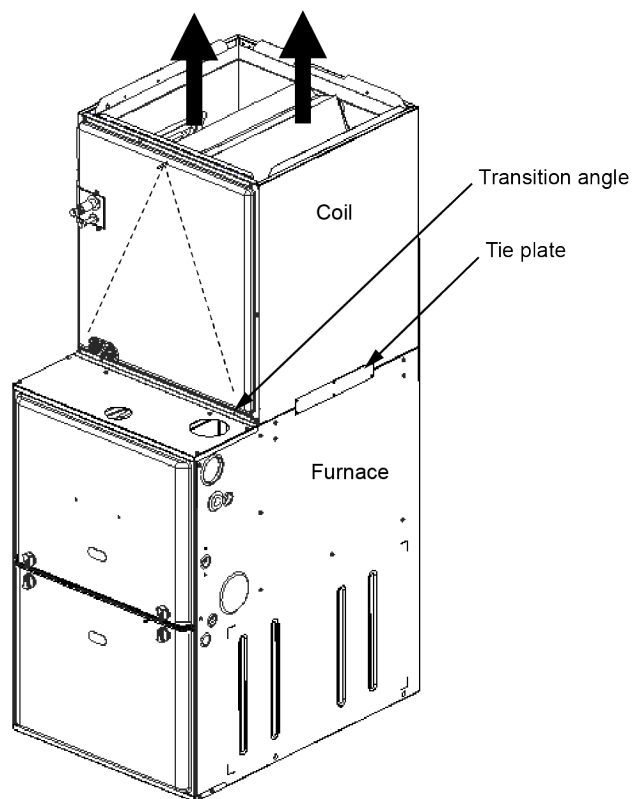
1. Attach the indoor coil cabinet to the duct connector.
2. Position the furnace on top of the coil cabinet.
3. Seal the connection to the furnace, coil cabinet, duct connector, and supply air duct to prevent air leakage.

Coil installation

Important: On all installations without a coil, use a removable access panel in the outlet duct so that smoke or reflected light are observable inside the casing, which indicates the presence of leaks in the heat exchanger. Ensure to attach this access panel securely to prevent leaks.

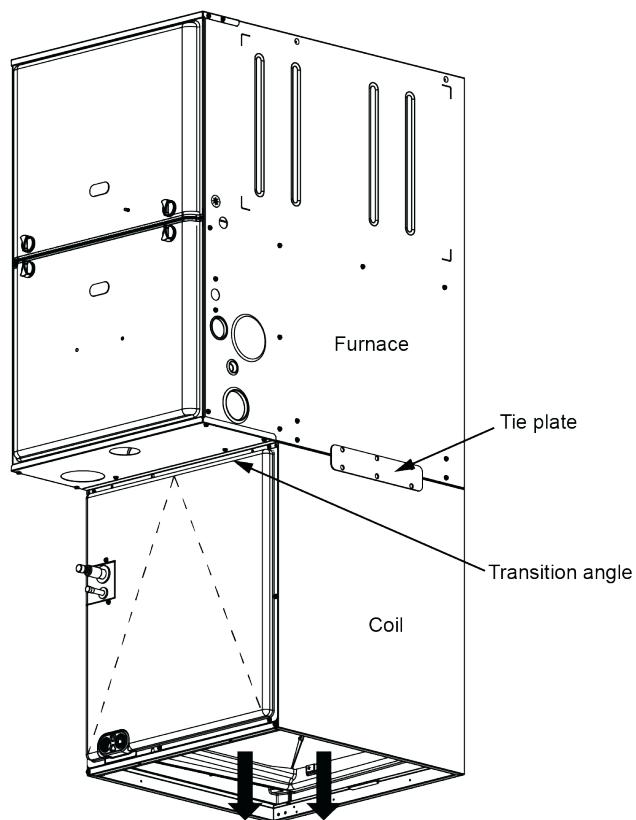
Mount the indoor coil on the supply side of the furnace as shown in [Figure 5](#) to [Figure 8](#). Refer to the installation instructions provided with each indoor coil.

Figure 5: Vertical upflow applications with furnaces



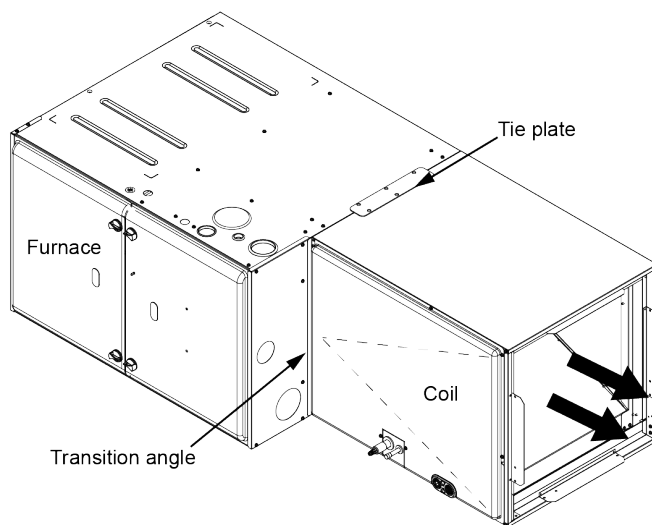
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Figure 6: Vertical downflow applications with furnaces



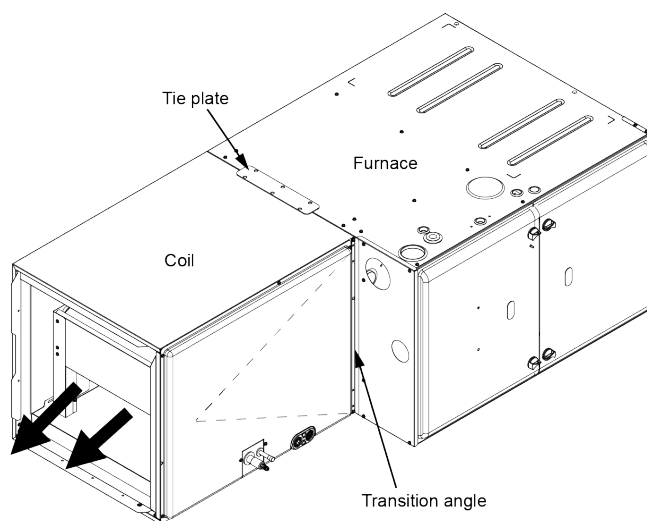
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Figure 7: Horizontal right application of the coil with the furnace



A1664-001

Figure 8: Horizontal left application of the coil with the furnace



A1665-001

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 connect to the rectangular duct under the floor and be sealed. Refer to the instructions supplied with the duct connector for correct installation.

See the separate accessory parts list at the end of these instructions for the approved accessory duct connectors.

Residential and modular home upflow return plenum connection

Return air may enter the furnace through the sides or bottom depending on the type of application. Do not connect return air 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 blockoff panel that must be left in place if using a side return. If installing the furnace on a flat, solid surface, this bottom panel provides an adequate seal to prevent air leakage through the unused bottom opening. However, if installing the furnace on a surface that is uneven or if installing the furnace on blocks or in another way where the furnace is 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.

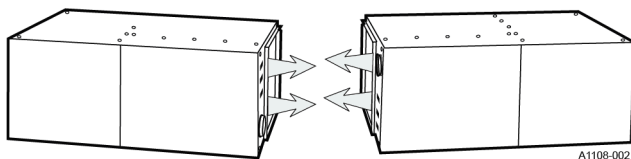
Bottom return and attic installations

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 the required service accessibility.

Horizontal application

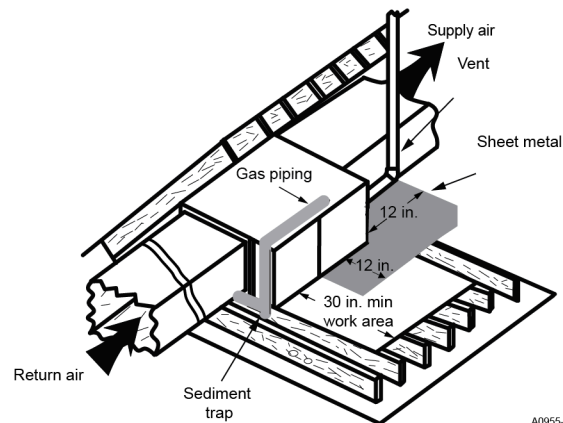
Figure 9: Horizontal application



- **Important:** It is possible to install this furnace in a horizontal position on either side as shown above. **Do not install this furnace on its back.**

Attic installation

Figure 10: Typical attic installation



This appliance is certified for line contact when installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs, or framing. This line may be in contact with combustible material. The filter rack must be a minimum distance of 18 in. (45.7 cm) from the furnace. Maintain required clearances to combustibles. See [Figure 10](#).

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.

Suspended furnace or 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 at risk of water damage.

The furnace can also be suspended from rafters or floor joists using rods, pipe angle supports, or straps.

When suspending the furnace, always support the unit with rods, straps, or angle supports, at three locations to correctly support the furnace.

1. Place one support at the supply end of the furnace.
2. Place one support located approximately in the center of the furnace near the blower shelf.
3. Place the third support at the return end of the furnace.

- ① **Note:** 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 correct 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 11](#) for details and additional information.

Figure 11: Typical suspended furnace or crawl space installation

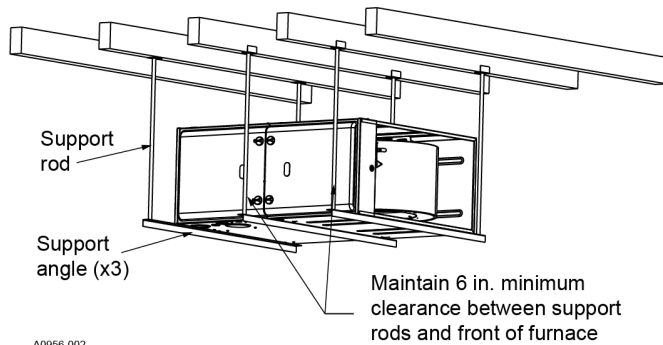
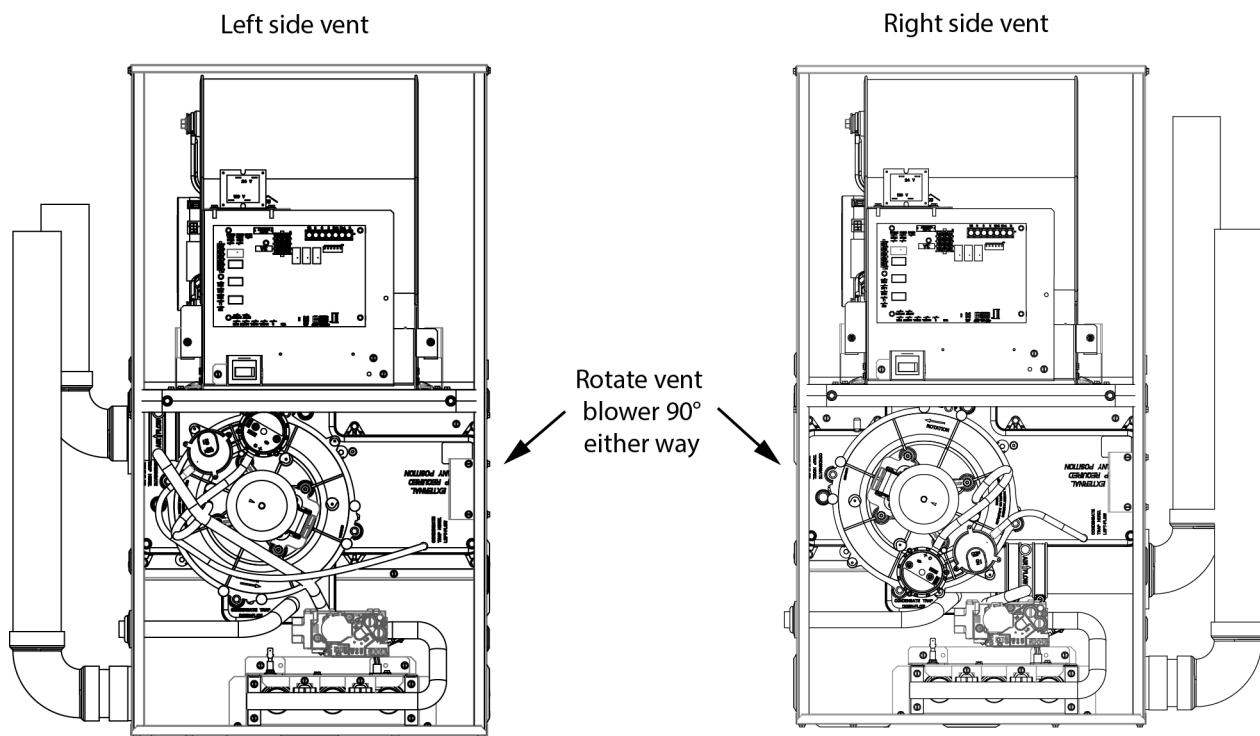


Figure 12: Downflow venting



A1805-002

- **Important:** During installation, the doors must remain on the furnace when moving or lifting the furnace.

Downflow application

The furnace is shipped in the upflow configuration. To configure the furnace in a downflow position, you must rotate the vent blower 90° left or right so that the vent pipe passes through the side of the furnace casing.

A field-supplied internal vent kit is available for downflow applications where the venting must be routed through the blower compartment:

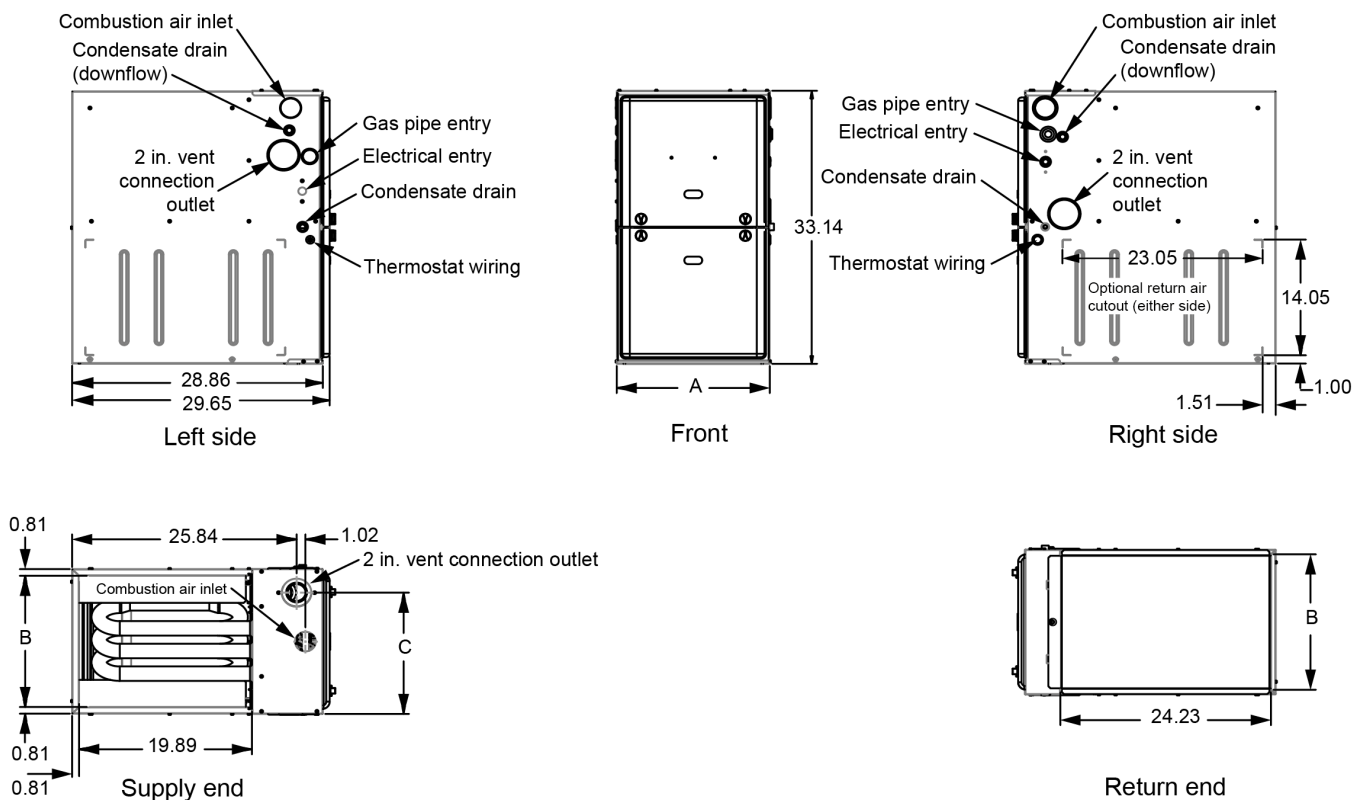
- S1-37348990001 internal vent kit 17.5 in.
- S1-37348991001 internal vent kit 21.0 in.
- S1-37348992001 internal vent kit 24.5 in.

- ① **Note:** There is no kit available for A width cabinet models.

Dimensions

The unit cabinet and duct dimensions are shown in [Figure 13](#) and [Table 2](#).

Figure 13: Dimensions (in.)



A1795-001

Table 2: Cabinet and duct dimensions

MBH (kW) input	Nominal CFM (m ³ /min)	Cabinet size	Cabinet dimensions						Approximate operating weights
			A (in.)	A (cm)	B (in.)	B (cm)	C (in.)	C (cm)	
26 (7.6)	800 (22.6)	A	14.5	36.8	13.4	34.0	11.7	29.7	103 (47)
40 (11.7)	1000 (28.3)	A	14.5	36.8	13.4	34	11.7	29.7	106 (48)
60 (17.6)	1200 (34.0)	A	14.5	36.8	13.4	34	11.7	29.7	109 (49)
60 (17.6)	1200 (34.0)	B	17.5	44.4	16.4	41.6	14.7	37.4	112 (51)
80 (23.4)	1200 (34.0)	B	17.5	44.4	16.4	41.6	14.7	37.4	117 (53)
80 (23.4)	1600 (45.3)	C	21	53.3	19.8	50.5	18.2	46.2	127 (58)
80 (23.4)	2000 (56.6)	C	21	53.3	19.8	50.5	18.2	46.2	135 (61)
100 (29.3)	1600 (45.3)	C	21	53.3	19.8	50.5	18.2	46.2	131 (59)
100 (29.3)	2000 (56.6)	C	21	53.3	19.8	50.5	18.2	46.2	138 (63)
120 (35.1)	2000 (56.6)	D	24.5	62.2	23.4	59.4	21.7	55.1	147 (67)

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.

Install filters external to the furnace cabinet. **Do not attempt to install filters inside the furnace.**

Table 3: Filter sizes (high velocity 600 FPM)

CFM (m³/min)	Cabinet size	Side (in.)	Bottom (in.)
800 (22.6)	A	16 x 25	14 x 25
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

Air velocity through throwaway type filters may not exceed 300 ft/min (91.4 m/min). All velocities over this require the use of high-velocity filters.

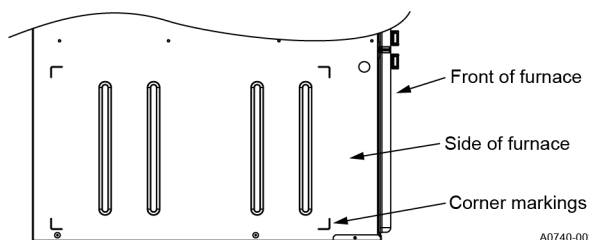
Do not exceed 1800 CFM using a single side return and a 16 x 25 in. filter. For CFM greater than 1800, you can use two side returns, or one side and the bottom or one side return with a transition to allow use of a 20 x 25 in. filter.

- ① **Note:** Single side return above 1800 CFM is approved if the filter velocity does not exceed the filter manufacturer's recommendation and a transition is used to allow use on a 20 x 25 in. filter.

Installing side return filters

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

Figure 14: Side return cutout markings



Install the side filter rack following the instructions provided with that accessory. If filters are 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 14](#).

Installing 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 or supports is required to support the weight of the external filter box.

Installing downflow filters

CAUTION

In downflow furnace arrangement, the filter must be located a minimum of 12 in. from the return air inlet of furnace.

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.

Filters 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. The use of straps or supports is required to support the weight of the external filter box.

Gas piping

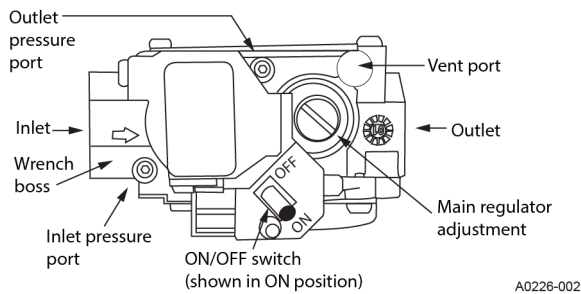
Gas safety

See [Figure 15](#) for the gas valve components.

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 psig (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 will cause damage to the furnace or some of its components that will result in property damage and loss of life.

Figure 15: Gas valve



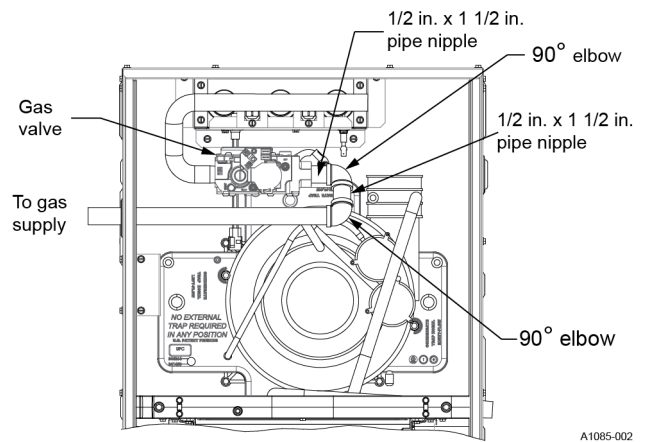
- **Important:** Plan the gas supply routing before determining the correct gas pipe entry. Use 90° conventional elbows and short pipe nipples to enter through the cabinet access holes.

Gas piping installation

Adhere to the following guidelines for gas piping installation:

- Use correctly sized wrought iron, or approved flexible or steel pipe when making gas connections to the unit.
- ① **Note:** 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 the furnace.
- For a left side supply gas pipe arrangement, use two 1/2 in. elbows and two 1/2 in. x 1 1/2 in. pipe nipples.
- The arrangement shown in [Figure 16](#) aligns the entrance hole in the furnace casing with the supply gas pipe. The furnace casing does not support installations completed using street elbows.

Figure 16: Left side supply gas pipe arrangement



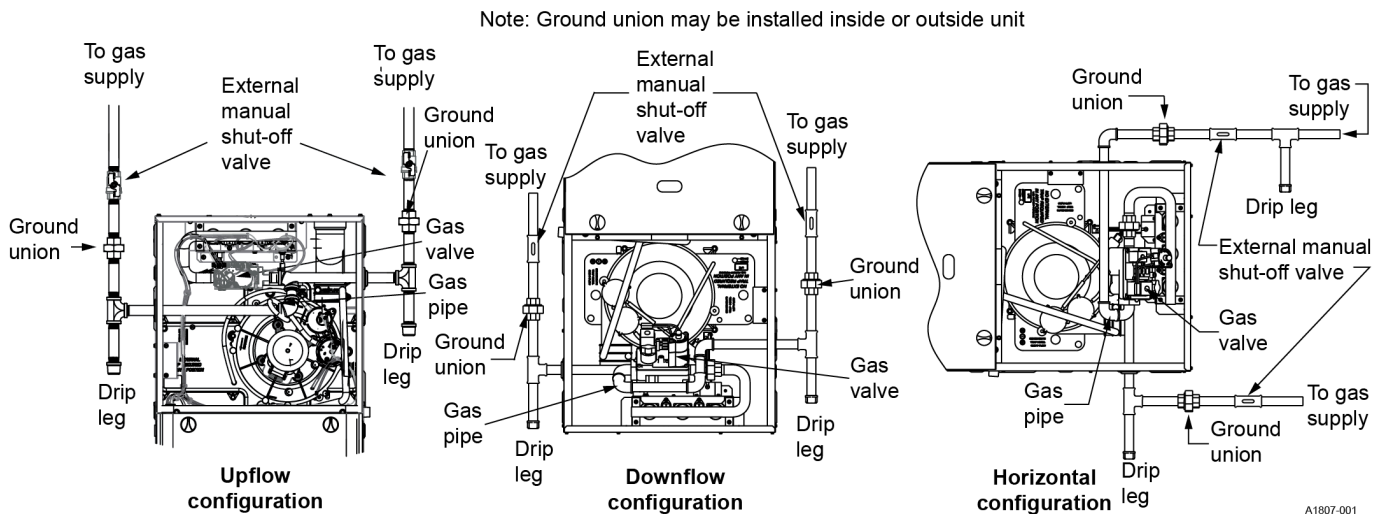
- If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.
- Use only approved gases.
- Use a drip leg and ground union as required. See [Figure 17](#).
- **Important:** An accessible 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 may be connected from either side of the furnace using any of the gas pipe entry plugs on both sides of the furnace. See [Downflow application](#) and [Figure 17](#).

Figure 17: Gas piping



Gas orifice conversion for propane

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

NOTICE

Model Z9ES026A08 is not approved for use with propane gas.

High altitude gas orifice conversion

The rating plate indicated gas input rate is for natural gas-fired operation at 0 ft to 2,000 ft (0 m to 610 m) above sea level. For reliable operation, set the furnace input rate as shown on the rating plate.

In the United States, you must reduce (derate) manifold pressure to reduce the furnace input rate for altitudes above 2,000 ft (610 m). This rate of input reduction (derate) must be in accordance with [Table 4](#).

Obtaining the correct input rate

1. Obtain the average yearly gas heat value (at installed altitude and location) from the local gas supplier.
2. Turn the gas valve **ON/OFF** switch to **OFF**.
3. Locate the manifold pressure port on the gas valve marked Out P. Use a 3/32 in. (2.4 mm) hex head wrench and loosen the set screw by turning it one turn counterclockwise. **Do not remove the set screw from the pressure port.**
4. Connect a manometer or similar device to the manifold pressure tap.
5. Turn the gas valve **ON/OFF** switch to **ON**.
6. Provide a thermostat call for heating or jumper the R and W thermostat connections on the control board to start the furnace in heating mode.
7. Remove the regulator adjustment cap from the gas valve pressure regulator and turn the adjusting screw counterclockwise (out), using a slotted screwdriver, to decrease the input rate or clockwise (in) to increase the input rate.
8. When the correct input is obtained, replace the cap that conceals the gas valve regulator adjustment screws.
9. Remove the manometer or similar device connected in Step 4 and tighten the pressure tap plug using the 3/32 in. (2.4 mm) hex head wrench.
10. Turn off all other gas appliances and pilots served by the meter.
11. Run the furnace for a minimum of 3 min.
12. Measure the time in seconds for the gas meter to complete one revolution and note the reading.
13. See [Table 14](#) for manifold pressure.

14. Multiply the gas rate ft³/h by the heating value (Btu/h/ft³) to obtain the input rate.

What to do next:

If the clocked rate does not match required input, increase the manifold pressure to increase input or decrease manifold pressure to decrease input. Repeat Step 2 to Step 14 until the correct input is achieved. Reinstall the regulator seal cap on gas valve.



Fire hazard

Failure to follow this warning could result in personal injury, death, and/or property damage. Reinstall the manifold pressure tap plug-in gas valve to prevent gas leak.

Altitude derating

Table 4: Altitude derating

Furnace input rate in kBtu/h and size	Altitude (ft)															
	0 ft to 2,000 ft				2,000 ft to 5,400 ft				5,401 ft to 7,800 ft				7,801 ft to 10,000 ft			
	Natural gas manifold pressure (in. W.C.)	Natural gas orifice	LP manifold pressure (in. W.C.)	LP orifice	Natural gas manifold pressure (in. W.C.)	Natural gas orifice	LP manifold pressure (in. W.C.)	LP orifice	Natural gas manifold pressure (in. W.C.)	Natural gas orifice	LP manifold pressure (in. W.C.)	LP orifice	Natural gas manifold pressure (in. W.C.)	Natural gas orifice	LP manifold pressure (in. W.C.)	LP orifice
26A08	3.5	51	—	—	3.5	51	—	—	3.5	51	—	—	3.5	51	—	—
40A10	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	8.5	55
60A10	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55
60B12	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55
80B12	3.5	45	10	55	3.5	45	9.9	55	3.5	45	10	55	3.5	45	9.5	55
80C16	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	7.5	55
80C20	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	9.5	55
100C16	3.5	45	10	55	3.5	45	10	55	3.5	45	9	55	3.5	45	8.3	55
100C20	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55	3.5	45	10	55
120D20	3.5	45	10	55	3.5	45	9.4	55	3.5	45	9	55	3.5	45	7.9	55

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.

Table 5: High-altitude pressure switches

Furnace input rate in kBtu/h and size	High-altitude pressure switch accessory kit part number
26A08	S1-1PS3313
40A10	S1-1PS3315
60A10	S1-1PS3313
60B12	S1-1PS3313
80B12	S1-1PS3316
80C16	S1-1PS3314
80C20	S1-1PS3314
100C16	S1-1PS3317
100C20	S1-1PS3318
120D20	S1-1PS3314



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 ensure 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.

Electric power

Electrical power connections



Use copper conductors only.

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 when installed in accordance with these instructions. See [Table 6](#) for specific furnace electrical data.

Table 6: Ratings and physical and electrical data

Input		Output		Nominal airflow		AFUE	Air temperature rise		Maximum outlet air temperature		Blower		Blower size (in.)	Fuse or circuit breaker (A)	Total unit (A)	Gas pipe connection NPT (in.)
MBH	kW	MBH	kW	CFM	m ³ /min	%	°F	°C	°F	°C	hp	A				
26	7.6	25	7.3	800	22.6	97.0	25 to 55	14 to 31	190	88	1/3	4.1	11 x 8	15	6.5	1/2
40	11.7	38	11.1	1000	28.3	96.0	30 to 60	17 to 33	190	88	1/2	6.4	11 x 8	15	8.8	1/2
60	17.6	57	16.7	1000	28.3	96.0	35 to 65	19 to 36	190	88	1/2	6.4	11 x 8	15	8.8	1/2
60	17.6	57	16.7	1200	34.0	96.0	30 to 60	17 to 33	190	88	1/2	6.4	11 x 8	15	8.8	1/2
80	23.4	76	22.3	1200	34.0	96.0	40 to 70	22 to 39	190	88	1/2	6.4	11 x 8	15	8.8	1/2
80	23.4	76	22.3	1600	45.3	96.0	40 to 70	19 to 36	190	88	3/4	8.4	11 x 10	20	10.8	1/2
80	23.4	76	22.3	2000	56.6	96.0	30 to 60	17 to 33	190	88	1	12.2	11 x 11	20	14.6	1/2
100	29.3	95	27.8	1600	45.3	96.0	40 to 70	22 to 39	190	88	3/4	8.4	11 x 10	20	10.8	1/2
100	29.3	95	27.8	2000	56.6	96.0	35 to 65	19 to 36	190	88	1	12.2	11 x 11	20	14.6	1/2
120	35.1	114	33.4	2000	56.6	96.0	45 to 75	25 to 42	190	88	1	12.2	11 x 11	20	14.6	1/2



Note:

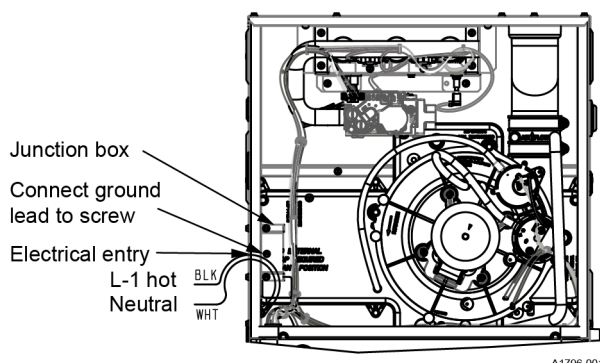
- Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE test procedures.
- Wire size and over current protection must comply with the National Electrical Code (NFPA-70, latest edition) and all local codes.
- Install the furnace so that the electrical components are protected from water.

Connecting the supply voltage

About this task:

Perform these steps to connect the supply voltage. See [Figure 18](#).

Figure 18: Electrical wiring



1. Provide a power supply separate from all other circuits. Install overcurrent protection and a disconnect switch in accordance with local and national electrical codes. Locate the switch close to the unit for convenience in servicing.
2. With the disconnect or fused switch in the OFF position, check all wiring against the unit wiring label. See [Wiring diagrams](#).
3. Remove the wiring box cover screws.
4. Route all power wiring through a conduit connector or other correct 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. There are two options for wiring.

Option 1 - Connect the wires in the following order:

- a. 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.
- b. Connect the black wire to L1 (hot) from the power supply.
- c. Connect the white wire to neutral.
- d. Connect the installer-supplied ground wire to the green equipment ground screw.

Option 2 - Use a field-provided 2 in. x 4 in. (5.1 cm x 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.

5. After making the wiring connections, replace the wiring box cover and screws. See [Figure 18](#).
6. Ensure correct polarity of the power supply and a correct ground connection for the furnace's control system. See [Figure 18](#).

► **Important:** The power connection leads and wiring box are factory-installed on the left side of the furnace. These can be relocated to the opposite side of the furnace, **except when the inducer is rotated to exit from the right side of the furnace**. Remove the screws and cut the wire tie holding the excess wiring. Reposition on the opposite side of the furnace and fasten using the holes provided.

Low-voltage control wiring connections

Install the field-supplied thermostat by following the instructions that come with the thermostat.

1. 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 block on the control board, as shown in [Figure 19](#) to [Figure 22](#).
2. Electronic thermostats require the common wire to be connected. Do not use power-stealing thermostats. Apply strain relief to thermostat wires passing through the cabinet.
3. 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 condensing unit (unit outside).

► **Important:** Set the heat anticipator in the room thermostat to 0.4 A. Setting it lower causes short cycles. Setting it higher causes the room temperature to exceed the set points.

► **Important:** Some electronic thermostats do not have adjustable heat anticipators. Set these thermostats 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 and air cleaners. The transformer can provide power for an air conditioning or heat pump contactor.

Figure 19: Standard ECM furnace and single-stage HP

Thermostat	Gas furnace	Single-stage heat pump
R	R	R
G	G	
Y1	Y/Y2	Y
W2	W2*	
E	W1	W OUT
W		W
O		O
C	COM	C

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Figure 20: Standard ECM furnace and multi-stage HP

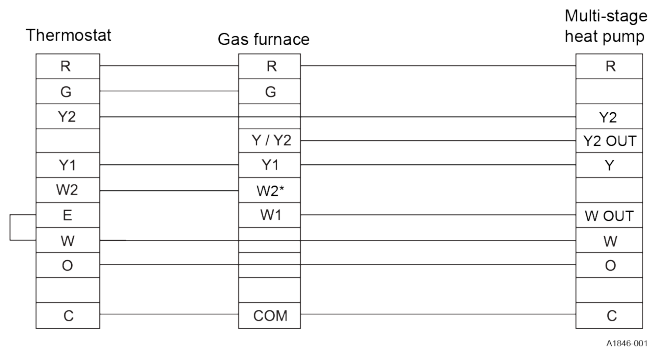


Figure 21: Standard ECM furnace and single-stage AC

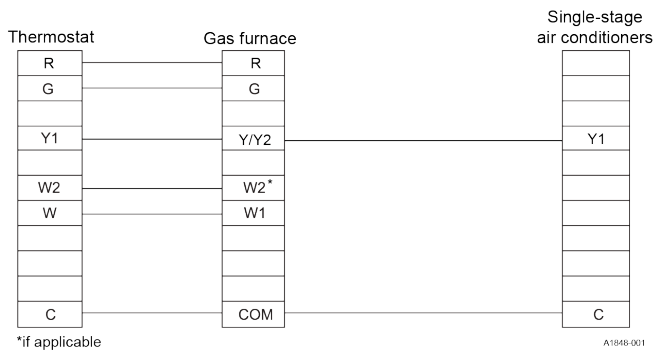
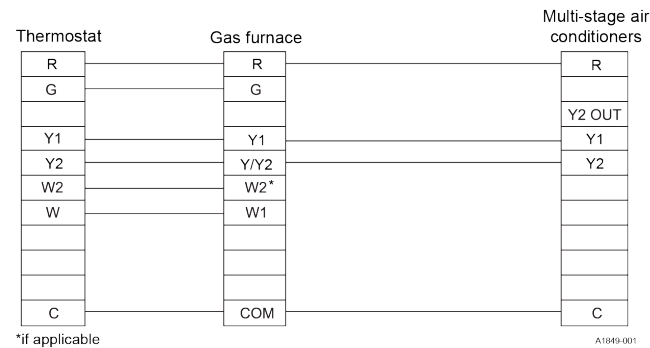


Figure 22: Standard ECM furnace and premium multi-stage AC



Accessory connections

The furnace control allows power-switching control of various accessories.

Electronic air cleaner connection

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

Humidifier connection

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

Furnace control twinning wiring

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). Both furnaces must have separate power circuits but the circuits **must** be from the same phase or leg of power.

When two identical furnaces are installed using the same duct system, it is important that the two furnace circulating air blowers operate simultaneously at all times. If one blower starts before the second blower, the duct system becomes pressurized and the blower on the second furnace may turn backwards, causing the second furnace to overheat and 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. When furnaces use the twinning capability, the two controls do not trade on and off during a W1 call. Only the control that is connected to the thermostat conditions while both blowers continue to operate at the same time and speed.



Twinned furnaces must be on the same power source or line leg (phase). Notify the job electrician early so they can correctly balance the electrical load. Failure to do this may result in control voltage polarity issues. See the Rapid Red Flash fault code in [Furnace control diagnostics](#).

Figure 23: Wiring for two single-stage furnace controls

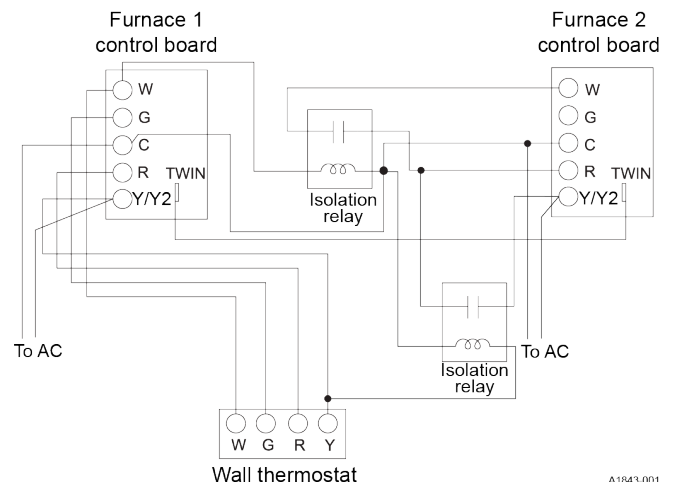


Figure 24: Wiring for two multi-stage furnace controls

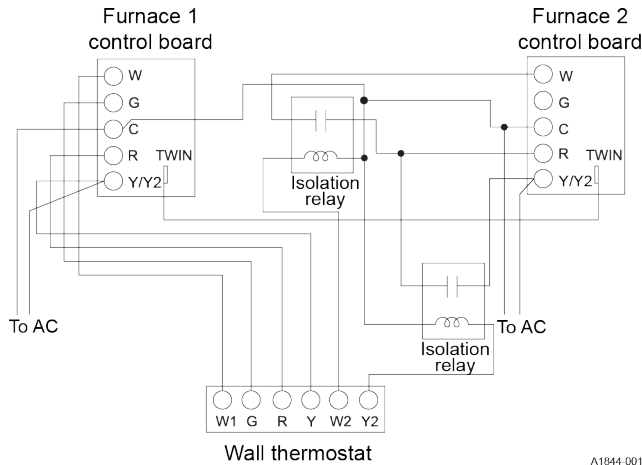
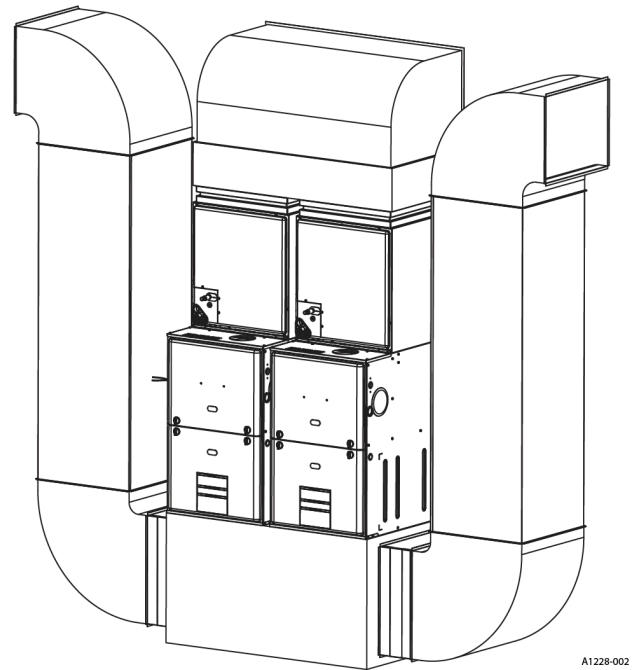


Figure 25: Twinned furnaces



Twinning duct system

Only apply twinned furnaces on a common duct system. Use a single air supply plenum for both furnaces and indoor coils. Do not use separate plenums and supply ducts systems. Use a single return air plenum, common to both furnaces. It is suggested that a return platform is used, 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.

Ensure that both furnaces are identical models in both heating capacity and CFM capacity. Operate both furnaces on the same motor speed taps. See [Figure 25](#) 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, use an air-mixing device in the plenum to mix the air from both furnaces. Install the mixing device 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 downstream from the furnace that is not operating in heat mode supply cold air to the occupied spaces.

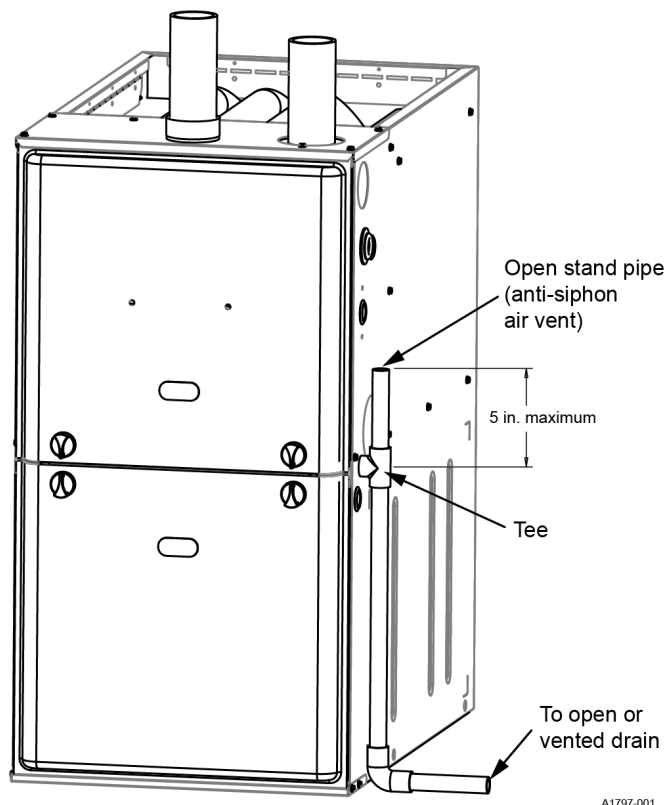
CAUTION

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.

Condensate piping and furnace venting configuration

Condensate drain location

Figure 26: Typical condensate drain, vertical installation



As shipped from the factory:

- For all 26k, 40k, 60k, and 80k 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.

Figure 27, Figure 28, Figure 29 and Figure 30 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, as shown in Figure 27, Figure 28, Figure 29, and Figure 30, be sure to cap all unused openings.

If rerouting hoses, cut off excess length so no sagging loops collect and hold condensate, as this stops the furnace operating.

Hose clamps are not needed for connecting to the condensate pan.

- **Important:** The furnace, indoor coil, and humidifier drains can be combined and drained together. The indoor coil drain can have an external, field-supplied trap before 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 correctly. Follow local plumbing or wastewater codes. The drain line must maintain a 1/4 in./ft (20 mm/m) downward slope to the drain.
- **Important:** If an external vent tee is being installed, then the drain line may 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 flows to the drain better if an open stand pipe is installed in the drain line. See Figure 26.

Do not drain other devices, such as a humidifier and evaporator 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 so 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 a significant length of combustion air pipe passes through conditioned space. You can avoid this problem by installing the supplied vent drain and drain hose located in the loose parts bag. Install the intake drain hose by connecting it to the inlet pipe coupling and to the collector box as shown in [Figure 27](#) to [Figure 30](#). 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 you use the intake drain, the bird screen **can not** 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 the case for all long horizontal venting in any furnace configuration. This stops 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.

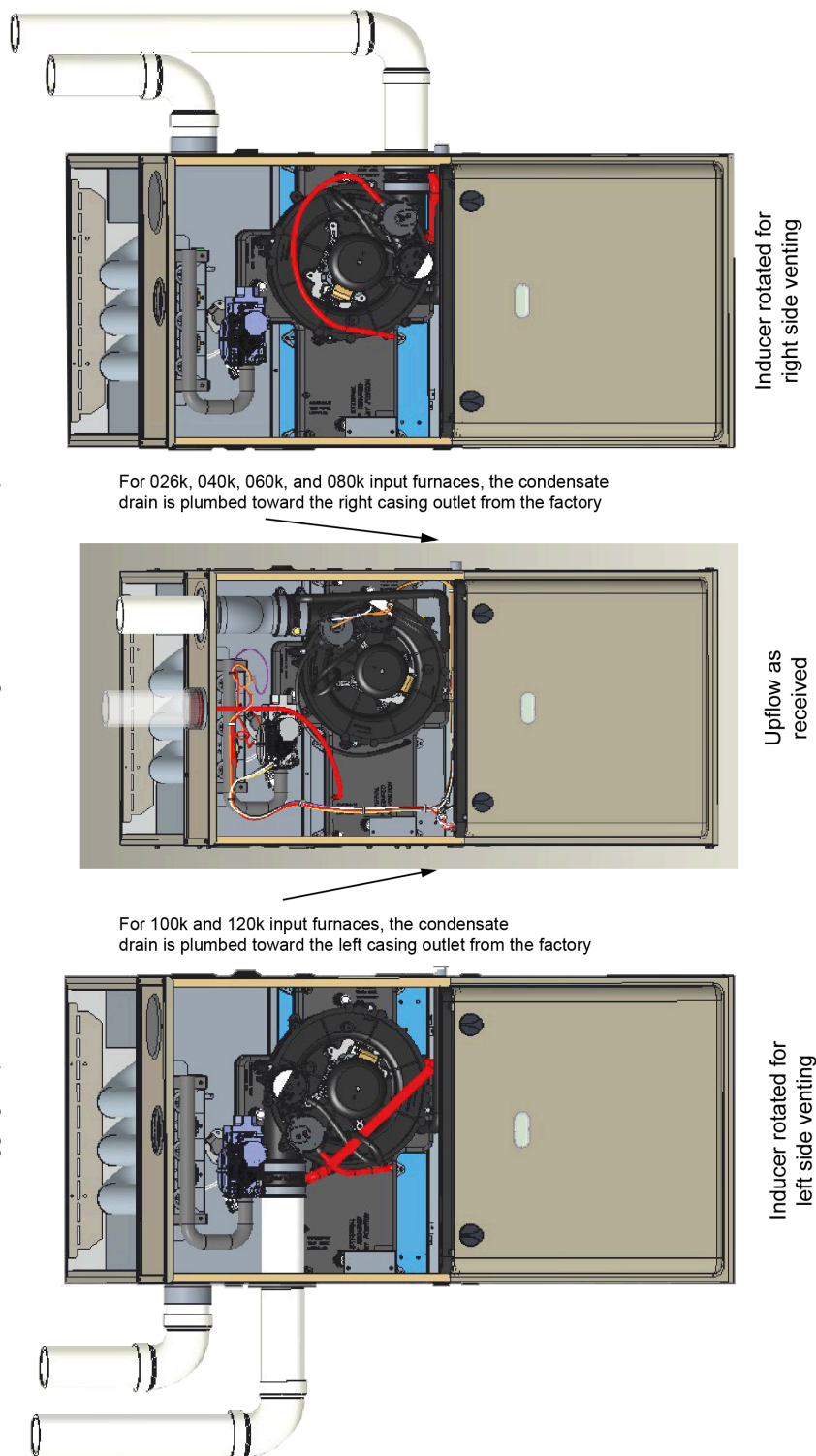


WARNING

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

Figure 27: Upflow configuration

If you need to change drain hose routing, ensure that you cap all unused openings. Cut off excess length when rerouting hoses so that no sagging loops collect and hold condensate, causing the furnace not to operate.

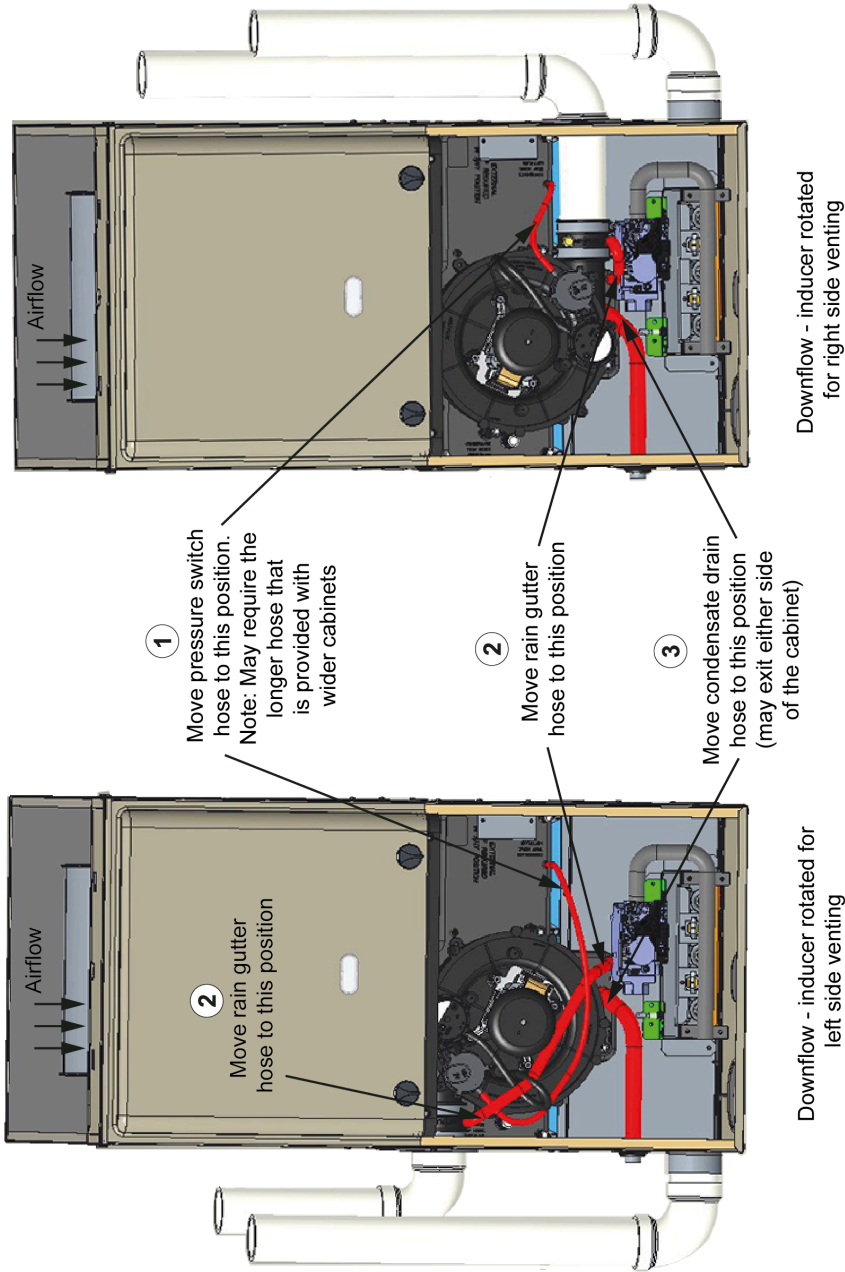


Condensate drain may exit cabinet on either side

A1781-002

Figure 28: Downflow configuration

If you need to change drain hose routing, ensure that you cap all unused openings. Cut off excess length when rerouting hoses so that no sagging loops collect and hold condensate, causing the furnace not to operate.



A1799-001

Figure 29: Horizontal left configuration

If you need to change drain hose routing, ensure that you cap all unused openings. Cut off excess length when rerouting hoses so that no sagging loops collect and hold condensate, causing the furnace not to operate.

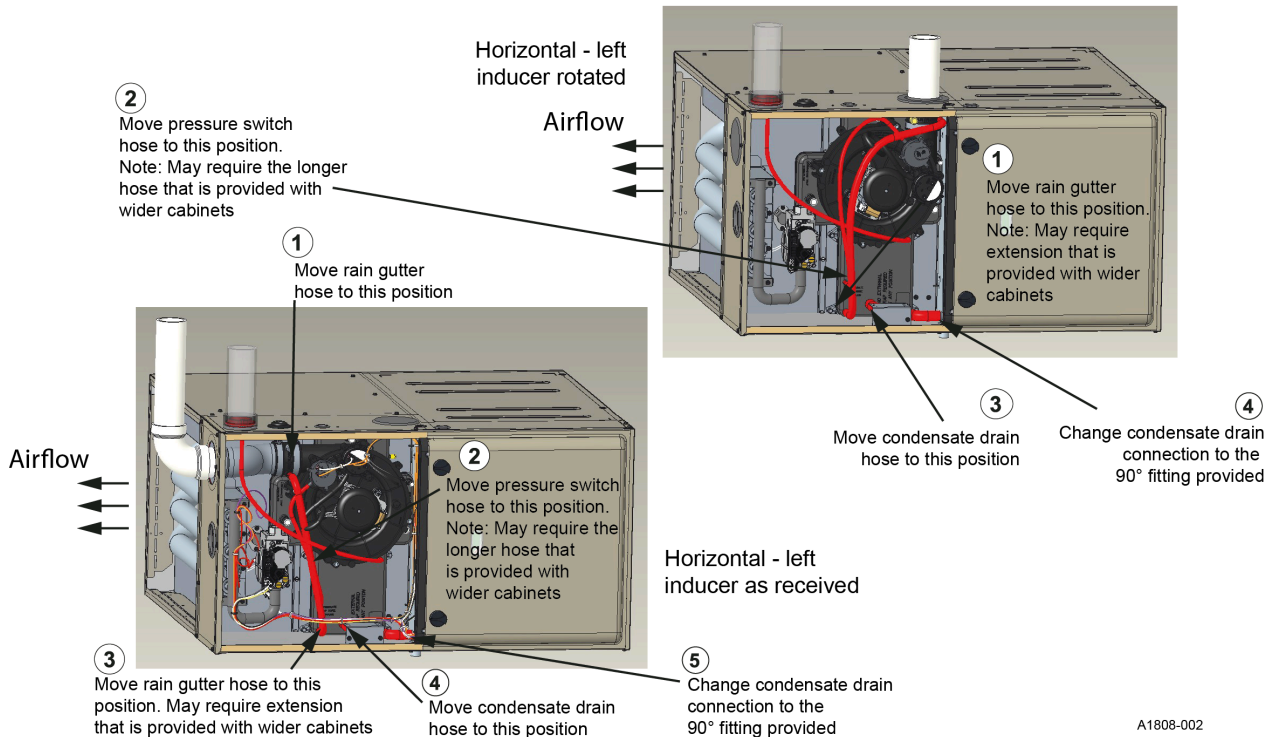
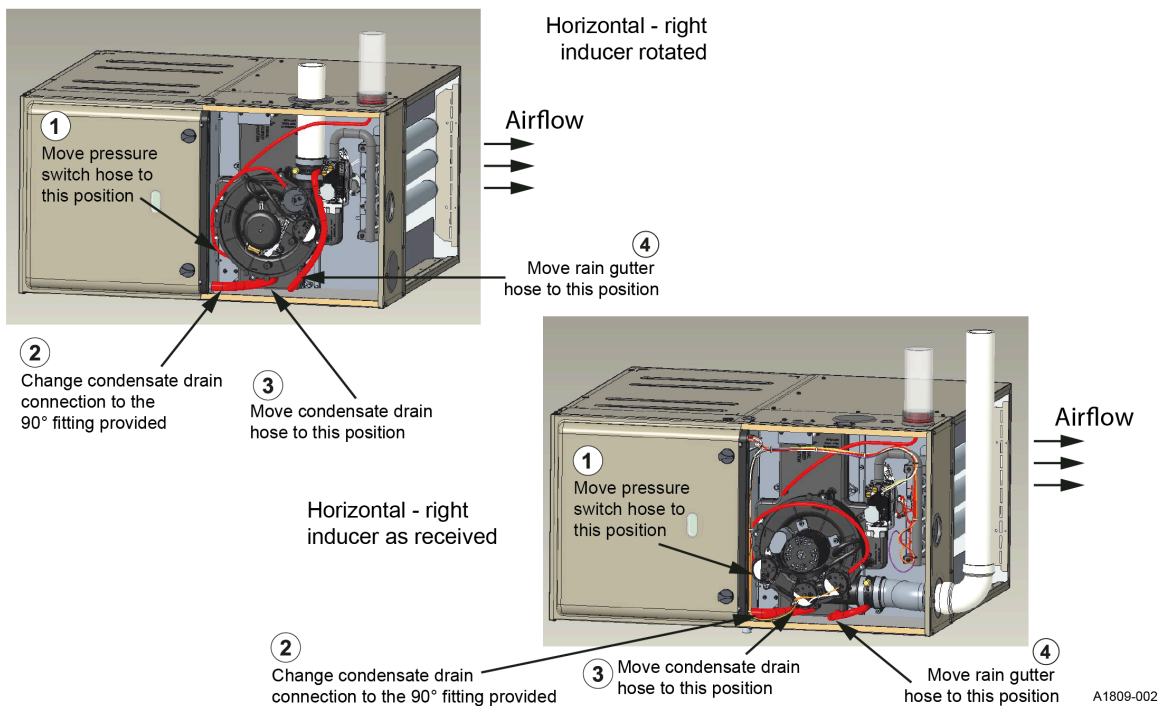


Figure 30: Horizontal right configuration

If you need to change drain hose routing, ensure that you cap all unused openings. Cut off excess length when rerouting hoses so that no sagging loops collect and hold condensate, causing the furnace not to operate.



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 venting system must be installed in accordance with the following:

- Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition)
 - Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition)
 - 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 to be insulated if 2 ft 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 and vent pipe sizing

Determine the size of pipe by the furnace model, the total length of pipe required, and the number of elbows required. See [Table 7](#), which 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.

These rules must also be followed:

1. If venting with PVC, use drain, waste, and vent (DWV) elbows with a long radius (sweep). Standard DWV elbows can be used, but as they have a longer equivalent length, they reduce the total length of pipe that will be allowed. If venting with CPVC, use long radius (sweep) elbows such as Spears Manufacturing LabWaste(R) series. Short radius (plumbing or pressure) elbows are not allowed for venting. The standard dimensions of the acceptable elbows are shown in [Figure 31](#).
2. **The maximum equivalent length listed in [Table 7](#) is for the vent piping and the air intake piping separately.** For example, if the table allows 65 equivalent ft for a particular model, then the vent can have 65 equivalent ft of pipe, **and** the combustion air intake can have another 65 equivalent ft of pipe.
3. Three vent terminal elbows, two for the vent and one for the combustion air intake, are already accounted for and do not need to be included in the equivalent length calculation.
4. All PVC, CPVC, or ABS combustion air and vent piping must conform to American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), D2846 (CPVC), F441 (CPVC), F442 (CPVC), D2261 (ABS-DWV), or F628 (Schedule 40 ABS). All IPEX System 1738 must conform to UL 1738 Standards and American Society for Testing and Materials (ASTM) standards D2665. Pipe cement and primer must conform to ASTM Standard D2546 (PVC), F493 (CPVC), or D2235 (ABS). If using ABS pipe, glue any joint where an ABS pipe joins to a PVC pipe with cement that is approved for use with both materials. Do not use metallic materials for venting or air intake.
5. 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. Install the 2 in. to 3 in. increase in the vertical position, to avoid creating an area that will pool water.
6. In Canada, vents must be certified to ULC S636, Standard for Type BH Gas Venting Systems.
7. In Canada, the first 3 ft (91.4 cm) of the vent must be readily accessible for inspection.
8. For single pipe systems, it is advised to install the combustion air coupling provided and install approximately 18 in. of pipe on the furnace.
9. The minimum vent length for all models is 5 ft (1.5 m).

Polypropylene vent or 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, go to <http://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

Table 7: Maximum equivalent pipe length

Furnace input rate in kBtu/h and size	Pipe size (in.)	Maximum equivalent pipe length (ft) by altitude (ft)			
		0 ft to 2,000 ft	2,001 ft to 5,400 ft	5,401 ft to 7,800 ft	7,801 ft to 10,100 ft
26A08	2	65	50	35	25
	3	90	75	60	50
	4	150	140	125	115
40A10	2	65	50	35	25
	3	90	75	60	50
	4	150	140	125	115
60A10	2	65	65	65	65
	3	90	90	90	90
	4	150	150	150	150
60B12	2	65	65	65	65
	3	90	90	90	90
	4	150	150	150	150
80B12	2	55	55	20	10
	3	80	80	50	40
	4	145	145	115	110
80C16	2	65	65	30	30
	3	90	90	55	55
	4	150	150	120	120
80C20	2	65	65	30	30
	3	90	90	55	55
	4	150	150	120	120
100C16	2	20	15	—	—
	3	65	60	55	50
	4	130	125	120	115
100C20	2	20	15	—	—
	3	65	60	55	55
	4	130	125	120	120
120D20	2	—	—	—	—
	3	90	70	60	50
	4	150	135	125	115

Consult the PolyPro installation instructions for assembly details.

For other PolyPro pipe and fitting part numbers, go to <http://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, go to <http://www.centrotherm.us.com>.

IPEX System 1738

- 2 in. PVC FGV coupling - 397352
- 3 in. PVC FGV coupling - 397353

Consult the IPEX System 1738 installation instructions for assembly details. For other IPEX System 1738 pipe and fitting part numbers, go to <http://www.ipexna.com/usa/products/plumbing-mechanical/flue-gas-venting-systems/system-1738-pvc>.

Figure 31: Elbow dimensions

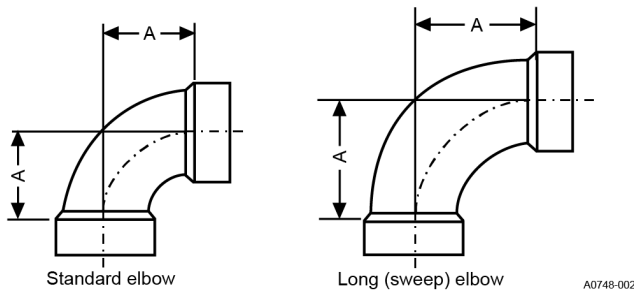


Table 8: Elbow dimensions

Elbow	Dimension A
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.

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 of how to calculate the equivalent length of pipe:

An 80,000 Btu/h furnace requires 32 ft of pipe and 5 90° elbows. Using 2 in. pipe and standard elbows, the total equivalent length is:

32 ft of 2 in. pipe = 32 equivalent ft

5 90° standard 2 in. elbows = (5 x 7) = 35 equivalent ft

Total = 67 equivalent ft of 2 in. pipe

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

By using sweep elbows, the total equivalent length is:

32 ft of 2 in. pipe = 32 equivalent ft

5 90° sweep 2 in. elbows = (5 x 5) = 25 equivalent ft

Total = 57 equivalent ft of 2 in. pipe

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

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

32 ft of 3 in. pipe = 32 equivalent ft

5 90° standard 3 in. elbows = (5 x 7) = 35 equivalent ft

Total = 67 equivalent ft of 3 in. pipe

This is less than the 90 ft maximum equivalent length of 3 in. pipe allowed for that model and is therefore 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° elbows is required for plenum clearance when the vent is increased to 3 in. (7.6 cm) or 4 in. (10.16 cm).

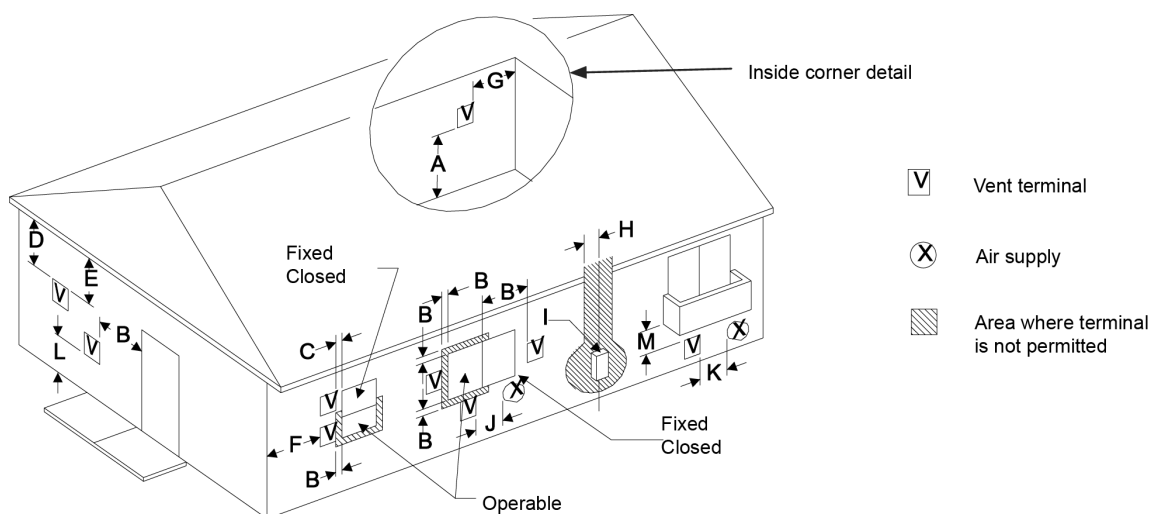
► **Important:** Accessory concentric vent/intake termination kits 1CT0302 and 1CT0303 for United States applications, and 1CT0302-636 and 1CT0303-636 for Canadian applications are available and approved for use with these furnaces. Horizontal sidewall vent terminations kits 1HT0901 and 1HT0902 are also approved for use with these furnaces. The above listed termination kits are **not** to be used with CPVC vent piping.

Combustion air and venting

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

Vent clearances

Figure 32: Home layout



A0668-002

Direct vent terminal clearances	Canadian installation	US installation
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 Btu/h (30 kW), 36 in. (91.4 cm) for models >100,000 Btu/h (30 kW).	Two-pipe (direct vent) applications: <ul style="list-style-type: none"> 9 in. (23 cm) for models <50,000 Btu/h (15 kW) 12 in. (30.5 cm) for models >50,000 Btu/h (15 kW) Single-pipe applications: <ul style="list-style-type: none"> 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 centerline 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 centerline 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

Direct vent terminal clearances	Canadian installation	US installation
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 Btu/h (30 kW), 3 ft (91.4 cm) for models >100,000 Btu/h (30 kW).	Two-pipe (direct vent) applications: <ul style="list-style-type: none"> 9 in. (23 cm) for models <50,000 Btu/h (15 kW) 12 in. (30.5 cm) for models >50,000 Btu/h (15 kW) Single-pipe applications: <ul style="list-style-type: none"> 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

❶ Note: Canadian installations:

- Must be in accordance with the current CSA B149.1-00, Natural Gas and Propane Installation Code and the current ANSI Z21.47 * CSA 2.3 American National Standard.
- For clearance above paved sidewalk or paved driveway located on public property, a vent must not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.
- The clearance under a veranda, porch, deck, or balcony is 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.

❶ Note: US installations:

- Must be in accordance with the current ANSI Z223.1/NFPA 54, National Gas Code and the current ANSI Z21.47 * CSA 2.3 American National Standard.
- The clearance to a window or door that may be opened must be 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.

Consider the following for vent clearances:

- 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 a forced air inlet.

- Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam can 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.
- The installer has responsibility for the provision of correct adequate venting and air supply for the application.
- The vent must extend high enough above the building, or a neighboring obstruction, so that wind from any direction does 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 in. (51 cm). Use a retaining type collar that is attached to the building surface to prevent movement of the vent pipe.

Vent system

This furnace is certified to be installed with one of the following vent configurations:

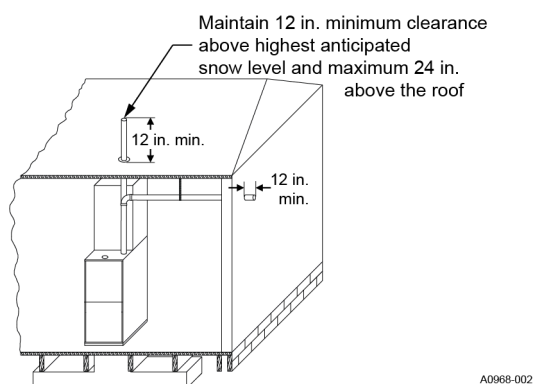
- **Horizontal vent system** - This vent system can be installed completely horizontal or combinations of horizontal, vertical, or offset using elbows.
- **Vertical vent system** - This vent system can be installed completely vertical or a combination of horizontal, vertical, or offset using elbows.

Vent applications and termination

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

- Observe all clearances listed in [Vent clearances](#).
- Position the termination where vent vapors do not damage plants, or shrubs, or air conditioning equipment.
- Locate the termination where it is not affected by wind gusts, light snow, airborne leaves, or susceptible to recirculation of flue gases.
- Locate the termination where it cannot be damaged or exposed to flying stones, balls, and similar.
- Position the termination where vent vapors are not objectionable.
- Horizontal portions of the vent system must slope upwards and be supported to prevent sagging.
- Install direct vent systems so that the vent and the combustion air pipes terminate in the same atmospheric zone. See [Figure 34](#) and [Figure 35](#).

Figure 33: Termination configuration - one 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 34: Termination configuration - two pipe

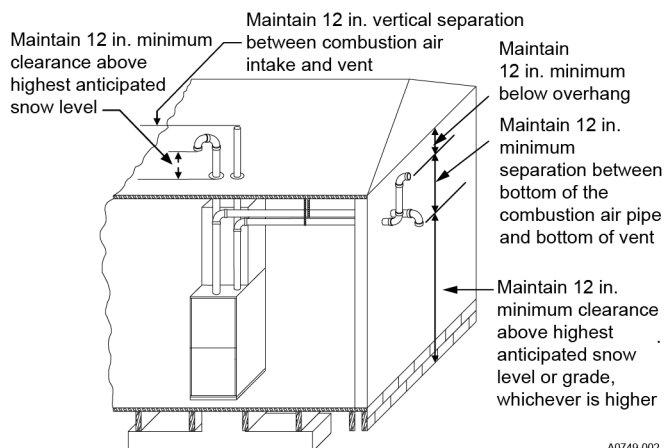
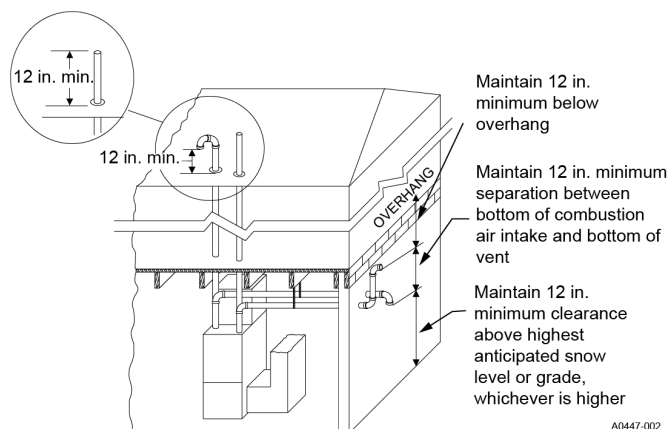


Figure 35: Termination configuration - two pipe basement



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 [Figure 33](#) and [Figure 41](#) is referred to in these instructions as ambient combustion air supply. Follow the instructions for ambient combustion air installations, paying particular attention to [Ambient combustion air supply](#). The vent for a single-pipe system must be installed as specified in [Vent applications and termination](#) with both vents terminating as shown in [Figure 36](#) and [Figure 37](#). 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 [Figure 35](#) and [Figure 36](#) can be installed so the combustion air pipe terminates as described in [Outdoor combustion air](#) or [Ventilated combustion air](#). Follow the instructions in [Outdoor combustion air](#) or [Ventilated combustion air](#) and the instructions for installing the vent system with the vent terminating as shown in [Figure 36](#) or [Figure 37](#). 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 36: Double horizontal combustion air intake and vent termination

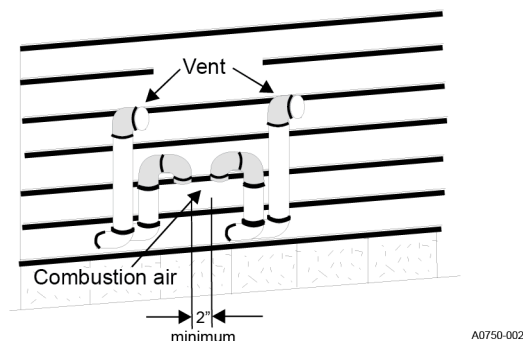
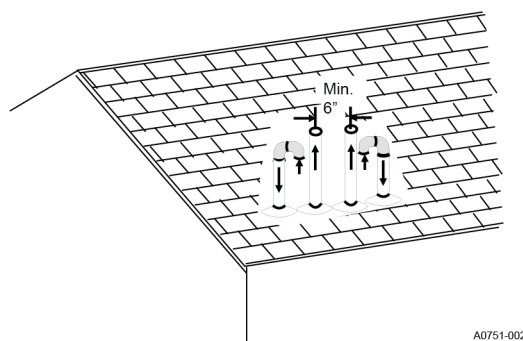


Figure 37: Double vertical combustion air intake and vent termination

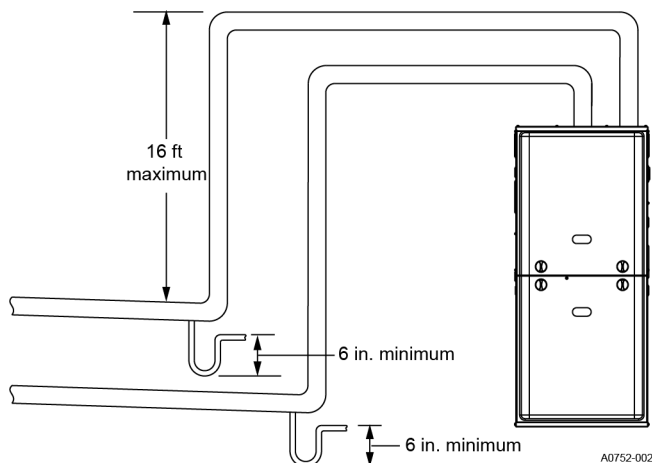


Downward venting

In some applications, it may be necessary to run the vent pipe and air intake downwards. In this case, follow these rules:

- Connect a condensate trap hose 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 6 in.
- The total vertical downward distance must not exceed 16 ft.
- The condensate drain hose must be connected to a condensate drain pump, 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 can fall below freezing.
- The condensate drain line must be primed at the initial start-up before the start of heating season.

Figure 38: 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.

This furnace is certified to be installed with one of three possible combustion air intake configurations:

1. **Outdoor combustion air:** This is a direct vent configuration where the combustion air is supplied through a PVC, CPVC, or ABS pipe that is connected to the 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 [Figure 34](#) and [Figure 35](#).
2. **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 32](#) for vent terminations. See [Ambient combustion air supply](#) for proper installation. See [Figure 41](#).
3. **Ventilated combustion air:** Combustion air is supplied through a PVC, CPVC, or ABS pipe that is connected to the 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 42](#) for attic and crawl space termination. Only the combustion air intake may terminate in the attic. The vent must terminate outside.

Outdoor combustion air

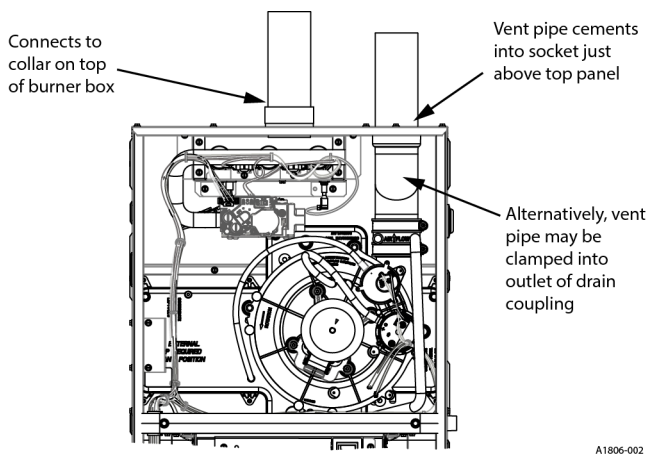
Combustion air intake/vent connections

This installation requires combustion air to be brought in from outdoors. This requires a correctly sized pipe, shown in [Figure 39](#), to bring air in from the outdoors to the furnace combustion air intake collar on the burner box. The second pipe, shown in [Figure 39](#), 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 39: Direct vent air intake connection and vent connection



Locate the combustion air intake pipe either through the wall (horizontal or side vent) or through the roof (vertical vent). Do not locate side vented systems where trees or shrubs can block or restrict supply air from entering the terminal.

In addition, locate the terminal assembly as far as possible from a swimming pool or a location where swimming pool chemicals are stored. Ensure that the terminal assembly follows the outdoor clearances listed in [Combustion air quality and list of contaminants](#).

Ambient combustion air supply

This type of installation draws the air required for combustion from within the space surrounding the furnace and from areas or rooms adjacent to the space surrounding the furnace. The combustion air can be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. It is not piped directly into the furnace. A single, correctly sized pipe from the furnace vent connector to the outdoors must be provided. Attach the supplied intake coupling and 18 in. (46 cm) of pipe to the furnace to prevent accidental blockage of the combustion air intake.

Figure 40: Ambient combustion air

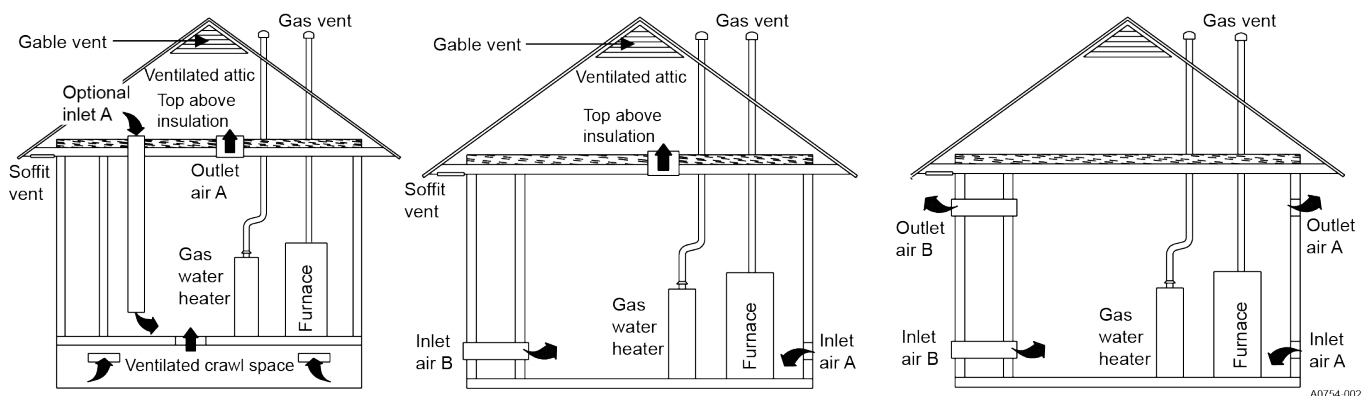
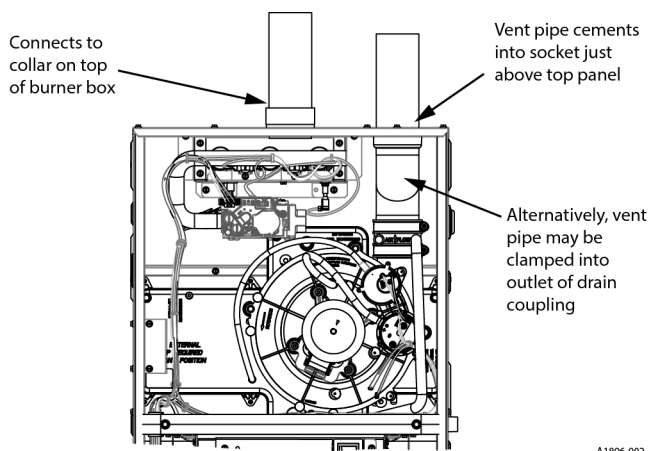


Figure 41: Combustion airflow path through the furnace casing



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WARNING

This type of installation requires that the supply air to the appliances be of a sufficient amount to support all of the appliances 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 ft³ (1.42 m³) per 1,000 Btu/h (0.2928 kW) input rating for all of the appliances installed in that area.

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

A **confined space** is an area with less than 50 ft³ (1.42 m³) per 1,000 Btu/h (0.2928 kW) input rating for all of the appliances installed in that area. The following must be considered to obtain adequate air for combustion and ventilation in confined spaces.

Dampers, louvers and grilles (Canada only)

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	Wood 20% to 25% ¹
Louvers or grilles	Metal 60% to 70% ¹
Screens ²	1/4 in. (6.4 mm) mesh or larger 100%

①

Note:

- Do not use less than 1/4 in. (6.4 mm) mesh.
- The free area of louvers and grille varies widely. The installer must follow louver or grille manufacturer's instructions.

- Calculate the free area of a supply air opening by subtracting the blockage area of all fixed louvers, grilles or screens from the gross area of the opening.
- Apertures in a fixed louver, a grille, or screen have no dimension smaller than 1/4 in. (0.64 cm).
- Manually operated dampers or manually adjustable louvers are not permitted for use.
- Automatically operated dampers or automatically adjustable louvers are interlocked so that the main burner cannot operate unless either the damper or the louver is in the fully open position.



WARNING

Always verify that any pre-existing venting system previously attached to a different Category I furnace is still properly sized for safe use of this furnace.

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

Btu/h input rating	Minimum free area required for each opening - in ² (cm ²)
26,000	26 (168)
40,000	40 (258)
60,000	60 (387)
80,000	80 (516)
100,000	100 (645)
120,000	120 (742)

Table 13: Free area

Btu/h input rating	Minimum free area required for each opening		
	Horizontal duct 2,000 Btu/h in ² (cm ²)	Vertical duct or opening to outside 4,000 Btu/h in ² (cm ²)	Round duct 4,000 Btu/h in ² (cm ²)
26,000	13 (84)	6.5 (42)	4 (10)
40,000	20 (129)	10 (64)	4 (10)
60,000	30 (193)	15 (97)	5 (13)
80,000	40 (258)	20 (129)	5 (13)
100,000	50 (322)	25 (161)	6 (15)
120,000	60 (387)	30 (193)	7 (18)

Example: Determining free area.
 Appliance 1 appliance 2 total input
 $100,000 + 30,000 = (130,000 \div 4,000) = 32.5 \text{ in}^2 \text{ vertical}$
 Appliance 1 appliance 2 total input
 $100,000 + 30,000 = (130,000 \div 2,000) = 65 \text{ in}^2 \text{ horizontal}$

Air supply openings and ducts

- An opening may be used in lieu of a duct to provide the outside air supply to the furnace 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 furnace. See [Combustion air source from outdoors](#) and [Combustion air and vent safety](#) for additional information.
- The duct must be either metal or a material meeting the class I requirements of CAN4-S110 Standard for Air Ducts.
- 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.
- The duct must terminate within 12 in. (30.5 cm) above and within 24 in. (61 cm) horizontally from the burner level of the furnace with the largest input.
- Only use a square or rectangular-shaped duct when the required free area of the supply opening is 9 in² (58.06 cm²) or larger. When using a square or rectangular duct, its small dimension must not be less than 3 in. (7.6 cm).
- An air inlet supply from outdoors must be equipped with a means to prevent the direct entry of rain and wind that does not reduce the required free area of the air supply opening.
- Locate an air supply inlet opening from the outdoors not less than 12 in. (30.5 cm) above the outside grade level.

Combustion air source from outdoors

- 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.
- One permanent opening starting 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 have a minimum free area of:
 - 1 in²/3,000 Btu/h (700 mm²/kW) of the total input rating of all equipment located in the enclosure
 - Not less than the sum of all vent connectors in the confined space
- 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.
- 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 a crawl space from which the combustion air is taken, must comply with the requirements specified in [Combustion air supply](#) 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 correctly sized pipes. One pipe brings combustion air from a correctly ventilated attic space or crawl space and a second pipe extends from the furnace vent connection (top right of unit) to the exterior of the building. See [Table 7](#) for intake pipe sizing, allowable length, and elbow usage.

Follow all notes, procedures and required materials in [Combustion air and vent pipe sizing](#) 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 42](#) 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 that you 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

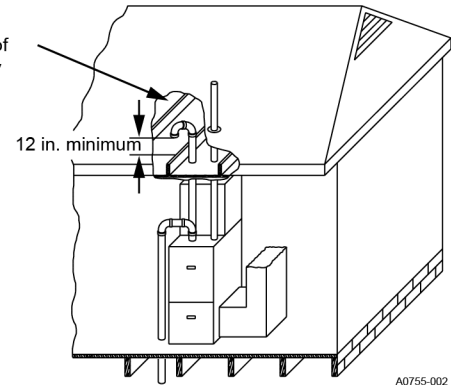
Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon monoxide poisoning or death.

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.
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 min 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 42: Attic and crawl space combustion air termination

12 in. minimum between bottom of air intake and any material below



Specially engineered installations

The above requirements for air supply 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 the 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 [Figure 27](#) to [Figure 30](#) for illustrations of different inducer rotation positions. An accessory internal vent kit for downflow applications is available for B, C, and D width model furnaces. The accessory kit allows the intake and exhaust piping to extend through the blower compartment to exit the top of the furnace.

Start-up and adjustments

The furnace installer **must** perform the following start-up checks on every new furnace installation:

- Gas piping leak check
- Furnace input rate check
- Air temperature rise check

See the instructions on how to perform each of these required installation checks in [Gas piping leak check](#), [Calculating the furnace input rate for natural gas](#), and [Gas heating airflow default settings](#).

➤ **Important:** You must check all electrical connections made in the field and in the factory for adequate tightness.

Gas piping leak check

- **Important:** Burner ignition may not be satisfactory on first start-up due to residual air in the gas line or until gas manifold pressure is adjusted. The ignition control makes three attempts to light before locking out.

When the gas supply is first connected to the furnace, loosen the ground union until you detect the odor of gas. 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 start-up procedure. Ensure adequate ventilation is available to dilute and carry away any vented gas.

With the 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 shut-off valve must be disconnected from the gas supply during any pressure testing of the system at test pressures in excess of 1/2 in. psig (3.45 kPa).

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

Running the ignition system sequence

1. Turn on the gas supply at the external valve and main gas valve.
2. Set the thermostat above room temperature to call for heat.

Result

System start-up then occurs as follows:

1. The induced draft blower motor starts and comes up to speed. Shortly after the inducer start-up, the hot surface igniter glows for approximately 17 s.
2. After this warm up, the ignition module energizes (opens) the main gas valve.
3. Approximately 30 s after a flame is established, the supply air blower starts.



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 rate for natural gas

About this task:

Burner orifices are sized to provide correct 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, you may need 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 the natural gas input rate by clocking the meter as follows:

1. Turn off all other gas appliances and pilots.
2. Operate the furnace for a minimum of 3 min in heating operation.
3. Measure the time (in seconds) for the gas meter to complete 1 revolution and note the reading. The 2 ft³ dial provides a more accurate measurement of gas flow.
4. See [Table 14](#) for cubic feet of gas per hour.
5. Multiply the ft³/h by the heating value (Btu/ft³) to obtain the input.

What to do next:

If the clocked rate does not match the input rate from the unit nameplate, follow the steps in [Adjusting the manifold gas pressure and input rate](#) to adjust the manifold pressure. Repeat Step 2 to Step 5 until the 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 (ft³/h) at full input

Time for one revolution	Size of test dial			Time for one revolution	Size of test dial		
s	1 ft ³	2 ft ³	5 ft ³	s	1 ft ³	2 ft ³	5 ft ³
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				

Adjusting the manifold gas pressure and input rate

Measure the inlet gas pressure and manifold gas pressure by connecting the U-tube manometer to the gas valve with a piece of tubing. Complete the steps in the Preparing to read gas pressure section and follow the steps in the Reading the inlet gas pressure section or the Reading the manifold gas pressure section as required. See [Figure 43](#) for the locations of the pressure ports on the gas valve.

Preparing to read gas pressure

1. Turn gas off at the ball valve or gas cock on gas supply line before the gas valve.
2. Find the pressure ports on the gas valve marked Out P and In P.
 - Take the manifold pressure at the port marked OUT P.
 - Take the gas line pressure 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 1 turn counter clockwise.

① **Note:** Do not remove the set screw from the pressure port.

Reading the inlet gas pressure

1. 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 [Figure 43](#) and [Figure 44](#) for connection details.
2. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.

Table 15: 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 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 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.

3. Once the correct gas inlet pressure has been established using [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.
4. Turn on the electrical and gas supplies, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved non-corrosive gas leak detection fluid or other non-flammable leak detection methods.

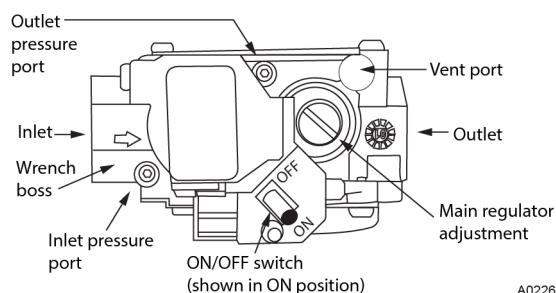
Reading the manifold gas pressure

About this task:

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.

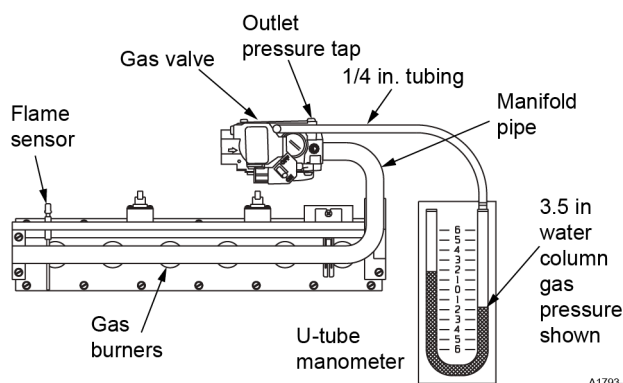
1. Connect the positive side of the manometer to the OUT P Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. See [Figure 43](#) and [Figure 44](#) for connection details.

Figure 43: Gas valve



- **Important:** If gas valve regulator is turned in (clockwise), manifold pressure increases. If the screw is turned out (counterclockwise), the manifold pressure decreases.

Figure 44: Reading gas pressure - Manifold pressure U tube connection



2. See [Figure 43](#) for location of pressure regulator adjustment cap and adjustment screws on main gas valve.
3. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.
4. Adjust the manifold pressure by adjusting the gas valve regulator screw for the appropriate gas per [Table 16](#):

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)

5. 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 [Calculating the furnace input rate for natural gas](#).
6. After 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.
7. Turn on the electrical and gas supplies, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved non-corrosive gas leak detection fluid or other non-flammable leak detection methods.

Airflow settings

Cooling airflow settings

This unit is equipped with a five-speed blower motor. Select the required cooling airflow 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. The use of airflow outside of this range can result in diminished air conditioning performance, lower overall energy efficiency, and higher electric utility bills. See [Continuous fan airflow default settings](#) for default cooling blower settings.

Continuous fan airflow default settings

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 results in higher than normal electrical energy usage and electric utility bills.

Gas heating airflow default settings

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 delivers the correct airflow for effective heating operation in most applications.

The default blower speed is shown in [Table 17](#). The use of a heating speed other than the default heating blower speed can 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 results in diminished heating performance and can cause the furnace temperature limit controls to shut down the furnace.

Measuring temperature rise



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 6](#). 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.

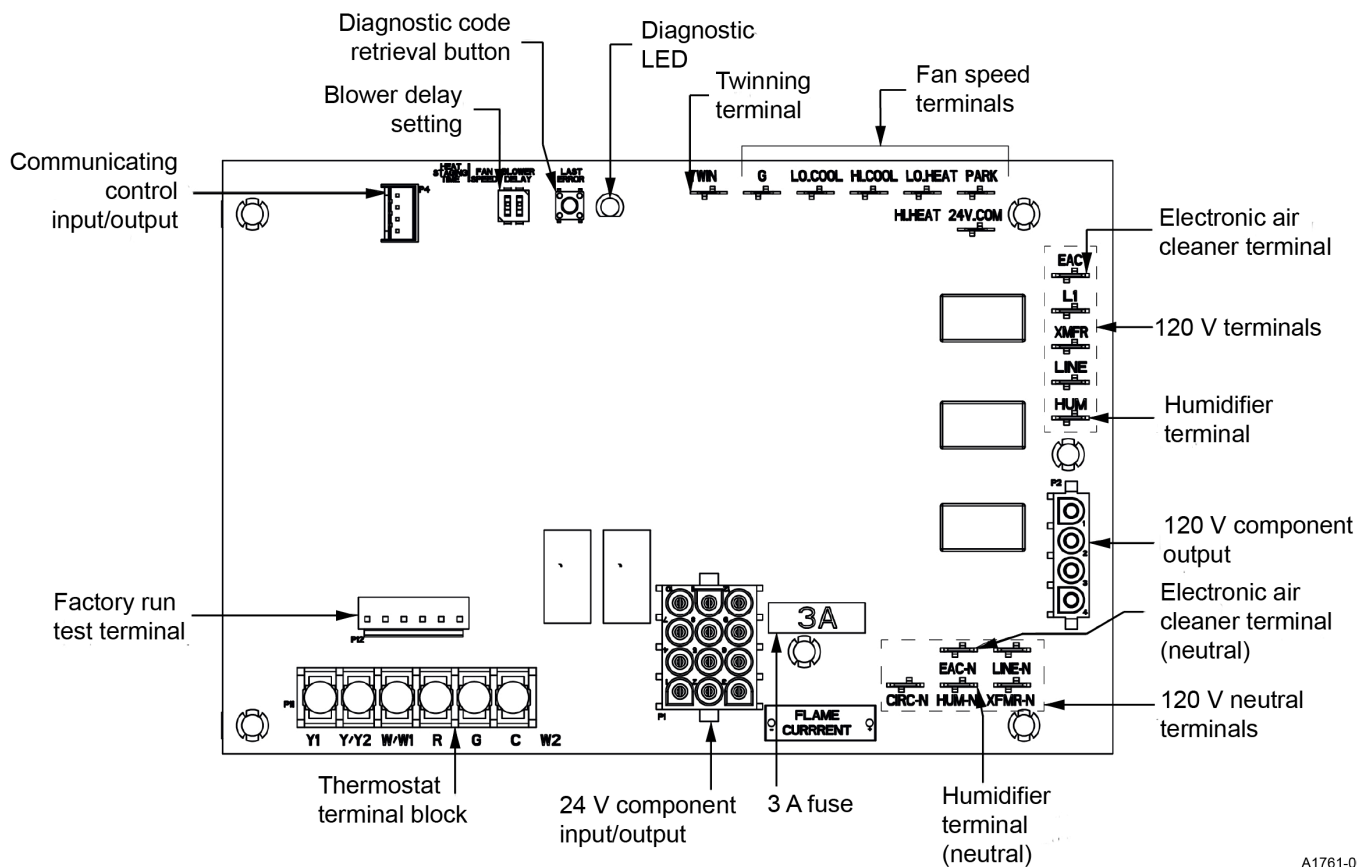
After about 5 min of operation, determine the furnace temperature rise. Measure the temperature of both the return air and the heated air in the ducts, about 6 ft (1.83 m) from the furnace, where they are not affected by radiant heat. Increase the blower speed to decrease the temperature rise. Decrease 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 45](#) and 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 the unused motor leads on the 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 four settings (60 s, 90 s, 120 s, and 180 s). The fan off delay is factory set. 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 blower delay DIP switches. See [Adjustment of blower control settings](#).

Figure 45: Furnace control board



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Table 17: Blower performance CFM - any position (without filter)

Model	Speed	Airflow (SCFM)							
		External static pressure (in. H ₂ O)							
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Z9ES026A08	High	950	900	875	850	800	775	750	725
	Medium high	875	850	825	775	750	725	675	650
	Medium	775	750	700	675	625	600	550	525
	Medium low	750	700	675	625	600	550	525	475
	Low	650	600	550	525	475	425	400	350
Z9ES040A10	High	1050	1025	1000	975	950	900	875	850
	Medium high	825	800	775	750	700	675	650	600
	Medium	775	750	700	675	625	600	550	525
	Medium low	725	675	650	600	550	525	475	450
	Low	575	525	475	425	375	325	275	225
Z9ES060A10	High	1100	1075	1050	1025	1000	950	925	900
	Medium high	1050	1000	975	950	925	875	850	825
	Medium	875	825	775	725	675	650	600	575
	Medium low	775	750	700	650	625	575	525	500
	Low	675	575	475	400	325	275	200	175
Z9ES060B12	High	1300	1275	1250	1225	1200	1175	1150	1100
	Medium high	1175	1150	1125	1100	1075	1050	1000	975
	Medium	1050	1025	1000	975	950	925	900	850
	Medium low	1000	975	950	900	875	850	800	775
	Low	900	850	800	750	700	675	625	600
Z9ES080B12	High	1400	1375	1350	1325	1300	1275	1250	1200
	Medium high	1250	1225	1200	1150	1125	1100	1075	1050
	Medium	1100	1075	1025	1000	975	950	900	875
	Medium low	975	950	900	875	825	800	750	725
	Low	775	725	675	625	600	550	500	450
Z9ES080C16	High	1750	1725	1700	1675	1625	1600	1550	1500
	Medium high	1575	1525	1500	1475	1450	1400	1375	1325
	Medium	1325	1275	1250	1200	1175	1125	1100	1050
	Medium low	1225	1175	1125	1075	1025	1000	950	900
	Low	1025	950	875	825	750	700	650	600
Z9ES080C20	High	1950	1925	1900	1850	1825	1775	1725	1675
	Medium high	1850	1800	1775	1750	1700	1675	1625	1575
	Medium	1550	1500	1475	1425	1375	1350	1300	1250
	Medium low	1325	1275	1250	1200	1150	1100	1050	1000
	Low	1200	1150	1075	1025	975	925	875	800
Z9ES100C16	High	1925	1900	1875	1825	1800	1750	1700	1650
	Medium high	1725	1700	1675	1625	1600	1575	1525	1500
	Medium	1600	1575	1550	1525	1500	1450	1425	1375
	Medium low	1325	1275	1225	1175	1125	1100	1050	1000
	Low	1225	1175	1125	1075	1025	975	925	875
Z9ES100C20	High	1975	1925	1900	1875	1825	1775	1725	1675
	Medium high	1800	1775	1750	1725	1675	1650	1600	1550
	Medium	1700	1675	1650	1625	1575	1550	1500	1450
	Medium low	1325	1275	1225	1175	1150	1100	1050	1000
	Low	1175	1125	1075	1025	975	925	875	825
Z9ES120D20	High	1950	1925	1900	1875	1825	1800	1750	1725
	Medium high	1825	1800	1750	1725	1700	1650	1625	1600
	Medium	1625	1575	1550	1500	1450	1425	1375	1350
	Medium low	1525	1475	1450	1400	1350	1325	1275	1250
	Low	1400	1350	1300	1275	1225	1175	1125	1075
Note: <ul style="list-style-type: none"> The airflow is expressed in standard cubic feet per minute (SCFM). The motor voltage is at 115 V. Do not use shaded values as heating speeds. 									

Taking a flue gas sample

About this task:

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 correctly 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 for 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.

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



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

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

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

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

Rollout switch controls

These controls are mounted on the burner assembly. If the temperature in the area surrounding burner exceeds its setpoint, 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:

- Blockage of combustion air piping or terminals
- Blockage of condensate drain piping
- Blockage of vent piping or terminal
- Failure of combustion air blower motor

See [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 can be caused by the following:

- A dirty filter
- Indoor blower motor failure
- Too many supply or return registers closed or blocked off
- Incorrectly set manifold gas pressure
- Incorrectly set indoor blower motor speed

The control module locks out if the limit trips five consecutive times. If this occurs, the control resets and tries ignition again after 1 h.

Normal operation and diagnostics

Normal operation sequence

The following sections describe the operation of the furnace. Refer to the *User's Information Manual* for component location.

Continuous blower

Cooling or 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 operates continuously on the speed tap that is connected to the control board G blower output. To obtain a different constant air circulation, change the blower motor speed tap 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 operates on the speed tap wire that is connected to the HI COOL or LO COOL cooling terminal on the control board depending on 24 V thermostat input on Y1 or Y/Y2. 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 correct amount of combustion air is being provided, the pressure switch closes 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 energizes 30 s after the gas valve opens, if a flame is detected. Normal furnace operation continues 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 operates for 15 s and the blower motor operates for the amount of time set by the fan-off delay DIP switch located on the control board. The heating cycle is now complete, and ready for the start of the next heating cycle.

Adjustment of blower control settings

This furnace is equipped with a time-on/time-off heating blower control. The blower-on delay is fixed at 30 s. The blower-off delay has four settings: 60 s, 90 s, 120 s, and 180 s. The blower-off delay is factory set to 120 s. The blower-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. You can adjust the blower-off timing by setting the blower delay DIP switches as shown in [Table 18](#). Each DIP switch has an on or off position. 0 represents the DIP switch in the off position and 1 represents the DIP switch in the on position. The factory setting is 10 or on, off as shown in [Figure 46](#).

Figure 46: Blower delay DIP switches - factory setting

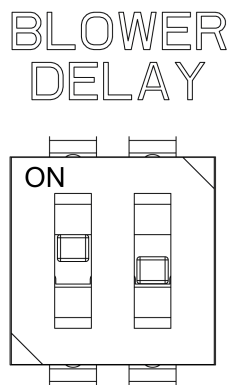


Table 18: DIP switch settings for blower-off timing

DIP switch setting	Blower-off delay (s)
00	60
01	90
10	120
11	180

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 clears the ignition attempt (retry) counter. If three retries occur during a call for heat, the furnace shuts down for 1 h. If at the end of the 1 h shut down there is a call for heat, the furnace initiates a normal start cycle. If the problem has not been corrected the furnace locks out after three retries.

A momentary loss of gas supply, a flame blowout, or a faulty flame probe circuit results in a disruption in the flame and is sensed within 1 s. The gas valve de-energizes and the control begins a recycle operation.

A normal ignition sequence begins 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 locks out for 60 min.

During burner operation, a momentary loss of power for 50 mins or longer de-energizes the gas valve. When the power is restored, the gas valve remains de-energized and the ignition sequence immediately restarts.

Troubleshooting

Make the following visual checks before doing the detailed troubleshooting outlined in the [Furnace control diagnostics](#):

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



WARNING

Never bypass any safety control to allow furnace operation. To do so allows furnace to operate under potentially hazardous conditions.

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

Never adjust pressure switch to allow furnace operation.

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 board continuously monitors its own operation and the operation of the system. If a fault occurs, the LED light indicates the fault code.

The SLOW flash speed is 2 s on and 2 s off. The other flash codes listed below have the following timing: LED light turns on for 1/3 s and off for 1/3 s. This pattern is repeated the number of times equal to the code. There is a 2 s pause between codes. For example, for the six red flashes code, the LED light flashes on and off six times and then remains off for 2 s.

Slow green flash: Standby, normal operation, fan only, and call for cooling.

Rapid amber flash: Amber LED light turns 1/10 s on and 1/10 s off indicating low flame signal warning.

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: Possible control failure. Remove and check the control voltage fuse. An open fuse results in a steady on red LED. 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.

Continuous amber flash: The flame sense current is below 0.35 μ A. Check and clean the flame sensor. Check for proper gas flow. Verify that the current is greater than 0.35 μ A at the flame current test pad.

Alternating red and amber flash: This indicates a refrigerant leak detected near the furnace.

1 red flash: This indicates that a flame was sensed when there was not a call for heat. The control turns 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 does 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 that 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 operates 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 operates as if the blower is not functioning, starts a hard lockout, and begins to flash the 11 red flashes error code. Cycle the power 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 also indicates 4 red flashes and enters a one-hour soft lockout.

5 red flashes: This indicates that the normally closed rollout switch has opened or that the limit switch has been open longer than 15 min. The rollout control is manually reset. Check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. The control enters a hard lockout. Cycle the power 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 five times during the call for heat. Check for faulty inducer, blocked vent pipe or faulty pressure switch. The furnace locks out for 1 h and then restarts.

7 red flashes: This 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 locks out for 1 h and then restarts.

8 red flashes: This indicates that the flame has been 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 locks out for 1 h and then restarts.

9 red flashes: This indicates reversed line voltage polarity, a grounding problem, or reversed low voltage transformer wires. Both heating and cooling operations are 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: This indicates the gas valve is energized with no call for heat. The main blower and inducer blower run and no ignition sequence is 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 enters a hard lockout and power must be cycled off and on to reset the control after the problem has been corrected.

14 red flashes: This indicates that a low voltage of < 19.2 VAC has been reached. This prevents further relay outputs for > 2 s.

15 red flashes: This indicates that a low voltage of < 16 VAC has been reached. This stops the current relay outputs for > 2 s.

4 amber flashes: This indicates that the control is receiving a Y signal from the thermostat without a G signal. The furnace operates normally in both heating and cooling, but this fault code is displayed 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 resets automatically after 1 h. This provides protection for an unoccupied structure if a temporary condition causes a furnace malfunction, for example, if a temporary interruption in the gas supply prevents the furnace from lighting. The control keeps trying to light each hour and resumes 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 does not automatically restart.

IGNITION CONTROL FLAME SENSE LEVELS

Normal flame sense current is approximately 3.7 μ A DC

Low flame signal warning starts at 1.5 μ A DC

Low flame signal control lockout point is

0.1 μ A DC

Diagnostic fault code storage and retrieval

The control in this furnace is equipped with memory that stores up to five error codes to allow a service technician to diagnose problems more easily. This memory is 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, only the five most recent are retained. The furnace control board has a LAST ERROR button, that is used to retrieve error codes. This function only works if there are no active thermostat signals. Any call for heating, cooling, or continuous fan must be terminated before attempting to retrieve error codes.

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

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

Fault code retrieval

Fault code retrieval is possible only when there are no active thermostat signals. To retrieve fault codes, push and release the SW button on control board. The LED flashes the last five fault codes beginning with the most recent fault code. If there are no fault codes in memory, the LED flashes green twice. To clear the fault code memory, press and hold the SW button until the LED flashes rapid green.

Replacement parts

Table 19: Replacement parts

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, igniter/flame sensor
Burner, main gas
Heat exchanger assembly
Manifold, gas
Panel, blockoff
Panel, door (two required)

Table 19: Replacement parts

Description
Panel, top
Shelf, blower
Miscellaneous
Bag, parts
Bracket, door
Diagram, wiring
Gasket, foam (door) (1.5 ft required)
Harness, wiring
Hose, condensate
Hose, rain gutter
Knob, quarter turn (four required)
Motor mount kit
Orifice, burner (natural no. 45)
Pan, condensate
Plug, seal, 7/8 in.
Plug, seal, 2 3/8 in.
Plug, vent pipe
Sight glass, oval (two required)
Tubing, silicon
Vent adapter

This is a generic parts list. To request a complete parts list, refer to the contact information in [Replacement part contact information](#):

Replacement part contact information

- Visit our website at <http://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:
 - Click the **Brand Links** button
 - Click the **Customer Service** button
- You can contact us by mail. Just send a written request to the following address:

Johnson Controls Ducted Systems

Consumer Relations

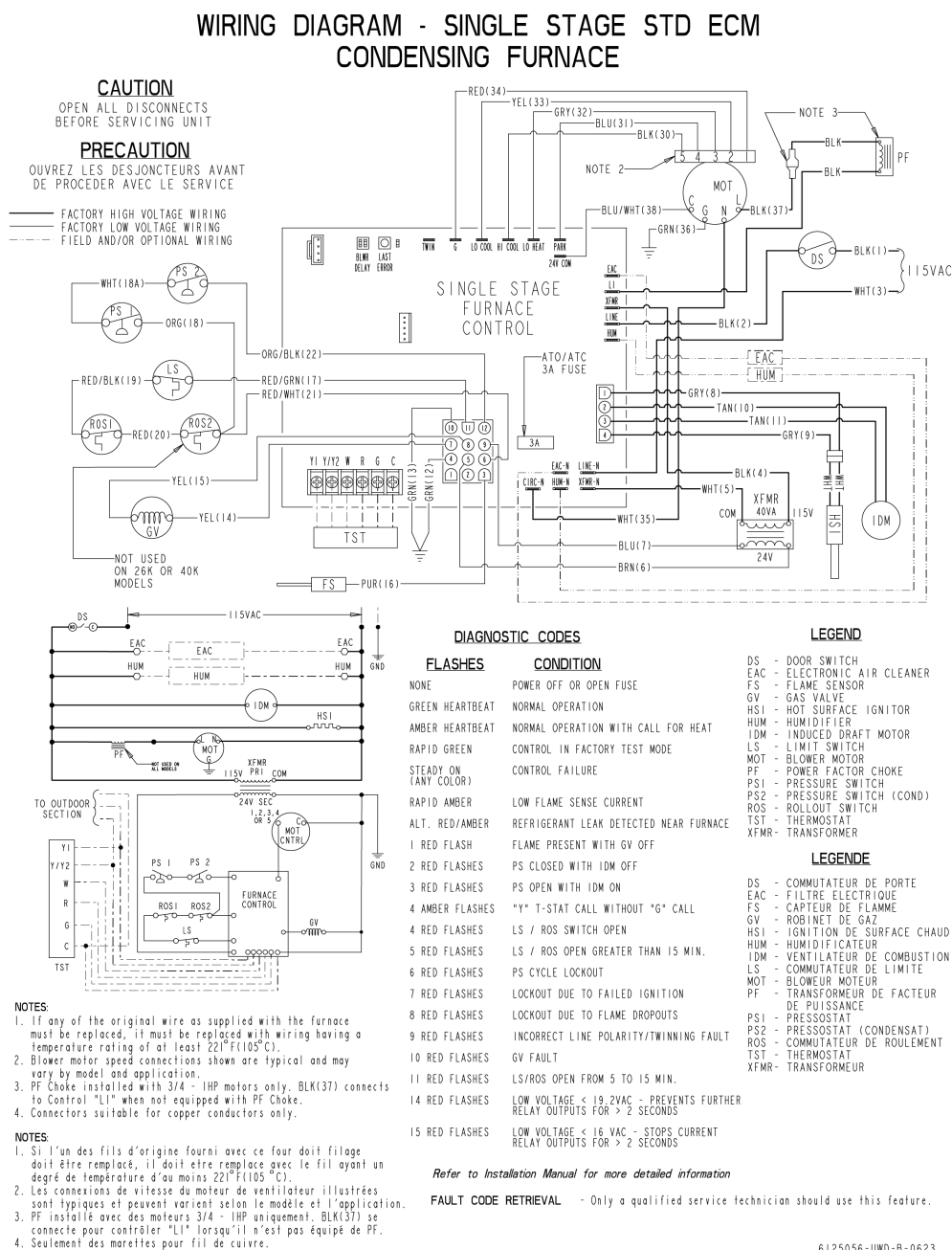
5005 York Drive

Norman, OK 73069

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Wiring diagrams

Figure 47: Wiring diagram



Fault code retrieval functions will work only if there is no active thermostat signals. To retrieve fault codes, push and release SW button on control board. The LED will flash the last five fault 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 press and hold the SW button until the LED flashes rapid green.

Start-up sheet

33" 96% 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 ☐ 1-Red (Low) ☐ 2-Yel (Med Lo) ☐ 3-Gray (Med) ☐ 4-Blue (Med High) ☐ 5-Black (High)

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

Cooling CFM delivery (use Blower Performance Data Chart)

Hi

Low

Air Side: Continuous Fan

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