

Installation Manual: TL8E and RUF18 Series - Single-Stage Ultra-Low NOx ECM Gas Furnace - 80% AFUE - Upflow or Horizontal

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About the unit

These high efficiency, compact, Ultra-Low NO_x (ULN) units employ induced combustion, reliable hot surface ignition, and high heat transfer tubular heat exchangers. The units are factory shipped for installation in upflow or horizontal applications and are for use only in natural gas applications.

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

The units are Category I listed and may be common vented with another gas appliance as allowed by the National Fuel Gas Code.

- **Important:** Do not twin these units. If more than one unit is needed in an application, each unit must have its own complete duct system and its own wall thermostat.

Certification



Assembled at a facility with an ISO 9001:2015-certified Quality Management System

GoTemp Pro app (Formerly DS Solutions app)

BHC Group Heating & Cooling believes in empowering our customers with up-to-date, unit-specific information. Download GoTemp Pro app, a powerful, comprehensive app designed for contractors on the jobsite, available now in the App Store for iOS and Google Play for Android. Use the app to scan the unique QR code on the unit rating plate for easy access to product information and resources such as nomenclature, technical guide, installation manual, wiring diagrams, parts list, product registration, warranty, and much more. Simplify your tasks, save time, and stay ahead with the most comprehensive app built for professionals.



iOS




Android

Safety

It is important to understand the safety symbols used in this manual. Read safety information carefully and follow all safety requirements.

Understanding safety symbols and instructions

 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.

Safety requirements

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.

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.

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.

Adhere to the following:

- Only natural gas is approved for use with the furnace.
- Install the furnace only in a location and position specified in these instructions.
- A gas-fired furnace for installation in a residential garage must be installed as specified in these instructions.
- Provide adequate combustion and ventilation air to the furnace space as specified in these instructions.
- Combustion products must be discharged outdoors. Connect this furnace only to an approved vent system as specified in [Connecting the vent system](#).
- Test for gas leaks as specified in these instructions.
- Always install the furnace to operate within the furnace's intended temperature rise range. Connect the furnace only to a duct system that has an external static pressure within the allowable range as specified on the furnace rating plate.
- When a furnace is installed so supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air must also be handled by ducts sealed to the furnace casing and terminating outside the space containing the furnace.
- Do not use this furnace for heating of buildings or structures under construction.
- When installed in a non-HUD-approved modular home or building constructed onsite, combustion air must not be supplied from occupied spaces.
- The size of the unit must be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods may be used.
- When moving or handling the furnace before installation, leave the doors on the furnace to provide support and prevent damage or warping of the cabinet. When lifting the furnace by the cabinet, support the ends of the furnace rather than lifting by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.
 - ▶ **Important:** During installation, the doors must remain on the furnace when moving or lifting the furnace.
- When lifting the furnace, it is acceptable to use the primary heat exchanger tubes as a lifting point provided that the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel. Do not use the top return bend of the heat exchangers as lifting points as the tubes may shift out of position or their location brackets/baffles.
- Refer to the unit rating plate for the furnace model number, and then see [Figure 1](#) for return air plenum dimensions. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed in [Table 2](#).
- Provide clearances for servicing ensuring that service access is allowed for both the burners and blower.
- These models **are not** CSA listed or approved for installation into a **HUD approved modular home** or a **manufactured (mobile) home**.
- This furnace is not approved for installation in trailers or recreational vehicles.
- Furnaces for installation on combustible flooring must not be installed directly on carpeting, tile, or other combustible material other than wood flooring.
- Check the rating plate and power supply to make sure that the electrical characteristics match. All models use nominal 115 VAC, 1 phase, 60 Hz power supply. **Do not connect this appliance to a 50 Hz power supply or a voltage above 130 V.**
- Install the furnace so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas-fired components. Only trained and qualified personnel must install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that apply.

Avoiding contaminants for combustion air

Adhere to the following:

- The furnace requires **outdoor air** for combustion when the furnace is located in any of the following environments:
 - Restricted environments
 - Commercial buildings
 - Buildings with indoor pools
 - Laundry rooms
 - Hobby or craft rooms
 - Areas near chemical storage areas
 - Areas where there is chemical exposure
- The furnace requires **outdoor air** for combustion when the furnace is located in an area where the furnace is exposed to the following substances and/or chemicals:
 - Permanent wave solutions
 - Chlorinated waxes and cleaners
 - Chlorine based swimming pool chemicals
 - Water softening chemicals
 - De-icing salts or chemicals
 - Carbon tetrachloride
 - Halogen type refrigerants
 - Cleaning solvents such as perchloroethylene
 - Printing inks, paint removers, varnishes, and other similar substances
 - Hydrochloric acid
 - Cements and glues
 - Antistatic fabric softeners for clothes dryers
 - Masonry acid washing materials
- When outdoor air is used for combustion, the combustion air intake duct system termination must be located external to the building and in an area where there is no exposure to the substances listed above.

WARNING

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

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

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

Following codes and standards

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

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

Safety

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

General installation

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

Combustion and ventilation air

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

Duct systems

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

Acoustical lining and fibrous glass duct

- **US and Canada:** 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

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

Electrical connections

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

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

Installation

Complete all installation stages. You may not need to perform some tasks outlined, depending on the specific installation. See [System components and operation](#) to familiarize yourself with system safety controls and system operation as required, and see [Troubleshooting](#) if needed.

- **Important:** Do not twin these units. If more than one unit is needed in an application, each unit must have its own complete duct system and its own wall thermostat.

Preparing for installation

Complete the necessary preparation before you begin the installation.

Selecting a location for installation

Before starting the installation, you must select a suitable location for the unit. For residential applications, you can install the unit in a basement, closet, alcove, attic, recreation room, garage, or crawl space. You can also install the unit in commercial applications.

WARNING

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

To select a location for installation, do the following:

- Select a location for the unit that meets the following general requirements for installation:
 - Requires a minimum amount of air intake/vent piping and elbows
 - Is as centralized with the air distribution as possible
 - Has adequate combustion air available, particularly when the appliance is not using outdoor combustion air
 - Does not interfere with proper air circulation in the confined space
 - Allows you to maintain all required clearances
- Select a location for the unit that meets any requirements that are specific to the type of installation as outlined in [Table 1](#).

Table 1: Additional location requirements for each type of installation

Type of installation	Additional location requirements
Installation in freezing temperatures	The location of the unit is in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. ► Important: Do not allow return air temperature to be below 55°F (13°C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.
Installation in a residential garage	The location of the unit allows you to do the following: <ul style="list-style-type: none"> • Install the furnace so the burners and the ignition source are located not less than 18 in. (46 cm) above the floor. • Locate or protect the unit to avoid physical damage by vehicles.
Installation in an attic	The location of the unit has floor support for required service access.

Providing the required clearances

You must provide all required clearances, for example, for combustible materials and unit access and service.

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

To provide the required clearances, do the following:

- Provide ample clearances to permit easy access to the unit. The following minimum clearances are recommended:
 - 24 in. (61 cm) between the front of the unit and an adjacent wall or another appliance, when access is required for servicing or 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 or vent connections
- Provide clearances in accordance with [Table 2](#).

Unit clearances to combustibles

Table 2: Unit clearances to combustibles - all surfaces identified with the unit in an upflow configuration

Application	Top in. (cm)	Front in. (cm)	Rear in. (cm)	Left side in. (cm)	Right side in. (cm)	Flue in. (cm)	Floor/bottom	Closet	Alcove	Attic	Line contact
Upflow	1 (2.5)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	6 (15.2)	Combustible	Yes	Yes	Yes	No
Upflow B-vent	1 (2.5)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	Combustible	Yes	Yes	Yes	No
Horizontal	1 (2.5)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	6 (15.2)	Combustible	No	Yes	Yes	Yes*
Horizontal B-vent	1 (2.5)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	Combustible	No	Yes	Yes	Yes*

① **Note:** *Line contact is only permitted between lines formed by the intersection of the rear panel and side panel (top panel when in horizontal position) of the unit jacket and building joists, studs, or framing.

Inspecting the unit

- ① **Note:** There are no shipping or spacer brackets that need to be removed from the interior of the unit.

To inspect the unit, do the following:

1. Inspect the unit immediately after receiving it for possible damage during transit.

2. If damage is evident, do the following:
 - a. Note the extent of any damage on the carrier's receipts.
 - b. Make a separate written request for the carrier's agent to inspect the unit.
 - c. Contact the local distributor for more information.

Transporting and handling the unit

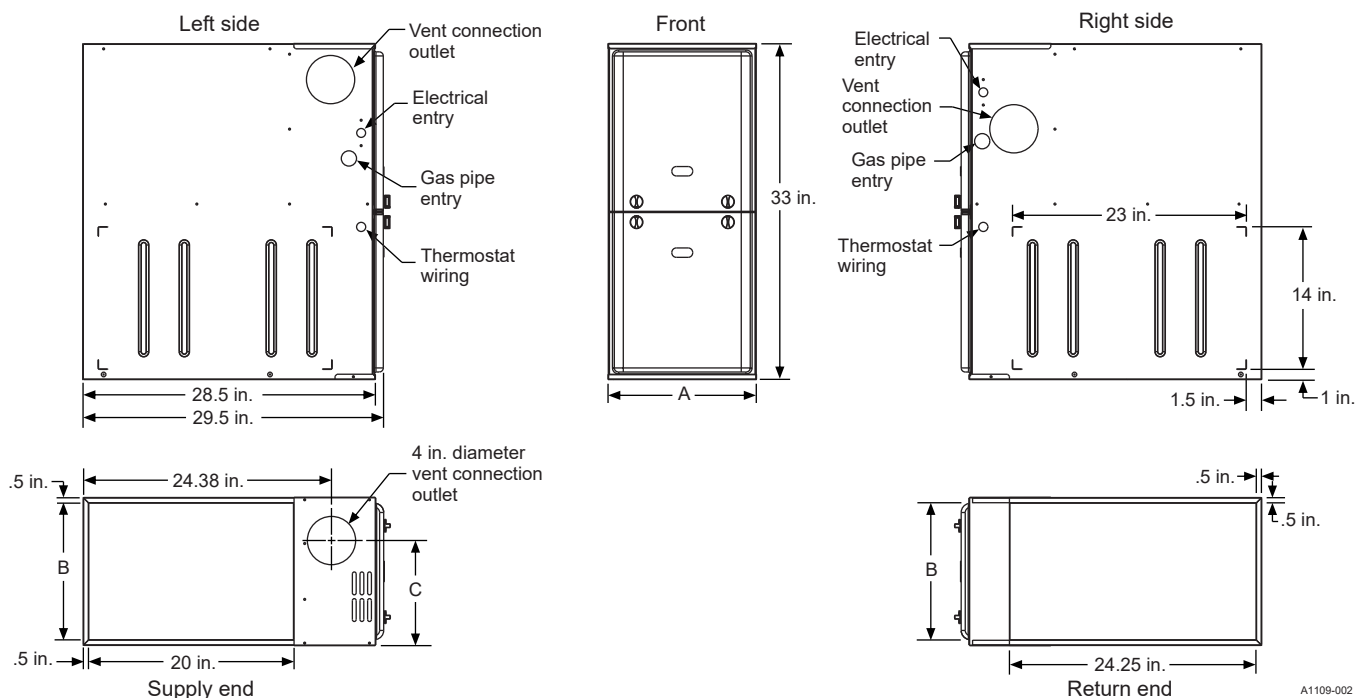
- Leave the doors on the unit when moving or handling the unit to provide support and to prevent damage or warping of the cabinet.
- When lifting the unit, support the ends of the unit rather than lifting the unit by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.
- You can use the primary heat exchanger tubes as a lifting point if the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel.
 - **Important:** Do not use the top return bend of the heat exchangers as lifting points because the tubes may shift out of position or their location brackets or baffles.
- Make sure that you check the unit for screws or bolts that may have loosened in transit before you begin the installation.
 - ⓘ **Note:** There are no shipping or spacer brackets that need to be removed from the interior of the unit.

Becoming familiar with the unit dimensions

- Make sure that you are familiar with the unit dimensions before you begin the installation. See [Figure 1](#) and [Table 3](#).

Dimensions

Figure 1: Dimensions



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Table 3: Cabinet and duct dimensions

Btu/h (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)	lb
60 (17.6)	1200 (34.0)	A	14 1/2	36.8	13 3/8	34.0	10.3	26.2	94
80 (23.4)	1600 (45.3)	C	21	53.3	19 7/8	50.5	13.6	34.5	114
100 (29.3)	2000 (56.6)	C	21	53.3	19 7/8	50.5	13.6	34.5	122

Installing the unit

You can install the unit in upflow or horizontal applications.

- **Important:** When installing the unit, ensure to install the indoor coil if applicable. For applications without an indoor coil, install a removable access panel in the outlet duct.

Designing and installing the ductwork

It is vital to the success of an installation to design and install the ductwork correctly. If the duct system is incorrectly sized the unit does not operate correctly.

WARNING

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

Refer to [Table 7](#) or the furnace rating plate for the correct rise range and static pressures.

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

CAUTION

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

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

To design and install the ductwork, do the following:

- Make sure that the design and installation of the duct system adhere to the following:
 - The duct system must handle an air volume appropriate for the served space and within the operating parameters of the unit specifications.
 - The duct system must be installed 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. When a unit is installed so the supply ducts carry air circulated by the unit to areas outside the space containing the unit, the return air must also be handled by a duct sealed to the unit casing and terminating outside the space containing the unit.

- 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.
- Be aware of the following for installations with an indoor coil:
 - You must install the indoor coil parallel with, or in the supply air side of the unit 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 unit. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position. See [Installing an indoor coil](#).
 - You can place the indoor coil directly on the unit outlet and seal it to prevent leakage. If you are installing an uncased indoor coil with a thermoplastic drain pan in the upflow or horizontal configuration, then an extra 2 in. minimum spacing may be needed to protect against drain pan distortion. See [Installing an indoor coil](#).
- Be aware that for installations without an indoor coil, you must install a removable access panel in the outlet duct. See [Installing a removable access panel in the outlet duct](#).
- Make sure that the ducts attached to the unit plenum are of sufficient size so the unit operates at the specified external static pressure and within the air temperature rise specified on the unit rating plate.
- When replacing an existing unit, if the existing plenum is not the same size as the new unit, remove the existing plenum and install a new plenum that is the correct size for the new unit. If the plenum is shorter than 12 in. (30.5 cm), the turbulent air flow may cause the limit controls not to operate as designed or the limit controls may not operate at all.

Using an existing duct system

- Check that the ductwork meets requirements and is correctly sized, and adjust the ductwork if needed. See [Designing and installing the ductwork](#) for more information about requirements.

Using the duct flanges

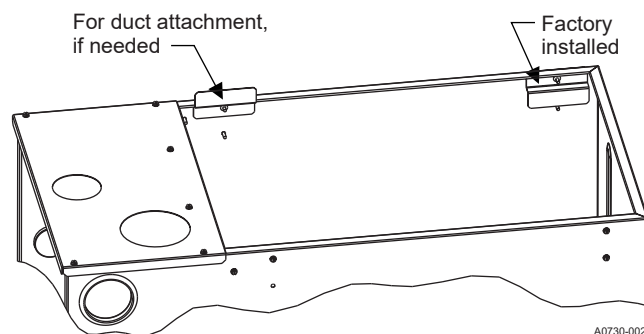
Four duct flanges are provided as part of the unit casing to attach ductwork to the unit. The duct flanges are rotated down for shipment.

► **Important:** If you do not use the duct flanges, they must remain in the rotated down position as shipped.

To use the duct flanges, do the following:

1. Remove the screw holding an individual duct flange.
2. Rotate the duct flange so it is in the upward position.
3. Reinstall the screw.
4. Repeat Steps 1 to 3 for all four duct flanges. See [Figure 2](#).

Figure 2: Duct attachment



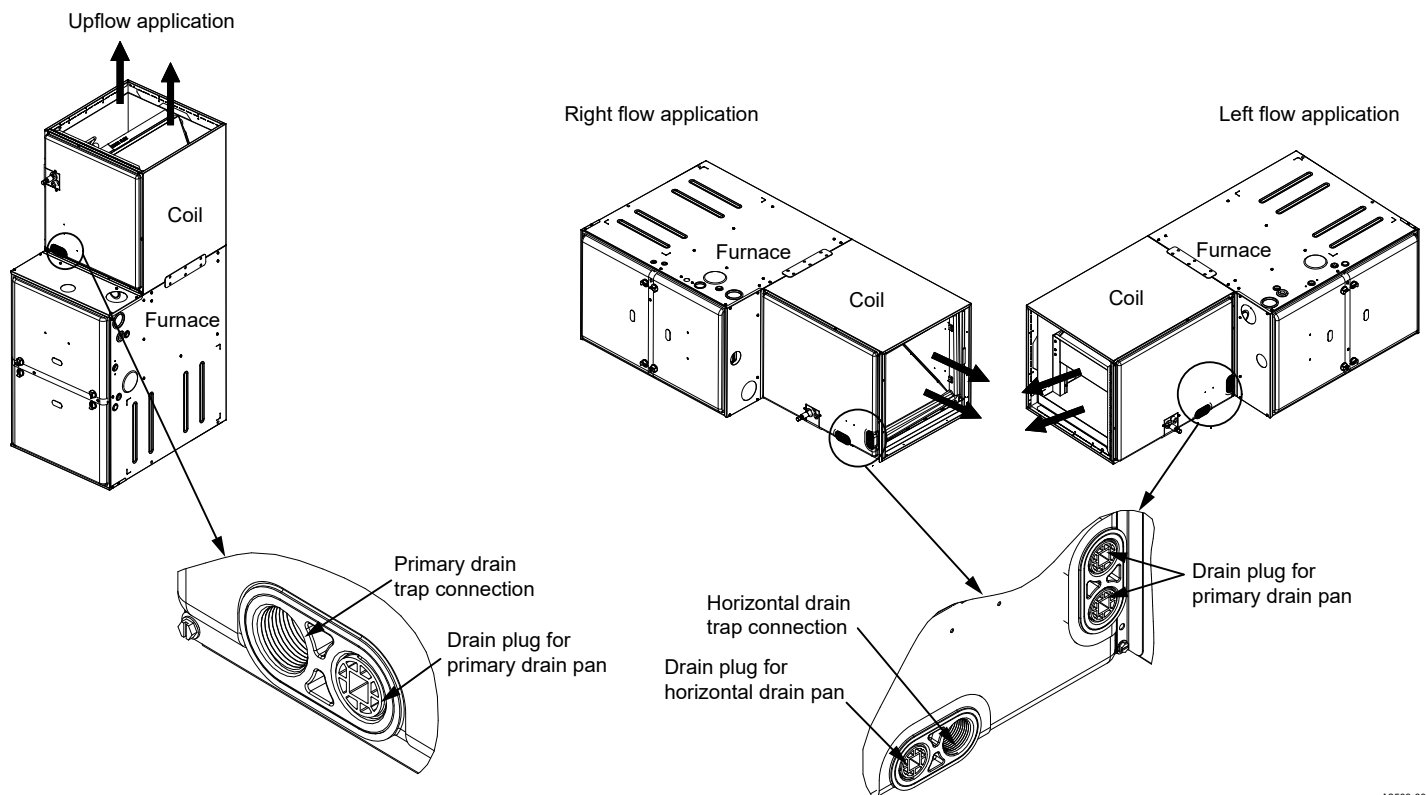
Installing an indoor coil

⚠ CAUTION

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

- To install the indoor coil, follow the installation instructions in the *Installation Manual* for the indoor coil. Mount the indoor coil on the supply side of the unit as shown in [Figure 3](#). See also [Figure 4](#), [Figure 5](#), or [Figure 6](#), depending on your specific application.

Figure 3: Furnace and coil attachment



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ⓘ **Note:** Verify that all drains are trapped or plugged.

Figure 4: Vertical upflow applications with furnaces

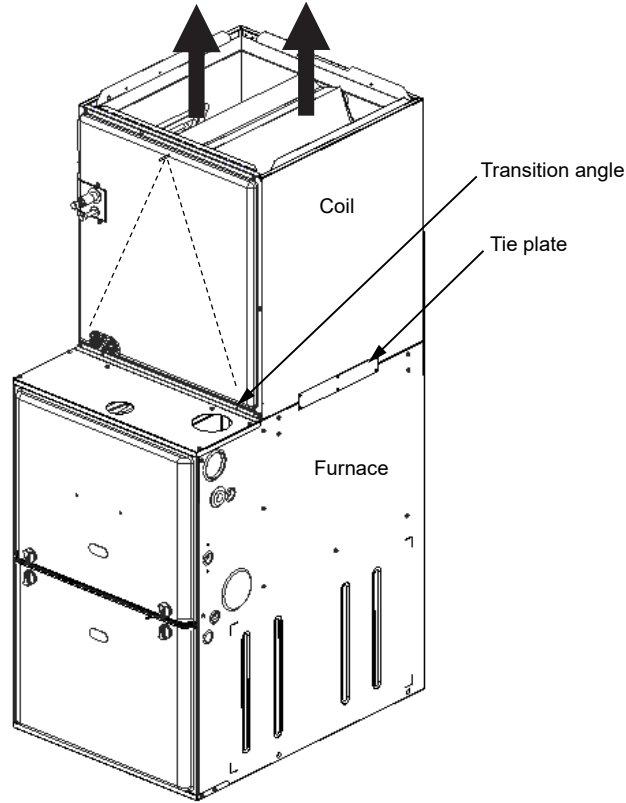


Figure 5: CTM horizontal right application with furnace

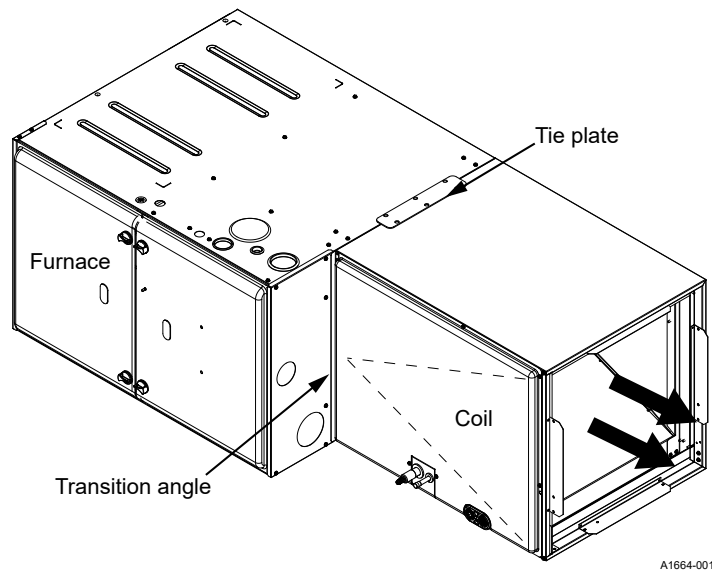
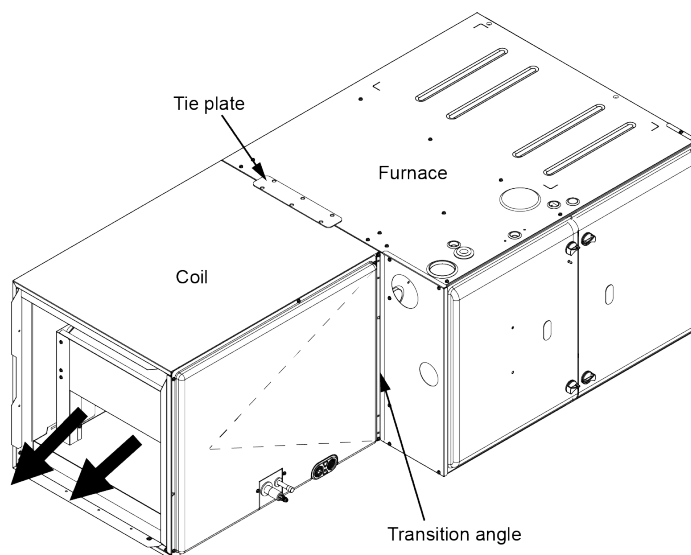


Figure 6: CTM horizontal left application with furnace



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- **Important:** You can place the indoor coil directly on the unit outlet and seal it to prevent leakage. If you are installing an uncased indoor coil with a thermoplastic drain pan in the upflow or horizontal configuration, then an extra 2 in. minimum spacing may be needed to protect against drain pan distortion.

Installing a removable access panel in the outlet duct

This task applies only for applications without an indoor coil.

- Install a removable access panel in the outlet duct so any smoke or reflected light is observable inside the casing to indicate the presence of leaks in the heat exchanger. Attach the access panel in a way that prevents leaks.

Positioning the unit

Before you begin:

Make sure that the location you have selected for the unit is suitable, you can provide the required clearances, and you are familiar with the requirements for handling the unit. See [Selecting a location for installation](#), [Providing the required clearances](#), and [Transporting and handling the unit](#).

How you position the unit varies depending on the type and place of installation. You can install the unit in an upflow or horizontal application. For residential applications, you can install the unit in a basement, closet, alcove, attic, recreation room, garage, or crawl space. You can also install the unit in commercial applications. You can set the unit on blocks or pads or suspend or hang the unit from rafters or floor joists as required.

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.

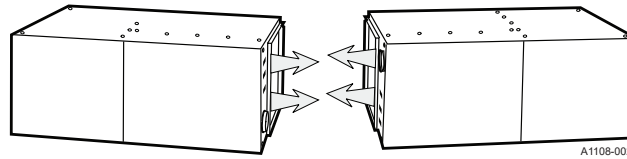
- **Important:** During installation, the doors must remain on the furnace when moving or lifting the furnace.

To position the unit, follow the guidance for your specific application:

- **For horizontal applications**, install the unit in a horizontal position on either side as shown in [Figure 7](#).

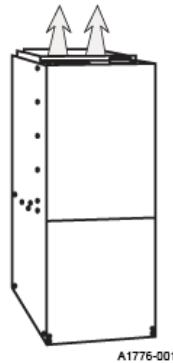
► **Important:** Do not install the unit on its back.

Figure 7: Horizontal application



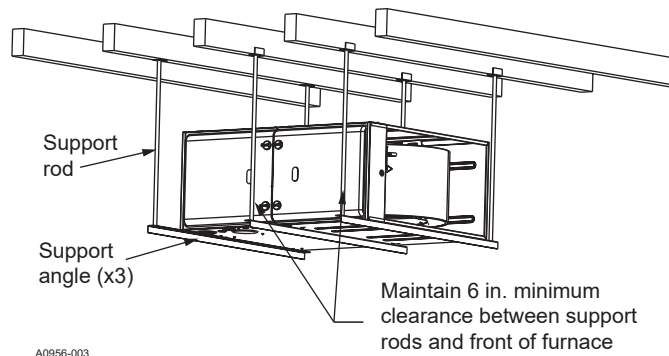
- **For upflow applications**, install the unit in an upflow position as shown in [Figure 8](#).

Figure 8: Upflow application



- **For applications where the unit is suspended**, for example, in attic or crawl space installations where the unit is suspended from rafters or floor joists, use rods, pipe angle supports, or straps as follows:
 - Support the unit with rods, pipe angle supports or straps at three locations. Place one support at the supply end of the unit, place the second support approximately in the center of the unit near the blower shelf, and place the third support at the return end of the unit.
 - Maintain a 6 in. (15.2 cm) minimum clearance between the front of the unit and the support rods or straps.
 - Make sure that all six suspension points are level to ensure correct and quiet unit operation.
 - Use a secure platform constructed of plywood or other building materials secured to the floor or ceiling joists. See [Figure 9](#).

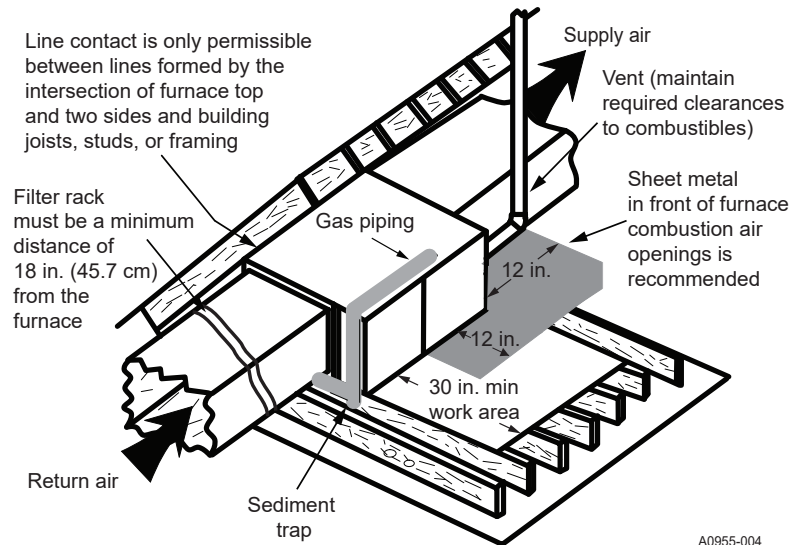
Figure 9: Typical suspension of unit in an attic or crawl space installation



- **For applications where the unit is installed on blocks or pads**, make sure that the blocks or pads are suitable and provide adequate height to ensure that the unit is not subject to water damage.

- **For applications in an attic**, be aware that the unit is certified for line contact only when the unit is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the unit and the building joists, studs, or framing. This line can be in contact with combustible material. See [Figure 10](#).

Figure 10: Typical attic installation - line contact



Connecting the unit to the ductwork

How you connect the unit to the ductwork varies depending on the type of application.

To connect the unit to the ductwork, follow the guidance for your specific application:

- **For upflow or horizontal applications**, attach the supply plenum to the unit outlet. Use an approved flexible duct connector and seal the connection to prevent air leakage. Make sure that the sheet metal is crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.
- **For all applications**, when connecting the return plenum, be aware that return air may enter the unit through the sides or bottom depending on the type of application. **Do not connect return air into the rear panel of the unit.**
- **For side return applications**, return air is pulled through an opening cut in the side of the unit casing. See [Figure 11](#). Leave the bottom blockoff panel that is supplied with the unit in place. If the unit is installed on a flat, solid surface, the bottom blockoff panel provides an adequate seal to prevent air leakage through the unused bottom opening. However, if the unit is installed on a surface that is uneven or if the unit is installed on blocks or otherwise raised off the floor, seal the edges of the bottom blockoff panel to the casing using tape or other appropriate gasket material to prevent air leakage.
- **For bottom return applications**, return air is usually pulled through a base platform or return air plenum. Make sure the return platform structure or return air plenum is suitable to support the weight of the unit. Remove the internal bottom panel.

Installing the air filter

You must install a field-supplied air filter for all applications. Install the air filter external to the unit cabinet. **Do not attempt to install the air filter inside the unit.** See [Table 4](#) for recommended air filter sizes. Depending on the specific application, you may install side return or horizontal air filters. When installing side return air filters, you need to make a cutout in the unit side panel as shown in [Figure 11](#).

⚠ CAUTION

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

⚠ CAUTION

In horizontal furnace arrangement, the filter must be located a minimum of 18 in. from the return air inlet of the furnace.

NOTICE

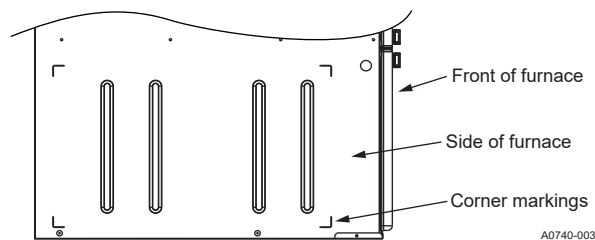
Single-side return above 1800 CFM is approved as long as the filter velocity does not exceed filter manufacturer's recommendation.

Table 4: Recommended air filter sizes - high velocity 600 FPM

CFM (m ³ /min)	Cabinet size	Side (in.)	Bottom (in.)
1200 (34.0)	A	16 x 25	14 x 25
1600 (45.3)	C	16 x 25	20 x 25
2000 (56.6)	C	(2) 16 x 25	20 x 25

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

Figure 11: Side-return cutout markings



- Install the air filter as outlined for the specific type of filter installation in [Installing the air filter](#).

Table 5: Installing the air filter

Type of filter installation	Approach
Side return	<ol style="list-style-type: none"> 1. Locate the L-shaped corner locators. 2. Use the L-shaped corner locators to determine the size of the cutout to be made in the unit side panel. See Figure 11. 3. Install the side return filter rack accessory kit using the instructions provided with the kit. <ul style="list-style-type: none"> ① Note: If an air filter is provided at another location in the return air system, the ductwork may be directly attached to the unit side panel. ➤ Important: Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with the accessory for side opening requirements. Do not cut the opening larger than the dimensions shown in Dimensions.
Horizontal	<ul style="list-style-type: none"> • Note that any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum before the filter. • Use straps and/or supports to support the weight of the external air filter box.

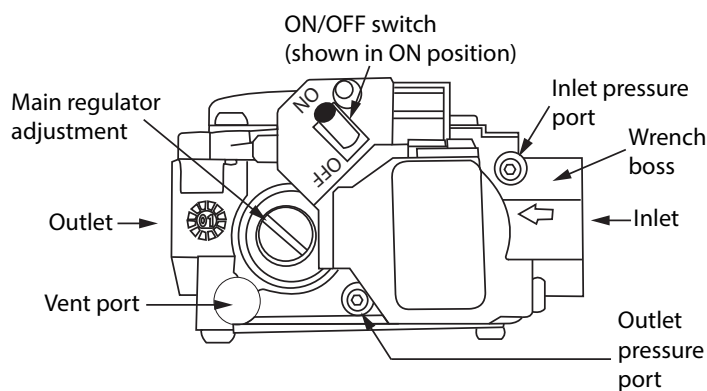
Connecting the gas supply

Follow all requirements when connecting the gas supply. This unit is constructed at the factory for natural gas-fired operation at 0 to 7,800 ft (0 to 2,377 m) above sea level. **Do not operate the unit at altitudes above 7,800 ft (2,377 m).**

Installing the gas piping

See [Figure 12](#) for the gas valve components.

Figure 12: Gas valve



A0226-003

⚠ DANGER

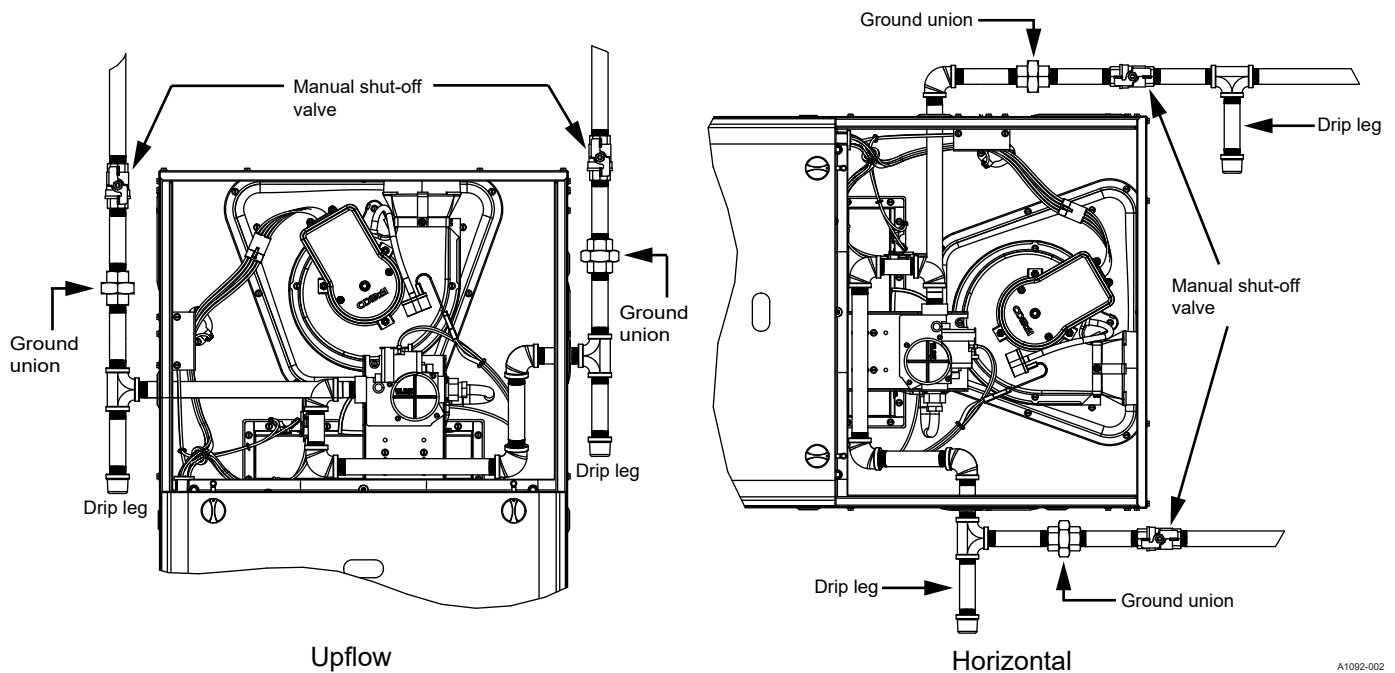
An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 PSI (14 in. W.C. [3.48 kPa]). Pressures exceeding 0.5 PSI (14 in. W.C. [3.48 kPa])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

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

To install the gas piping, do the following:

- Use correctly sized wrought iron or approved flexible or steel pipe when making gas connections to the unit. If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.
- Be aware that some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes.
- Use only a gas type that is approved for the unit as specified on the unit rating plate and in these instructions.
- Install a drip leg and a ground union. See [Figure 13](#).

Figure 13: Gas piping



A1092-002

- **Important:** You must install an accessible manual shutoff valve upstream of the unit gas controls and within 6 ft (1.8 m) of the furnace.
- Isolate the furnace from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (3.5 kPa).

⚠ 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.

- Be aware that you can connect gas piping from either side of the unit using either of the gas pipe entry locations. See [Figure 1](#) and [Figure 13](#).

Connecting the electrical wiring

Follow all requirements when connecting the unit wiring and see [Table 7](#) and [Figure 24](#) as needed.

Connecting the power supply

See [Figure 24](#) for the unit wiring diagram and see [Table 7](#) for specific unit electrical data as needed throughout this procedure.

⚠ CAUTION

Use copper conductors only.

► **Important:**

- Field wiring to the unit must be grounded.
- Electric wires that are field installed must conform to the temperature limitation for 63°F (35°C) rise wire specified in these instructions.
- The residential supply must have a bonded neutral.

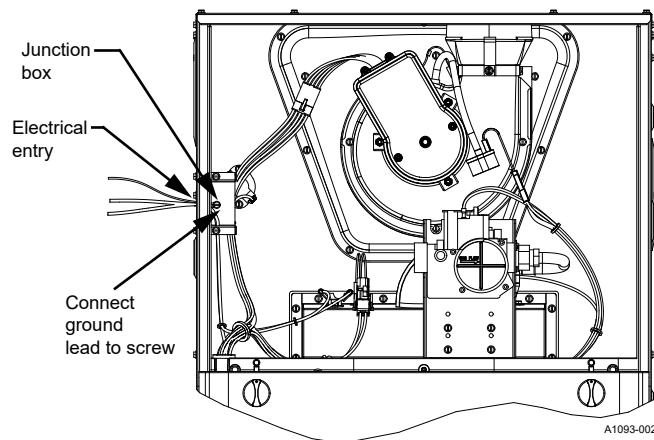
To connect the power supply, do the following

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.
 - **Important:** You must locate the disconnect 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 [Figure 24](#).
3. Use one of the wiring methods outlined in [Table 6](#) to connect the power wiring.

Table 6: Connecting the power wiring

Wiring method	Approach
Using a conduit connector or other proper connection	<ol style="list-style-type: none"> 1. Remove the screws from the wiring box cover. 2. Route the power wiring through the opening in the unit into the junction box with a conduit connector or other proper connection. 3. Observe that in the junction box there is a black wire, a white wire, and a green ground screw. 4. Connect the power supply as shown on the unit wiring label, available on the inside of the blower compartment door or in Figure 24, and in Figure 14 as follows: <ol style="list-style-type: none"> a. Connect the black furnace lead to the L1 (hot) wire from the power supply. b. Connect the white furnace screw to neutral. c. Connect the power supply ground to the green screw (equipment ground). 5. When the wiring connections are complete, replace the wiring box cover and screws.
Using a field provided box and cover	<ol style="list-style-type: none"> 1. Use a field provided 2 in. (5.1 cm) x 4 in. (10.2 cm) box and cover on the outside of the unit. 2. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel.

Figure 14: Electrical wiring



3. Make sure that the furnace's control system has correct polarity of the power supply and a proper ground connection. See [Figure 14](#).
 - **Important:** The power connection leads and wiring box can be relocated to the left side of the unit. Remove the screws and cut wire tie holding excess wiring. Reposition on the left side of the unit and fasten using the holes provided.

Ratings and physical and electrical data

Table 7: Ratings and physical and electrical data

Input		Output		Nominal airflow		AFUE	Air temperature rise		Maximum outlet air temperature		Blower		Blower size	Recommended fuse or circuit breaker	Total unit	Gas pipe connection, NPT
MBH	kW	MBH	kW	CFM	m ³ /min	%	°F	°C	°F	°C	hp	A	in.	A	A	in.
60	17.6	48	14.1	1200	34.0	80.0	35-65	19-36	190	88	1/2	6.4	11 x 8	15	9.0	1/2
80	23.5	64	18.8	1600	45.3	80.0	35-65	19-36	190	88	1/2	6.4	11 x 10	15	9.0	1/2
100	29.3	80	23.4	2000	56.6	80.0	35-65	19-36	190	88	3/4	8.8	11 x 11	15	11.4	1/2

① 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.
- The furnace must be installed so the electrical components are protected from water.

Connecting the control wiring

► **Important:** If the unit has an add-on indoor coil to be paired with an outdoor unit using an A2L refrigerant, you must use a refrigerant detection system (RDS).

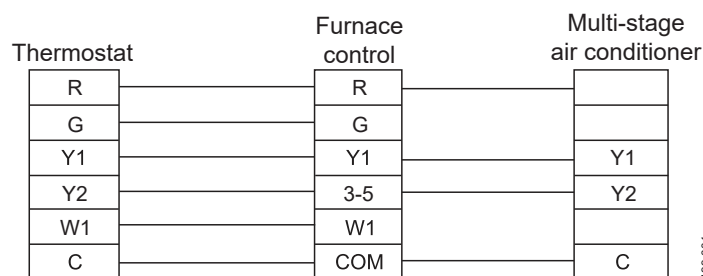
The unit control board allows power-switching control of various accessories. You can use the following if required:

- Humidifier: There are two 1/4 in. (0.64 cm) spade terminals for humidifier connections on the unit control board: HUM and NEUTRAL. The HUM and NEUTRAL terminals provide 115 VAC (1.0 A maximum) during heating system operation. A mounting hole is provided on the control panel next to the unit control board for mounting a humidifier transformer if required.
- Electronic air cleaner: There are two 1/4 in. (0.64 cm) spade terminals for electronic air cleaner connections on the unit control board: EAC and NEUTRAL. The EAC and NEUTRAL terminals provide 115 VAC (1.0 A maximum) during circulating blower operation.

To connect the control wiring, do the following:

1. Install the field-supplied thermostat according to the installation instructions included with the thermostat.
2. Make sure that the thermostat set to the **OFF** position and the main electrical source is disconnected.
3. Connect the thermostat wiring from the wiring connections on the thermostat to the low-voltage terminal block on the unit control board. See [Figure 15](#), [Figure 16](#), [Figure 17](#), or [Figure 18](#), depending on your specific application.

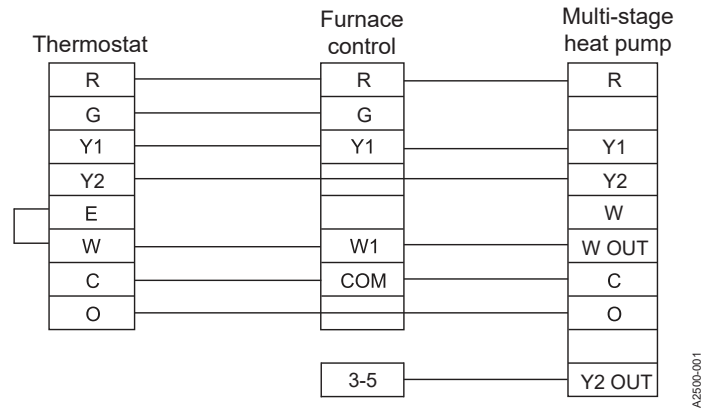
Figure 15: Control wiring - ULN standard ECM gas furnace and standard multi-stage air conditioner - conventional wiring



NOTICE

Y2 connected directly to blower motor tap is required for high speed cooling.

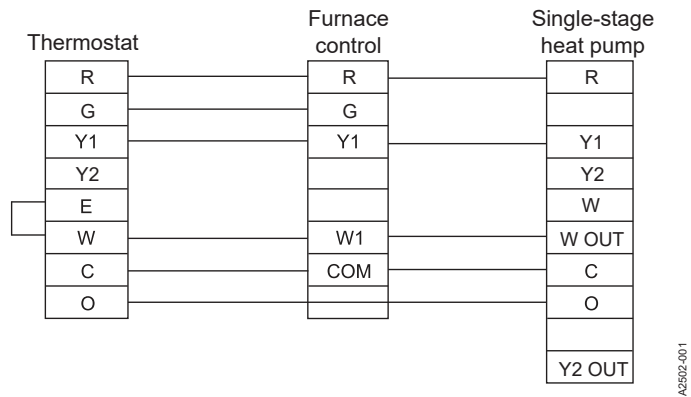
Figure 16: Control wiring - ULN standard ECM gas furnace and standard multi-stage heat pump - conventional wiring



NOTICE

The room thermostat **must** control fossil fuel operation.
 Y2 OUT connected directly to blower motor tap is required for high speed heat pump heating/cooling.

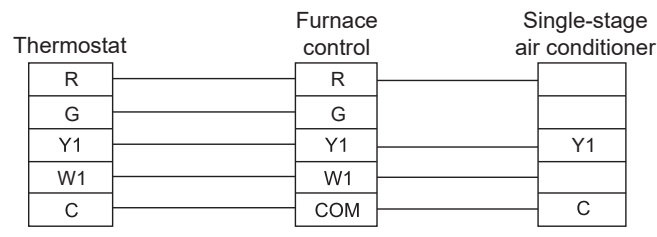
Figure 17: Control wiring - ULN standard ECM gas furnace and standard single-stage heat pump - conventional wiring



NOTICE

The room thermostat **must** control fossil fuel operation.

Figure 18: Control wiring - ULN standard ECM gas furnace and standard single-stage air conditioner - conventional wiring



4. Be aware that electronic thermostats require a 24 V common wire to be connected. **Do not** use power-stealing thermostats.
5. Apply strain relief to the thermostat wires passing through the unit cabinet.
6. If air conditioning equipment is installed, use thermostat wiring to connect the **Y** and **C** terminals on the unit control board to the correct wires on the outdoor unit.
7. If you are using a system with an outdoor unit containing A2L refrigerants, interface the RDS with the system. Refer to the *Installation Manual* for the RDS or an indoor coil with a factory-installed RDS for low-voltage wiring instructions and diagrams.

► **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.
- Electronic thermostats do not have adjustable heat anticipators. They must be set to six cycles per hour. Follow the instructions provided by the thermostat manufacturer.

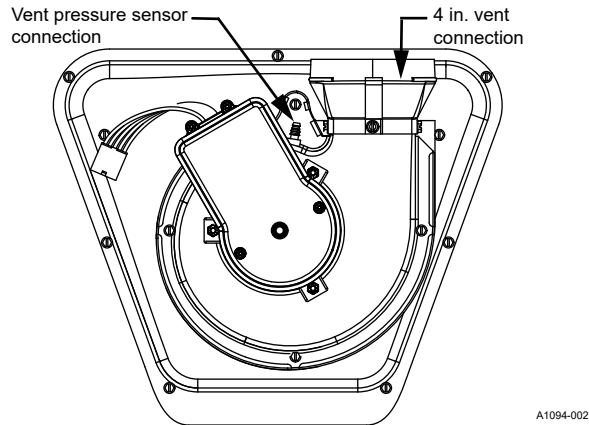
► **Important:** The 24 V, 40 VA transformer is sized only for the unit components, so do not connect it to power auxiliary devices such as humidifiers and air cleaners. The 24 V, 40 VA transformer can provide power for an air conditioning unit or heat pump.

8. If a humidifier is installed, connect the humidifier to the **HUM** and **NEUTRAL** terminals on the unit control board.
9. If an electronic air cleaner is installed, connect the electronic air cleaner to the **EAC** and **NEUTRAL** terminals on the unit control board.

Connecting the vent system

- Be aware that the unit is provided with a flue transition that is sized for 4 in. diameter vent connections. If a larger size vent connector is required, install that connection external to the unit.
- Be aware that the unit is shipped from the factory as shown in [Figure 19](#) and [Figure 20](#).

Figure 19: Combustion air inducer



- **Follow all requirements for connecting the vent system** as outlined in relevant codes and standards, [Safety](#), and the following:
 - [CATEGORY 1 - 450 F. MAX. VENT TEMP.](#)
 - [Venting](#)
 - [Venting into an existing chimney](#)
 - [Fan-assisted combustion system](#), including [Ambient combustion air supply](#) , [Dampers, louvers, grilles, and screens - Canada only](#), [Air supply openings and ducts](#), [Combustion air source from outdoors](#), [Ventilated combustion air](#), and [Vent and supply \(outside\) air safety check procedure](#)

CATEGORY 1 - 450 F. MAX. VENT TEMP.

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

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

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

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

Venting

Category I venting consists of vertically venting one or more appliances in B-vent or masonry chimney (as allowed), using single wall metal pipe or B-vent connectors. Type B-vent system extends in a general vertical direction and does not contain offsets exceeding 45°. A vent system having not more than one 60° offset is permitted.

Venting into an existing chimney

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

Where use of an existing chimney is unavoidable, follow these rules:

- The masonry chimney must be built and installed in accordance with nationally recognized building codes or standards and must be lined with approved fire clay tile flue liners or other approved liner material that will resist corrosion, softening, or cracking from flue gases. **THIS FURNACE IS NOT TO BE VENTED INTO AN UNLINED MASONRY CHIMNEY.**
- This furnace must be vented into a fire clay tile lined masonry chimney only if a source of dilution air is provided, such as by common venting with a draft hood equipped water heater. If no source of dilution air is available, Type B vent or masonry chimney vent kit 1CK0604 must be used. Refer to the instructions supplied with the kit to correctly apply these masonry chimney kits.
- The chimney must extend at least 3 ft (91 cm) above the highest point where it passes through a roof of a building and at least 2 ft higher than any portion of the building with a horizontal distance of 10 ft.
- The chimney must extend at least 5 ft (1.5 m) above the highest equipment draft hood or flue collar.

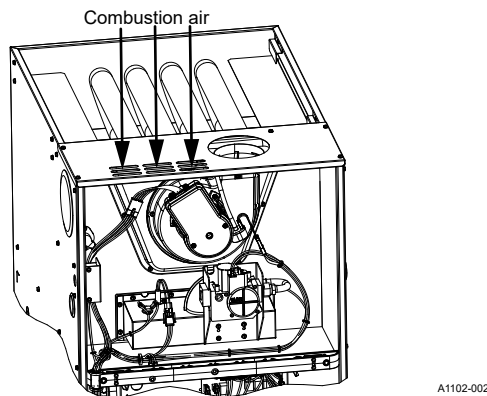
Fan-assisted combustion system

This appliance is equipped with an integral mechanical means to draw products of combustion through the heat exchanger.

Ambient combustion air supply

This type of installation draws the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. A single, correctly sized pipe from the furnace vent connector to the outdoors must be provided. Combustion air is brought into the furnace through the unit top panel opening.

Figure 20: Combustion airflow path through the furnace casing to the burner compartment



WARNING

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

An **unconfined space** is not less than 50 cu ft (1.42 m³) per 1,000 Btu/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 are furnished with openings or louvers.

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

Dampers, louvers, grilles, and screens - Canada only

Note: This topic applies only to Canada.

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

WARNING

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

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

Table 8: Unconfined space minimum area

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

Table 9: 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)
60,000	30 (193)	15 (97)	5 (13)
80,000	40 (258)	20 (129)	5 (13)
100,000	50 (322)	25 (161)	6 (15)

Example: Determining free area.

Appliance 1 appliance 2 total input

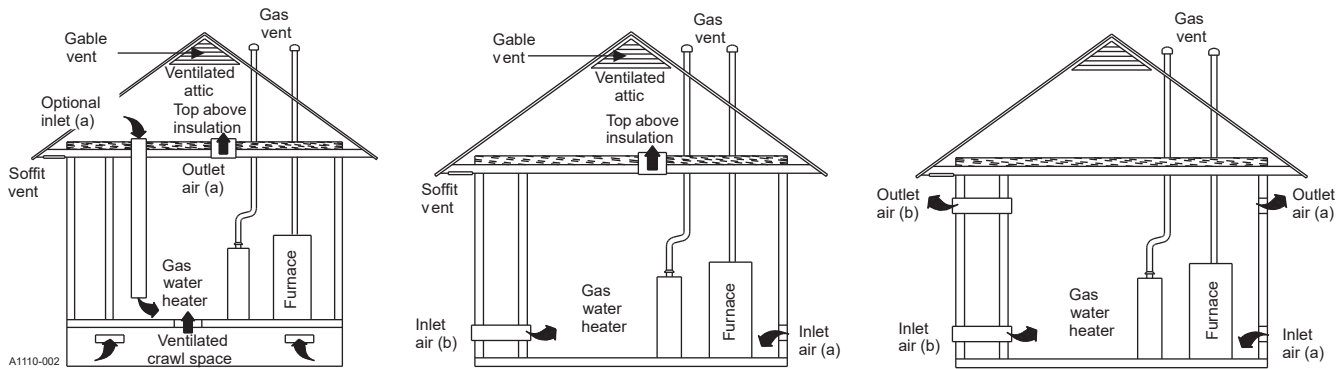
$$100,000 + 30,000 = (130,000 \div 4,000) = 32.5 \text{ in}^2 \text{ vertical}$$

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

Figure 21: Ambient combustion air



- An opening can be used in lieu of a duct to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening must be located within 12 in. (30.5 cm) horizontally from the burner level of the appliance. See [Combustion air source from outdoors](#) and [Vent and supply \(outside\) air safety check procedure](#) for additional information and safety check procedure.
- The duct must be either metal, or a material meeting the class 1 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 appliance having the largest input.
- A square or rectangular shaped duct must only be used when the required free area of the supply opening is 9 in.² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimension shall 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. Such means must not reduce the required free area of the air supply opening.
- An air supply inlet opening from the outdoors must be located not less than 12 in. (30.5 cm) above the outside grade level.

Combustion air source from outdoors

- Two permanent openings, one within 12 in. (30.48 cm) of the top and one within 12 in. (30.48 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, commencing within 12 in. (30.48 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. (15.24 cm) from the front of the appliance. The opening must communicate directly with the outdoors and shall have a minimum free area of:
 - 1 in.²/ 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 10](#) to estimate free area.

Table 10: Estimated free area

Wood or Metal	Wood 20–25%*
Louvers or Grilles	Metal 60–70% *
Screens**	1/4 in. (0.635 cm) mesh or larger 100%
<p>① Note:</p> <ul style="list-style-type: none"> *Do not use less than 1/4 in. (0.64 cm) mesh. **Free area of louvers and grille varies widely. Follow the louver or grille manufacturer’s instructions. 	

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 source from outdoors](#) 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 properly ventilated attic space or crawl space and the second pipe extends from the furnace vent connection (top right of unit) to the exterior of the building.

Vent and supply (outside) air safety check procedure

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

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

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

Horizontal portions of the venting system must be supported to prevent sagging using hangers or perforated straps and must slope upwards not less than 1/4 in/ft (21 mm/m) from the furnace to the vent terminal.

Follow the venting safety procedure below. This procedure is designed to detect an inadequate ventilation system that can cause the appliances in the area to operate incorrectly causing unsafe levels of carbon monoxide or an unsafe condition to occur.

 **WARNING****CARBON MONOXIDE POISONING HAZARD**

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

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

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows.
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.

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

8. Any corrections to the venting system and/or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1 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.

Starting up the unit

You **must** do an ignition check for every new unit installation as part of starting up the unit.

► Important:

- Burner ignition may not be satisfactory when you start up the unit for the first time due to residual air in the gas line or until you adjust the gas manifold pressure. The ignition control makes three attempts to light before locking out.
- All electrical connections made in the field and in the factory must be checked for proper tightness.

To run and check the ignition system sequence, do the following:

1. Check all electrical connections made in the factory and in the field for correct tightness.
2. Turn on the gas supply at the external valve and main gas valve.
3. Set the temperature setting on the thermostat higher than the room temperature to create a call for heating.
4. Wait while system start-up occurs, checking that ignition occurs correctly. System start-up happens as follows:
 - a. The induced draft blower starts and runs for several seconds to bring fresh combustion air into the combustion chamber. Then the induced draft blower shuts off and the hot surface igniter glows for about 17 s.
 - b. After this warm up, the induced draft blower starts again and the ignition module opens the main gas valve.
 - c. After flame is established, the supply air blower starts in about 30 s.
5. Based on how system start-up occurs, proceed as follows:
 - If the unit lights reliably and without undue ignition noise, the gas and air mixture in the burner is correct. With the unit in operation, proceed to check and configure the system.
 - If the burner does not light after several attempts, it may be necessary to adjust the gas flow rate. Before attempting to adjust the gas flow rate, make sure that the other necessary conditions for ignition are met, for example, the gas valve is turned on, the main gas cock is open, and the igniter comes on. If the burner does not light, or lights and immediately goes out, increase the gas pressure at the gas valve. If the burner does not light even after the manifold pressure has reached 4.0 in. W.C., you may be dealing with abnormally low gas heating value and need to change the main gas orifice to a larger size. When ignition occurs correctly, with the unit in operation, proceed to check and configure the system.

Checking and configuring the system

You **must** complete all required checks and configure unit settings correctly at the time of installation to ensure correct system operation.

Checking the gas piping for leaks

You **must** do a gas piping leak check for every new unit installation. When the gas supply is initially connected to the unit, the gas piping may be full of air, so you must purge it by loosening the ground union before you check the gas piping for leaks.

⚠ WARNING**FIRE OR EXPLOSION HAZARD**

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

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

► Important:

- The unit and its equipment shut-off valve must be disconnected from the gas supply during any pressure testing of that system at test pressures in excess of 1/2 PSI (3.45 kPa).
- The unit 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.
- Burner ignition may not be satisfactory when you start up the unit for the first time due to residual air in the gas line or until you adjust the gas manifold pressure. The ignition control makes three attempts to light before locking out.

To check the gas piping for leaks, do the following:

1. Make sure that correct ventilation is available to dilute and carry away any vented gas.
2. Loosen the ground union until the odor of gas is detected. When gas is detected, immediately retighten the union.
3. Allow 5 min for any gas to dissipate before proceeding to check for leaks.
4. With the unit 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.
5. If a leak or leaks are detected, take appropriate action to stop any leak. If a leak persists, replace the faulty component.

Checking the unit input rate

You **must** verify the natural gas input rate by clocking the gas meter for every new unit installation.

NOTICE

Do not set manifold pressure less than 3.0 in. W.C. or more than 4.0 in. W.C. for natural gas at sea level. If manifold pressure is outside this range, change main burner orifices.

⚠ 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.

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.

To check the unit input rate, do the following:

1. Turn off all other gas appliances and pilots.
2. Run the unit for a minimum of 3 min in heating operation.
3. Measure the time in seconds for the gas meter to complete one revolution and note this measurement.
 - ① **Note:** The 2 cubic feet test dial provides a more accurate measurement of gas flow.
4. See [Table 11](#) for the cubic feet per hour of gas for the specific time and test dial size.
5. Multiply the cubic feet per hour by the heating value (Btu/cu ft) to calculate the input rate.
6. Check if the input rate matches the input rate on the unit rating plate. If the input rate does not match the input rate on the unit rating plate, adjust the manifold pressure as outlined in [Measuring and adjusting manifold gas pressure](#). Repeat Step 2 to Step 6 until you get the correct input rate.

⚠ CAUTION

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

Gas rate in cubic feet per hour

Table 11: Gas rate in cubic feet per hour

Seconds for 1 revolution	Size of test dial		
	1 cu ft	2 cu ft	5 cu ft
10	360	720	1800
11	327	655	1636
12	300	600	1500
13	277	555	1385
14	257	514	1286
15	240	480	1200
16	225	450	1125
17	212	424	1059
18	200	400	1000
19	189	379	947
20	180	360	900
21	171	343	857
22	164	327	818
23	157	313	783
24	150	300	750
25	144	288	720
26	138	277	692
27	133	267	667
28	129	257	643
29	124	248	621
30	120	240	600
31	116	232	581

Table 11: Gas rate in cubic feet per hour

Seconds for 1 revolution	Size of test dial		
	1 cu ft	2 cu ft	5 cu ft
32	113	225	563
33	109	218	545
34	106	212	529
35	103	206	514
36	100	200	500
37	97	195	486
38	95	189	474
39	92	185	462
40	90	180	450
41	88	176	439
42	86	172	429
43	84	167	419
44	82	164	409
45	80	160	400
46	78	157	391
47	76	153	383
48	75	150	375
49	73	147	367
50	72	144	360
51	71	141	355
52	69	138	346
53	68	136	340
54	67	133	333
55	65	131	327
56	64	129	321
57	63	126	316
58	62	124	310
59	61	122	305
60	60	120	300
62	58	116	290
64	56	112	281
66	54	109	273
68	53	106	265
70	51	103	257
72	50	100	250
74	48	97	243
76	47	95	237
78	46	92	231
80	45	90	225
82	44	88	220
84	43	86	214
86	42	84	209
88	41	82	205
90	40	80	200
92	39	78	196
94	38	76	192
96	38	75	188
98	37	74	184
100	36	72	180
102	35	71	178
104	35	69	173
106	34	68	170

Table 11: Gas rate in cubic feet per hour

Seconds for 1 revolution	Size of test dial		
	1 cu ft	2 cu ft	5 cu ft
108	33	67	167
110	33	65	164
112	32	64	161
116	31	62	155
120	30	60	150

Measuring and adjusting inlet gas pressure

You can measure inlet gas pressure by connecting a manometer to the inlet pressure port on the gas valve with a piece of tubing. See [Figure 12](#) for the location of the inlet pressure port, which is the port marked **IN P**.

► **Important:** You take the inlet gas pressure reading at the port marked **IN P**. You take the manifold gas pressure reading at the port marked **OUT P**.

To measure and adjust inlet gas pressure, do the following:

1. Turn off gas at the ball valve or gas cock on the gas supply line before the gas valve, and turn off the electrical supply.
2. Locate the inlet pressure port marked **IN P** on the gas valve as shown in [Figure 12](#).
3. Using a 3/32 in. (2.4 mm) hex head wrench, loosen the set screw by turning it 1 turn counter clockwise. **Do not remove the set screw from the inlet pressure port.**
4. 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, because it references atmospheric pressure.

ⓘ **Note:** See [Figure 22](#) for an illustration of connecting a U-tube manometer.

5. Turn on the gas and electrical supplies and follow the operating instructions to place the unit back in operation.
6. Measure the inlet gas pressure. Adjust the inlet gas pressure if needed. See [Table 12](#).

Table 12: Inlet gas pressure operating range

Gas type	Minimum	Maximum
Natural gas	4.5 in. W.C. (1.12 kPa)	10.5 in. W.C. (2.61 kPa)
<p>► Important: The table specifies what the minimum and maximum gas line pressures must be for the unit to operate safely. The gas line pressure must be a minimum of 7 in. W.C. (1.74 kPa) to obtain the Btu input specified on the unit rating plate and/or the nominal manifold pressure specified in these instructions and on the unit rating plate.</p>		

7. When the inlet gas pressure is correct, turn the gas valve to **OFF** and turn the electrical supply switch to **OFF**. Then, remove the flexible tubing from the **IN P** pressure tap on the gas valve and tighten the **IN P** pressure tap plug using the 3/32 in. (2.4 mm) hex head wrench.
8. Turn on the electrical and gas supplies, and with the burners in operation, check for gas leakage around the inlet pressure port on the gas valve using an approved non-corrosive gas leak detection fluid or other non-flammable leak detection methods.

Measuring and adjusting manifold gas pressure

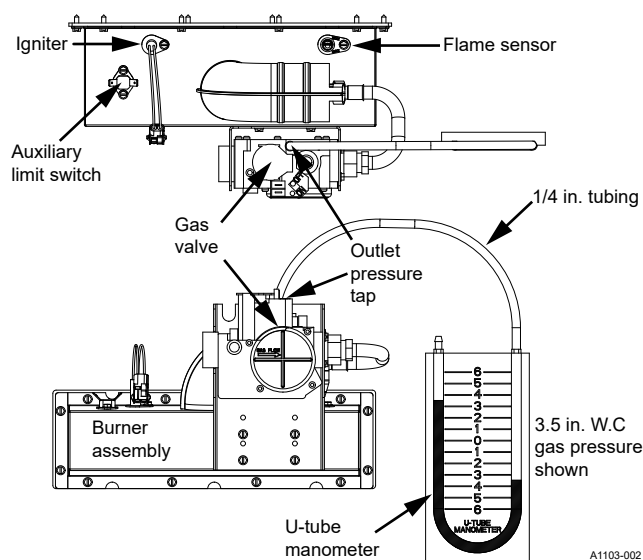
You can measure manifold gas pressure by connecting a manometer to the outlet pressure port on the gas valve with a piece of tubing. See [Figure 12](#) for the location of the outlet pressure port, which is the port marked **OUT P**.

► **Important:** You take the inlet gas pressure reading at the port marked **IN P**. You take the manifold gas pressure reading at the port marked **OUT P**.

To measure and adjust manifold gas pressure, do the following:

1. Turn off gas at the ball valve or gas cock on the gas supply line before the gas valve, and turn off the electrical supply.
2. Locate the outlet pressure port marked **OUT P** on the gas valve as shown in [Figure 12](#).
3. Using a 3/32 in. (2.4 mm) hex head wrench, loosen the set screw by turning it 1 turn counter clockwise. **Do not remove the set screw from the outlet pressure port.**
4. Connect the positive side of the manometer to the **OUT P** tap on the gas valve. See [Figure 22](#). Do not connect any tubing to the negative side of the manometer, because it references atmospheric pressure.

Figure 22: Connecting a U-tube manometer to read manifold gas pressure



5. Locate the pressure regulator adjustment cap and adjustment screw on the main gas valve as shown in [Figure 12](#).
6. Remove the cap from the pressure regulator to gain access to the adjustment screw.
 - **Important:** You must remove the cap from the pressure regulator entirely to gain access to the adjustment screw. Loosening or tightening the cap does not adjust the flow of gas.
7. Turn on the gas and electrical supplies and follow the operating instructions to place the unit back in operation.
8. Measure the manifold gas pressure. Adjust the manifold gas pressure for the type of gas used if needed by adjusting the gas valve regulator screw so the manifold gas pressure is in accordance with [Table 13](#).

Table 13: Nominal manifold pressure

Gas type	Nominal manifold pressure
Natural gas	3.5 in. W.C. (0.87 kPa)

- **Important:** If the gas valve regulator screw is turned in (clockwise), the manifold pressure increases. If the gas valve regulator screw is turned out (counter clockwise), the manifold pressure decreases.
9. Re-calculate the unit input rate as outlined in [Checking the unit input rate](#) to make sure you have not exceeded the specified unit input rate on the unit rating plate.
 10. When the Btu (kW) input is correct, turn the gas valve to **OFF** and turn the electrical supply switch to **OFF**. Then, remove the flexible tubing from the **OUT P** pressure tap on the gas valve and tighten the **OUT P** pressure tap plug using the 3/32 in.(2.4 mm) hex head wrench.

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

Checking the air temperature rise

You **must** check the air temperature rise for every new unit installation.



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 7](#).

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.

To check the air temperature rise, do the following:

- After about 10 min of operation, determine the unit 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 or decrease the blower speed to increase the temperature rise if needed. See [Configuring airflow settings](#).

Configuring airflow settings

The unit has a standard ECM motor. The blower motor speed taps are located on the unit control board in the blower compartment. See [Figure 23](#). To use the same speed tap for heating and cooling, the terminals must be jumpered together. The control board changes blower speeds based on other 24-V thermostat inputs: Y and W respectively. The unit has a time-on and time-off heating fan control. The heating blower on delay time is fixed at 30 s. [Table 14](#) shows the available settings for the heating blower off delay time. You can adjust the heating blower off delay time using the heat jumper. The selected time setting must be long enough to adequately cool the unit, but not so long that cold air is blown into the heated space. The unit also has a cooling blower on time delay. [Table 15](#) shows the available settings. You can adjust the cooling blower on delay time using the cool jumper.

Table 14: Heating blower off delay settings

Setting	Heating blower off delay timing
A	60 s
B	90 s
C	120 s - default setting
D	180 s

Table 15: Cooling blower on delay settings

Setting	Cooling blower on delay timing
A	6 s
B	24 s

To configure airflow settings, do the following:

- To change the blower speed, use [Figure 23](#) and [Figure 24](#) as a guide. Make sure to place all unused motor leads on the PARK terminals. Two PARK terminals are provided.

- To adjust the heating blower off delay time, position the HEAT jumper on the two pins for the required setting: A, B, C, or D. See [Table 14](#).
- To adjust the cooling blower on delay time, position the COOL jumper on the two pins for the required setting: A or B. See [Table 15](#).

Airflow performance data - any position - without filter

Table 16: Airflow performance data - any position - without filter

Model input (MBH)	Motor speed	External static pressure (in. W.C.)							
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
		SCFM	SCFM	SCFM	SCFM	SCFM	SCFM	SCFM	SCFM
60	High	1363	1328	1282	1257	1211	1180	1145	1100
	Medium High	1161	1128	1083	1045	999	959	916	876
	Medium	974	941	898	859	811	762	720	667
	Medium Low	796	758	714	664	612	562	516	464
	Low	720	685	636	589	529	473	431	375
80	High	1780	1730	1690	1650	1604	1574	1534	1501
	Medium High	1576	1540	1504	1455	1408	1359	1316	1268
	Medium	1443	1401	1357	1312	1258	1216	1163	1114
	Medium Low	1259	1211	1164	1114	1065	1011	950	894
	Low	1080	1030	978	927	872	816	757	680
100	High	2197	2138	2096	2052	2007	1958	1904	1869
	Medium High	1767	1736	1696	1659	1611	1560	1516	1468
	Medium	1581	1521	1476	1442	1400	1344	1295	1250
	Medium Low	1406	1358	1316	1269	1222	1177	1131	1087
	Low	1205	1146	1098	1039	993	939	890	820
① Note:	<ul style="list-style-type: none"> • Airflow expressed in standard cubic feet per minute (SCFM) • Motor voltage at 115 V 								

System components and operation

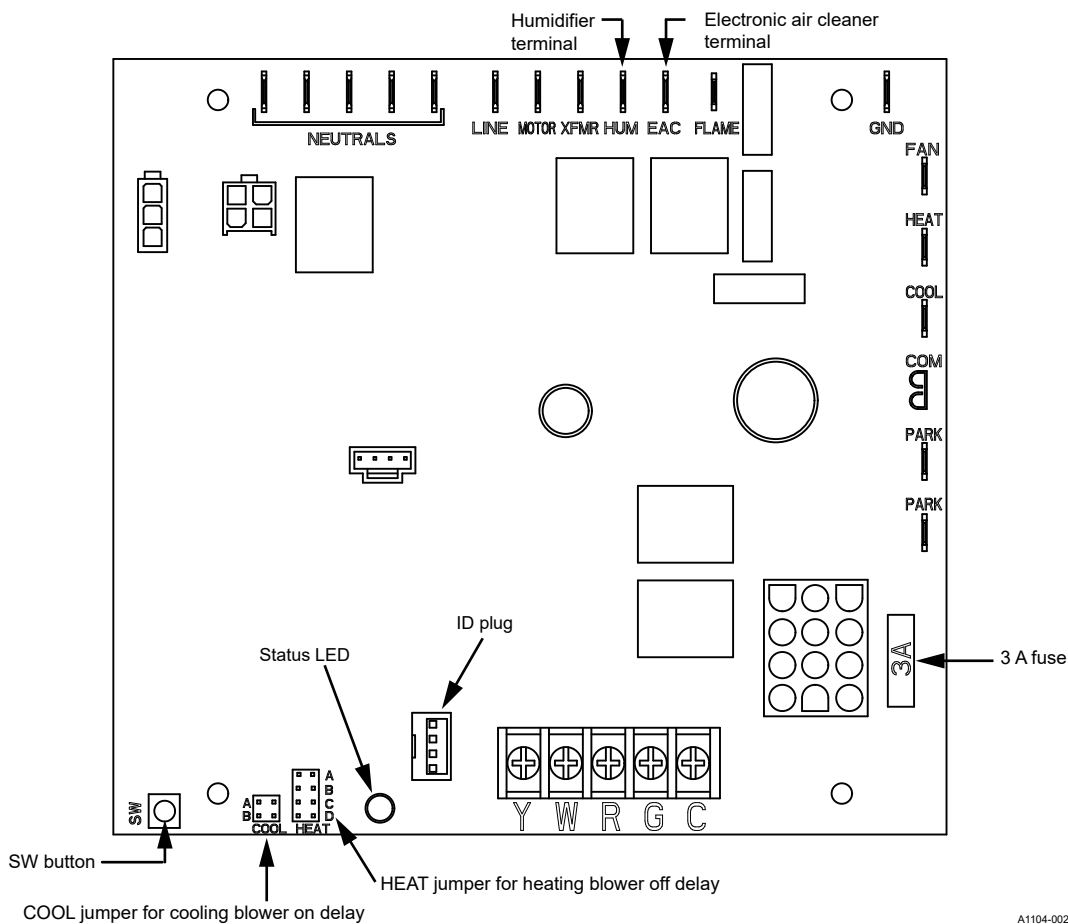
It is important to be familiar with the different system components and understand how they operate.

Control board

Figure 23 shows the unit control board, which includes the following:

- **Status LED:** Indicates system status and fault codes
- **Heat jumper:** Used to configure the heating blower off delay time
- **Cool jumper:** Used to configure the cooling blower on delay time
- **SW button:** Used to view and clear stored fault codes
- **HUM terminal:** Used to connect a humidifier
- **EAC terminal:** Used to connect an electronic air cleaner

Figure 23: Control board



A1104-002

Safety controls

The unit has the following safety controls:

- **Control circuit fuse:** A 3 A fuse is provided on the unit control board to protect the 24 V transformer from overload caused by control circuit wiring errors. The fuse is an ATO 3, automotive fuse.

- **Blower door safety switch:** The 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 the unit depends on the panel that covers the blower compartment being in place and correctly positioned.

CAUTION

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

- **Auxiliary limit switch:** The auxiliary limit switch is mounted on the burner assembly. If the temperature in the area surrounding the burner exceeds its setpoint, the gas valve is de-energized. The operation of this control indicates a malfunction in the combustion air blower or heat exchanger or a blocked vent pipe connection. Corrective action is required.
- **Pressure sensor:** The unit is supplied with a pressure sensor, which monitors the flow through the combustion air/vent piping system.
- **Limit control:** The unit has a high-temperature limit control located on the unit vestibule panel near the gas valve. This is an automatic reset control that provides overtemperature protection due to reduced airflow. This may be caused by the following:
 - A dirty filter
 - Indoor fan motor failure
 - Too many supply or return registers closed or blocked off
 The unit control board locks out if the high-temperature limit control trips five consecutive times. If this occurs, the control board resets and attempts ignition again after 1 h.

Heating operation

When the thermostat switch is set to heat mode, the fan switch is in the auto position, and there is a call for heating, the thermostat circuit is completed between terminals R and W. The induced draft blower starts and runs for several seconds to bring fresh combustion air into the combustion chamber. Then the induced draft blower shuts off and the hot surface igniter glows for about 17 s. After this warm up, the induced draft blower starts again and the ignition module opens the main gas valve. The blower motor energizes 30 s after the gas valve opens, if a flame is detected. Normal unit 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 heating blower off delay time selected using the heat jumper on the unit control board. See [Configuring airflow settings](#). The heating cycle is now complete, and ready for the start of the next heating cycle.

If the flame is not detected within 7 s of the gas valve opening, or 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 period 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 unit control board clears the ignition attempt (retry) counter. If three retries occur during a call for heating, the unit shuts down for 1 h. At the end of the 1 h shutdown, if there is a call for heating, the unit initiates a normal start cycle. If the problem has not been corrected, the unit locks out after three retries.

A momentary loss of gas supply, flame blowout, or faulty flame probe circuit results in a disruption in the flame and is sensed within 1.0 s. The gas valve de-energizes and the unit control board begins a recycle operation. A normal ignition sequence begins after a 15 s inter-purge period. If during the five recycles the gas supply does not

return, or the fault condition is not corrected, the unit control board locks out for 60 min. During burner operation, a momentary loss of power for 50 ms or longer de-energizes the gas valve. When the power is restored, the gas valve remains de-energized and the ignition sequence immediately restarts.

Indoor circulating blower operation

Cooling/heating thermostats have a fan switch that has two positions:

- **On:** In the on position, the indoor circulating blower operates continuously. The thermostat circuit is completed between terminals R and G. The motor operates continuously on the speed tap wire that is connected to the fan terminal on the unit control board. To obtain a different continuous indoor circulating blower speed, you must change the wire connected to the fan connection with one of the speed tap wires located on the park terminals.
- **Auto:** In the auto position, the indoor circulating blower operates when there is a call for cooling. 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 cool terminal on the unit control board. The fan off setting is fixed at 60 s to improve cooling efficiency.

Hot surface ignition system

The furnace has a hot surface ignition system.

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.

Lockout

It is important to understand the following:

- **Soft lockout:** The unit control board has a built-in 1 h soft lockout. During a soft lockout, the unit control board responds to calls for cooling or indoor circulating blower operation but does not respond to calls for heating. A soft lockout resets automatically after 1 h. This provides protection for an unoccupied structure if a temporary condition causes a unit malfunction, for example, if a temporary interruption in gas supply prevents the unit from lighting. The unit control board keeps trying to light each hour and resumes normal operation if the gas supply is restored. To reset a soft lockout and override the 1 h lockout time, follow the procedure outlined in [Resetting a lockout](#).
- **Hard lockout:** When a fault code indicating a potentially hazardous condition for users or occupants of the space where the unit is located occurs, the unit control board enters a hard lockout. During a hard lockout, the unit control board responds to calls for cooling or indoor circulating blower operation, but does not respond to calls for heating. To reset a hard lockout, follow the procedure outlined in [Resetting a lockout](#).

Troubleshooting

⚠ WARNING

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

Do not try to repair controls. Replace defective controls with BHC Group Heating & Cooling Source 1 Parts.

Never adjust pressure switch to allow furnace operation.

Complete the following checks before doing the detailed troubleshooting outlined in [Using unit control board diagnostics](#):

1. Check that the power to the unit and the ignition control module is on.
2. Check that the manual shut-off valves in the gas line to the unit are open.
3. Make sure that 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 response. Then, use the information in [Using unit control board diagnostics](#) to check the system operation and follow the troubleshooting guidance for specific issues as need.

Using unit control board diagnostics

The unit has built-in, self-diagnostic capability. The unit control board continuously monitors its own operation and the operation of the system. The status LED on the control board flashes red, green, or amber to indicate various conditions, for example, when there are active faults, when there are no thermostat calls, and when there is a call for heating. If a fault occurs, the status LED indicates the fault code. [Table 17](#) provides an overview of the status LED codes.

- ① **Note:** For the slow flash codes, the slow flash speed of the status LED is 2 s on and 2 s off. For the red flash codes, the status LED turns on for 1/4 s and turn off for 1/4 s. This pattern is repeated the number of times equal to the code. There is a 1.5 s pause between codes. For example, for the 6 red flashes code, the status LED flashes on and off six times and then remains off for 1.5 s. This pattern repeats as long as the fault condition remains.

Table 17: Understanding status LED codes

Status LED	Condition	Solution
Steady on green	Indicates normal operation with no thermostat calls	No action is needed.
1 green flash	Indicates normal operation with a call for heating	No action is needed.
2 green flashes	Indicates normal operation with a call for cooling	No action is needed.
3 green flashes	Indicates normal operation with a call for continuous indoor circulating blower operation	No action is needed.

Table 17: Understanding status LED codes

Status LED	Condition	Solution
Steady off	Indicates an issue with power to the unit control board or possible control board failure	If the LED does not flash at all, check for power to the control board and check for a blown fuse on the control board. If the control board is correctly powered and the fuse is not blown, the control board may need to be replaced.
Steady on red	Indicates unit control board failure	Turn off the power to the unit and turn on the power to the unit again. If the fault code returns, the control board must be replaced. The control board is not field-repairable.
1 red flash	Indicates system lockout due to too many retries	There are numerous possible causes and solutions for this fault.
2 red flashes	Indicates a pressure sensor null error. The pressure sensor is sensing pressure when there should not be any pressure.	Check for a faulty pressure sensor or miswiring.
3 red flashes	Indicates a pressure sensor span error. The pressure sensor is not sensing the correct pressure.	Check for the following: <ul style="list-style-type: none"> • Faulty inducer • Blocked vent pipe • Broken pressure sensor hose • Disconnected pressure sensor or inducer wires • Faulty pressure sensor
4 red flashes	Indicates the high-temperature limit control is open. The limit control has opened its normally closed contacts. The unit control board operates the supply air blower and inducer while the open limit condition exists.	Check for the following: <ul style="list-style-type: none"> • Dirty filter • Incorrectly sized duct system • Incorrect blower speed setting • Incorrect firing rate • Loose limit switch wiring • Faulty blower motor <p>ⓘ Note: If the high-temperature limit control opens five times within a single call for heat, the status LED on the unit control board emits 4 red flashes and enters a 1 h soft lockout.</p>

Table 17: Understanding status LED codes

Status LED	Condition	Solution
5 red flashes	Indicates flame is present with the gas valve off. The unit control board has sensed a flame during a period when the gas valve is not supposed to be open.	Check for miswiring. ① Note: The unit control board enters a hard lockout. After the problem is corrected, you must turn off the power and turn on the power again to reset the control board. See Resetting a lockout .
6 red flashes	Indicates the auxiliary limit switch is open. The limit switch mounted on the burner box is open, indicating an overheating condition in the burner.	Check for a blocked vent or an overfired condition.
7 red flashes	Indicates a gas valve short circuit. The unit control board has sensed that the gas valve circuit is shorted.	Check for miswiring of the gas valve or a shorted gas valve wire.
Rapid red flashes	Indicates incorrect line voltage polarity. The polarity of the incoming power to the unit is reversed.	Check high-voltage wires and transformer connections for correct polarity.
1 amber flash	Indicates low flame current. The flame current being sensed by the flame sensor has dropped below the normal level. The unit continues to operate in this condition, but if the flame current continues to drop, the burners shut down.	Check for a dirty or bent flame sensor.
2 amber flashes	Indicates ID plug failure. The unit is equipped with an ID plug on the control board that is used to transmit model-specific information to the control board. If this error occurs, it means that the control board is unable to detect the ID plug. The unit does not operate correctly without the correct ID plug installed.	Replace the ID plug.
3 amber flashes	Indicates the control fuse is open. The low-voltage fuse on the unit control board has opened or is missing.	Check the wiring and check the control fuse.

IGNITION CONTROL FLAME SENSE LEVELS

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

Viewing and clearing fault code history

The status LED on the unit control board indicates active faults. See [Using unit control board diagnostics](#) and [Table 17](#). The unit control board is equipped with memory that stores up to five fault codes to allow service technicians to diagnose problems more easily. This memory is retained even if power to the unit is lost. If more than five fault codes have occurred since the last reset, only the five most recent fault codes are retained. You view and clear fault code history using the SW button.

► **Important:** This feature must be used only by a qualified service technician.

To view and clear fault code history, do the following:

1. Make sure that there are no active thermostat calls.
2. On the unit control board, press the **SW** button. If stored fault codes are present, the fault codes display. If there are no stored fault codes, the status LED on the unit control board emits 2 green flashes.

① **Note:** When stored fault codes display, the most recent fault code displays first. There is a 2 s pause between each fault code. There is a 5 s pause when all the fault codes have been displayed. You can press the **SW** button again to view the fault codes again.

3. Press and hold the **SW** button for more than 5 s to clear the stored fault codes if required.

Resetting a lockout

You can reset a soft or hard lockout if required. Soft lockouts reset automatically after 1 h. Hard lockouts do not reset automatically. See [Lockout](#) for more information about soft and hard lockouts.

- **To reset a soft lockout**, turn off the power to the unit control board and turn on the power again **or** let the 1 h lockout time expire.
- **To reset a hard lockout**, turn off the power to the unit control board and turn on the power again.

Sourcing replacement parts

Table 18: Replacement parts list

Part type	Description	
Motor	Motor, direct drive blower	
	Blower, combustion	
Electrical	Switch, limit	
	Control, furnace	
	Igniter	
	Sensor, flame	
	Sensor, pressure	
	Switch, door	
	Transformer	
	Valve, gas	
	Control, temperature	
Air moving	Housing, blower	
	Housing, blower with wheel	
	Wheel, blower	
Fabricated parts	Baffle, flue	
	Burner, main gas	
	Shelf, blower	
	Rail, blower - 2 required	
	Bracket, blower track - 2 required	
	Heat exchanger assembly	
	Pan, bottom	
	Panel, top	
	Panel, door - 2 required	
	Vent pan, combustion (with gasket)	
	Panel, blockoff	
	Miscellaneous	Orifice, burner
		Sight glass, oval - 2 required
Gasket, foam (door) - 1.5 ft required		
Gasket, intake pan		
Plug, vent hole		
Bracket, door		
Wiring harness		
Ferrule - 3 required		
Grommet - 3 required		
Motor mount		
Tubing, silicon		
Diagram, wiring		
Knob, quarter turn - 4 required		

This is a generic parts list. To request a complete parts list, use the customer service contact information available online or send a written request by mail. Visit our website at <http://www.source1parts.com> to search for a part or browse the catalog, find a dealer or distributor, or find customer service contact information. To do so, select **Brand Links**, then select **Customer Service**. To contact us by mail, use the following address:

BHC Group Heating & Cooling
 Customer Relations
 5005 York Drive
 Normal, OK 73069

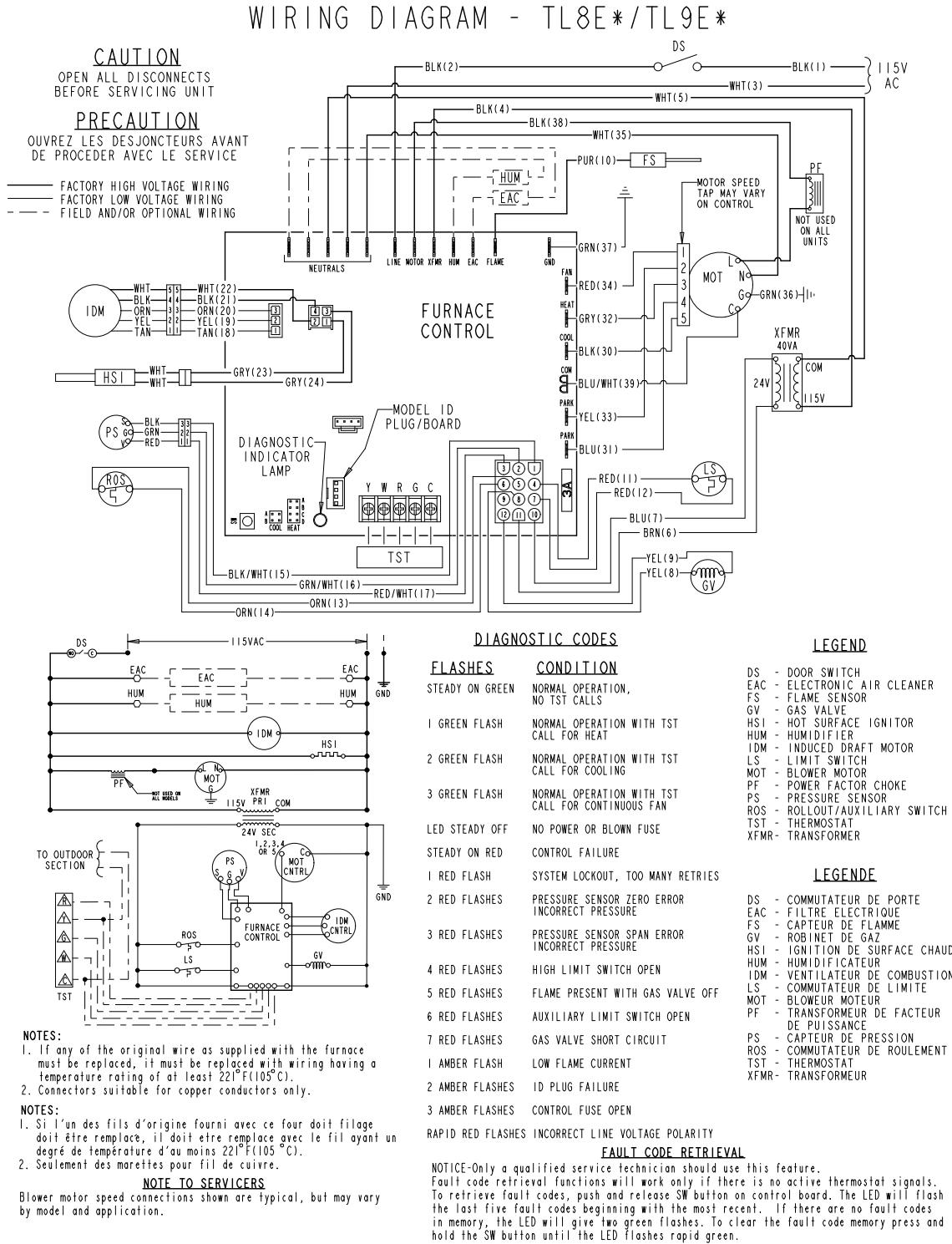
Third-party trademarks

Third-Party Trademarks Notice: For information about third-party trademarks, refer to the relevant company websites.

Wiring diagram

Note: Figure 24 applies to TL8E, TL9E, and RUF18 models.

Figure 24: Wiring diagram



Start-up sheet

33" 80% AFUE ECM Single Stage Ultra-Low NOx 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 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

Venting: B Vent

Vertical Termination Vent Pipe Size # of 90 Degree Ells # of 45 Degree Ells Total Height

Connector Size Connector Length

Horizontal Term. (with External Power Vent) Vent Pipe Size # of 90 Degree Ells # of 45 Degree Ells

Venting: Lined Masonry Chimney

B Vent Connector Single Wall Connector Connector Size Connector Length Chimney Height

of 90 Degree Ells # of 45 Degree Ells

Venting system is the proper size, within the limitations of the chart in the installation instructions, properly connected to the furnace, and properly pitched

Other appliances in same common vent:			
Water Heater	<input type="checkbox"/> BTUH Input <input style="width: 50px;" type="text"/>	Fan Assisted?	<input type="radio"/> Y <input type="radio"/> N
Furnace	<input type="checkbox"/> BTUH Input <input style="width: 50px;" type="text"/>	Fan Assisted?	<input type="radio"/> Y <input type="radio"/> N
Other	<input type="checkbox"/> BTUH Input <input style="width: 50px;" type="text"/>	Fan Assisted?	<input type="radio"/> Y <input type="radio"/> N

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	
Inlet Gas Pressure (in. w.c.) <input style="width: 50px;" type="text"/>	Manifold Gas Pressure (in. w.c.) <input style="width: 50px;" type="text"/> CO ₂ in Vent <input style="width: 50px;" type="text"/>
Calculated input in btuh - clock the gas meter (Nat Gas Only) <input style="width: 100px;" type="text"/>	CO in Vent <input style="width: 50px;" type="text"/>
Air Side: System External Static Pressure	
Supply static before indoor coil (in w.c.) <input style="width: 50px;" type="text"/>	Supply static after indoor coil (in w.c.) <input style="width: 50px;" type="text"/>
Return Static (in w.c.) before filter <input style="width: 50px;" type="text"/>	Return Static (in w.c.) after filter (furnace side) <input style="width: 50px;" type="text"/>
Total External Static Pressure <input style="width: 50px;" type="text"/>	
Air Side: Heating	
Heat Blower Speed Selected <input type="radio"/> 5-Red (Low) <input type="radio"/> 4-Yel (Med Lo) <input type="radio"/> 3-Gray (Med) <input type="radio"/> 2-Blue (Med High) <input type="radio"/> 1-Black (High)	
Temperature rise in degrees F <input style="width: 50px;" type="text"/>	
Air Side: Cooling	
Cool Blower Speed Selected <input type="radio"/> 5-Red (Low) <input type="radio"/> 4-Yel (Med Lo) <input type="radio"/> 3-Gray (Med) <input type="radio"/> 2-Blue (Med High) <input type="radio"/> 1-Black (High)	
Cooling CFM delivery (use Blower Performance Data Chart) <input style="width: 50px;" type="text"/>	
Air Side: Continuous Fan	
Blower Speed Selected <input type="radio"/> 5-Red (Low) <input type="radio"/> 4-Yel (Med Lo) <input type="radio"/> 3-Gray (Med) <input type="radio"/> 2-Blue (Med High) <input type="radio"/> 1-Black (High)	
Cycle Test	
<input type="checkbox"/> Operate the furnace through several heating cycles from the thermostat, noting and correcting any problems	
<input type="checkbox"/> Operate the furnace through continuous fan cycles from the thermostat, noting and correcting any problems	
<input type="checkbox"/> Operate the furnace through cooling cycles (as applicable), noting and correcting any problems	
Clean Up	
<input type="checkbox"/> Installation debris disposed of and furnace area cleaned up?	
Owner Education	
<input type="checkbox"/> Give owner the owner's manual provided	
<input type="checkbox"/> Explain operation of system to equipment owner	
<input type="checkbox"/> Explain the importance of regular filter replacement and equipment maintenance	
<input type="checkbox"/> Explain thermostat use and programming (if applicable) to owner	
Additional Job Detail	
<div style="border: 1px solid black; width: 100%; height: 100%;"></div>	