

INSTALLATION MANUAL

SINGLE-STAGE ECM RESIDENTIAL GAS FURNACES

MODELS: TL8E

80% Upflow/Horizontal - Ultra-Low NOx
Natural Gas Only



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These high efficiency, compact 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.

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

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

SECTION I: SAFETY



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

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

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

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

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

⚠ WARNING

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

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

SPECIFIC SAFETY RULES AND PRECAUTIONS

- Only Natural gas is approved for use with this furnace.
- Install this 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 SECTION VI: VENT SYSTEM of these instructions.
- Test for gas leaks as specified in these instructions.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

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

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

- 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 a duct or 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 on-site, 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 can be used.
- When moving or handling this 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 the furnace by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.
- 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, because the tubes can shift out of position or their location brackets/baffles.

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

SAFETY REQUIREMENTS

⚠ CAUTION

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

- Refer to the unit rating plate for the furnace model number, and then see Figure 6 for return air plenum dimensions. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed in Table 1.
- Provide clearances for servicing, ensuring that service access is allowed for both the burners and blower.
- These models **are not** CSA listed or approved for installation in 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 be 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.

COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

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
- Near chemical storage areas
- 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
- Deicing salts or chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- 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 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.

CODES AND STANDARDS

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

In the United States and Canada, follow all codes and standards 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/CGA-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:
National Fire Protection Association Inc.
Batterymarch Park
Quincy, MA 02269
or for only the NFGC, contact:
American Gas Association,
400 N. Capital, N.W.
Washington DC 20001
or www.NFPA.org
- CANADA: NSCNGPIC. For a copy, contact:
Standard Sales, CSA International
178 Rexdale Boulevard
Etobicoke, (Toronto) Ontario Canada M9W 1R5

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 1 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.

INSPECTION

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

FURNACE LOCATION AND CLEARANCES

Locate the furnace using the following guidelines:

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

Installation in freezing temperatures:

- Install the furnace in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions.

⚠ WARNING

Improper installation in an ambient below 32°F (0°C) could create a hazard, resulting in damage, injury, or death.

- Do not allow the return air temperature to be below 55°F (13°C) for extended periods. To do so can cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.

Clearances for access/service:

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

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

Installation in a residential garage:

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

Table 1: Unit Clearances to Combustibles (All Dimensions in Inches, and All Surfaces Identified with the Unit in an Upflow Configuration)

Application	Top	Front	Rear	Left Side	Right Side	Flue	Floor/Bottom	Closet	Alcove	Attic	Line Contact
	in. (cm)	in. (cm)	in. (cm)	in. (cm)	in. (cm)	in. (cm)					
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 ¹
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

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

SECTION II: DUCTWORK

DUCTWORK GENERAL INFORMATION

The duct system's design and installation must:

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

⚠ CAUTION

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

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

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

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

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

⚠ WARNING

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

Refer to Table 4 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.

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

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

DUCT FLANGES

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

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

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

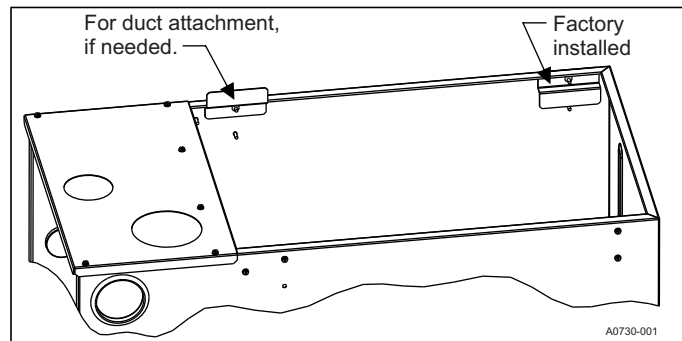


Figure 1: Duct Attachment

DUCTWORK INSTALLATION AND SUPPLY PLENUM CONNECTION



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

COIL INSTALLATION

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

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

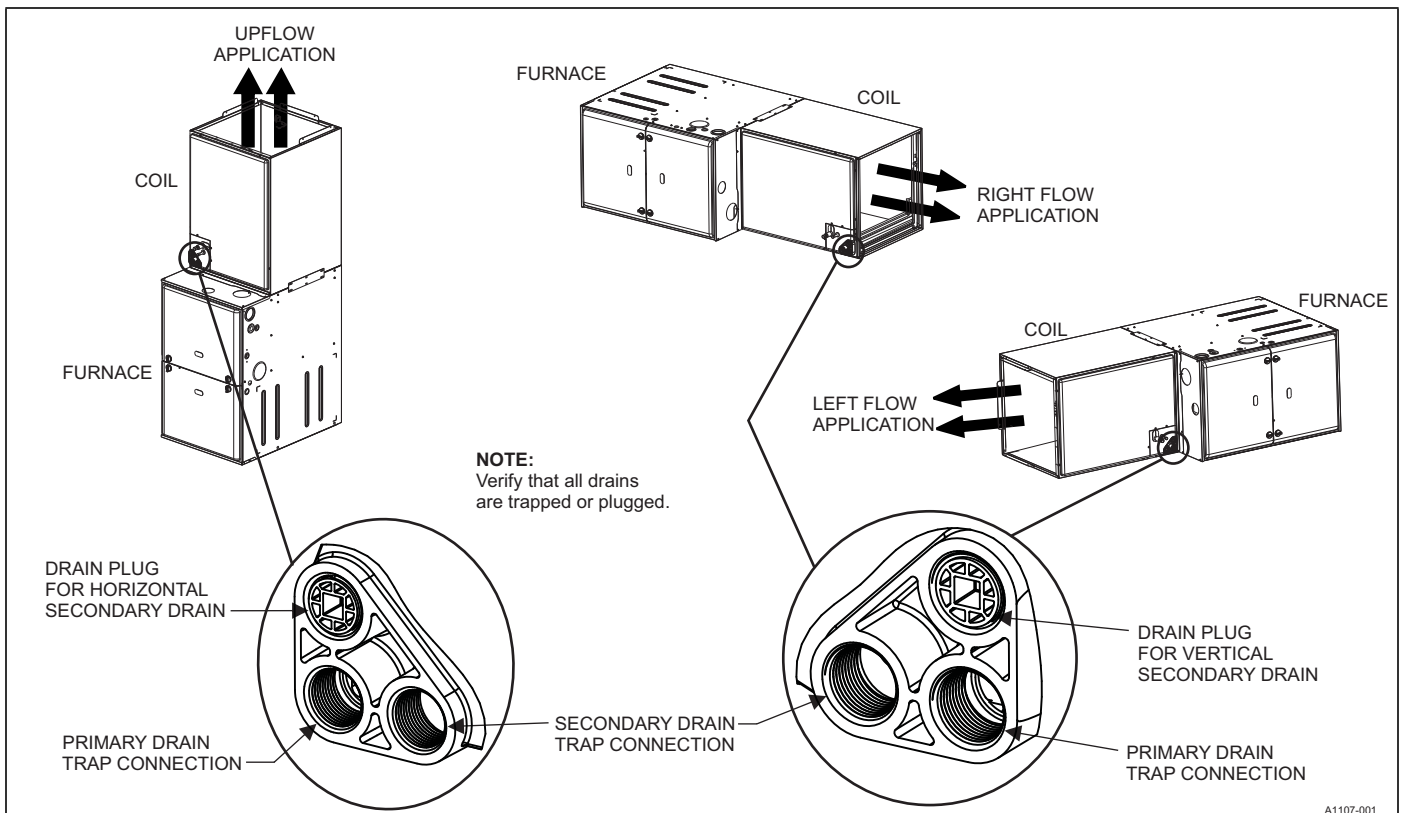


Figure 2: Furnace and Coil Attachment

RESIDENTIAL AND MODULAR HOME UPFLOW RETURN PLENUM CONNECTION

Return air can enter the furnace through the sides or bottom, depending on the type of application. Return air must not be connected into the rear panel of the unit.

SIDE RETURN APPLICATION

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

BOTTOM RETURN AND ATTIC INSTALLATIONS

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

The internal bottom panel must be removed for this application.

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

HORIZONTAL APPLICATION

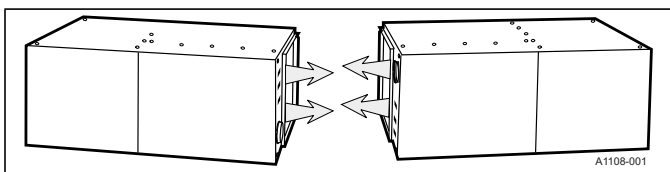


Figure 3: Horizontal Application

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

ATTIC INSTALLATION

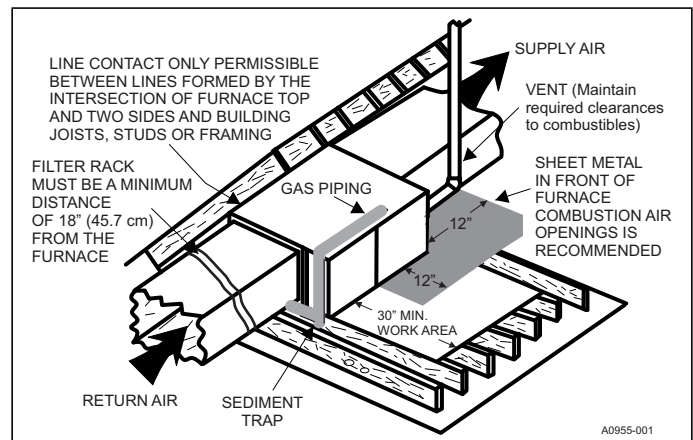


Figure 4: Typical Attic Installation

This appliance is certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs, or framing. This line can be in contact with combustible material. Refer to Figure 4.

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

⚠ 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.

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, support the ends of the furnace rather than lifting the furnace by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.

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

SUSPENDED FURNACE/CRAWL SPACE INSTALLATION

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

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

All six suspension points must be level to ensure proper and quiet furnace operation. When suspending the furnace, use a secure platform constructed of plywood or other building materials secured to the floor or ceiling joists. Refer to Figure 5 for details and additional information.

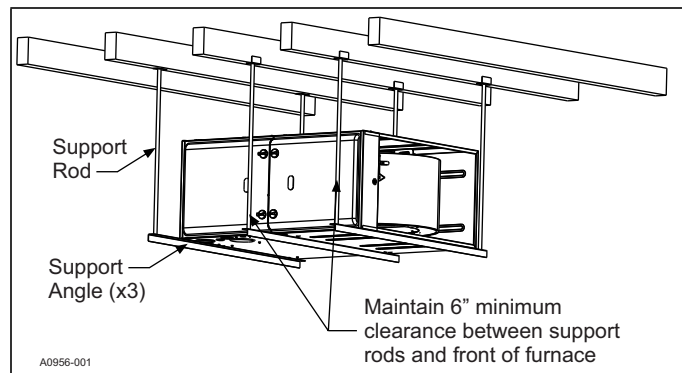


Figure 5: Typical Suspended Furnace / Crawl Space Installation

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

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

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

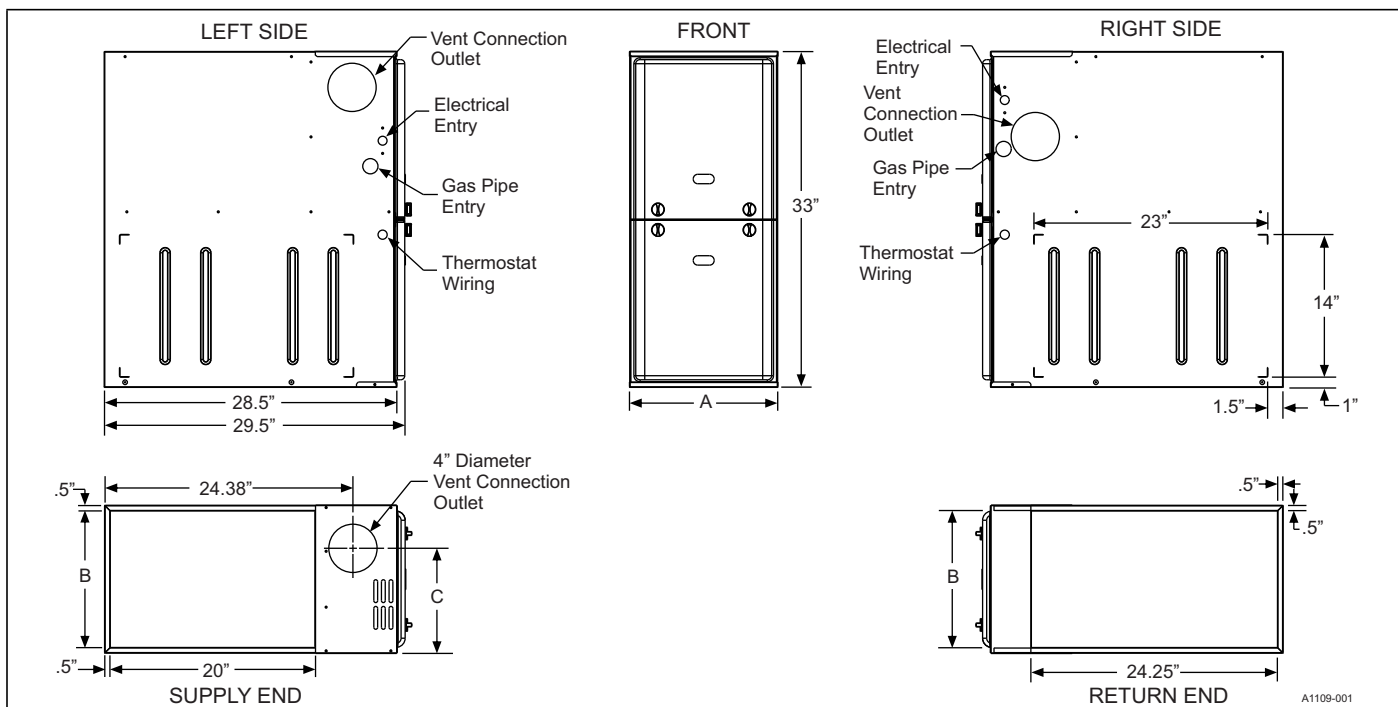


Figure 6: Dimensions

Table 2: Cabinet and Duct Dimensions

BTUH (kW) Input	Nominal CFM (m ³ /min)	Cabinet Size	Cabinet Dimensions (in.)						Approximate Operating Weights
			A	A (cm)	B	B (cm)	C	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

SECTION III: FILTERS

FILTER INSTALLATION

⚠ CAUTION

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

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

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

NOTICE

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

Table 3: Recommended 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

Notes:

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

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

SIDE RETURN

Locate the L shaped corner locators. These indicate the size of the cutout to be made in the furnace side panel. Refer to Figure 7.

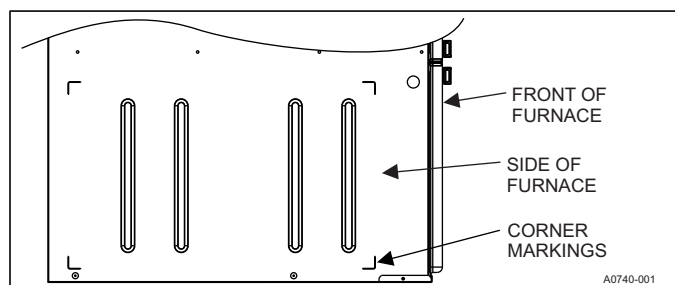


Figure 7: Side Return Cutout Markings

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

IMPORTANT: Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with that accessory for side opening requirements. Do not cut the opening larger than the dimensions shown in Figure 6.

HORIZONTAL FILTERS

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

SECTION IV: GAS PIPING

GAS SAFETY

⚠ DANGER

An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 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.

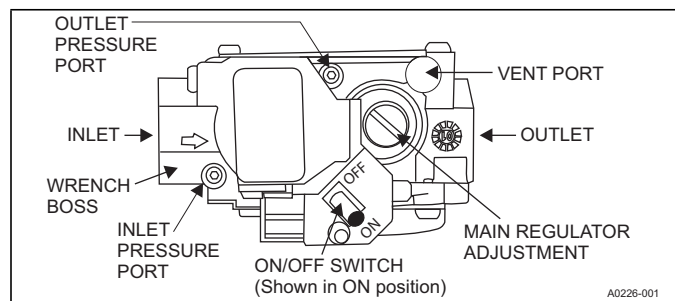


Figure 8: Gas Valve

IMPORTANT: Plan your gas supply before determining the correct gas pipe entry. Use 90-degree service elbows, or short nipples and conventional 90-degree elbows to enter through the cabinet access holes.

GAS PIPING INSTALLATION

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

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. Refer to Figure 9.

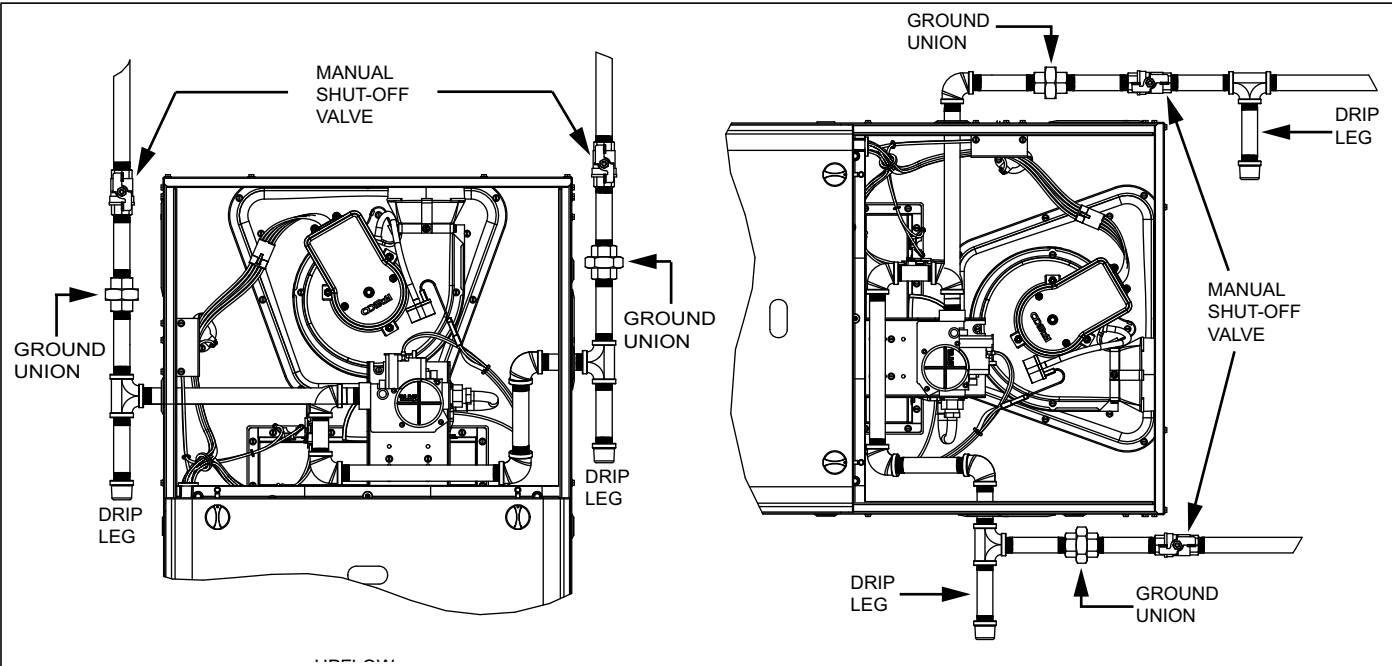


Figure 9: Gas Piping

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

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (3.5 kPa).

Gas piping can be connected from either side of the furnace using either of the gas pipe entry locations shown in Figures 6 and 9.

⚠ 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.

HIGH ALTITUDE

This furnace is constructed at the factory for natural gas-fired operation at 0 to 5,000 ft (0 to 1,524 m) above sea level.

SECTION V: ELECTRICAL POWER

ELECTRICAL POWER CONNECTIONS

Field wiring to the unit must be grounded. Electric wires that are field installed must conform to the temperature limitation for 63°F (35°C) rise wire specified in these instructions. Refer to Table 4 in these instructions for specific furnace electrical data.

The residential supply must have a bonded neutral.

⚠ CAUTION

Use copper conductors only.

Table 4: Ratings and Physical/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

Notes:
Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE test procedures.
Wire size and overcurrent protection must comply with the National Electrical Code (NFPA-70-latest edition) and all local codes.
The furnace must be installed so the electrical components are protected from water.

SUPPLY VOLTAGE CONNECTIONS

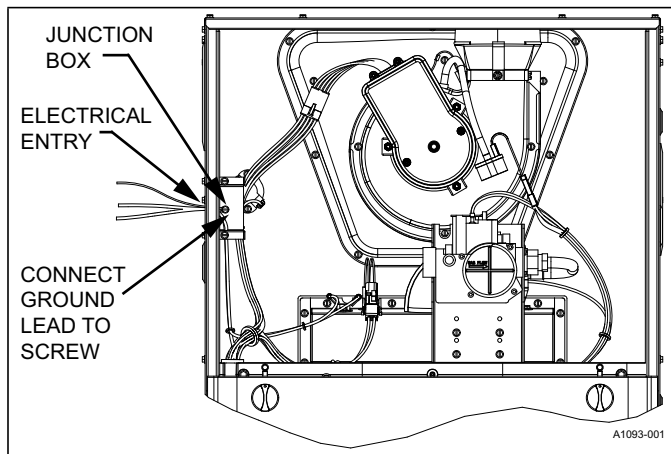


Figure 10: Electrical Wiring

1. Provide a power supply separate from all other circuits. Install over-current protection and disconnect switch per local/national electrical codes. The switch must be close to the unit for convenience in servicing. With the disconnect or fused switch in the OFF position, check all wiring against the unit wiring label. Refer to the wiring diagram in this instruction.
2. Remove the screws retaining the wiring box cover. Route the power wiring through the opening in the unit into the junction box with a conduit connector or other proper connection. In the junction box, there are two wires: a black wire and a white wire. Connect the power supply as shown on the unit-wiring label on the inside of the blower compartment door or the wiring schematic in this section. The black furnace lead must be connected to the L1 (hot) wire from the power supply. The white furnace screw must be connected to neutral. Connect the power supply ground to the green screw (equipment ground). An alternate wiring method is to use a field provided 2 in. (5.1 cm) x 4 in. (10.1 cm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel.

After making the wiring connections, replace the wiring box cover and screws. Refer to Figure 10.

3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. Refer to Figure 10.

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

LOW VOLTAGE CONTROL WIRING CONNECTIONS

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the low-voltage terminal block on the integrated furnace control board, as shown in Figures 11, 12, and 13. Electronic thermostats require the common wire to be connected. Apply strain relief to thermostat wires passing through the cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the furnace control board to the proper wires on the outdoor unit.

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

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

The 24-V, 40-VA transformer is sized only for the furnace components, and must not be connected to power auxiliary devices such as humidifiers and air cleaners. The transformer can provide power for a split system air conditioner or heat pump.

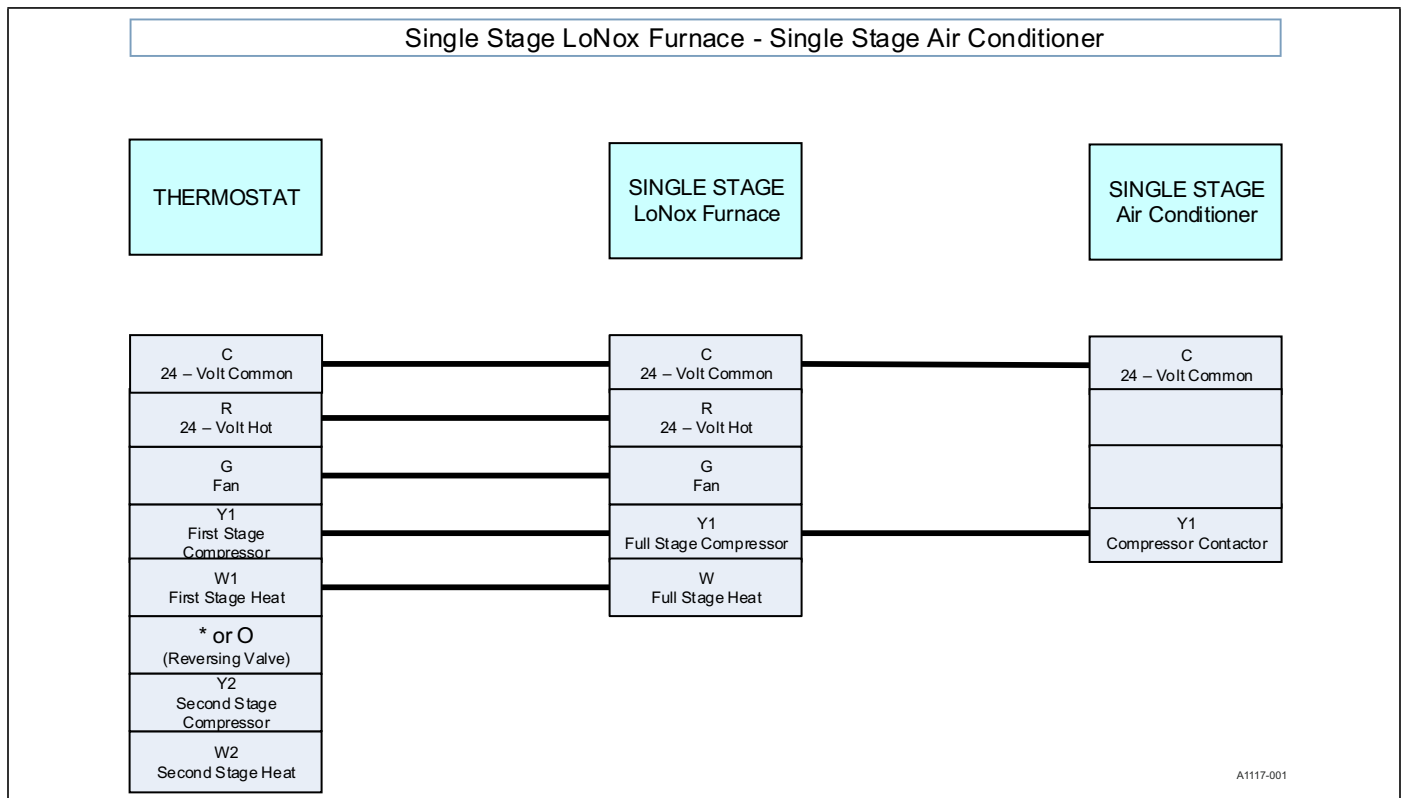


Figure 11: Thermostat Chart - Single Stage AC with Single Stage Furnaces

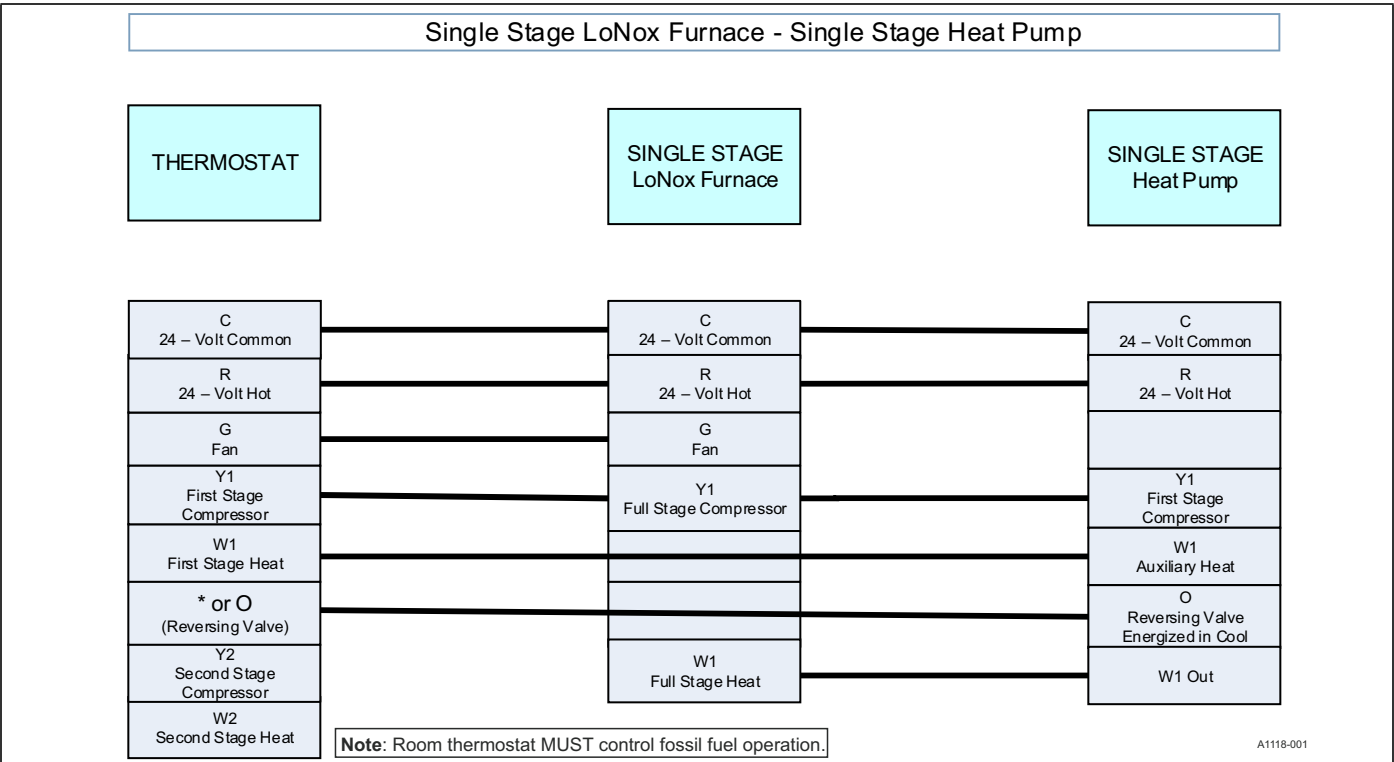


Figure 12: Thermostat Chart - Single Stage HP with Single Stage Furnaces

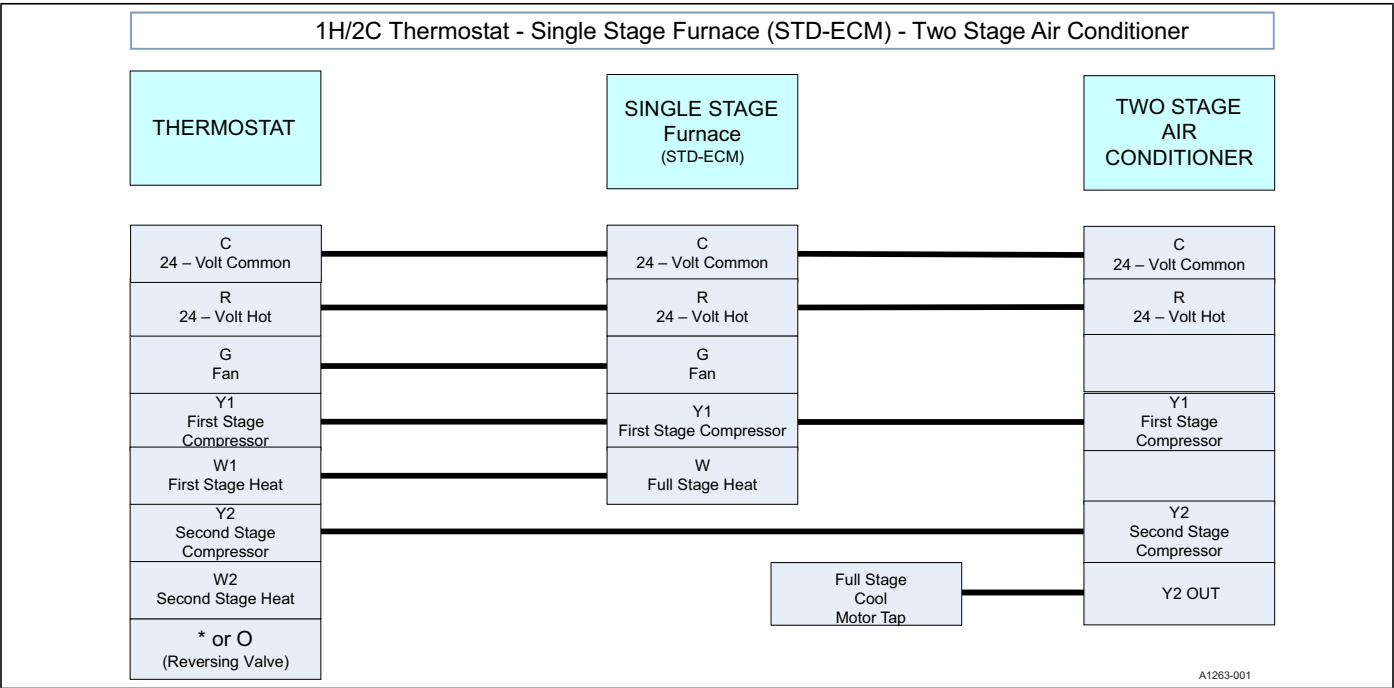


Figure 13: Thermostat Chart - 1H/2C - Single Stage Furnace (STD-ECM) - Two Stage Air Conditioner

ACCESSORY CONNECTIONS

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

ELECTRONIC AIR CLEANER CONNECTION

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

HUMIDIFIER CONNECTION

Two 1/4 in. (6.4 mm) spade terminals (HUM and NEUTRAL) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 A maximum) during heating system operation. A mounting hole is provided on the control panel next to the furnace control board for mounting a humidifier transformer if required.

TWINNING

These furnaces are not to be twinned. If more than one furnace is needed in an application, each furnace must have its own complete duct system and its own wall thermostat.

SECTION VI: VENT SYSTEM

VENT CONNECTIONS

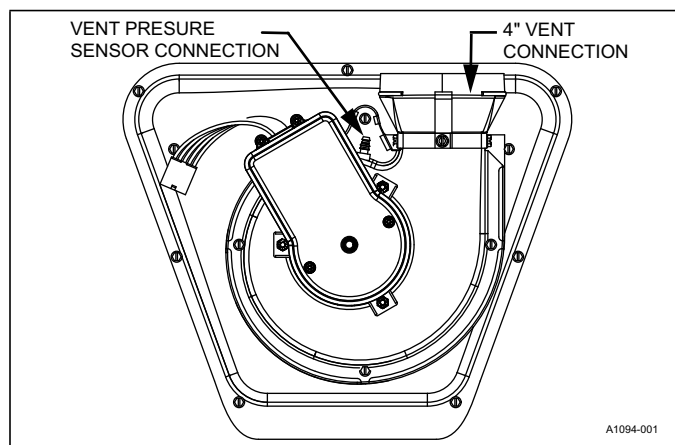


Figure 14: Combustion Air Inducer

All models are provided with a flue transition that is sized for 4-in. diameter vent connections. If a larger size vent connector is required, that connection must be installed external to the furnace. Figure 14 shows the furnace as it is shipped from the factory.

CATEGORY 1 - 450 F. MAX. VENT TEMPERATURE

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 can 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 resists 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 S1-1CK0604 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 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.

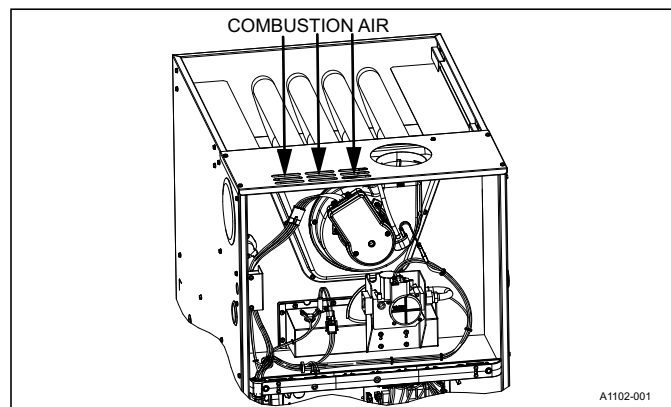


Figure 15: Combustion Airflow Path Through the Furnace Casing to the Burner Compartment

⚠ 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/hr (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/hr (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.

Louvers, Grilles, and Screens

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, refer to Table 5 to estimate free area.

Table 5: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20–25%* Metal 60–70% *
Screens+	1/4 in. (0.635 cm) mesh or larger 100%

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

+ Free area of louvers and grille varies widely. Follow the louver or grille manufacturer's instructions.

Dampers, Louvers, Grilles, and Screens (Canada Only)

- 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, grille, or screen must have no dimension smaller than 1/4 in. (6.4 mm).
- A manually operated damper or manually adjustable louvers are not permitted for use.
- An automatically operated damper or automatically adjustable louvers must be interlocked so that the main burner can not 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 6: Unconfined Space Minimum Area

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

Table 7: Free Area

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

Example: Determining Free Area.

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

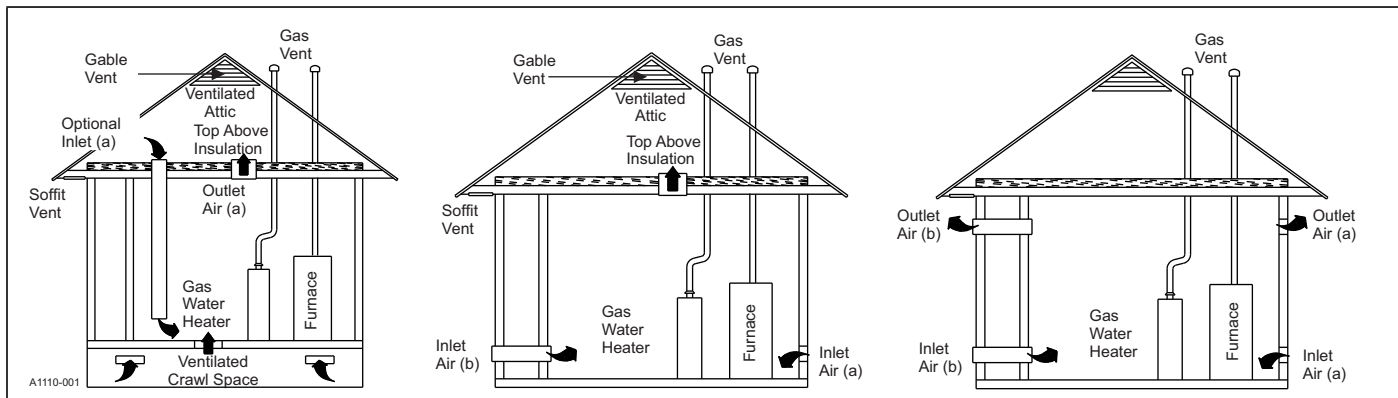


Figure 16: Ambient Combustion Air

Air Supply Openings and Ducts

- An opening can be used in lieu of a duct to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening must be located within 12 in. (30.5 cm) horizontally from the burner level of the appliance. See the Combustion Air Source from Outdoors section and the Vent and Supply (Outside) Air Safety Check Procedure section for additional information and the 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 in² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimension must not be less than 3 in. (7.6 cm).

- 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. (30.5 mm) of the top and one within 12 in. (30.5 mm) 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. (30.5 cm) of the top of the enclosure, is permitted where the equipment has clearances of at least 1 in. (2.54 cm) from the sides and back of the appliance and 6 in. (15.24 cm) from the front of the appliance. The opening must communicate directly with the outdoors and have a minimum free area of:
 - 1 in.²/3,000 BTU/hr (700mm²/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, refer to Table 5 to estimate free area.

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 the Combustion Air Source from Outdoors section in this manual or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type of installation requires two correctly sized pipes. One pipe brings combustion air from a correctly ventilated attic space or crawl space and 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 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 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. (-0.025 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.

SECTION VII: START-UP AND ADJUSTMENTS

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

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

Instructions on how to perform each of these required installation checks are listed in the sections below.

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

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

GAS PIPING LEAK CHECK

⚠ WARNING**FIRE OR EXPLOSION HAZARD**

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

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

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

When the gas supply is first connected to the furnace, loosen the ground union until the odor of gas is detected. When gas is detected, immediately tighten the union and check for gas leaks. Allow 5 min for any gas to dissipate before continuing with the start-up procedure. Make sure that proper ventilation is available to dilute and carry away any vented gas.

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

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

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

IGNITION CHECK

This furnace lights reliably and without undue ignition noise if the gas-air mixture in the burner is correct. In most cases, it is not necessary to make any adjustments to the factory settings. However, 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., you may have abnormally low gas heating value and it is necessary to change the main gas orifice to a larger size.

IGNITION SYSTEM SEQUENCE

1. Turn the gas supply ON at external valve and main gas valve.
2. Set the thermostat above room temperature to call for heat.
3. System start-up occurs 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.

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

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

CALCULATING THE FURNACE INPUT

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.

Verify natural gas input rate by clocking meter.

1. Turn off all other gas appliances and pilots.
2. Run the furnace for a minimum of 3 min in heating operation.
3. Measure time (in seconds) for gas meter to complete one revolution and note reading. The 2 cubic feet dial provides a more accurate measurement of gas flow.
4. Refer to Table 8 for cubic feet of gas per hour.
5. Multiply cubic feet per hour by heating value (BTU/cu. ft) to obtain input.

If clocked rate does not match the input rate from the unit nameplate, follow the steps in the next section to adjust the manifold pressure. Repeat Steps 2 to 5 until correct input is achieved.

⚠ CAUTION

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

Table 8: Gas Rate (CU FT/HR)

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

ADJUSTMENT OF MANIFOLD GAS PRESSURE AND INPUT RATE

Inlet and manifold gas pressure can be measured by connecting the U tube manometer to the gas valve with a piece of tubing. Follow the appropriate section in the instructions below. Refer to Figure 17 for an illustration of the locations of the pressure ports on the gas valve.

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

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

Read the inlet gas pressure

Connect the positive side of the manometer to the IN P tap on the gas valve. Do not connect any tubing to the negative side of the manometer, because it references atmospheric pressure. Refer to Figure 18 for connection details.

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

Table 9: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Minimum*	Maximum
Natural Gas	4.5 in. W.C. (1.12 kPa)	10.5 in. W.C. (2.61 kPa)

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

- 7 in. W.C. (1.74 kPa)

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

2. When the correct gas inlet pressure has been established (see Table 9), turn the gas valve to OFF and turn the electrical supply switch to OFF. Remove the flexible tubing from the gas valve pressure tap and tighten the pressure tap plug using the 3/32 in. (2.4 mm) hex head wrench.
3. Turn on the electrical and gas supplies, and with the burners in operation, check for gas leakage around the gas valve pressure port using an approved non-corrosive gas leak detection fluid or other non-flammable leak detection methods.

Read the manifold gas pressure

Connect the positive side of the manometer to the OUT P tap on the gas valve. Do not connect any tubing to the negative side of the manometer, because it references atmospheric pressure. Refer to Figure 18 for connection details.

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

1. Refer to Figure 17 for location of pressure regulator adjustment cap and adjustment screws on main gas valve.
2. Turn on gas and electrical supplies and follow the operating instructions to place the unit back in operation.

3. Adjust manifold pressure by adjusting gas valve regulator screw for the appropriate gas per the following:

Table 10: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas	3.5 in. W.C. (0.87 kPa)

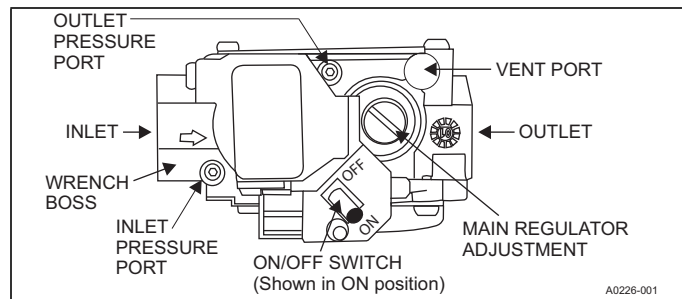


Figure 17: Gas Valve

IMPORTANT: If gas valve regulator is turned in (clockwise), manifold pressure increases. If screw is turned out (counter clockwise), manifold pressure decreases.

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

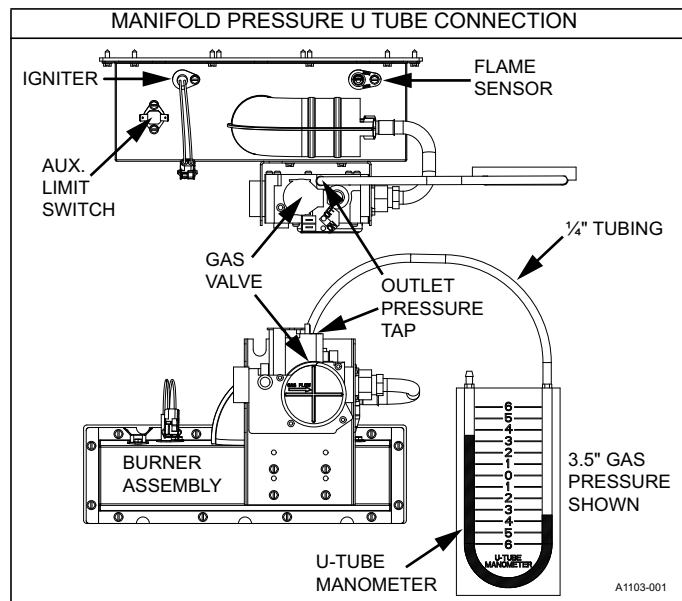


Figure 18: Reading Gas Pressure

ADJUSTMENT OF TEMPERATURE RISE

⚠ DANGER

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

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

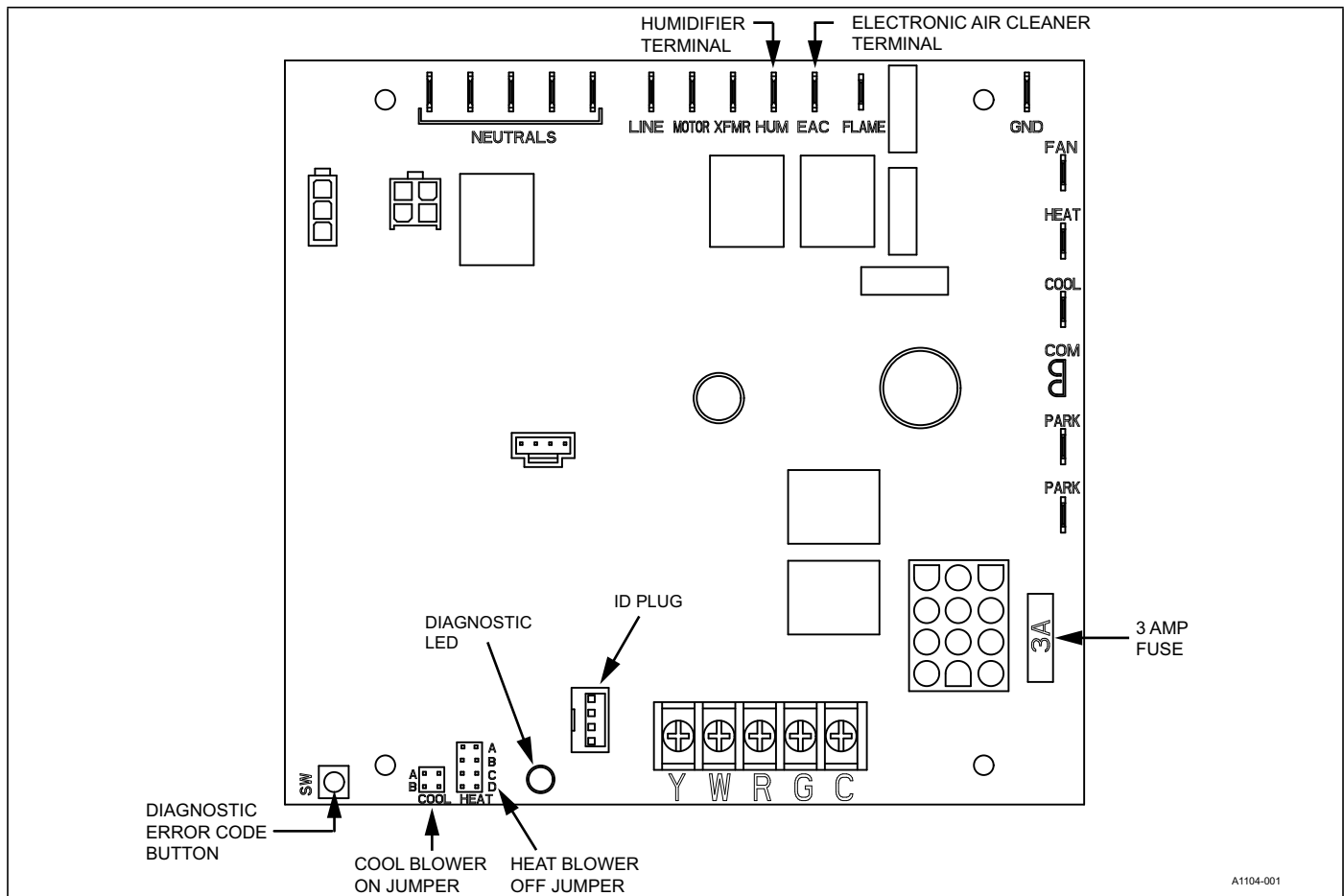
After about 5 min of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts about 6 ft (1.83 m) from the furnace, where they are not affected by radiant heat. Increase the blower speed to decrease the temperature rise. Decrease the blower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

This furnace has a standard ECM motor. The blower motor speed taps are located on the furnace control board in the blower compartment. Refer to Figure 19 and the unit wiring label to change the blower speed. Place all unused motor leads on the PARK terminals. Two PARK terminals are provided. To use the same speed tap for heating and cooling, the terminals must be jumpered together. This control changes blower speeds based on other 24-V thermostat inputs (Y, W) respectively.

ADJUSTMENT OF FAN CONTROL SETTINGS

The furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 s. The fan off delay has four settings (A = 60 s, B = 90 s, C = 120 s, D = 180 s). The fan off delay is factory set to 120 s. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan off timing can be adjusted by positioning the jumper on two of the four pins as shown in Figure 19.

The furnace is also equipped with a cooling fan on time delay. The cooling fan on delay has two settings (A = 6 s, B = 24 s). The cooling fan on delay can be adjusted by positioning the COOL jumper as shown in Figure 19.



A1104-001

Figure 19: Furnace Control Board

Table 11: Blower Performance CFM - Any Position (Without Filter)

Models	Speed	Airflow Data (SCFM) ^{1, 2}							
		External Static Pressure (in. H ₂ O)							
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
060A12	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
080C16	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
100C20	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. Airflow expressed in standard cubic feet per minute (SCFM).

2. Motor voltage at 115 V.

SECTION VIII: SAFETY CONTROLS

CONTROL CIRCUIT FUSE

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

BLOWER DOOR SAFETY SWITCH

⚠ CAUTION

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

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

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

AUXILIARY LIMIT SWITCH

The switch is mounted on the burner assembly. If the temperature in 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

This furnace is supplied with a pressure sensor, which monitors the flow through the combustion air/vent piping system.

LIMIT CONTROLS

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

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

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

SECTION IX: OPERATION AND DIAGNOSTICS

SEQUENCE OF OPERATION

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

Continuous Blower

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the ON position, the thermostat circuit is completed between terminals R and G. The motor operates continuously on the speed tap wire that is connected to the FAN terminal on the furnace control board. To obtain a different circulating fan (continuous blower) speed, change the wire connected to the FAN connection with one of the speed tap wires located on the PARK terminals.

Intermittent Blower - Cooling

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

Heating Cycle

When the thermostat switch is set on HEAT and the fan is set on AUTO, and there is a call for heat, a circuit is completed between terminals R and W of the thermostat. 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 furnace operation continues until the thermostat circuit between R and W is opened, which causes the ignition system and gas valve to de-energize and the burner flames to be extinguished. The vent motor operates for 15 s and the blower motor operates for the amount of time set by the fan-off delay jumper located on the control board. See Figure 19. The heating cycle is now complete, and ready for the start of the next heating cycle.

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

A momentary loss of gas supply, 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 control begins a recycle operation. A normal ignition sequence begins after a 15-s inter-purge. If during the five recycles the gas supply does not return, or the fault condition is not corrected, the ignition control locks out for 60 min.

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

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.

TROUBLESHOOTING

Make the following visual checks before troubleshooting:

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

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 UPG Source 1 Parts. Never adjust pressure switch to allow furnace operation.

FURNACE CONTROL DIAGNOSTICS

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

The flash codes listed below have the following timing: the LED light turns on for 1/4 s and turns 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, the 6 Red Flashes code means the LED light flashes on and off six times and then remains off for 1.5 s. This pattern repeats as long as the fault condition remains.

Steady on Green: Indicates normal operation with no thermostat calls.

1 Green Flash: Indicates normal operation with a thermostat call for heat.

2 Green Flashes: Indicates normal operation with a thermostat call for cooling.

3 Green Flashes: Indicates normal operation with a thermostat call for continuous fan.

LED Steady Off: If the LED light 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 a control failure. Turn off the power to the furnace and turn on the power to the furnace 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.

2 Red Flashes: Indicates a pressure switch 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 switch span error. The pressure sensor is not sensing the correct pressure. Check for the following:

- Faulty inducer
- Blocked vent pipe
- Broken pressure sensor hose
- Disconnected pressure sensor or inducer wires
- Faulty pressure sensor

4 Red Flashes: Indicates the high limit switch is open. The main limit switch has opened its normally closed contacts. The control operates the supply air blower and inducer while the open limit condition exists. Check for the following:

- Dirty filter
- Incorrectly sized duct system
- Incorrect blower speed setting
- Incorrect firing rate
- Loose limit switch wiring
- Faulty blower motor

If the main limit switch opens five times within a single call for heat, the control indicates 4 Red Flashes and enters a 1-h soft lockout.

5 Red Flashes: Indicates flame is present with the gas valve off. The control board has sensed a flame during a period when the gas valve is not supposed to be open. Check for miswiring. The control 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.

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 control board has sensed that the gas valve circuit is shorted. Check for miswiring of the gas valve or a shorted gas valve wire.

1 Amber Flash: Indicates low flame current. The flame current being sensed by the flame sensor has dropped below the normal level. The furnace 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 furnace 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 is unable to detect the ID plug. The furnace does not operate correctly without the correct ID plug installed.

3 Amber Flashes: Indicates the control fuse is open. The low-voltage fuse on the control board has opened or is missing.

Rapid Red Flashes: Indicates incorrect line voltage polarity. The polarity of the incoming power to the furnace is reversed.

Soft Lockout: The control includes a soft lockout that resets automatically after 1 h. This provides protection to an unoccupied structure if a temporary condition causes a furnace malfunction, for example, if a temporary interruption in gas supply prevents the furnace from lighting. The control keeps trying to light each hour and resumes normal operation if the gas supply is restored.

Hard Lockout: Some fault conditions result in a hard lockout, and you must turn off the power to the control and turn on the power to the control again to reset the control. The control does not automatically restart.

IGNITION CONTROL FLAME SENSE LEVELS

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

DIAGNOSTIC FAULT CODE STORAGE AND RETRIEVAL

The control in the furnace is equipped with memory that stores up to five error codes to allow a service technician to diagnose problems more easily. This memory is retained even if power to the furnace is lost.

Note: This feature must only be used by a qualified service technician.

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

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

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

SECTION X: REPLACEMENT PARTS LIST

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 w/WHEEL
WHEEL, BLOWER
FABRICATED PARTS
BAFFLE, FLUE
BURNER, MAIN GAS
SHELF, BLOWER
RAIL, BLOWER (2 required)

DESCRIPTION (Continued)
FABRICATED PARTS
BRACKET, BLOWER TRACK (2 required)
HEAT EXCHANGER ASSEMBLY
PAN, BOTTOM
PANEL, TOP
PANEL, DOOR (2 required)
VENT PAN, COMBUSTION (w/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)

REPLACEMENT PART CONTACT INFORMATION

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

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

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

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

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

SECTION XI: WIRING DIAGRAM

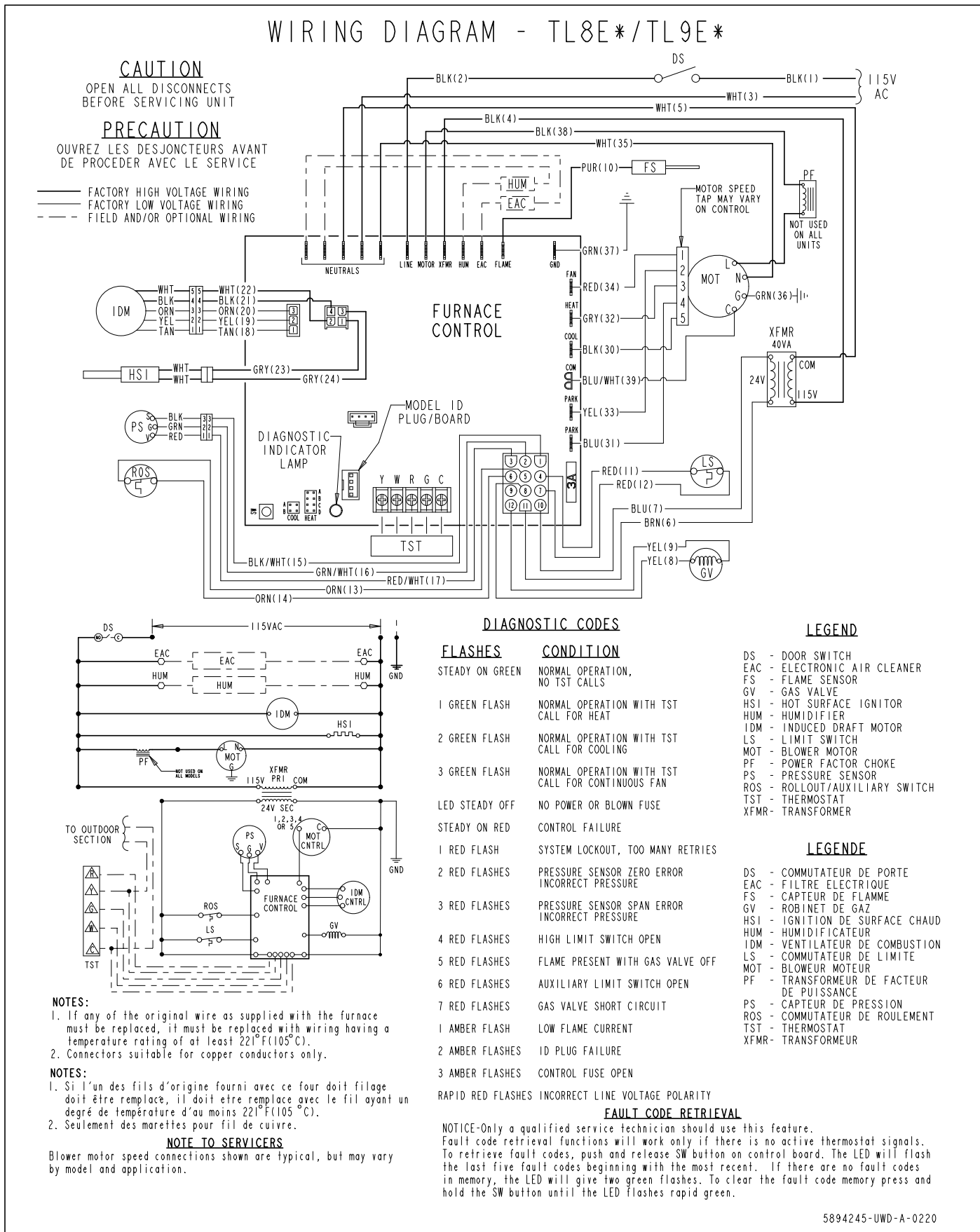


Figure 20: Wiring Diagram

SECTION XII: 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 ☐ BTUH Input Fan Assisted? ☐ Y ☐ NFurnace ☐ BTUH Input Fan Assisted? ☐ Y ☐ NOther ☐ BTUH Input Fan Assisted? ☐ Y ☐ 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 SideInlet Gas Pressure (in. w.c.) Manifold Gas Pressure (in. w.c.) CO₂ in Vent Calculated input in btuh - clock the gas meter (Nat Gas Only) CO in Vent **Air Side: System External Static Pressure**Supply static before indoor coil (in w.c.) Supply static after indoor coil (in w.c.) Return Static (in w.c.) before filter Return Static (in w.c.) after filter (furnace side) Total External Static Pressure **Air Side: Heating**Heat Blower Speed Selected ☐ 5-Red (Low) ☐ 4-Yel (Med Lo) ☐ 3-Gray (Med) ☐ 2-Blue (Med High) ☐ 1-Black (High)Temperature rise in degrees F **Air Side: Cooling**Cool Blower Speed Selected ☐ 5-Red (Low) ☐ 4-Yel (Med Lo) ☐ 3-Gray (Med) ☐ 2-Blue (Med High) ☐ 1-Black (High)Cooling CFM delivery (use Blower Performance Data Chart) **Air Side: Continuous Fan**Blower Speed Selected ☐ 5-Red (Low) ☐ 4-Yel (Med Lo) ☐ 3-Gray (Med) ☐ 2-Blue (Med High) ☐ 1-Black (High)**Cycle Test**

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

Clean Up

- ☐ Installation debris disposed of and furnace area cleaned up?

Owner Education

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

Additional Job Detail