Installation, Start-up, Operating and Service and Maintenance Instructions

NOTE: Read the entire instruction manual before starting the installation.

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Required Notice for Massachusetts Installations

IMPORTANT

The Commonwealth of Massachusetts requires compliance with regulation 248 CMR as follows:
5.08: Modifications to NFPA-54, Chapter 10
2) Revise 10.8.3 by adding the following additional requirements:
   a. For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

   1. INSTALLATION OF CARBON MONOXIDE DETECTORS. At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.
      a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
      b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

   2. APPROVED CARBON MONOXIDE DETECTORS. Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

   3. SIGNAGE. A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".

   4. INSPECTION. The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

   5. EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4:
      (1.) The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and
      (2.) Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

   c. MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM PROVIDED. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:
      1. Detailed instructions for the installation of the venting system design or the venting system components; and
      2. A complete parts list for the venting system design or venting system.

   d. MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies “special venting systems”, the following requirements shall be satisfied by the manufacturer:
      1. The referenced “special venting system” instructions shall be included with the appliance or equipment installation instructions; and
      2. The “special venting systems” shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

   e. A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

For questions regarding these requirements, please contact the Commonwealth of Massachusetts Board of State Examiners of Plumbers and Gas Fitters, 239 Causeway Street, Boston, MA 02114. 617-727-9952.
SAFETY CONSIDERATIONS

⚠️ WARNING

FIRE, EXPLOSION, ELECTRICAL SHOCK, AND CARBON MONOXIDE POISONING HAZARD

Failure to follow this warning could result in dangerous operation, personal injury, death, or property damage.

Improper installation, adjustment, alteration, service, maintenance, or use can cause carbon monoxide poisoning, explosion, fire, electrical shock, or other conditions which may cause personal injury or property damage. Consult a qualified service agency, local gas supplier, or your distributor or branch for information or assistance. The qualified service agency must use only factory-authorized and listed kits or accessories when modifying this product.

⚠️ WARNING

FIRE HAZARD

Failure to follow this warning could result in personal injury, death, or property damage.

Solvents, cements and primers are combustible. Keep away from heat, sparks and open flame. Use only in well-ventilated areas. Avoid breathing in vapor or allowing contact with skin or eyes.

⚠️ CAUTION

FURNACE RELIABILITY HAZARD

Failure to follow this caution may result in unit component damage.

Application of this furnace should be indoors with special attention given to vent sizing and material, gas input rate, air temperature rise, unit leveling, and unit sizing.

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause death, personal injury, or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory-authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing.

Installing and servicing heating equipment can be hazardous due to gas and electrical components. Only trained and qualified personnel should install, repair, or service heating equipment. Untrained personnel can perform basic maintenance functions such as cleaning and replacing air filters. All other operations must be performed by trained service personnel. When working on heating equipment, observe precautions in literature, on tags, and on labels attached to or shipped with furnace and other safety precautions that may apply.

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 may not have kept up with changing residential construction practices. We require these instructions as a minimum for a safe installation.

Follow all safety codes. Wear safety glasses, protective clothing, and work gloves. Have a fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit.

⚠️ CAUTION

CUT HAZARD

Failure to follow this caution may result in personal injury. Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing, safety glasses and gloves when handling parts, and servicing furnaces.

This is the safety-alert symbol ⚠️. When you see this symbol on the furnace and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which will result in severe personal injury or death. WARNING signifies a hazard which could result in personal injury or death. CAUTION is used to identify hazards which may result in minor personal injury or product and property damage. NOTE and NOTICE are used to highlight suggestions which will result in enhanced installation, reliability, or operation.

1. Use only with type of gas approved for this furnace. Refer to the furnace rating plate.
2. Install this furnace only in a location and position as specified in the “Location” section of these instructions.
3. Provide adequate combustion and ventilation air to the furnace space as specified in “Air for Combustion and Ventilation” section.
4. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in the “Venting” section of these instructions.
5. 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, as specified in the “Gas Piping” section.
6. Always install furnace to operate within the furnace’s intended temperature-rise range with a duct system which has an external static pressure within the allowable range, as specified in the “Start-Up, Adjustments, and Safety Check” section. See furnace rating plate.
7. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by ducts sealed to the furnace casing and terminating outside the space containing the furnace. See “Air Ducts” section.
8. A gas-fired furnace for installation in a residential garage must be installed as specified in the warning box in the “Location” section.
9. The furnace may be used for construction heat provided that the furnace installation and operation complies with the first CAUTION in the LOCATION section of these instructions.
10. These Multipoise Gas-Fired Furnaces are CSA design-certified for use with natural and propane gases (see furnace rating plate) and for installation in alcoves, attics, basements, closets, utility rooms, crawlspaces, and garages. The furnace is factory-shipped for use with natural gas. A CSA (A.G.A. and C.G.A.) listed accessory gas conversion kit is required to convert furnace for use with propane gas.
11. See Table 2 for required clearances to combustible construction.
12. Maintain a 1-in. (25 mm) clearance from combustible materials to supply air ductwork for a distance of 36 in. (914 mm) horizontally from the furnace. See NFPA 90B or local code for further requirements.

13. These furnaces SHALL NOT be installed directly on carpeting, combustible tile, or any other combustible material other than wood flooring. In downflow installations, factory accessory floor base MUST be used when installed on combustible materials and wood flooring. Special base is not required when this furnace is installed on manufacturer’s Coil Assembly Part No. CNRV, CNPV, CAP, or CAR or when Coil Box Part No. KCAKC is used. See Table 2 for clearance to combustible construction information.

**NOTICE**

**Important Installation and Start-up Procedures**

Failure to follow this procedure may result in a nuisance smoke or odor complaint.

The manifold pressure, gas rate by meter clocking, temperature rise and operation must be checked after installation. Minor smoke and odor may be present temporarily after start-up from the manufacturing process. Some occupants are more sensitive to this minor smoke and odor. It is recommended that doors and windows be open during the first heat cycle.

**INTRODUCTION**

This 4-way multipoise Category IV condensing furnace is CSA design-certified as a direct-vent (2-pipe) or non-direct vent (1-pipe) furnace. See Fig. 2. The furnace is factory-shipped for use with natural gas. The furnace can be converted in the field for use with propane gas when a factory-supplied conversion kit is used. Refer to the furnace rating plate for conversion kit information.

This furnace is not approved for installation in mobile homes, recreational vehicles, or outdoors.

This furnace is designed for minimum continuous return-air temperature of 60°F (15°C) db or intermittent operation down to 55°F (13°C) db such as when used with a night setback thermostat. Return-air temperature must not exceed 80°F (27°C) db. Failure to follow these return-air temperature limits may affect reliability of heat exchangers, motors, and controls. See Fig. 3.

The furnace should be sized to provide 100 percent of the design heating load requirement plus any margin that occurs because of furnace model size capacity increments. Heating load estimates can be made using approved methods available from Air Conditioning Contractors of America (Manual J); American Society of Heating, Refrigerating, and Air-Conditioning Engineers; or other approved engineering methods. Excessive oversizing of the furnace could cause the furnace and/or vent to fail prematurely.

For accessory installation details, refer to the applicable instruction literature.

**NOTE:** Remove all shipping materials, loose parts bag, and literature before operating the furnace. See Table 1.

**CODES AND STANDARDS**

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

**Safety**

- **CANADA:** National Standard of Canada, Natural Gas and Propane Installation Code (NSCNGPIC) CAN/CSA B149.1-2010

**General Installation**

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

**Combustion and Ventilation Air**

- **US:** Section 9.3 of the NFPA54/ANSI Z223.1-2012 Air for Combustion and Ventilation
- **CANADA:** Part 8 of the CAN/CSA B149.1–2010, Venting Systems and Air Supply for Appliances

**Duct Systems**

- **US and CANADA:** Air Conditioning Contractors Association (ACCA) Manual D, Sheet Metal and Air Conditioning Contractors National Association (SMACNA), or American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 2005 Fundamentals Handbook Chapter 35

**Acoustical Lining and Fibrous Glass Duct**

- **US and CANADA:** current edition of SMACNA, NFPA 90B as tested by UL Standard 181 for Class I Rigid Air Ducts

**Gas Piping and Gas Pipe Pressure Testing**

- **US:** NFPA 54/ANSI Z223.1-2012 NFGC; Chapters 5, 6, 7, and 8 and national plumbing codes.
- **CANADA:** CAN/CSA-B149.1–2010, Parts 4, 5, 6, and 9.

In the state of Massachusetts:

- This product must be installed by a licensed plumber or gas fitter.
- When flexible connectors are used, the maximum length shall not exceed 36 in. (914 mm).
- When lever type gas shutoffs are used they shall be T-handle type.
- The use of copper tubing for gas piping is not approved by the state of Massachusetts.

**Electrical Connections**

- **US:** National Electrical Code (NEC) NFPA 70-2011
- **CANADA:** Canadian Electrical Code CSA C22.1

**Condensate Drain Connection**

- **US:** National Standard Plumbing Code 2009, Section 8.7.
- **Canada:** National Plumbing Code of Canada 2010 in Canada.
ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS PROCEDURE

⚠️ CAUTION

FURNACE RELIABILITY HAZARD
Failure to follow this caution may result in unit component damage.
Electrostatic discharge can affect electronic components. Take precautions during furnace installation and servicing to protect the furnace electronic control. Precautions will prevent electrostatic discharges from personnel and hand tools which are held during the procedure. These precautions will help to avoid exposing the control to electrostatic discharge by putting the furnace, the control, and the person at the same electrostatic potential.

1. Disconnect all power to the furnace. Multiple disconnects may be required. DO NOT TOUCH THE CONTROL OR ANY WIRE CONNECTED TO THE CONTROL PRIOR TO DISCHARGING YOUR BODY’S ELECTROSTATIC CHARGE TO GROUND.
2. Firmly touch the clean, unpainted, metal surface of the furnace chassis which is close to the control. Tools held in a person’s hand during grounding will be satisfactorily discharged.
3. After touching the chassis, you may proceed to service the control or connecting wires as long as you do nothing to recharge your body with static electricity (for example: DO NOT move or shuffle your feet, do not touch ungrounded objects, etc.).
4. If you touch ungrounded objects (and recharge your body with static electricity), firmly touch a clean, unpainted metal surface of the furnace again before touching control or wires.
5. Use this procedure for installed and uninstalled (ungrounded) furnaces.
6. Before removing a new control from its container, discharge your body’s electrostatic charge to ground to protect the control from damage. If the control is to be installed in a furnace, follow items 1 through 4 before bringing the control or yourself in contact with the furnace. Put all used and new controls into containers before touching ungrounded objects.
7. An ESD service kit (available from commercial sources) may also be used to prevent ESD damage.

ACCESSORIES
See Product Data Sheet for a list of accessories for this product.
### Table 1 – Factory-Supplied Installation Parts

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet Choke Plate (provided with 40K BTUH furnaces only; see Note)</td>
<td>1</td>
</tr>
<tr>
<td>Air Intake Pipe Flange</td>
<td>1</td>
</tr>
<tr>
<td>Vent Pipe Flange</td>
<td>1</td>
</tr>
<tr>
<td>Pipe Flange Gaskets</td>
<td>2</td>
</tr>
<tr>
<td>Sharp Tip Screws (Vent and Inlet Flanges)</td>
<td>10</td>
</tr>
<tr>
<td>Vent Pipe Coupling</td>
<td>1</td>
</tr>
<tr>
<td>Vent Pipe Coupling Clamps</td>
<td>2</td>
</tr>
<tr>
<td>Pressure Switch Tube</td>
<td>1</td>
</tr>
<tr>
<td>Rubber Drain Elbow</td>
<td>1</td>
</tr>
<tr>
<td>Drain Tube Clamps</td>
<td>4</td>
</tr>
<tr>
<td>1/2-in. CPVC to 3/4-in. PVC Pipe Adapter</td>
<td>1</td>
</tr>
<tr>
<td>Gas Line Grommet</td>
<td>1</td>
</tr>
<tr>
<td>Junction Box Cover</td>
<td>1</td>
</tr>
<tr>
<td>Junction Box Base</td>
<td>1</td>
</tr>
<tr>
<td>Green Ground Screw</td>
<td>1</td>
</tr>
<tr>
<td>Blunt Tip Screws (Junction Box)</td>
<td>3</td>
</tr>
<tr>
<td>Thermostat Wire Grommet</td>
<td>1</td>
</tr>
<tr>
<td>Drain Extension Tube (Z-pipe) (Provided separately in furnace)</td>
<td>1</td>
</tr>
</tbody>
</table>

**NOTE:** Only used for 40K BTUH furnaces from 0-2000 ft. (0 to 610 M) above sea level for total equivalent vent lengths under 10 ft. (3 M)

### Table 2 – Minimum Clearances to Combustible Materials for All Units

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>REAR</td>
<td>0</td>
</tr>
<tr>
<td>FRONT</td>
<td>1 in. (25 mm)</td>
</tr>
<tr>
<td>Required for service</td>
<td>24 in. (610 mm)</td>
</tr>
<tr>
<td>All Sides of Supply Plenum</td>
<td>1 in. (25 mm)</td>
</tr>
<tr>
<td>Sides</td>
<td>0</td>
</tr>
<tr>
<td>Vent</td>
<td>0</td>
</tr>
<tr>
<td>Top of Furnace</td>
<td>1 in. (25 mm)</td>
</tr>
</tbody>
</table>

*Consult local building codes.*
NOTES:
1. Doors may vary by model.
2. Minimum return-air openings at furnace, based on metal duct. If flex duct is used, see flex duct manufacturer’s recommendations for equivalent diameters.
   a. For 800 CFM-16-in. (406 mm) round or 14 1/2 x 12-in. (368 x 305 mm) rectangle.
   b. For 1200 CFM-20-in. (508 mm) round or 14 1/2 x 19 1/2-in. (368 x 495 mm) rectangle.
   c. For 1600 CFM-22-in. (559 mm) round or 14 1/2 x 22 1/16-in. (368 x 560 mm) rectangle.
   d. Return air above 1800 CFM at 0.5 in. w.c. ESP on 24.5” casing, requires one of the following configurations: 2 sides, 1 side and a bottom or bottom only. See Air Delivery table in this document for specific use to allow for sufficient airflow to the furnace.
3. Vent and Combustion air pipes through blower compartment must use accessory “Vent Kit - Through the Cabinet”. See accessory list for current part number.
THE BLOWER IS LOCATED TO THE RIGHT OF THE BURNER SECTION, AND CONDITIONED AIR IS DISCHARGED TO THE LEFT.

THE BLOWER IS LOCATED BELOW THE BURNER SECTION, AND CONDITIONED AIR IS DISCHARGED UPWARD.

THE BLOWER IS LOCATED ABOVE THE BURNER SECTION, AND CONDITIONED AIR IS DISCHARGED DOWNWARD.

THE BLOWER IS LOCATED TO THE LEFT OF THE BURNER SECTION, AND CONDITIONED AIR IS DISCHARGED TO THE RIGHT.

Fig. 2 - Multipoise Orientations

SUPPLY AIR

MAX 80°F / 27°C

MIN 60°F / 16°C

32°F / 0°C MINIMUM INSTALLED AMBIENT OR FREEZE PROTECTION REQUIRED

Fig. 3 - Freeze Protection and Return Air Temperature

Fig. 4 - Prohibited Installations

Fig. 5 - Installation in a Garage
See Table 1 for loose parts bag contents.

This furnace must:
• be installed so the electrical components are protected from water.
• not be installed directly on any combustible material other than wood flooring (refer to SAFETY CONSIDERATIONS).
• be located close to the chimney or vent and attached to an air distribution system. Refer to Air Ducts section.
• be provided ample space for servicing and cleaning. Always comply with minimum fire protection clearances shown in Table 2 or on the furnace clearance to combustible construction label.

These furnaces are shipped with materials to assist in proper furnace installation. These materials are shipped in the main blower compartment.

- The furnace is permanently installed with all electrical wiring, piping, venting and ducting installed according to these installation instructions. A return air duct is provided, sealed to the furnace casing, and terminated outside the space containing the furnace. This prevents a negative pressure condition as created by the circulating air blower, causing a flame rollout and/or drawing combustion products into the structure.
- The furnace is controlled by a thermostat. It may not be “hot wired” to provide heat continuously to the structure without thermostatic control.
- Clean outside air is provided for combustion. This is to minimize the corrosive effects of adhesives, sealers and other construction materials. It also prevents the entrainment of drywall dust into combustion air, which can cause fouling and plugging of furnace components.
- The temperature of the return air to the furnace is maintained between 55°F (13°C) and 80°F (27°C), with no evening setback or shutdown. The use of the furnace while the structure is under construction is deemed to be intermittent operation per our installation instructions.
- The air temperature rise is within the rated rise range on the furnace rating plate, and the gas input rate has been set to the nameplate value.
- The filters used to clean the circulating air during the construction process must be either changed or thoroughly cleaned prior to occupancy.
- The furnace, ductwork and filters are cleaned as necessary to remove drywall dust and construction debris from all HVAC system components after construction is completed.
- Verify proper furnace operating conditions including ignition, gas input rate, air temperature rise, and venting according to these installation instructions.

General
These furnaces are shipped with materials to assist in proper furnace installation. These materials are shipped in the main blower compartment.

The following types of furnace installations may require OUTDOOR AIR for combustion due to chemical exposures:
• Commercial buildings
• Buildings with indoor pools
• Laundry rooms
• Hobby or craft rooms
• Chemical storage areas

If air is exposed to the following substances, it should not be used for combustion air, and outdoor air may be required for combustion:
• Permanent wave solutions
• Chlorinated waxes and cleaners
• Chlorine based swimming pool chemicals
• Water softening chemicals
• De-icing salts or chemicals
• Carbon tetrachloride
• Halogen type refrigerants
• Cleaning solvents (such as perchloroethylene)
• Printing inks, paint removers, varnishes, etc.
• Hydrochloric acid
• Cements and glues
• Antistatic fabric softeners for clothes dryers
• Masonry acid washing materials

All fuel-burning equipment must be supplied with air for fuel combustion. Sufficient air must be provided to avoid negative pressure in the equipment room or space. A positive seal must be made between the furnace cabinet and the return-air duct to prevent pulling air from the burner area.

Failure to follow this warning could result in personal injury, death and/or property damage.

When the furnace is installed in a residential garage, the burners and ignition sources must be located at least 18 in. (457 mm) above the floor. The furnace must be located or protected to avoid damage by vehicles. When the furnace is installed in a public garage, airplane hangar, or other building having a hazardous atmosphere, the furnace must be installed in accordance with the NFPA 54/ANSI Z223.1-2012 or CAN/CSA B149.2-2010. See Fig. 5.
**Location Relative to Cooling Equipment**

The cooling coil must be installed parallel with, or on the downstream side of the unit to avoid condensation in the heat exchangers. When installed parallel with the furnace, dampers or other flow control must prevent chilled air from entering the furnace. If the dampers are manually operated, they must be equipped with means to prevent operation of either unit unless the damper is in the full-heat or full-cool position.

**AIR FOR COMBUSTION AND VENTILATION**

**Introduction**

**Direct Vent (2-pipe) Applications**

When the furnace is installed as a direct vent (2-pipe) furnace, no special provisions for air for combustion are required. However, other gas appliances installed in the space with the furnace may require outside air for combustion. Follow the guidelines below to insure that other gas appliances have sufficient air for combustion.

**Non-Direct Vent (1-pipe) Applications**

When the furnace is installed as a non-direct vent (1-pipe) furnace, it will be necessary to insure there is adequate air for combustion. Other gas appliances installed with the furnace may also require air for combustion and ventilation in addition to the amount of combustion air and ventilation air required for the furnace. Follow the guidelines below to insure that the furnace and other gas appliances have sufficient air for combustion.

**Ventilated Combustion Air Applications**

When the furnace is installed using the ventilated combustion air option, the attic or crawlspace must freely communicate with the outdoor to provide sufficient air for combustion. The combustion air pipe cannot be terminated in attics or crawlspaces that use ventilation fans designed to operate during the heating season. If ventilation fans are present in these areas, the combustion air pipe must terminate outdoors as a Direct Vent/2-Pipe system.

All air for combustion is piped directly to the furnace from a space that is well ventilated with outdoor air (such as an attic, crawl space, or equipment closet) and the space is well isolated from the living space or garage. In addition, other gas appliances installed in the space with the furnace may require outside air for combustion. Follow the guidelines below to insure that the roof or crawlspace walls have sufficient free area to provide sufficient air for combustion and ventilation for the furnaces. The guidelines below can be used to insure that other gas appliances have sufficient air for combustion.

Provisions for adequate combustion, ventilation, and dilution air must be provided in accordance with:
- Canada: Part 8 of the CAN/CSA B149.1-2010, Venting Systems and Air Supply for Appliances.

**OUTDOOR COMBUSTION AIR METHOD**

1. Provide the space with sufficient air for proper combustion, ventilation, and dilution of flue gases using permanent horizontal or vertical duct(s) or opening(s) directly communicating with the outdoors or spaces that freely communicate with the outdoors.
2. Fig. 6 illustrates how to provide TWO OUTDOOR OPENINGS, one inlet and one outlet combustion and ventilation air opening, to the outdoors.
   a. One opening MUST commence within 12 in. (300 mm) of the ceiling and the second opening MUST commence within 12 in. (300 mm) of the floor.
   b. Size openings and ducts per Fig. 6 and Table 3.
   c. TWO HORIZONTAL DUCTS require 1 sq. in. (645 sq. mm) of free area per 2,000 Btuh (1,100 mm²/kW) of combined input for all gas appliances in the space per Fig. 6 and Table 3.
   d. TWO OPENINGS OR VERTICAL DUCTS require 1 sq. in. (645 sq. mm) of free area per 4,000 Btuh (550 mm²/kW) for combined input of all gas appliances in the space per Fig. 6 and Table 3.
3. ONE OUTDOOR OPENING requires:
   a. 1 sq. in. (645 sq. mm) of free area per 3,000 Btuh (734 mm²/kW) for combined input of all gas appliances in the space per Fig. 6 and Table 3.
   b. Not less than the sum of the areas of all vent connectors in the space.

The opening shall commence within 12 in. (300 mm) of the ceiling. Appliances in the space shall have clearances of at least 1
The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces (crawl or attic) that freely communicate with the outdoors.

**Indoor Combustion Air® NFPA & AGA**

**Standard and Known-Air-Infiltration Rate Methods**

**Indoor air** is permitted for combustion, ventilation, and dilution, if the **Standard** or **Known-Air-Infiltration** Method is used.

---

**WARNING**

**CARBON MONOXIDE POISONING HAZARD**

Failure to follow this warning could result in personal injury or death.

Many homes require air to be supplied from outdoors for furnace combustion, ventilation, and dilution of flue gases.

The furnace combustion air supply must be provided in accordance with this instruction manual.

---

**Standard Method**

1. The space has no less volume than 50 cubic feet per 1,000 Btuh of the maximum input ratings for all gas appliances installed in the space and
2. The air infiltration rate is not known to be less than 0.40 air changes per hour (ACH).

The **Known Air Infiltration Rate** Method shall be used, if the infiltration rate is known to be:

1. Less than 0.40 ACH and
2. Equal to or greater than 0.10 ACH

Infiltration rates greater than 0.60 ACH shall not be used. The minimum required volume of the space varies with the number of ACH and shall be determined per Table 4 or Equations 1 and 2. Determine the minimum required volume for each appliance in the space and add the volumes together to get the total minimum required volume for the space.

**Table 4 - Minimum Space Volumes** were determined by using the following equations from the current edition of the National Fuel Gas Code ANSI Z223.1/NFPA 54, 9.3.2.2:

1. For other than fan-assisted appliances, such as a draft hood-equipped water heater:

\[
\text{Volume}_{\text{Other}} = \frac{21 \text{ft}^3}{\text{ACH}} \left(\frac{I_{\text{other}}}{1000 \text{ Btu/hr}}\right)
\]

\[\text{A04002}\]

2. For fan-assisted appliances such as this furnace:

\[
\text{Volume}_{\text{Fan}} = \frac{15 \text{ft}^3}{\text{ACH}} \left(\frac{I_{\text{fan}}}{1000 \text{ Btu/hr}}\right)
\]

\[\text{A04003}\]

If: \(I_{\text{other}} = \) combined input of all other than fan-assisted appliances in Btuh/hr

If\(\text{fan} = \) combined input of all fan-assisted appliances in Btuh/hr

ACH = air changes per hour (ACH shall not exceed 0.60.)

The following requirements apply to the **Standard** Method and to the **Known Air Infiltration Rate** Method.

1. Adjoining rooms can be considered part of a space if:
   a. There are no closeable doors between rooms.
   b. Combining spaces on same floor level. Each opening shall have free area of at least 1 in.\(^2\)/1,000 Btuh (2,000 mm\(^2\)/kW) of the total input rating of all gas appliances in the space, but not less than 100 in.\(^2\) (0.06 m\(^2\)). One opening shall commence within 12 in. (300 mm) of the ceiling and the second opening shall commence within 12 in. (300 mm) of the floor. The minimum dimension of air openings shall be at least 3 in. (80 mm). See Fig. 7.
2. An attic or crawlspace may be considered a space that freely communicates with the outdoors provided there are adequate permanent ventilation openings directly to outdoors having free area of at least 2 in.\(^2\)/1,000 Btuh (4,400 mm\(^2\)/kW) of total input rating of all gas appliances.
3. In spaces that use the **Indoor Combustion Air** Method, infiltration should be adequate to provide air for combustion, permanent ventilation and dilution of flue gases. However, in buildings with unusually tight construction, additional air MUST be provided using the methods described in the **Outdoor Combustion Air** Method section.
4. Unusually tight construction is defined as Construction with:
   a. Walls and ceilings exposed to the outdoors have a continuous, sealed vapor barrier. Openings are gasketed or sealed and
   b. Doors and openable windows are weatherstripped and
   c. Other openings are caulked or sealed. These include joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at penetrations for plumbing, electrical and gas lines, etc.

**Combination of Indoor and Outdoor Air**

1. Indoor openings shall comply with the **Indoor Combustion Air** Method below and,
2. Outdoor openings shall be located as required in the **Outdoor Combustion Air** Method mentioned previously and,
3. Outdoor openings shall be sized as follows:
   a. Calculate the Ratio of all Indoor Space volume divided by required volume for **Indoor Combustion Air** Method below.
   b. Outdoor opening size reduction Factor is 1 minus the Ratio in a. above.
   c. Minimum size of Outdoor openings shall be the size required in **Outdoor Combustion Air** Method above multiplied by reduction Factor in b. above. The minimum dimension of air openings shall be not less than 3 in. (80 mm).
### Table 3 – Minimum Free Area Required for Each Combustion Air Opening or Duct to Outdoors

<table>
<thead>
<tr>
<th>Furnace Input (BTUH)</th>
<th>Two Horizontal Ducts (1 SQ. IN./2,000 BTUH) (1,100 SQ. MM/KW)</th>
<th>Single Duct or Opening (1 SQ. IN./3,000 BTUH) (734 SQ. MM/KW)</th>
<th>Two Openings or Vertical Ducts (1 SQ. IN./4,000 BTUH) (550 SQ. MM/KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Free Area of Opening and Duct Sq. In. (mm)</td>
<td>Round Duct In. (mm) Dia</td>
<td>Free Area of opening and Duct Sq. In. (mm)</td>
</tr>
<tr>
<td>40,000*</td>
<td>20 (12904)</td>
<td>5 (127)</td>
<td>14 (8696)</td>
</tr>
<tr>
<td>60,000</td>
<td>30 (19355)</td>
<td>6 (152)</td>
<td>20 (13043)</td>
</tr>
<tr>
<td>80,000</td>
<td>40 (25807)</td>
<td>7 (178)</td>
<td>27 (17391)</td>
</tr>
<tr>
<td>100,000</td>
<td>50 (32258)</td>
<td>8 (203)</td>
<td>34 (21739)</td>
</tr>
<tr>
<td>120,000</td>
<td>60 (38709)</td>
<td>9 (229)</td>
<td>40 (26087)</td>
</tr>
<tr>
<td>140,000*</td>
<td>70 (45161)</td>
<td>10 (254)</td>
<td>47 (30435)</td>
</tr>
</tbody>
</table>

*Not all families have these models.

### EXAMPLES: Determining Free Area

**Furnace**

**Water Heater**

**Total Input**

**Examples**:

- **Determining Free Area**
  - **Furnace**: 100,000 + 30,000 = (130,000 divided by 4,000) = 32.5 Sq. In. for each two Vertical Ducts or Openings
  - **Furnace**: 60,000 + 40,000 = (100,000 divided by 3,000) = 33.3 Sq. In. for each Single Duct or Opening
  - **Furnace**: 80,000 + 30,000 = (110,000 divided by 2,000) = 55.0 Sq. In. for each two Horizontal Ducts

### Table 4 – Minimum Space Volumes for 100% Combustion, Ventilation and Dilution Air from Outdoors

<table>
<thead>
<tr>
<th>ACH</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>120</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>1,050</td>
<td>1,400</td>
<td>1,750</td>
<td>2,000</td>
<td>2,500</td>
<td>3,000</td>
<td>3,500</td>
<td>4,000</td>
<td>4,500</td>
<td>5,000</td>
</tr>
<tr>
<td>0.50</td>
<td>1,260</td>
<td>1,680</td>
<td>2,100</td>
<td>2,500</td>
<td>3,000</td>
<td>3,500</td>
<td>4,000</td>
<td>4,500</td>
<td>5,000</td>
<td>5,500</td>
</tr>
<tr>
<td>0.40</td>
<td>1,575</td>
<td>2,100</td>
<td>2,625</td>
<td>3,100</td>
<td>3,600</td>
<td>4,000</td>
<td>4,500</td>
<td>5,000</td>
<td>5,500</td>
<td>6,000</td>
</tr>
<tr>
<td>0.30</td>
<td>2,100</td>
<td>2,800</td>
<td>3,500</td>
<td>4,000</td>
<td>4,500</td>
<td>5,000</td>
<td>5,500</td>
<td>6,000</td>
<td>6,500</td>
<td>7,000</td>
</tr>
<tr>
<td>0.20</td>
<td>3,150</td>
<td>4,200</td>
<td>5,250</td>
<td>6,000</td>
<td>6,750</td>
<td>7,500</td>
<td>8,250</td>
<td>9,000</td>
<td>9,750</td>
<td>10,500</td>
</tr>
<tr>
<td>0.10</td>
<td>6,300</td>
<td>8,400</td>
<td>10,500</td>
<td>12,000</td>
<td>13,500</td>
<td>15,000</td>
<td>16,500</td>
<td>18,000</td>
<td>19,500</td>
<td>21,000</td>
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<tr>
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<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

NP = Not Permitted

*Minimum dimensions of 3 in. (76mm)

**NOTE**: Use any of the following combinations of openings: A & B, C & D, D & E, F & G

---

**Fig. 6 - Air for Combustion, Ventilation, and Dilution for Outdoors**

**Fig. 7 - Air for Combustion, Ventilation, and Dilution from Indoors**
CONDENSATE TRAP

Condensate Trap - Upflow Orientation
When the furnace is installed in the upflow position, it is not necessary to relocate the condensate trap or associated tubing. Refer to Fig. 8 for upflow condensate trap information. Refer to Condensate Drain section for information how to install the condensate drain.

Condensate Trap - Downflow Orientation.
When the furnace is installed in the downflow position, the condensate trap will be initially located at the upper left corner of the collector box, as received from the factory. See the top image in Fig. 9. When the furnace is installed in the downflow orientation, the condensate trap must be relocated for proper condensate drainage. See the bottom image in Fig. 9.

To Relocate the Condensate Trap:
- Orient the furnace in the downflow position.
- Fig. 9 shows the condensate trap and tubing before and after relocation. Refer to Fig. 9 to begin the trap conversion.
- Refer to Condensate Drain section for information how to install the condensate drain.

Condensate Trap - Horizontal Orientation.
When the furnace is installed in the horizontal right position, the condensate trap will be initially located at the bottom of the collector box, as received from the factory. See the top image in Fig. 10. When the furnace is installed in the horizontal left position, the condensate trap will be initially located at the top of the collector box, as received from the factory. See the top image in Fig. 11. In both cases the trap must be repositioned on the collector box for proper condensate drainage. See the bottom images in Fig. 10 and 11.

A field-supplied, accessory Horizontal Installation Kit (trap grommet) is required for all direct-vent horizontal installations (only). The kit contains a rubber casing grommet designed to seal between the furnace casing and the condensate trap. See Fig. 16.

NOTICE
The field-supplied, accessory horizontal drain trap grommet is ONLY REQUIRED FOR DIRECT VENT APPLICATIONS. It is NOT required for applications using single-pipe or ventilated combustion air venting.

NOTICE
The condensate trap extends below the side of the casing in the horizontal position. A minimum of 2-in. (51 mm) of clearance is required between the casing side and the furnace platform for the trap to extend out of the casing in the horizontal position. Allow at least 1/4-in. per foot (20 mm per meter) of slope down.

To Relocate the Condensate Trap:
- Remove the knockout in the casing for the condensate trap.
- Install the grommet in the casing when required for direct-vent horizontal applications.
- Orient the furnace in the desired position.
- Allow for 2 in. (51 mm) of clearance underneath the furnace for the condensate trap and drain line.
- Fig. 10 shows the condensate trap and tubing before and after relocation in the horizontal right position.
- Fig. 11 shows the condensate trap and tubing before and after relocation in the horizontal left position.
- Refer to the appropriate figure to begin the trap conversion.
- Refer to Condensate Drain section for information how to install the condensate drain.

Fig. 8 - Upflow Trap Configuration
(Appearance may vary)
1. Remove relief tube from relief port on condensate trap.
2. Remove the screw that secures the trap to the collector box and remove trap.
3. Remove middle and bottom plugs. DO NOT DISCARD.
4. Remove pressure switch tube from front pressure switch and discard. A new tube is shipped in the loose parts bag.
5. Loosen clamp on inlet to vent elbow.
6. Remove tube from relief port.
7. Connect the new pressure switch tube from Loose Parts bag to port on front pressure switch.
8. Route tube through inducer stand-offs to adjust position of the tube.
9. Trim excess tube. Connect pressure switch tube to port on collector box.
10. Install the two plugs previously removed on the open ports of the collector box.

**Unconverted Factory Configuration as Viewed in the Downflow Orientation**

**Downflow Trap Configuration**

**Fig. 9 - Downflow Trap Configuration**

(Appearance may vary)
1. Remove the screw that secures the trap to the collector box and remove trap.

2. If alternate vent position is required, loosen clamp on inlet of vent elbow.

3. Remove plug from collector box. DO NOT DISCARD.

4. Slide relief tube in standoffs to adjust length.

5. Vent elbow shown in alternate orientation. Tighten clamp on inlet to vent elbow 15 lb.-in.

NOTE: Remove knockout in casing before re-installing the condensate trap.

Attach condensate trap with screw to collector box.

Align trap over middle and right-hand port on collector box.

Horizontal Right Trap Configuration

Fig. 10 - Horizontal Right Trap Configuration
(Appearance may vary)
If alternate vent position is required, loosen clamp on vent elbow inlet.

Remove relief tube from port on collector box.

Remove the screw that secures the condensate trap to the collector box and remove trap.

Remove relief tube from relief port on condensate trap.

Remove front pressure switch tube and discard. A new tube is shipped in the Loose Parts bag.

Remove relief tube from relief port on condensate trap.

Remove middle and right plug from collector box. DO NOT DISCARD.

Remove the screw that secures the condensate trap to the collector box and remove trap.

Remove relief tube from port on collector box.

NOTE: Remove knockout in casing before re-installing the condensate trap.

Install two plugs previously removed in open ports on collector box.

Connect the new pressure switch tube from Loose Parts bag to port on front pressure switch.

Route pressure switch tube underneath relief tube and connect to port on collector box.

Connect relief tube to relief port on condensate trap.

Attach condensate trap with screw to collector box.

Align trap over middle and right-hand port on collector box.

Slide relief tube in stand-offs to adjust length.

Rotate elbow to desired position and torque clamp on inlet 15 lb.-in.
CONSENSATE DRAIN CONNECTION

⚠️ CAUTION

FROZEN AND BURST WATER PIPE HAZARD
Failure to protect against the risk of freezing may result in property damage.
Special precautions MUST be made if installing furnace in an area which may drop below freezing. This can cause improper operation or damage to equipment. If furnace environment has the potential of freezing, the drain trap and drain line must be protected. The use of accessory drain trap heaters, electric heat tape and/or RV antifreeze is recommended for these installations.

PROPERTY DAMAGE HAZARD
Failure to follow this caution may result in burst water pipes and/or property damage.

If a condensate pump is installed, a plugged condensate drain or a failed pump may cause the furnace to shut down. Do not leave the home unattended during freezing weather without turning off water supply and draining water pipes or otherwise protecting against the risk of frozen pipes.

DO NOT trap the drain line in any other location than at the condensate drain trap supplied with the furnace. If possible, DO NOT route the drain line where it may freeze. The drain line must terminate at an inside drain to prevent freezing of the condensate and possible property damage.

Special precautions MUST be made if installing furnace in an area which may drop below freezing. This can cause improper operation or damage to the equipment. If the furnace environment has the potential of freezing, the drain trap and drain line must be protected. A self-regulating, shielded and waterproof heat tape rated at 3 to 6 watt per foot (10 to 20 watt per meter) at 115 volt, 40°F (4°C) may be used to help provide freeze protection. Wrap the drain trap and drain line with the heat tape and secure with appropriate plastic ties. Follow the heat tape manufacturer’s recommendations. Prime the trap before furnace operation.

The condensate drain line must be supported and/or secured per local codes. Supports and clamps should be spaced to prevent the drain line from sagging or being dislocated from the furnace or termination point. In the absence of local codes, consult the current edition of the National Standard Plumbing Code 2009, in the U.S. or the National Plumbing Code of Canada 2010 in Canada.

Upflow/Downflow Orientation

In the Upflow or Downflow orientation, the condensate trap is inside the furnace casing. The condensate drain must be routed from the trap through the furnace casing. The condensate drain can be routed through the left or right side of the casing. (The left or right side is as you are viewing/facing the furnace from the front.) The furnace condensate drain can be connected to the indoor coil condensate drain, humidifier or auxiliary drain traps as shown in Fig. 13.

NOTE: On narrower casings, it may be easier to remove the condensate trap, connect the drain line components and re-install the condensate trap. Read the steps thoroughly to familiarize yourself with the required steps.

For Right Side Condensate Drain:

1. Remove the 7/8-in. knock-out from the right side of the casing. See Fig. 12 For suggested knockout removal technique.)
2. Remove the pre-formed rubber drain elbow and two spring clamps from the loose parts bag.
3. Slide a spring clamp 1-inch (25 mm) down the plain end (the end without the formed grommet) of the drain elbow.
4. From inside the casing, insert the formed grommet end of the elbow through the 7/8-in. knockout in the casing.
5. Pull the grommet through the casing from the outside until it is seated in the knockout
6. Attact the plain end of the drain elbow to the outlet stub on the drain trap. Secure the drain elbow to the trap with the spring clamp.

The remaining drain line can be constructed from field supplied 1/2-in. CPVC or 3/4-in. PVC pipe, in compliance with local building codes. A factory-supplied 1/2-in. CPVC to 3/4-in. PVC adapter is supplied in the loose parts bag for use as required.
7. Install the adapter or connect the 1/2-in. CPVC pipe by sliding a spring clamp over the open end of the grommet on the outside the furnace casing.
8. Open the spring clamp and insert the long end of the adapter or the 1/2-in. CPVC pipe into the outlet stub on the drain tube.
9. Connect additional condensate piping to a code-approved drain, or to a condensate pump approved for use with acidic furnace condensate and compatible with mineral and vegetable oils, such as canola oil.

Allow at least 1/4-in. per foot (20 mm per meter) of slope down and away from the furnace in horizontal sections of drain line.

TIP FROM CONTRACTORS: Contractors have found that temporarily removing the inducer assembly in upflow applications while performing the steps, below, makes upflow left-side drain connections easier.

For Left Side Condensate Drain Connection:

1. For left side condensate drainage, the drain line is routed from the condensate trap, behind the inducer (upflow) or gas valve (downflow) and out through the left side of the furnace casing. A pre-formed 1/2-in. CPVC “Z-pipe” is provided with the furnace. The Z-pipe is long enough to extend across the casing for drain connections.
2. Locate the Z-pipe. Remove the pre-formed drain elbow and four spring clamps from the loose parts bag.
3. The Z-pipe is connected to the condensate trap and the outside of the furnace by modifying the formed rubber drain elbow as shown in Fig. 15.
4. Remove the formed grommet from the rubber drain elbow by cutting the elbow along the vertical line located about 1-3/8 in. (35 mm) away from the formed grommet. See Fig. 15. DO NOT DISCARD THE FORMED GROMMET OR THE RUBBER ELBOW. Both of these pieces will be used.

Assemble and route the drain line to the opposite side of the furnace as detailed below:
5. Remove the knock-out from the left side of the casing. See Fig. 12 for suggested knockout removal technique.
6. From the outside of the casing, insert the angled end of the Z-pipe through drain hole in the left side of the casing and behind the inducer or gas valve. Allow the Z-pipe to temporarily rest on the blower shelf (upflow) or burner box (downflow). (NOTE: When the inducer housing has been removed to ease installation in upflow applications, this step is not needed.)
7. After inserting the Z pipe through the casing, slide a spring clamp over each end of the Z pipe.
8. From inside the casing, insert the short end of the formed grommet cut from the rubber drain elbow through the 7/8-in. drain knockout in the casing.
9. Pull the grommet through the casing from the outside until it is seated in the knockout.
10. Align the Z-pipe with the long end of the grommet inside the furnace and insert slightly. The angled end of the tube at the other side of the casing should be facing the front of the furnace.
11. Slide a spring clamp over the end of the remaining rubber drain elbow.
12. Attach the drain elbow to the angled end of Z-pipe and the drain trap outlet stub. Adjust the length of Z-pipe inserted into the grommet at the opposite side of the furnace as necessary for proper fit and positioning. In both upflow and downflow orientations, the Z-pipe should NOT be resting on any sheet metal parts.
13. Secure the rubber elbow to the drain trap and the Z-pipe with spring clamps.
14. Secure the grommet to the Z-pipe with the spring clamp.

The remaining drain line can be constructed from field supplied 1/2-in. CPVC or 3/4-in. PVC pipe, in compliance with local building codes. A factory-supplied 1/2-in. CPVC to 3/4-in. PVC adapter is supplied in the loose parts bag for use as required.

15. Install the adapter or connect the 1/2-in. CPVC pipe by sliding a spring clamp over the open end of the elbow on the outside the furnace casing.
16. Open the spring clamp and insert the long end of the adapter or the 1/2-in. CPVC pipe into the outlet stub on the drain tube.
17. Connect additional condensate piping to a code-approved drain, or to a condensate pump approved for use with acidic furnace condensate and compatible with mineral and vegetable oils, such as canola oil.

Allow at least 1/4-in. per foot (20 mm per meter) of slope down and away from the furnace in horizontal sections of drain line.

### NOTICE

The field-supplied, accessory horizontal drain trap grommet is ONLY REQUIRED FOR DIRECT VENT APPLICATIONS.
It is NOT required for applications using single-pipe or ventilated combustion air venting.

**TIP FROM CONTRACTORS:** When installing the furnace horizontally, use the entire drain elbow (that is, do NOT cut as shown in Fig. 15 to connect the trap to the drain line. This helps to prevent bumps and shocks to the drain line from damaging the furnace drain trap. Avoid misalignment of the drain pipe which may cause kinks in the elbow.

**Horizontal Orientation**

1. The condensate trap outlet extends 2-in. (51 mm) below the furnace casing. Leave enough clearance between the furnace and the furnace platform for the trap.
CUT HAZARD

Failure to follow this caution may result in personal injury. Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing, safety glasses and gloves when handling parts, and servicing furnaces.

Fig. 12 - Knockout Removal

Fig. 13 - Example of Field Drain Attachment

Fig. 14 - Formed Rubber Drain Grommet

Fig. 15 - Modify Rubber Drain Elbow
NOTE: Trap grommet is required only for direct-vent applications.

Remove knockout. Install grommet before relocating condensate trap.

**Fig. 16 - Horizontal Drain Trap Grommet**

Attachment elbow to condensate trap

Cut formed end off condensate drain elbow

Connect short end of “Z” pipe to modified drain elbow

Factory supplied 1/2-in. CPVC to 3/4-in. PVC adapter

TRAP, DRAIN ELBOW WITH DISCHARGE PIPE

Left side drain routed behind inducer

NOTE: Remove Inducer Housing for easier access, if desired.

**Fig. 17 - Drain Trap Connection and Routing**

(Appearance may vary)

---

**INSTALLATION**

**NOTICE**

This furnace is certified to leak 2% or less of nominal air conditioning CFM delivered when pressurized to 1-in. water column with all present air inlets, including bottom closure in upflow and horizontal applications, air outlets, and plumbing and electrical ports sealed.

---

**Upflow Installation**

NOTE: The furnace must be pitched as shown in Fig. 23 for proper condensate drainage.

**Supply Air Connections**

For a furnace not equipped with a cooling coil, the outlet duct shall be provided with a removable access panel. This opening shall be accessible when the furnace is installed and shall be of such a size that the heat exchanger can be viewed for possible openings using light assistance or a probe can be inserted for sampling the air stream. The cover attachment shall prevent leaks.

Connect supply-air duct to flanges on furnace supply-air outlet. Bend flange upward to 90° with wide duct pliers. See Fig. 20. The supply-air duct must be connected to ONLY the furnace supply-outlet-air duct flanges or air conditioning coil casing (when used). DO NOT cut main furnace casing side to attach supply air duct, humidifier, or other accessories. All supply-side accessories MUST be connected to duct external to furnace main casing.

**Return Air Connections**

---

**WARNING**

**FIRE HAZARD**

A failure to follow this warning could cause personal injury, death and/or property damage.

Never connect return-air ducts to the back of the furnace. Follow instructions below.

The return-air duct must be connected to bottom, sides (left or right), or a combination of bottom and side(s) of main furnace casing. Bypass humidifier may be attached into unused return air side of the furnace casing. See Fig. 24, 25, and 26.

**Bottom Return Air Inlet**

These furnaces are shipped with bottom closure panel installed in bottom return-air opening. Remove and discard this panel when bottom return air is used. To remove bottom closure panel, perform the following:

1. Tilt or raise furnace and remove 4 screws holding bottom plate. See Fig. 22.
2. Remove bottom plate.
3. Remove bottom closure panel.
4. Reinstall bottom plate and screws.

**Side Return Air Inlet**

These furnaces are shipped with bottom closure panel installed in bottom return-air opening. This panel MUST be in place when only side return air is used.

NOTE: Side return-air openings can be used in UPFLOW and some HORIZONTAL configurations. Do not use side return-air openings in DOWNFLOW configuration. See Fig. 24, 25, and 26.

**Leveling Legs (If Desired)**

In upflow position with side return inlet(s), leveling legs may be used. See Fig. 21. Install field-supplied, 5/16 x 1-1/2 in. (8 x 38 mm) (max) corrosion-resistant machine bolts, washers and nuts.

NOTE: Bottom closure must be used when leveling legs are used. It may be necessary to remove and reinstall bottom closure panel to install leveling legs. To remove bottom closure panel, see Item 1 in Bottom Return Air Inlet section in Step 1 above.

To install leveling legs:

1. Position furnace on its back. Locate and drill a hole in each bottom corner of furnace.
2. For each leg, install nut on bolt and then install bolt with nut in hole. (Install flat washer if desired.)
3. Install another nut on other side of furnace base. (Install flat washer if desired.)
4. Adjust outside nut to provide desired height, and tighten inside nut to secure arrangement.
5. Reinstall bottom closure panel if removed.

**Downflow Installation**

**NOTE:** The furnace must be pitched as shown in Fig. 23 for proper condensate drainage.

**Supply Air Connections**

**NOTE:** For downflow applications, this furnace is approved for use on combustible flooring when any one of the following 3 accessories are used:
- Special Base, KGASB
- Cased Coil Assembly Part No. CNPV, CNRV, CAP, or CAR
- Coil Box Part No. KCAKC

1. Determine application being installed from Table 8.
2. Construct hole in floor per Table 8 and Fig. 19.
3. Construct plenum to dimensions specified in Table 8 and Fig. 19.
4. Install special base coil assembly or coil box as shown in Fig. 19.

**NOTE:** It is recommended that the perforated supply-air duct flanges be completely removed from furnace when installing the furnace on a factory-supplied cased coil or coil box. To remove the supply-air duct flange, use wide duct pliers or hand seamers to bend flange back and forth until it breaks off. Be careful of sharp edges. See Fig. 20.

**Return Air Connections**

**WARNING**

**FIRE HAZARD**
A failure to follow this warning could cause personal injury, death and/or property damage.

Never connect return-air ducts to the back of the furnace. Follow instructions below.

The return-air duct must be connected to return-air opening (bottom inlet). **DO NOT** cut into casing sides (left or right).

**CAUTION**

**CUT HAZARD**
Failure to follow this caution may result in personal injury. Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing, safety glasses and gloves when handling parts, and servicing furnaces.

Connect supply-air duct to supply-air outlet on furnace. Bend flange inward past 90° with wide duct pliers See Fig. 20. The supply-air duct must be connected to ONLY the furnace supply outlet or air conditioning coil casing (when used). When installed on combustible material, supply-air duct must be connected to ONLY the factory-approved accessory subbase, or a factory-approved air conditioning coil casing. **DO NOT** cut main furnace casing to attach supply side air duct, humidifier, or other accessories. All supply-side accessories MUST be connected to duct external to furnace casing.

**Horizontal Installation**

**NOTE:** The furnace must be pitched forward as shown in Fig. 23 for proper condensate drainage.

**CAUTION**

**MINOR PROPERTY HAZARD**
Failure to follow this caution may result in minor property damage.

Local codes may require a drain pan under entire furnace and condensate trap when a condensing furnace is used in an attic application or over a finished ceiling.

The furnace can be installed horizontally in an attic or crawlspace on either the left-hand (LH) or right-hand (RH) side. The furnace can be hung from floor joists, rafters or trusses or installed on a non-combustible platform, blocks, bricks or pad.

**Platform Furnace Support**
Construct working platform at location where all required furnace clearances are met. See Table 2 and Fig. 27. For furnaces with 1-in. (25 mm) clearance requirement on side, set furnace on non-combustible blocks, bricks or angle iron. For crawlspace installations, if the furnace is not suspended from the floor joists, the ground underneath furnace must be level and the furnace set on blocks or bricks.

**Suspended Furnace Support**
The furnace must be supported under the entire length of the furnace with threaded rod and angle iron. See Fig. 28. Secure angle iron to bottom of furnace as shown.

**Roll-Out Protection**
Provide a minimum 12-in. x 22-in. (305 x 559 mm) piece of sheet metal for flame roll-out protection in front of burner area for furnaces closer than 12-in. (305 mm) above the combustible deck or suspended furnaces closer than 12-in. (305 mm) to joists. The sheet metal MUST extend underneath the furnace casing by 1-in. (25 mm) with the door removed.

The bottom closure panel on furnaces of widths 17-1/2-in. (445 mm) and larger may be used for flame roll-out protection when
bottom of furnace is used for return air connection. See Fig. 27 for proper orientation of roll-out shield.

**Supply Air Connections**

For a furnace not equipped with a cooling coil, the outlet duct shall be provided with a removable access panel. This opening shall be accessible when the furnace is installed and shall be of such a size that the heat exchanger can be viewed for possible openings using light assistance or a probe can be inserted for sampling the air stream. The cover attachment shall prevent leaks.

Connect supply-air duct to flanges on furnace supply-air outlet. Bend flange upward to 90° with wide duct pliers. See Fig. 20. The supply-air duct must be connected to ONLY the furnace supply-outlet-air duct flanges or air conditioning coil casing (when used). **DO NOT** cut main furnace casing side to attach supply air duct, humidifier, or other accessories. All supply-side accessories MUST be connected to duct external to furnace main casing.

**Return Air Connections**

The return-air duct may be connected to bottom of the furnace. The side of casing that faces downward may also be used for return air connection. A combination of the bottom and downward facing side may also be used. The upward facing side of the casing cannot be used as a return air connection. See Fig. 26.

**Bottom Return Air Inlet**

These furnaces are shipped with bottom closure panel installed in bottom return-air opening. Remove and discard this panel when bottom return air is used. To remove bottom closure panel, perform the following:

1. Tilt or raise furnace and remove 4 screws holding bottom plate. See Fig. 22.
2. Remove bottom plate.
3. Remove bottom closure panel.
4. Reinstall bottom plate and screws.

**Side Return Air Inlet**

These furnaces are shipped with bottom closure panel installed in bottom return-air opening. This panel MUST be in place when side return air inlet(s) are used without a bottom return air inlet. Not all horizontal furnaces are approved for side return air connections. See Fig. 26.

**Filter Arrangement**

![WARNING]

**FIRE, CARBON MONOXIDE AND POISONING HAZARD**

Failure to follow this warning could result in fire, personal injury or death.

Never operate a furnace without a filter or filtration device installed. Never operate a furnace with filter or filtration device access doors removed.

Due to the relatively high pressure drops of 1-in. (25 mm) thick after-market filter media, it is recommended that the filtration system be designed for at least 2-in. (51 mm) thick media.

**TIPS FROM CONTRACTORS:** Install a media cabinet capable of incorporating a 4-in. (102 mm) thick media filter. This allows room for future upgrades to other IAQ devices.

Provide duct transitions, as required, to smoothly transition airflow from the return duct system to the filter. See the Air Ducts section. Excessive filter pressure drop often compromises system airflow and duct performance, causes inadequate airflow to the furthest ends of the duct system, as well as causes excess noise and higher than anticipated electrical consumption.

Design the duct system FIRST to determine how much pressure drop may be allowed in the filter system. See the Air Ducts section.

For upflow applications, the filter can be installed on either side of the furnace, the bottom of the furnace or any combination of side and bottom of the furnace. (See Fig. 18 and 24.)

For downflow applications, the filter rack (or field supplied accessory air cleaner) must only be connected to the bottom opening on the furnace. (See Fig. 18 and 25.)

For horizontal applications, the filter rack (or field supplied accessory air cleaner) can be connected to the bottom opening on the furnace. For side return use in the horizontal position, refer to Fig. 26. If both side and bottom openings are used in Fig. 26, each opening used will require a filter.

A filter rack or any field supplied accessory air cleaner may also be installed in the common return duct prior to entering the return air opening in any orientation.

Refer to the instructions supplied with the Filter Rack or accessory air filter for additional assembly and installation options.

See Table 7 for recommended filter size details.

Pressure drop must be taken into account when sizing filters, filter racks, IAQ devices, and associated system ductwork. See Table 5 for a comparison of Pressure Drop (initial/clean resistance to airflow) versus Airflow for a variety of filter media types and sizes. These are representative numbers. Consult the filter or IAQ device manufacturers’ specification sheet for performance data for a particular filter media or IAQ device.

Design the filter and associated ductwork for the best match of pressure drop versus filter size. Best practice usually chooses filter systems with pressure drops under 0.2 in. W.C. (50 Pa), with the best blower electrical efficiency and system airflow performance occurring with filter pressure drops under 0.1 in. W.C. (25 Pa).
### Table 5 – Filter Media Pressure Drop (Clean) Versus Airflow - In. W.C. (Pa)


### Table 6 – Filter Media Pressure Drop (Clean) Versus Face Velocity - In. W.C. (Pa)

<table>
<thead>
<tr>
<th>Face Velocity (m/s)</th>
<th>(1-in. / 2.5 cm)</th>
<th>(2-in. / 5 cm)</th>
<th>(1-in. / 2.5 cm)</th>
<th>(2-in. / 5 cm)</th>
<th>(1-in. / 2.5 cm)</th>
<th>(2-in. / 5 cm)</th>
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<tr>
<td>200</td>
<td>0.04</td>
<td>0.05</td>
<td>0.05</td>
<td>0.08</td>
<td>0.18</td>
<td>0.20</td>
</tr>
<tr>
<td>300</td>
<td>0.05</td>
<td>0.09</td>
<td>0.09</td>
<td>0.13</td>
<td>0.30</td>
<td>0.34</td>
</tr>
<tr>
<td>400</td>
<td>0.07</td>
<td>0.13</td>
<td>0.13</td>
<td>0.20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>500</td>
<td>0.08</td>
<td>0.18</td>
<td>0.18</td>
<td>0.27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>600</td>
<td>0.09</td>
<td>0.23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>700</td>
<td>0.10</td>
<td>0.29</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

If the filter size that you are looking for is not contained in Table 5, refer to Table 6 for a comparison of Pressure Drop (initial/clean resistance to airflow) versus Face Velocity for a variety of filter media types.

The following equations relate Face Velocity (FPM), Filter Area and Airflow (CFM):

- Filter Face Velocity = Airflow / Filter Area
- Minimum Filter Area = Rated System Airflow / Maximum Filter Face Velocity
<table>
<thead>
<tr>
<th>FURNACE CASING WIDTH</th>
<th>FILTER SIZE</th>
<th>AIR FILTER SELECTED</th>
<th>FILTER TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 – 3/16 † (360)</td>
<td>16 x 25 x 3/4 (406 x 635 x 19)</td>
<td>14 x 25 x 3/4 (356 x 635 x 19)</td>
<td>Washable*</td>
</tr>
<tr>
<td></td>
<td>16 x 25 x 3/4 (406 x 635 x 19)</td>
<td>20 x 25 x 3/4 (508 x 635 x 19)</td>
<td>Washable*</td>
</tr>
<tr>
<td></td>
<td>16 x 25 x 3/4 (406 x 635 x 19)</td>
<td>24 x 25 x 3/4 (610 x 635 x 19)</td>
<td>Washable*</td>
</tr>
</tbody>
</table>

* Recommended to maintain air filter face velocity. See Product Data for part number.
† Not all families have these models.

<table>
<thead>
<tr>
<th>FILTER CABINET HEIGHT – IN (MM)</th>
<th>FILTER SIZE – IN (MM)</th>
<th>FILTER TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 (406)</td>
<td>(1) 16 x 25 x 3/4* (406 x 635 x 19) or (1) 16 x 25 x 4 – 5/16 (406 x 635 x 110)</td>
<td>Washable or Media*</td>
</tr>
<tr>
<td>20 (508)</td>
<td>(1) 20 x 25 x 3/4* (508 x 635 x 19) or (1) 20 x 25 x 4 – 5/16 (508 x 635 x 110)</td>
<td>Washable or Media*</td>
</tr>
<tr>
<td>24 (610)</td>
<td>(1) 24 x 25 x 3/4* or (610 x 635 x 19) or (1) 24 x 25 x 4 – 5/16 (610 x 635 x 110)</td>
<td>Washable or Media*</td>
</tr>
</tbody>
</table>

* Filters with a side return – air may have a different filter size. Measure the filter to obtain the correct size.
* Recommended to maintain air filter face velocity. See Product Data for part number.
Accessory Side Filter Rack

Accessory Bottom Filter Rack

Fig. 18 - Media Filter
![Diagram of a plenum opening on combustible flooring](https://example.com/diagram.png)

**Table 8 – Opening Dimensions - In. (mm)**

<table>
<thead>
<tr>
<th>FURNACE CASING WIDTH IN. (mm)</th>
<th>APPLICATION</th>
<th>PLENUM OPENING</th>
<th>FLOOR OPENING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Upflow Applications on Combustible or Noncombustible Flooring (KGASB subbase not required)</td>
<td>12–11/16 (322)</td>
<td>21–5/8 (549)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Noncombustible Flooring (KGASB subbase not required)</td>
<td>12–9/16 (319)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow applications on combustible flooring (KGASB subbase required)</td>
<td>11–13/16 (284)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Combustible Flooring with CNPV, CNRV, CAR or CAP Coil Assembly or KCAKC coil box (KGASB subbase not required)</td>
<td>12–5/16 (319)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Noncombustible Flooring (KGASB subbase not required)</td>
<td>15–7/8 (403)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow applications on combustible flooring (KGASB subbase required)</td>
<td>15–1/8 (384)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Combustible Flooring with CNPV, CNRV, CAR or CAP Coil Assembly or KCAKC coil box (KGASB subbase not required)</td>
<td>15–1/2 (394)</td>
<td>19 (483)</td>
</tr>
<tr>
<td>17–1/2 (445)</td>
<td>Upflow Applications on Combustible or Noncombustible Flooring (KGASB subbase not required)</td>
<td>19–1/2 (495)</td>
<td>21–5/8 (549)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Noncombustible Flooring (KGASB subbase not required)</td>
<td>19–3/8 (492)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow applications on combustible flooring (KGASB subbase required)</td>
<td>18–5/8 (473)</td>
<td>19 (483)</td>
</tr>
<tr>
<td>21 (533)</td>
<td>Downflow Applications on Combustible Flooring with CNPV, CNRV, CAR or CAP Coil Assembly or KCAKC coil box (KGASB subbase not required)</td>
<td>19 (483)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Upflow Applications on Noncombustible Flooring (KGASB subbase not required)</td>
<td>23 (584)</td>
<td>21–1/8 (537)</td>
</tr>
<tr>
<td></td>
<td>Downflow Applications on Noncombustible Flooring (KGASB subbase not required)</td>
<td>22–7/8 (581)</td>
<td>19 (483)</td>
</tr>
<tr>
<td></td>
<td>Downflow applications on combustible flooring (KGASB subbase required)</td>
<td>22–1/8 (562)</td>
<td>19 (483)</td>
</tr>
<tr>
<td>24–1/2 (622)</td>
<td>Downflow Applications on Combustible Flooring with CNPV, CNRV, CAR or CAP Coil Assembly or KCAKC coil box (KGASB subbase not required)</td>
<td>22–1/2 (572)</td>
<td>19 (483)</td>
</tr>
</tbody>
</table>

* Not all families have these models.
UPFLOW | DOWNFLOW | HORIZONTAL

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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<td>NO</td>
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<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

120° MIN

90°

Fig. 20 - Duct Flanges

Fig. 21 - Leveling Legs

LEVEL 0-IN. (0 MM) TO 1/2-IN. (13 MM) MAX

MIN 1/4-IN. (6 MM) TO 1/2-IN. (13 MM) MAX

Fig. 23 - Furnace Pitch Requirements
ANY COMBINATION OF 1, 2, OR 3 PERMITTED.

Fig. 24 - Upflow Return Air Configurations and Restrictions

Fig. 25 - Downflow Return Air Configurations and Restrictions

Fig. 26 - Horizontal Return Air Configurations and Restrictions
ROLLOUT PROTECTION REQUIRED
Install 12” x 22” (305 x 559 mm) sheet metal in front of burner compartment area.

NOTE: FURNACE SHOWN AS DIRECT VENT APPLICATION, REFER TO THE VENTING SECTION FOR ALLOWABLE VENT CONFIGURATIONS

Fig. 27 - Working Platform for Attic Installation
NOTE: Local codes may require a drain pan and condensate trap when a condensing furnace is installed over a finished ceiling.

Fig. 28 - Suspended Furnace Installation
NOTE: Local codes may require a drain pan and condensate trap when a condensing furnace is installed over a finished ceiling.
General Requirements

The duct system should be designed and sized according to accepted national standards such as those published by: Air Conditioning Contractors Association (ACCA Manual D), Sheet Metal and Air Conditioning Contractors National Association (SMACNA) or American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) or consult *The Air Systems Design Guidelines* reference tables available from your local distributor. The duct system should be sized to handle the required system design CFM at the design external static pressure. The furnace airflow rates are provided in Table 9-Air Delivery-CFM (With Filter). When a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

Secure ductwork with proper fasteners for type of ductwork used. Seal supply- and return-duct connections to furnace with code approved tape or duct sealer.

**NOTE:** Flexible connections should be used between ductwork and furnace to prevent transmission of vibration.

Ductwork passing through unconditioned space should be insulated to enhance system performance. When air conditioning is used, a vapor barrier is recommended.

Maintain a 1-in. (25 mm) clearance from combustible materials to supply air ductwork for a distance of 36-in. (914 mm) horizontally from the furnace. See NFPA 90B or local code for further requirements.

Return Duct Sizing

Refer to the Filter Selection and Duct Sizing section for information on the proper selection of filter sizes and the associated ductwork and duct transitions. Improperly designed filtering systems and return ductwork are the most common causes of airflow and/or noise complaints in HVAC systems.

Ductwork Acoustical Treatment

**NOTE:** Metal duct systems that do not have a 90 degree elbow and 10 ft. (3 M) of main duct to the first branch take-off may require internal acoustical lining. As an alternative, fibrous ductwork may be used if constructed and installed in accordance with the latest edition of SMACNA construction standard on fibrous glass ducts. Both acoustical lining and fibrous ductwork shall comply with NFPA 90B as tested by UL Standard 181 for Class 1 Rigid air ducts.

**NOTE:** For horizontal applications, the top most flange may be bent past 90° to allow the evaporator coil to hang on the flange temporarily while the remaining attachment and sealing of the coil are performed.
<table>
<thead>
<tr>
<th>UNIT SIZE</th>
<th>RETURN-AIR CONNECTION</th>
<th>SPEED TAPS</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>030040</td>
<td>SIDE/BOTTOM</td>
<td>Gray</td>
<td>1120</td>
<td>1080</td>
<td>1030</td>
<td>980</td>
<td>925</td>
<td>875</td>
<td>820</td>
<td>760</td>
<td>690</td>
<td>630</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow</td>
<td>880</td>
<td>845</td>
<td>810</td>
<td>780</td>
<td>740</td>
<td>710</td>
<td>680</td>
<td>640</td>
<td>515</td>
<td>570</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue</td>
<td>695</td>
<td>665</td>
<td>620</td>
<td>575</td>
<td>535</td>
<td>495</td>
<td>455</td>
<td>420</td>
<td>370</td>
<td>280</td>
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<td>640</td>
<td>595</td>
<td>540</td>
<td>495</td>
<td>460</td>
<td>420</td>
<td>370</td>
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<td>285</td>
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<td>160</td>
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<td>1175</td>
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<td>940</td>
<td>880</td>
<td>825</td>
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<td></td>
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<td>Yellow</td>
<td>940</td>
<td>905</td>
<td>870</td>
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<td>805</td>
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<td>735</td>
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<td>670</td>
<td>630</td>
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**NOTE**
1. A filter is required for each return—air inlet. Airflow performance includes a 3/4-in. (19 mm) washable filter media such as contained in a factory-authorized accessory filter rack. See accessory list. To determine airflow performance without this filter, assume an additional 0.1 in. w.c. available external static pressure.

2. **ADJUST THE BLOWER SPEED TAPS AS NECESSARY FOR THE PROPER AIR TEMPERATURE RISE FOR EACH INSTALLATION.**
3. Shaded areas indicate that this airflow range is **BELOW THE RANGE ALLOWED FOR HIGH—STAGE HEATING OPERATION. THESE AIRFLOW RANGES MAY ONLY BE USED FOR LOW—STAGE HEAT OR COOLING.**
4. Airflows over 1800 CFM require bottom return, two—side return, or bottom and side return. A minimum filter size of 20" x 25" (508 x 635 mm) is required.
5. For upflow applications, air entering from one side into both the side of the furnace and a return air base counts as a side and bottom return.
6. The “—” entry indicates an unstable operating condition.
Gas piping must be installed in accordance with national and local codes. Refer to current edition of NFBCG in the U.S.A. Refer to current edition of NSCNGPIC in Canada.

Installations must be made in accordance with all authorities having jurisdiction. If possible, the gas supply line should be a separate line running directly from meter to furnace.

NOTE: Use a back-up wrench on the inlet of the gas valve when connecting the gas line to the gas valve.

In the state of Massachusetts:
1. Gas supply connections MUST be performed by a licensed plumber or gas fitter.
2. When flexible connectors are used, the maximum length shall not exceed 36 in. (915 mm).
3. When lever handle type manual equipment shutoff valves are used, they shall be T-handle valves.
4. The use of copper tubing for gas piping is NOT approved by the state of Massachusetts.

Refer to Table 10 for recommended gas pipe sizing. Risers must be used to connect to furnace and to meter. Support all gas piping with appropriate straps, hangers, etc. Use a minimum of one hanger every 6 ft. (2 M). Joint compound (pipe dope) should be applied sparingly and only to male threads of joints. Pipe dope must be resistant to the action of propane gas.

An accessible manual equipment shutoff valve MUST be installed external to furnace casing and within 6 ft. (2.0 M) of furnace. Install a sediment trap in riser leading to furnace as shown in Fig. 30. Connect a capped nipple into lower end of tee. Capped nipple should extend below level of furnace gas controls. Place a ground joint union between furnace gas control valve and exterior manual equipment gas shutoff valve.

A 1/8-in. (3 mm) NPT plugged tapping, accessible for test gauge connection, MUST be installed immediately upstream of gas supply connection to furnace and downstream of manual equipment shutoff valve.

Piping should be pressure and leak tested in accordance with the current addition of the NFBCG in the United States, local, and national plumbing and gas codes before the furnace has been connected. Refer to current edition of NSCNGPIC in Canada. After all connections have been made, purge lines and check for leakage at furnace prior to operating furnace.

NOTE: The furnace gas control valve inlet pressure tap connection is suitable to use as test gauge connection providing test pressure DOES NOT exceed maximum 0.5 psig (14-in. w.c.) stated on gas control valve. See Fig. 54.

If pressure exceeds 0.5 psig (14-in. w.c.), gas supply pipe must be disconnected from furnace and capped before and during supply pipe pressure test. If test pressure is equal to or less than 0.5 psig (14-in. w.c.), turn off electric shutoff switch located on furnace gas control valve and accessible manual equipment shutoff valve before and during supply pipe pressure test. After all connections have been made, purge lines and check for leakage at furnace prior to operating furnace.

The gas supply pressure shall be within the maximum and minimum inlet supply pressures marked on the rating plate with the furnace burners ON and OFF.

Some installations require gas entry on right side of furnace (as viewed in upflow). See Fig. 29.

Gas Pipe Grommet

For direct vent (2-pipe) applications, the knockout for the gas pipe must be sealed to prevent air leakage. Remove the knockout, install the grommet in the knockout, then insert the gas pipe. The grommet is included in the loose parts bag. See Fig. 29.
Table 10 – Maximum Capacity of Pipe

<table>
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<th>NOMINAL IRON PIPE SIZE IN. (MM)</th>
<th>LENGTH OF PIPE – FT. (M)</th>
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<td>1/2 (13)</td>
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<td>680</td>
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<td>1-1/4 (32)</td>
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</tr>
<tr>
<td>1-1/2 (39)</td>
<td>2100</td>
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</table>

* Cubic ft of gas per hr for gas pressures of 0.5 psig (14- - - in. w.c.) or less and a pressure drop of 0.5- - - in. w.c. (based on a 0.60 specific gravity gas). Ref: Table 10 above and 6.2 of NFPA54/ANSI Z223.1–2012.

ELECTRICAL CONNECTIONS

**WARNING**

**ELECTRICAL SHOCK, FIRE OR EXPLOSION HAZARD**

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

Improper servicing could result in dangerous operation, serious injury, death or property damage.

- Before servicing, disconnect all electrical power to furnace.
- When servicing controls, label all wires prior to disconnection. Reconnect wires correctly.
- Verify proper operation after servicing.

115-v Wiring

Furnace must have a 115-v power supply properly connected and grounded.

**NOTE:** Proper polarity must be maintained for 115-v wiring. If polarity is incorrect, control LED status indicator light will flash rapidly and furnace will NOT operate.

Verify that the voltage, frequency, and phase correspond to that specified on unit rating plate. Also, check to be sure that service provided by utility is sufficient to handle load imposed by this equipment. Refer to rating plate or Table 11 for equipment electrical specifications.

**U.S.A. Installations:** Make all electrical connections in accordance with the current edition of the National Electrical Code (NEC) NFPA 70 and any local codes or ordinances that might apply.

**Canada Installations:** Make all electrical connections in accordance with the current edition of the Canadian Electrical Code CSA C22.1 and any local codes or ordinances that might apply.

CAUTION

FURNACE MAY NOT OPERATE HAZARD

Failure to follow this caution may result in intermittent furnace operation.

Furnace control must be grounded for proper operation or else control will lock out. Control must remain grounded through green/yellow wire routed to gas valve and manifold bracket screw.
WARNING

FIRE HAZARD
Failure to follow this warning could result in personal injury, death, or property damage.
Do not connect aluminum wire between disconnect switch and furnace. Use only copper wire. See Fig. 32.

NOTE
Electrical Box on Furnace Casing Side
and secure the mounting bracket with the screws. See Fig. 31.
Align the J-Box mounting bracket against the inside of the casing of the casing. Remove the knock-out from the casing. Drill two (2) parts bag. Select a 7/8-in. (22 mm) knock-out on the desired side of the casing. Remove the J-Box cover and mounting bracket from the loose parts bag included with the furnace. The J-Box can be mounted on the left or right side of the casing, as viewed from the upflow position. See Fig. 31.
Remove the J-Box cover and mounting bracket from the loose parts bag. Select a 7/8-in. (22 mm) knock-out on the desired side of the casing. Remove the knock-out from the casing. Drill two (2) 1/8-in. (3 mm) pilot holes in the casing dimples by the desired 7/8-in. (22 mm) knock-out.
Align the J-Box mounting bracket against the inside of the casing and secure the mounting bracket with the screws. See Fig. 31.

Electrical Box on Furnace Casing Side
NOTE: Check that duct on side of furnace will not interfere with installed electrical box.
1. Fasten a field-supplied external electrical box to the outside of the casing by driving two field-supplied screws from inside electrical box into casing. See Fig. 32.
2. Route field power wiring into external electrical box.
3. Pull furnace power wires through 1/2-in. (12 mm) diameter hole in J-Box. If necessary, loosen power wires from strain—relief wire-tie on furnace wiring harness.
4. Connect any code required external disconnect(s) to field power wiring.
5. Route external field power wires through holes in electrical box and casing.
6. Connect field ground wire and factory ground wire to green ground screw on J-Box mounting bracket as shown in Fig. 31.
7. Connect field power and neutral leads to furnace power leads as shown in Fig. 34.
8. Attach furnace J-Box cover to mounting bracket with screws supplied in loose parts bag. Do not pinch wires between cover and bracket.
9. Complete external disconnect wiring and installation. Connect line voltage leads as shown in Fig. 32. Use best practices (NEC in U.S.A. for wire bushings, strain relief, etc., CANADA: Canadian Electrical Code CSA C22.1)

Power Cord Installation in Furnace J-Box
NOTE: Power cords must be able to handle the electrical requirements listed in Table 11. Refer to power cord manufacturer’s listings.
1. Install J-Box mounting bracket to inside of furnace casing. See Fig. 31.
2. Route listed power cord through 7/8-in. (22 mm) diameter hole in casing and J-Box bracket.
3. Secure power cord to J-Box bracket with a strain relief bushing or a connector approved for the type of cord used.
4. Pull furnace power wires through 1/2-in. (12 mm) diameter hole in J-Box. If necessary, loosen power wires from strain—relief wire-tie on furnace wiring harness.
5. Connect field ground wire and factory ground wire to green ground screw on J-Box mounting bracket as shown in Fig. 31.
6. Connect power cord power and neutral leads to furnace power leads as shown in Fig. 34.
7. Attach furnace J-Box cover to mounting bracket with screws supplied in loose parts bag. Do not pinch wires between cover and bracket. See Fig. 31.

BX Cable Installation in Furnace J-Box
1. Install J-Box mounting bracket to inside of furnace casing. See Fig. 31.
2. Route BX connector through 7/8-in. (22 mm) diameter hole in casing and J-Box bracket.
3. Secure BX cable to J-Box bracket with connectors approved for the type of cable used.
4. Connect field ground wire and factory ground wire to green ground screw on J-Box mounting bracket as shown in Fig. 31.
5. Connect field power and neutral leads to furnace power leads as shown in Fig. 34.
6. Attach furnace J-Box cover to mounting bracket with screws supplied in loose parts bag. Do not pinch wires between cover and bracket.

24-V Wiring
Make field 24-v connections at the 24-v terminal strip. See Fig. 35. Connect terminal Y/Y2 as shown in Fig. 34 for proper cooling operation. Use only AWG No. 18, color-coded, copper thermostat wire.
NOTE: Use AWG No. 18 color-coded copper thermostat wire for lengths up to 100 ft. (31 M). For wire lengths over 100 ft., use AWG No. 16 wire.
The 24-v circuit contains an automotive-type, 3-amp. fuse located on the control. Any direct shorts during installation, service, or maintenance could cause this fuse to blow. If fuse replacement is required, use ONLY a 3-amp. fuse of identical size. See Fig. 35.

Thermostats
A single stage heating and cooling thermostat can be used with the furnace. The furnace control board CPU will control the furnace and outdoor unit staging. A two stage heating and cooling thermostat can also be used to control the staging. For two stage thermostat control of the furnace staging, turn SW1-LHT ON at the furnace control board. For two stage thermostat control of a 2-stage outdoor unit, remove the ACRDJ jumper from the furnace control board. Refer to typical thermostat wiring diagrams and the Sequence of Operation section for additional details. Consult the thermostat installation instructions for specific information about configuring the thermostat. See Fig. 35 and 36.
Accessories. (See Fig. 33 and 35.)

1. Electronic Air Cleaner (EAC)
   Connect an accessory Electronic Air Cleaner (if used) using 1/4-in. female quick connect terminals to the two male 1/4-in. quick-connect terminals on the control board marked EAC-1 and EAC-2. The terminals are rated for 115VAC, 1.0 amps maximum and are energized during blower motor operation.

2. Humidifier (HUM)
   The HUM terminal is a 24 VAC output, energized when the gas valve relay is operating during a call for heat.
   Connect an accessory 24 VAC, 0.5 amp. maximum humidifier (if used) to the ¼-in. male quick-connect HUM terminal and COM-24V screw terminal on the control board thermostat strip.

   NOTE: If the humidifier has its own 24 VAC power supply, an isolation relay may be required. Connect the 24 VAC coil of the isolation relay to the HUM and COM/24V screw terminal on the control board thermostat strip. See Fig. 33.

Alternate Power Supplies
This furnace is designed to operate on utility generated power which has a smooth sinusoidal waveform. If the furnace is to be operated on a generator or other alternate power supply, the alternate power supply must produce a smooth sinusoidal waveform for compatibility with the furnace electronics. The alternate power supply must generate the same voltage, phase, and frequency (Hz) as shown in Table 11 or the furnace rating plate.

Power from an alternate power supply that is non-sinusoidal may damage the furnace electronics or cause erratic operation.
Contact the alternate power supply manufacturer for specifications and details.

Table 11 – Electrical Data

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* Permissible limits of the voltage range at which the unit operates satisfactorily.
# Unit ampacity = 125 percent of largest operating component’s full load amps plus 100 percent of all other potential operating components’ (EAC, humidifier, etc.) full load amps.
†Time–delay type is recommended.
‡Length shown is as measured one way along wire path between furnace and service panel for maximum 2 percent voltage drop.
Fig. 31 - Installing J-Box (When Used)

Fig. 32 - Field-Supplied Electrical Box on Furnace Casing

Fig. 33 - Field-supplied Isolation Relay for Humidifiers with Internal Power Supply
Fig. 34 - Typical Two-Stage Field Wiring Diagram

Fig. 35 - Example of Two-Stage Furnace Control
Modulating and 2-Stage Furnace with Single-Speed Air Conditioner

See notes 2, 5, 7, 10, 11, 16, and 17

Modulating and 2-Stage Furnace with Single-Speed Heat Pump

See notes 1, 2, 4, 6, 7, 9, 10, 11, 15, 16, and 17

Modulating and 2-Stage Furnace with Two-Speed Air Conditioner

See notes 2, 5, 8, 10, 11, 12, 16, and 17

Modulating and 2-Stage Furnace with Two-Speed Heat Pump

See notes 1, 2, 3, 4, 6, 8, 9, 10, 12, 13, 15, 16, and 17

Fig. 36 - Thermostat Wiring Diagrams
NOTES FOR THERMOSTAT WIRING DIAGRAMS

1. Heat pump MUST have a high pressure switch for dual fuel applications.
2. Refer to outdoor equipment Installation Instructions for additional information and setup procedure.
3. If the heat pump date code is 1501E or earlier, select the “ZONE” position on the two speed heat pump control. Heat pumps with date code 1601E and later do not have or require a “ZONE” selection.
4. Outdoor Air Temperature Sensor must be attached in all dual fuel applications.
5. Configure the thermostat for air conditioner installations. Refer to thermostat instructions.
6. Configure thermostat for heat pump installations. Refer to thermostat instructions.
7. Configure thermostat for single-stage compressor operation. Refer to thermostat instructions.
8. Configure thermostat for two-stage compressor operation. Refer to thermostat instructions.
10. NO connection should be made to the furnace HUM terminal when using a thermostat with a 24 volt humidifier output.
11. Optional connection - If wire is connected to W2 on furnace control board, either dip switch SW1-2 or SW1-LHT on furnace control should be set in ON position to allow thermostat to control furnace staging.
12. Optional connection - If wire is connected to Y2 on furnace control board, ACRDJ jumper on furnace control should be removed to allow thermostat to control outdoor unit staging.
13. Furnace must control its own staging operation via furnace control algorithm. This is factory default.
14. The RVS Sensing terminal “L” should not be connected. This is used internally to sense defrost operation.
15. If thermostat has internal control of heat pump balance point, DO NOT SELECT the “FURNACE INTERFACE” or “BALANCE POINT” option on the two-speed heat pump control board. Refer to thermostat instructions.
16. Configure Dehumidify function to remove 24 VAC from Dehum terminal on a demand to dehumidify.
17. Thermostat signals may vary. Consult thermostat installation instructions for more information.

VENTING

NOTE: Planning for the venting system should be done in conjunction with planning for the ductwork, drainage, and furnace accessories, such as air cleaners and humidifiers. Begin assembling the venting system AFTER the furnace is set in place in the required orientation.

Venting for this furnace shall follow all Local codes for Category IV venting systems. This furnace is CSA approved for venting with PVC/ABS DWV venting systems. This furnace is also CSA approved for venting with M&G DuraVent® PolyPro® polypropylene venting systems.

NOTE: THESE INSTRUCTIONS DO NOT CONTAIN DETAILED INSTALLATION INSTRUCTIONS FOR POLYPROPYLENE VENTING SYSTEMS. Refer to the polypropylene venting system manufacturer’s installation instructions for the polypropylene venting system installation.

NOTE: When using polypropylene venting systems, all venting materials used, including the vent terminations, must be from the same manufacturer.

Special Venting Requirements for Installations in Canada

Installation in Canada must conform to the requirements of CSA B149 code. Vent systems must be composed of pipe, fittings, cements, and primers listed to ULC S636. The special vent fittings, accessory concentric vent termination kits and accessory external drain trap available from the furnace manufacturer have been certified to ULC S636 for use with these Royal Pipe and IPEX PVC vent components which have been certified to this standard. In Canada, the primer and cement must be of the same manufacturer as the vent system – GVS-65 Primer (Purple) for Royal Pipe or IPEX System 636, Pvc/CPVC Primer, Purple Violet for Flue Gas Venting and GVS-65 PVC Solvent Cement for Royal Pipe or IPEX System 636/14, PVC Cement for Flue Gas Venting, rated Class II A, 65 deg C. must be used with this venting system - do not mix primers and cements from one manufacturer with a vent system from a different manufacturer. Follow the manufacturer’s instructions in the use of primer and cement and never use primer or cement beyond its expiration date.

The safe operation, as defined by ULC S636, of the vent system is based on following these installation instructions, the vent system manufacturer’s installation instructions, and proper use of primer and cement. All fire stop and roof flashing used with this system must be UL listed material. Acceptability under Canadian standard CAN/CSA B149 is dependent upon full compliance with all installation instructions. Under this standard, it is recommended that the vent system be checked once a year by qualified service personnel.

The authority having jurisdiction (gas inspection authority, municipal building department, fire department, etc.) should be consulted before installation to determine the need to obtain a permit.

*IPEX System 636™ is a trademark of IPEX Inc.

Consignes spéciales pour l’installation de ventilation au Canada

L’installation faite au Canada doit se conformer aux exigences du code CSA B149-2010. Ce système de ventilation doit se composer de tuyaux, raccords, ciments et apprêts conformes au ULC S636. La tuyauterie de ventilation des gaz, ses accessoires, le terminal concentrique mural ainsi que l’ensemble du drain de condensation extérieur fourni par le fabricant de cette fournaise ont été certifiés ULCS 636 pour l’application des composantes Royal Pipe, IPEX PVC qui sont certifiées à ce standard. Au Canada, l’apprêt et le ciment doivent être du même fabricant que le système d’évacuation. L’apprêt GVS-65 (Purple) et le ciment-solvant GVS-65 doivent être utilisé avec les Royal Pipe. Système IPEX 636, apprêt PVC/CPVC, Purple pour évacuation des gaz de combustion et système IPEX 636(1), ciment PVC pour évacuation des gaz de combustion, coté classe II A, 65 deg C. doivent être utilisés avec le système d’évacuation IPEX 636 – Ne pas combiner l’apprêt et le ciment d’un manufacturier avec un système d’évacuation d’un manufacturier différent.

Bien suivre les indications du manufacturier lors de l’utilisation de l’apprêt et du ciment et ne pas utiliser ceux-ci si la date d’expiration est atteinte.

L’opération sécuritaire, tel que défini par ULC S636, du système de ventilation est basé sur les instructions d’installation suivantes, ainsi que l’usage approprié de l’apprêt et ciment. Tout arrêt feu et solin de toit utilisés avec ce système doivent être des matériaux listés UL. L’acceptation du standard Canadien CAN/CSA B149 est directement relié à l’installation conforme aux instructions ci-haut mentionnées. Le standard Canadien recommande l’inspection par un personnel qualifié et ce, une fois par année.

Les autorités ayant juridiction (inspecteurs de gaz, inspecteurs en bâtiments, département des incendies, etc) devraient être consultées avant l’installation afin de déterminer si un permis est requis.
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. Seal any unused openings in venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 or the CSA B149 Natural Gas and Propane Installation Code and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies, which could cause an unsafe condition.
3. As far as practical, close all building doors and windows and all doors between the space in which the appliance(s) connected to the venting system are located and other spaces of the building.
5. Turn on clothes dryers and any appliance not connected to the venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they are operating at maximum speed. Do not operate a summer exhaust fan.
6. Follow the lighting instructions. Place the appliance being inspected into operation. Adjust the thermostat so appliance is operating continuously.
7. Test for spillage from draft hood equipped appliances at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
8. If improper venting is observed during any of the above tests, the venting system must be corrected in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1 Natural Gas and Propane Installation Code.
9. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-fired burning appliance to their previous conditions of use.

Other gas appliances with their own venting system may also use the abandoned chimney as a raceway providing it is permitted by local code, the current edition of the National Fuel Gas Code, and the vent or liner manufacturer’s installation instructions. Care must be taken to prevent the exhaust gases from one appliance from contaminating the combustion air of other gas appliances.

Do not take combustion air from inside the chimney when using ventilated combustion air or single-pipe vent option. These furnaces can be vented as direct-vent (two-pipe), ventilated combustion air or non-direct (single-pipe) vent system. Each type of venting system is described below. Common venting between these furnaces or other appliances is prohibited.

Materials

U.S.A.

Combustion air and vent pipe, fittings, primers, and solvents must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards. See Table 13 for approved materials for use in the U.S.A. This furnace is also CSA approved for venting with M&G DuraVent® PolyPro® polypropylene venting systems.

Canada

Special Venting Requirements for Installations in Canada, Installation in Canada must conform to the requirements of CAN/CSA B149 code. Vent systems must be composed of pipe, fittings, cements, and primers listed to ULC S636. M&G DuraVent PolyPro polypropylene venting systems are ULC S636 listed.

NOTE: When using polypropylene venting systems, all venting materials used, including the vent terminations must be from the same manufacturer.

Venting Systems

General

If this furnace replaces a furnace that was connected to a vent system or chimney, the vent or vent connectors of other remaining appliances may need to be re-sized. Vent systems or vent connectors of other appliances must be sized to the minimum size as determined using appropriate table found in the current edition of National Fuel Gas Code NFPA 54/ANSI Z-223.1. In Canada, refer to CAN/CSA-B149.1.

An abandoned masonry chimney may be used as a raceway for properly insulated and supported combustion-air (when applicable) and vent pipes. Each furnace must have its own set of combustion-air and vent pipes and be terminated individually, as shown in Fig. 48 for Direct Vent (2-Pipe) system, or Fig. 49 for single-pipe or ventilated combustion air option.

A furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.
Direct Vent / 2-Pipe System

In a direct-vent (2-pipe) system, all air for combustion is taken directly from outdoor atmosphere, and all flue products are discharged to outdoor atmosphere. Combustion-air and vent pipes must terminate together in the same atmospheric pressure zone, either through the roof (preferred) or a sidewalk. See Fig. 46 for references to clearances required by National code authorities.

Optional Inlet Pipe Moisture Trap

When sizing venting systems, the equivalent length of the optional inlet pipe moisture trap must be taken into account.

Ventilated Combustion Air Systems

In a ventilated combustion air option, the vent terminates and discharges the flue products directly to the outdoors similar to a direct vent system. See Fig. 47 for references to clearances required by National code authorities. All air for combustion is piped directly to the furnace from a space that is well ventilated with outdoor air (such as an attic or crawl space) and the space is well isolated from the living space or garage. Combustion air requirements for this option are the same as the requirements for providing outside air for combustion for a single pipe vent system. Refer to the “Air For Combustion and Ventilation” Section.

Non-Direct Vent (1-pipe) System

In a non direct-vent (1-pipe) system, all air for combustion is taken from the area adjacent to furnace, and all flue products are discharged to outdoor atmosphere. Air for combustion must be supplied as described in the Air For Combustion and Ventilation Section. Do not use an abandoned chimney to supply outside air to the furnace. See Fig. 47 for references to vent clearances required by National code authorities.

A combustion air pipe to the outdoors is not required for a single-pipe vent system. A 12-in. (304 mm) long pipe with a 2-in. (51 mm) tight radius 90 degree elbow is required to be attached to the combustion air pipe adapter on the furnace. See Fig. 50. This short inlet air pipe helps to ensure stable combustion, as well as allow for sound attenuation. To aid sound attenuation, point the inlet air pipe away from occupants. An extra elbow and/or five feet of pipe may be used to accomplish the sound attenuation function.

Table 12 – Vent Termination Kit for Direct Vent (2-pipe) Systems

<table>
<thead>
<tr>
<th>DIRECT VENT (2-PIPE) TERMINATION SYSTEM</th>
<th>TERMINATION SYSTEM</th>
<th>DIAMETER OF COMBUSTION AIR AND VENT PIPES – IN. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-in. (51 mm) Concentric Vent Kit</td>
<td>Single Penetration of Wall or Roof</td>
<td>1, 1–1/2, 2, or 2–1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(24, 36, 51, 64 mm)</td>
</tr>
<tr>
<td>3-in. (76 mm) Concentric Vent Kit</td>
<td>Single Penetration of Wall or Roof</td>
<td>2–1/2, 3 or 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(64, 78, 102 mm)</td>
</tr>
</tbody>
</table>

Direct Vent / 2-Pipe System

In a direct-vent (2-pipe) system, all air for combustion is taken directly from outdoor atmosphere, and all flue products are discharged to outdoor atmosphere. Combustion-air and vent pipes must terminate together in the same atmospheric pressure zone, either through the roof (preferred) or a sidewalk. See Fig. 50 for references to clearances required by National code authorities.

Notice

Optional Configuration for Combustion Air Inlet Pipe

In applications where there is a risk of excessive moisture entering the combustion air inlet pipe, a moisture trap may be added to the inlet pipe to help prevent moisture from entering the furnace from the combustion air inlet pipe. See Fig. 53.

When sizing venting systems, the equivalent length of the optional inlet pipe moisture trap must be taken into account.

Ventilated Combustion Air Systems

In a ventilated combustion air option, the vent terminates and discharges the flue products directly to the outdoors similar to a direct vent system. See Fig. 47 for references to clearances required by National code authorities.

All air for combustion is piped directly to the furnace from a space that is well ventilated with outdoor air (such as an attic or crawl space) and the space is well isolated from the living space or garage. Combustion air requirements for this option are the same as the requirements for providing outside air for combustion for a single pipe vent system. Refer to the “Air For Combustion and Ventilation” Section.

Non-Direct Vent (1-pipe) System

In a non direct-vent (1-pipe) system, all air for combustion is taken from the area adjacent to furnace, and all flue products are discharged to outdoor atmosphere. Air for combustion must be supplied as described in the Air For Combustion and Ventilation Section. Do not use an abandoned chimney to supply outside air to the furnace. See Fig. 47 for references to vent clearances required by National code authorities.

A combustion air pipe to the outdoors is not required for a single-pipe vent system. A 12-in. (304 mm) long pipe with a 2-in. (51 mm) tight radius 90 degree elbow is required to be attached to the combustion air pipe adapter on the furnace. See Fig. 50. This short inlet air pipe helps to ensure stable combustion, as well as allow for sound attenuation. To aid sound attenuation, point the inlet air pipe away from occupants. An extra elbow and/or five feet of pipe may be used to accomplish the sound attenuation function.

Notice

Optional Venting Below the Furnace

The venting system may be positioned below the furnace if the instructions for the External Vent Trap Kit are followed. The External Vent Trap Kit is only approved for PVC/ABS DWV venting systems.

Carefully follow the instructions provided with the external vent trap kit.

WARNING

Carbon Monoxide Poisoning Hazard

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

The instructions included with this furnace DO NOT APPLY to vent systems that are located below the furnace. Carefully follow the instructions provided with the external vent trap kit.

Proper ventilation of the venting system is critical when placing all or part of the venting system below the level of the furnace. VENT GASSES COULD BE RELEASED FROM THE DRAINAGE SYSTEM if the instructions provided with the External Vent Trap Kit are not followed.

Locating the Vent Termination

General

NOTE: Termination Requirements for the Provinces of Alberta and Saskatchewan are located at the end of this section.

Combustion-air inlet pipe (direct vent/2-pipe system only) and vent pipe must terminate outside structure, either through sidewall or roof.

For vent termination clearance, references to National codes are shown in Fig. 46 for Direct Vent/2-Pipe system and Fig. 47 for Ventilated Combustion Air/Non-direct Vent/1-Pipe system. For exterior terminal arrangements, refer to Fig. 48 for Direct Vent/2-Pipe system and Fig. 49 for Ventilated Combustion Air/Non-direct/1-Pipe system. Contact Local code authorities for other requirements to and/or exemptions from the National codes shown in the figures.

Roof termination is often preferred since it is less susceptible to damage or contamination, is usually located away from adjacent structures, is less prone to icing conditions, and it often has less visible vent vapors. Sidewall terminations may require sealing or shielding of building surfaces with a corrosive resistance material due to the corrosive properties of combustion products from the vent system, as well as protection of adjacent structures.
When determining appropriate location for termination, consider the following guidelines:

1. Comply with all clearance requirements stated in Fig. 46 or Fig. 47 per application.
2. Termination or termination kit should be positioned where vent vapors will not damage plants/shrubs or air conditioning equipment.
3. Termination or termination kit should be positioned so that it will not be affected by wind eddy, such as inside building corners, nor by recirculation of flue gases, airborne leaves, or light snow.
4. Termination or termination kit should be positioned where it will not be damaged by or subjected to foreign objects such as stones, balls, etc.
5. Termination or termination kit should be positioned where vent vapors are not objectionable.

Direct Vent / 2-Pipe System

Direct vent (2-pipe) vent and combustion air pipes must terminate outside the structure. See Fig. 46 for references to vent clearances required by National code authorities. Allowable vent and combustion air terminations are shown in Fig. 48.

CARBON MONOXIDE POISONING HAZARD

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

For all venting configurations for this appliance and other gas appliances placed into operation for the structure, provisions for adequate combustion, ventilation, and dilution air must be provided in accordance with:


Canadian Installations: Part 8 of CAN/CSA-B149.1-10. Venting Systems and Air Supply for Appliances and all authorities having jurisdiction.

Ventilated Combustion Air

The vent pipe for a Ventilated Combustion Air System must terminate outdoors. See Fig. 47 for references to vent clearances required by National code authorities. Allowable vent terminations are shown in Fig. 49. The combustion air pipe terminates in a well-ventilated attic or crawl space. Follow the clearances as shown in Fig. 51.

The combustion air pipe cannot terminate in attics or crawl spaces that use ventilation fans designed to operate in the heating season. If ventilation fans are present in these areas, the combustion air pipe must terminate outdoors as a Direct Vent System.

Non-Direct Vent / 1-Pipe System

The vent pipe for a Non Direct Vent (1-pipe) system must terminate outdoors. See Fig. 47 for references to vent clearances required by National Code authorities. Allowable vent terminations are shown in Fig. 49.

A combustion air inlet pipe to the outdoors is not required for a Non-Direct (single-pipe) Vent System. A 12-in. long section of pipe with a tight radius 2-in. (51 mm) 90 degree elbow is required to be attached to the furnace. See Fig. 50. This short inlet air pipe helps to ensure stable combustion, as well as allow for sound attenuation. To aid sound attenuation, point the inlet air pipe away from occupants. An extra elbow and/or five feet of pipe may be used to accomplish the sound attenuation function.

Termination Requirements for the Provinces of Alberta and Saskatchewan

The Provinces of Alberta and Saskatchewan require a minimum unobstructed distance of 4 ft. (1.2 M) from the foundation to the property line of the adjacent lot for vent termination of any appliance with an input over 35,000 btuh. If there is less than 4 ft. (1.2 M) of unobstructed distance to the property line of the adjacent lot, no type of vent termination is permitted for appliances with inputs greater than 35,000 btuh.

There are no additional restrictions on unobstructed distances greater than 8 ft. (2.4 M). All single, two-pipe and concentric vents may be used, providing all other Code and manufacturer’s requirements in these instructions are adhered to. Refer to the appropriate Vent Termination section above for locating the vent termination.

If the unobstructed distance from the foundation to the property line of the adjacent lot is no less than 4 ft. (1.2 M) and no greater than 8 ft. (2.4 M), it will be necessary to re-direct the flue gas plume. In this situation, a concentric vent kit cannot be used. A 2-pipe termination (or single pipe termination when permitted) that re-directs the flue gas away by use of an elbow or tee, certified to ULC S636 from the adjacent property line must be used. See Fig. 50.

The concentric vent kit currently cannot be modified to attach an elbow to the vent portion of the rain cap. A tee attached to the rain cap could potentially direct the flue gas plume toward the intake air stream and contaminate the incoming combustion air for the furnace.

Refer to Fig. 50 for terminations approved for use in Alberta and Saskatchewan.

Size the Vent and Combustion Air Pipes

General

<table>
<thead>
<tr>
<th>VENT OR COMBUSTION AIR PIPE DIAMETERS</th>
<th>APPROVED 2-PIPE TERMINATION FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-in.</td>
<td>3-in.</td>
</tr>
<tr>
<td>1 1/2-in.</td>
<td>X</td>
</tr>
<tr>
<td>2-in.</td>
<td>X</td>
</tr>
<tr>
<td>2 1/2-in.</td>
<td>N/A</td>
</tr>
<tr>
<td>3-in.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Optional accessory 2-pipe termination brackets are sized for 2-in. and 3-in. pipe. If a termination bracket is required for a 4-in. termination, field fabricate the necessary brackets and clamps.

Furnace combustion air and vent pipe connections are sized for 2-in. (50 mm ND) PVC/ABS DWV pipe. The combustion air and vent pipe connections also accommodate 60 mm polypropylene venting systems with outside diameters of approximately 60 mm (2-3/8 inches). Any pipe diameter change should be made outside furnace casing in vertical pipe. Any change in diameter to the pipe must be made as close to the furnace as reasonably possible. See Fig. 39.

The Maximum Vent Length for the vent and combustion air pipe (when used) is determined from the Maximum Equivalent Vent
Length in Table 15 or 17, minus the number of fittings multiplied by the deduction for each type of fitting used from Table 16.

**NOTICE**

**OPTIONAL CONFIGURATION FOR COMBUSTION AIR INLET PIPE**

In applications where there is a risk of excessive moisture entering the combustion air inlet pipe, a moisture trap may be added to the inlet pipe to help prevent moisture from entering the furnace from the combustion air inlet pipe. See Fig. 53.

When sizing venting systems, the equivalent length of the optional moisture trap (15 feet/5 M) must be taken into account.

### Optional Combustion Air Inlet Moisture Trap

As an option to prevent moisture from trickling into the furnace vestibule, a trap can be installed in the intake air pipe near the furnace. Connecting a drain line to the trap is optional as trace amounts of moisture will evaporate into the intake air stream. If the combustion air inlet is located near a moisture exhaust duct, or there are other concerns of excessive moisture being drawn into the combustion air inlet, it is encouraged to connect a drain line to the trap.

The trap can be constructed from a running tee of the same diameter of the intake air pipe with EITHER a removable cap attached to a 6-inch long pipe connected to the tee or the External Vent Trap Kit to help prevent contaminants from entering the furnace. See Fig. 53.

The External Vent Trap Kit accessory may be used as a trap for the combustion air inlet pipe if a large amount of moisture must be removed. The drain line may be connected to the same drain as the furnace condensate and the evaporator coil condensate line ONLY if the inlet air trap drain and the evaporator coil drain empty into an open segment of pipe above the drain. See Fig. 53. When using the External Vent Trap Kit, refer to those instructions for proper drain connections.

The tee may also be connected to the intake air pipe on the side of the casing. See Fig. 53.

In any configuration, it will be necessary to add the equivalent length of the tee (15 feet/5 M) to the Total Equivalent Vent Length of the venting system.

**NOTICE**

### ADDITIONAL INFORMATION FOR POLYPROPYLENE VENTING SYSTEMS

Polypropylene venting systems include flexible vent pipe. These flexible vent pipes have a different equivalent vent length than straight sections of PVC/ABS DWV vent pipe. Be sure to make the appropriate deductions from the Maximum Equivalent Vent Length (MEVL), or additions to the Total Equivalent Vent Length (TEVL), when applying flexible vent pipes in polypropylene venting systems. See the polypropylene vent system manufacturer’s installation instructions for details.

When using metric-sized venting systems, use these equivalencies for obtaining the proper MEVL from the Tables:

| Pipe Size | Vent Tables for elbows and flexible vent pipe. Factory accessory concentric vent terminations or pipe lengths and elbows used for “standard” vent terminations do not require a deduction from the Maximum Equivalent Vent Length. See vent termination figures associated with Table 15. Include a deduction for a Tee when used for Alberta and Saskatchewan terminations.

**NOTE:** Polypropylene venting systems MAY require additional deductions from the MEVL, or additions to the TEVL, for vent terminations and flexible pipe sections. See the polypropylene venting system manufacturer’s instructions for details on equivalent lengths of vent terminations and flexible vent pipes, and for calculating total vent lengths.

To calculate the Total Equivalent Vent Length (TEVL) of the venting system:

1. Measure the individual distance from the furnace to the termination for each pipe.
2. Count the number of elbows for each pipe.
3. For each pipe, multiply the number of elbows by the equivalent length for the type of elbow used. Record the equivalent length of all the elbows for each pipe.
4. If a Tee is used on the termination (Alberta and Saskatchewan, when required) record the equivalent length of the Tee used.
5. Calculate Total Equivalent Vent Length by adding the equivalent lengths of the fittings to the lengths of the individual vent and combustion air pipes.
6. When using polypropylene venting systems with flexible vent pipes, perform adjustments for the equivalent length of the flexible vent pipe to the calculated total equivalent venting system length. See the polypropylene vent system manufacturer’s instructions for details.
7. Select a diameter of vent pipe from Tables 15 and 17 and note the Maximum Equivalent Vent Length (MEVL) shown for that application for that specific furnace input size. Compare the Total Equivalent Vent Length (TEVL) to the MEVL:
   - If the Total Equivalent Vent Length is shorter than the Maximum Equivalent Vent Length for the diameter of pipe chosen, then that diameter of pipe selected may be used.
   - If the Total Vent Length is longer than the Maximum Equivalent Vent Length for the diameter of pipe chosen, that diameter pipe MAY NOT be used for venting the furnace. Try the next larger diameter pipe.

**NOTE:** If the calculated Total Equivalent Vent Lengths results in different diameter pipes for the vent and combustion air, select the larger diameter for both pipes.

**NOTE:** If the Maximum Vent Length for diameter of the pipe selected is longer than the measured length and the equivalent length of all the fittings and terminations (TEVL), recalculate Total Equivalent Vent Length using the next smaller diameter. If the Maximum Equivalent Vent Length is still longer than the longer TEVL of the vent pipe or combustion air pipe, then that diameter of pipe selected may be used.

When installing vent systems pipe lengths of 10 ft. (3 M) or less, use the smallest allowable pipe diameter. Using a pipe size greater than required for short venting systems may result in loss of efficiency, incomplete combustion, flame disturbance, or flame sense lockout.

For vent systems longer than 10 ft. (3 M), any larger diameter vent pipe shown in Table 15 or 17 FOR THAT SIZE FURNACE may be used.

**Combustion Air and Vent Piping Insulation Guidelines**

**NOTE:** Use closed cell, neoprene insulation or equivalent.
The vent pipe may pass through unconditioned areas. The amount of exposed pipe allowed is shown in Table 14.

1. Using winter design temperature (used in load calculations), find appropriate temperature for your application and furnace model.
2. Determine the amount of total and exposed vent pipe.
3. Determine required insulation thickness for exposed pipe length(s).
4. When combustion air inlet piping is installed above a suspended ceiling, the pipe **MUST** be insulated with moisture resistant insulation such as Armaflex or other equivalent type of insulation.
5. Insulate combustion air inlet piping when run in warm, humid spaces.
6. Install the insulation per the insulation manufacturer’s installation instructions.

**NOTE:** Pipe length (ft. / M) specified for maximum pipe lengths located in unconditioned spaces cannot exceed total allowable pipe length as calculated from Table 15 or 17.

### Configure the Furnace

**WARNING**

**CARBON MONOXIDE POISONING HAZARD**

Failure to follow this warning could result in personal injury or death.

To route the vent pipe and combustion air pipe through the furnace, the manufacturer supplied kit must be used. Failure to properly seal the blower compartment from the furnace vestibule could result in the circulation of carbon monoxide throughout the structure. The vent pipe and combustion air pipe must be a continuous pipe while passing through the blower compartment. Seals supplied in this kit must be installed per the instructions provided. Follow all procedures outlined in these instructions.

### Install the Vent and Combustion Air Pipes

With the furnace installed in the required position, remove the desired knockouts from the casing. It will be necessary to remove one knockout for the vent pipe and the other knockout for the combustion air connection. See Fig. 12.

Use a flat blade screwdriver and tap on the knockout on opposite sides, where the knockout meets the casing. Fold the knockout down with duct pliers and work the knockout back and forth until it is removed. Trim any excess metal from the knockout with tin snips.

The vent elbow can be rotated to the required location on the casing if necessary. See Fig. 38. To rotate the vent elbow:

1. Loosen the clamp on the inlet of the vent elbow attached to the inducer.
2. Rotate the vent elbow to the required position. There are rounded notches on the vent elbow to align it with the inducer housing for each orientation.
3. Tighten the clamp around the vent elbow. Torque the clamp to 15 lb-in. See Fig. 40-43.

**Installing the Vent Pipe Adapter and Combustion Air Pipe Adapter**

**WARNING**

**CARBON MONOXIDE POISONING HAZARD**

Failure to follow this warning could result in personal injury or death.

To route the vent pipe and combustion air pipe through the furnace, the manufacturer supplied kit must be used. Failure to properly seal the blower compartment from the furnace vestibule could result in the circulation of carbon monoxide throughout the structure. The vent pipe and combustion air pipe must be a continuous pipe while passing through the blower compartment. Seals supplied in this kit must be installed per the instructions provided. Follow all procedures outlined in these instructions.

**NOTE:** The rubber coupling that attaches to the vent pipe adapter must be used. The adapter seals the vent pipe to the casing and reduces the strain on the vent elbow attached to the inducer.

1. Apply the gaskets to the vent pipe and combustion air pipe adapters. If supplied, remove and discard round center “slug” from interior of gasket. See Fig. 37.

**NOTE:** The vent pipe adapter can be distinguished from the inlet pipe adapter by the absence of an internal pipe-stopping ring. The vent pipe can pass through the vent pipe adapter; it cannot pass through the inlet pipe adapter.

1. Align the screw holes in the plastic vent pipe adapter with the dimples in the casing.
2. Pilot drill the screw holes for the adapter in the casing and attach the vent pipe adapter to the furnace with sheet metal screws
3. Slide the end of the rubber vent coupling with notches in it over the standoffs on the vent pipe adapter.
4. Insert a length of vent pipe through the coupling into the outlet of the vent elbow.
5. Tighten the clamp around the outlet of the vent elbow. Torque the clamp to 15 lb-in.

**NOTICE**

The following instructions are for PVC/ABS DWV vent piping only. **DO NOT USE THESE TECHNIQUES FOR POLYPROPYLENE VENT PIPING SYSTEMS.** See the polypropylene vent system manufacturer’s instructions for installing polypropylene venting systems.

Install the remaining vent and combustion air pipes as shown below. It is recommended that all pipes be cut, prepared, and pre-assembled before permanently cementing any joint.

1. Working from furnace to outside, cut pipe to required length(s).
2. De-burr inside and outside of pipe.
3. Chamfer outside edge of pipe for better distribution of primer and cement.
4. Clean and dry all surfaces to be joined.
5. Check dry fit of pipe and mark insertion depth on pipe.
6. Insert the vent pipe into the vent elbow.
7. Torque clamp on vent elbow 15 lb-in.
8. Torque clamp on vent coupling 15 lb-in.
9. Insert the combustion air pipe into the adapter.
10. Pilot drill a screw hole through the adapter into the combustion air pipe and secure the pipe to the adapter with sheet metal screws. **DO NOT DRILL INTO POLYPROPYLENE VENT PIPES.** Use an optional accessory vent coupling, if needed.
11. Seal around the combustion air pipe with silicone or foil tape. **SILICONE SEALERS MAY NOT BE APPROPRIATE FOR POLYPROPYLENE VENT SYSTEMS. SEE POLYPROPYLENE VENT SYSTEM MANUFACTURER’S INSTRUCTIONS.**
12. After pipes have been cut and pre-assembled, apply generous layer of cement primer to pipe fitting socket and end of pipe to insertion mark. Quickly apply approved cement to end of pipe and fitting socket (over primer). Apply cement in a light, uniform coat on inside of socket to prevent buildup of excess cement. **DO NOT CEMENT POLYPROPYLENE FITTINGS.**
13. While cement is still wet, twist pipe into socket with 1/4-in. turn. Be sure pipe is fully inserted into fitting socket.
14. Wipe excess cement from joint. A continuous bead of cement will be visible around perimeter of a properly made joint.
15. Handle pipe joints carefully until cement sets.
16. Horizontal portions of the venting system shall be supported to prevent sagging. Support combustion air piping and vent piping a minimum of every 5 ft. (1.5M) [3 ft. (91M) for SDR-21 or -26 PVC] using perforated metal hanging strap or commercially available hangars designed to support plastic pipe.
17. Prevent condensate from accumulating in the pipes by sloping the combustion air piping and vent piping downward towards furnace a minimum of 1/4-in. per linear ft. with no sags between hangers.
18. Complete the vent and combustion air pipe installation by connecting the concentric vent or by installing the required termination elbows as shown in Figs. 48, 49 and 50. For Ventilated Combustion Air Termination, See Fig. 51.
19. Use appropriate methods to seal openings where combustion air pipe and vent pipe pass through roof or sidewall.

**WARNING**

**CARBON MONOXIDE POISONING HAZARD**

Failure to follow this warning could result in personal injury or death.

**DO NOT** use cement to join polypropylene venting systems. Follow the polypropylene venting system manufacturer’s instructions for installing polypropylene venting systems.

---

**Optional Installation of the Vent Pipe**

NOTE: **DO NOT USE THIS TECHNIQUE FOR POLYPROPYLENE VENTING SYSTEMS.**

This option provides a disconnect point for the vent pipe. The vent pipe must be cemented to the plastic vent pipe adapter to maintain a sealed vestibule. See Fig. 44.

**Installing the Vent Termination**

**Roof Terminations**

A roof termination of any type will require a 4-in. (102 mm) flashing for a 2 in. (50 mm ND) concentric vent or a 5-in. diameter (127 mm) flashing for a 3-in. (80 mm ND) concentric vent kit. For two-pipe or single pipe vent systems, a flashing for each pipe of the required diameter will be necessary.

It is recommended that the flashing be installed by a roofer or competent professional prior to installing the concentric vent. The terminations can be installed on a flat or pitched roof.

**Concentric Vent**

Single or multiple concentric vent must be installed as shown in Fig. 48. Maintain the required separation distance between vents...
or pairs of vents as shown in Fig. 48 and all clearance shown in Fig. 46.

**WARNING**

CARBON MONOXIDE POISONING HAZARD

Failure to follow this warning could result in personal injury or death.

DO NOT use cement to join polypropylene venting systems. Follow the polypropylene venting system manufacturer’s instructions for installing polypropylene venting systems.

NOTE: Follow the instructions of the vent terminal manufacturer. These instructions are provided as a reference, only.

Cut one 4-in. (102 mm) diameter hole for 2-in. (50 mm ND) kit, or one 5-in. (127 mm) diameter hole for 3-in. (80 mm ND) kit in the desired location.

Loosely assemble concentric vent/combustion air termination components together using instructions in kit.

Slide assembled kit with rain shield REMOVED through hole in wall or roof flashing.

NOTE: Do not allow insulation or other materials to accumulate inside of pipe assembly when installing it through hole.

Disassemble loose pipe fittings. Clean and cement using same procedures as used for system piping. DO NOT CEMENT POLYPROPYLENE FITTINGS.

**Two-Pipe and Single-Pipe Terminations**

Single and two pipe vent must be installed as shown in Fig. 48 and 49. Maintain the required separation distance between vents or pairs of vents as shown in Fig. 48 and 49 and all clearance shown in Fig. 46 and 47.

NOTE: Do not allow insulation or other materials to accumulate inside of pipe assembly when installing it through hole.

Cross the required number of holes in the roof or sidewall for vent and (when used) combustion air pipes. Sidewall holes for two-pipe vent terminations should be side-by-side, allowing space between the pipes for the elbows to fit on the pipes.

Holes in the roof for direct-vent two-pipe terminations should be spaced no more than 18 in. (457 mm) apart to help avoid vent gas recirculation into combustion air intake.

Termination elbows will be installed after the vent and (if used) combustion air pipe is installed.

NOTE: Follow the instructions of the vent terminal manufacturer. These instructions are provided as a reference, only.

Determine an appropriate location for termination kit using the guidelines provided in section “Locating The Vent Termination” in this instruction.

1. Cut one 4-in. diameter hole for 2-in. kit, or one 5-in. diameter hole for 3-in. kit.
2. Loosely assemble concentric vent/combustion air termination components together using instructions in kit.
3. Slide assembled kit with rain shield REMOVED through hole.

NOTE: Do not allow insulation or other materials to accumulate inside of pipe assembly when installing it through hole.

4. Locate assembly through sidewall with rain shield positioned no more than 1-in. (25 mm) from wall as shown in Fig. 48.
5. Disassemble loose pipe fittings. Clean and cement using same procedures as used for system piping. DO NOT CEMENT POLYPROPYLENE FITTINGS.

**2-Pipe and 1-Pipe Vent Termination**

NOTE: Follow the instructions of the vent terminal manufacturer. These instructions are provided as a reference, only.

Determine an appropriate location for termination kit using the guidelines provided in section “Locating The Vent Termination” in this instruction.

1. Cut two holes, one for each pipe, of appropriate size for pipe size being used.
2. Loosely install elbow in bracket (if used) and place assembly on combustion-air pipe.
3. Install bracket as shown in Fig. 48 and 50.

NOTE: For applications using vent pipe option indicated by dashed lines in Fig. 48 and 49, rotate vent elbow 90° from position.

4. Disassemble loose pipe fittings. Clean and cement using same procedures as used for system piping. DO NOT CEMENT POLYPROPYLENE FITTINGS.

**Inducer Outlet Restrictor**

To improve efficiency and operation of 40,000 BTUH input models on very short vent systems, an inducer outlet restrictor is required to be installed on the outlet of the inducer assembly. The outlet restrictor is shipped in the loose parts bag.

To determine if the outlet restrictor is required, see Table 15 and Table 17. Failure to use an outlet choke when required may result in flame disturbance or flame sense lockout.

To install the outlet restrictor:

1. Remove the vent elbow from the inducer outlet.
2. Align the lock tabs on the outlet restrictor with the slots on the inside outlet of the inducer assembly.
3. Snap the outlet restrictor in place.
4. Re-install the vent elbow.
5. Torque vent elbow clamp 15-lb-in.
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<th>FITTINGS</th>
<th>SOLVENT CEMENT AND PRIMERS</th>
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* Not all families have these models.

* Pipe length (ft) specified for maximum pipe lengths located in unconditioned spaces. Pipes located in unconditioned space cannot exceed total allowable pipe length calculated from Table 15 or 17.

† Insulation thickness based on R value of 3.5 per in.
NOTE: Maximum Equivalent Vent Length (MEVL) includes standard and concentric vent termination and does NOT include elbows. Use Table 16 - Deductions from Maximum Equivalent Vent Length to determine allowable vent length for each application.

**Table 15 – Maximum Equivalent Vent Length - Ft. (M)**

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<td>Vent Pipe Diameter (in.)</td>
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<td>210 (64.0)</td>
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<td>127 (38.7)</td>
</tr>
<tr>
<td>80,000</td>
<td>17 (5.2)</td>
<td>64 (19.5)</td>
</tr>
<tr>
<td>100,000</td>
<td>NA</td>
<td>22 (6.7)</td>
</tr>
<tr>
<td>120,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>140,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>3001 to 4000 (914 to 1219)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40,000</td>
<td>39 (11.9)</td>
<td>184 (56.1)</td>
</tr>
<tr>
<td>60,000</td>
<td>23 (7.0)</td>
<td>119 (36.3)</td>
</tr>
<tr>
<td>80,000</td>
<td>15 (4.6)</td>
<td>59 (18.0)</td>
</tr>
<tr>
<td>100,000</td>
<td>NA</td>
<td>19 (5.8)</td>
</tr>
<tr>
<td>120,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>140,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>4001 to 4500 (1219 to 1370)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40,000</td>
<td>36 (11.0)</td>
<td>177 (53.9)</td>
</tr>
<tr>
<td>60,000</td>
<td>21 (6.4)</td>
<td>115 (35.1)</td>
</tr>
<tr>
<td>80,000</td>
<td>14 (4.3)</td>
<td>56 (17.1)</td>
</tr>
<tr>
<td>100,000</td>
<td>NA</td>
<td>17 (5.2)</td>
</tr>
<tr>
<td>120,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>140,000</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**NOTES:** See notes at end of venting tables. See Table 17 for altitudes over 4500 ft. (1370 M)

**Table 16 – Deductions from Maximum Equivalent Vent Length - Ft. (M)**

<table>
<thead>
<tr>
<th>Pipe Diameter (in.):</th>
<th>1-1/2</th>
<th>2</th>
<th>2-1/2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitered 90° Elbow</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Medium Radius 90° Elbow</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Long Radius 90° Elbow</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mitered 45° Elbow</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Medium Radius 45° Elbow</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Long Radius 45° Elbow</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Tee</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Concentric Vent Termination</td>
<td>NA</td>
<td>0</td>
<td>NA</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Standard Vent Termination</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**ELBOW CONFIGURATIONS**

- Long
- Medium
- Mitered

**VENT TERMINAL CONFIGURATIONS**

- Standard 2-in., 3-in., or optional 4-in. termination.
Venting System Length Calculations

The Total Equivalent Vent Length (TEVL) for EACH combustion air or vent pipe equals the length of the venting system, plus the equivalent length of elbows used in the venting system from Table 16.

Standard vent terminations or factory accessory concentric vent terminations count for zero deduction.

See vent system manufacturer’s data for equivalent lengths of flexible vent pipe or other termination systems. **DO NOT ASSUME** that one foot of flexible vent pipe equals one foot of straight PVC/ABS DWV vent pipe.

Compare the Total Equivalent Vent Length to the Maximum Equivalent Vent Lengths in Tables 15 and 17.

**Example 1**

A direct-vent 60,000 Btuh furnace installed at 2100 ft. (640 M). Venting system includes, FOR EACH PIPE, 100 feet (30 M) of vent pipe, 95 feet (28 M) of combustion air inlet pipe, (3) 90° long radius elbows, (2) 45° long radius elbows and a factory accessory concentric vent kit.

Can this application use 2-in. (50 mm ND) PVC/ABS DWV vent piping?

<table>
<thead>
<tr>
<th>Measure the required linear length of air inlet and vent pipe; insert the longest of the two here:</th>
<th>100 ft</th>
<th>Use length of the longer of the vent or air inlet piping system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add equiv length of (3) 90° long-radius elbows (use the highest number of elbows for either the vent or inlet pipe)</td>
<td>3 x 3 ft = 9 ft.</td>
<td>From Table 16</td>
</tr>
<tr>
<td>Add equiv length of (2) 45° long-radius elbows (use the highest number of elbows for either the vent or inlet pipe)</td>
<td>2 x 1.5 ft = 3 ft.</td>
<td>From Table 16</td>
</tr>
<tr>
<td>Add equiv length of of vent termination</td>
<td>0 ft.</td>
<td>From Table 16</td>
</tr>
<tr>
<td>Add correction for flexible vent pipe, if any</td>
<td>0 ft.</td>
<td>From Vent Manufacturer’s instructions; zero for PVC/ABS DWV</td>
</tr>
</tbody>
</table>

**Total Equivalent Vent Length (TEVL)**

112 ft. Add all of the above lines

**Maximum Equivalent Vent Length (MEVL)**

127 ft. For 2” pipe from Table 15

**Is TEVL less than MEVL?**

YES Therefore, 2” pipe may be used

---

**Example 2**

A direct-vent 60,000 Btuh furnace installed at 2100 ft. (640 M) Venting system includes, FOR EACH PIPE, 100 feet (30 M) of vent pipe, 95 feet (28 M) of combustion air inlet pipe, (3) 90° long radius elbows, and a polypropylene concentric vent kit. Also includes 20 feet (6 M) of flexible polypropylene vent pipe, included within the 100 feet (30 M) of vent pipe.

Assume that one meter of flexible 60 mm or 80 mm polypropylene pipe equals 1.8 meters of PVC/ABS pipe. **VERIFY FROM VENT MANUFACTURER’S INSTRUCTIONS.**

Can this application use 60 mm (O.D.) polypropylene vent piping? If not what size piping can be used?

<table>
<thead>
<tr>
<th>Measure the required linear length of air inlet and vent pipe; insert the longest of the two here:</th>
<th>100 ft</th>
<th>Use length of the longer of the vent or air inlet piping system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add equiv length of (3) 90° long-radius elbows (use the highest number of elbows for either the vent or inlet pipe)</td>
<td>3 x 3 ft = 9 ft.</td>
<td>From Vent Manufacturer’s instructions</td>
</tr>
<tr>
<td>Add equiv length of (2) 45° long-radius elbows (use the highest number of elbows for either the vent or inlet pipe)</td>
<td>0 x 3 ft = 0 ft.</td>
<td>From Vent Manufacturer’s instructions</td>
</tr>
<tr>
<td>Add equiv length of of vent termination</td>
<td>9 M x 3 ft/M = 18 ft.</td>
<td>From Vent Manufacturer’s instructions</td>
</tr>
<tr>
<td>Add correction for flexible vent pipe, if any</td>
<td>1.8 x 20 ft = 36 ft.</td>
<td>From Vent Manufacturer’s instructions</td>
</tr>
</tbody>
</table>

**Total Equivalent Vent Length (TEVL)**

163 ft. Add all of the above lines

**Maximum Equivalent Vent Length (MEVL)**

127 ft. For 2” pipe from Table 15

**Is TEVL less than MEVL?**

NO Therefore, 60mm pipe may NOT be used; try 80 mm

**Maximum Equivalent Vent Length (MEVL)**

250 ft. For 3” pipe from Table 15

**Is TEVL less than MEVL?**

YES Therefore, 80 mm pipe may be used
NOTE: Maximum Equivalent Vent Length (MEVL) includes standard and concentric vent termination and does NOT include elbows.
Use Table 16 - Deductions from Maximum Equivalent Vent Length to determine allowable vent length for each application.

Table 17 – Maximum Equivalent Vent Length - Ft. (M)
4501 to 10,000 Ft. (0 to 1370 M) Altitude

<table>
<thead>
<tr>
<th>Altitude FT (M)</th>
<th>Unit Size</th>
<th>DIRECT VENT (2.PIPE) AND SINGLE-PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vent Pipe Diameter (in.) 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/2</td>
</tr>
<tr>
<td>4501 to 5000 (1370 to 1524)</td>
<td>40,000</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
<tr>
<td>5001 to 6000 (1524 to 1829)</td>
<td>40,000</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
<tr>
<td>6001 to 7000 (1829 to 2134)</td>
<td>40,000</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
<tr>
<td>7001 to 8000 (2134 to 2438)</td>
<td>40,000</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
<tr>
<td>8001 to 9000 (2438 to 2743)</td>
<td>40,000</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
<tr>
<td>9001 to 10,000 (2743 to 3048)</td>
<td>40,000</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>60,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>80,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>120,000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>140,000</td>
<td>NA</td>
</tr>
</tbody>
</table>

NOTES:
1. Use only the vent pipe sizes shown for each furnace. It is NOT necessary to choose the smallest diameter pipe possible for venting.
2. NA – Not allowed. Pressure switch will not close, or flame disturbance may result.
3. Total equivalent vent lengths under 10' for 40,000 BTUH furnaces from 0 to 2000 ft. (0 to 610 M) above sea level require use of an outlet choke plate. Failure to use an outlet choke when required may result in flame disturbance or flame sense lockout.
4. Not all furnace families include 140,000 BTUH input models.
5. Vent sizing for Canadian installations over 4500 ft. (1370 M) above sea level are subject to acceptance by local authorities having jurisdiction.
6. Size both the combustion air and vent pipe independently, then use the larger size for both pipes.
7. Assume the two 45° elbows equal one 90° elbow. Wide radius elbows are desirable and may be required in some cases.
8. Elbow and pipe sections within the furnace casing and at the vent termination should not be included in vent length or elbow count.
9. The minimum pipe length is 5 ft. (2 M) linear feet (meters) for all applications.
10. Use 3---in. (76 mm) diameter vent termination kit for installations requiring 4---in. (102 mm) diameter pipe.
Attach gaskets to vent pipe and combustion air adapters.

**Fig. 37 - Vent Coupling and Adapter with Gaskets**

**PSC INDUCER ASSEMBLY**

**Fig. 38 - Inducer Vent Elbow**

**Fig. 39 - Combustion Air and Vent Pipe Diameter Transition Location and Elbow Configuration**
Rotate vent elbow to required position.

Any other unused knockout may be used for combustion air connection.

**UPFLOW LEFT CONFIGURATION**

**UPFLOW RIGHT CONFIGURATION**

**UPFLOW VERTICAL VENT**

---

**DOWNFLOW LEFT CONFIGURATION**

**DOWNFLOW RIGHT CONFIGURATION**

**DOWNFLOW VERTICAL**

---

Fig. 40 - Upflow Configurations (Appearance may vary)
See “Notes for Venting Options”

Fig. 41 - Downflow Configurations (Appearance may vary)
See “Notes for Venting Options”
HORIZONTAL LEFT – VERTICAL VENT CONFIGURATION

Alternate combustion air connection.

Rotate vent elbow to required position.

Fig. 42 - Horizontal Left (Appearance may vary)
See “Notes for Venting Options”

HORIZONTAL RIGHT – VERTICAL VENT CONFIGURATION

ALTERNATE COMBUSTION AIR CONNECTIONS

Requires Accessory Vent Kit
See Product Data for Current Kit Number

HORIZONTAL LEFT – LEFT VENT CONFIGURATION

Fig. 43 - Horizontal Right (Appearance may vary)
See “Notes for Venting Options”

HORIZONTAL RIGHT – RIGHT VENT CONFIGURATION

ALTERNATE COMBUSTION AIR CONNECTIONS

Requires Internal Vent Kit
See Product Data for Current Kit Number

HORIZONTAL RIGHT – LEFT VENT CONFIGURATION

Requires Accessory Vent Kit
See Product Data for Current Kit Number
NOTES FOR VENTING OPTIONS

1. Attach vent pipe adapter with gasket to furnace casing.
2. Align notches in rubber coupling over standoffs on adapter. Slide clamps over the coupling.
3. Slide vent pipe through adapter and coupling into vent elbow.
4. Insert vent pipe into vent elbow.
5. Torque all clamps 15 lb.-in.
6. Attach combustion air pipe adapter with gasket to furnace.
7. Attach combustion air pipe to adapter with silicone. Pilot drill a 1/8-in. hole in adapter and secure with a #7 x 1/2-in. sheet metal screw.

Fig. 44 - Optional Vent Pipe Flush with Adaptor

Fig. 45 - Combustion Air Pipe Attachment
**NOTE:** The following is based upon National codes for gas appliances and is provided as a reference. Refer to local codes which may supersede these standards and/or recommendations.

<table>
<thead>
<tr>
<th>Item</th>
<th>Clearance Description</th>
<th>Canadian Installations (1) (per CAN/CSA B149.1)</th>
<th>U.S. Installations (2) (per ANSI Z223.1/NFPA 54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clearance above grade, veranda, porch, deck, balcony or anticipated snow level</td>
<td>12 in. (305 mm)</td>
<td>12 in. (305 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 in. (457 mm) above roof surface.</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Clearance to a window or door that may be opened</td>
<td>12 in. (305 mm) for appliances &gt;10,000 Btuh (3 kW) and &lt;=100,000 Btuh (30 kW)</td>
<td>9 in. (229 mm) for appliances &gt;10,000 Btuh (3 kW) and &lt;=50,000 Btuh (15 kW)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36 in. (914 mm) for appliances &gt;100,000 Btuh (30 kW)</td>
<td>12 in. (305 mm) for appliances &gt;50,000 Btuh (15kW)</td>
</tr>
<tr>
<td>C</td>
<td>Clearance to a permanently closed window</td>
<td>For clearances not specified in ANSI Z223.1/NFPA 54 or CAN/CSA B149.1, clearances shall be in accordance with local installation codes and the requirements of the gas supplier and the manufacturer’s installation instructions.</td>
<td>Manufacturer’s Recommendation: See Notes 3-8.</td>
</tr>
<tr>
<td>D</td>
<td>Vertical clearance to a ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the centerline of the terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Clearance to an unventilated soffit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Clearance to an outside corner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Clearance to an inside corner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Clearance to each side of the centerline extended above electrical meter or gas service regulator assembly</td>
<td>3 ft. (914 mm) within 15 ft. (4.6 M) above the meter/regulator assembly.</td>
<td>3 ft. (914 mm) within 15 ft. (4.6 M) above the meter/regulator assembly.</td>
</tr>
<tr>
<td>I</td>
<td>Clearance to service regulator vent outlet</td>
<td>3 ft. (914 mm)</td>
<td>See Note 4.</td>
</tr>
<tr>
<td>J</td>
<td>Clearance to non—mechanical air supply inlet to building or the combustion air inlet to any other appliance</td>
<td>12 in. (305 mm) for appliances &gt;10,000 Btuh (3 kW) and &lt;=100,000 Btuh (30 kW)</td>
<td>9 in. (229 mm) for appliances &gt;10,000 Btuh (3 kW) and &lt;=50,000 Btuh (15 kW)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36 in. (914 mm) for appliances &gt;100,000 Btuh (30 kW)</td>
<td>12 in. (305 mm) for appliances &gt;50,000 Btuh (15kW)</td>
</tr>
<tr>
<td>K</td>
<td>Clearance to a mechanical air supply inlet</td>
<td>6 ft. (1.8 M)</td>
<td>3 ft. (914 mm)</td>
</tr>
<tr>
<td>L</td>
<td>Clearance under a veranda, porch, deck, or balcony</td>
<td>12 in. (305 mm).</td>
<td>Manufacture’s Recommendation: See Notes 3-8.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Clearance to each side of the centerline extended above or below vent terminal of the furnace to a dryer or water heater vent, or other appliance’s direct vent intake or exhaust</td>
<td>12 in. (305 mm)</td>
<td>12 in. (305 mm)</td>
</tr>
<tr>
<td>N</td>
<td>Furnace combustion air intake clearance to a water heater vent, dryer vent or other types of appliance exhausts.</td>
<td>3 ft. (914 mm)</td>
<td>3 ft. (914 mm)</td>
</tr>
<tr>
<td>O</td>
<td>Clearance from a plumbing vent stack</td>
<td>3 ft. (914 mm)</td>
<td>3 ft. (914 mm)</td>
</tr>
<tr>
<td>P</td>
<td>Clearance above paved sidewalk or paved driveway located on public property</td>
<td>7 ft. (2.1 M)</td>
<td>See Note 4.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vent shall not terminate above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.</td>
<td></td>
</tr>
</tbody>
</table>

> greater than, ≥ greater than or equal to, < less than, ≤ less than or equal to

**Notes:**

1. In accordance with the current CAN/CSA B149.1, Natural Gas and Propane Installation Code.
2. In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code
3. **NOTE:** This table is based upon National codes for gas appliances, and are provided as a reference. Refer to Local codes which may supersede these standards and/or recommendations.
4. For clearances not specified in ANSI Z223.1/NFPA 54 or CAN/CSA B 149.1, clearances shall be in accordance with local installation codes and the requirements of the gas supplier and the manufacturer’s installation instructions.
5. When locating vent terminations, consideration must be given to prevailing winds, location, and other conditions which may cause recirculation of the combustion products of adjacent vents. Recirculation can cause poor combustion, inlet condensate problems, vent termination icing and/or accelerated corrosion of the heat exchangers.
6. Design and position vent outlets to avoid ice build-up on and moisture damage to surrounding surfaces.
7. The vent for this appliance shall not terminate:
   a. Near soffit vents of crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or property damage; or
   b. Where condensate vapor could cause damage could be detrimental to the operation of regulators, relief valves, or other equipment.
8. Avoid venting under a deck or large overhang. Recirculation could occur and cause performance or system problems. Ice build-up may occur.

Fig. 46 - Direct Vent Termination Clearance
NOTE: The following is based upon National codes for gas appliances and is provided as a reference. Refer to local codes which may supersede these standards and/or recommendations.

<table>
<thead>
<tr>
<th>Item</th>
<th>Clearance Description</th>
<th>Canadian Installations (1) (per CAN/CSA B149.1)</th>
<th>U.S. Installations (2) (per ANSI Z223.1/NFPA 54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clearance above grade, veranda, porch, deck, balcony or anticipated snow level</td>
<td>12 in. (305 mm) above roof surface.</td>
<td>12 in. (305 mm) above roof surface.</td>
</tr>
<tr>
<td>B</td>
<td>Clearance to a window or door that may be opened</td>
<td>12 in. (305 mm) for appliances &gt;10,000 Btuh (3 kW) and ≤100,000 Btuh (30 kW), 36 in. (914 mm) for appliances &gt;100,000 Btuh (30 kW)</td>
<td>4ft. (1.2M) below or to the side of the opening, 1 ft (.3M) above the opening. Manufacturer’s Recommendation: See Note 8.</td>
</tr>
<tr>
<td>C</td>
<td>Clearance to a permanently closed window</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Vertical clearance to a ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the centerline of the terminal</td>
<td>For clearances not specified in ANSI Z223.1/NFPA 54 or CAN/CSA B149.1, clearances shall be in accordance with local installation codes and the requirements of the gas supplier and the manufacturer’s installation instructions. Manufacturer’s Recommendation: See Notes 3-8.</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Clearance to an unventilated soffit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Clearance to an outside corner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Clearance to an inside corner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Clearance to each side of the centerline extended above electrical meter or gas service regulator assembly</td>
<td>3 ft. (.9 M) within 15 ft. (4.6 M) above the meter/regulator assembly.</td>
<td>3 ft. (.9 M) within 15 ft. (4.6 M) above the meter/regulator assembly.</td>
</tr>
<tr>
<td>I</td>
<td>Clearance to service regulator vent outlet</td>
<td>3ft. (9 M)</td>
<td>See Note 4.</td>
</tr>
<tr>
<td>J</td>
<td>Clearance to non—mechanical air supply inlet to building or the combustion air inlet to any other appliance</td>
<td>12 in. (305 mm) for appliances &gt;10,000 Btuh (3 kW) and ≤100,000 Btuh (30 kW), 36 in. (914 mm) for appliances &gt;100,000 Btuh (30 kW)</td>
<td>4ft. (1.2M) below or to the side of the opening, 1 ft (.3M) above the opening. Manufacturer’s Recommendation: See Note 8.</td>
</tr>
<tr>
<td>K</td>
<td>Clearance to a mechanical air supply inlet</td>
<td>6 ft. (1.8 M)</td>
<td>3ft. (9 M)</td>
</tr>
<tr>
<td>L</td>
<td>Clearance under a veranda, porch, deck, or balcony</td>
<td>12 in. (305 mm)</td>
<td>See Note 4. Manufacturer’s Recommendation: See Notes 3-8.</td>
</tr>
<tr>
<td>M</td>
<td>Clearance to each side of the centerline extended above or below vent terminal of the furnace to a dryer or water heater vent, or other appliance’s direct vent intake or exhaust</td>
<td>12 In. (305 mm)</td>
<td>12 in. (305 mm)</td>
</tr>
<tr>
<td>N</td>
<td>Clearance to a moisture exhaust duct (dryer vent, spa exhaust, etc.)</td>
<td>12 in. (305 mm) See Note 4</td>
<td>12 in. (305 mm) See Note 4</td>
</tr>
<tr>
<td>O</td>
<td>Clearance from a plumbing vent stack</td>
<td>3 ft. (9 M)</td>
<td>3 ft. (9 M)</td>
</tr>
<tr>
<td>P</td>
<td>Clearance above paved sidewalk or paved driveway located on public property</td>
<td>Vent shall not terminate above a sidewalk or paved driveway that is located between two single-family dwellings and serves both dwellings.</td>
<td>See Note 4.</td>
</tr>
</tbody>
</table>

Notes:
1. In accordance with the current CAN/CSA B149.1, Natural Gas and Propane Installation Code.
2. In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code
3. NOTE: This table is based upon National codes for gas appliances, and are provided as a reference. Refer to Local codes which may supersede these standards and/or recommendations.
4. For clearances not specified in ANSI Z223.1/NFPA 54 or CAN/CSA B 149.1, clearances shall be in accordance with local installation codes and the requirements of the gas supplier and the manufacturer’s installation instructions.
5. When locating vent terminations, consideration must be given to prevailing winds, location, and other conditions which may cause recirculation of the combustion products of adjacent vents. Recirculation can cause poor combustion, inlet condensation problems, vent termination icing and/or accelerated corrosion of the heat exchangers.
6. Design and position vent outlets to avoid ice build-up on and moisture damage to surrounding surfaces.
7. The vent for this appliance shall not terminate:
   a. Near soffit vents of crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or property damage; or
   b. Where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.
8. These National standards apply to all non-direct-vent gas appliances. Contact Local code officials for additional requirements and/or exclusions.

Fig. 47 - Ventilated Combustion Air and Non-Direct Vent Termination Clearance
**Fig. 48 - Combustion Air and Vent Pipe Termination for Direct Vent (2-Pipe) System**

- **Abandoned masonry used as raceway**
- **12 in. (305 mm) min. from overhang or roof (Typ.)**
- **Maintain 12 in. (305 mm) min. separation between bottom of combustion air and bottom of vent (Typ.)**
- **At least 36 in. (914 mm)**
- **6 in. (152 mm) minimum clearance between wall and end of vent pipe.**
- **10 in. (254 mm) maximum pipe length**
- **90°**

**Fig. 49 - Vent Pipe Termination for Non-Direct Vent and Ventilated Combustion Air System**

- **Abandoned masonry used as raceway**
- **12 in. min. (305 mm) from overhang or roof**
- **6 in. (152 mm) minimum clearance between wall and end of vent pipe.**
- **10 in. (254 mm) maximum pipe length**
- **Maintain 12 in. (305 mm) min. clearance above highest anticipated snow level or grade whichever is greater.**
- **Maintain 12 in. (305 mm) min. clearance above highest anticipated snow level or grade whichever is greater.**
- **Sidewall Termination with Straight Pipe (preferred)**
- **Maintain 12 in. (305 mm) min. clearance above highest anticipated snow level or grade whichever is greater.**
OPTIONAL TERMINATION BRACKET FOR 2-PIPE TERMINATIONS

12 IN. (305 MM) MIN. SEPARATION BETWEEN BOTTOM OF COMBUSTION AIR AND BOTTOM OF VENT.

12-IN. (305 MM) ABOVE ANTICIPATED SNOW LEVEL

Fig. 50 - Alberta and Saskatchewan Vent Termination
Fig. 51 - Vent Terminations for Ventilated Combustion Air
EXAMPLE FOR UPFLOW INSTALLATIONS. MAY BE APPLIED TO OTHER CONFIGURATIONS.

Fig. 52 - Sample Inlet Air Pipe Connection for Polypropylene Venting Systems

Fig. 53 - Optional Combustion Air Inlet Moisture Trap
START-UP, ADJUSTMENT, AND SAFETY CHECK

NOTICE

Important Installation and Start-up Procedures

Failure to follow this procedure may result in a nuisance smoke or odor complaint.

The manifold pressure, gas rate by meter clocking, temperature rise and operation must be checked after installation. Minor smoke and odor may be present temporarily after start-up from the manufacturing process. Some occupants are more sensitive to this minor smoke and odor. It is recommended that doors and windows be open during the first heat cycle.

General

1. Furnace must have a 115-v power supply properly connected and grounded.

NOTE: Proper polarity must be maintained for 115-v wiring. Control status indicator light flashes rapidly and furnace does not operate if polarity is incorrect if the furnace is not grounded.

2. Thermostat wire connections at terminals R, W/W1, G, and Y/Y2 must be made at 24-v terminal block on furnace control.

3. Natural gas service pressure must not exceed 0.5 psig (14-in. w.c., 350 Pa), but must be no less than 0.16 psig (4.5-in. w.c., 1125 Pa).

4. Blower door must be in place to complete 115-v electrical circuit and supply power to the furnace components.

CAUTION

UNIT OPERATION HAZARD

Failure to follow this caution may result in intermittent unit operation or performance dissatisfaction.

These furnaces are equipped with a manual reset limit switch in burner assembly. This switch opens and shuts off power to the gas valve if an overheat condition (flame rollout) occurs in the burner assembly/enclosure. Correct inadequate combustion-air supply, improper gas pressure setting, improper burner or gas orifice positioning, or improper venting condition before resetting switch. DO NOT jumper this switch.

Before operating furnace, check flame rollout manual reset switch for continuity. If necessary, press button to reset switch.

EAC-1 terminal is energized whenever blower operates. HUM terminal is only energized when the gas valve is energized in heating.

Thermostat Setup Switch

This furnace can be installed with either a single-stage heating or a 2-stage heating thermostat. Setup switch SW-1 (LHT) is used to configure the furnace for single or two stage thermostat operation.

For single-stage thermostats, connect thermostat W to W/W1 at furnace control terminal block. See Fig. 34. For single-stage thermostats, the control will determine, based on length of previous heating on and off cycles, when to operate in low- and high-gas heat for optimum comfort. Setup switch SW-1 (LHT) must be in the factory-shipped OFF position. See Fig. 34 and 66 for setup switch information.

If a 2-stage heating thermostat is to be used, move SW-1 (LHT) to ON position before starting furnace. This overrides built-in control process for selecting high and low fire and allows the 2-stage thermostat to select gas heating modes. The W2 from thermostat must be connected to W2 on control terminal block.

Prime Condensate Trap with Water

WARNING

CARBON MONOXIDE POISONING HAZARD

Failure to follow these warnings could result in personal injury or death.

Failure to use a properly configured trap or NOT water-priming trap before operating furnace may allow positive pressure vent gases to enter the structure through drain tube. Vent gases contain carbon monoxide which is tasteless and odorless.

CAUTION

UNIT OPERATION HAZARD

Failure to follow this caution may result in intermittent unit operation or performance satisfaction.

Condensate trap must be PRIMED or proper draining may not occur. The condensate trap has two internal chambers which can ONLY be primed by pouring water into the inducer drain side of condensate trap.

WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow this warning could result in personal injury, death, and/or property damage.

Never purge a gas line into a combustion chamber. 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.

1. Remove upper and middle collector box drain plugs opposite of the condensate trap. See Fig. 61.

2. Connect field-supplied 5/8-in. (16 mm) ID tube with attached funnel to upper collector box drain connection. See Fig. 61.

3. Pour one quart (liter) of water into funnel/tube. Water should run through collector box, overfill condensate trap, and flow into open field drain.

4. Remove funnel; replace collector box drain plug.

5. Connect field-supplied 5/8-in. (16 mm) ID tube to middle collector box drain port.

6. Pour one quart (liter) of water into funnel/tube. Water should run through collector box, overfill condensate trap, and flow into open field drain.

7. Remove funnel and tube from collector box and replace collector box drain plug.

Purge Gas Lines

If not previously done, purge the lines after all connections have been made and check for leaks.
**Adjustments**

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIRE HAZARD</strong></td>
</tr>
<tr>
<td>Failure to follow this warning could result in personal injury, death and/or property damage.</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FURNACE DAMAGE HAZARD</strong></td>
</tr>
<tr>
<td>Failure to follow this caution may result in reduced furnace life.</td>
</tr>
<tr>
<td>DO NOT redrill orifices. Improper drilling (burrs, out-of-round holes, etc.) can cause excessive burner noise and misdirection of burner flames. This can result in flame impingement of heat exchangers, causing failures. See Fig. 55.</td>
</tr>
</tbody>
</table>

For proper operation and long term reliability, the Furnace input rate must be within +/-2 percent of input rate on furnace rating plate, or as adjusted for altitude. The gas input rate on rating plate is for installations at altitudes up to 2000 ft. (609.6M).

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The NATURAL GAS manifold pressure adjustments in Table 21 compensate for BOTH altitude AND gas heating value. DO NOT apply an additional de-rate factor to the pressures show in Table 21. The values in this table are NOT referenced to sea level; they are AS-MEASURED AT ALTITUDE.</td>
</tr>
<tr>
<td>The heating content of natural gas at altitude may already provide for a reduction in capacity of the furnace. Be sure to obtain the expected in-season gas heating value of the gas from the gas supplier BEFORE making any adjustment for capacity or altitude. Refer to Table 21. No adjustments to the furnace may be necessary at altitude for certain gas heating values.</td>
</tr>
<tr>
<td>Refer to the instructions provided in the factory-specified LP/Propane conversion kit for instructions for setting gas manifold pressures for LP/Propane applications.</td>
</tr>
</tbody>
</table>

In the USA, the input rating for altitudes above 2000 ft. (609.6M) must be reduced by 2 percent for each 1000 ft. (304.8M) above sea level. Refer to Table 18.

In Canada, the input rating must be reduced by 5 percent for altitudes of 2000 ft. (609.6M) to 4500 ft. (1371.6M) above sea level. The natural gas manifold pressures in Table 21 adjust for both altitude and natural gas heating value.

**NOTE:** For Canadian altitudes of 2000 to 4500 ft. (610 to 1372 M), use USA altitudes of 2001 to 3000 ft. (611 to 914 M) in Table 21.

To adjust manifold pressure to obtain the proper input rate, first, determine if the furnace has the correct orifice installed. At higher altitudes or different gas heat contents, it may be necessary to change the factory orifice to a different orifice. Tables have been provided in the furnace installation instructions to match the required orifice to the manifold pressure to the heat content and specific gravity of the gas. To do this:

1. Obtain average yearly gas heat value (at installed altitude) from local gas supplier.
2. Obtain average yearly gas specific gravity from local gas supplier.
3. Find installation altitude in Table 21.
4. Find closest natural gas heat value and specific gravity in Table 21. Follow heat value and specific gravity lines to point of intersection to find orifice size and low- and high-heat manifold pressure settings for proper operation.
5. Check and verify burner orifice size in furnace. NEVER ASSUME ORIFICE SIZE. ALWAYS CHECK AND VERIFY.

6. Replace orifice with correct size, if required as shown in Table 21. Use only factory-supplied orifices. See EXAMPLE 1.

**EXAMPLE 1:** 0 - 2000 ft. (0 - 609.6M) altitude

- **Heating value** = 1050 Btu/cu ft.
- **Specific gravity** = 0.62
- Therefore: Orifice No. 44

(Furnace is shipped with No. 44 orifices. In this example, all main burner orifices are the correct size and do not need to be changed to obtain proper input rate.)

**Manifold pressure:** 3.4-in. w.c. (847 Pa) for high heat, 1.4-in. w.c. (349 Pa) for low heat.

**NOTE:** To convert gas manifold Table pressures to Pascals, multiply the in. w.c. value by 249.1 Pa/in. w.c. (1 in. w.c. = 249.1 Pa).

1. Adjust manifold pressure to obtain low fire input rate. See Fig. 54.
   a. Turn gas valve ON/OFF switch to OFF.
   b. Remove manifold pressure tap plug from gas valve.
   c. Connect a water column manometer or similar device to manifold pressure tap.
   d. Turn gas valve ON/OFF switch to ON.
   e. Move setup SW-1 (LHT) on furnace control to ON position to lock furnace in low-heat operation. See Fig. 35 and 66.
   f. Manually close blower door switch.
   g. Jumper R and W/W1 thermostat connections on control to start furnace. See Fig. 35.
   h. Remove regulator adjustment cap from low heat gas valve pressure regulator and turn low-heat adjusting screw (3/16 or smaller flat-tipped screwdriver) counterclockwise (out) to decrease input rate or clockwise (in) to increase input rate. See Fig. 54.

i. Install low-heat regulator adjustment cap.

**NOTICE**

DO NOT set low-heat manifold pressure less than 1.3-in. w.c. (324 Pa) or more than 1.7-in. w.c. (423 Pa) for natural gas. If required manifold pressure is outside this range, change main burner orifices.

---

For the complete documentation, please refer to the actual publication or manual.
j. Reinstall manifold pressure tap plug from gas valve.
k. Move setup switch SW-1 (LHT) to off position after completing low-heat adjustment.
l. Leave manometer or similar device connected and proceed to Step 2.

2. Adjust manifold pressure to obtain high fire input rate. See Fig. 54.
   a. Jumper R to W/W1 and W2 thermostat connections on furnace control. This keeps furnace locked in high-heat operation.
   b. Remove regulator adjustment cap from high-heat gas valve pressure regulator. See Fig. 54 and turn high heat adjusting screw (3/16-in. or smaller flat-tipped screwdriver) counterclockwise (out) to decrease input rate or clockwise (in) to increase input rate.
   c. When correct input is obtained, replace caps that conceal gas valve regulator adjustment screws. Main burner flame should be clear blue, almost transparent. See Fig. 59.
   d. Remove jumpers R to W/W1 and R to W2.

3. Verify natural gas input rate by clocking meter.
   **NOTE:** Contact your HVAC distributor or gas supplier for metric tables, if required.
   a. Turn off all other gas appliances and pilots served by the meter.
   b. Move setup switch SW-1 (LHT) to ON position. This keeps furnace locked in low-heat operation when only W/W1 is energized.
   c. Jumper R to W/W1.
   d. Run furnace for 3 minutes in low-heat operation.
   e. Measure time (in sec) for gas meter to complete one revolution and note reading. The 2 or 5 cubic feet dial provides a more accurate measurement of gas flow.
   f. Refer to Table 20 for cubic ft. of gas per hr.
   g. Multiply gas rate cu ft./hr by heating value (Btu/hr/cu ft.) to obtain input rate.
   h. If clocked rate does not match required input from Step 1, increase manifold pressure to increase input or decrease manifold pressure to decrease input. Repeat steps b through e of Step 1 until correct low-heat input is achieved. Reinstall low heat regulator seal cap on gas valve.
   i. Jumper R to W/W1, and W2. This keeps furnace locked in high-heat operation when both W/W1 and W2 are energized.
   j. Repeat items d through h for high-heat operation, repeating Step 2 and adjusting the high-heat regulator screw, as required.

4. Restore furnace to normal operating condition.
   a. Turn gas valve ON/OFF switch to OFF.
   b. Remove water column manometer or similar device from manifold pressure tap.
   c. Replace manifold pressure tap plug to gas valve.
   d. Turn gas valve ON/OFF switch to ON.
   e. Move setup SW-1 (LHT) on furnace control to position required for attached thermostat (OFF for single-stage thermostats, ON for two-stage thermostats).
   f. Check for gas leaks and verify furnace operation.

---

**NOTICE**

DO NOT set high-heat manifold pressure less than 3.2-in. w.c. (797 Pa) or more than 3.8 in. w.c. (947 Pa) for natural gas. If required manifold pressure is outside this range, change main burner orifices to obtain manifold pressure in this range.

c. When correct input is obtained, replace caps that conceal gas valve regulator adjustment screws. Main burner flame should be clear blue, almost transparent. See Fig. 59.
d. Remove jumpers R to W/W1 and R to W2.

---

**CAUTION**

**CAUTION**

FURNACE DAMAGE HAZARD
Failure to follow this caution may result in:
- Overheating the heat exchangers or condensing flue gases in heat exchanger areas not designed for condensate.
- Shortened furnace life
- Component damage.

Temperature rise must be within limits specified on furnace rating plate. Recommended operation is at midpoint of rise range or slightly above.

Place SW-1 (LHT) in ON position. Jumper R to W/W1 and W2 to check high-gas-heat temperature rise. To check low-gas-heat temperature rise, remove jumper to W2. Determine air temperature rise for both high and low gas heat. Do not exceed temperature rise ranges specified on unit rating plate for high and low gas heat.

This furnace must operate within the temperature rise ranges specified on the furnace rating plate. Determine the air temperature as follows:

1. Place duct thermometers in return and supply ducts as close to furnace as possible. Be sure thermometers do not “see” heat exchangers so that radiant heat does not affect thermometer readings. This is particularly important with straight run ducts.
2. When thermometer readings stabilize, subtract return-air temperature from supply-air temperature to determine temperature rise.

If the temperature rise is outside this range, check the following:

1. Gas input for low- and high gas heat operation.
2. Derate for altitude if applicable.
3. Return and supply ducts for excessive restrictions causing static pressures greater than 0.50-in. w.c. (125 Pa).
4. Adjust temperature rise by adjusting blower speed.
   - Increase blower speed to reduce temperature rise.
   - Decrease blower speed to increase temperature rise.
For low-heat, the following connections can be made at LO HT on control:

a. Orange blower motor lead
b. Red blower motor lead - Factory Setting

**Adjust Thermostat Heat Anticipator**
Mechanical thermostat. Set thermostat heat anticipator to match the amp. draw of the electrical components in the R-W/W1 circuit. Accurate amp. draw readings can be obtained at the wires normally connected to thermostat subbase terminals, R and W. The thermostat anticipator should NOT be in the circuit while measuring current.

1. Set SW-1 (LHT) switch on furnace control board to ON.
2. Remove thermostat from subbase or from wall.
3. Connect an amp. meter across the R and W subbase terminals or R and W wires at wall.
4. Record amp. draw across terminals when furnace is in low heat and after blower starts.
5. Set heat anticipator on thermostat per thermostat instructions and install on subbase or wall.
6. Turn SW-1 (LHT) switch OFF.
7. Install blower access door.

Electronic thermostat: Set cycle rate for 3 cycles per hr.

**Check Safety Controls**
The flame sensor, gas valve, and pressure switch were all checked in the Start-up procedure section as part of normal operation.

1. Check Main Limit Switch This control shuts off combustion system and energizes air-circulating blower motor, if furnace overheats. By using this method to check the temperature limit control, it can be established that the limit is functioning properly and that the limit will operate if there is a restricted return-air supply or motor failure. If the limit control does not function during this test, the cause must be determined and corrected.
   a. Run furnace for at least 5 minutes.
   b. Gradually block off return air with a piece of cardboard or sheet metal until the limit trips.
   c. Unblock return air to permit normal circulation.
   d. Burners will re-light when furnace cools down.

2. Check Pressure Switch(es) This control proves operation of the draft inducer blower.
   a. Turn off 115-v power to furnace.
   b. Disconnect inducer motor lead wires from wire harness.
   c. Turn on 115-v power to furnace.
   d. Set thermostat to “call for heat” and wait 1 minute. When pressure switch is functioning properly, hot surface igniter should NOT glow and control diagnostic light flashes a status code 32. If hot surface igniter glows when inducer motor is disconnected, shut down furnace immediately.
   e. Determine reason pressure switch did not function properly and correct condition.
   f. Turn off 115-v power to furnace.
   g. Reconnect inducer motor wires, replace outer door, and turn on 115-v power.
   h. Blower will run for 90 sec before beginning the call for heat again.
   i. Furnace should ignite normally.
Checklist

1. Put away tools and instruments. Clean up debris.
2. Verify that the jumper is removed from the TEST/TWIN terminal. Verify that there is nothing plugged into the PLT connector. (Note: If there is a jumper connector plugged into PLT, remove it and discard.) See Fig. 35.
3. Verify that Heating Operating Mode switch SW-1 is set properly. See Fig. 35.
4. Verify that the Blower/Heat Off Delay SW-2 and SW-3 switches are set as desired. See Fig. 35.
5. Verify that the blower (lower door in upflow position) and control (“Main” or upper door in upflow position) doors are properly installed.
6. Verify that the Status LED glows. If not, check that the power supply is energized and that the blower door is secure. See Fig. 57 to interpret diagnostic codes.
7. Cycle test furnace with room thermostat to be sure that it operates properly with the room thermostat. Check all modes including Heat, Cool and Fan.
8. Check operation of accessories per manufacturer’s instructions.
10. Attach entire literature packet to furnace.

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Fig. 54 - Gas Valve

Fig. 55 - Orifice Hole

Fig. 56 - Amp. Draw Check with Ammeter
SERVICE

LED CODE

STATUS

CONTINUOUS OFF - Check for 115VAC at L1 & L2, & 24VAC at SEC-1 & SEC-2.
CONTINUOUS ON - Control has 24VAC power.
RAPID FLASHING - Line voltage (115VAC) polarity reversed. If twinned, refer to twinning kit instructions.

If status code recall is needed, briefly remove then reconnect one main limit wire to display last stored status code. Repeat remove-and-reconnect 4 more times for previous 4 status codes, after which the 5 codes repeat. Status code 11 will display when less than 4 previous status codes exist.

11 NO PREVIOUS CODE - Stored status codes are erased automatically after 72 hours. On RED LED boards stored status codes can also be erased when power (115VAC or 24VAC) to control is interrupted.
12 BLOWER ON AFTER POWER UP (115VAC or 24VAC) - Blower runs for the selected blower on-delay time, if unit is powered up during a call for heat (R-W-W1 closed) or (R-W-W1) opens during blower on-delay.
13 LIMIT CIRCUIT LOCKOUT - Lockout occurs if a limit or flame rollout switch is open longer than 3 minutes.
   - Control will auto reset after three hours. - Refer to #33
14 IGNITION LOCKOUT - Control will auto-reset after three hours. Refer to #34.
21 GAS HEATING LOCKOUT - Control will NOT auto reset. Check for:
   - Mis-wired gas valve
   - Defective control (valve relay)
22 ABNORMAL FLAME-PROVING SIGNAL - Flame is proved while gas valve is de-energized.
   - Inducer will run until fault is cleared. Check for:
   - Leaky gas valve - Stuck-open gas valve
23 PRESSURE SWITCH DID NOT OPEN - Check for:
   - Obstructed pressure tubing
   - Pressure switch stuck closed
24 SECONDARY VOLTAGE FUSE IS OPEN - Check for:
   - Short circuit in secondary voltage (24VAC) wiring.
31 HIGH-HEAT PRESSURE SWITCH OR RELAY DID NOT CLOSE OR REOPENED - Control relay may be defective, refer to status code #32
32 LOW-HEAT PRESSURE SWITCH DID NOT CLOSE OR REOPENED - If open longer than 5 minutes, before retry. If opens during blower on-delay period, blower will come on for the selected blower off-delay.
   - Excessive wind
   - Restricted vent
   - Defective inducer motor
   - Low inlet gas pressure (if LP gas used)
   - Defective pressure switch
   - Low inlet voltage (115VAC)
   - Inadequate combustion air supply
   - Proper vent sizing
   - Disconnected or obstructed pressure tubing
   - Condensate drainage restricted or blocked
33 LIMIT CIRCUIT FAULT - Indicates a limit or flame rollout switch is open. Blower will run for 4 minutes or until open switch remains whichever is longer. If open longer than 3 minutes, code changes to lockout #33. If open less than 3 minutes status code #33 continues to flash until blower shuts off. Flame rollout switch requires manual reset.
   - Dirty filter or restricted duct system
   - Proper vent sizing
   - Restricted vent
   - Loose blower wheel
   - Excessive wind
   - Defective blower motor
   - Defective switch or connections
   - Inadequate combustion air supply (Flame Roll-out Switch open).
34 IGNITION PROVING FAILURE - Control will try three more times before lock out #14 occurs.
   - Oxide buildup on flame sensor (clean with fine steel wool)
   - Proper flame sensor microamps (5 microamps D.C. min., 4.0 - 6.0 nominal)
   - Manual valve shut-off - Control ground continuity - Gas valve defective or gas valve turned off
   - Low inlet gas pressure
   - Inadequate flame carryover or rough ignition
   - Defective Hot Surface Ignitor
   - Flame sensor must not be grounded
   - Green/yellow wire MUST be connected to furnace sheet metal
43 LOW-HEAT PRESSURE SWITCH OPEN WHILE HIGH-HEAT PRESSURE SWITCH IS CLOSED - Check for:
   - Disconnected or obstructed pressure tubing
   - Mis-wired pressure switches
   - Low-pressure pressure switch stuck open
45 CONTROL CIRCUITY LOCKOUT - Auto-reset after one hour lockout due to:
   - Gas valve relay stuck open
   - Flame sensor circuit failure
   - Software check error
   - Reset power to clear lockout. Replace control if status code repeats.

COMPONENT TEST

To initiate the component test sequence turn OFF the room thermostat or disconnect the “R” thermostat lead. Briefly short the TEST/TWIN terminal to the “Com 24V” terminal. Status LED will flash last status code and then turn ON the inducer motor. The inducer motor will start in HIGH speed and remain on HIGH speed until the end of the test then shift to LOW speed for 7 to 15 seconds. The hot surface ignitor, blower motor LO HEAT speed, blower motor HI HEAT speed, and blower motor COOL speed will be turned ON for 10-15 seconds each. Gas Valve and Humidifier will not be turned on.

When the blower is turned OFF the inducer will be switched to low-speed for 10 seconds.

Fig. 57 - Service Label Information
Table 18 – Altitude Derate Multiplier for U.S.A.*

<table>
<thead>
<tr>
<th>ALTITUDE FT.</th>
<th>ALTITUDE M</th>
<th>PERCENT OF DERATE</th>
<th>DERATE MULTIPLIER FACTOR*</th>
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*Derate multiplier factors are based on midpoint altitude for altitude range.

Table 19 – Blower Off Delay Setup Switch

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<th>BLOWER OFF DELAY (SEC.)</th>
<th>SETUP SWITCH (SW–2 AND SW–3) POSITION</th>
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Table 20 – Gas Rate (CU ft./hr)

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<th>SIZE OF TEST DIAL 1 Cu Fl.</th>
<th>2 Cu Fl.</th>
<th>5 Cu Fl.</th>
<th>SECONDS FOR 1 REVOLUTION</th>
<th>SIZE OF TEST DIAL 1 Cu Fl.</th>
<th>2 Cu Fl.</th>
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### Table 21 – Orifice Size and Manifold Pressure (in. w.c.) for Gas Input Rate

**TWO-STAGE FURNACE**

(TABULATED DATA BASED ON 20,000 BTUH HIGH-HEAT / 13,000 BTUH LOW-HEAT PER BURNER, DERATED 2%/1000 FT (305M) ABOVE SEA LEVEL)

<table>
<thead>
<tr>
<th>ALTITUDE RANGE</th>
<th>AVG. GAS HEAT VALUE AT ALTITUDE (Btu/ cu ft)</th>
<th>SPECIFIC GRAVITY OF NATURAL GAS</th>
</tr>
</thead>
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<tr>
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<td>0.60</td>
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<td>ft (m)</td>
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<tr>
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<td>925</td>
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<td>44 3.7 / 1.6</td>
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<td>44 3.7 / 1.6</td>
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<td>825</td>
<td>850</td>
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*Note: The table continues with similar data entries for various altitude ranges and gas heat values.*
Table 21 - Orifice Size and Manifold Pressure (in. w.c.) for Gas Input Rate (Cont.)

TWO-STAGE FURNACE
(TABULATED DATA BASED ON 20,000 BTUH HIGH-HEAT / 13,000 BTUH LOW-HEAT PER BURNER,
DERATED 2%/1000 FT (305M) ABOVE SEA LEVEL)

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<th>ALTITUDE RANGE</th>
<th>AVG. GAS HEAT VALUE AT ALTITUDE (Btu/cu ft)</th>
<th>SPECIFIC GRAVITY OF NATURAL GAS</th>
<th>0.58</th>
<th>0.60</th>
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* Orifice numbers shown in **BOLD** are factory-installed.
SERVICE AND MAINTENANCE PROCEDURES

Untrained personnel can perform basic maintenance functions such as cleaning and replacing air filters. All other operations must be performed by trained service personnel. A qualified service person should inspect the furnace once a year.

⚠️ WARNING

FIRE, INJURY OR DEATH HAZARD
Failure to follow this warning could result in personal injury, death and/or property damage.

The ability to properly perform maintenance on this equipment requires certain knowledge, mechanical skills, tools, and equipment. If you do not possess these, do not attempt to perform any service and maintenance on this equipment other than those procedures recommended in the Owner’s Manual.

⚠️ CAUTION

ENVIRONMENTAL HAZARD
Failure to follow this caution may result in environmental pollution.

Remove and recycle all components or materials (i.e. oil, refrigerant, control board, etc.) before unit final disposal.

⚠️ WARNING

ELECTRICAL SHOCK, FIRE OR EXPLOSION HAZARD
Failure to follow this warning could result in personal injury or death, or property damage.

Before installing, modifying, or servicing system, main electrical disconnect switch must be in the OFF position and install a lockout tag. There may be more than one disconnect switch. Lock out and tag switch with a suitable warning label. Verify proper operation after servicing.

⚠️ CAUTION

ELECTRICAL OPERATION HAZARD
Failure to follow this caution may result in improper furnace operation or failure of furnace.

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

General

These instructions are written as if the furnace is installed in an upflow application. An upflow furnace application is where the blower is located below the combustion and controls section of the furnace, and conditioned air is discharged upward. Since this furnace can be installed in any of the 4 positions shown in Fig. 2, you must revise your orientation to component location accordingly.

Electrical Controls and Wiring

Each pressure switch is labeled with the reference location (noted as “COLLECTOR BOX-LPS” or “HOUSING-HPS” on the switch). The nominal break point of each switch is shown on the label below the reference location in inches of water column, “W.C.” The maximum and minimum break point of the switch is +/- 0.05 inches of water column from the nominal break point of the switch. The maximum make point of the switch is 0.10 inches of water above the maximum break point of the switch.

Example: Nominal break point on pressure switch is 0.68-in. W.C. The minimum break point of the switch is 0.63-in. W.C. The maximum break point of the switch is 0.73-in. W.C. The maximum make point of the switch is 0.83-in. W.C.

The electrical ground and polarity for 115-v wiring must be properly maintained. Refer to Fig. 34 for field wiring information and to Fig. 66 for furnace wiring information.

NOTE: If the polarity is not correct, the STATUS LED on the control will flash rapidly and prevent the furnace from heating. The control system also requires an earth ground for proper operation of the control and flame-sensing electrode.

The 24-v circuit contains an automotive-type, 3-amp. fuse located on the control. See Fig. 35. Any shorts of the 24-v wiring during installation, service, or maintenance will cause this fuse to blow. If fuse replacement is required, use ONLY a 3-amp. fuse. The control LED will display status code 24 when fuse needs to be replaced.

Troubleshooting

Refer to the service label. See Fig. 57.

The Troubleshooting Guide can be a useful tool in isolating furnace operation problems. Beginning with the word “Start,” answer each question and follow the appropriate arrow to the next item. See Fig. 65.

The Guide will help to identify the problem or failed component. After replacing any component, verify correct operation sequence. Proper instrumentation is required to service electrical controls.

The control in this furnace is equipped with a Status Code LED (Light-Emitting Diode) to aid in installation, servicing, and troubleshooting. Status codes can be viewed at the indicator in blower door. The amber furnace control LED is either ON continuously, rapid flashing, or a code composed of 2 digits. The first digit is the number of short flashes, the second digit is the number of long flashes.

For an explanation of status codes, refer to service label located on control door or Fig. 57, and the troubleshooting guide which can be obtained from your distributor.

Retrieving Stored Fault Codes

NOTE: Fault codes cannot be retrieved if a thermostat signal (24-v on W, Y, G, etc.) is present, or if any delays such as blower off-delays are active. The stored status codes will NOT be erased from the control memory when 115- or 24-v power is interrupted. See the Service Label (Fig. 57) for more information. The most recent fault code may be retrieved as follows:

1. Leave 115-v power connected to furnace.
2. Observe the status LED through the blower door (the lower door on upflow applications) indicator. Refer to the Service Label (Fig. 57) to interpret the LED.
3. Remove the Main/Control door (the upper door on upflow installations).
4. BRIEFLY disconnect and reconnect ONE of the main limit wires.
5. The LED will flash the last stored fault code. Refer to the Service Label (Fig. 57) to interpret the LED.
6. A component test sequence will follow.
7. Reinstall the Main/Control door.

Component Self-Test

NOTE: The furnace control component test allows all components to run for a short time; except the gas valve and humidifier terminal HUM are not energized for safety reasons. The EAC-1 terminal is energized when the blower is energized. This feature helps diagnose a system problem in case of a component failure. The component test feature will not operate if any thermostat signal is present at the control and not until all time delays are completed.

To Begin Component Self-Test:
1. Remove blower access door.
2. Disconnect the thermostat R lead from furnace control.
3. Manually close blower door switch.

Caution must be taken when manually closing this switch for service purposes.

WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury, or death.
Blower door switch opens 115-v power to furnace control. No component operation can occur unless switch is closed. Exercise caution to avoid electrical shock from exposed electrical components when manually closing this switch for service purposes.

4. For approximately 2 sec, short (jumper) the COM-24v terminal on control to the TEST/TWIN 3/16—in. (5 mm) quick-connect terminal on control until the LED goes off. Remove jumper from terminals. See Fig. 35.

NOTE: If TEST/TWIN and COM-24v terminals are jumpered longer than 2 sec, LED will flash rapidly and ignore component test request.

Component test sequence is as follows:
   a. LED will display previous status code 4 times.
   b. Inducer motor starts and continues to run until Step g of component test sequence.
   c. After 7 sec the hot surface igniter is energized for 15 sec., then off.
   d. Blower motor operates on LO-HT speed for 10 sec.
   e. Blower motor operates on HI-HT speed for 10 sec.
   f. Blower motor operates on COOL speed for 10 sec.
   g. Inducer motor goes to low speed for 10 sec, then stops.
5. Reconnect R lead to furnace control, remove tape from blower door switch, and re-install blower door.
6. Verify furnace shut down by lowering thermostat setting below room temperature.
7. Verify that furnace restarts by raising thermostat setting above room temperature.

Checklist
1. Put away tools and instruments. Clean up debris.
2. Verify that the jumper is removed from the TEST/TWIN terminal. Verify that there is nothing plugged into the PLT connector. (Note: If there is a jumper connector plugged into PLT, remove it and discard.) See Fig. 35.

For continuing high performance and to minimize possible furnace failure, periodic maintenance must be performed on this furnace. Consult your local dealer about proper frequency of maintenance and the availability of a maintenance contract.

WARNING

ELECTRICAL SHOCK AND FIRE HAZARD

Failure to follow this warning could result in personal injury, death, and/or property damage.

Never store flammable or combustible materials on, near, or in contact with the furnace, such as:
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 or plastic containers, gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids, or other volatile fluids.
3. Paint thinners and other painting compounds, paper bags, or other paper products. Exposure to these materials could lead to corrosion of the heat exchangers.

WARNING

CARBON MONOXIDE POISONING AND FIRE HAZARD

Failure to follow this warning could result in personal injury, death, and/or property damage.

Never operate furnace without a filter or filtration device installed. Never operate a furnace with filter or filtration device access doors removed.
To clean or replace filters, proceed as follows:

1. Check and clean air filter each month or more frequently if required. Replace if torn.
2. Check blower motor and wheel for cleanliness each heating and cooling season. Clean as necessary.
3. Check electrical connections for tightness and controls for proper operation each heating season. Service as necessary.
4. Inspect burner compartment before each heating season for rust, corrosion, soot or excessive dust. If necessary, have furnace and burner serviced by a qualified service agency.
5. Inspect the vent pipe/vent system before each heating season for water leakage, sagging pipes or broken fittings. Have vent pipes/vent system serviced by a qualified service agency.
6. Inspect any accessories attached to the furnace such as a humidifier or electronic air cleaner. Perform any service or maintenance to the accessories as recommended in the accessory instructions.

Cleaning and/or Replacing Air Filter

The air filter type may vary depending on the application or orientation. The filter is external to the furnace casing. There are no provisions for an internal filter with this furnace. See “Filter Arrangement” under the “Installation” section of this manual.

Blower Motor and Wheel Maintenance

To ensure long life, economy, and high efficiency, clean accumulated dirt and grease from blower wheel and motor annually.

The inducer and blower motors are pre-lubricated and require no additional lubrication. These motors can be identified by the absence of oil ports on each end of the motor.

The following items should be performed by a qualified service technician. Clean blower motor and wheel as follows:

1. Turn off electrical supply to furnace.
2. Remove blower door.
3. All factory wires can be left connected, but field thermostat and accessory wiring may need to be disconnected depending on their length and routing.
4. Disconnect the vent and combustion air pipe by:
   a. Loosen the clamps on the vent couplings and combustion air pipe external to the furnace.
   b. Separate the pipes from the couplings and move them aside.
   c. Loosen the clamps on the vent couplings and combustion air pipe located on the blower shelf.
   d. Separate the pipes from the blower compartment and set aside.
   e. Remove the couplings from the pipe adapters and set aside.
   f. After servicing the blower, reverse steps a through e.
   g. Tighten all clamps 15 lb-in.

Disconnect the vent and combustion air pipe by:

a. Loosen the clamps on the vent couplings and combustion air pipe external to the furnace.
b. Separate the pipes from the couplings and move them aside.
c. Loosen the clamps on the vent couplings and combustion air pipe located on the blower shelf.
d. Separate the pipes from the blower compartment and set aside.
e. Remove the couplings from the pipe adapters and set aside.
f. After servicing the blower, reverse steps a through e.
g. Tighten all clamps 15 lb-in.

See Fig. 63 for steps 5 through 14.

5. Remove screws securing blower assembly to blower shelf and slide blower assembly out of furnace. Detach ground wire and disconnect blower motor harness plugs from blower motor.

NOTE: Blower wheel is fragile. Use care.

6. Clean blower wheel and motor by using a vacuum with soft brush attachment. Be careful not to disturb balance weights (clips) on blower wheel vanes. Do not bend wheel or blades as balance will be affected.

7. If greasy residue is present on blower wheel, remove wheel from the blower housing and wash it with an appropriate degreaser. To remove wheel:
   a. Mark blower wheel location on shaft before disassembly to ensure proper reassembly.
   b. Loosen setscrew holding blower wheel on motor shaft.

NOTE: Mark blower mounting arms and blower housing so each arm is positioned at the same hole location during reassembly.

a. Mark blower wheel orientation and cutoff plate location to ensure proper reassembly.
b. Remove screws securing cutoff plate and remove cutoff plate from housing.
c. Remove bolts holding motor mounts to blower housing and slide motor and mounts out of housing.
d. Remove blower wheel from housing.
g. Clean wheel per instructions on degreaser cleaner. Do not get degreaser in motor.

8. Reassemble motor and blower wheel by reversing items 7b through 7f. Ensure wheel is positioned for proper rotation.

9. Torque motor mounting bolts to 40 +/- 10 lb-in. when reassembling.

10. Torque blower wheel set screw to 160 +/- 20 lb-in. when reassembling.

11. Verify that blower wheel is centered in blower housing and set screw contacts the flat portion of the motor shaft. Loosen set screw on blower wheel and reposition if necessary.

12. Spin the blower wheel by hand to verify that the wheel does not rub on the housing.

13. Reinstall blower assembly in furnace.

14. Reinstall 2 screws securing blower assembly to blower deck.

15. Reconnect blower leads to furnace control. Refer to furnace wiring diagram, and connect thermostat leads if previously disconnected.

NOTE: Be sure to attach ground wire and reconnect blower harness plugs to blower motor.

### WARNING

**ELECTRICAL OPERATION HAZARD**

Failure to follow this warning could result in personal injury or death.

Blower door switch opens 115-v power to control. No component operation can occur unless switch is closed. Caution must be taken when manually closing this switch for service purposes.

16. Downflow or horizontal furnaces with vent pipe through furnace only:
   a. Install and connect short piece of vent pipe inside furnace to existing vent.
   b. Connect vent connector to vent elbow.

17. Turn on electrical supply. Manually close blower door switch. Use a piece of tape to hold switch closed. Check for component operation can occur unless switch is closed. Caution must be taken when manually closing this switch for service purposes.

NOTE: If R-W/W1 thermostat terminals are jumpered at the time blower door switch is closed, blower will run for 90 sec before beginning a heating cycle.

   a. Perform component self-test as shown at the bottom of the Service Label, located on the control door.
   b. Verify blower is rotating in the correct direction

18. If furnace is operating properly, RELEASE BLOWER DOOR SWITCH. Remove any jumpers or reconnect any disconnected thermostat leads. Replace blower door.

19. Turn on gas supply and cycle furnace through one complete heating cycle. Verify the furnace temperature rise as shown in Adjustments Section. Adjust temperature rise as shown in Adjustments Section.

### Cleaning Burners and Flame Sensor

The following items must be performed by a qualified service technician. If the burners develop an accumulation of light dirt or dust, they may be cleaned by using the following procedure:

**NOTE:** Use a back-up wrench on the gas valve to prevent the valve from rotating on the manifold or damaging the mounting to the burner assembly.

- Remove individual wires from terminals on gas valve.
- Disconnect Hot Surface Igniter (HSI) wires from HSI.
- Disconnect Flame Sensor wire from Flame Sensor.
- Support the manifold and remove the 4 screws that secure the manifold assembly to the burner assembly and set aside. Note the location of the green/yellow wire and ground terminal.
- Inspect the orifices in the manifold assembly for blockages or obstructions. Remove orifice and clean or replace orifice.
- Remove the four screws that attach the top plate of the casing to the furnace.
- Raise top plate up slightly and prop it up with a small piece of wood or folded cardboard.
- Support the burner assembly and remove the screws that attach the burner assembly to the heat exchanger cell panel.
- Remove wires from both rollout switches.
- Slide one-piece burner out of slots on sides of burner assembly.
- Remove the flame sensor from the burner assembly.
- (Optional) Remove the Hot Surface Igniter (HSI) and bracket from the burner assembly.
- Check igniter resistance. Nominal resistance is 40 to 70 ohms at room temperature and is stable over the life of the igniter.
- Clean burner with a brush and a vacuum.
- Clean the flame sensor with fine steel wool (0000 grade). Do not use sand paper or emery cloth.

**To reinstall burner assembly:**

1. Install the Hot Surface Igniter (HSI) and bracket in burner assembly.
2. Install flame sensor on burner.
3. Align the edges of the one-piece burner with the slots in the burner assembly and slide the burners forward until they are fully seated in the burner assembly.
4. Align the orifices in the manifold assembly with the support rings on the end of the burner.
5. Insert the orifices in the support rings of the burners.

**NOTE:** If manifold does not fit flush against the burner, do not force the manifold on the burner assembly. The burners are not fully seated forward in the burner assembly. Remove the manifold and check burner positioning in the burner assembly assembly before re-installing the manifold.

- Attach the green/yellow wire and ground terminal to one of the manifold mounting screws.
7. Install the remaining manifold mounting screws.
8. Check the igniter alignment. See Fig. 58, 60 and 64.
9. Attach the wires to the roll-out switches.
10. Align the burner assembly with the openings in the primary cell inlet panel and attach the burner assembly to the cell panel.
11. Connect the wire for the flame sensor.
12. Connect the wire for the Hot Surface Igniter.

**NOTE:** Use Teflon tape.

13. Install the gas pipe to the gas valve.

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### Flushing Collector Box and Drainage System

**WARNING**

**FIRE OR EXPLOSION HAZARD**

Failure to follow this warning could result in personal injury, death, and/or property damage.

Never purge a gas line into a combustion chamber. 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.

14. Check for gas leaks with a commercially available soap solution made specifically for the detection of leaks.
15. Turn gas on at electric switch on gas valve and at external shut-off or meter
16. Turn power on at external disconnect, fuse or circuit breaker.
17. Run the furnace through two complete heating cycles to check for proper operation
18. Install control door when complete.

### Servicing Hot Surface Igniter

The igniter does **NOT** require annual inspection. Check igniter resistance before removal. Refer to Fig. 58, 60 and 64.

1. Turn off gas and electrical supplies to furnace.
2. Remove control door.
3. Disconnect igniter wire connection.
4. Check igniter resistance. Igniter resistance is affected by temperature. Only check resistance when the igniter is at room temperature.
   a. Using an ohm meter, check resistance across both igniter leads in connector.
   b. Cold reading should be between 40 ohms and 70 ohms.
5. Remove igniter assembly.
   a. Using a 1/4-in. driver, remove the two screws securing the igniter mounting bracket to the burner assembly See Fig. 64.
   b. Carefully withdraw the igniter and bracket assembly through the front of the burner assembly without striking the igniter on surrounding parts.
   c. Inspect igniter for signs of damage or failure.
   d. If replacement is required, remove the screw that secures the igniter on igniter bracket and remove the igniter.
6. To replace igniter and bracket assembly, reverse items 5a through 5d.
7. Reconnect igniter harness to the igniter, dressing the igniter wires to ensure there is no tension on the igniter itself. See Fig. 64.
8. Turn on gas and electrical supplies to furnace.
9. Verify igniter operation by initiating control board self-test feature or by cycling thermostat.
10. Replace control door.

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**WARNING**

**ELECTRICAL SHOCK AND FIRE HAZARD**

Failure to follow this warning could result in personal injury, death, and/or property damage.

Turn off the gas and electrical supplies to the furnace and install lockout tag before performing any maintenance or service. Follow the operating instructions on the label attached to the furnace.

1. Turn off gas and electrical supplies to furnace.
2. Remove control door.
3. Disconnect pressure switch tube from pressure switch port.

**NOTE:** Ensure the pressure switch tube disconnected from the pressure switch is higher than the collector box opening or water will flow out of tube.

4. Remove the collector box plug from the top port on the upper corner of the collector box. See Fig. 61.
5. Attach a funnel with a flexible tube to port on the collector box.
6. Flush inside of collector box with water until discharge water from condensate trap is clean and runs freely.
7. Repeat steps 4 thru 6 with middle plug on upper corner of collector box.
8. Remove the pressure switch tube from the collector box.

**NOTE:** Do **NOT** blow into tube with tube connected to the pressure switch.

9. Clean pressure switch port on collector box with a small wire. Shake any water out of pressure switch tube.
10. Reconnect tube to pressure switch and pressure switch port.
11. Remove the relief tube from the port on the collector box and the trap.
12. Clean the relief port on collector box and the trap with a small wire. Shake any water out of the tube.
13. Reconnect relief tube to trap and collector box ports.

### Cleaning Condensate Drain and Trap

**NOTE:** If the condensate trap is removed, a new gasket between the trap and collector box is required. Verify a condensate trap gasket is included in the service kit or obtain one from your local distributor.

1. Disconnect power at external disconnect, fuse or circuit breaker.
2. Turn off gas at external shut-off or gas meter.
3. Remove control door and set aside.
4. Turn electric switch on gas valve to OFF.
5. Disconnect external drain from condensate drain elbow or drain extension pipe inside the furnace and set aside.
6. Disconnect the condensate trap relief hose from collector box port and condensate trap.

**NOTE:** If condensate has a heat pad attached to the trap, trace the wires for the pad back to the connection point and disconnect the wires for the heat pad.

7. Remove the screw that secures the condensate trap to the collector box, remove the trap and set aside.
8. Remove the trap gasket from the collector box if it did not come off when the trap was removed.
9. Discard the old trap gasket.
10. Rinse condensate trap in warm water until trap is clean.
11. Flush condensate drain lines with warm water. Remember to check and clean the relief port on the collector box.
12. Shake trap dry.
13. Clean port on collector box with a small wire.

**To re-install Condensate Drain and Trap:**

1. Remove adhesive backing from condensate trap gasket
2. Install gasket on collector box
3. Align the condensate trap with the drain opening on the collector box and secure the trap with the screw
4. Attach the relief hose to the relief port on the condensate trap and collector box.
5. Secure tubing to prevent any sags or traps in the tubing.
6. Connect condensate drain elbow or drain extension elbow to the condensate trap
7. Connect the leads of the condensate heat pad (if used)
8. Connect external drain piping to the condensate drain elbow or drain extension pipe.
9. Turn gas on at electric switch on gas valve and at external shut-off or meter
10. Turn power on at external disconnect, fuse or circuit breaker.
11. Run the furnace through two complete heating cycles to check for proper operation
12. Install control door when complete.

Checking Heat Pad Operation (If Applicable)
In applications where the ambient temperature around the furnace is 32°F or lower, freeze protection measures are required. If this application is where heat tape has been applied, check to ensure it will operate when low temperatures are present.

NOTE: The Heat Pad, when used, should be wrapped around the condensate drain trap. There is no need to use heat tape within the furnace casing. Most heat tapes are temperature activated, and it is not practical to verify the actual heating of the tape. Check the following:
1. Check for signs of physical damage to heat tape such as nicks, cuts, abrasions, gnawing by animals, etc.
2. Check for discolored heat tape insulation. If any damage or discolored insulation is evident, replace heat tape.
3. Check that heat tape power supply circuit is on.

Cleaning Heat Exchangers
The following items must be performed by a qualified service technician.

Primary Heat Exchangers
If the heat exchangers get an accumulation of light dirt or dust on the inside, they may be cleaned by the following procedure:

NOTE: If the heat exchangers get a heavy accumulation of soot and carbon, both the primary and secondary heat exchangers should be replaced rather than trying to clean them thoroughly due to their intricate design. A build-up of soot and carbon indicates that a problem exists which needs to be corrected, such as improper adjustment of manifold pressure, insufficient or poor quality combustion air, improper vent termination, incorrect size or damaged manifold orifice(s), improper gas, or a restricted heat exchanger (primary or secondary). Action must be taken to correct the problem.
1. Turn off gas and electrical supplies to furnace.
2. Remove control door.
3. Disconnect wires or connectors to flame rollout switch, gas valve, igniter, and flame sensor.
4. Using backup wrench, disconnect gas supply pipe from furnace gas control valve.
5. Remove two screws attaching top filler plate and rotate upwards to gain access to screws attaching burner assembly to cell panel.
6. Remove screws attaching burner assembly to cell panel. See Fig. 64.

NOTE: Burner cover, manifold, gas valve, and burner assembly should be removed as one assembly.
7. Clean heat exchanger openings with a vacuum and a soft brush. See Fig. 62.

NOTE: After cleaning, inspect the heat exchangers to ensure they are free of all foreign objects that may restrict flow of combustion products.
8. Reverse items 6 through 1 for reassembly.
9. Refer to furnace wiring diagram and reconnect wires to flame rollout switch, gas valve, igniter, and flame sensor.
10. Turn on gas and electrical supplies to furnace.
11. Check furnace operation through 2 complete heat operating cycles. Look at burners. Burner flames should be clear blue, almost transparent. See Fig. 59.
12. Check for gas leaks.

Secondary Heat Exchangers
The condensing side (inside) of the secondary heat exchanger CANNOT be serviced or inspected without complete removal of the heat exchanger assembly. Detailed information on heat exchanger removal can be obtained from your Distributor.

13. Replace main furnace door.

WARNING

ELECTRICAL SHOCK AND FIRE HAZARD
Failure to follow this warning could result in personal injury, death, and/or property damage.

Turn off the gas and electrical supplies to the furnace and install lockout tag before performing any maintenance or service. Follow the operating instructions on the label attached to the furnace.

2. Remove control door.
3. Disconnect wires or connectors to flame rollout switch, gas valve, igniter, and flame sensor.
4. Using backup wrench, disconnect gas supply pipe from furnace gas control valve.
5. Remove two screws attaching top filler plate and rotate upwards to gain access to screws attaching burner assembly to cell panel.
6. Remove screws attaching burner assembly to cell panel. See Fig. 64.

NOTE: Burner cover, manifold, gas valve, and burner assembly should be removed as one assembly.
7. Clean heat exchanger openings with a vacuum and a soft brush. See Fig. 62.

NOTE: After cleaning, inspect the heat exchangers to ensure they are free of all foreign objects that may restrict flow of combustion products.
8. Reverse items 6 through 1 for reassembly.
9. Refer to furnace wiring diagram and reconnect wires to flame rollout switch, gas valve, igniter, and flame sensor.
10. Turn on gas and electrical supplies to furnace.
11. Check furnace operation through 2 complete heat operating cycles. Look at burners. Burner flames should be clear blue, almost transparent. See Fig. 59.
12. Check for gas leaks.
Since the furnace uses a condensing heat exchanger, some water will accumulate in the unit as a result of the heat transfer process. Therefore, once it has been operated, it cannot be turned off and left off for an extended period of time when temperatures will reach 32°F (0°C) or lower unless winterized. Follow these procedures to winterize your furnace:

1. Obtain propylene glycol (RV/swimming pool antifreeze or equivalent).
2. Turn off gas and electrical supplies to your furnace.
3. Remove furnace control door.
4. Remove the top unused rubber plug from the port on the collector box opposite the condensate trap. See Fig. 61.
5. Connect a field supplied 3/8-in. (9.5-mm) ID tube to the open port on the collector box.
6. Insert a field supplied funnel into the tube.
7. Pour 1 quart of anti-freeze solution into the funnel/tube. Antifreeze should run through the inducer housing, overfill condensate trap and flow to an open drain.
8. Replace the rubber plug in the port on the collector box.
9. Remove the middle unused rubber plug from the port on the collector box opposite the condensate trap. See Fig. 61.
10. Repeat Steps 5 through 8.
11. If a condensate pump is used, check with pump manufacturer to verify pump is safe for use with antifreeze used. Allow pump to start and pump anti-freeze to open drain.
12. Replace main door.
13. When furnace is re-started, flush condensate pump with clear water to check for proper operation before re-starting furnace.
14. Propylene glycol need not be removed before re-starting furnace.
Fig. 63 - Blower Assembly

Fig. 64 - Burner Assembly
SEQUENCE OF OPERATION

NOTE: Furnace control must be grounded for proper operation or control will lockout. Control is grounded through green wire connected to gas valve and burner bracket screw. Using the schematic diagram in Fig. 66, follow the sequence of operation through the different modes. Read and follow the wiring diagram very carefully.

NOTE: If a power interruption occurs during a call for heat (W/W1 or W/W1-and-W2), the control run the blower for the selected blower off-delay period two sec after power is restored and if the thermostat is still calling for gas heating. The LED light will flash code 12 during this period, after which the LED will be ON continuous, as long as no faults are detected. After this period, the furnace will respond to the thermostat normally.

The blower door must be installed for power to be conducted through the blower door interlock switch ILK to the furnace control CPU, transformer TRAN, inducer motor IDM, blower motor BLWM, hot-surface igniter HSI, and gas valve GV.  

1. Two-Stage Heating (Adaptive mode) with Single-Stage Thermostat

See Fig. 35 and 36 for thermostat connections)

NOTE: The low-heat only switch (LHT) selects either the low-heat only operation mode when ON, (see item 2. below) or the adaptive heating mode when OFF in response to a call for heat. See Fig. 35. When the W2 thermostat terminal is energized it will always cause high-heat operation when the R to W circuit is closed, regardless of the setting of the low-heat only switch. This furnace can operate as a two-stage furnace with a single-stage thermostat because the furnace control CPU includes a programmed adaptive sequence of controlled operation, which selects low-heat or high-heat operation. This selection is based upon the stored history of the length of previous gas-heating periods of the single-stage thermostat.

The furnace will start up in either low- or high-heat. If the furnace starts up in low-heat, the control CPU determines the low-heat on-time (from 0 to 16 minutes) which is permitted before switching to high-heat.

If the power is interrupted, the stored history is erased and the control CPU will select low-heat for up to 16 minutes and then switch to high-heat, as long as the thermostat continues to call for heat. Subsequent selection is based on stored history of the thermostat cycle times.

The wall thermostat “calls for heat”, closing the R to W circuit. The furnace control performs a self-check, verifies the low-heat and high-heat pressure switch contacts LPS and HPS are open, and starts the inducer motor IDM in high-speed.

a. Inducer Prepurge Period

(1.) If the furnace control CPU selects low-heat operation the inducer motor IDM comes up to speed, the low-heat pressure switch LPS closes, and the furnace control CPU begins a 15-sec prepurge period. After the low-heat pressure switch re-closes the furnace control CPU will begin a 15-sec prepurge period, and continue to run the inducer motor IDM at high-speed.

(2.) If the furnace control CPU selects high-heat operation, the inducer motor IDM remains running at high-speed, and the high-heat pressure switch relay HPSR is de-energized to close the NC contact. When sufficient pressure is available the high-heat pressure switch HPS closes, and the high-heat gas valve solenoid GV-HI is energized. The furnace control CPU begins a 15-sec prepurge period after the low-heat pressure switch LPS closes. If the high-heat pressure switch HPS fails to close and the low-heat pressure switch LPS closes, the furnace will operate at low-heat gas flow rate until the high-heat pressure switch closes for a maximum of 2 minutes after ignition.

b. Igniter Warm-Up—At the end of the prepurge period, the (Hot Surface Igniter) HSI is energized for a 17-second igniter warm-up period.

c. Trial-for-Ignition Sequence—When the igniter warm-up period is completed the main gas valve relay contacts GVR-1 and -2 close to energize the gas valve solenoid GV-M, the gas valve opens, and 24 vac power is supplied for a field-installed humidifier at the HUM terminal. The gas valve solenoid GV-M permits gas flow to the burners where it is ignited by the HSI. Five sec after the GVR closes, a 2-sec flame proving period begins. The HSI igniter will remain energized until the flame is sensed or until the 2-sec flame proving period begins. If the furnace control CPU selects high-heat operation, the high-heat gas valve solenoid GV-HI is also energized.

d. Flame-Proving—When the burner flame is proved at the flame-proving sensor electrode FSE, the inducer motor IDM switches to low-speed unless running at high-speed, and the furnace control CPU begins the blower-ON delay period and continues to hold the gas valve GV-M open. If the burner flame is not proved within two sec, the control CPU will close the gas valve GV-M, and the control CPU will repeat the ignition sequence for up to three more Trials—For-Ignition before going to Ignition —Lockout. Lock-out will be reset automatically after three hours, by momentarily interrupting 115 vac power to the furnace, or by interrupting 24 vac power at SEC1 or SEC2 to the furnace control CPU (not at W/W1, G, R, etc.). If flame is proved when flame should not be present, the furnace control CPU will lock out of Gas-Heating mode and operate the inducer motor IDM on high speed until flame is no longer proved.

e. Blower-ON Delay—If the burner flame is proven the blower—ON delay for low-heat and high-heat are as follows:

Low-Heat—45 sec after the gas valve GV-M is energized the blower motor (BLWM) is energized at LO HEAT speed.

High-Heat—25 sec after the gas valve GV-M is energized the BLWM is energized at HI HEAT speed. Simultaneously, the electronic air cleaner (EAC-1) terminal is energized and remains energized as long as the BLWM is energized.

f. Switching from Low-to High-Heat—If the furnace control CPU switches from low-heat to high-heat, the furnace control CPU will switch the inducer motor IDM speed from low to high. The high-heat pressure switch relay HPSR is de-energized to close the NC contact. When sufficient pressure is available the high-heat pressure switch HPS closes, and the high-heat gas valve solenoid GV-HI is energized. The blower motor BLWM will switch to HI HEAT speed five sec after the furnace control CPU switches from low-heat to high-heat.

g. Switching from High- to Low-Heat—The furnace control CPU will not switch from high-heat to low-heat while the thermostat R-to-W circuit is closed when using a single stage thermostat.

h. Blower—OFF Delay—When the thermostat is satisfied, the R to W circuit is opened, de-energizing the gas valve GV-M, stopping gas flow to the burners, and de-energizing the humidifier terminal HUM. The inducer motor IDM will remain energized for a 15-sec post-purge period. The blower motor BLWM and air cleaner terminal EAC-1 will remain energized for 90, 120, 150, or 180 sec (depending on selection at blower—OFF delay switches). The furnace
control CPU is factory-set for a 120-sec blower-OFF delay.

2. Two-Stage Thermostat and Two-Stage Heating  See Fig. 35 and 36 for thermostat connections)

NOTE: In this mode the LHT must be ON to select the low-heat only operation mode in response to closing the thermostat R-to-W1 circuit. Closing the thermostat R-to-W1 and W2 circuits always causes high-heat operation, regardless of the setting of the low-heat-only switch.

The wall thermostat “calls for heat”, closing the R-to-W1 circuit for low-heat or closing the R-to-W1 and W2 circuits for high-heat. The furnace control performs a self-check, verifies the low-heat and high-heat pressure switch contacts LPS and HPS are open, and starts the inducer motor IDM in high-speed.

The start up and shut down functions and delays described in item 1. above apply to the 2-stage heating mode as well, except for switching from low- to high-heat and vice versa.

a. Switching from Low- to High-Heat—If the thermostat R-to-W1 circuit is closed and the R-to-W2 circuit closes, the furnace control CPU will switch the inducer motor IDM speed from low to high. The high-heat pressure switch relay HPSR is de-energized to close the NC contact. When sufficient pressure is available the high-heat pressure switch HPS closes, and the high-heat gas valve solenoid GV-HI is energized. The blower motor BLWM will switch to HI HEAT speed five sec after the R-to-W2 circuit closes.

b. Switching from High- to Low-Heat—If the thermostat R-to-W2 circuit opens, and the R-to-W1 circuit remains closed, the furnace control CPU will switch the inducer motor IDM speed from high to low. The high-heat pressure switch relay HPSR is energized to open the NC contact and de-energize the high-heat gas valve solenoid GV-HI. When the inducer motor IDM reduces pressure sufficiently, the high-heat pressure switch HPS will open. The gas valve solenoid GV-M will remain energized as long as the low-heat pressure switch LPS remains closed. The blower motor BLWM will switch to LO HEAT speed five sec after the R-to-W2 circuit opens.

3. Cooling Mode—The thermostat “calls for cooling.”

a. Single-Speed Cooling— See Fig. 35 and 36 for thermostat connections)
The electronic air cleaner terminal EAC-1 is energized with 115 vac when the blower motor BLWM is operating.

When the thermostat is satisfied, the R-to-G and Y circuits are opened. The outdoor unit will stop, and the furnace blower motor BLWM will continue operating on the COOL speed for an additional 90 sec. Jumper Y/Y2 to DHUM to reduce the cooling off-delay to 5 sec. See Fig. 35.

b. Single-Stage Thermostat and Two-Speed Cooling (Adaptive Mode) See Fig. 35 and 36 for thermostat connections)
This furnace can operate a two-speed cooling unit with a single-stage thermostat because the furnace control CPU includes a programmed adaptive sequence of controlled operation, which selects low-cooling or high-cooling operation. This selection is based upon the stored history of the length of previous cooling period of the single-stage thermostat.

NOTE: The air conditioning relay disable jumper ACRDJ must be connected to enable the adaptive cooling mode in response to a call for cooling. See Fig. 35. When ACRDJ is in place, the furnace control CPU can turn on the air conditioning relay ACR to energize the Y/Y2 terminal and switch the outdoor unit to high-cooling.

The furnace control CPU can start up the cooling unit in either low- or high-cooling. If starting up in low-cooling, the furnace control CPU determines the low-cooling on-time (from 0 to 20 minutes) which is permitted before switching to high-cooling. If the power is interrupted, the stored history is erased and the furnace control CPU will select low-cooling for up to 20 minutes and then energize the air conditioning relay ACR to energize the Y/Y2 terminal and switch the outdoor unit to high-cooling, as long as the thermostat continues to call for cooling. Subsequent selection is based on stored history of the thermostat cycle times. The wall thermostat “calls for cooling”, closing the R-to-G-and-Y circuits. The R-to-Y1 circuit starts the outdoor unit on low-cooling speed, and the R-to-G-and-Y1 circuits start the furnace blower motor BLWM at low-cool speed (same speed as LO HEAT).

If the furnace control CPU switches from low-cooling to high-cooling, the furnace control CPU will energize the air conditioning relay ACR. When the air conditioning relay ACR is energized the R-to-Y1-and-Y2 circuits switch the outdoor unit to high-cooling speed, and the R-to-G-and-Y1-and-Y2 circuits switch the furnace blower motor BLWM to COOL speed.

NOTE: When transitioning from low-cooling to high-cooling the outdoor unit compressor will shut down for 1 minute while the BLWM continues to run at low-cool speed (same speed as LO-HEAT) until the outdoor unit compressor comes back on at high speed.

The electronic air cleaner terminal EAC-1 is energized with 115 vac whenever the blower motor BLWM is operating. When the thermostat is satisfied, the R-to-G-and-Y circuit are opened.
The outdoor unit stops, and the furnace blower BLWM and electronic air cleaner terminal EAC-1 will remain energized for an additional 90 sec. Jumper Y1 to DHUM to reduce the cooling off-delay to 5 sec. See Fig. 35.

c. Two-Stage Thermostat and Two-Speed Cooling— See Fig. 35 and 36 for thermostat connections.

NOTE: The air conditioning relay disable jumper ACRDJ must be disconnected to allow thermostat control of the outdoor unit staging. See Fig. 35.

The thermostat closes the R-to-G-and-Y1 circuits for low-cooling or closes the R-to-G-and-Y1-and-Y2 circuits for high-cooling. The R-to-Y1 circuit starts the outdoor unit on low-cooling speed, and the R-to-G-and-Y1 circuit starts the furnace blower motor BLWM on low-cool speed (same speed as LO HEAT). The R-to-Y1-and-Y2 circuits start the outdoor unit on high-cooling speed, and the R-to-G-and-Y/Y2 circuits start the furnace blower motor BLWM on COOL speed. The electronic air cleaner terminal EAC-1 is energized with 115 vac whenever the blower motor BLWM is operating. When the thermostat is satisfied, the R-to-G-and-Y1 or R-to-G-and-Y1-and-Y2 circuits are opened. The outdoor unit stops, and the furnace blower BLWM and electronic air cleaner terminal EAC-1 will remain energized for an additional 90 sec. Jumper Y1 to DHUM to reduce the cooling off-delay to 5 sec. See Fig. 35.

4. Dehumidification Mode See Fig. 35 and 36 for Thermodistat connections.
The dehumidification output, D or DHUM on the Thermodistat should be connected to the furnace control thermostat terminal DHUM. The dehumidification output, D or DHUM from a thermostat. When there is a dehumidify demand, the DHUM input is activated, which means 24 vac signal is removed from the DHUM input terminal. In other words, the DHUM input logic is reversed. The DHUM input is turned ON when no dehumidify demand exists. Once 24 vac is detected by the furnace control on the DHUM input, the furnace control dehumidification capability is activ-
ated. If the DHUM input is low for more than 48 hours, the furnace control reverts back to non-Thermostat mode. The cooling operation described in item 3. above also applies to operation with a dehumidification thermostat. The exceptions are listed below:

a. Low cooling - When the R-to-G-and-Y1 circuit is closed and there is a demand for dehumidification, the furnace blower motor BLWM will continue running at low-cool speed (same speed as LO HEAT). The cooling off-delay is decreased from 90 sec to 5 sec.

b. High cooling - When the R-to-G-and-Y/Y2 circuit is closed and there is a demand for dehumidification, the furnace blower motor BLWM will drop the blower speed from COOL to HI HEAT for a maximum of 10 minutes before reverting back to COOL speed. If there is still a demand for dehumidification after 20 minutes, the furnace control CPU will drop the blower speed back to HI HEAT speed. This alternating 10-minute cycle will continue as long as there is a call for cooling.

c. Cooling off-delay - When the “call for cooling” is satisfied and there is a demand for dehumidification, the cooling blower-off delay is decreased from 90 sec to 5 sec.

5. Continuous Blower Mode

When the R-to-G circuit is closed by the thermostat, the blower motor BLWM will operate on continuous-blower speed (can be set to LO HEAT, HI HEAT, or COOL speed). Factory default is LO HEAT speed. Terminal EAC-1 is energized as long as the blower motor BLWM is energized.

a. High heat - When the W/W1-and-Y1-or R-to-W/W1-and-Y1-and-G circuits are energized, the furnace control CPU will switch to or turn on the blower motor BLWM at HI HEAT speed. When the W/W1 input signal disappears, the furnace control CPU will drop the blower speed back to HI HEAT speed. If there is still a demand for dehumidification after 20 minutes, the furnace control CPU will drop the blower speed back to HI HEAT speed. This alternating 10-minute cycle will continue as long as there is a call for cooling.

b. Cooling off-delay - When the “call for cooling” is satisfied and there is a demand for dehumidification, the cooling blower-off delay is decreased from 90 sec to 5 sec.

NOTE: If the blower-off delay is set to the maximum, the adjustable continuous-fan feature is locked (i.e., fan speed cannot be changed from its current setting).

6. Heat Pump

See Fig. 35 and 36 for thermostat connections. When installed with a heat pump, the furnace control automatically changes the timing sequence to avoid long blower off times during demand defrost cycles. When the R-to-W/W1-and-Y1 or R-to-W/W1-and-Y1-and-G circuits are energized, the furnace control CPU will switch to or turn on the blower motor BLWM at low-cool speed (same speed as LO HEAT), and begin a low-heat cycle. The blower motor BLWM will remain on until the end of the prepurge period, then shut off for 24 sec then come back on at LO HEAT speed. When the W/W1 input signal disappears, the furnace control begins a normal inducer post-purge period and the blower remains running at LO HEAT speed. If the R-to-W/W1-and-Y1-and-G signals disappear at the same time, the blower motor BLWM will remain on for the selected blower-off delay period. If the R-to-W/W1-and-Y1 signals disappear, leaving the G signal, the blower motor BLWM will remain on for the selected blower-off delay period then switch to continuous-blower speed.

When the R-to-W/W1-and-Y/Y2, R-to-W/W1-and-Y/Y2-and-G, R-to-W/W1-and-Y1-and-Y/Y2, or R-to-W/W1-and-Y1-and-Y/Y2-and-G circuits are energized, the furnace control CPU will switch to or turn on the blower motor BLWM at COOL speed, and begin a high-heat cycle. The blower motor BLWM will remain on until the end of the prepurge period, then shut off for 24 sec then come back on at HI HEAT speed. When the W/W1 input signal disappears, the furnace control begins a normal inducer post-purge period and the blower switches to COOL speed after a 3 sec delay. If the R-to-W/W1-and-Y/Y2-and-G or R-to-W/W1-and-Y1-and-Y/Y2-and-G signals disappear at the same time, the blower motor BLWM will remain on for the selected blower-off delay period. If the R-to-W/W1-and-Y/Y2 or R-to-W/W1-and-Y1-and-Y/Y2 signals disappear, leaving the G signal, the blower motor BLWM will remain on for the selected blower-off delay period then switch to continuous-blower speed.

Component Self-Test

Refer to page 72 for instructions.
Troubleshooting Guide

Is LED status light on?

YES

Is there 115V at L1 and L2?

YES

Replace furnace control.

NO

Is door switch closed?

NO

Is door switch closed?

YES

Is there 24V at SEC-1 and SEC-2?

NO

Is there 115V going to switch?

YES

Replace door switch.

NO

Check for continuity in wire from circuit breaker to furnace.

Is there 115V going to switch?

NO

Check for correct line voltage polarity. If units are twinned, check for proper low-voltage (24V) transformer phasing.

Is LED status light blinking rapidly without a pause?

NO

Check room thermostat or interconnecting cable.

YES

To recall status code briefly remove and reconnect one RED wire from the draft safeguard switch to display stored status code. You can also recall the previous status code by momentarily shorts the TEST/TWIN terminal to Com24V terminal until the LED goes out. LED will flash the status code of the previous fault or status code #11 (1 short and 1 long flash) if there was no previous fault. After the control repeats the code 4 times, the control will start the component test sequence. Once initiated the control will turn the inducer ON at high-heat speed. The inducer will run for the entire component test. The HS1, blower motor LO HEAT speed, HI HEAT speed, and COOL speed will run for 10 – 15 seconds each. Gas valve and humidifier will not be turned on. When the blower motor is turned OFF the inducer will be switched to low-speed for 10 seconds.

Is LED status light blinking ON/OFF slowly with a combination of short and long flashes?

YES

Determine status code. The status code is a 2 digit number with the first digit determined by the number of short flashes and the second digit by the number of long flashes?

NO

Go to section below for the status code that was flashed.

YES

Was there a previous status code other than #11?

NO

Does the control respond to WI/W1, WI2, Y1, YY2, and G (24V) thermostat signals?

NO

Is 24V present at WI/W1, WI2, Y1, YY2 or G thermostat terminals on the furnace control?

YES

Disconnect all the thermostat wires from the furnace control.

NO

Run system through a low-heat, high-heat, or cooling cycle to check operation. Status codes are erased after 72 hours.

Does the problem repeat when using a jumper wire?

YES

The thermostat is not compatible with the furnace control. Either install a ballast resistor, connect the Com24V thermostat terminal to the thermostat, or replace the thermostat.

NO

Replace furnace control.
Troubleshooting Guide (Cont)

11 NO PREVIOUS CODE - Stored codes are erased after 72 hours. Run system through a low-heat, high-heat, or cooling cycle to check system.

12 BLOWER ON AFTER POWER UP - (115V OR 24V) - Normal operation. Blower runs for the selected blower off-delay, if unit is powered up during a call for heat (R-WW1 closed) or when (R-WW1 opens) during the blower on-delay period.

13 LIMIT CIRCUIT LOCKOUT - Lockout occurs if the limit or flame rollout is open longer than 3 minutes. Control will auto-reset after 3 hours. See code 33.

14 IGNITION LOCKOUT - System failed to ignite gas and prove flame in 4 attempts. Control will auto-reset after 3 hours. See status code 34.

21 GAS HEATING LOCKOUT - Turn off power and wait 5 minutes to retry. Check for:
- Stuck closed gas valve relay on control.
- Miswire or short to gas valve wire.

22 ABNORMAL FLAME-PROVING SIGNAL Flame is proved while gas valve is de-energized. Inducer will run until fault is cleared. Check for:
- Stuck open or leaky gas valve.

23 PRESSURE SWITCH DID NOT OPEN - Check for:
- Obstructed pressure tube.
- Pressure switch stuck closed.

24 SECONDARY VOLTAGE FUSE IS OPEN Check for:
- Short circuit in secondary voltage (24V) wiring including thermostat leads. Disconnect thermostat leads to isolate short circuit.

31 HIGH-HEAT PRESSURE SWITCH OR RELAY DID NOT CLOSE OR REOPENED - Check for:
- Control relay may be defective.
- Gas valve is miswired.
- See status code 32.

32 LOW-HEAT PRESSURE SWITCH DID NOT CLOSE OR REOPENED - If opens during blower on-delay period, blower will come on for the selected blower off-delay, if open longer than 5 minutes inducer shuts off for 15 minutes before retry. Check for:
- Proper vent sizing.
- Air leak between vestibule and blower compartment.
- Low inlet gas pressure (if LGPS used).
- Disconnected or obstructed pressure tube.
- Defective or miswired pressure switches.
- Excessive wind.
- Plugged condensate drain.
- Water in vent piping, possible sagging pipe.
-Restricted vent.
- Defective inducer motor.
- Low inducer voltage (115 VAC).

33 LIMIT CIRCUIT FAULT - Indicates the limit or flame rollout is open. Blower will run for 4 minutes or until open switch remains whichever is longer. If open longer than 3 minutes, code changes to lockout #13. If open less than 3 min. status code #33 continues to flash until blower shuts off. Flame rollout requires manual reset. Check for:
- Loose blower wheel.
- Defective switch or connections.
- Dirty filter or restricted duct system.
- Improper gas input adjustment.
- Improper limit switch or no limit gasket.

34 IGNITION PROVING FAILURE - If flame is not sensed during the trial for ignition period, the control will repeat the ignition sequence 3 more times before lockout #14 occurs. If flame signal is lost during the blower on-delay period, blower will come on for the selected blower off-delay. Check the following items first before proceeding to the next step:
- Gas valve turned off.
- Green/Yellow wire MUST be connected to furnace sheet metal.
- Flame sensor must be grounded.
To determine whether the problem is in the gas valve, igniter, or flame sensor the system can be operated in the component test mode to check the igniter. First remove the R thermostat connection from the control and initiate the component test sequence. Is the DC microamps below 0.5?

35 LOW-HEAT PRESSURE SWITCH OPEN WHILE HIGH-HEAT PRESSURE SWITCH IS CLOSED - Check for:
- Low-heat pressure switch stuck open.
- Disconnected or obstructed pressure tube.
- Miswired pressure switches.
- Low inlet gas pressure (if LGPS used).

41 LOW-HEAT PRESSURE SWITCH DID NOT OPEN - Check for:
- Low-heat pressure switch stuck open.
- Software check error.
- Reset power to clear lockout. Replace control if code repeats.

42 LOCKOUT Auto-reset after 1 hour lockout due to:
- Flame circuit failure.
- Gas valve relay stuck open.
- Software check error. Reset power to clear lockout. Replace control if code repeats.

43 CONTROL CIRCUITRY - This control is auto-reset after 1 hour lockout due to:
- Flame circuit failure.
- Gas valve relay stuck open.
- Software check error. Reset power to clear lockout. Replace control if code repeats.

44 IGNITION PROVING FAILURE - This control is auto-reset after 1 hour lockout due to:
- Flame circuit failure.
- Gas valve relay stuck open.
- Software check error. Reset power to clear lockout. Replace control if code repeats.

45 IGNITION PROVING FAILURE - This control is auto-reset after 1 hour lockout due to:
- Flame circuit failure.
- Gas valve relay stuck open.
- Software check error. Reset power to clear lockout. Replace control if code repeats.

83 Troubleshooting Guide (Cont)
NOTES:
1. If any of the original equipment wire is replaced use wire rated for 105°C.
2. Use only copper wire between the disconnect switch and the furnace junction box (JB).
3. This wire must be connected to furnace sheet metal for control to prove flame.
4. Symbols are electrical representation only.
5. Solid lines inside PCB are printed circuit board conductors and are not included in legend.
6. Replace only with a 3 amp fuse.
8. Neutral connections are interchangeable within the NEUTRAL connector block.
9. Blower motor speed selections are for average conditions, see installation instructions for optimum selection.
10. Factory connected when LGPS is not used.
11. Ignition-lockout will occur after four consecutive unsuccessful triate-for-ignition. Control will auto-reset after three hours.
13. Blower-off delay: gas heating selections are 90, 120, 150 or 180 seconds, cooling or heat pump 90 seconds or 5 seconds when damper def is active.

Fig. 66 - Wiring Diagram
PARTS REPLACEMENT INFORMATION GUIDE

Casing Group
Blower door
Bottom plate
Control door
Door knob assembly
Top filler plate

Electrical Group
3-Amp fuse
Circuit board
Control box
Door switch
Junction box
Limit switch(es)
Transformer

Blower Group
Blower housing
Blower motor
Blower wheel
Capacitor (when used)
Capacitor strap (when used)
Cut-off plate
Power choke (where used)

Filter Group
Filter(s)
Media Cabinet (when used)

Gas Control Group
Burner
Flame sensor
Gas valve
Hot surface igniter
Manifold
Orifice

Heat Exchanger Group
Containment plate
Coupling box
Heat exchanger assembly
Primary HX cell panel
Secondary HX assembly
Tubing gaskets

Inducer Group
Collector box
Condensate trap
Condensate trap elbow
Gaskets
Inducer
Inducer assembly
Inducer motor capacitor (when used)
Inducer motor module (when used)
Pressure switch(es)

TO OBTAIN INFORMATION ON PARTS: Consult your installing dealer or classified section of your local telephone directory under “Heating Equipment” or “Air Conditioning Contractors and Systems” headings for dealer listing by brand name or contact:
Consumer Relations Department
P.O. Box 4952
Syracuse, New York 13221-4952
1-800-428-4326

Have available the model number, series number, and serial number located on the unit rating plate to ensure correct replacement part.

Model Nomenclature

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VOLTAGE /MOTOR</th>
<th>MAJOR SERIES</th>
<th>HEATING STAGES</th>
<th>COOLING CAPACITY</th>
<th>HEATING CAPACITY</th>
<th>WIDTH/ MINOR SERIES/VARIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG95</td>
<td>X</td>
<td>A</td>
<td>T</td>
<td>30</td>
<td>040</td>
<td>AAAA</td>
</tr>
</tbody>
</table>

WARNING
FIRE, EXPLOSION, ELECTRICAL SHOCK AND CARBON MONOXIDE POISONING HAZARD
Failure to follow this warning could result in dangerous operation, personal injury, death or property damage.
Improper installation, adjustment, alteration, service, or maintenance can cause personal injury, property damage, or death. Consult a qualified installer, service agency, or your local gas supplier for information or assistance. The qualified installer or service agency must use only factory-authorized replacement parts, kits, or accessories when modifying this product.