



GTH2E

NATURAL AND PROPANE GAS
TWO STAGE HIGH EFFICIENCY
(CONDENSING)
WARM AIR FURNACE

INSTALLATION, OPERATION & MAINTENANCE MANUAL



Manufactured by:

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1 - FURNACE DIMENSIONS AND CLEARANCE TO COMBUSTIBLES

Figure 1 - Furnace Dimensions

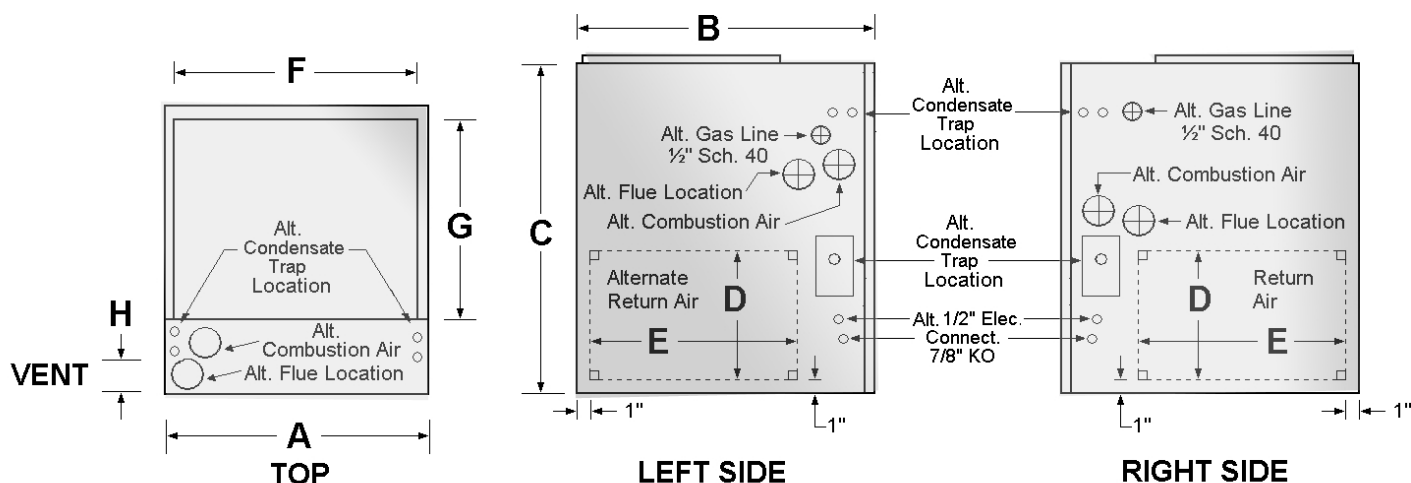
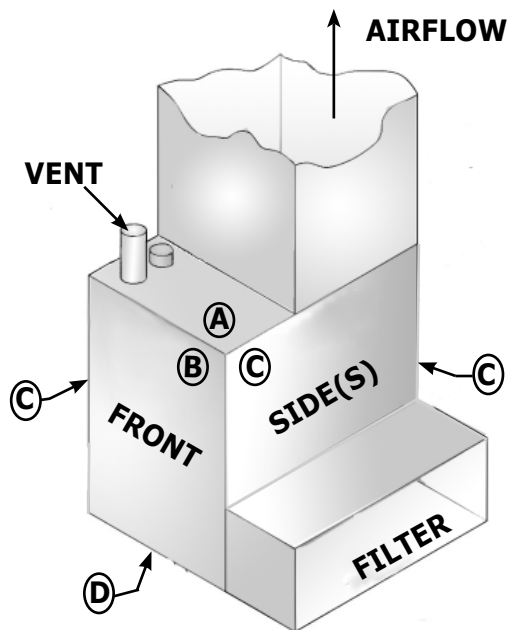


TABLE 1 - FURNACE DIMENSIONS

Model	Width A	Depth B	Height C	Vent H	Supply Air (F x G)	Return Air (D x E)
60	16 ⁷ / ₈ "	29"	40"	2"	15 ⁷ / ₈ " x 20"	14" X 22"
80	18 ¹ / ₂ "	29"	40"	2"	17 ¹ / ₂ " x 20"	14" X 22"
100	20 ¹ / ₂ "	29"	40"	2"	19 ¹ / ₂ " x 20"	14" X 22"
120	23 ¹ / ₂ "	29"	40"	2"	22 ¹ / ₂ " x 20"	14" X 22"

Figure 2 - Clearance To Combustibles



⚠ WARNING

Fire hazard. Do not install furnace on carpeting or other combustible material. Exception: may be installed on wood flooring. Failure to follow these instructions could result in death or serious injury.

Table 2 - FURNACE CLEARANCE TO COMBUSTIBLES

SIDE	Distance
A	1" or Non-Combustible Floor
B	0", Service Clearance 24" or more
C	0"
D	Combustible Floor (must not be placed on carpet or non-ceramic tile)
All models are approved for closet installation	

For downflow installations use optional subbase kit. See Replacement Parts List.

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PLEASE READ THIS MANUAL CAREFULLY AND KEEP IN A SAFE PLACE FOR FUTURE REFERENCE BY A
SERVICE TECHNICIAN.

Introduction

- ☐ Gas fired
- ☐ Two stage
- ☐ Condensing
- ☐ Upflow, downflow
- ☐ Horizontal, left and right warm air furnace
- ☐ Suitable for residential and light commercial heating applications from 60,000 to 120,000 BTU/Hr.
- ☐ Furnace is CSA design certified as Category IV indirect or direct vent central forced air furnace.
- ☐ When installed as direct vent furnace, all combustion air is supplied to furnace burners through air intake system. (See Section 8, "Ventilation and Combustion Air.")
- ☐ Models may be fired by natural gas or LP gas (propane) and may be field converted from natural gas to LP gas.

3 - WARNINGS AND SAFETY SYMBOLS

General

Installation shall be completed by qualified agency.

WARNING

Fire, explosion, asphyxiation and electrical shock hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

2.2 Become familiar with symbols identifying potential hazards.



This is the safety alert symbol. Symbol alerts you to potential personal injury hazards. Obey all safety messages following this symbol to avoid possible injury or death.

DANGER

Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices not related to personal injury.

WARNING

Fire, explosion, asphyxiation hazard. Do not install this furnace in a mobile home. Failure to follow these instructions could result in death or serious injury.

WARNING

Do not store or use gasoline or other flammable vapors and liquids, or other combustible materials in the vicinity of this or any other appliance.

Installation shall conform to requirements of authority having jurisdiction or in absence of such requirements:

USA

- National Fuel Gas Code, ANSI Z223.1/NFPA 54.
- National Electrical Code, NFPA 70.

CANADA

- Installation Code for Natural Gas and Propane Installation CAN/CGA-B149.
- Canadian Electrical Code Part 1 CAN/CSA C22.1.

Requirements for Commonwealth of Massachusetts:

Boiler installation must conform to Commonwealth of Massachusetts code 248 CMR which includes but is not limited to:

- Installation by licensed plumber or gas fitter.

WARNING

Fire, explosion, asphyxiation hazard. Do not install this furnace in a mobile home. Failure to follow these instructions could result in death or serious injury.

WARNING

Fire, explosion, asphyxiation hazard. Residential garage installation shall be installed so burners and ignition source are located no less than 18" above the floor. Locate furnace to protect from physical damage by vehicles. Failure to follow these instructions could result in death or serious injury.

Installation Requirements

- Installation of UL and ULC recognized fuel gas detectors installed in accordance with their manufacturer's instructions is recommended.
- Use type of gas approved for this furnace. Refer to furnace rating plate.
- Install furnace in dry indoor locations (protected from weather).
- Provide adequate combustion and ventilation air to furnace space as specified in Section 8 of this manual, "Ventilation and Combustion Air."
- Combustion products must be discharged outdoors. Connect furnace to approved vent system only, as specified in Section 9 of this manual, "Venting and Combustion Air Piping."
- Install furnace to operate within furnace's intended temperature-rise range with duct system, which has external static pressure within allowable range, as specified in Sections 5, 7, and 23 of this manual, "Furnace Sizing," "Ductwork," and "Airflow."
- Install furnace so supply ducts carry air circulated by furnace to areas outside space containing the furnace. Return air shall be handled by duct(s) sealed to furnace casing and terminating outside space containing furnace. (Example - Furnace for heating home located in attached garage).
- Gas-fired furnace for installation in residential garage must be installed so burners and ignitor are no less than 18" above the floor. Furnace must be located, or protected to avoid physical damage by vehicles.
- Do not use furnace for temporary heating of buildings under construction.

4 - INSTALLATION REQUIREMENTS

Installation Requirements Specific To The State Of Massachusetts For Direct Vent, Mechanical Vent, And Domestic Hot Water Appliances.

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 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 gas fitter 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 gas fitter 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 ANS/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 5.0(2)(a)1. through 4.

5. EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a)1. through 4.:

- A. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA54 as adopted by the Board; and
- B. 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.

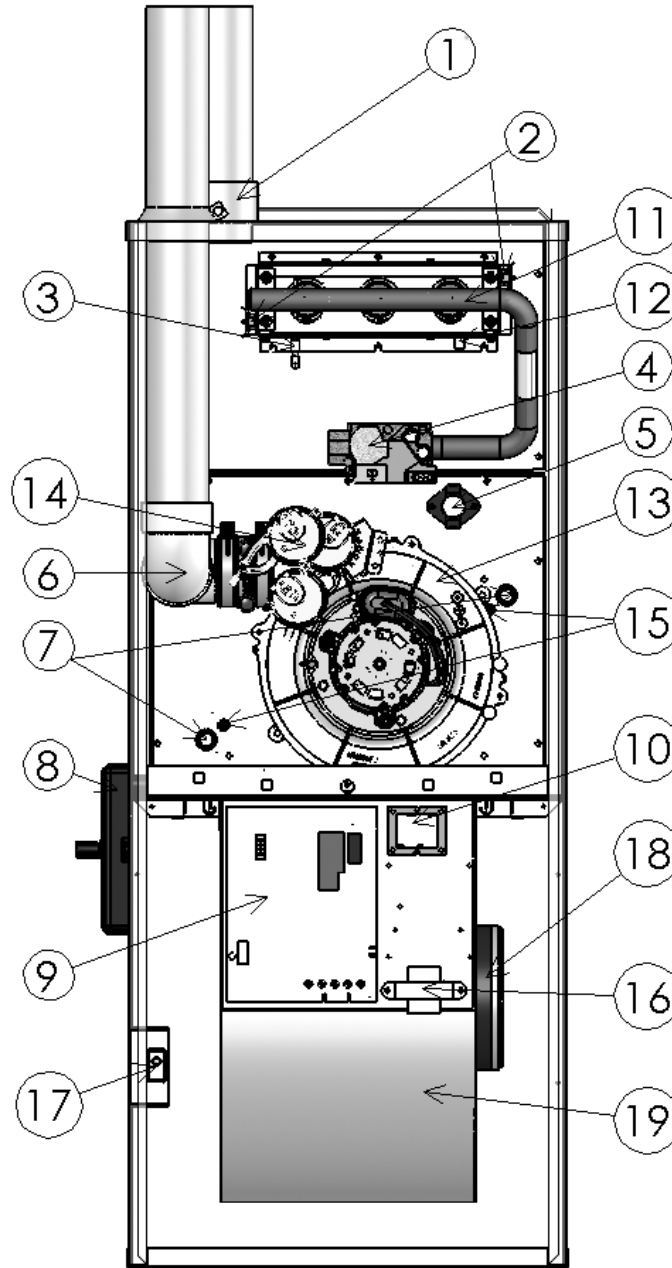
6. MANUFACTURER REQUIREMENTS -

- A. 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:
 - Detailed instructions for the installation of the venting system design or the venting system components; and
 - A complete parts list for the venting system design or venting system.
- B. 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:
 - The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and
 - 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.

7. INSTALLATION INSTRUCTIONS: 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.

4 - INSTALLATION REQUIREMENTS

Figure 3 – Furnace Components



Item	Description	Qty	Item	Description	Qty
1	Combustion Air Intake Fitting	1	11	Burner Assembly	1
2	Flame Roll-out Switch	2	12	Igniter	1
3	Flame Sensor	1	13	Two Speed Induced Draft Blower	1
4	Two Stage Gas Valve	1	14	Pressure Switch Assembly	1
5	Air High Temperature Limit	1	15	Front Manifold Cover Pressure Tap	2
6	Vent and Drain Assembly	1	16	PFC "Choke Coil"	1
7	Drain for Recovery Coil	2	17	Door Switch and Junction Box	1
8	Condensate Trap	1	18	ECM Blower Motor	1
9	Two Stage Integrated Control Board	1	19	Blower	1
10	Transformer for 24 VAC	1			

5 - FURNACE SIZING

Furnace Sizing

Maximum hourly heat loss for each heated space shall be calculated in accordance with procedures described in manuals of the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), or by any other method which is suitable for local conditions, provided results obtained are in substantial agreement with, and not less than those obtained using the procedure described in their manuals.

In the United States, "Manual J - Load Calculation," published by Air Conditioning Contractors of America, describes suitable procedure for calculating maximum hourly heat loss.

Replacement Applications

Retrofit application, do not rely on capacity of existing heating equipment as method to size new furnace.

Older furnaces may be equipped with large belt drive blower systems, operating at low RPM's. When replacing an existing furnace, verify existing ductwork can handle airflow necessary for reasonable temperature rise.

Some older gas furnaces operated with system temperature rise of 70° - 100°F. GTH2E is designed to operate with system temperature rise (ΔT) of High Fire 35° - 65°F, Low Fire 25° - 55°F. If furnace selected has identical output capacity as original furnace, a substantial increase in system air flow will be required.

See Tables 3A and B and airflow characteristics in Section 23 of this manual, "Airflow."

Table 3A - Range Of Temperature Rise

Furnace Model	Temperature Rise
60, 80, 100, 120	High Fire (HF) 35 - 65°F
	Low Fire (LF) 25 - 55°F

Table 3B - Air Flow For Temperature Rise

Furnace Model	High Fire (HF) CFM Required for a ΔT of F			
	35	45	55	65
60	1501	1167	955	808
80	2001	1557	1274	1078
100	2502	1946	1592	1347
120	3002	2335	1910	1616
Furnace Model	Low Fire (LF) CFM Required for a ΔT of F			
	25	35	45	55
60	901	700	573	485
80	1201	934	764	647
100	1501	1167	955	808
120	1801	1401	1146	970

Existing Ductwork

Assess existing ductwork for its air handling capabilities.

- Residential applications, recommended air velocity of supply air trunk duct is 700 feet per minute (fpm), and should not exceed 900 fpm.
- Recommended air velocity of a supply air branch run is 600 fpm, and should not exceed 900 fpm. Values are slightly lower for flexible ducting.
- Recommended air velocity of return air trunk duct is 600 fpm, and should not exceed 700 fpm.
- Recommended and maximum air velocity of return air branch 600 fpm.

"Equal Friction Chart," as published by ASHRAE and AHRI, is the basis for various air duct calculators available through heating supply companies.

Following air velocity guide lines, according to "Equal Friction Chart," or slide rule air duct calculator, a typical 6" round duct has a capacity of approximately 100 cfm.

An under-sized return air system prevents sufficient quantities of air from reaching supply air system and reduces service life of furnace and its components.

6 - LOCATION OF UNIT

1. General Guidelines

- A. Provide combustion air and ventilation air in accordance with the section "Air for Combustion and Ventilation," of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or Sections 8.2, 8.3 or 8.4 of Natural Gas and Propane Installation Code, CAN/CSA B149.1, or applicable provisions of local building codes
- B. Locate as near as possible to existing or proposed duct system.
- C. Locate furnace where convenient for condensate removal. Use condensate pump if necessary. Drain tubing must not terminate outdoors. Select a condensate pump approved for furnace condensate applications.
- D. Locate furnace location for access for servicing and within clearance to combustibles guidelines marked on appliance rating plate.
- E. Install furnace level to allow for proper drainage of condensate. Furnace may shut down if condensate does not drain freely away from the furnace.
- F. Install on a firm base when installed in up-flow position. Would typically be concrete floor if installing in a basement.
- G. If furnace is installed so return air will enter through the bottom, support perimeter of furnace.
- H. Horizontal position installation, support furnace from the bottom, or suspended. (Figure 3)
- I. Commercial installation such as commercial (repair) garage, burners and ignition source must be minimum of 4½ feet (1375 mm) above floor. Protect furnace from physical damage by metal barriers or other means.

2. Other Considerations

- A. Use outdoor air for combustion if furnace installed where combustion air is laden with chemical compounds as may be found in swimming pool chemicals, laundry detergents, etc.
- B. Installation in area over finished ceiling or living area, install field fabricated auxiliary drain pan under furnace to protect area from condensate spills. Auxiliary pan should be large enough to collect spilled condensate from air conditioning evaporator coil assembly if applicable.

- C. Furnace is approved for installation in attics, alcoves, utility rooms, closets and crawl spaces. Furnace installed in utility room, verify location allows access for servicing or removal of other appliances installed in room.
- D. Installation in area where freezing may occur, take steps to protect condensate trap and drain line from freezing. Use of self-regulating 5 or 6 watt per foot heat tape covered with jacket of insulation is suggested.

3. Installation In Upflow, Downflow Or Horizontal Positions

- **UPFLOW INSTALLATION:** Vent positioning, pressure switch location and drain locations in accordance with instructions in this manual.
 - **HORIZONTAL INSTALLATION:** Vent positioning, pressure switch location and drain locations in accordance with instructions in this manual.
 - **NON-SUSPENDED INSTALLATION:** Maintain clearances to combustibles as outlined in Figure 2, Table 2. Support furnace in such a way as to not allow twisting or sagging of the cabinet.
 - **SUSPENDED INSTALLATION:** Maintain clearances to combustibles as outlined in Figure 2, Table 2. Furnace may be suspended by field fabricating a cradle of angle iron and threaded rod. Secure furnace with 2" minimum slotted angle or equivalent as shown in Figure 4. Support furnace as to not allow twisting or sagging of the cabinet. Position supports as to not interfere with accessing burner and blower compartments.
 - **DOWNFLOW INSTALLATION:** Vent positioning, pressure switch location and drain locations in accordance with instructions in this manual.
- ☐ Floor opening must provide adequate clearances to combustible material.
 - ☐ ½" clearance is required between plenum and combustible material.
 - ☐ For sections of plenum with direct line of sight with heat exchanger, 1" clearance is required.
 - ☐ If installed on non-combustible material, zero clearance is required. See Parts list for optional sub-base kit.
 - ☐ Rear of the furnace must be elevated 1/4" higher than the front from a level position for proper condensate drainage.
 - ☐ Do not use a rear return on this appliance. Use only side and end returns.

4. Air Conditioning

Furnace may be used as part of an air conditioning system. Wiring and control system is "air conditioning ready."

- Installation of furnace and air conditioner above finished space, install drain pan under unit.
- Air conditioning evaporator coil must be downstream of heat exchanger. Cooled air passing over warmer heat exchanger tubes can cause condensation inside the tubes, resulting in corrosion and premature failure.
- Parallel duct system may be installed to direct air from furnace through evaporator coil only. Use dampers or other means to bypass heat exchanger. If (summer/winter) dampers are used, interlock to prevent system operation unless dampers are in full open or full closed position.

WARNING

Fire hazard. Do not install furnace on carpeting or other combustible material. Exception: may be installed on wood flooring. Failure to follow these instructions could result in death or serious injury.

Clearance to Combustibles

See Figure 2, Table 2 for certified clearances to combustibles and dimensional information. See appliance rating plate affixed to furnace for model number, serial number and clearance to combustibles information.

Furnace requires minimum 24" of front clearance for service purposes. For this purpose, service clearance takes precedence over clearance to combustibles.

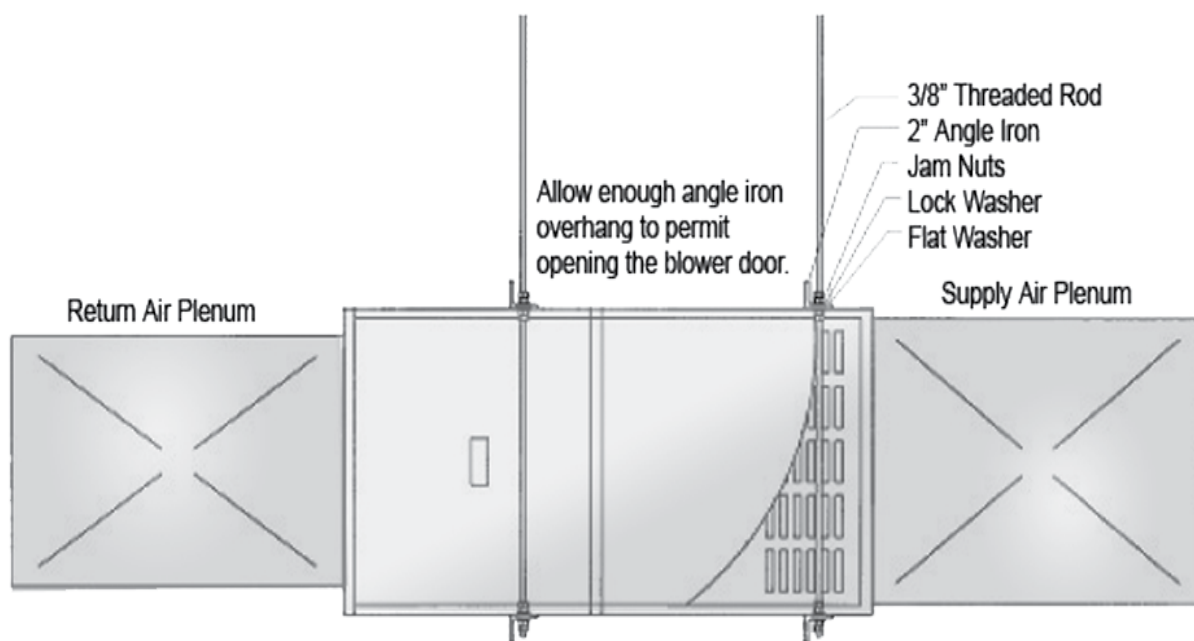
Inspection / Access Panel

If air conditioning coil is not used in supply air plenum, recommend outlet duct be provided with removable access panel.

Install so heat exchanger may be inspected for possible openings using light assistance or probe that can be inserted for sampling air stream.

Fabricate access cover to prevent leaks

Figure 4 - Suggested Method For Suspending Horizontal Furnace



General Information

- Proper airflow is required for proper operation of this furnace.
- Insufficient airflow may cause erratic operation, could cause furnace to cycle on high temperature limit, and may damage heat exchanger.
- Excessive airflow may result in excessively noisy duct system and may result in undesirable consequences such as creating uncomfortable drafts.
- Air conditioning used with the furnace, duct system must be capable of delivering correct amount of airflow for each system.
- Size and construct ductwork in accordance with accepted industry standards. Duct sizing and construction information may be obtained from:
 - A. A.C.C.A. (Air Conditioning Contractors of America)
 - B. A.S.H.R.A.E. (American Society of Heating, Refrigeration and Air Conditioning Engineers)
 - C. H.R.A.I. (Heating, Refrigerating and Air Conditioning Institute (Canada))
 - D. S.M.A.C.N.A. (Sheet Metal and Air Conditioning Contractors' National Association (United States))
- Above professional organizations have duct sizing manuals available.
- Total static pressure drop of air distribution system (including filters) should not exceed 1.0" w.c.

⚠ WARNING

Asphyxiation hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

- Do not allow gas piping to be routed through joist spaces that are used for return air purposes.
- Do not use joist spaces for return air purposes if joist space already contain plumbing stacks, chimney components, etc. Unless portion used for return air purposes can be completely isolated from portions with other usages.
- Do not allow products of combustion from flue to enter return air or supply air ductwork.
- All return air ductwork must be adequately sealed and secured to furnace with sheet metal screws. Tape sheet metal seams in vicinity of furnace with duct tape or similar material.
- Furnace mounted on a platform with return air through bottom, seal air tight between furnace and return air plenum. Floor or platform must provide sound support of furnace without sagging, cracks or gaps around base, providing a seal between support and base.

Models capable of 5 tons of airflow for air conditioning must have dual return air inlets for optimal airflow and air filtration.

Air filtration assume maximum velocity of 300 FPM for disposable type filters or 600 FPM for permanent type air filters.

GUIDE: Filter free area (in²) = 144 x (CFM / desired velocity (FPM))

Some high efficiency filters have greater than normal resistance to airflow. This can adversely affect furnace operation.

Ductwork Steps

1. Position furnace to minimize ductwork length and fittings.
2. Cut open a return air inlet. Choices are furnace bottom, either side, or any combination thereof (i.e., two sides or a side and the bottom).
3. DO NOT USE THE REAR PANEL AS A RETURN AIR INLET. There is insufficient room to permit adequate airflow.

In all cases, cut inlet air opening full width of knock-outs.

4. Connect return air duct or filter fitting to furnace. Seal connection air tight to prevent entraining combustion gases from adjacent fuel burning appliance, or entraining combustion air from this furnace or adjacent fuel burning appliances.
5. Verify adequate space and accessibility for air filter removal.
6. If two return air inlets are used, both must be equipped with filters.
7. If air conditioning evaporator coil is required, position on supply air side of furnace. Verify no air can bypass evaporator coil.
8. Connect supply air plenum to supply air outlet.

Flexible duct connectors are effective in preventing telegraphing of mechanical noise from furnace to other parts of the home via the ductwork.

If using flexible connectors, verify adjoining duct is independently supported.

WARNING

Fire, explosion, and asphyxiation hazard. Failure to properly vent or supply combustion air to this furnace can cause carbon monoxide poisoning, explosion or fire. Read this manual and understand all requirements before beginning installation.

Definitions

- ❑ **Vent and Chimney** refer to open passageways that convey vent gasses from furnace, or its vent connector to outside. Vents can be horizontal or vertical. When they serve only one gas appliance, they are called "dedicated" vents or chimneys. When they serve multiple gas appliances, they are called "common" vents or chimneys.
- ❑ **Vent Connector** refers to a pipe or duct that connects the furnace to a vent or chimney. Vent connectors usually run from the furnaces vent collar to the vent or chimney. Vent connectors may have vertical and horizontal runs.
- ❑ **Venting System** refers to a continuous open passageway from the vent collar to the outside. Venting systems usually have a vent connector(s) and a vent or chimney. Venting systems commonly serve a single furnace, or a single furnace and a hot water heater. Other multiple appliance venting systems are less common.
- ❑ **Fan Assisted Combustion System** refers to an appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger. This series furnace uses a draft inducer to draw combustion products through the heat exchanger and is considered to have a fan-assisted combustion system. Category IV furnaces with fan-assisted combustion systems must not be vented into single wall metal vents.

General Considerations

If replacing Category I type furnace connected to chimney serving other appliances, take steps to ensure the remaining appliances vent properly after removal of existing furnace. There is a probability the existing chimney will be too large.

Remove vent connector of furnace being replaced, seal off inlet to vent from furnace. Test remaining appliances connected to common vent individually following these steps:

1. Permanently seal any unused openings into common vent system.
2. Visually inspect venting system for proper size and horizontal pitch. Determine there is no blockage, restriction, leakage, corrosion, collapsed materials such as fallen bricks, or any other deficiency that could lead to an unsafe condition.

3. Duplicate winter operating conditions such as closing all windows and doors in the building. If remaining appliances are in a mechanical room, close door to room. Close fireplace dampers if any, turn on any appliances that exhaust air to the outdoors on maximum speed. This would include clothes dryers, range hoods, bathroom fans, etc. Attic fans or other fans used only in summer should be exempted from the test.
4. Follow the lighting instructions of the appliance being tested and turn it on to continuous operation.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Detect for spillage using a match flame, taper (candle).
6. After it has been proven that each appliance to remain connected to the common venting system properly vents when tested as listed above, return the windows, doors, fireplace dampers, appliances, etc. to the condition they were in prior to the test.
7. If improper venting is observed during any of the tests, the common venting system must be re-sized. In Canada, refer to the latest addition if CAN/GGA-B149, Natural Gas or Propane Installation Code. In the United States, refer to the latest ANSI Z223.1 National Fuel Gas Code (NEPA 54), or AGA-GAMA Venting Tables for Category I furnaces.

The furnace products of combustion include both flue gases and condensate. All venting and drain materials are plastic.

Acceptable Materials In The United States

For United States installations, the combustion air and vent piping and fittings may be comprised of:

- Schedule 40 PVC, ASTM D1785 or CSA B137.3
- PVC-DWV, ASTM D2665 or CSA B181.2
- Schedule 40 CPVC, ASTM F441 or CSA B137.6
- PVC PRIMER AND SOLVENT CEMENT: ASTM D2564

Follow piping manufacturers instructions on proper installation of piping and fittings including cutting, de-burring, priming, cementing, curing and supporting.

Acceptable Materials In Canada

1. Piping materials and fittings for flue gas venting must be ULC S636 listed and identified as such.
2. First 3ft. (900mm) of venting must be readily available for visual inspection.
3. Specified primers and glues of certified vent system must be from single system manufacture, and not intermixed with other system manufacturer's vent system parts.
4. Components of the certified vent system must not be interchanged with other vent systems, or unlisted pipe, and or fittings.
5. Follow venting manufacturers instructions on installation, cutting, de-burring, cementing, curing and supporting of venting system.
6. Furnace can be vented with ULC S636 certified PVC material with a rating of 65° C or more.
7. Supplied PVC street elbows are certified for use within the vestibule. Use approved transition cement certified by ULC S636 venting supplier.
8. Optional Concentric Vent Termination Kits are certified for use. Use approved transition cement certified by ULC S636 venting supplier.
9. Combustion air piping does not have flue gases traveling through it and may be installed with common ABS, PVC or CPVC piping or fittings. Install this piping, fittings, primer and cement per manufacturer's instructions including cementing, cutting, curing and supporting the piping.

10 - NON-DIRECT VENT FURNACE INSTALLATIONS (USING INDOOR COMBUSTION AIR)

WARNING

Asphyxiation hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

- Adequate provisions for combustion and ventilation air must be in accordance with CAN/CGA-B149 in Canada, and ANSI Z223.1 - 1992, section 5.3, "Air for Combustion and Ventilation," in the United States. Check with local authorities for any additional building codes bylaws or regulations.
- The furnace, although designed as direct vent type appliance, may be installed with intake vent inside the structure.
- This furnace must be provided with enough fresh air for proper combustion and ventilation of flue gases. Most homes require outside air be brought to the furnace area.
- Air for combustion and ventilation purposes must not originate from a corrosive atmosphere. Furnace failure caused by corrosive elements is excluded from warranty coverage.

Following types of installation sites (but not limited to the following) REQUIRE OUTDOOR AIR for combustion because of chemical exposures:

- Commercial buildings
- Buildings with indoor swimming pools
- Furnaces installed in laundry rooms
- Furnaces in hobby or craft rooms
- Furnaces installed near chemical storage areas

Exposure to the following substances in combustion air supply (but not limited to the following) also require OUTDOOR AIR for combustion:

- Aerosols, particularly CFC based or propelled aerosols
- Air fresheners
- "Airplane Glue" and similar adhesives and cements
- Ammonia, as commonly found in permanent wave solutions used in hair dressing salons
- Anti-static fabric softeners used in clothes dryers
- Carbon tetrachloride
- Chlorinated cleaners and waxes
- Chlorine and bromine based swimming pool chemicals
- De-icing salts or chemicals (rock salt, etc.)
- Dry cleaning fluids such as perchloroethylene
- Fumes from curing polyurethane and similar substances
- Halogen based refrigerants including R-12 and R-22
- Hydrochloric acid, muriatic acid and other acid based masonry washing and curing materials
- Printer's inks, paint removers, varnishes, varsol, toluene, etc.
- Water softener salt and chemicals

Combustion air must be free of acid forming chemicals such as sulphur, fluorine and chlorine. These elements are found in aerosol sprays, detergents, bleaches, cleaning solvents, air fresheners, paint and varnish removers, refrigerants, and many other commercial and household products.

When burned in a gas flame, vapors from these products form acid compounds. Acid compounds increase dew point temperature of flue products and are highly corrosive after they condense.

CASE 1 - Furnace Located In An Unconfined Space

- Unconfined space does not necessarily mean that ventilation will not have to be introduced from outdoors, particularly in airtight homes. Minimum requirement for unconfined space is a volume of 50 cubic feet for each 1000 BTU/Hr for all fuel burning appliances located within the unconfined area.
- If the amount of combustion and ventilation air is insufficient to properly operate the furnace and other fuel burning appliances within the unconfined area, it will be necessary to supply it from the outdoors based on the criteria used when calculating the air supply for a confined space.
- When planning to use inside air in an unconfined space, test for proper furnace operation (as well as other fuel burning appliances located within the unconfined space) with respect to adequate combustion and ventilation air with fireplace dampers open, clothes dryer running, bathroom exhaust fans on, kitchen range hood on, etc.

CASE 2 - Furnace Located In A Confined Space

- Confined space, (any space smaller than minimums discussed in Case 1), must have two air openings; one within 12" of ceiling and the other within 12" of the floor.
- Air openings must be sized based on whether combustion and ventilation air is being taken from indoors or outdoors, the method outdoor air (if used) is introduced, and taking into account any other fuel burning appliances in the confined space.
- If sufficient indoor combustion and ventilation air is available for furnace and all other fuel burning appliances, size each opening on the basis of one square inch of free area per 1000 BTU/Hr. See Figure 5.
- Consider all clothes dryers, bathroom fans, range hoods, etc., when making this calculation.
- Minimum requirement for these openings is 100 square inches, even for furnace models under 100,000 BTU/Hr.
- If using grilles to cover the two openings, factor in free area of the grille. Typically, sidewall grille will have free area approximately 50% of its nominal size. Consequently, if required opening is 10 x 10, it will have to be doubled if using sidewall grille with 50% free area.
- If exhaust fan, fireplace, clothes dryer or any similar device is present in the indoor area from which combustion and ventilation air will be drawn, negative pressure could be a problem if natural infiltration from outdoors does not match rate at which air is exhausted.

Figure 5 - Combustion/Dilution Air From Heated Inside Sources (Case 2)

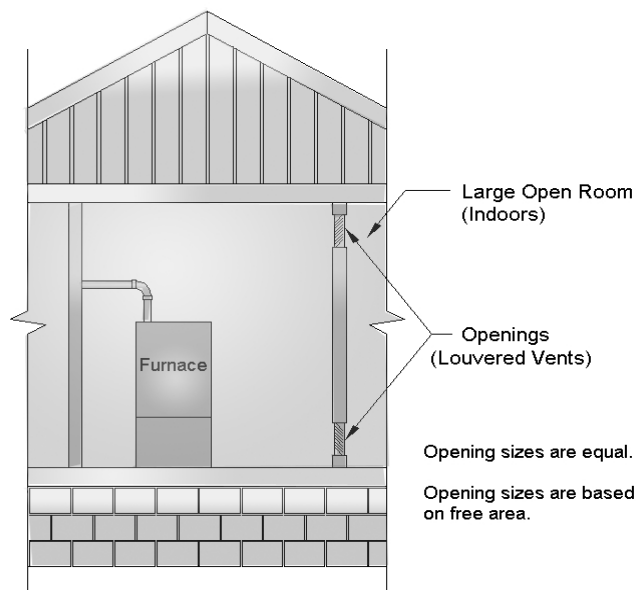
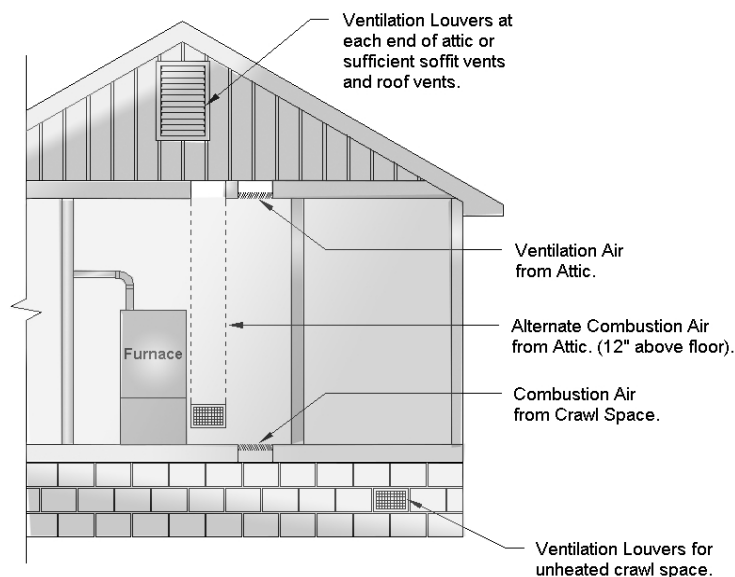


Figure 6 - Outside Air For Combustion, Attic Or Crawl Space (Case 3)



CASE 3 - Furnace Located In A Confined Space, Outdoor Air From Attic Or Crawl Space

- Free area of each of the two combustion and ventilation air openings is based on minimum of 1 square inch per 4000 BTU/Hr. One opening can originate from the floor drawing combustion and ventilation air from ventilated crawl space.
- Other opening may communicate freely with a ventilated attic. If using attic air, verify the opening is ducted from the ceiling high enough to be above the insulation. The attic must be adequately vented with soffit vents or gable vents. See **Figure 6**.
- Alternative to creating an opening in the floor to draw air from a crawl space, a duct may be dropped from the attic terminating 12" above the floor.
- Following table shows minimum free areas and round pipe sizes when drawing combustion air vertically from the attic or crawl space for furnace only. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace. See Table 4.

TABLE 4 - VERTICAL AIR SUPPLY (CASE 3)

Model	Free Area Ea. Opening	Round Pipe Size
60	15 in. ²	5 in.
80	20 in. ²	6 in.
100	25 in. ²	6 in.
120	30 in. ²	7 in.

Use of Exhaust Fan (Power Vent)

- If the attic has an exhaust fan (power vent), it may create a negative pressure sufficiently large enough to prevent the attic from being an effective source of combustion and ventilation air.
- Powered attic fans do not customarily run during heating season; however, some are controlled by a humidistat as well as a thermostat, which may allow some operation during heating season.
- Choices are (a) use direct vent option; (b) obtain outdoor air from elsewhere; or (c) interlock the attic exhaust fan with the furnace such that the two cannot operate simultaneously.

CASE 4 - Furnace Located In A Confined Space, Horizontal Outdoor Air Duct

- Similar to Case 3, outdoor air for combustion and ventilation may be drawn through horizontal ducting.
- Free area for each opening is calculated on the basis of a minimum of 1 square inch per 2000 BTU/Hr input.
- Following table shows minimum free areas and round pipe sizes when drawing combustion air horizontally from outdoors for the furnace only. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace.

TABLE 5 - HORIZONTAL AIR SUPPLY (CASE 4)

Model	Free Area Ea. Opening	Round Pipe Size
60	30 in. ²	7 in.
80	40 in. ²	8 in.
100	50 in. ²	8 in.
120	60 in. ²	9 in.

Outdoor Grilles

- If grilles are used on outside wall, size properly.
- Most sidewall grilles have only 50% free area.
- In the case of a unit with 100,000 Btuh input, which requires a pair of 8" round pipes to obtain sufficient combustion and ventilation air, duct could be an equivalent rectangular duct; 8" x 7" for example.
- Based on 50% free area for the inlet grilles, actual grille size would have to be 14" x 8" or its equivalent. A transition may be used to reduce to smaller duct size if necessary.
- Outdoor grilles must be installed in location where they will not be obstructed in any manner.

CASE 5 - Furnace Located In A Confined space, Outdoor Air Ducted with Single Opening (US Only)

- Provide One permanent opening, commencing within 12 in. (300 mm) of top of the enclosure.
- Appliance shall have clearances of at least 1 in. (25 mm) from sides and back and 6 in. (150 mm) from front of appliance.
- Opening shall directly communicate with outdoors or shall communicate through vertical or horizontal duct to outdoors or spaces that freely communicate with outdoors and shall have minimum free area of following:
 1. $1 \text{ in}^2/3000 \text{ BTU/hr}$ ($700 \text{ mm}^2 \text{ per kW}$) of total input rating of all appliances located in the enclosure, and
 2. Not less than the sum of areas of all vent connectors in that space"

Connection To Furnace Non-Direct Vent

When using indoor air or the non-direct vent configuration, the combustion air inlet to the furnace must be protected from blockage. Use a double elbow arrangement if supplying combustion air through the top, or downward pointing single elbow if supplying combustion air through the side. See Figure 8.

Figure 7 - Outdoor Air For Combustion, Horizontal (Case 4)

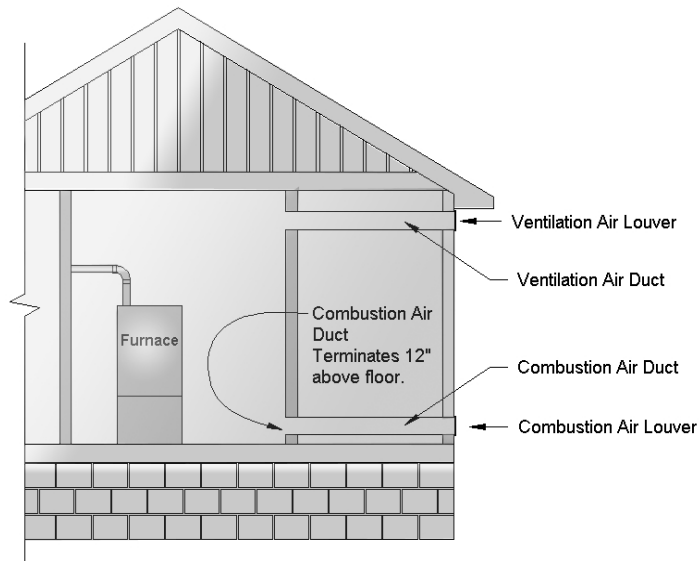
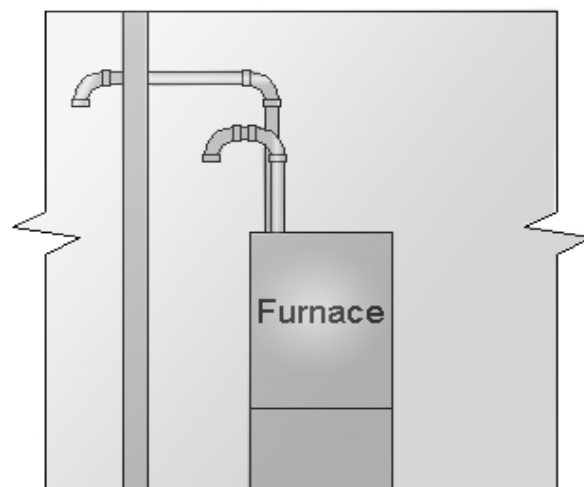


Figure 8 - Non-Direct Combustion Air Inlet



⚠ WARNING

Asphyxiation, explosion, fire hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

General Information

- Accumulation of snow around combustion air intake and exhaust termination may have negative effects on appliance operation and/or performance.
- Snow accumulation should be considered when locating combustion air intake and exhaust terminations.
- Inspect combustion air intake and exhaust termination periodically to ensure they are clear of obstructions. i.e. vegetation, debris, snow, etc.
- Failure to follow all venting guidelines may result in erratic furnace operation, freeze-up of exhaust air piping, or sooting of the furnace.

All exhaust piping must be installed in accordance with CAN/CGA-B149 in Canada; the latest edition of National Fuel Gas Code, NFPA 54 / ANSI Z223.1 in the United States, as well as in accordance with local codes.

- Venting may be vertical or horizontal.
- Minimum vent length - 25 total equivalent feet. See Venting Table 6.
- Horizontal piping must slope back towards furnace at minimum rate of $\frac{1}{4}$ " to the foot, so condensate drains towards the furnace.
- Support horizontal runs at least every 3 feet. Horizontal sections must not dip or sag.
- Insulate all vent runs through unconditioned space where freezing might occur with 1" thick, medium density, foil-faced Fiberglass insulation. An equivalent "arm-a-flex" or "rub-a-tex" may also be used as long as there is no heat tape applied to the vent pipe.
- For horizontal runs where water may collect, wrap vent pipe with self regulating 3 or 5 watt heat tape. Heat tape must be CSA, UL, or ULC listed and installed per manufacturer's instructions.
- ***Do not common vent with any other appliance.***
- If venting vertically, do not vent up a chimney serving another appliance or install in a chase with a metal or high temperature plastic pipe from another gas or fuel burning appliance unless required clearances to combustibles can be maintained between furnace venting system and other pipes.

- See Table 6 combustion air and exhaust piping size.
- When calculating allowable vent lengths, be sure to count all termination fittings in addition to concentric vent as a straight pipe.
- Take building orientation and presence of other buildings or other nearby structures into consideration when planning venting system location.
- Some external structures could create air turbulence around vent termination leading to downdrafts and venting problems.
- In windy and hilly locations, roof venting may improve operations. Maximum venting length is based on 30 mph winds, areas where higher gusts are dominant it is suggested to shorten horizontal vent length.
- Install vent and combustion air intake so both are located in same wind pressure zone.

Do not connect furnace to chimney or flue serving other appliances or solid fuel burning appliance.

Vent Termination

- ☐ Pass horizontal vents through exterior wall.
- ☐ Terminate vent approximately 8" or more from wall.
- ☐ See Figure 9 standard horizontal vent detail.

Figure 9 - Standard (Straight) Horizontal Vent Detail

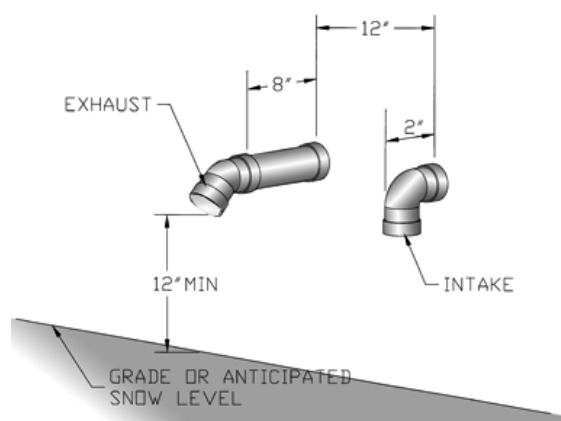


TABLE 6 - Direct And Non-Direct Vent Lengths

MAXIMUM ALLOWABLE LENGTH OF EXHAUST OR INTAKE

MODEL	PIPE SIZE	NUMBER OF 90° ELBOWS							NOTES
		0	1	2	3	4	5	6	
60	1½"	25	20	15	10	5	-	-	<ol style="list-style-type: none"> Count concentric vent fitting as straight pipe. Use medium or long sweep elbows where possible. One 90° elbow is equivalent to two 45° elbows. For direct vent, the listed lengths are allowed for each vent (intake and exhaust). For non-direct vent, the listed lengths are allowed for exhaust. The intake should have a 1½" or 2" snorkel intake fitting. See Figure 9. Include the 2 vestibule elbows when calculating total vent length for all models.
	2"	75	70	65	60	55	50	45	
	3"	100	95	90	85	80	75	70	
80	2"	50	45	40	35	30	25	20	
	3"	100	95	90	85	80	75	70	
100	2"	50	45	40	35	30	25	20	
	3"	100	95	90	85	80	75	70	
120	3"	100	95	90	85	80	75	70	

When 1½" or 3" pipe is used, exit the cabinet with 2" pipe. Reduce or increase immediately after exiting the cabinet making provisions to secure the vent bracket between cabinet and fitting.
Use of a concentric termination reduces the allowable length by 5 feet from lengths shown in this table.

Figure 10 - Periscoped Vent Detail

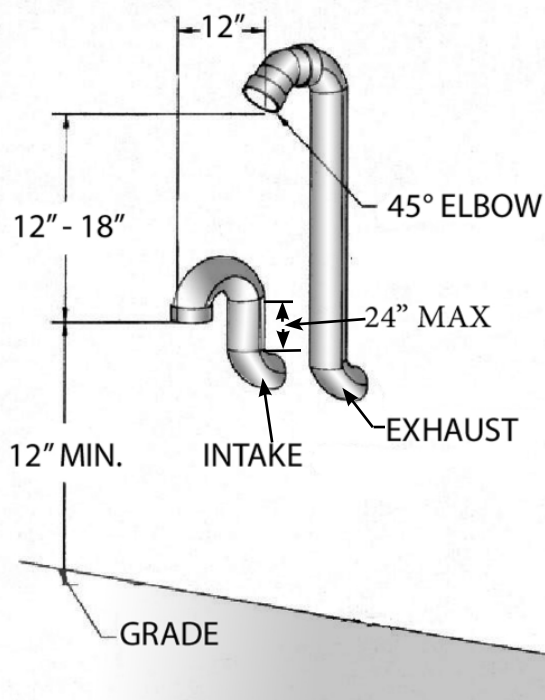
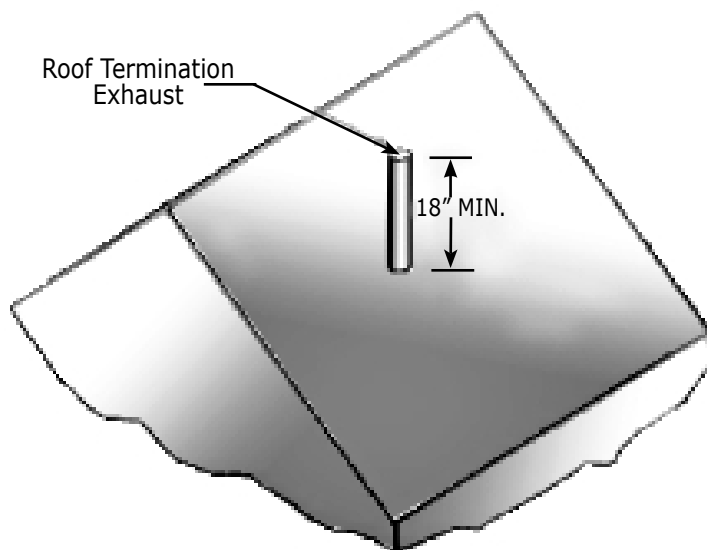


Figure 11 - Vertical Venting



General Guidelines for Venting

- Proper clearance to grade by straight out configuration cannot be achieved, termination may be raised by use of pair of 90° elbows. See **Figure 9**, Exhaust Detail Only.

NOTICE

Length of pipe and elbows count toward maximum allowable vent length as shown in Table 6.

- Other than initial increaser/reducer, venting system must stay consistent in regards to pipe diameter through out entire vent length. Vent may also terminate in vertical venting configuration through the roof. No termination fitting is required.
- Extend exhaust pipe through the roof 18" above highest point where it extends through the roof, surface and above any obstruction within an 18" horizontal distance. See Figure 11.
- Insulate exterior vent pipe greater than 24" with ½" insulation to prevent moisture from freezing within pipe and accumulating.
- Size exhaust pipe as specified in Table 6 - Direct and Non-Direct Vent Lengths. Table lists maximum allowable length of pipe with respect to number of 90° elbows used. For purposes of this calculation, one 90° elbow is equivalent to two 45° elbows.
- Avoid locating terminal in locations where dripping condensate may cause problems such as sidewalks, patios, above planters, near windows where exhaust gases may cause fogging, etc. Avoid locating termination too close to shrubs and other vegetation.
- Moisture in flue gases condenses as it leaves the terminal. Moisture can freeze on exterior walls, on soffits, and other nearby objects. Some discoloration is to be expected; however, improper location or installation can cause structural or exterior finish damage to the building.
- Caulk all cracks, seams or joints within 6 foot radius of termination.
- Do not terminate under a deck unless there is adequate clearance to prevent damage from flue gases. Termination may be located at the end of a patio deck. Piping running beneath the deck must be suitably insulated and suspended in a manner to prevent condensate from collecting and freezing.
- Do not locate terminal on side of building facing prevailing winter winds.

Canada

Non-direct vent exhaust shall not terminate in addition to general guidelines:

- Directly above paved sidewalk or paved driveway which is located between two single-family dwellings and serves both dwellings;
- Less than 7 feet above paved sidewalk or paved driveway located on public property;
- Within 6 feet of mechanical air supply inlet to any building;
- Above meter/regulator assembly within 3 feet horizontally of center line of regulator;
- Within 6 feet of any service regulator vent outlet;
- Less than 12" above grade level or anticipated snow level;
- Within 12" of any door, window, or non-mechanical air supply inlet to any building;
- Within 12" of combustion air inlet of any other appliance;
- Underneath veranda, porch or deck, unless (a) veranda, porch or deck is fully open on minimum of two sides beneath floor, and (b) distance between top of vent termination and underside of veranda, porch or deck is greater than 12".

U.S.A.

Non-direct vent exhaust shall be installed in accordance with following in addition to general guidelines:

- Clearance from bottom of terminal to grade shall be 12".
- Vent shall not terminate over public walkways or over area where condensate or vapor could create nuisance or hazard.
- Vent terminal shall be installed 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, soffit, under eave vent or gravity air inlet to building.
- Vent terminal shall have minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
- Locate vent terminal 3 feet above any forced air inlet located within 10 feet. Any fresh air or make-up air inlet, such as for dryer or furnace area is considered forced air inlet.
- Locate vent terminal no fewer than 6 feet from inside corner formed by two exterior walls; 10 foot distance is recommended.
- Recommended clearance from overhangs is minimum of 1 foot vertically for each foot horizontally up to 6 feet.

Furnace Venting Installations

Non-Direct Vent Installation (Using Indoor Combustion Air)

Non-direct vent installations require only vent pipe. This may be desirable when using outdoor combustion air is not practical.

- Provisions are not made for routing of combustion air;
- Outdoor environment may contain contaminants undesirable for combustion.

Direct Vent Installation (Using Outdoor Combustion Air)

Direct vent configuration is preferred installation method. Advantages are:

- No special kit or modifications are required for direct vent installations;
- Dedicated combustion air and vent piping eliminates need to use already heated air for combustion purposes;
- Probability of corrosive contaminants being present in combustion air is greatly reduced;
- Direct vent configuration is unaffected by any other appliances, exhaust fans, or other devices that may create negative pressure conditions while operating.
- No vents for combustion and ventilation air are required in confined spaces

Combustion Air

- This furnace is certified as Category IV Type FSP Non-Direct and Direct Vent Furnace.
- When installed as direct vent furnace, all combustion air is supplied from outdoors via plastic piping system.
- All components are field supplied except for adapter used to connect piping to furnace.
- Combustion air piping, like exhaust piping, must be air tight throughout system. Adapter joining combustion air to furnace is supplied with gasket to maintain the seal.
- Supplied adapter is made of PVC. If planning to use ABS pipe, use an all-purpose cleaner and ABS to PVC transition cement. If planning to use CPVC pipe, use all-purpose cleaner, a clear or purple primer and all-purpose cement approved for purpose.
- Additional information about cleaners, primers, solvents and cements may be obtained from their manufacturers.
- Installation in vicinity of other fuel burning appliances, adequate combustion air must be available for non-direct vent appliances. See Section 11 of this manual, Determining Combustion Air.

Combustion Air

HORIZONTAL - Combustion air termination is made up of medium or long sweep 90° elbow pointing downward to prevent rain from readily entering combustion air intake piping.

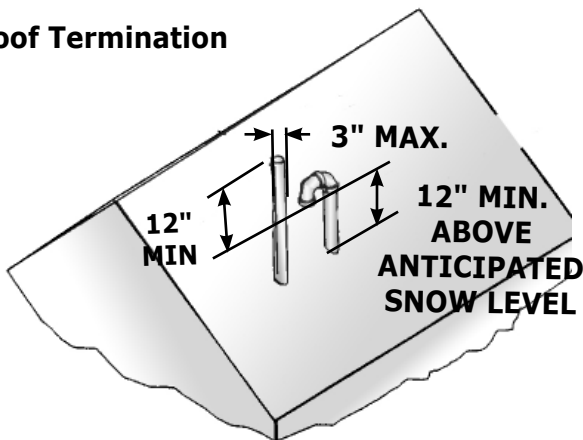
Intake screening is optional; however, unless there is reason to use one, screen may actually encourage formation of rime ice, which could cause intake to become blocked in certain weather conditions.

If required clearance to grade cannot be obtained with straight through configuration, combustion air intake pipe may be periscoped up to 24" to gain extra height. See Figure 10.

VERTICAL - Combustion air termination is made up of pair of medium or long sweep 90° elbow pointing downward to prevent rain from entering combustion air intake piping. Termination inlet must be positioned within 3" of companion exhaust piping. Locate combustion air inlet minimum of 12" above grade, and 12" below exhaust outlet. See Figure 12.

Figure 12 - Standard Vertical Venting Detail

Roof Termination



Exhaust

Horizontal - Exhaust termination is normally 45° elbow or medium or long sweep 90° elbow pointing within 45° of downward position, away from combustion air intake terminal.

If required clearance to grade cannot be obtained with straight through configuration, exhaust pipe may be periscoped up to 24" to gain extra height. Flue gases may be expelled horizontally. Use same size pipe as interior run and count fittings and length as part of total vent length. See Figure 10.

If winter prevailing wind conditions are variable and likely to blow flue gases back in on combustion air intake, exhaust termination may be raised 18-24" above combustion air intake terminal to take advantage of natural buoyancy of flue gases to help prevent re-circulation of exhaust. See Figure 10.

VERTICAL - No termination fitting is required if venting vertically through roof. End of the exhaust pipe must be 12" higher than the entrance of combustion air intake terminal. (Figure 12)

Exhaust pipe extending through the roof must extend minimum of 18" above any obstruction within an 18" horizontal distance.

Concentric Venting Kit

Concentric venting terminal kits may be used for this series furnace. They provide a means of obtaining combustion air and exhausting products of combustion utilizing a single penetration through the exterior wall. This can be useful when there is limited wall space available. Kits are available in 2" and 3" sizes. If venting the 60000 Btuh model with 1½" vent material, and a concentric vent kit is necessary, a increase coupling may be used to connect to the 2" concentric venting kit. Read the instructions supplied with the kit for additional installation instructions and details.

Concentric Vent Termination Installation Instructions

Follow the concentric vent termination manufactures instructions for installation of the concentric vent termination kit. These instructions can be found by contacting the furnace manufacture. Furnace manufacture contact information is found on the front cover of this installation manual and operating instructions.

Location

- Avoid locating the terminals where the flue gas could become stagnant and allow recirculation into the combustion air intake.
- Avoid locating the terminal in locations where dripping condensate may cause problems such as sidewalks, patios, above planters, near windows where exhaust gases may cause fogging, etc.
- Avoid locating the termination too close to shrubs and other vegetation. The condensate may stunt or kill them.
- Caulk all cracks, seams or joints within a 6 foot radius of the termination.
- Do not terminate under a deck unless there is adequate clearance to prevent damage from the flue gases. A termination may be located at the end of a patio deck. Piping running beneath the deck must be suitably insulated and suspended in a manner to prevent condensate from collecting and freezing.
- Do not locate the terminal on the side of the building facing the prevailing winter winds.

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- Improper location or installation can result in structural damage to the building, damage to the exterior finish of the building, or may allow recirculation or freezing of the flue gases onto or into the combustion air intake.
- Moisture in the flue gases condenses as it leaves the terminals. This moisture can freeze on exterior walls, soffits, and other nearby objects. Some discoloration is to be expected.
- The vent terminal should be located no fewer than 6 feet from an inside corner formed by two exterior walls. A 10 foot distance is recommended.
- Recommended clearance for overhangs is a minimum of 1 foot vertically for each foot horizontally up to 6 feet.
- As a protection against freezing, do not expose a 3" x 2" reducing coupling to outdoor ambient temperatures.
- Any adjacent painted surfaces should be in good condition; no cracks, peeling paint, etc. If wooden surfaces that may be periodically exposed to flue gases are present, consider treating with a sealer.

Figure 13 - Multiple Venting (Standard Horizontal)

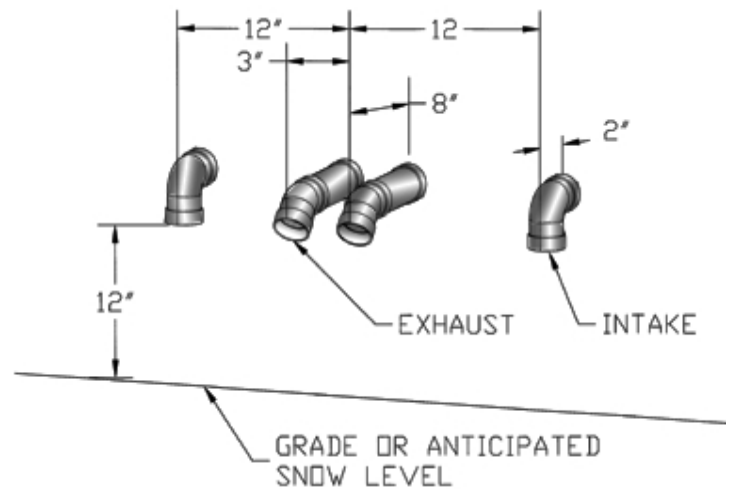
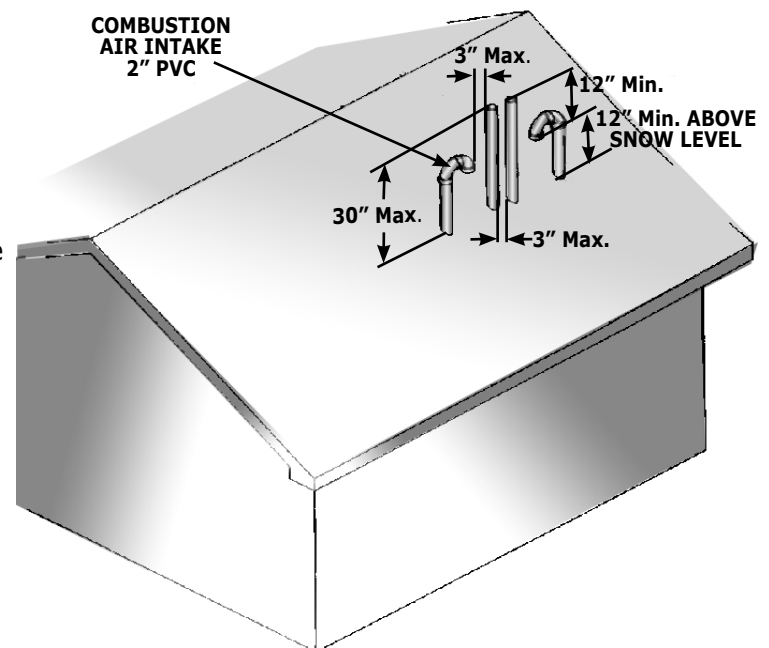


Figure 14 - Multiple Venting (Standard Vertical)



Multiple Venting

- When installing multiple furnaces in close proximity, each requires dedicated combustion air and exhaust venting.
- **Do Not Common Vent.**
- If two furnaces are to be installed in close proximity, combustion air intake and exhaust terminations may be installed as shown. See **Figures 13 and 14**.
- If more than two furnaces are being installed in close proximity, each additional combustion air intake and exhaust termination set shall not terminate less than 12 in (300 mm) apart.
- Recirculation of flue gases may occur causing intake pipe to freeze shut during cold weather operation if venting system is not installed per these guidelines.

Note: Canadian installations of 120000 Btuh require 3 ft (900 mm).

In Canada

In addition to general guidelines, both non-direct and direct vent exhaust shall not terminate:

- Directly above a paved sidewalk or paved driveway which is located between two single-family dwellings and serves both dwellings;
- Less than 7 feet above a paved sidewalk or paved driveway located on public property;
- Within 6 feet of a mechanical air supply inlet to any building;
- Above a meter/regulator assembly within 3 feet horizontally of the center line of the regulator;

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- Within 6 feet of any service regulator vent outlet;
- Less than 12" above grade level or anticipated snow level;
- Within 12" of any door, window, or non-mechanical air supply inlet to any building;
- Within 12" of the combustion air inlet of any other appliance; Note: Canadian installations of 120,000 BTU/h requires 3 ft. (900 mm)
- Underneath a veranda, porch or deck, unless (a) the veranda, porch or deck is fully open on a minimum of two sides beneath the floor, and (b) the distance between the top of the vent termination and the underside of the veranda, porch or deck is greater than 12".
- See Figures 17A and 17B for terminal clearances.

In The U.S.A.

In addition to the general guidelines, in United States, both non-direct and direct vent exhaust shall be installed in accordance with the following:

- The clearance from the bottom of the terminal to grade shall be 12".
- The vent shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard.
- The vent terminal shall be installed at least 1 foot from any opening through which flue gases could enter a building.
- The vent terminal shall have a minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
- Locate the vent terminal 3 feet horizontally from the vent of any side wall vented fuel gas appliance or electric clothes dryer, except in the case where two or more of these furnaces are multi-vented. (See "Multiple Venting")
- See **Figures 17A and 17B** for terminal clearances.

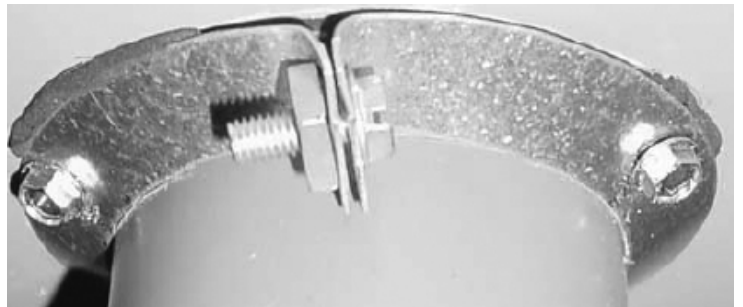
General

- ❑ Clean and de-burr all pipe cuts. The shavings must not be allowed to block the exhaust, combustion air inlet or condensate drain lines.
- ❑ If pipe and fittings are to be other than PVC, use the proper cleaner, primer and cement for the dissimilar materials.
- ❑ There must not be any openings between the blower division panel and the combustion compartment. The blower compartment is under greater suction than the combustion compartment and can pull combustion air from the burners and cause incomplete combustion and erratic furnace operation.
- ❑ Vent must be clamped to the furnace panel using the gasket and clamp provided. The intake must use the threaded PVC connector with the gasket and lock nut.

Routing Options

- Install furnace in any of four positions. See Figures 18-25.
- Installer consider following services: gas pipe, electrical power, drain trap, intake and exhaust vents.
- Consider air conditioning connections and drain, access to filter(s) and access to furnace and a/c for repair.
- Drains and traps of furnaces installed in spaces subjected to freezing temperature must also be protected against freezing.
- Vent must be clamped to exterior panel(s) with clamp provided.
- Place gasket between clamp and side panel.
- Tighten clamp and fasten in place using three screws provided.
- Clamp should secure vent pipe to prevent internal damage if vent pipe is tampered with.
- Combustion air inlet fitting is 2" PVC Socket to Pipe Thread adapter.
- Choose intake location and open appropriate knock out.
- Install adapter to exterior panel using gasket (on outside of panel and locknut on inside of panel).

Figure 15 -Vent Clamp and Gasket

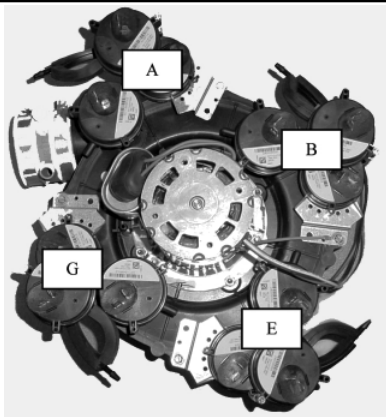


13 - TERMINATIONS

Keep pressure switch hose above heat exchanger drain.

Figure 16 , Table 7 - Pressure Switch Positioning

ORIENTATION		ROTATE INDUCER	RECOMMEND MOUNTING
FURNACE	FLUE		
Down	Left	Y	B or G
Down	Right	N	G
Up	Left	N	A or E
Up	Right	Y	G
Up	Vertical	N	A or E
Horz. Left	Vertical	Y	E
Horz. Right	Vertical	N	A or E
Horz. Right	Right	N	A or E



EXAMPLE: In a Horizontal Right/Vertical application (not shown), when furnace is horizontal, room air is exiting from right side of furnace, and flue is vertical (existing from left side panel in upflow position). Mount pressure switch at location A or E.

Venting Installation Instructions

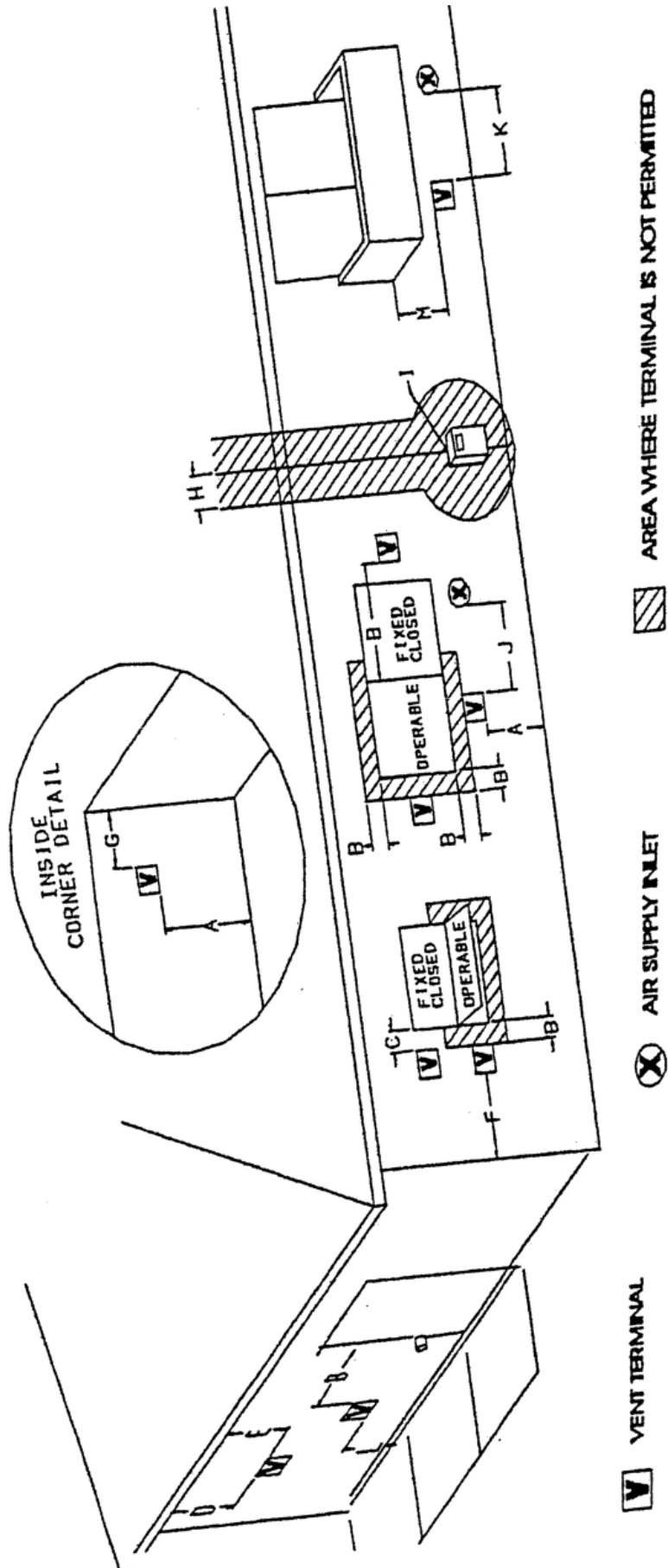
1. Remove 4 inducer screws
2. Disconnect inducer wire connection.
3. Remove pressure switch and front manifold cover hose.
4. Remove pressure switches if applicable.
5. Remove inducer.
6. Reverse bands on rubber drain coupling so screws are accessible if necessary. (Do not reverse drain coupling.) Confirm directional arrow on drain coupling points away from inducer.
7. Remove appropriate knock out.
8. Install inducer in correct orientation with 4 screws removed in step 1.
9. Install pressure switches so they are above heat exchanger drain. See pressure switches recommended mounting table.

10. Complete venting as installation requires. If exiting top panel, use two street elbows to route vent. One elbow secured to inducer, will angle toward front of cabinet. Second nested inside directed towards top panel. 120,000 BTUH input unit requires extension between inducer and first elbow. If exiting side panels route pipe straight outside cabinet. Pipe exiting cabinet in any installation should be long enough to install vent clamp on outside of cabinet.
11. Rotate drain coupling so drain holes are angled downward and tighten coupling bands.
12. Tighten vent clamp and secure in place using three screws provided.

Always secure or support vent and intake to floor joists or rafters to avoid sagging and possible fatigue of venting materials. This ensures proper drainage and prevents spilling products of combustion into the building.

- Completely isolate blower compartment from burner compartment.
- In tight rooms with other combustion devices, blower compartment must be completely isolated from the room.
- Combustion compartment must also be completely isolated from room (unless indirect vent).
- Sometimes knockout tool will punch too deep and open holes. Use caulking on inside of cabinet to seal any holes. Verify combustion door gasket is in good condition.

Figure 17A & 17B- Direct Vent & Non-Direct Termination Clearances



14 - VENT CLEARANCES

Figure 17A - Direct Vent Termination Clearances

DIRECT VENT TERMINATION CLEARANCES			
	Clearance	Canadian Installations - 1	US Installations -2
A =	Clearance above grade, veranda, porch, deck, or balcony	12 inches (30cm)	12 inches (30cm)
B =	Clearance to window or door that may be opened	6 inches (15cm) for appliances \leq 10,000 Btuh (3kW), 12 inches (30 cm) for appliances $>$ 10,000 Btuh (3kW) and \leq 100,000 Btuh (30kW), 36 inches (91cm) for appliances $>$ 100,000 Btuh (30kW)	6 inches (15cm) for appliances \leq 10,000 Btuh (3kW), 9 inches (23 cm) for appliances $>$ 10,000 Btuh (3kW) and \leq 50,000 Btuh (15kW), 12 inches (30 cm) for appliances $>$ 50,000 Btuh (15kW)
C =	Clearance to permanently closed window	*	*
D =	Vertical clearance to ventilated soffit located above the termination within a horizontal distance of 2 feet (61 cm) from the center line of the termination	*	*
E =	Clearance to unventilated soffit	*	*
F =	Clearance to outside corner	*	*
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator.	*
I =	Clearance to service regulator vent outlet	3 feet (91 cm)	*
J =	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (15 cm) for appliances \leq 10,000 Btuh (3kW), 12 inches (30 cm) for appliances $>$ 10,000 Btuh (3kW) and \leq 100,000 Btuh (30 kW), 36 inches (91 cm) for appliances $>$ 100,000 Btuh (30 kW)	6 inches (15 cm) for appliances \leq 10,000 Btuh (3kW), 9 inches (23 cm) for appliances $>$ 10,000 Btuh (3kW) and \leq 50,000 Btuh (15 kW), 12 inches (30 cm) for appliances $>$ 50,000 Btuh (15 kW)
K =	Clearance to mechanical air supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13m) +	*
M =	Clearance under veranda, porch, deck or balcony	12 inches (30 cm) ++	*

1 In accordance with the current CSA B149.1.1, Natural Gas and Propane Installation Code

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

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

++ Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor

* For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B149.1, the following statement shall be included:

" Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's installation instructions."

14 - VENT TERMINATION CLEARANCES

Figure 17B - Non-Direct Vent Termination Clearances

NON - DIRECT VENT TERMINATION CLEARANCES			
	Clearance	Canadian Installations - 1	US Installations -2
A =	Clearance above grade, veranda, porch, deck, or balcony	12 inches (30cm)	12 inches (30cm)
B =	Clearance to window or door that may be opened	6 inches (15cm) for appliances \leq 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and \leq 100,000 Btuh (30kW), 36 inches (91cm) for appliances > 100,000 Btuh (30kW)	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening
C =	Clearance to permanently closed window	*	*
D =	Vertical clearance to ventilated soffit located above the termination within a horizontal distance of 2 feet (61 cm) from the center line of the termination	*	*
E =	Clearance to unventilated soffit	*	*
F =	Clearance to outside corner	*	*
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator.	*
I =	Clearance to service regulator vent outlet	3 feet (91 cm)	*
J =	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (15 cm) for appliances \leq 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and \leq 100,000 Btuh (30 kW), 36 inches (91 cm) for appliances > 100,000 Btuh (30 kW)	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening
K =	Clearance to mechanical air supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13m) +	7 feet (2.13m)
M =	Clearance under veranda, porch, deck or balcony	12 inches (30 cm) ++	*

1 In accordance with the current CSA B149.1.1, Natural Gas and Propane Installation Code

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

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

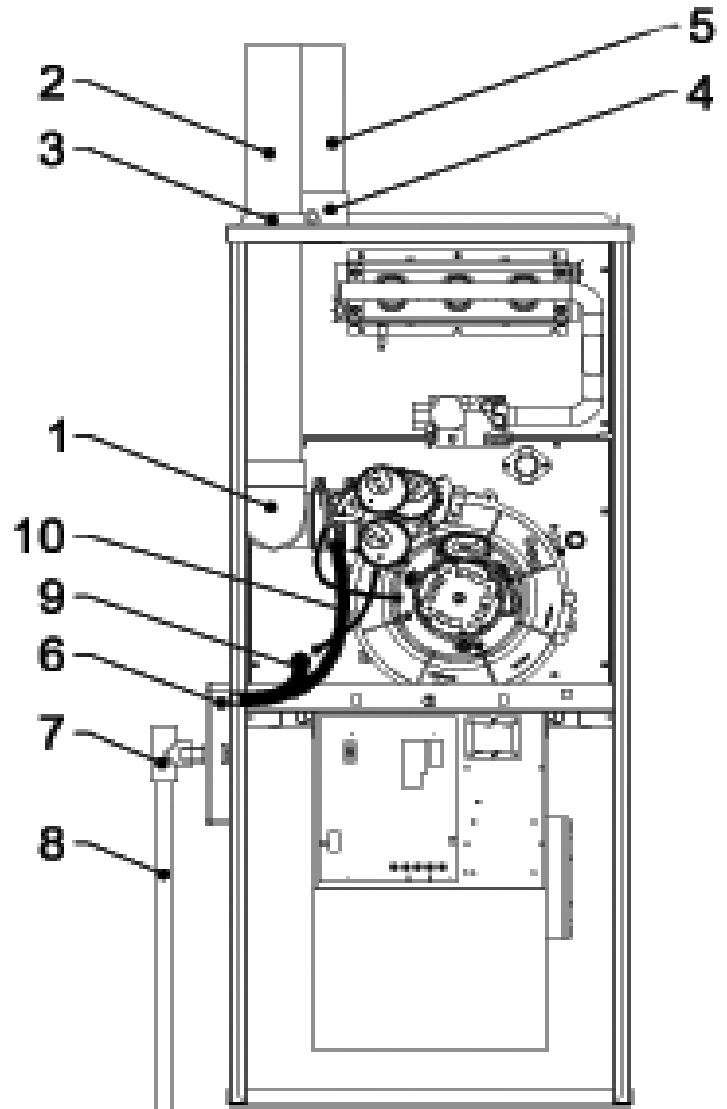
++ Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor

* For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B149.1, the following statement shall be included:

" Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's installation instructions."

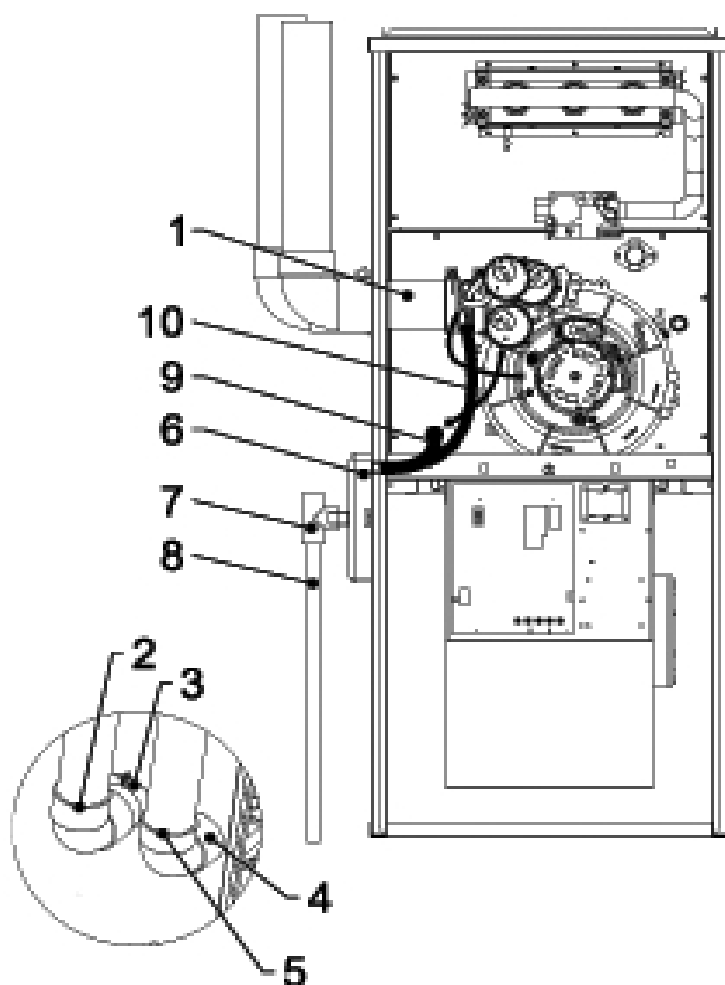
Instructions for Upflow with Top Venting	
1.	Connect two (2) 2" Street elbows (in parts bag) to coupler on exhauster (Add 2" nipple for 120K BTU units). Verify exhaust coupler drain outlet is facing downward 15°.
2.	Remove 2.5" knockout and connect 2" vent pipe (field supplied). If using 1.5" or 3" vent, make transition as close as possible to unit and on vertical section.
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws. (All parts from parts bag).
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on outside of unit using 2" nut. If using 1.5" or 3" intake, make transition as close as possible to unit and on vertical section. (All parts from parts bag).
5.	Connect 2" intake pipe. (Field supplied).
6.	Remove two (2) 7/8" knockouts and install condensate trap with gasket. Hold in place with two (2) screws **Condensate trap can be placed on either side of unit**. (All parts supplied in parts bag).
7.	**IMPORTANT** Connect 1/2" tee fitting (field supplied) to outlet of condensate trap.
8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
9.	Connect one end of 5/8" tubing (in parts bag) to drain on front manifold cover. Route to larger outlet on condensate trap. Cut excess tube. Hold in place with supplied hose clamps. Slope tubing towards drain trap with no sags.
10.	Connect one end of 1/2" tubing (in parts bag) to lower drain outlet on exhauster coupler. Route to smaller inlet on condensate trap. Cut excess tube and hold in place with supplied hose clamps. Slope tubing towards drain trap with no sags.

Figure 18 - Upflow with Top Venting



Instructions for Upflow with Left Side Venting	
1.	Remove 2.5" knockout. Connect 2" nipple approximately 7" long (field supplied) to coupler on exhaust-er. Verify exhauster coupler drain outlet is facing downward 15°.
2.	Connect 2" elbow and 2" vent pipe (field supplied).
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws. If using 1.5" or 3" vent, make transition as close as possible to unit and on vertical section. (All parts from parts bag.)
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on outside of unit, use 2" nut to fasten. (All parts from parts bag).
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to unit and on vertical section.
6.	Remove two (2) 7/8" knockouts. Install condensate trap with gasket. Hold in place with two (2) screws (all parts supplied in parts bag). **Condensate trap can be placed on either side of unit**
7.	**IMPORTANT** Connect 1/2" tee fitting (field supplied) to outlet of condensate trap.
8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
9.	Connect one end of 5/8" tubing (in parts bag) to drain on front manifold cover. Route to larger outlet on condensate trap. Cut excess tube and hold in place with supplied hose clamps. Slope tubing towards drain trap with no sags.
10.	Connect one end of 1/2" tubing (in parts bag) to lower drain outlet on exhauster coupler. Route to smaller inlet on condensate trap. Cut excess tube and hold in place with supplied hose clamps. Slope tubing towards drain trap with no sags.

Figure 19 - Upflow with Left Side Venting



15 - VENT AND DRAINING OPTION - UPFLOW

Instructions for Upflow with Right Side Venting

1.	Remove 2.5" knockout and connect 2" nipple approximately 2.5" long (field supplied) to the coupler on the exhauster. Ensure exhauster coupler drain outlet is facing downward 15°.
2.	Connect 2" elbow and 2" vent pipe (field supplied)
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag).
5.	Connect 2" elbow and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.
6.	Remove two (2) 7/8" knockouts and install the condensate trap with gasket, hold in place with two (2) screws (all parts supplied in parts bag). **Condensate trap can be placed on either side of unit**
7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
10.	Connect one end of the 1/2" tubing (in parts bag) to the lowest drain outlet on the exhauster coupler, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

Figure 20 - Upflow with Right Side Venting

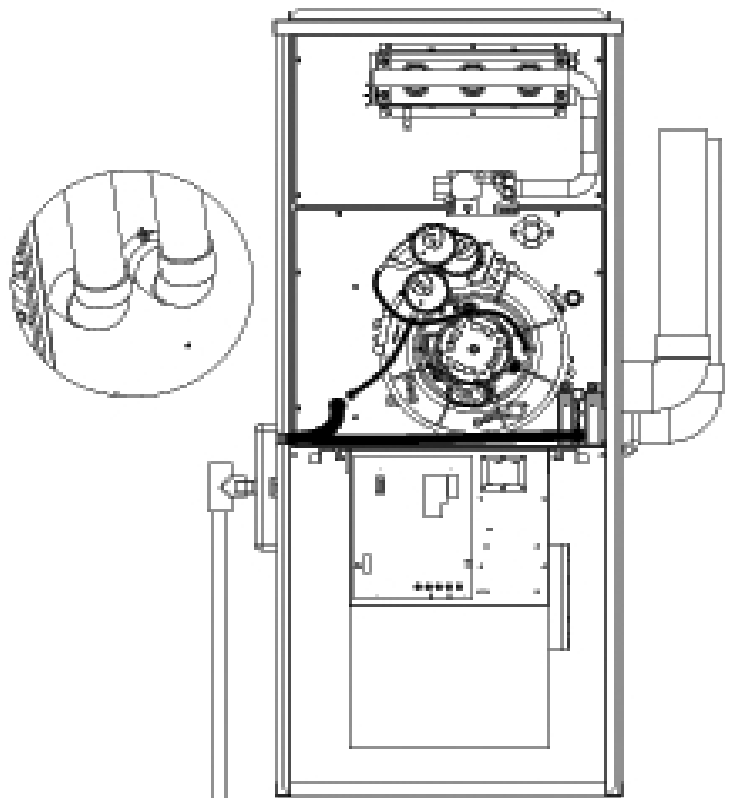
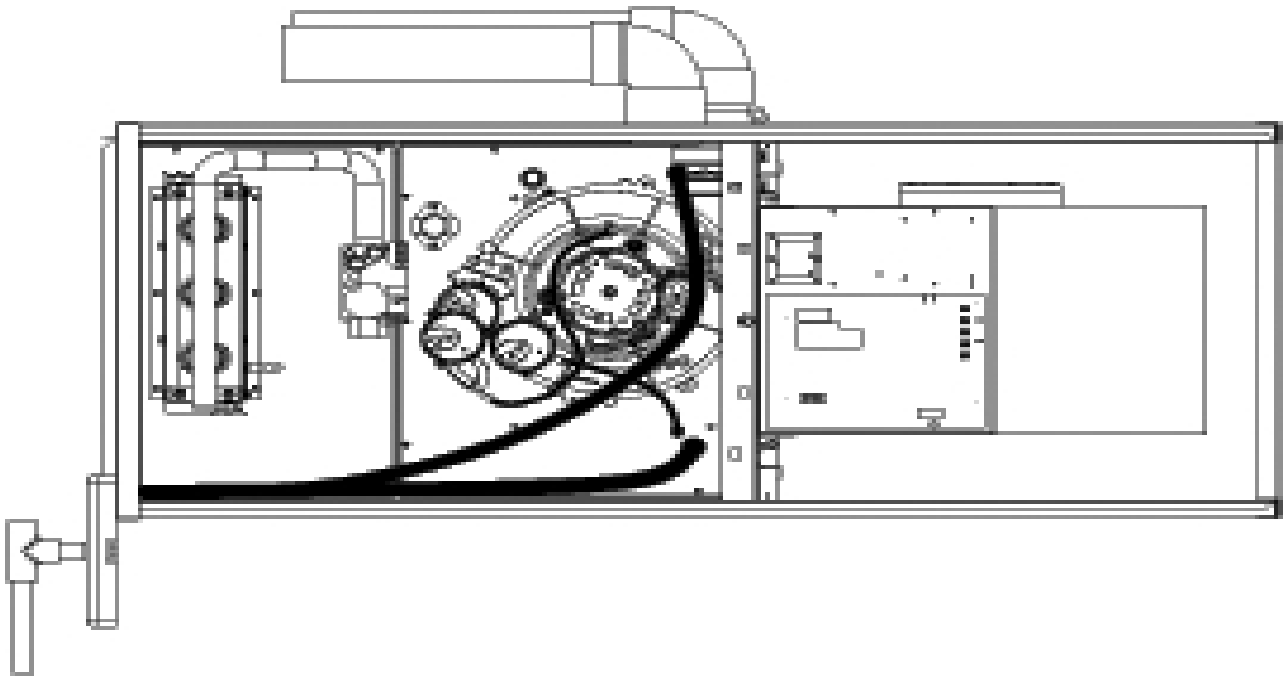


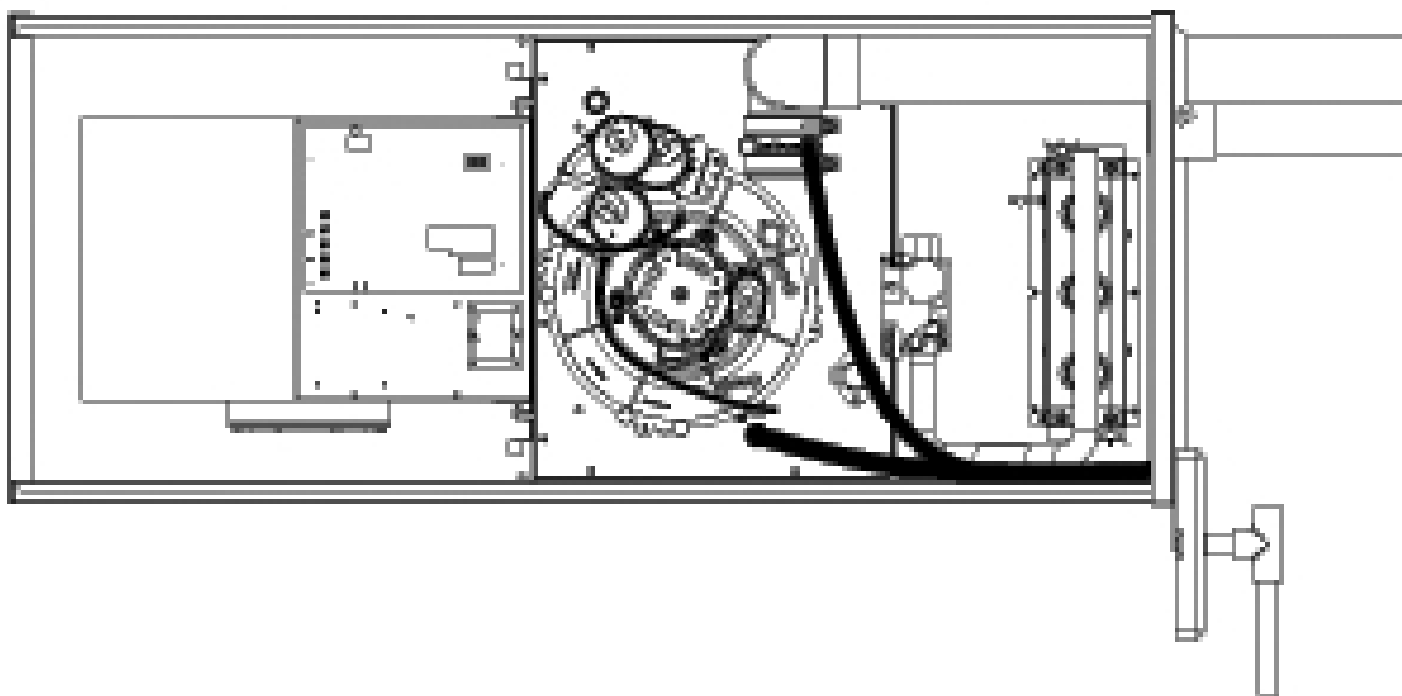
Figure 21 - Horizontal Left with Top Venting



Instructions for Horizontal Left with Top Venting

1.	Remove 2.5" knockout and connect 2" nipple approximately 2.5" long (field supplied) to the coupler on the exhaustor. Ensure exhaustor coupler drain outlet is facing downward 15°.	6.	Remove two (2) 7/8" knockouts and install the condensate trap bracket by removing and reusing the 2 top panel screws, install condensate trap with gasket, hold in place with 2 screws (all parts supplied in parts bag).
2.	Connect 2" elbow and 2" vent pipe (field supplied).	7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.	8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag). **Refer to page 26 for inducer orientation**	9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.	10.	Connect one end of the 1/2" tubing (in parts bag) to the lower drain outlet on the exhaustor coupler, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

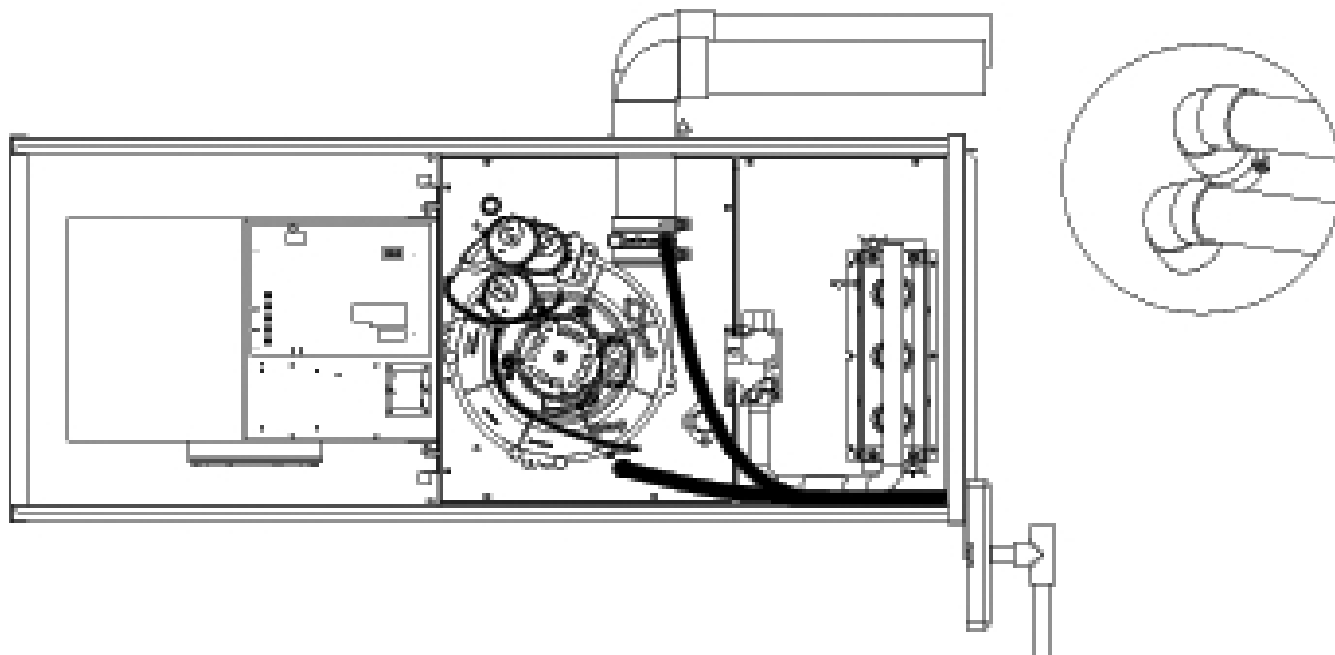
Figure 22 - Horizontal Right with Right Side Venting



Instructions for Horizontal Right with Right Side Venting

1.	Connect two (2) 2" Street elbows (in parts bag) to the coupler on the exhaustor (Add 2" nipple for 120K BTU units). Ensure exhaustor coupler drain outlet is facing downward 15°.	6.	Remove two (2) 7/8" knockouts and install the condensate trap bracket by removing and reusing the 2 top panel screws, install condensate trap with gasket, hold in place with 2 screws (all parts supplied in parts bag).
2.	Remove 2.5" knockout and connect 2" vent pipe (field supplied). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.	7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.	8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag). **Refer to page 26 for inducer orientation**	9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.	10.	Connect one end of the 1/2" tubing (in parts bag) to the lower drain outlet on the exhaustor coupling, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

Figure 23 - Horizontal Right with Top Venting



Instructions for Horizontal Right with Top Venting

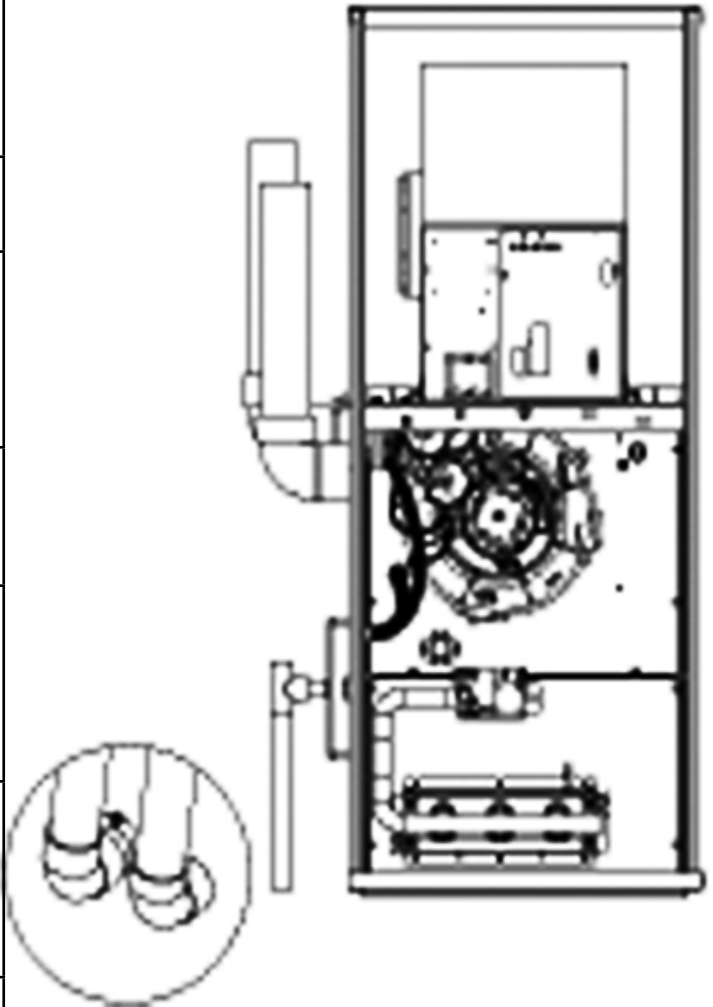
1.	Remove 2.5" knockout and connect 2" nipple approximately 7" long (field supplied) to the coupler on the exhaustor. Ensure exhaustor coupler outlet is facing right side approximately 15°.	6.	Remove two (2) 7/8" knockouts and install the condensate trap bracket by removing and reusing the 2 top panel screws, install condensate trap with gasket, hold in place with 2 screws (all parts supplied in parts bag).
2.	Connect 2" elbow and 2" vent pipe (field supplied).	7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.	8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag). **Refer to page 26 for inducer orientation**	9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.	10.	Connect one end of the 1/2" tubing (in parts bag) to the lower drain outlet on the exhaustor coupler, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

15 - VENT AND DRAINING OPTION - DOWNFLOW

Instructions for Downflow with Left Side Venting

1.	Remove 2.5" knockout and connect 2" nipple approximately 2.5" long (field supplied) to the coupler on the exhaustor. Ensure exhaustor coupler drain outlet is facing downward 15°.
2.	Connect 2" elbow and 2" vent pipe (field supplied)
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag).
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.
6.	Remove two (2) 7/8" knockouts and install the condensate trap with gasket, hold in place with two (2) screws (all parts supplied in parts bag). **Condensate trap can be placed on either side of unit**
7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
10.	Connect one end of the 1/2" tubing (in parts bag) to the lower drain outlet on the exhaustor coupler, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

Figure 24 - Downflow with Left Side Venting

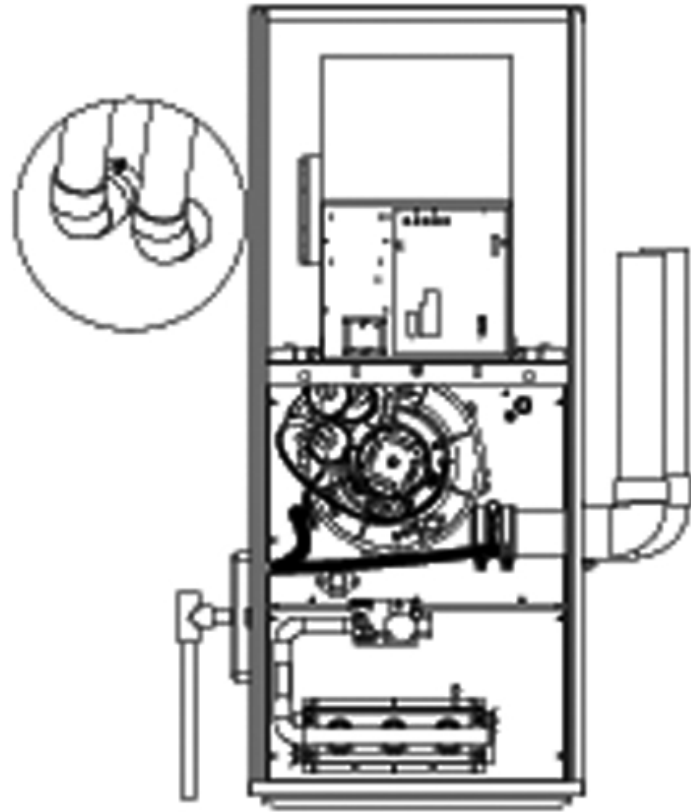


15 - VENT AND DRAINING OPTION - DOWNFLOW

Instructions for Downflow with Right Side Venting

1.	Remove 2.5" knockout and connect 2" nipple approximately 7" long (field supplied) to the coupler on the exhaustor. Ensure exhaustor coupler drain outlet is facing downward 15°.
2.	Connect 2" elbow and 2" vent pipe (field supplied).
3.	Install gasket on panel then vent bracket, use three (3) self tapping screws (all parts from parts bag). If using 1.5" or 3" vent, make transition as close as possible to the unit and on a vertical section.
4.	Remove 2.5" knockout and connect 2" air intake coupler with gasket on the outside of unit, use the 2" nut to fasten this (all parts from parts bag).
5.	Connect 2" street elbow (from parts bag) and intake pipe (field supplied). If using 1.5" or 3" intake, make transition as close as possible to the unit and on a vertical section.
6.	Remove two (2) 7/8" knockouts and install the condensate trap with gasket, hold in place with two (2) screws (all parts supplied in parts bag). **Condensate trap can be placed on either side of unit**
7.	**IMPORTANT** Connect a 1/2" tee fitting (field supplied) to the outlet of the condensate trap.
8.	Connect 1/2" drain tube (field supplied) and route to floor drain or condensate pump.
9.	Connect one end of the 5/8" tubing (in parts bag) to the drain on the front manifold cover, route to the larger outlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.
10.	Connect one end of the 1/2" tubing (in parts bag) to the lower drain outlet on the exhaustor coupler, route to the smaller inlet on the condensate trap, cut excess tube and hold in place with supplied hose clamps. Tubing should slope towards drain trap with no sags.

Figure 25 - Downflow with Right Side Venting



NOTICE

Fill condensate drain trap assembly with water before starting furnace. To fill condensate drain trap assembly, temporarily remove vent drain hose from induced blower assembly elbow/drain fitting. Pour approximately one cup of water down hose. Water will begin running out condensate drain trap outlet when it is full. Refasten vent drain hose to induced blower assembly elbow/drain fitting.

General

- Provide for draining condensate away.
- Furnace is supplied with drain trap assembly.
- See Figures 18 -25 for possible locations of drain trap.
- Point drain holes down 15° to allow drain coupling on inducer for most effective use.
- Drain hose supplied with furnace is long enough to reach either side panel. Cut near blower division panel to prevent kinking in drain lines.
- Two inlets to drain trap are for vent pipe and condensate collection. Vent pipe inlet is smaller than condensate collection inlet. Verify drain hoses are properly connected.

Drain Hose Installation

1. Select drain trap location suitable for orientation of furnace. Remove corresponding knockouts. See Figures 18-25.
2. Attach drain trap assembly to exterior of side panel when furnace is upflow or downflow using two screws provided.
3. For horizontal positions, use supplied mounting bracket. Secure bracket to top panel. Remove two top panel screws. Fasten bracket to top panel with removed screws. Secure trap assembly using screws provided to mounting bracket.
4. Slide short end of 5/8" formed tube over appropriate condensate outlet on front manifold cover. Fasten by tightening tube clamp approximately 1/8" from end of tube.
5. Cut formed drain tube to required length, if necessary. Slide tube over condensate inlet on drain trap (larger diameter inlet hole). Tighten tube clamp approximately 1/8" from end of tube.
6. Rotate exhaustor coupling 15° downwards. Remove yellow cap over lowest vent drain outlet. Slide short end of 1/2" drain tube on exhaustor coupling drain. Tighten tube clamp approximately 1/8" from end of tube.
7. Cut formed vent drain tube to required length if

necessary. Slide over inlet on drain trap (smaller diameter inlet hole). Tighten tube clamp approximately 1/8" from end of tube.

8. Drain tubes must slope towards drain trap.

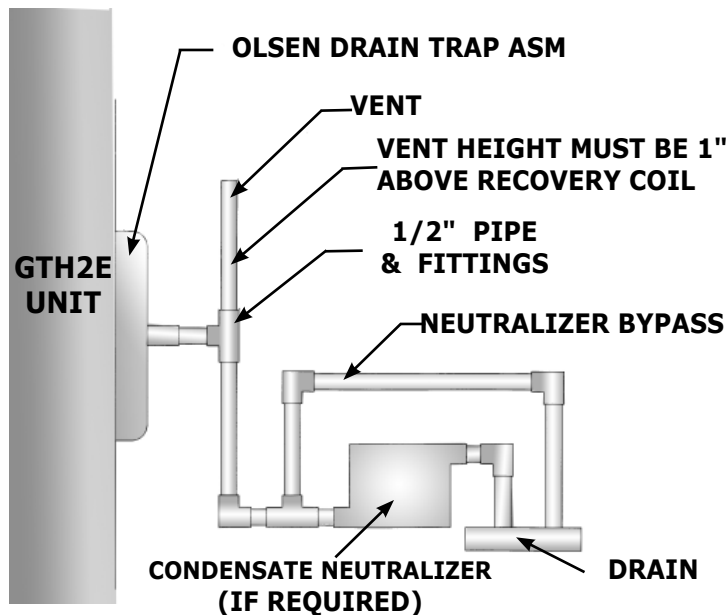
Verify drain hoses do not create traps prior to condensate trap assembly. A secondary trap will cause intermittent operation due to pressure switches opening.

Drain Piping

- Condensate from outlet of drain trap assembly must be conveyed to floor drain, sump pit, or, if these are unavailable, to condensate pump.
- If using condensate pump, verify it is approved for furnace condensate.
- Do not drain condensate outdoors.
- Do not run condensate line through areas where freezing might occur. Freezing of condensate can result in erratic furnace operation and in property damage.

Figure 26 - Condensate Trap/Condensate Drainage With Vent



Figure 27 - Condensate Bypass

- Condensate drainage configuration requires a vent.
- Less than one inch rise anywhere along horizontal route of drain tube is needed to create a vapor lock, which prevents condensate from draining away freely, and result in erratic furnace operation.
- Typical configuration is to cement side branch of 1/2" PVC tee to drain trap assembly outlet, with end branches oriented vertically. See Figure 27.
- 1" piece of 1/2" PVC pipe cemented to upper end branch serves as vent, which will prevent creation of vapor lock, and serves as overflow in event drain line becomes blocked.
- Same sized piece of pipe cemented to lower end branch permits connection to condensate outlet with 5/8" ID 7/8" OD flexible tubing, or condensate may be piped entirely in PVC to floor drain/sump/condensate pump.
- If air conditioning evaporator coil drain is to share furnace drain line, connect with tee fitting downstream from trap. **Do not connect evaporator coil condensate drain upstream of furnace drain trap assembly.**

Condensate Neutralizers

- Local codes may require use of condensate neutralizer.
- If furnace condensate is to be routed to septic system, it may be advisable to use condensate neutralizer.
- Condensate neutralizers such as the Ward Industries 90+ Neutralizer are available through heating supply wholesalers.
- When using condensate neutralizers it is advisable to install with an overflow bypass tube. See Figure 27.

Gas Supply

Furnace is factory equipped to burn natural gas only. Conversion to LP gas requires special natural gas to LP conversion kit. Kits are available see Parts Manual.

⚠ WARNING

Fire, explosion, and asphyxiation hazard. Furnace is equipped to burn natural gas only. Failure to follow instructions listed in this manual could result in death or serious injury

- Connect this furnace only to gas supplied by commercial utility or supplier.
- Private gas wells do not generally provide gas with consistent, uniform and predictable heating values and densities. Many non-commercial wells contain impurities such as sulphur, which may damage the furnace.
- Furnace cannot operate properly or safely using fuels outside normal commercial standards.

Gas Piping

- **Canada**, install gas piping in accordance with CAN/CGA-B149.1 and 2, and in accordance with any local codes.
- **United States**, install gas piping in accordance with NFPA 54 / ANSI Z223.1 and any local codes.
- If local codes allow use of flexible gas appliance connector, always use new listed connector. Do not use connector, which has previously serviced another gas appliance.
- To maintain a good seal in burner area, gas piping through side panel into furnace must be ½" A53 black iron pipe. Pipe passes through rubber grommet custom manufactured to seal tightly around gas pipe.

Figure 28 - Furnace Gas Pipe Connections (Note Rubber Grommet)



- Gas piping may enter furnace from either side. Once gas pipe routing is determined, select and remove applicable knockout. Install grommet in the hole.
- Install BMI ground joint union between gas valve and side panel to allow easy removal of burner for service.

NOTICE

Use a backup wrench to prevent twisting of the control assembly and gas valve. Any strains on gas valve can affect positioning of orifices relative to burners. This could result in faulty burner operation.

- Install manual gas shut-off valve and dirt pocket as close to furnace as possible. Verify with local codes required distance.
- Ensure valve is readily accessible.
- Ensure manual shut-off valve and gas valve are not subjected to high pressures.

Gas Inlet Pressure

- ☐ Natural gas inlet supply pressure should be 5" to 7" w.c. (7" w.c. recommended).
- ☐ LP gas inlet supply pressure should be 11" to 14" w.c. (12" w.c. recommended).
- ☐ Maintain pressures while all other gas fired appliances are operating at maximum conditions.
- ☐ Do not exceed 14" w.c. inlet pressure with either fuel.
- ☐ Gas valve has two adjustable internal regulators for controlling burner manifold pressure. Burner manifold high fire and low fire pressures are listed on furnace rating plate.

Leak Testing

Pressure test all new gas piping installations as specified by CAN/CGA-B149.1 & 2, or NFPA 54 ANSI Z223.1 or ANSI/NFPA 58, "Standard for the Storage and Handling of Liquefied Petroleum Gases."

Gas piping that has not been pressure tested, from manual shut-off valve to furnace gas valve for example, should be leak tested using electronic combustible gas detector, commercially prepared leak detector, or other locally approved method.

Prepare leak detector solution by mixing small quantity of dish detergent with water and daubing it onto gas piping, and joints.

Purging Gas Lines

DANGER

Fire Hazard. Do not use matches, candles, open flames, or other methods providing ignition source. Failure to comply will result in death or serious injury.

DANGER

Fire hazard. Never purge a gas line into the combustion Chamber. Never use a match, taper, cigarette lighter, flame or any other ignition source to check for leaks in a gas line. Failure to comply will result in death or serious injury.

CAUTION

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

HIGH ALTITUDE

Canada, furnace may be converted for high altitude (2000-4500 feet) by changing burner orifices. See section 28 Replacement Parts List for Conversion kits.

United States, modifications for high altitude are based on a 2% reduction of input capacity for every 1000 feet above 2000 feet above sea level. See Table 8 for impact of altitude for selected elevations. Consult with local fuel suppliers or authorities to determine local regulations or customs.

NATURAL TO LP GAS: Furnace is manufactured as natural gas (sea level) appliance that may be converted to LP gas. See section 28 Replacement Parts List for Conversion Kit part number.

LP TO NATURAL GAS: Furnace is manufactured as natural gas appliance, if, after LP gas conversion it becomes necessary to convert back to natural gas and original parts are unavailable, conversion kit is available. See section 28 Replacement Parts List.

Conversion Steps

To convert from sea level to high altitude, from natural gas to LP gas, or from LP gas to natural gas, follow these steps:

1. Turn off gas supply to furnace.
2. Shut off electrical power to furnace.
3. Remove front door to expose gas train and burner assembly.
4. Unfasten ground joint union between gas valve and gas supply piping if applicable.
5. Unplug wires connected to gas valve.
6. Unfasten burner manifold pipe from burner assembly, held in place by 2 screws on either end of manifold pipe.
7. Remove existing orifices with 7/16" socket, box or open end wrench. Install replacement orifices. Orifice spuds are brass, and do not normally require pipe dope. Light grease may be used to lubricate threads. Orifice spuds have tapered threads. **Do Not Over-Tighten!!**
8. Install burner manifold pipe assembly following steps 4, 5, and 6 in reverse order.
9. Remove both regulator cover screws. See Figure 30.
10. Remove both regulator adjustment screws (beneath cover screws).
11. Remove both Natural Gas regulator springs (color-coded silver/plain) from regulator sleeves.
12. Insert L.P. regulator springs (provided in conversion kit and color-coded white) into regulator sleeves.

TABLE 8 - HIGH ALTITUDE SPECIFICATIONS (U.S.A.)

MODEL	ALTITUDE (FT)	ORIFICE SIZE (DMS)	
		NATURAL	LP GAS
All	0-2000	45	55
	2000-3000	48	56
	3000-4000	49	57
	4000-5000	50	58
	5000-6000	51	60
	6000-7000	52	61
	7000-8000	53	62
	8000-9000	54	63
	9000-10000	55	65

† Gas input ratings are certified for elevations to 2000 ft. For elevations above 2000 ft, reduce ratings 2% for each 1000 ft above sea level.
Canada, derate the unit 5% for elevations from 2000 to 4000 ft above sea level.

TABLE 9- HIGH ALTITUDE SPECIFICATIONS (CANADA)

MODEL	ALTITUDE (FT)	INPUT BTU/HR	OUTPUT BTU/HR	ORIFICE SIZE (DMS)		QTY.
				NATURAL	LP GAS	
60	0 - 2000	60000	57000	45	55	3
	2000 - 4500	54000	51300	46	56	
80	0 - 2000	80000	76000	45	55	4
	2000 - 4500	72000	68400	46	56	
100	0 - 2000	100000	95000	45	55	5
	2000 - 4500	90000	85500	46	56	
120	0 - 2000	120000	114000	45	55	6
	2000 - 4500	108000	102600	46	56	

† Gas input ratings are certified for elevations to 2000 ft. For elevations above 2000 ft, reduce ratings 2% for each 1000 ft above sea level.
Canada, derate the unit 5% for elevations from 2000 to 4000 ft above sea level.

Figure 29 - Burner Assembly



Figure 30 - White-Rodgers 36G54 Springs and Regulator Screws

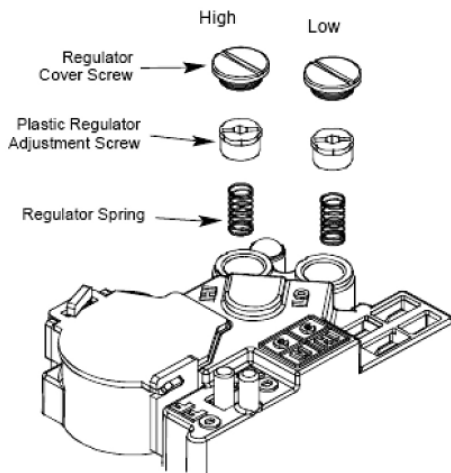
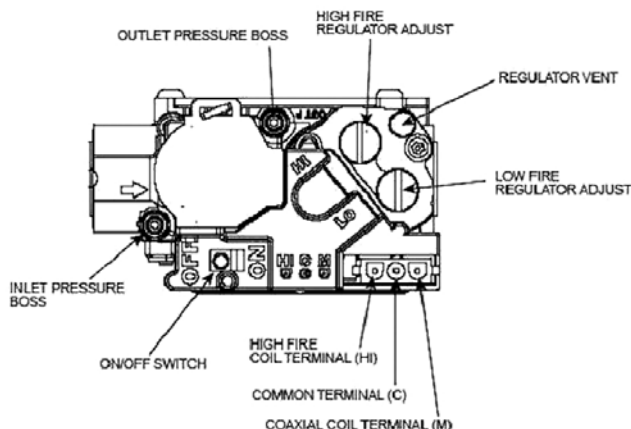


Figure 31 - White Rodgers 36G54 Gas Valve



13. Replace High regulator adjustment screw and adjust approximately 12 turns in, from fully out.
14. Replace low regulator adjustment screw and adjust approximately 8 turns in, from fully out.
15. Apply liberal amount of pipe joint compound or pipe thread tape to threads and reassemble piping previously removed.

Pipe joint compound must be resistant to L.P. gas.

Checking The Inlet Gas Pressure

All regulator adjustments must be done by a trained, qualified technician.

White-Rodgers 36G54 Two Stage Gas Valve.

1. Turn off gas and electrical supply.
2. Back inlet pressure test screw (inlet pressure boss, see Figure 31) out one turn (counterclockwise ↺, not more than one turn) with 3/32" Allen wrench.
3. Attach hose and calibrated U-tube manometer to inlet pressure boss. Hose should overlap boss 3/8". Manometer must have scale range of at least 0" to 15" of water column.
4. Turn ON gas and electrical supply and operate furnace and all other gas consuming appliances on the same gas supply line. Using soap and water solution, check for leaks around gas valve/manifold connection and burner orifices. Repair any leaks before continuing.
5. Measure furnace gas inlet pressure with burners firing. Inlet pressure must be within range specified on furnace rating plate. 5-7" w.c (Natural Gas) or 11-14" w.c. (LP). If inlet pressure differs from rating plate, make necessary adjustments to pressure regulator, gas piping size, etc. and/or consult with local gas utility.
6. Turn off gas and electrical supply to furnace, remove manometer hose from inlet pressure tap boss, and tighten inlet pressure tap screw using 3/32" Allen wrench. (clockwise ↻, 7 in-lb minimum).
7. If working on natural gas system, contact gas utility.

If problems were encountered with obtaining enough pressure on manifold, examine gas piping system to ensure it is correctly sized. Pipe sizing is specified in CAN/CGA-B-149.1 & 2, and in NFPA 54 / ANSI Z223.1. Be sure to check for restrictions, partially closed valves, etc.

Setting The Manifold Gas Pressure

Test gas manifold pressure by following these steps:

White-Rodgers 36G54 Two Stage Gas Valve.

1. Turn off gas and electrical supply before proceeding.
2. Back outlet pressure test screw (outlet pressure boss) out one turn (counterclockwise ↺, not more than one turn) with 3/32" Allen wrench. Attach hose and calibrated U-tube manometer to outlet pressure boss. Hose should overlap boss 3/8". Manometer must have scale range of at least 0" to 15" of water column. See Figure 31.
3. Turn on gas supply and electrical power to furnace and energize main solenoid by connecting R to W1 on integrated control board. Do not energize HI solenoid.
4. Remove regulator cover screw from low outlet pressure regulator adjust tower and turn plastic regulator adjustment screw clockwise ↻ to increase manifold pressure or counterclockwise ↺ to reduce manifold pressure. Adjust regulator according to manufacturer's specifications listed on appliance rating plate. Replace regulator cover screw. (fig.31)
5. Energize main solenoid and HI terminal by connecting R to W1 and W1/W2 on integrated control board. Remove regulator cover screw from high outlet pressure regulator adjust tower and turn plastic regulator adjustment screw clockwise ↻ to increase manifold pressure or counterclockwise ↺ to reduce manifold pressure. Manifold pressure should be set to 1.5" w.c low fire, 3.5" w.c high fire for natural gas, 4.0" w.c low fire, 10.5" w.c high fire for LP gas. Adjust regulator according to manufacturer's specifications listed on appliance rating plate. When correct pressure has been established, securely replace regulator cover screw. (fig.31)
6. Turn off gas and electrical supply to furnace.
7. Remove manometer hose from outlet pressure tap boss. Tighten outlet pressure tap screw using 3/32" Allen wrench. (clockwise ↻, 7 in-lb minimum).
8. Turn on gas supply and electrical power to furnace.
9. Turn on system power and energize valve.
10. Using leak detection solution or soap suds, check for leaks at pressure boss screw. Bubbles forming indicate a leak. Shut off gas and fix all leaks immediately

In some circumstances, high inlet pressure can be remedied with use of in-line appliance regulator. If in-line appliance regulator is used, ensure it has the capacity to adequately handle the gas volume required by the furnace and any other appliances receiving gas from header serving the furnace.

Figure 32 - Valve Pressure Kit

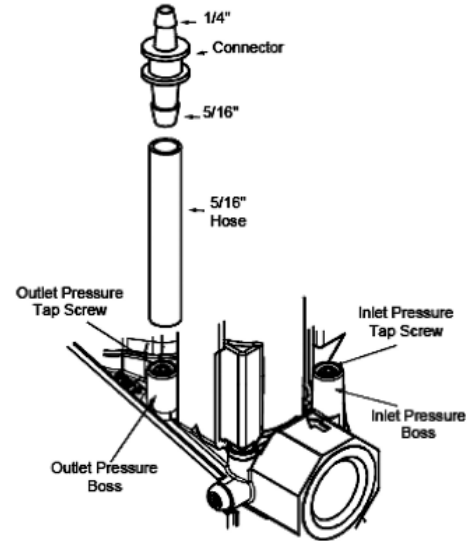
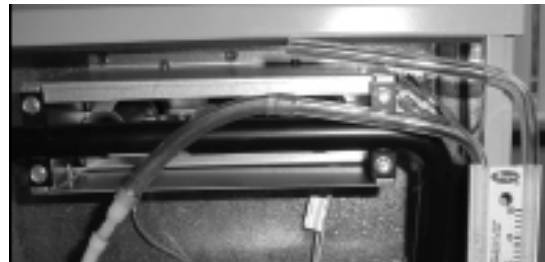


Figure 33 - Manometer Measuring Gas Inlet Pressure



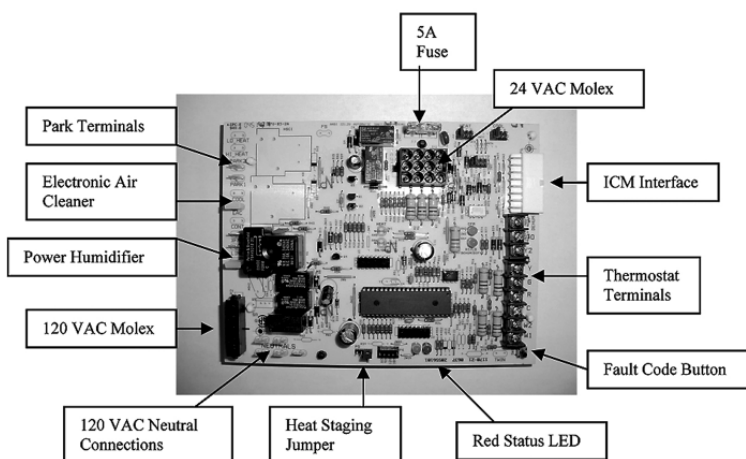
! WARNING

Electrical shock hazard. Turn OFF electrical power supply at service panel before making electrical connections. Failure to do so could result in death or serious injury.

Figure 34 - Electrical Connections/Molex Connector



Figure 35 - Integrated Hot Surface Ignition Control



Electrical Wiring & Connections

- **Canada**, all electrical work must be in accordance with the latest edition of CSA-C22.1, Canadian Electrical Code Part 1, and any applicable local code.
- **United States**, all electrical work must be in accordance with the latest edition of the National Electrical Code, ANSI / NFPA 70.
- Verify available electrical supply is compatible with voltage, frequency and phase listed on appliance rating plate.
- All furnaces are rated 120 vac, 60 Hz, 1 Ø. Amperage rating is 15 amps or less.
- Each furnace requires a dedicated 20 amp over-current device, either 20 amp circuit breaker or 20 amp Type D time delay fuse.
- Furnace cabinet must have an uninterrupted ground. Ground wire is provided in electrical junction box. Do not use gas piping as ground.
- Protect electrical wiring and components from moisture including water and condensate.
- It is permissible to connect furnace accessories such as humidifier transformers, condensate pumps and electronic air cleaners. If adding accessory equipment to furnace circuit, verify combined amperages listed on appliance rating plates does not exceed rating of over-current device.
- Separate service switch is necessary if circuit breaker is in a location where accessing it requires getting close to the furnace, or if furnace is located between main electrical panel and entry to furnace room.
- Clearly label Furnace switch (service switch). Install in a location where it is not likely to be mistaken as being light switch or similar control.

! WARNING

Electrical shock hazard. Furnace is equipped with blower door safety switch. Do not disable this switch. Failure to follow these instructions could result in death or serious injury.

120V Furnace Connection

Furnace is shipped fully wired except for connections to house wiring.

Furnace power connections are made in a junction box inside blower compartment. Junction box is factory installed on left hand side; however, it may be moved to right hand side.

Junction box contains

- BLACK wire connect to L1 (hot),
- WHITE wire connect to L2,
- Neutral,
- GREEN wire connect to ground.

L1 (hot) and L2 (neutral) polarity must be observed when making field connections to furnace.

Ignition control may not sense flame if L1 and L2 are reversed. Ground is also essential.

To move junction box to the right hand side of unit:

1. Use copper conductors only.
2. Unfasten junction box from left hand side.
3. Remove right side panel knock-out.
4. Remove junction box cover hook screw and install on opposite side of the box.
5. Fasten junction box to right hand panel.

Low Voltage Wiring

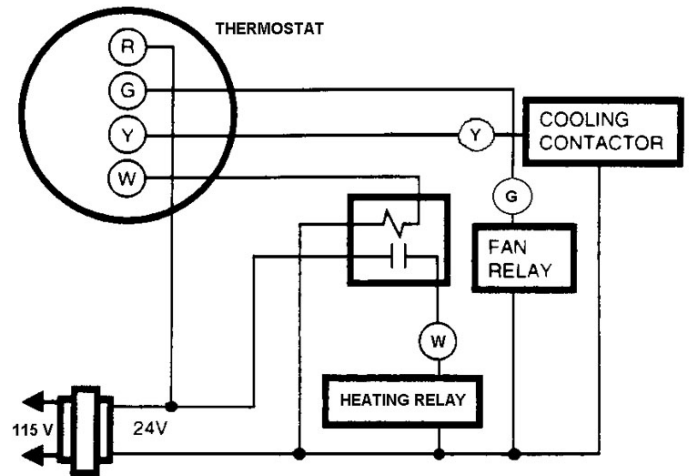
Low voltage terminals are located in control box mounted to blower assembly.

Furnace is air conditioning ready. Insert thermostat and air conditioner contactor low voltage wiring through knockout provided in side panel above supply voltage knockout using field supplied bushing. Route control wiring to control panel to connect to 24 volt terminal screws.

Thermostat

- Room thermostat must be compatible with integrated control in the furnace.
- Electro-mechanical thermostats should be rated 30 V / 1.5 amps.
- Most electronic or microprocessor based thermostats except those with "current robbing" circuits should work satisfactorily. Consult thermostat manufacturer instructions for technical and installation details.
- Most compatibility problems can be overcome by use of isolation relay. Isolation relay should be SPST with 24 volt coil. Switch ratings should be minimum of 0.5 amps. See Figure 36.
- Thermostat and control wiring should be minimum of 18 AWG copper. Excessive lengths of wire may result in enough voltage drop to impair the proper functioning of the furnace. For thermostat wires in excess of 25 feet, use 16 AWG; 50 feet, use 14 AWG.

Figure 36- Isolation Relay



Single Stage Thermostat

- Automatic heat staging option allows single stage thermostat to be used with two stage furnace.
- Control provides a movable jumper (P5) to select between 5 minute and *10 minute automatic staging.
- Automatic staging time begins when blower is energized after heat blower delay period.
- Jumper in 5 minute position, control automatically starts high heat after 5 minutes of continuous low heat operation.
- Jumper is 10 minute position (Factory Setting), control automatically starts high heat after 10 minutes of continuous low heat operation. When high heat is started from automatic staging, demand for high heat remains until heat call is satisfied.

Two Stage Thermostat

When connecting two stage thermostat, jumper (P5) must be in "NONE" position. Control runs high heat from thermostat W2 demand.

Thermostat Location

Locate thermostat approximately 5 feet above floor, on inside wall where there is good natural air circulation, and thermostat is exposed to average room temperatures.

Avoid locations where thermostat is exposed to cold drafts, heat from nearby lamps or appliances, exposure to sunlight, heat from inside wall stacks, etc.

Thermostat Heat Anticipator Setting: 0.1 AMP (Honeywell)

Electronic Air Cleaner

Integrated furnace control can supply power and control an electronic air cleaner rated at 120 vac, 1.0 amp max. 120 volt power is available at these terminals when circulating fan is operating in heating or cooling modes.

Power Humidifier

- Integrated furnace control can supply power and control line voltage humidifier or primary of a 120 / 24 volt humidifier step down transformer, rated at 120 vac, 1.0 amp max.
- All HUM and EAC terminals are 120V. Do not directly connect 24V equipment to these terminals.
- Furnace is equipped with HSI (Hot Surface Ignition) device. Each time the room thermostat calls for heat, HSI lights the main burners directly. See lighting instructions located on the furnace.

Condensate Trap Assembly Initial Startup

- Fill condensate drain trap with water per section 16 "Condensate Drains" prior to starting furnace.
- Dry trap will allow flue gases to flow through recovery coil drain, which prevents condensate from draining from recovery coil.
- If condensate accumulates in recovery coil, recovery coil pressure switch will sense this condition and break its electrical contacts, and extinguish combustion.
- Induced blower will stop after brief post-purge cycle, condensate will drain out and fill trap.
- If thermostat is still calling for heat, ignition sequence will start again after 5 minute delay.

To Start The Furnace

1. Remove burner compartment access door.
2. Shut off electrical power to furnace. Set room thermostat to its lowest setting.
3. Verify manual gas control switch has been in "OFF" position for at least 5 minutes. Do not attempt to manually light main burners.
4. Turn gas control switch to "ON" position.
5. Replace burner compartment access door.
6. Restore electrical power to the furnace.
7. Set room thermostat to a point above room temperature to light the furnace.
8. After burners are lit, set room thermostat to desired temperature.

To Shut Down The Furnace

WARNING

Fire, explosion, and asphyxiation hazard. If overheating occurs or gas burners fail to shut off, close manual gas valve for the furnace before shutting off electrical power to the furnace. Failure to follow these instructions could cause death or serious injury.

1. Set room thermostat to its lowest setting.
2. Remove burner compartment access door.
3. Turn gas control switch to "OFF" position.
4. Furnace appliance shut-off valve may be closed if desired.
5. Power to furnace must remain on for air conditioner to work.
6. Check all plastic vents and wires for damage before restarting furnace if overheating, or gas burner fails to shut off.

Sequence Of Operation

1. Room temperature drops causing room thermostat to call for first stage heat by connecting "W1" to "R". Control verifies limit switch is closed and both low and high pressure switches are open. The control energizes the induced draft motor on high speed and waits for the low pressure switch to close. The inducer remains on high speed and begins a 15 second pre-purge period. The high pressure switch is ignored. If the low pressure switch does not close within 60 seconds, the control will flash "2" on the red Status LED, and de-energize the inducer for 60 minutes.
2. When the 15 second pre-purge time has elapsed, the control energizes the HSI output for a 5 second warm-up period (10 seconds on retries). The control energizes the low main gas valve. 4 seconds after the gas is energized, the control de-energizes the HSI output and leaves the gas energized another 1 second for flame proving. If flame is present at the end of trial for ignition time, the control leaves the gas valve energized, inducer on high speed, and begins heat blower on delay. The control always ignites on high inducer/low gas and ignores second stage call for heat until low heat is established for 15 seconds.
3. Blower on delay time begins when the gas valve is energized. The control provides the ECM (Electronically Commutated Motor) low heat speed signal when flame is proven, and starts a 30 second soft start (slowly ramp up) blower delay before full capacity blower level.
4. When there is a demand for 2nd stage heat from thermostat W2 or automatic staging, the control changes the inducer from low to high speed. When high pressure switch closes, the control changes indoor blower speed from Low heat to High heat and energizes high gas output. If the High pressure switch is open the Green LED will flash. If the High pressure switch is closed the Green LED will be on. High gas valve drops out while High pressure switch is open because it is directly in series with the High pressure switch.
5. When the thermostat W2 call ends and W1 remains (two stage thermostat), the control de-energizes the high gas output and immediately changes inducer speed from high to low. With the thermostat heating contacts open (single stage thermostat), the flames extinguish immediately and the inducer blower stops after a 5 second post purge time.
6. Blower off delay is handled by the ECM (Electronically Commutated Motor). The control de-energizes the ECM heat signal when the gas valve de-energizes, and starts a programmed soft stop (slowly ramp down) delay period.

In The Event Of Flame Failure:

- If flame is lost, control de-energizes gas valve within 2 seconds, switches induced draft motor to high speed (if not already on high), and begins timing inter-purge delay.
- Indoor blower motor is energized and/or remains energized on heat speed for programmed delay off time.
- When inter-purge delay completes, control re-cycles up to 5 flame losses (4 re-cycles) within single call for heat before going into lockout. Control flashes "8" on red LED if lockout is due to too many flame losses.

Checking Furnace Input

Never adjust furnace input to exceed input shown on rating plate.

- ☐ Natural gas supply pressure should be maximum of 7" w.c. and minimum of 5" w.c.
- ☐ Burner manifold pressure is factory set to 3.5" w.c. High Fire, 1.5" w.c. Low Fire.
- ☐ Furnace input rating is based on 1000 BTU/cu. ft. gas with specific gravity of 0.6.

Since heating values for gas vary geographically, actual furnace input and output will vary accordingly.

- For example, natural gas with 1000 BTU/cu. ft. heating value will reduce input to 93% of rated input.
- Natural gas with 1100 BTU/cu. ft. heating value will increase input to approximately 103% of rated input.
- This is not usually problem, adjustments to compensate for this can be made by minor adjustments to burner manifold pressure or by changing burner orifice size.
- Any adjustments to burner manifold pressure should be carried out with use of manometer or calibrated magnehelic gauge.
- Do not adjust gas valve pressure regulator more than ± 0.3 " w.c.

In previous example where heating value of gas is 1100 BTU/cu. ft., burner manifold pressure can be reduced 3% to 3.4" w.c., which is within ± 0.3 " w.c. specification to bring input into compliance.

Refer to Setting the Gas Manifold Pressure and High Altitude in Gas Supply & Piping section of this manual.

Contact fuel supplier for specific gas heating content values.

$$\text{Input} = \frac{\text{Heating Value of Gas} \times 3600}{\text{Time in Sec. for 1 cu. ft.}}$$

where:

- input is expressed in BTU/Hr
- heating value of gas is expressed in BTU/ft³
- and time is number of seconds required for test dial to indicate 1 cubic foot.

If using gas meter with SI (metric) units:

- 1 cubic foot = 0.0283 cubic meters
- 1 cubic meter = 35.315 cubic feet
- 0.01 cubic meter = 0.3531 cubic feet
- 0.5 cubic meter = 1.766 cubic feet

Temperature Rise Check

When duct system is complete and air filter or filters are in place, determine if airflow is correct for both low and high fire input rates.

1. Insert duct thermometer in supply air duct. Place thermometer as close as practical to furnace, but out of "line of sight" of heat exchanger (prevents false readings due to radiant heat). Verify thermometer location is within duct air stream. Avoid locations such as inside radius of an elbow, etc.
2. Insert duct thermometer in return air duct as close to furnace as practical. Verify thermometer location is unaffected by humidifier bypass ducts, etc. Choose location well within main air stream.
3. Operate furnace long enough to obtain steady state conditions at both input rates (High Fire and Low Fire).
4. When the two thermometers have stabilized, approximately 5-8 minutes, compare readings. Subtract return air temperature from supply air temperature. Difference is the temperature rise, also called ΔT .
5. Compare measured ΔT to temperature rise range shown on rating plate. Unless stated differently on rating plate, temperature rise should normally range between 35° to 65°F High Fire, 25° to 55°F Low Fire. When adjusting temperature rise, ideal temperature is approximately mid-range. If measured ΔT is above approved temperature range, there is too little air flow. Increase by selecting appropriate "HEAT" jumper setting, removing restrictions in ductwork, or adding supply or return ductwork. If measured ΔT is too low, there is too much air flow.

Calculating Air Flow

Measure air flow in duct system by direct measurement with electronic or sloped manometers and velometers, or counting number of times amber CFM LED on control board flashes. Each flash signifies 100 CFM; count flashes and multiply by 100 to determine actual CFM delivered (for example: 10 flashes x 100 = 1000 CFM).

Or use following formula.

$$\text{CFM} = \frac{\text{Output}}{1.085 \times \Delta T}$$

where:

- CFM is airflow in cubic feet per minute;
- ΔT is the temperature rise; and
- Output is the furnace output capacity from the rating plate.

NOTE: Output will vary directly with input. If actual input is below stated input, output will be reduced in same ratio (93%).

Table 10A - Range Of Temperature Rise

Furnace Model	Temperature Rise
60, 80, 100, 120	High Fire (HF) 35 - 65°F
	Low Fire (LF) 25 - 55°F

Table 10B - Air Flow For Temperature Rise

Furnace Model	High Fire (HF) CFM Required for a ΔT of:			
	35	45	55	65
60	1501	1167	955	808
80	2001	1557	1274	1078
100	2502	1946	1592	1347
120	3002	2335	1910	1616
Furnace Model	Low Fire (LF) CFM Required for a ΔT of:			
	25	35	45	55
60	901	700	573	485
80	1201	934	764	647
100	1501	1167	955	808
120	1801	1401	1146	970

TABLE 11 - COOLING AIR FLOW

MODEL		ESP 0.1" to 1.0" w.c.		
Input	A/C Tonnage	ADJUST Jumper	COOL Jumper	CFM
60000	3 Ton	NORM	A	1200
			B	1000
			C	800
			D	600
80000	3 Ton	NORM	A	1200
			B	1000
			C	800
			D	600
80000	4 Ton	NORM	A	1600
			B	1200
			C	1000
			D	800
100000	5 Ton	NORM	A	2000
			B	1600
			C	1200
			D	800
120000	5 Ton	NORM	A	2000
			B	1600
			C	1200
			D	800

Note: Moving ADJUST jumper from NORM position to (+) or (-) position increases or lowers CFM by 15%

⚠ WARNING

Electrical shock hazard. Turn OFF electrical power supply at service panel before making electrical connections. Failure to do so could result in death or serious injury.

Adjusting Blower Speeds

- Unit is factory set to run at middle of heating temperature rise range as listed on rating plate.
- Cooling speed is set to maximum airflow designated in model number.
- Three sets of 4 position movable jumpers are provided for Heat, Cool, and Adjust taps for variable speed motor.
- Tap jumpers apply signals to ECM motor without other interaction with control board.

Table 11A - Heating Speeds

ALL MODELS		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire ΔT Range 25-55 °F	High-Fire ΔT Range 35-65 °F
A	NORM	40 °F	50 °F
B	NORM	35 °F	45 °F
C	NORM	45 °F	55 °F
D	NORM	50 °F	60 °F

Note: Moving the ADJUST jumper from the NORM position to the (+) or (-) position will increase or lower the temperature rise by 15%

Table 11B - Heating CFM

060-3		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire CFM	High-Fire CFM
A	NORM	700	1050
B	NORM	850	1105
C	NORM	575	880
D	NORM	525	819

Table 11C- Heating CFM

080-4		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire CFM	High-Fire CFM
A	NORM	1000	1350
B	NORM	1150	1495
C	NORM	900	1206
D	NORM	800	1104

Table 11D - Heating CFM

120-5		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire CFM	High-Fire CFM
A	NORM	1650	2200*
B	NORM	1900	2200*
C	NORM	1500	2070
D	NORM	1325	1815

* Motor CFM maximum $\Delta\Delta$

Table 11E - Heating CFM

080-3		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire CFM	High-Fire CFM
A	NORM	1050	1376
B	NORM	1250	1400*
C	NORM	900	1242
D	NORM	780	1108

* Motor CFM maximum

Table 11F - Heating CFM

100-5		ESP 0.1" to 1.0" w.c.	
HEAT Jumper	ADJUST Jumper	Low-Fire CFM	High-Fire CFM
A	NORM	1200	1620
B	NORM	1400	1820
C	NORM	1100	1474
D	NORM	950	1349

Note: Moving the ADJUST jumper from the NORM position to the (+) or (-) position will increase or lower the temperature rise by 15%

Blower Speed Adjustment

1. Remove blower compartment door.
2. Locate 4 position movable HEAT jumper to adjust heat speed.
3. Remove jumper from position A and place on corresponding letter B, C, or D as required. Refer to Tables 11A-11F Heating Speeds.
4. Verify Temperature rise whenever blower speed is changed.
5. To adjust cooling airflow, remove COOL jumper from position A and place on corresponding letter B, C, or D. Refer to Table 11 - Cooling Air Flow.
6. Moving ADJUST jumper from NORM to (+) or (-) position will cause airflow to be increased or lowered by 15%.
7. TEST position on ADJUST tap is not used.

Dehumidification

- Dehumidification feature is built into variable speed motor. At start of each cooling cycle, variable speed motor will run at 82% of rated airflow for 7.5 minutes.
- After 7.5 minutes has elapsed, motor will increase to 100% of rated airflow.
- If feature is not desired, clip jumper wire between Y and O on integrated furnace control board. With Y and O not jumpered, variable speed will reach 100% of rated airflow within 10 seconds of call for cooling.
- Additional dehumidification can be achieved by connecting humidistat to DEHUM and R terminals on integrated furnace control board. Variable speed motor will operate at 10% reduction in normal cooling airflow rate when there is call for dehumidification.
- Both dehumidification methods above can be utilized on same furnace.

Setting Blower "On" And "Off" Timings

- Blower on/off delays are handled by ECM motor programming. Control de-energizes ECM heat signal when gas valve de-energizes.
- ECM variable speed motor delivers constant airflow within wide range of external static pressures.
- Soft Start- ECM variable speed motor slowly ramps up to required operating speed. Feature in heating cycle allows heat exchanger to reach operating temperature before set heat speed, which minimizes noise and increases comfort.
- Soft Stop - At end of heating or cooling cycle, ECM variable speed motor will slowly ramp down allowing for increased energy efficiency, and reduced noise levels.

Continuous Fan Operation

When thermostat continuous fan (G) switch is on without call for heat or cooling, indoor fan is immediately energized up to 50% of cooling speed.

Fan remains energized as long as call for fan remains without call for heat or cooling. Allows for continuous circulation of air between calls for heating or cooling.

If call for heat (W) occurs during continuous fan, blower will de-energize.

If call for cool (Y) occurs simultaneously with call for fan (G), call for cool overrides call for fan and blower remains off for cooling on delay period.

Table 12 - Continuous Fan CFM

MODEL	Motor HP	COOL Jumper	ADJUST Jumper	Continuous Fan (CFM)
060-3	1/2	A	NORM	600
080-3	1/2	A	NORM	600
080-4	3/4	A	NORM	825
100-5	1	A	NORM	865
120-5	1	A	NORM	930

Note: Moving the ADJUST jumper from the NORM position to the (+) or (-) position will increase or lower the continuous fan CFM by 15%

⚠ DANGER

Before servicing, turn off electrical power at service switch. Close manual gas valve to turn gas supply OFF to boiler. Failure to comply will result in death or serious injury.

⚠ CAUTION

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

NOTICE

Verify proper operation after servicing.

NOTICE

Perform regular service and maintenance by qualified service agency at least once every 12 months to assure safe, trouble free operation and maximum efficiency.

Air Filter

- Inspect filter frequently and clean as necessary. Recommend monthly inspection.
- Avoid use of fiberglass throw-away filters. May block up quickly, resulting in higher than normal operating temperatures, and lower efficiency.
- HEPA filters can do effective air filtration. Some models may cause a large pressure drop across filter. Contractor should assess capabilities of duct system to deliver sufficient air flow if this type of filter is considered.
- Do not operate the furnace for prolonged periods of time without an air filter.
- A portion of dust entrained in air may lodge in supply air ductwork and registers. Any recirculated dust particles will be heated and charred by contact with furnace heat exchanger. Residue may soil ceilings, walls, drapery, carpets, and other household articles.
- If two return air inlets are used, both must be equipped with filters.

Recommendation

Electronic air filters using electrostatic precipitation to remove dust are an excellent filtration device. 16" x 25" model is ideal fit with this furnace in case of side mounted return air inlet.

Furnace control module is supplied with electrical terminals for use with electronic air cleaners.

A 16" x 25" x 1" filter kit can be ordered for use on this appliance. This kit includes the filter rack and washable filter. See Parts List.

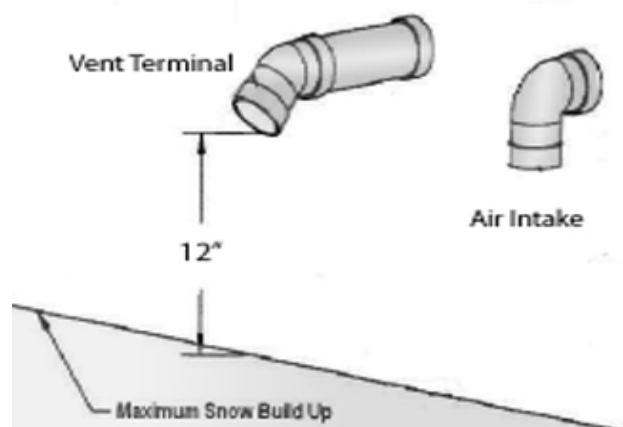
Lubrication

- Both induced draft blower motor and circulating fan motor are ball-bearing type motors. Neither require routine lubrication.
- Motor bearings were pre-lubricated by motor manufacturer. Do not attempt to lubricate them. Excess lubrication will shorten service life of motors, and attract buildup of dust and dirt.
- Induced blower motor and circulating fan motor must be cleaned periodically by a qualified service technician. Dust buildup in ventilation ports of motor will cause motor to not dissipate heat properly resulting in reduced service life.

Terminations

- Inspect combustion air and exhaust terminals to ensure they are free of obstructions and debris.
- If screens are used in either terminal, verify they are free of debris, corrosion, or anything preventing free flow of air.
- Homeowner should inspect vent and terminal and air intake in weather conditions when snow build-up occurs to ensure they are free and clear of snow. Maintain at least one foot of clearance between snow build-up and vent/combustion air intake openings at all times. Clear away excess snow to maintain this clearance.

Figure 37 - Vent Terminal Clearance



Intake Air/Exhaust Piping

Inspect combustion air intake piping and exhaust piping periodically for sags, evidence of leakage etc. If either condition exists, contact your installation contractor, service agency or fuel supplier.

⚠ WARNING

Asphyxiation hazard. Holes in exhaust piping or furnace heat exchanger can allow toxic fumes to enter home and circulate through duct system resulting in carbon monoxide poisoning or death. If leaks are found in furnace heat exchanger, it must be replaced. Failure to follow these instructions could cause death or serious injury.

NOTICE

Never attempt to operate furnace without blower door and combustion compartment door in place or when blower has failed

Operating Tips

1. During heating season, keep windows and doors closed to reduce heating load on the system.
2. Avoid excessive use of kitchen exhaust hoods and other exhaust fans to reduce heating load on the system.
3. Arrange furniture and drapes so that supply air registers and return air grilles are unobstructed.
4. Avoid use of plastic deflectors on supply air registers which tend to short circuit the warm air straight into the return air grilles.
5. Avoid placing heat producing appliances such as televisions, radios, lamps, etc. in location to influence the thermostat.
6. Keep combustible articles at least 3 feet away from furnace.
7. Do not block access for servicing furnace.

Annual Inspection/Service

Have furnace inspected annually by a qualified installation contractor, service agency or fuel supplier. Your annual inspection will normally cover the following:

Heat Exchanger

- Inspect heat exchanger for corrosion.
- Flue passages (heat exchanger tubes) should be free of scale or excessive corrosion.
- Top row of heat exchanger tubing is accessible for cleaning with small diameter wire-handled brush by removing burner assembly.
- Bottom row is only accessible if heat exchanger is removed and rear flue box cover is removed.
- Prior to removal of rear flue box cover or front manifold cover, verify replacement gaskets are available to ensure proper sealing of heat exchanger when re-assembled.

- Recovery coil (secondary heat exchanger) may be cleaned by accessing rear flue box cover or removing front manifold cover.
- After clearing accumulated scale, observe burner flames. If flame distortion, check combustion air intake and exhaust piping and terminals for blockage. Check for signs of soot in condensate drainage. If flame distortion continues after eliminating blockage in piping as the cause, it may be necessary to replace the tubular heat exchanger.

Burners

Inspect burners to ensure that they are free of deterioration, dust and debris, and properly aligned with heat exchanger. In most cases, a simple vacuuming with brush attachment will adequately clean burner assembly and burner compartment.

Be careful when working on the burner assembly. The hot surface igniter is fragile and can break easily.

Flame Sensor

Inspect and clean flame sensor with fine steel wool or scrubbing pad. Check wiring connection to verify it is tight and corrosion free. Small amounts of corrosion can significantly increase internal resistance of the connection. A small increase in resistance can result in a large decrease in flame signal.

Drainage

- Inspect condensate drainage system and clean if necessary. If drain trap assembly, or any other component becomes blocked, condensate may backup into secondary or primary heat exchanger causing nuisance trip-outs of pressure switches or limit switch.
- Observe condensate for signs of dirt, carbon, debris, etc.
- If condensate neutralizer has been added to condensate drain, it should be inspected, cleaned, or condensate neutralizing media should be replaced to ensure clear condensate flow.

Induced Blower

Inspect induced blower motor and clean if necessary. Clear any dust buildup from ventilation ports.

Circulating Fan

Check the condition of circulating fan to ensure it is free of excessive dust buildup, debris, etc. Inspect mechanical fasteners and check for proper tightness and parts alignment. Clean motor ventilation ports if necessary to prevent restriction to cooling by air over motor.

Electrical

Examine all electrical connections to ensure they are tight and corrosion free. Repair or replace any connections that have become loose or corroded.

Furnace Operation

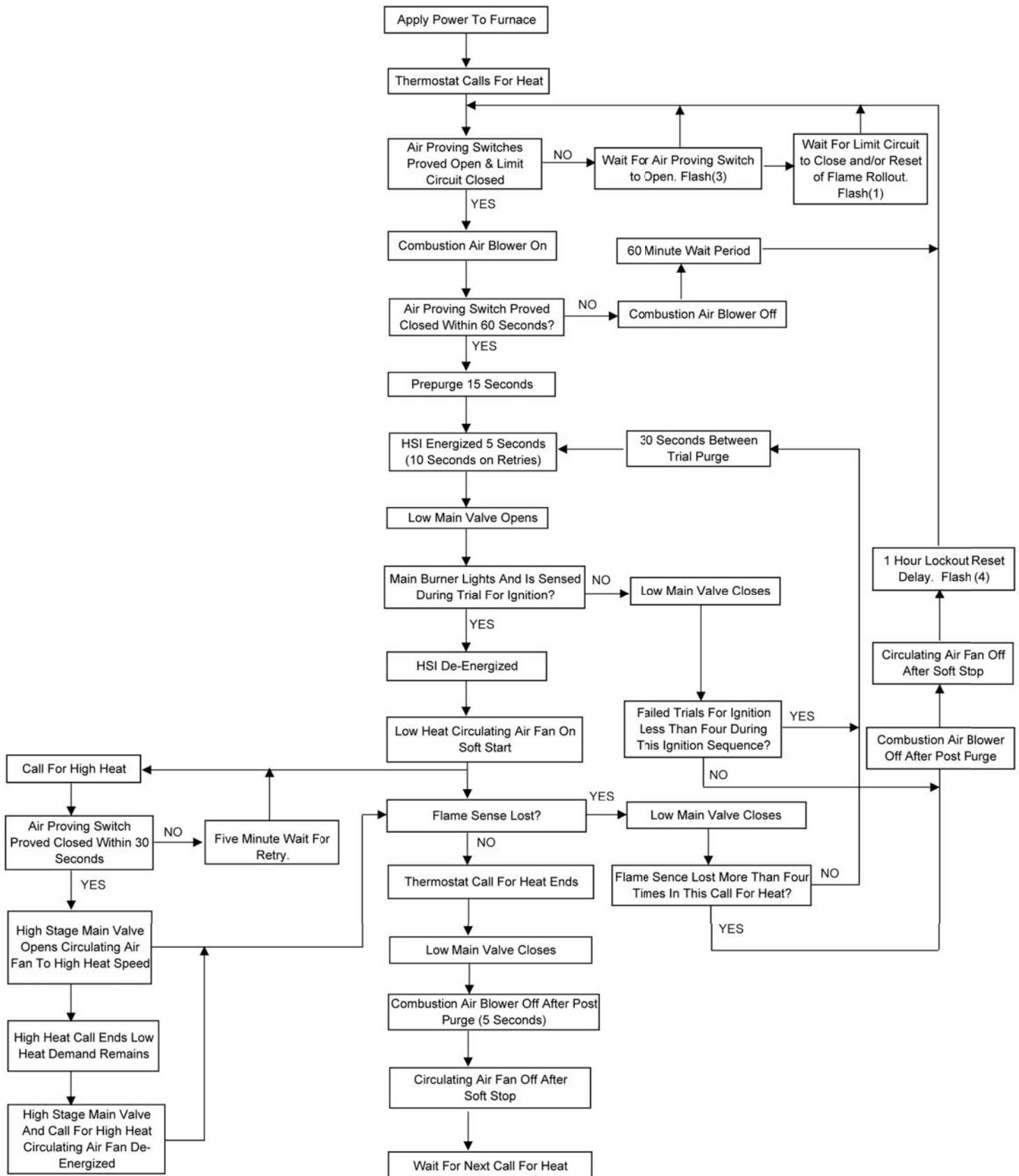
Cycle furnace during annual inspection and servicing to:

1. Test all safety related controls.
2. Determine temperature rise falls within range shown on appliance rating plate.
3. Verify burner ignition is smooth and flames are smooth soft blue, and not impinging on heat exchanger.

24 - TROUBLESHOOTING FLOWCHART

SEQUENCE OF OPERATION

Troubleshooting Flowchart



25 - DIAGNOSTIC CODES FOR STATUS LED

A RED LED is provided to indicate furnace operating status		
LED Condition	Fault Condition	Check
LED ON	Normal operation	No action required. Control OK.
LED OFF	No power to control or control hardware fault detected	Line voltage input power at L1 and Neutral connectors control board. System wire harness in good condition and securely connected at both ends.
1 Flash	High limit switch open	Open limit switch. Limit switch and wiring in good condition and securely connected. Check for blocked air filter, correct temperature rise, blower speed selection, closed ducts, ect.
2 Flashes	Pressure switches open with inducer on	Pressure switches operation, tubing and wiring. Obstruction or restrictions in venting preventing proper air flow.
3 Flashes	Pressure switches closed with inducer off	Pressure switches stuck closed. Pressure switches mis-wired or jumpered.
4 Flashes	Control in 1 hour lockout	Gas supply OFF, or gas supply pressure too low to operate furnace. Damaged or broken HSI element. Line voltage input power at L1 and Neutral connectors control board. Furnace not properly earth grounded. Flame sensor rod contaminated or in incorrect position. HSI element located in wrong position. Hot surface element or flame sensor wiring in good condition and properly connected.
5 Flashes	L1/Neutral Polarity problem	Check supply voltage to ensure proper polarity to L1 and Neutral connections.
6 Flashes	Not Used	
7 Flashes	Pressure switch cycle lockout	Pressure switches operation, tubing and wiring. Obstruction or restrictions in venting preventing proper air flow.

25 - DIAGNOSTIC CODES FOR STATUS LED

A RED LED is provided to indicate furnace operating status		
LED Condition	Fault Condition	Check
8 Flashes	Lockout due to too many flame dropouts	Check system for proper ground. Dirty, oxidized or failed flame sensor.
9 Flashes	Not used	
10 Flashes	Flame present with gas off	Flame at main burner. Gas valve.

A GREEN LED is provided to indicate high heat state	
LED off	No demand for high heat
LED on	High heat demand, operating normally
LED flashing	High heat demand, high pressure switch not closed

Fault Code History

Control stores last 5 fault codes in memory. When push-button switch is pressed for less than 5 seconds, control will flash stored fault codes when switch is released. Most recent fault code is flashed first, oldest last.

Fault history may be cleared by holding push-button switch for more than 5 seconds.

VENTING CHECKLIST	✓
Vent pipe must be sloped to drain from outlet back to furnace.	
Exposed vents and drains must be heat traced.	
Vents exiting house must be well sealed to prevent exhausts from re-entering the house.	
Vents and intake must be 12" above grade. For Massachusetts see page 7.	
In Canada all venting material must be identified as ULC S636 and be readily accessible for visual inspection for the first 3ft. (900mm)	
Use large radius elbows where possible.	
Exhaust vents must not be near windows or other fresh air intakes.	
Support vents firmly. Keep out of work areas to prevent damage.	
Clamp and gasket all vent exits to furnace panels to insure airtight seal.	
Equivalent vent length must be less than the allowable length in Table 6 Direct and Non-Direct Vent Lengths.	
If there is a choice, the exhaust should be shorter than the intake vent.	
For indirect vent, installer must calculate size of room to determine if outside air is required.	
Use direct vent for commercial installations that use chemicals (Hair Salons, etc.)	
Avoid exposure to windy side of house.	
Heat Exchanger (suction) drain must be trapped separate from vent drain (pressure). A/C drain must not be inserted before heat exchanger and vent drain trap.	
Exhaust vent and combustion air intake must be located within the same wind pressure zone when installed in a direct vent application using outdoor combustion air.	

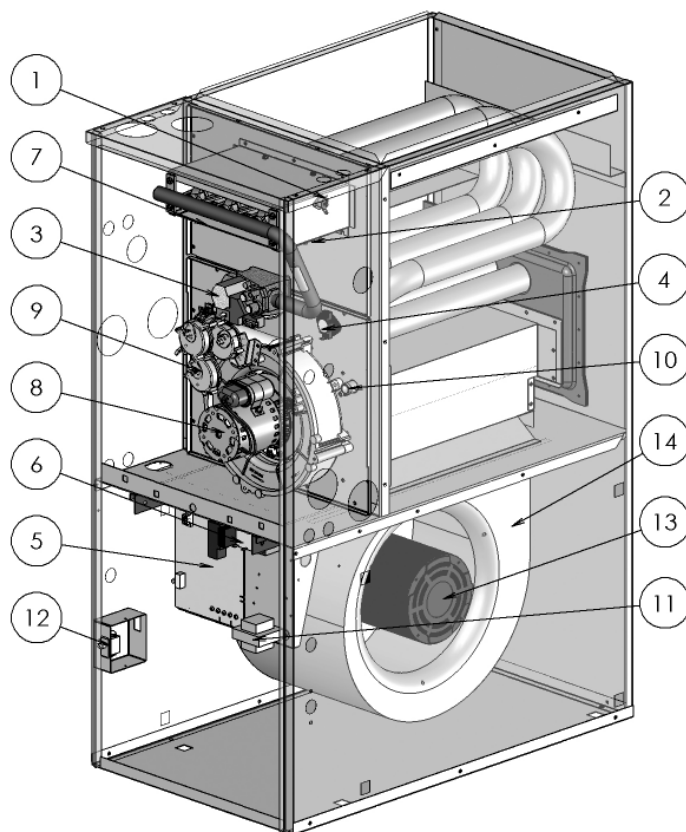
28 - REPLACEMENT PARTS LIST

Replacement Parts List		
Item	Kit Number	Repair Parts List for Two Stage High Efficient Furnace
1	550001515	FLAME ROLLOUT SWITCH 350°F, ALL MODELS
2	550001528	FLAME SENSOR, ALL MODELS
3	550001656	TWO STAGE GAS VALVE 36G54, ALL MODELS
WHITE RODGERS 36G54 TWO STAGE 24V GAS VALVE SET FOR NG		
4	550001514	LIMIT SWITCH 160°F 100-5, 120-5
	550001525	LIMIT SWITCH 150°F 60-3, 80-3, 80-4
5	550001655	INTEGRATED CONTROL BOARD, ALL MODELS
UT ELECTRONICS CONTROLS 1170-23		
6	550001533	TRANSFORMER 120V/24V SEC., ALL MODELS
7	550001527	HSI (HOT SURFACE IGNITOR), ALL MODELS
8	550001653	TWO SPEED INDUCED BLOWER, ALL MODELS
JAKEL AX3490 INDUCED BLOWER WITH GASKET AND TERMINATION		
9	550001649	PRESSURE SWITCH SET, ALL MODELS
MPL INC. HG-0.70"W.C. LF-0.30" W.C. FMC-0.30" W.C.		
10	550001522	FRONT MANIFOLD COVER 60-3, 80-3, 80-4
	PLASTIC FRONT MANIFOLD COVER WITH GASKETS	
	550001523	FRONT MANIFOLD COVER 100-5, 120-5
	PLASTIC FRONT MANIFOLD COVER WITH GASKETS	
11	550001660	"PFC" CHOKE COIL 80-4, 100-5, 120-5
12	550001532	DOOR SWITCH, ALL MODELS
13	550001657	1HP ECM MOTOR 120-5
	550001861	1HP ECM MOTOR 100-5
	550001658	1/2HP ECM MOTOR 60-3
	550001866	1/2HP ECM MOTOR 80-3
	550001659	3/4HP ECM MOTOR 80-4
14	550001520	BLOWER 12-7T W/WHEEL 60-3, 80-3, 80-4
	550001536	BLOWER 12-10T W/WHEEL 100-5, 120-5
15*	550001534	FUSE 5 AMP, ALL MODELS
16*	550001458	FILTER, ALL MODELS KIT INCLUDES: RACK, RAIL, 16" X 25" PERMANENT FILTER
17*	29570	CONCENTRIC VENT, 2" DIA.
18*	29571	CONCENTRIC VENT, 3" DIA.
19*	550001521	PARTS BAG HI, ALL MODELS
20*	550001654	WIRE HARNESS HIGH 2ST, ALL MODELS
ALL WIRE HARNESSES INCLUDED		
21*	550001815	MOTOR MOUNTING ARMS & HRDWR, ALL MODELS INCLUDES: 48 FRAME MOTOR MOUNTING BAND WITH FASTENERS ,3 - 12" DIAMETER MOTOR MOUNTING ARMS
22*	550001641	CONV. NG, LP, HIGH ALT, 2ST, CAN/US, ALL MODELS
ALL FUELS AND ALTITUDES SPRINGS AND ORIFICES		
23*	550001816	CONV. LP, NG 2ST, CAN/US, ALL MODELS
LP SPRINGS AND ORIFICES		
24*	550001648	CONV. NG, LP, 2ST, CAN/US, ALL MODELS
NG SPRINGS AND ORIFICES		
25*	550001346	FLOOR SUB-BASE KIT, ALL MODELS

* Not Shown

REPLACEMENT PARTS LIST

HIGH EFFICIENCY TWO STAGE GAS FURNACE



NOTES

[illegible]

GTH2E
NATURAL AND PROPANE GAS TWO
STAGE HIGH EFFICIENCY (CONDENSING)
WARM AIR FURNACE



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