

Installation, Operation and Maintenance

CATEGORY IV NATURAL GAS AND LP GAS

HIGH EFFICIENCY

TWO STAGE VARIABLE SPEED

WARM AIR FURNACE

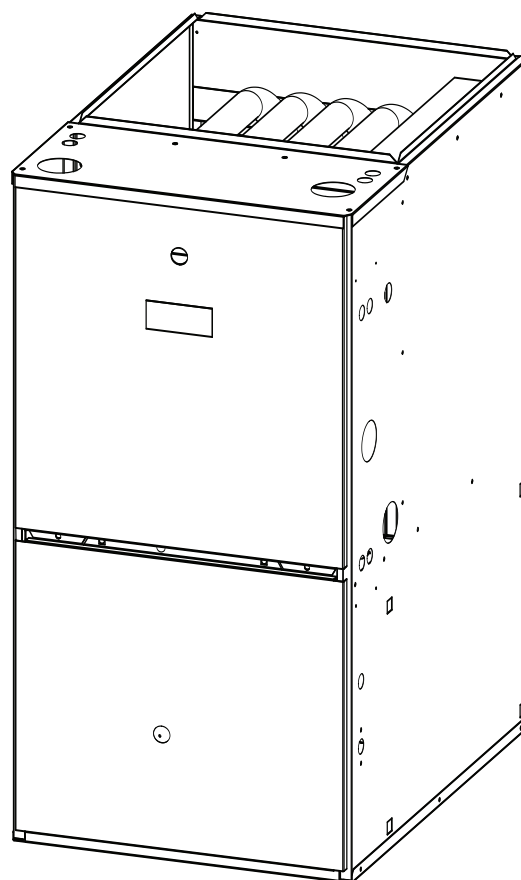
MODEL HG95E054 HG95E072
HG95E090 HG95E108

For future reference write down the model, serial number, and date of purchase. Use these numbers in any correspondence or service calls concerning your furnace.

Model
Serial Number
Date of Purchase

Keep these instructions for future reference.

Please read the operating instructions and safety precautions carefully and thoroughly before installing and operating your furnace. Keep this manual in a safe place for future reference.



**USER'S INSTRUCTION GUIDE
LOCATED AFTER PAGE 43 OF THIS
INSTALLATION, OPERATION AND
MAINTENANCE MANUAL**

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INTRODUCTION

This 95% efficient gas fired furnace series is CGA / AGA design certified as a Category IV (condensing with positive vent pressure) non-direct or direct vent central forced air furnace. It is an upflow, downflow, horizontal left and right furnace suitable for residential and light commercial heating applications from 54,000 to 108,000 BTU/Hr. When installed as a direct vent furnace, all combustion air is supplied directly to the furnace burners through a special air intake system. (See Section "Ventilation and Combustion Air.")

All models may be fired by natural gas or field convertible to LP gas (propane). The furnace is shipped completely assembled except for the drain trap assembly and the venting. Please inspect for damage when the furnace is unpacked.

SAFETY

Throughout the manual, symbols and words are used to draw attention to potentially hazardous conditions.

DANGER

THIS INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

WARNING

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

CAUTION

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, MAY RESULT IN MINOR OR MODERATE INJURY.

Safety Rules:

1. Use this furnace only with type of gas approved for this furnace. Refer to the furnace rating plate.
2. Install this furnace only in dry indoor locations (protected from weather).
3. Provide adequate combustion and ventilation air to the furnace space as specified in the Determining Combustion Air section on page 13 of these instructions.
4. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in the Furnace Venting section on page 14 of these instructions.
5. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections as specified in the Gas Supply section on page 28 of these instructions.

6. Always install furnace to operate within the furnace's intended temperature rise range with a duct system which has an external static pressure within the allowable range, as specified in the Furnace Sizing section on page 4, the Ductwork section on page 7, and the Airflow section on page 35 of these instructions.
7. When a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. (Furnace for heating the home located in the attached garage, for example).
8. A gas fired furnace for installation in a residential garage must be installed so that the burners and ignitor are no less than 18 inches above the floor. The furnace must be located, or protected to avoid physical damage by vehicles.
9. **THIS FURNACE IS NOT TO BE USED FOR TEMPORARY HEATING FOR BUILDINGS UNDER CONSTRUCTION.**

DANGER

DO NOT INSTALL THIS FURNACE IN A MOBILE HOME!
THIS FURNACE IS NOT APPROVED FOR INSTALLATION IN A MOBILE HOME. DOING SO COULD CAUSE FIRE, PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

WARNING

THE FURNACE CONTAINS FOIL COVERED FIBERGLASS INSULATION. INHALATION OF FIBERGLASS PARTICLES IS ASSOCIATED WITH RESPIRATORY DISEASE INCLUDING CANCER.

WARNING

THE FUEL SUPPLIER NORMALLY ODORIZES NATURAL GAS AND PROPANE. IN SOME CASES, THE ODORANT MAY NOT BE PERCEIVABLE. INSTALLATION OF UL AND CUL RECOGNIZED FUEL GAS DETECTORS INSTALLED IN ACCORDANCE WITH THEIR MANUFACTURER'S INSTRUCTIONS IS RECOMMENDED AS AN ADDITIONAL MARGIN OF SAFETY.

DANGER

FIRE OR EXPLOSION HAZARD

IF THE INFORMATION IN THESE INSTRUCTIONS IS NOT FOLLOWED EXACTLY, A FIRE OR EXPLOSION MAY RESULT, CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

CAUTION

MAKE SURE TO REMOVE FOAM BLOWER HOUSING SHIPPING SUPPORTS BEFORE OPERATING FURNACE.
SHIPPING SUPPORTS ARE LOCATED ON THE BOTTOM RIGHT AND BOTTOM LEFT SIDES OF BLOWER HOUSING.

 DANGER

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, OR A CELLULAR PHONE FROM A LOCATION WELL AWAY FROM THE BUILDING. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT
- DO NOT ENTER THE BUILDING UNTIL AUTHORIZED TO DO SO BY THE GAS SUPPLIER OR THE FIRE DEPARTMENT

IMPROPER INSTALLATION, OPERATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE INJURY, PROPERTY DAMAGE OR LOSS OF LIFE. REFER TO THIS MANUAL FOR PROPER INSTALLATION, OPERATION, SERVICE, AND MAINTENANCE INSTRUCTIONS.

A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER MUST PERFORM INSTALLATION AND SERVICE.

DO NOT DESTROY THIS MANUAL

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

 WARNING

THESE INSTRUCTIONS ARE INTENDED AS AN AID TO QUALIFIED SERVICE PERSONNEL FOR PROPER INSTALLATION, ADJUSTMENT AND OPERATION OF THIS FURNACE. READ THESE INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING INSTALLATION OR OPERATION. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN IMPROPER INSTALLATION, ADJUSTMENT, SERVICE OR MAINTENANCE, POSSIBLY RESULTING IN FIRE, ELECTRICAL SHOCK, CARBON MONOXIDE POISONING, EXPLOSION, PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

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.

 WARNING

THE EXHAUST GASES FROM THIS FURNACE CONTAIN CHEMICALS, WHICH ON SOME OCCASIONS MAY INCLUDE CARBON MONOXIDE (CO). CARBON MONOXIDE IS AN ODORLESS, TASTELESS, CLEAR COLORLESS GAS, WHICH IS HIGHLY TOXIC. EVEN LOW CONCENTRATIONS ARE SUSPECTED OF CAUSING BIRTH DEFECTS AND OTHER REPRODUCTIVE HARM.

UL AND CUL RECOGNIZED CO DETECTORS ARE RECOMMENDED FOR ALL BUILDINGS EQUIPPED WITH FOSSIL FUEL BURNING APPLIANCES. ALL CO DETECTORS SHOULD BE INSTALLED IN ACCORDANCE WITH THEIR MANUFACTURER'S INSTRUCTIONS AND APPLICABLE LOCAL BUILDING CODES.

 DANGER

WHEN THIS FURNACE IS INSTALLED IN A RESIDENTIAL GARAGE, IT MUST BE INSTALLED SO THE BURNERS AND IGNITION SOURCE ARE LOCATED NO LESS THAN 18 INCHES ABOVE THE FLOOR TO PREVENT THE RISK OF IGNITING FLAMMABLE VAPORS WHICH MAY BE PRESENT IN THE GARAGE.

THE FURNACE MUST BE LOCATED OR PROTECTED TO AVOID PHYSICAL DAMAGE BY VEHICLES.

FAILURE TO HEED THESE WARNINGS CAN CAUSE A FIRE OR EXPLOSION, RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

CODES:

This furnace must be installed:

- In accordance with all local codes, bylaws and regulations by those authorities having jurisdiction
- In the United States, this furnace must be installed in accordance with the current ANSI Z223.1 (NFPA 54) National Fuel Gas Code
- In Canada, this furnace must be installed in accordance with the current CAN/CGA -B149 Installation Code for Fuel Burning Appliances

Electrical connections must be made in accordance with:

- Any applicable local codes, bylaws and regulations
- Canada: current edition of CAN/CSA C22.1, Canadian Electrical Code (Part 1)
- United States: current edition of ANSI/NFPA 70, National Electrical Code

Codes and additional information may be obtained from:

- American Gas Association
1515 Wilson Boulevard
Arlington, VA, 22209
703-841-8400
- National Fire Protection Association
1 Batterymarch Park
Quincy, MA, 02269-9101
617-770-3000
- Canadian Gas Association
Suite 1, 243 Consumers Road
North York, ON, M2J 5E3
416-498-1994

INSTALLATION REQUIREMENTS SPECIFIC TO THE STATE OF MASSACHUSETTS FOR DIRECT VENT 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 (7) FEET ABOVE FINISHED GRADE IN THE AREA OF THE VENTING, INCLUDING BUT NOT LIMITED TO DECKS AND PORCHES, THE FOLLOWING REQUIREMENTS SHALL BE SATISFIED:

1. INSTALLATION OF CARBON MONOXIDE DETECTORS:

At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or 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 backup 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 revisions 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. PRODUCT-APPROVED VENT/AIR-INTAKE:

A product-approved vent terminal must be used and, if applicable, a product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions.

6. 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.

FURNACE SIZING

The maximum hourly heat loss for each heated space shall be calculated in accordance with the procedures described in Manual J titled, "Load Calculation" published by the Air Conditioning Contractors of America, or by any other method which is suitable for local conditions, provided the results obtained are in substantial agreement with, and not less than those obtained using the procedure described in their manual.

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

If the installation is a retrofit application, do not rely on the capacity of the existing heating equipment as a method to size the new furnace. Many of the heat transfer multiples listed in earlier versions of load calculation manuals were much higher than those listed in more recent editions. It is possible that energy saving measures have been completed since the installation of the existing furnace. This might include additional insulation in the attic or walls, the application of sprayed foam insulation, the addition of storm windows and doors, weather stripping, caulking, etc.

Many of the older furnaces were equipped with large belt drive blower systems, operating at low RPMs. If replacing an existing furnace, be sure that the existing ductwork can handle the amount of airflow necessary for a reasonable temperature rise. Most older gas furnaces operated with a system temperature rise of 70 - 100°F. This series furnace has been designed for operation with a system temperature rise (ΔT) of 35 - 65°F. If the furnace selected has an identical output capacity as the original furnace, a substantial increase in system airflow will be required.

Existing ductwork should be assessed for its air handling capabilities. For residential applications, the recommended air velocity of a supply air trunk duct is 700 feet per minute (fpm), and should not exceed 900 fpm. The recommended air velocity of a supply air branch run is 600 fpm, and should not exceed 900 fpm. These values are slightly lower for flexible ducting. The recommended air velocity of a return air trunk duct is 600 fpm, and should not exceed 700 fpm. The recommended and maximum air velocity of a return air branch is 600 fpm.

The equal friction chart, as published by ASHRAE and HRAI, is the basis for the various air duct calculators available through heating supply companies.

IMPORTANT

The return air system is equally as important as the supply air system. An undersized return air system will prevent sufficient quantities of air from reaching the supply air system, properly sized or otherwise, and will consequently reduce the service life of the furnace and its components.

AIR CONDITIONING

This furnace may be used as part of an air conditioning system. The furnace wiring and control system are "air conditioning ready". There are the following factors to consider:

- The air conditioning evaporator coil must be downstream of the heat exchanger. The cooled air passing over the warm ambient air inside the heat exchanger tubes can cause condensation inside the tubes, resulting in corrosion and premature failure.
- A parallel duct system can be installed to direct the air from the furnace through the evaporator coil only. Use dampers or other means to bypass the heat exchanger. If [summer/winter] dampers are used, they should be interlocked to prevent system operation unless the dampers are in the full open or full closed position.

INSPECTION / ACCESS PANEL

If an air conditioning coil is not to be used in the supply air plenum, it is recommended that the outlet duct be provided with a removable access panel, which is accessible when installed so the heat exchanger may be viewed for possible openings using light assistance or a probe that can be inserted for sampling the air stream. The access cover must be fabricated in such a manner as to prevent leaks.

LOCATION of UNIT

General

1. The furnace is not weatherized. Select a dry indoor location.
2. Select a location where the exhaust and combustion air piping can be routed between the furnace and their terminations with a minimum of lengths and fittings. Be sure to check that the proposed termination location will meet code requirements with respect to location and minimum clearances. (See venting section for minimum and maximum limits.)
3. Select a location as near as possible to the existing or proposed duct system.
4. The furnace location must permit access for servicing, and be within the clearance to combustibles guidelines as marked on the appliance rating plate.
5. The furnace should be installed on a firm base when installed in the upflow position. This is typically a concrete floor if installing the furnace in a basement.
6. If the furnace is being installed so that the return air will enter through the bottom, the perimeter of the furnace must be properly supported.
7. When installed in the horizontal position, the furnace may be supported from the bottom, or suspended.
8. When installed in the down flow position on a combustible floor, subbase kit #30476 is required (contact manufacturer for availability).
9. The furnace location must have provisions for condensate drainage. If a suitable drain is unavailable near the furnace, a condensate pump must be used. The condensate pump drain tubing must not terminate outdoors; similar to some air conditioning condensate installations. Be sure to select a condensate pump that has been approved for furnace condensate applications.
10. The furnace must be installed level, or tilted slightly down in the front, to allow for the proper drainage of condensate. The furnace may shut down during operation if the condensate does not drain freely away from the furnace.
11. If the furnace is installed in an area where freezing may occur, a garage, an attic, a crawl space or any unconditioned space, steps must be taken to protect the condensate trap and drain line from freezing. One possible measure could be to use a self-regulating 5 or 6 watt per foot heat tape covered with a jacket of insulation. Heat tapes are available in plumbing supply houses.

Other Considerations:

1. This furnace is not to be used for temporary heating of buildings or structures under construction.
2. If this furnace is to be used with air conditioning and is to be installed in an area over a finished ceiling or living area, install a field fabricated auxiliary drain pan under the furnace to protect that area from accidental condensate spills. The auxiliary pan should be large enough to collect accidentally spilled condensate from the air conditioning evaporator coil assembly if applicable. Follow local codes.
3. These furnaces are approved for installation in attics, alcoves, utility rooms, closets and crawlspaces. If this furnace is to be installed in a utility room, be sure that it is located in such a way as to allow access for servicing or the removal of any other appliance, (hot water heater, for example).
4. If the furnace is to be installed in a residential garage, the burners must be a minimum of 18 inches (460 mm) above the floor.
5. If the furnace is to be installed in a commercial (repair) garage, the burners must be a minimum of 4.5 feet (1375 mm) above the floor.
6. The furnace must be protected from physical damage by metal barriers or other acceptable means.
7. If the furnace is to be located in an area where the combustion air is laden with chemical compounds such as bromine, chlorine or fluorine, as may be found in swimming pool chemicals, laundry detergents, etc., use outdoor air for combustion. These compounds when exposed to flame, form acids, which attack the heat exchanger and other components.

A partial list of these contaminants includes:

- Aerosols, particularly CFC based aerosols
- Air fresheners
- "Airplane" glue and similar cements
- Ammonia, as is commonly found in permanent wave solutions used in women's hair dressing salons
- Anti-static fabric softeners used in clothes dryers
- Carbon tetrachloride
- Chlorinated cleaners and waxes
- Chlorine and bromine based swimming pool chemicals and treatments
- De-icing salts or chemicals, rock salt, etc.
- Dry cleaning solutions such as perchloroethylene
- Halogen based refrigerants including R-12 and R-22
- Hydrochloric acid, muriatic acid, or other acid based masonry washing compounds
- Polyurethane and similar derivatives fumes
- Printer's inks, paint removers, furniture strippers, varnishes, varsol, toluene, etc.
- Water softener salts and chemicals

CLEARANCES

Table 2 provides the certified clearances to combustibles.

IMPORTANT

This furnace requires a minimum of 24-inches of front clearance for service purposes. For this purpose, service clearance takes precedence over clearance to combustibles.

TABLE 2: CLEARANCES TO COMBUSTIBLES

	UPFLOW	COUNTERFLOW	HORIZONTAL
TOP	1"	0"	2"
PLENUM TOP/BOTTOM	1"	1"	2.5"
PLENUM SIDES	0.5"	0.5"	0.5"
UNIT FRONT	0" *	0" *	0" *
UNIT BACK	0"	0"	0"
UNIT SIDES	0"	0"	1" **
UNIT BASE	0" ***	0" ****	0"
UNIT FLUE PIPE	0"	0"	0"
ENCLOSURE	CLOSET	CLOSET	CLOSET

* 24" REQUIRED FOR SERVICE

ALL DIMENSIONS IN INCHES

** SUPPLY AIR END / RETURN AIR END

*** CERTIFIED FOR CLOSET INSTALLATION ON COMBUSTIBLE FLOORING

**** CERTIFIED FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN INSTALLED ON SPECIAL BASE PART.

See the appliance rating plate affixed to the furnace for specific model number, serial number and clearance to combustibles information.

FIGURE 2: DIMENSIONS

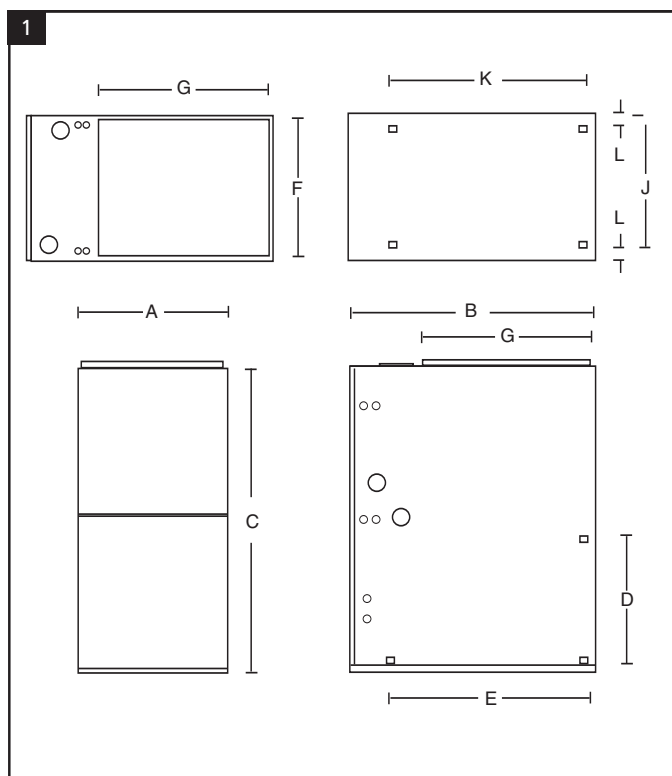


TABLE 3: DIMENSIONS

DIMENSIONS (Inches)				
	WIDTH	DEPTH	HEIGHT	SUPPLY
	A	B	C	F x G
54,000	17.5	29	40	16.5 x 19
72,000	20.5	29	40	19.5 x 19
90,000	20.5	29	40	19.5 x 19
108,000	24.5	29	40	24 x 19

MODEL INPUT	RETURN			VENT
	SIDE	BOTTOM		
	D x E	J x K	L	
54,000	14 x 22	16 x 19	3/4	2
72,000	14 x 22	19 x 19	3/4	2
90,000	14 x 22	19 x 19	3/4	2
108,000	14 x 22	23 x 19	3/4	2

⚠ DANGER ⚠

COMBUSTIBLE MATERIAL MUST NOT BE PLACED ON OR AGAINST THE FURNACE JACKET.

PLACEMENT OF COMBUSTIBLE MATERIALS ON, AGAINST OR AROUND THE FURNACE JACKET CAN CAUSE AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

⚠ DANGER ⚠

THE AREA AROUND THE FURNACE MUST BE KEPT CLEAR AND FREE OF ALL COMBUSTIBLE MATERIALS INCLUDING GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

THE HOMEOWNER SHOULD BE CAUTIONED THAT THE FURNACE AREA MUST NOT BE USED AS A BROOM CLOSET OR FOR ANY OTHER STORAGE PURPOSE.

UPFLOW FURNACES ARE DESIGN CERTIFIED FOR INSTALLATION ON COMBUSTIBLE FLOORS. THIS SHALL BE INTERPRETED AS A WOOD FLOOR ONLY.

THE FURNACE MUST NOT BE INSTALLED DIRECTLY ON CARPETING, VINYL TILE, OR OTHER COMBUSTIBLE MATERIAL EXCEPT WOOD. INSTALLATION ON COMBUSTIBLE MATERIAL CAN RESULT IN FIRE, CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

DUCTWORK

Proper airflow is required for the correct operation of this furnace. Insufficient airflow may cause erratic operation, could cause the furnace to cycle on the high temperature limit, and may damage the heat exchanger. Excessive airflow may result in an excessively noisy duct system and may result in undesirable consequences such as creating uncomfortable drafts and causing drapes or curtains to blow around.

If air conditioning is to be used with the furnace, the duct system must be capable of delivering the correct amount of airflow for each system.

The ductwork should be sized and constructed in accordance with accepted industry standards. Duct sizing and construction information may be obtained from:

- A.C.C.A. (Air Conditioning Contractors of America)
- A.S.H.R.A.E. (American Society of Heating, Refrigeration and Air Conditioning Engineers)
- H.R.A.I. (Heating, Refrigerating and Air Conditioning Institute (Canada))
- S.M.A.C.N.A. (Sheet Metal and Air Conditioning Contractors' National Association (United States))

All of the above professional organizations have duct sizing manuals available.

The total static pressure drop of the air distribution system should not exceed 0.5 inches water column.

Guide:

Filter free area (in²) = 144 x (CFM / desired velocity (fpm))

IMPORTANT

Some high efficiency filters have a greater than normal resistance to airflow. This can adversely affect furnace operation. Pressure check the static differential from before the filter to the supply.

NOTE

When calculating an air filter size use the free air not the advertised size.

NOTE

UNITS FOR 4 AND 5 TON CF AIR CONDITIONING MUST HAVE DUAL RETURN AIR INLETS FOR OPTIMAL AIRFLOW AND AIR FILTRATION. IF NOT SPECIFICALLY STATED BY THE FILTER MANUFACTURER, FOR EFFECTIVE AIR FILTRATION, ASSUME A MAXIMUM VELOCITY OF 300 FPM FOR DISPOSABLE TYPE FILTERS, OR 600 FPM FOR PERMANENT TYPE FILTERS.

⚠ WARNING ⚠

DO NOT, UNDER ANY CIRCUMSTANCES, CONNECT RETURN OR SUPPLY AIR DUCTWORK TO OR FROM ANY OTHER HEAT-PRODUCING DEVICE SUCH AS A FIREPLACE INSERT, STOVE, ETC. DOING SO MAY RESULT IN FIRE, CARBON MONOXIDE POISONING, EXPLOSION, PERSONAL INJURY, LOSS OF LIFE, OR PROPERTY DAMAGE.

Ductwork Steps:

1. Position the furnace to minimize ductwork length and fittings.
2. Cut open a return air inlet. The choices are:
 - a) either side
 - b) furnace bottom
 - c) any combination, i.e. two sides or a side and the bottom.

In all cases, cut the inlet air opening the full width of the knockouts.

NOTE

When two return air inlets are used, both must be equipped with filters.

⚠ CAUTION ⚠

DO NOT USE THE REAR PANEL AS A RETURN AIR INLET. THERE IS INSUFFICIENT AREA TO PERMIT ADEQUATE AIRFLOW.

3. Install the filter rack(s) (field supplied).
4. Connect the return air duct or fitting to the furnace. The connection should be as air tight as possible to prevent entraining combustion gases from an adjacent fuel burning appliance, or entraining combustion air for this furnace .
5. Ensure that there is adequate space and accessibility for the air filter.
6. If an air conditioning evaporator coil is required, position it on the top of the furnace. Ensure that no air can bypass the evaporator coil.
7. Connect the supply air plenum to the supply air outlet. Flexible duct connectors are an effective device to prevent the telegraphing of mechanical noise from the furnace to other parts of the home via the ductwork. If using flexible connectors, ensure that the adjoining duct is independently supported.

Adequate provisions for combustion and ventilation air must be in accordance with ANSI Z223.1 (NFPA 54), section 5.3 "Air for Combustion and Ventilation" in the United States, and CAN/CGA B149 in Canada. Check with local authorities for any additional building codes, bylaws or regulations.

INSTALLATION POSITIONS

The furnace can be installed in any of four positions:

- Upflow
- Downflow
- Horizontal left
- Horizontal right

Maintain clearances to combustibles as outlined in Table 2. Support the furnace cabinet to prevent twisting or sagging.

General Considerations

When choosing an installation position the installer must consider the following connections:

- Combustion air intake
- Exhaust vent
- Gas pipe
- Electrical wiring
- Condensate drain trap

Also consider the air conditioning connections, a/c drain, access to filter(s) and access to furnace and a/c for repair.

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

IMPORTANT

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

IMPORTANT

If the pipe and fittings are to be other than PVC, use the proper cleaner, primer and cement for the dissimilar materials.

IMPORTANT

Drains and traps of furnaces installed in spaces subjected to freezing temperature must also be protected against freezing.

IMPORTANT

Clean and de-burr all pipe cuts. The shavings must not be allowed to block the exhaust, combustion air inlet or condensate drain lines.

Combustion Air Inlet Connection

The combustion air inlet fitting is a 2" PVC Socket to Pipe Thread adapter. Choose the intake location and open the appropriate knock out. Install the adapter to the exterior panel using the gasket on the outside of the panel and the locknut on the inside of the panel.

IMPORTANT

If the pipe is increased in size with a reducer it must be on a vertical section of the pipe to facilitate draining the vent. Reducing the size of pipe to exit the house (as shown on page 19, Figures 4 and 6), the reducer can be on the horizontal.

⚠ WARNING ⚠

THERE MUST NOT BE ANY OPENINGS BETWEEN THE BLOWER DIVISION PANEL AND THE COMBUSTION COMPARTMENT. THE BLOWER COMPARTMENT IS UNDER GREATER SUCTION THEN THE COMBUSTION COMPARTMENT AND CAN PULL COMBUSTION AIR FROM THE BURNERS AND CAUSE INCOMPLETE COMBUSTION AND ERRATIC FURNACE OPERATION.

IMPORTANT

Keep pressure switch hose above heat exchanger drain and exhaust port.

Exhaust Vent Connection

The exhaust vent must be clamped to the exterior panel(s) with the clamp provided. Place the gasket between the clamp and the side panel. Tighten clamp and fasten in place using the three screws provided.

The clamp should secure the vent pipe to prevent internal damage if the vent pipe is tampered with.

⚠ WARNING ⚠

THE 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.

Instructions for Re-orienting Air Inducer

This furnace comes assembled ready for left side or vertical venting. Rotate the inducer 180 degrees to exit the right hand side.

1. Disconnect inducer wire connections.
2. Remove pressure switch hoses.
3. Remove pressure switches.
4. Remove 4 inducer screws
5. Remove inducer.
6. Reverse the bands on the rubber drain coupling so the screws are accessible if necessary. (Do not reverse the drain coupling.) Confirm that directional arrows on drain coupling point away from inducer.
7. Remove the appropriate knock out.
8. Reinstall the inducer in the correct orientation with 4 screws removed in step 1.
9. Reinstall the pressure switches so that the switches and hose is above the heat exchanger drain.
10. Complete the external venting as installation requires.
11. Rotate the drain coupling so the drain holes are angled downward and tighten coupling bands.
12. Tighten the vent clamp and secure in place using the screws provided.

INSTALLATION POSITIONS

Non-Suspended Installation

Maintain clearances to combustibles as outlined in Table 2 on page 6. The furnace must be supported in such a way as to not allow twisting or sagging of the cabinet.

Horizontal Suspended Installation

The furnace may be suspended in either the horizontal right or left position by field fabricated a cradle of angle iron and threaded rod. Secure the furnace with 2 inch minimum slotted angle or equivalent, as shown in figure below. The furnace must be supported in such a way as not to allow twisting or sagging of the cabinet. Position the supports so as not to interfere with accessing the burner and blower compartments.

SUSPENDED INSTALLATION

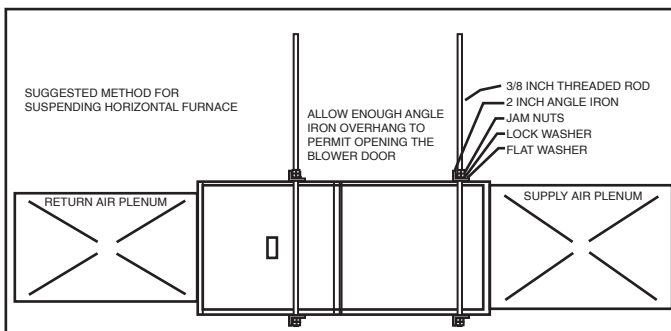


FIGURE A : RIGHT INDUCER POSITION

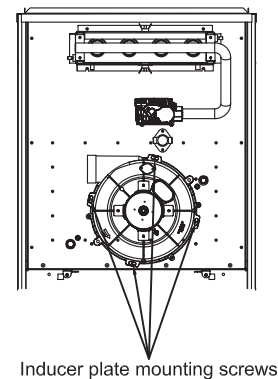
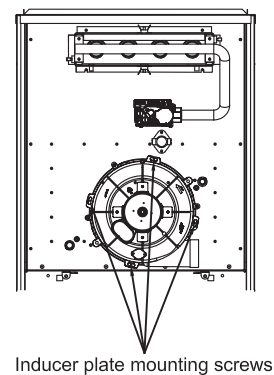


FIGURE B : LEFT INDUCER POSITION



Upflow Installation

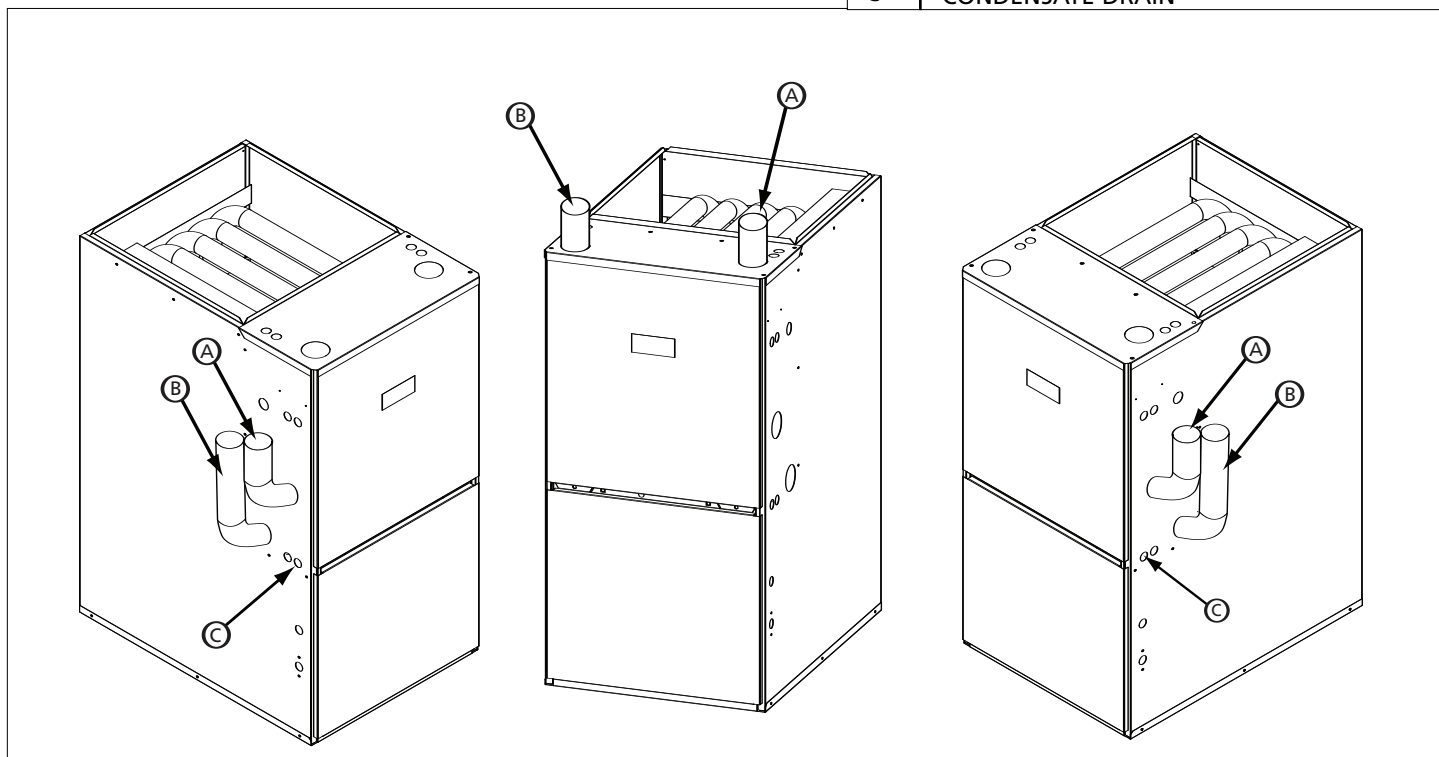
The combustion air and exhaust vent may exit through the top, left or right side of the cabinet when viewed in the upflow position. The inducer is installed so that the exhaust vent may exit the top and left sides without requiring rotation.

If exhaust vent exits the top panel, use the two street elbows to route the vent. One elbow secured to the inducer drain connector, will angle toward the front of cabinet with the second nested inside directed towards the top panel. (The 108,000 BTUH will require an extension between the inducer and the first elbow that is not provided.)

If exhaust vent exits the left-side panel the pipe can be routed straight outside the cabinet. **If exhaust vent exists the right-side panel the inducer requires rotation.**

The exhaust vent pipe exiting the cabinet in any installation should be long enough to install the vent clamp on the outside of the cabinet.

A	COMBUSTION AIR
B	EXHAUST VENT
C	CONDENSATE DRAIN



Downflow Installation

When the furnace is installed in the downflow position the combustion air and exhaust vent may exit through the left or right side of the cabinet (when viewed in the upflow position.). The inducer is installed so that the left side exits require no rotation.

If exhaust vent exits the left-side panel the pipe can be routed straight outside the cabinet.

If exhaust vent exists the right-side panel the inducer requires rotation.

The pipe exiting the cabinet in any installation should be long enough to install the vent clamp on the outside of the cabinet.

The opening in the floor must provide adequate clearances to the combustible material.

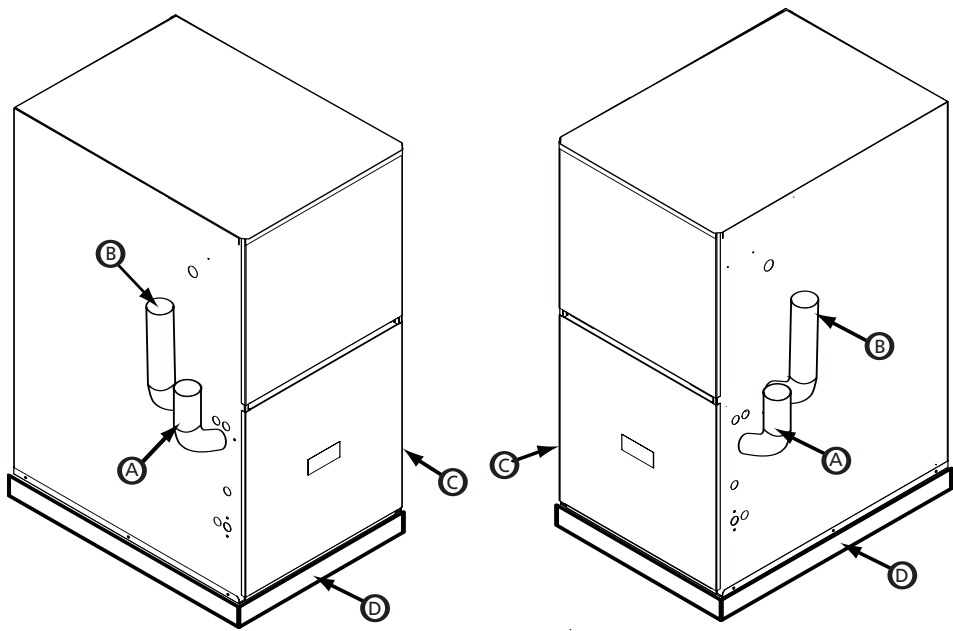
A half-inch of clearance will be required between the plenum and the combustible material. If installed on a non-combustible material, zero clearance is required.

In the downflow installation, this furnace can only vent through the left or right side of the furnace.

The condensate drain trap can be mounted on the right or left side.

⚠ WARNING ⚠

WHEN INSTALLED IN THE DOWNFLOW POSITION ON A COMBUSTIBLE FLOOR, SUBBASE KIT IS REQUIRED. FAILURE TO INSTALL SUBBASE KIT COULD RESULT IN FIRE, DEATH OR SERIOUS INJURY.



A	COMBUSTION AIR
B	EXHAUST VENT
C	CONDENSATE DRAIN
D	SUBBASE KIT - REQUIRED WHEN INSTALLED IN THE DOWNFLOW POSITION ON A COMBUSTIBLE FLOOR

Horizontal Left Installation

In the horizontal left installation the combustion air and exhaust vent may exit through the top or right side of the cabinet (when viewed in the upflow position). In the horizontal left installation, it is not permissible to vent downwards. **The inducer will require rotation if the right side exit is used.**

If exiting the top panel, use the two street elbows to route the vent. One elbow secured to the inducer drain connector, will angle toward the front of cabinet with the second nested inside directed towards the top panel. (The 108,000 BTUH will require an extension between the inducer and the first elbow that is not provided.)

If exiting the right-side the pipe can be routed straight outside the cabinet after the inducer has been rotated.

The pipe exiting the cabinet in any installation should be long enough to install the vent clamp on the outside of the cabinet.

NOTE

It is not permissible to use a rear of the furnace as a return.

IMPORTANT

The furnace must be installed level or sloping towards the front to facilitate proper drainage.

Horizontal Right Installation

In the horizontal right installation the combustion air and exhaust vent may exit through the top or left side of the cabinet (when viewed in the upflow position). It is not permissible to vent downwards. The inducer is installed so that the top and left side exits require no rotation.

If exhaust vent exits the top panel, use the two street elbows to route the vent. One elbow secured to the inducer drain connector, will angle toward the front of cabinet with the second nested inside directed towards the top panel. (The 108,000 BTUH will require an extension between the inducer and the first elbow that is not provided.)

If exhaust vent exits the left-side panel the pipe can be routed straight outside the cabinet.

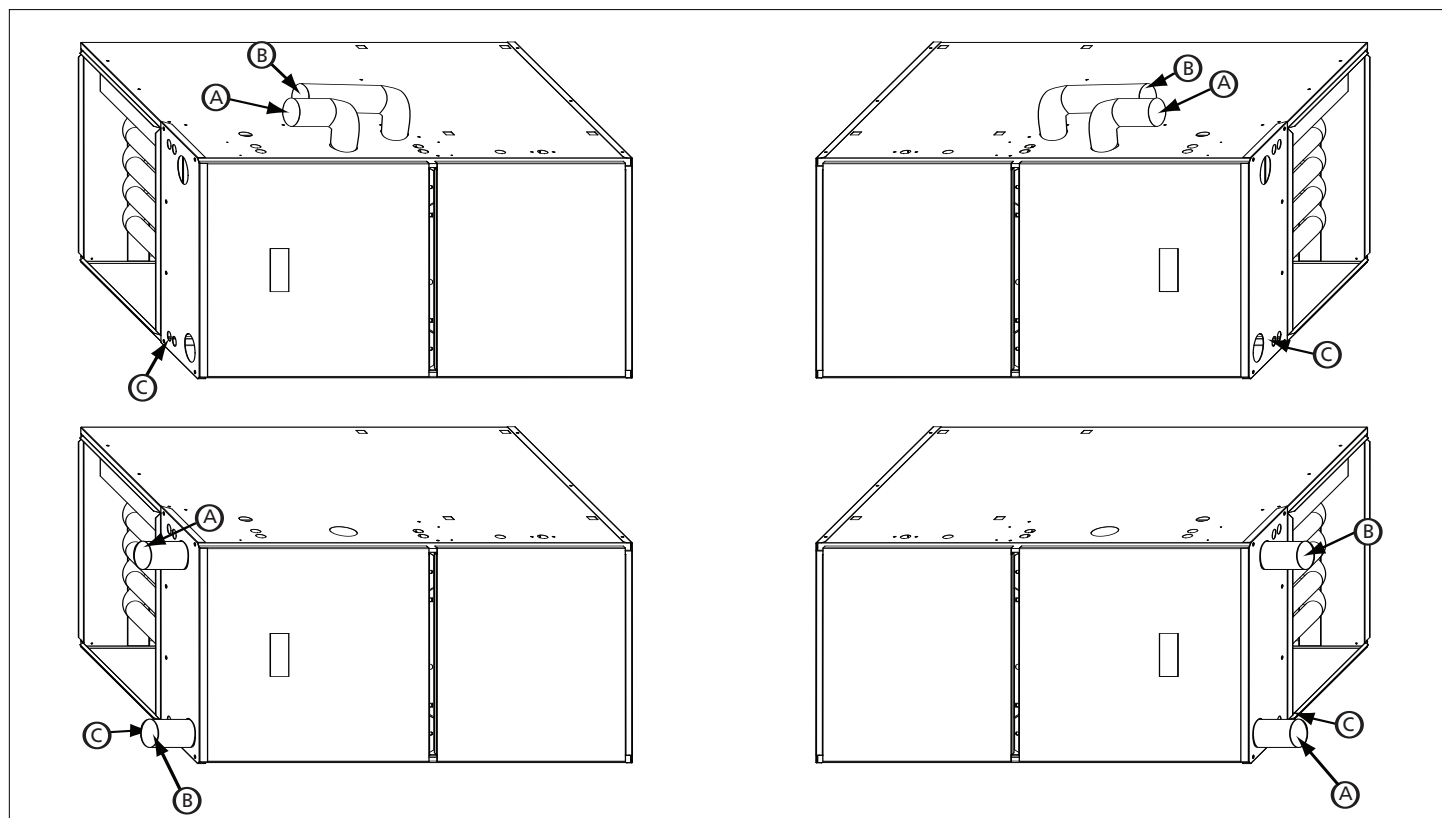
The pipe exiting the cabinet in any installation should be long enough to install the vent clamp on the outside of the cabinet.

NOTE

It is not permissible to use a rear of the furnace as a return.

IMPORTANT

The furnace must be installed level or sloping towards the front to facilitate proper drainage.



A	COMBUSTION AIR
B	EXHAUST VENT
C	CONDENSATE DRAIN

CASE 1:

FURNACE LOCATED IN AN UNCONFINED SPACE

Unconfined space does not necessarily mean that combustion and ventilation will not have to be introduced from the outdoors, particularly in airtight homes. Refer to the appropriate installation code requirements regarding the minimum combustion air required 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.

NOTE

If planning to use the inside air of an unconfined space, remember to 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

A confined space, (any space smaller than the minimums discussed in CASE 1), must have two air openings one within 12 inches of the ceiling and the other within 12 inches of the floor. The air openings must be sized based on whether the 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 the furnace and all other fuel burning appliances, even when clothes dryers, bathroom fans, range hoods, etc. are running, size each opening according to the appropriate installation codes.

NOTE

If using grilles to cover the two openings, factor in the free area of the grille. Typically, a grille will have a free area approximately 50% of its nominal size. Consequently, if the required opening is 10 inches x 10 inches, it will have to be doubled if using a sidewall grille with 50% free area.

IMPORTANT

If an exhaust fan, fireplace, clothes dryer or any similar device is present in the indoor area from which the combustion and ventilation air will be drawn, negative pressure could be a problem if natural infiltration from the outdoors does not match the rate at which air is exhausted.

CASE 3:

FURNACE LOCATED IN A CONFINED SPACE, OUTDOOR

AIR FROM ATTIC OR CRAWL SPACE

In this circumstance, refer to the appropriate installation code for the free area of the combustion and ventilation air openings. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace. 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 the heating season; however, some are controlled by a humidistat as well as a thermostat, which may allow some operation during the heating season.

The choices are (a) use the 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, OUTDOOR AIR DUCTED HORIZONTALLY

Similar to CASE 3, outdoor air for combustion and ventilation may be drawn through horizontal ducting.

Consult the appropriate installation code for the free area for openings. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace.

IMPORTANT

The outdoor grilles must be installed in a location where they will not be obstructed in any manner.

If grilles are used on the outside wall, they must be sized properly. Most sidewall grilles have only 50% free area, so the grill size opening must be twice the size of the free air opening requirement.

⚠ WARNING ⚠

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 THE JOIST SPACE ALREADY CONTAINS PLUMBING STACKS, CHIMNEY COMPONENTS, ETC. UNLESS THE PORTION USED FOR RETURN AIR PURPOSES CAN BE COMPLETELY ISOLATED FROM PORTIONS WITH OTHER USAGES.

FURNACE VENTING

Direct Venting Pipe Connections

(USING OUTDOOR COMBUSTION AIR)

The direct vent configuration is the preferred installation method. The primary advantages are:

- Dedicated combustion air and vent piping eliminates the need to use already heated air for combustion purposes
- The probability of corrosive contaminants being present in the combustion air is greatly reduced
- The direct vent configuration is unaffected by any other appliances, exhaust fans, or other devices that tend to create negative pressure conditions while operating
- No vents for combustion and ventilation air are required in confined spaces

⚠ DANGER ⚠

READ, UNDERSTAND AND FOLLOW ALL INSTRUCTIONS IN THIS SECTION. FAILURE TO PROPERLY VENT OR SUPPLY COMBUSTION AIR TO THIS FURNACE CAN CAUSE CARBON MONOXIDE POISONING, OR AN EXPLOSION OR FIRE, RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

⚠ DANGER ⚠

THIS FURNACE AND ANY OTHER FUEL BURNING APPLIANCE MUST BE PROVIDED WITH ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION OF THE FLUE GASES. MOST HOMES WILL REQUIRE THAT OUTSIDE AIR BE BROUGHT TO THE FURNACE AREA. FAILURE TO DO SO CAN CAUSE PERSONAL INJURY OR DEATH FROM CARBON MONOXIDE POISONING.

Combustion Air Inlet Piping

This furnace is certified as a Category IV Type FSP Non-Direct and Direct Vent Furnace. When installed as a direct vent furnace, all combustion air is supplied from the outdoors via the plastic piping system. All components are field supplied except for the adapter used to connect the piping to the furnace.

⚠ DANGER ⚠

The following types of installation sites (but not limited to the following) will 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.

The combustion air piping, like the exhaust piping, must be air tight throughout the system. The adapter joining the combustion air to the furnace is supplied with a gasket to maintain the seal.

IMPORTANT

The 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 an all-purpose cleaner, a clear or purple primer and all-purpose cement approved for the purpose. Additional information about cleaners, primers, solvents and cements may be obtained from their manufacturers.

⚠ CAUTION ⚠

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 the dew point temperature of the flue products and are highly corrosive after they condense.

Any furnace failure caused by corrosive elements is excluded from warranty coverage.

Exposure to the following substances in the combustion air supply (but not limited to the following) will 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
- Antistatic fabric softeners used in clothes dryers
- Carbon tetrachloride
- Chlorinated cleaners and waxes
- Chlorine and bromine based swimming pool chemicals
- Deicing salts or chemicals, e.g. 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

Air Filters

IAQ types of air filters may cause higher static, higher temperature rise and erratic furnace operation and, with an ECM drive, can cause blower over speed more noise. Also the consumer may at some time want to add UV treatment, and electrostatic air cleaners or HEPA filters. Thus the return duct should be sized larger than traditionally and also more clearance space allow around the return duct for future equipment.

Angling the air filter is one method of installing a larger area air filter. Table below shows the recommended air filter sizes. By examining the table one can see that many existing installations have undersized air filters, resulting in poorer air quality.

RECOMMENDED AIR FILTER AREA (SQUARE INCHES), FOR DISPOSABLE AND PERMANENT TYPE FILTERS

COOL (TONS)	AIR FLOW (SCFM)	DISPOSABLE	PERMANENT
		AREA (INCH ²)	AREA (INCH ²)
1.5	650	312	156
2	810	389	194
2.5	1000	480	240
3	1150	552	276
3.5	1350	648	324
4	1550	744	372
5	1750	840	420
HEAT INPUT			
(BTU/HR)			
54,000	919	441	221
72,000	1226	588	294
90,000	1532	735	368
108,000	1839	883	441

Exhaust Vent Piping

WARNING

NEVER ALLOW THE PRODUCTS OF COMBUSTION FROM THE FLUE TO ENTER THE RETURN AIR OR SUPPLY AIR DUCTWORK.

ALL RETURN AIR DUCTWORK MUST BE ADEQUATELY SEALED AND SECURED TO THE FURNACE WITH SHEET METAL SCREWS. TAPE THE SHEET METAL SEAMS IN THE VICINITY OF THE FURNACE WITH DUCT TAPE OR SIMILAR MATERIAL.

WHEN THE FURNACE IS MOUNTED ON A PLATFORM WITH RETURN AIR THROUGH THE BOTTOM, IT MUST BE SEALED AIR TIGHT BETWEEN THE FURNACE AND THE RETURN AIR PLENUM. THE FLOOR OR PLATFORM MUST PROVIDE SOUND PHYSICAL SUPPORT OF THE FURNACE WITHOUT SAGGING, CRACKS OR GAPS AROUND THE BASE, PROVIDING A SEAL BETWEEN THE SUPPORT AND THE BASE.

FAILURE TO PREVENT PRODUCTS OF COMBUSTION FROM BEING CIRCULATED INTO THE LIVING SPACE CAN CREATE POTENTIALLY HAZARDOUS CONDITIONS, INCLUDING CARBON MONOXIDE POISONING THAT COULD RESULT IN PERSONAL INJURY OR DEATH.

WARNING

READ AND FOLLOW ALL INSTRUCTIONS IN THIS SECTION. FAILURE TO PROPERLY VENT THIS FURNACE CAN CAUSE CARBON MONOXIDE POISONING OR AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

Definitions

"Vent" and "Chimney" refer to open passageways that convey vent gases from the furnace, or its vent connector, to the outside. Vents and chimneys usually run vertically or nearly vertically. 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 furnace's 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.

⚠ CAUTION ⚠

FAILURE TO FOLLOW ALL VENTING GUIDELINES MAY RESULT IN ERRATIC FURNACE OPERATION, FREEZE-UP OF THE VENTILATION AIR PIPING, OR SOOTING OF THE FURNACE.

Guidelines

- Venting may be vertical or horizontal.
- Minimum vent length - 25 total equivalent feet. (See page 18, Table 4 - Venting Table)
- Horizontal piping must slope back towards the furnace at a minimum rate of 1/4" to the foot, so that condensate drains towards the furnace.
- Horizontal runs must be supported at least every 3 feet. Horizontal sections must not dip or sag
- All vent runs through unconditioned space where freezing might occur should be insulated with 1" thick, medium density, foil-faced Fiberglass insulation. An equivalent "arm-aflex" 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 the vent pipe with self regulating 3 or 5 watt heat tape. The heat tape must be CSA, UL, or ULC listed and installed per the 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 the required clearances to combustibles can be maintained between the PVC pipe and other pipes.
- 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.
- Take the building orientation and the presence of other buildings or other nearby structures into consideration when planning the venting system location. Certain external structures could create air turbulence around the vent termination leading to downdrafts and similar venting problems. In windy and hill locations, roof venting may improve operations. Maximum venting length is based on 30 mph winds, areas where higher gusts are dominant it is suggest to shorten the horizontal vent length, increase the diameter of the vent, or vent vertically.
- The exhaust vent and combustion air intake shall be installed so that both are located in the same wind pressure zone.

JOINING PIPE AND FITTINGS

Acceptable Materials for Combustion Air and Exhaust Vent Pipe

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

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
- ABS-DWV, ASTM D2661 or CSA B181.1
- Schedule 40 CPVC, ASTM F441 or CSA B137.6

In Canada, construct all combustion-air and vent pipes for this unit of CSA or ULC S636 listed schedule-40 PVC, PVC-DWV or ABS-DWV pipe and pipe cement. SDR pipe is not approved in Canada. In addition, the first three feet of the exhaust must be accessible for visual inspection.

Procedure for Cementing Joints (ASTM D2855):

It is preferable to use a single type of plastic throughout the venting and combustion air piping; however, if dissimilar piping or fitting materials are used, they must be joined with an appropriate transition cement. Dissimilar pipe segments may be joined together by mechanical means (i.e., 2" rubber coupling).

⚠ DANGER ⚠

SOLVENT CEMENTS AND PRIMERS ARE HIGHLY FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND DO NOT ASSEMBLE NEAR HEAT SOURCE OR OPEN FLAME. DO NOT SMOKE. AVOID SKIN OR EYE CONTACT. OBSERVE ALL CAUTIONS AND WARNINGS PRINTED ON MATERIAL CONTAINERS. FAILURE TO FOLLOW THESE GUIDELINES MAY RESULT IN FIRE, EXPLOSION OR ASPHYXIATION CAUSING PERSONAL INJURY OR LOSS OF LIFE.

⚠ WARNING ⚠

All pipe, fittings, solvent cement, primers and procedures must conform to American National Standards Institute and American Society for Testing Materials (ANSI / ASTM) standards.

PIPE AND FITTINGS: ASTM D1785, D2466 and D2564

PVC PRIMER AND SOLVENT CEMENT: ASTM D2564

ABS PIPE AND FITTINGS: Use ABS Primer and Solvent Cement D2235

CPVC SOLVENT CEMENT: F493

IMPORTANT

For proper installation, DO NOT thin or use solvent cement that has become curdled, lumpy or thickened.

PROCEDURE:

This guide is intended specifically for PVC pipe; however, the general procedure applies to all plastic piping systems.

MATERIALS: PVC Cleaner / Primer and PVC Solvent Cement.

IMPORTANT

After cutting pipe, remove all ragged edges and burrs. This will reduce restriction (pressure drop) throughout the venting and combustion air system.

1. Cut the pipe end square. Chamfer edge of pipe. Clean the fitting socket and pipe joint area of all dirt, grease and moisture.
2. After checking the pipe and socket for proper fit, wipe socket and pipe with cleaner / primer. Apply a liberal coat of primer to inside surface of socket and outside surface of pipe. **DO NOT ALLOW THE PRIMER TO DRY BEFORE APPLYING THE CEMENT.**

NOTE

If alignment is critical, make an alignment mark with a lead pencil on the outside of the socket to the portion of pipe beyond the joint. This will allow proper alignment as the joint is processed.

3. Apply a thin coat of solvent cement to the inside surface of the fitting socket. Quickly apply a heavy coat of solvent cement to the pipe end and insert it into the socket with a slight twisting motion until it bottoms out. If alignment is critical, match up the pencil marks made prior to this step.

NOTE

Cement must be fluid; if not, re-coat.

4. Hold the pipe in the fitting for 30 seconds to prevent the tapered socket from pushing the pipe out of the fitting. Failure to do this may result in a weak or leaky joint.
5. Wipe all excess cement from the joint with a rag. Allow 15 minutes before handling. Cure time varies according to fit, temperature and humidity.

NOTE

Stir the solvent cement frequently while using. Use a natural bristle brush or the dauber supplied with the container. If a dauber was not supplied, a 1 inch brush is ideal.

Observe shelf precautions printed on containers. Minimize the exposure of the container's contents to air. For applications below 32°F (0°C), use only low temperature-type solvent cement.

Direct Vent Piping Termination

⚠ CAUTION ⚠

Moisture in the flue gases condenses as it leaves the terminal. This 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 a 6 foot radius of the termination.

⚠ CAUTION ⚠

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.

General Guidelines

The external portion of the piping in all cases is to consist of 2" pipe. If 3" pipe is used between the furnace and terminal, transition to 2" within 18" or less of the exterior wall.

When 3" pipe is used, exit the cabinet with 2" pipe. Reduce or increase immediately after exiting the cabinet in a vertical run making provisions to secure the vent bracket between cabinet and fitting.

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.

Avoid locating the terminal in locations where dripping condensate may cause problems such as side walks, 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.

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.

Calculating Piping Length

When calculating allowable vent lengths, be sure to count all termination fittings in addition to counting the concentric vent as a straight pipe. The ventilation pipe extending through the roof must extend 18" above the highest point where it extends through the roof, surface and above any obstruction within an 18" horizontal distance. The ventilation pipe must extend a minimum of 12" above the anticipated snow level.

Exterior vent pipe greater than 24" should be insulated with 1/2" insulation to prevent moisture from freezing within the pipe and accumulating.

Size the ventilation pipe as specified in Table 4 - Direct and Non-Direct Vent Lengths. This table lists the maximum allowable length of pipe with respect to the number of 90° elbows used. For the purposes of this calculation, one 90° elbow is equivalent to two 45° elbows.

⚠ WARNING ⚠

DO NOT CONNECT FURNACE TO A CHIMNEY OR FLUE SERVING OTHER APPLIANCES OR A SOLID FUEL BURNING APPLIANCE.

TABLE 4:
VENT LENGTHS- DIRECT/NON-DIRECT VENT LENGTHS

		MAXIMUM ALLOWABLE STRAIGHT LENGTH OF EXHAUST OR INTAKE						
MODEL	PIPE SIZE	NUMBER OF 90° ELBOWS						
		0	1	2	3	4	5	6
054	2	70	65	60	55	50	45	40
	3	150	140	130	120	110	100	90
072	2	70	65	60	55	50	45	40
	3	150	140	130	120	110	100	90
090	2	70	65	60	55	50	45	40
	3	150	140	130	120	110	100	90
108	2	70	65	60	55	50	45	40
	3	150	140	130	120	110	100	90

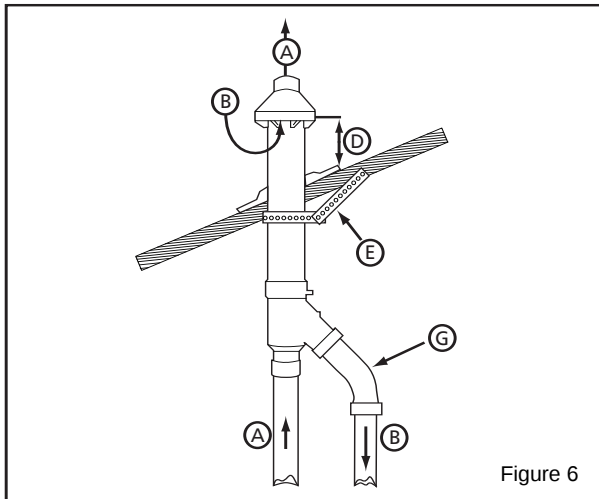
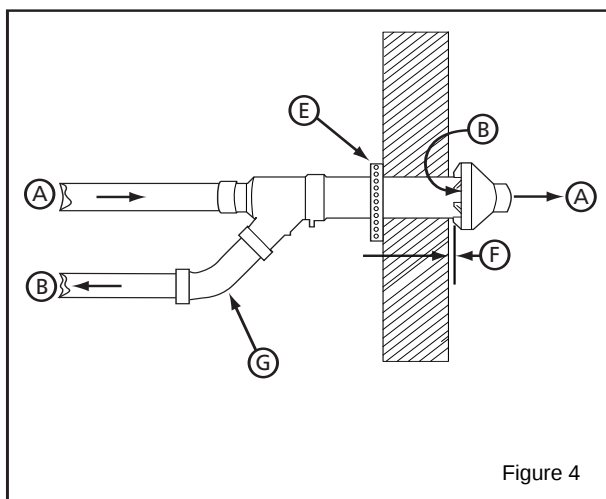
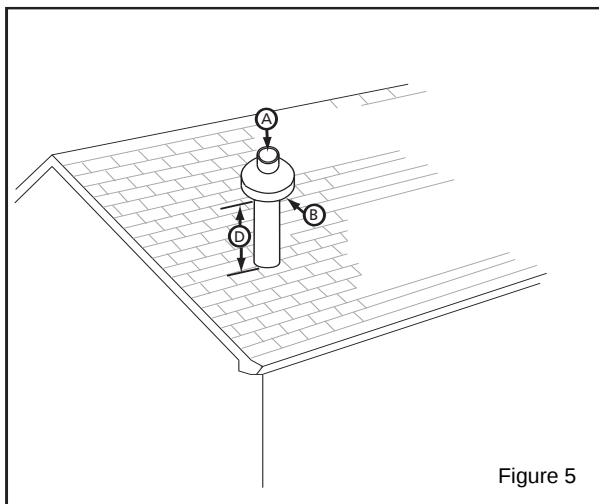
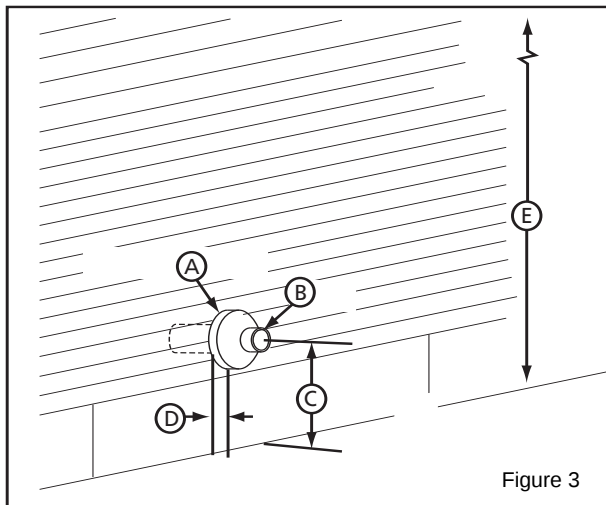
- Count concentric vent fitting as straight pipe.
- Use medium or long sweep elbows where possible.
- One 90° elbow is equivalent to two 45° elbows.
- For direct vent, the above is the length allowed for each vent (intake and exhaust)
- For non-direct vent, the above is length allowed for exhaust. The intake should have a two inch upside down "U" intake installed on the cabinet intake fitting.

TERMINATION OF COMBUSTION AIR AND VENTILATION PIPE USING A 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. Read the instructions supplied with the kit for additional installation instructions and details.

The concentric venting terminal has the combustion air intake built into the assembly. If using the concentric vent terminal, there must be a minimum of 12" clearance to grade or anticipated snow level. There are no means available to raise the terminal externally. If planning to use this terminal kit, see Figures 5 and 6.

The concentric vent termination kits may also be used in the vertical position.



A	VENT
B	COMBUSTION AIR
C	MAINTAIN 12" CLEARANCE (18" FOR CANADA) ABOVE HIGHEST ANTICIPATED SNOW LEVEL.
D	MAINTAIN 12" CLEARANCE (18" FOR CANADA) ABOVE HIGHEST ANTICIPATED SNOW LEVEL. MAXIMUM 24" ABOVE ROOF.

E	STRAP (FIELD SUPPLIED)
F	1" MAXIMUM
G	ELBOW (FIELD SUPPLIED)

HORIZONTAL TERMINATION OF COMBUSTION AIR AND EXHAUST VENT

Horizontal Combustion Air Termination

The combustion air termination is a 2" medium or long sweep 90° elbow pointing downward to prevent rain from readily entering the combustion air intake piping. An intake screening is optional; however, unless there is a compelling reason to use one, the screen may actually encourage the formation of rime ice, which could cause the intake to become blocked in certain weather conditions.

Horizontal Exhaust Vent Termination

Horizontal vents should pass through the exterior wall. Figure 8 shows a standard horizontal vent detail. Terminate the vent approximately 8" or more from the wall. If it is not possible to obtain proper clearance to grade or anticipated snow level by a straight out configuration, the termination may be raised by the use of a pair of 90° elbows.

The exhaust termination is normally a 2" 45° elbow or a medium or long sweep 90° elbow pointing within 45° of the downward position, away from the combustion air intake terminal.

If the required clearance to grade or anticipated snow level cannot be obtained with the "straight through" configuration, the exhaust pipe may be "periscoped" up to 24" to gain extra height. (Figure 9) In this case, the flue gases may be expelled horizontally. Use the same size pipe as the interior run and count the fittings and length as part of the total vent length.

If winter prevailing wind conditions are variable and likely to occasionally blow flue gases back in on the combustion air intake, the exhaust termination may be raised 18-24" above the combustion air intake terminal to take advantage of the natural buoyancy of the flue gases to help prevent re-circulation of the exhaust. (Figure 9)

NOTE

Length of pipe and elbows count toward maximum allowable vent length as shown in Table 4.

If the required clearance to grade or anticipated snow level cannot be obtained with the "straight through" configuration, the combustion air intake pipe may be "periscoped" up to 24" to gain extra height (Figure 9)

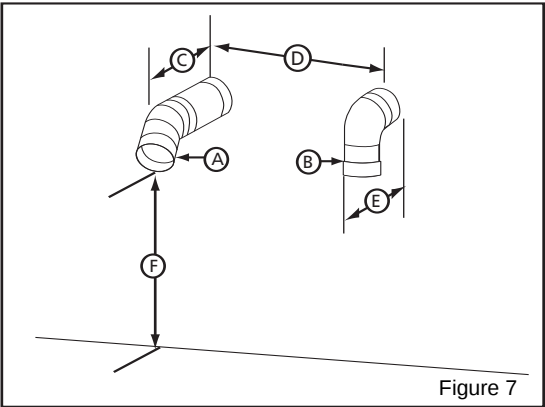


Figure 7

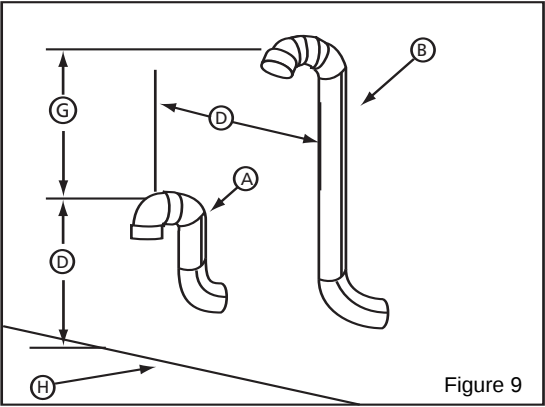


Figure 9

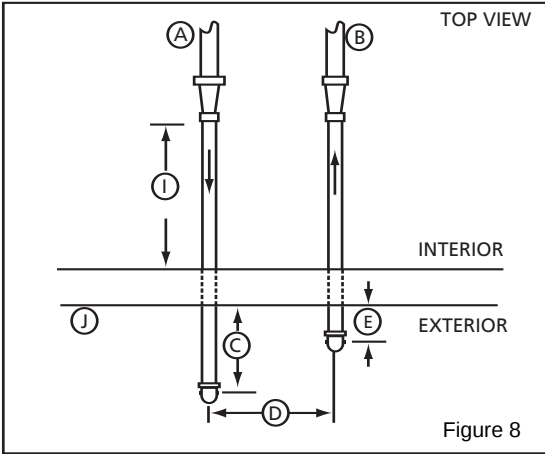


Figure 8

A	EXHAUST VENT
B	COMBUSTION AIR
C	8"
D	12"
E	2"
F	12" CLEARANCE ABOVE GRADE OR ANTICIPATED SNOW LEVEL
G	12" - 18"
H	GRADE OR ANTICIPATED SNOW LEVEL
I	18" MAX
J	OUTSIDE WALL

VERTICAL TERMINATION OF COMBUSTION AIR AND EXHAUST VENT

Vertical Combustion Air Termination

The combustion air termination is a pair of 2" medium or long sweep 90° elbows pointing downward to prevent rain from entering the combustion air intake piping.

If 3" piping is used, it should be reduced to 2" within 18" of the point where the pipe penetrates the roof. The termination inlet must be positioned within 3" of the companion exhaust piping.

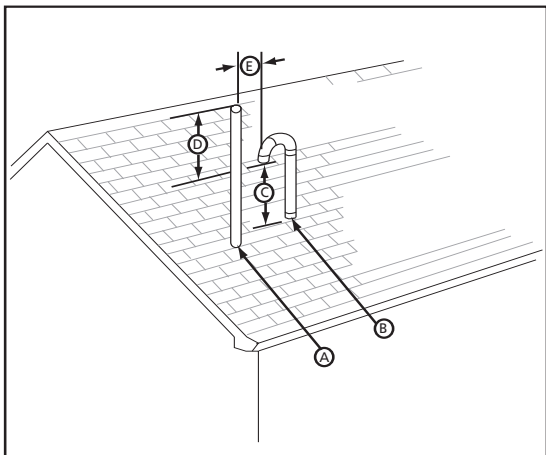
The combustion air inlet must be located a minimum of 12" above the anticipated snow level, and 12" below the exhaust outlet.

Vertical Exhaust Vent Termination

The exhaust vent may terminate in a vertical venting configuration through the roof.

No termination fitting is required if venting vertically through a roof. The end of the exhaust pipe must be 12" higher than the entrance of the combustion air intake terminal.

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



(A)	COMBUSTION AIR
(B)	EXHAUST
(C)	8"
(D)	12"
(E)	2"
(F)	12" CLEARANCE ABOVE GRADE OR HIGHEST ANTICIPATED SNOW LEVEL.

MULTIPLE VENTING

IMPORTANT

When installing multiple furnaces in close proximity, each requires dedicated combustion air and exhaust venting.

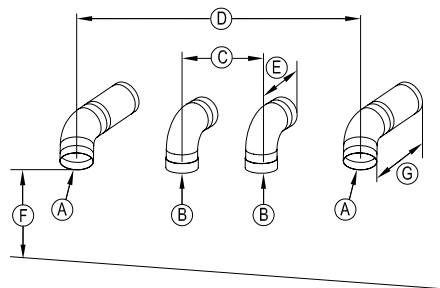
⚠ WARNING ⚠

COMMON VENTING IS PROHIBITED

If two of these furnaces are to be installed in close proximity, the combustion air intake and exhaust terminations may be installed as shown in Figures 10.

If more than two furnaces are being installed in close proximity, each additional combustion air intake and exhaust termination set must be installed a minimum of 4 feet apart. This is an exception to the 10 foot requirement mentioned in the "Location" section on the previous page. If using the concentric venting kits, two terminals may be centered 12 inches apart.

Figure 10



(A)	COMBUSTION AIR
(B)	EXHAUST
(C)	8"
(D)	12"
(E)	2"
(F)	12" CLEARANCE ABOVE GRADE OR HIGHEST ANTICIPATED SNOW LEVEL.
(G)	8"

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

The furnace, although designed as a direct vent type appliance, may be installed with the intake vent inside the structure. Non-direct vent installations require only an exhaust vent pipe.

Non-direct venting may be desirable when:

- Using outdoor combustion air is not practical
- The furnace is in a garage or attic
- Provisions are not made for routing of combustion air
- The outdoor environment may contain contaminants undesirable for combustion

⚠ WARNING ⚠

THIS FURNACE AND ANY OTHER FUEL BURNING APPLIANCE MUST BE PROVIDED WITH ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION OF THE FLUE GASES. MOST HOMES WILL REQUIRE THAT OUTSIDE AIR BE BROUGHT TO THE FURNACE AREA. FAILURE TO DO SO CAN CAUSE PERSONAL INJURY, OR DEATH FROM CARBON MONOXIDE POISONING.

⚠ DANGER ⚠

SOLVENT CEMENTS AND PRIMERS ARE HIGHLY FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND DO NOT ASSEMBLE NEAR HEAT SOURCE OR OPEN FLAME. DO NOT SMOKE. AVOID SKIN OR EYE CONTACT. OBSERVE ALL CAUTIONS AND WARNINGS PRINTED ON MATERIAL CONTAINERS. FAILURE TO FOLLOW THESE GUIDELINES MAY RESULT IN FIRE, EXPLOSION OR AS-PHYXIATION CAUSING PERSONAL INJURY OR LOSS OF LIFE.

Connecting a Non-Direct Vent to the Furnace

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 a downward pointing single elbow if supplying combustion air through the side.

⚠ WARNING ⚠

READ AND FOLLOW ALL INSTRUCTIONS IN THIS SECTION. FAILURE TO PROPERLY VENT THIS FURNACE CAN CAUSE CARBON MONOXIDE POISONING OR AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

IMPORTANT

If the furnace is to be installed in the vicinity of other fuel burning appliances, adequate combustion air must be available for the non-direct vent appliances. See Section 10 of this manual, "Determining Combustion Air."

IN THE U.S.A.

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

- The clearance from the bottom of the terminal to grade shall be 12" or increased to maintain 12" above the anticipated accumulated snow level.
- 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 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, soffit, under eave vent or gravity air inlet to the 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 above any forced air inlet located within 10 feet. Any fresh air or make-up air inlet, such as for a dryer or furnace area is considered a forced air inlet. 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.

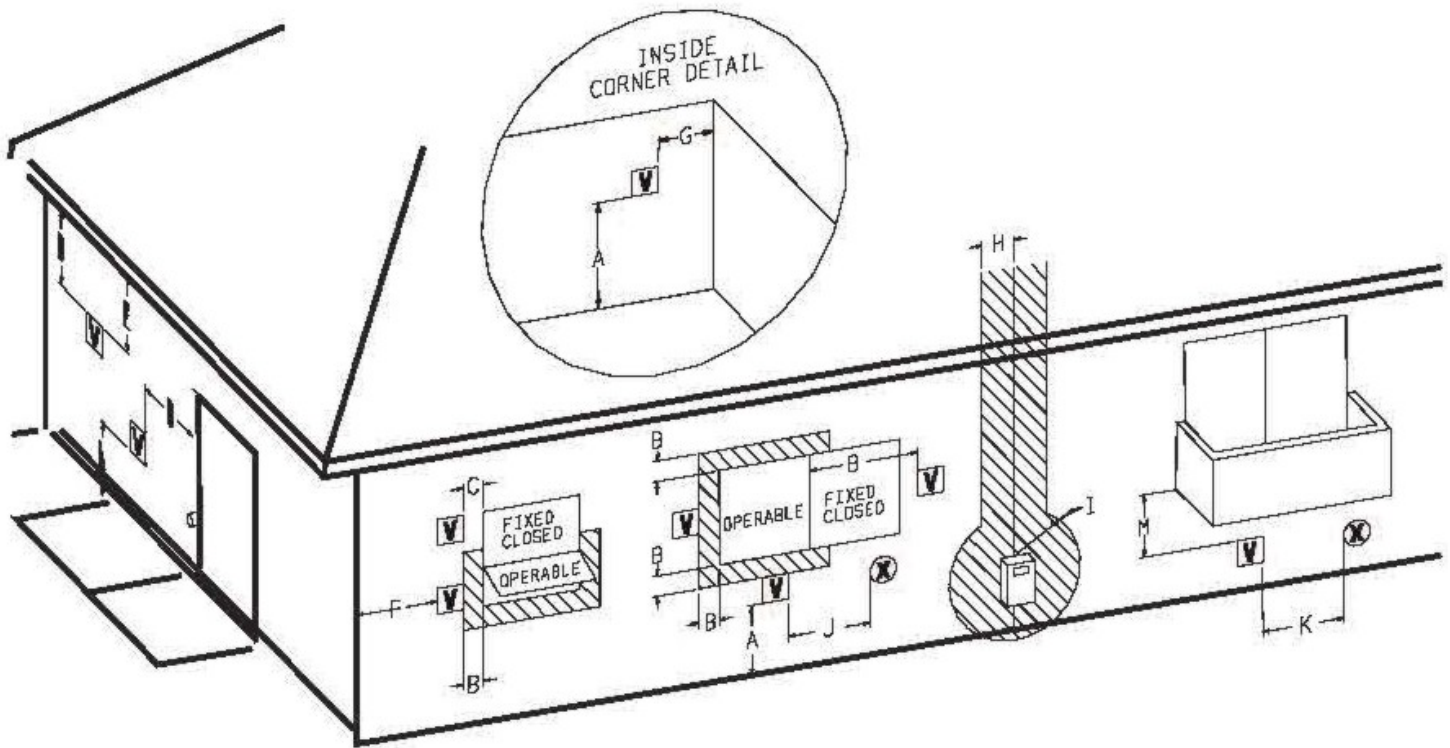
Recommended clearance from overhangs is a minimum of 1 foot vertically for each foot horizontally up to 6 feet.

IN CANADA

In addition to the general guidelines, in Canada, the non-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 centerline of the 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 the combustion air inlet of any other appliance;
- 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".

Other Than Direct Vent Terminal Clearances



V VENT TERMINAL

X AIR SUPPLY INLET

AREA WHERE TERMINAL IS NOT PERMITTED

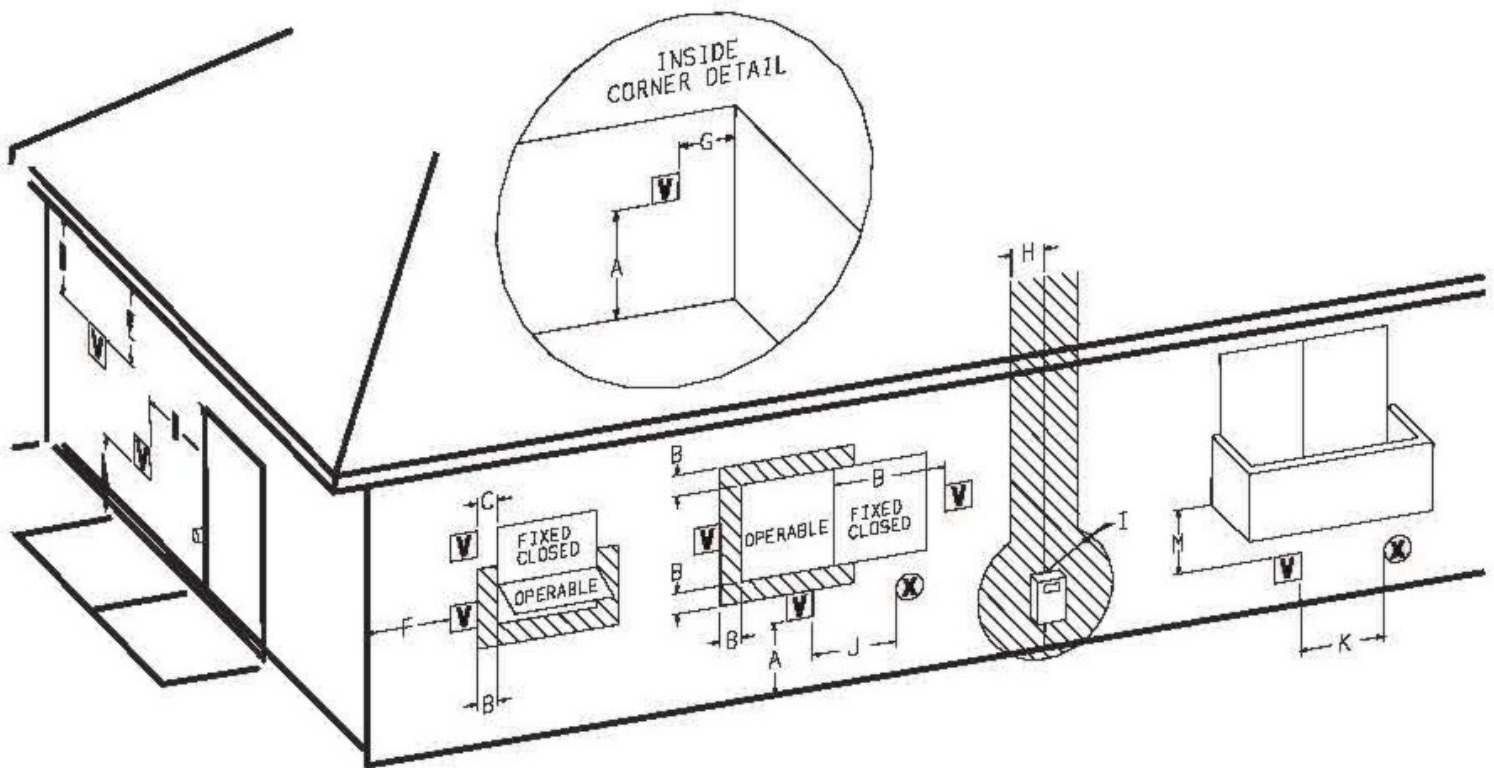
	Canadian Installations	US Installations
A = Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B = Clearance to window or door that may be opened	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	4 ft (121 cm) below or to side of opening; 1 ft (30 cm) above opening
C = Clearance to permanently closed window	*	*
D = Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	*	*
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 ft (91 cm) within a height 15 ft (458 cm) above the meter / regulator assembly	*
I = Clearance to service regulator vent outlet	3 ft (91 cm)	*
J = Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	4 ft (121 cm) below or to side of opening; 1 ft (30 cm) above opening
K = Clearance to a mechanical air supply inlet	6 ft (183 cm)	3 ft (91 cm) above if within 10 ft (305 cm) horizontally
L = Clearance above paved sidewalk or paved driveway located on public property	7 ft (213 cm) **	7 ft (213 cm)
M = Clearance under veranda, porch deck, or balcony	12 in (30 cm) ***	*

* For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B1 49.1, 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."

** A vent shall not terminate directly above a sidewalk or paveble Cell Footnoted 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.

Direct Vent Terminal Clearances



V VENT TERMINAL **X** AIR SUPPLY INLET **▨** AREA WHERE TERMINAL IS NOT PERMITTED

	Canadian Installations	US Installations
A = Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B = Clearance to window or door that may be opened	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and 100,000 Btu (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and 50,000 Btuh (15 kW), 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
C = Clearance to permanently closed window	*	*
D = Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	*	*
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 ft (91 cm) within a height 15 ft (457 cm) above the meter / regulator assembly	*
I = Clearance to service regulator vent outlet	3 ft (91 cm)	
J = Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	6 in (15 cm) for appliances 10,000 Btuh (3 kW), 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and 50,000 Btuh (15 kW), 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K = Clearance to a mechanical air supply inlet	6 ft (183 cm)	3 ft (91 cm) above if within 10 ft (305 cm) horizontally
L = Clearance above paved sidewalk or paved driveway located on public property	7 ft (213 cm) **	*
M = Clearance under veranda, porch deck or balcony	12 in (30 cm) ***	*

* For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B1 49.1, 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."

** 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.

CONDENSATE DRAINS

The furnace will condense as much as a half pound of water per hour (approximately 2 imperial quarts, 2½ U.S. quarts or 2¼ liters). It is necessary to make provisions for draining the condensate away.

The furnace is supplied with a drain trap assembly. See page 26, Figures 11-14 for possible locations of the drain trap.

The drain coupling on the inducer will work better if the drain holes are pointed down about 15 degrees. The drain hose supplied with the furnace is long enough to reach either side panel; however, it must be cut near the blower division panel and fitted with the elbows and clamps provided. This is to prevent kinking in the drain lines.

⚠ CAUTION ⚠

The two inlets to the drain trap are for vent pipe and condensate collection. The vent pipe inlet is smaller than the condensate collection inlet. Ensure that the drain hoses are properly connected.

DRAIN HOSE INSTALLATION

1. Select a drain trap location suitable for the orientation of the furnace and remove the corresponding knock-outs. See page 26, figures 11-14.
2. Affix the drain trap assembly to the exterior of the side panel when the furnace is upflow or downflow using two screws provided. For horizontal positions the installer will need to use the mounting bracket supplied and secure the bracket to the top panel. Remove two top panel screws and fasten bracket to top panel with removed screws. Secure trap assembly using screws provided to the mounting bracket.
2. Slide a hose clamp over the end of each hose.
3. Slide each hose over the appropriate inlet.
4. Slide each hose clamp to approximately 1/8" from the end of the hose.
5. Fasten each drain hose to its inlet by tightening the hose clamps.
6. Cut each drain hose near the blower division panel, at the point where kinking is able to occur.
7. Slide a hose clamp over the ends of the hose connecting to the vent drain and condensate drain.
8. Insert an end of the plastic elbow (supplied) into each hose.
9. Cut hose lengths from the remaining lengths of hose to fit between elbows and the drain trap inlets of both the vent drain and the condensate drain.
10. Slide a hose clamp over the ends of the hoses and secure to their appropriate connection. Slide each hose clamp to approximately 1/8" to 1/4" from the end of the hose then tighten.

⚠ CAUTION ⚠

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

DRAIN PIPING

Condensate from the outlet of the drain trap assembly must be conveyed to a floor drain, sump pit, or, if these are unavailable, to a condensate pump. If using a condensate pump, be sure that it is approved for use for furnace condensate.

⚠ CAUTION ⚠

Do not drain the condensate outdoors. Do not run the condensate line through areas where freezing might occur. Freezing of condensate can result in erratic furnace operation and in property damage.

The condensate drainage configuration requires a vent. It takes less than a one inch rise anywhere along the horizontal route of the drain tube to create a vapor lock, which will prevent condensate from draining away freely, and result in erratic furnace operation.

IMPORTANT

If an air conditioning evaporator coil drain is to share the furnace drain line, it should be connected with a tee fitting down-stream from the trap. Do not connect the evaporator coil condensate drain upstream of the furnace drain trap assembly.

FIGURES 11-14 : CONDENSATE TRAP / CONDENSATE DRAINAGE WITH VENT. (NEXT PAGE)

HORIZONTAL FLOW RIGHT

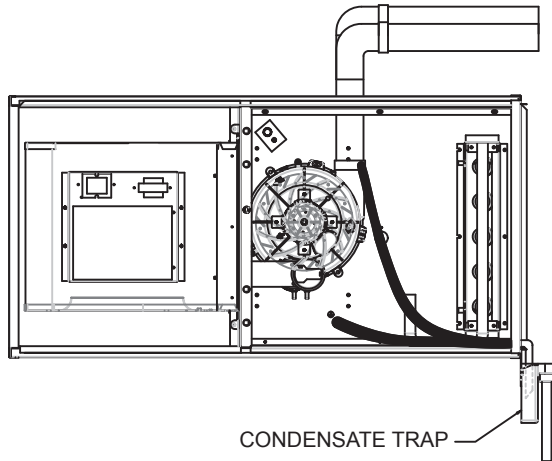


FIGURE 11

HORIZONTAL FLOW LEFT

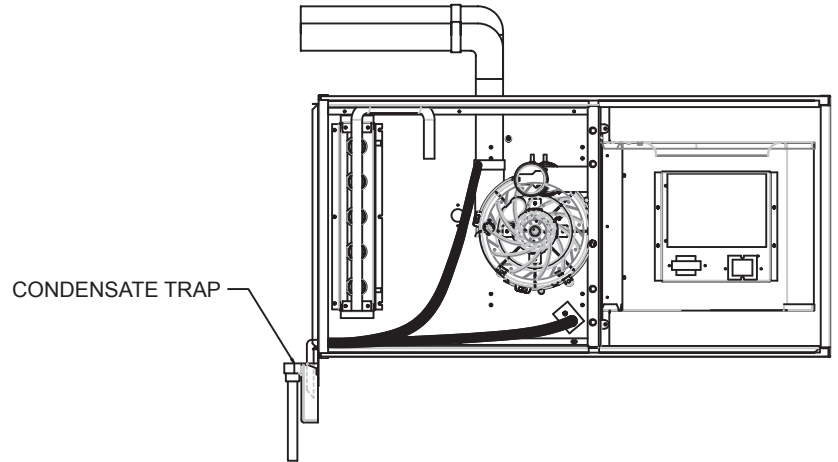


FIGURE 12

UPFLOW

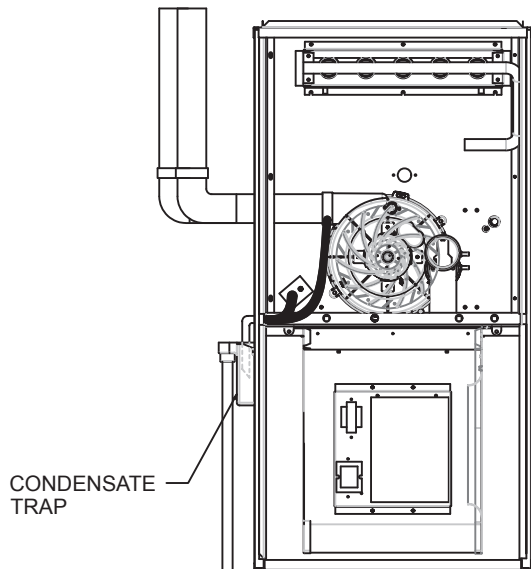


FIGURE 13

DOWNFLOW

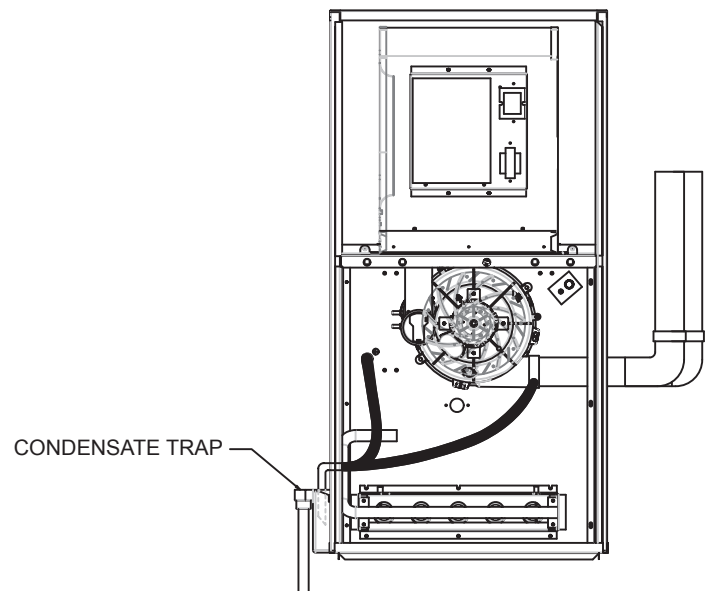


FIGURE 14



CONDENSATE DRAIN INSTALLATION

1. Identify which side the condensate drain trap will be installed on the unit. Condensate trap may be mounted on either the left or right side of the unit, when looking at the front. Some installation positions will only allow one option to mount the drain.
2. Using the appropriate template (left vs. right), mark the mounting and drain holes.
3. Drill holes and de burr, if necessary
4. Secure the condensate drain trap to the side of the furnace using the mounting holes that were just drilled
5. Install one rubber grommet (provided) into each of the drain holes and then insert the 90 degree (black) drain tubes so that they extend down into the top of the drain trap.

Inside the top front cover, connect the drain tubing from the flue connector to one of the drain pipes that were just installed.

Do the same for the second drain pipe located in the lower right of the inner front panel. 1/2 ID tubing should be used. It may be necessary to secure the tubing with a hose clamp depending on the fit. Be cautious not to over tighten the clamp.

7. Pipe the remainder of the drain to the condensate pump using PVC pipe. A 3/4" PVC coupling will fit over the drain connection on the trap.

IMPORTANT

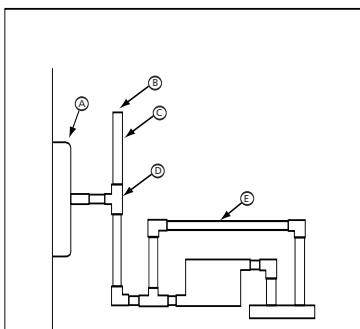
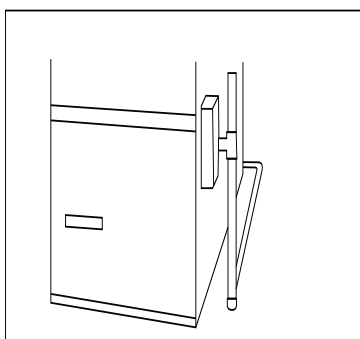
The condensate drain trap assembly should be full of water before starting the furnace.

CONDENSATE NEUTRALIZERS

Some local codes may require the use of a condensate neutralizer. If the furnace condensate is to be routed to a septic system, it may be advisable to use a condensate neutralizer.

Condensate neutralizers such as the Ward Industries 90+ Neutralizer are available through heating supply wholesalers.

When condensate neutralizers are used, it is advisable to install it with an overflow bypass tube.



- A - Condensate Trap Assembly
- B - Open to Atmosphere
- C - Standpipe (1/2" PVC)(Minimum 1" Higher than Trap Assembly)
- D - Tee(1/2" PVC)
- E - Overflow Bypass Tube

GAS SUPPLY

⚠ WARNING ⚠

THIS FURNACE IS FACTORY EQUIPPED TO BURN NATURAL GAS ONLY.

CONVERSION TO L.P. GAS REQUIRES SPECIAL KIT .

FAILURE TO USE THE PROPER CONVERSION KIT CAN CAUSE FIRE, EXPLOSION, CARBON MONOXIDE POISONING, PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

⚠ CAUTION ⚠

CONVERSION OF THIS FURNACE REQUIRES SPECIALIZED EQUIPMENT. A TRAINED AND QUALIFIED INSTALLER, SERVICE AGENCY OR GAS SUPPLIER MUST COMPLETE CONVERSION.

⚠ CAUTION ⚠

CONNECT THIS FURNACE ONLY TO GAS SUPPLIED BY A 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. THIS FURNACE CANNOT OPERATE PROPERLY OR SAFELY USING FUELS OUTSIDE NORMAL COMMERCIAL STANDARDS.

Gas Piping

In the United States, the gas piping should be installed in accordance with ANSI Z223.1 / NFPA 54 and any local codes. In Canada, the gas piping should be installed in accordance with CAN/CSA-B149, and in accordance with any local codes.

The gas piping may enter the furnace from either side.

Install a BMI ground joint union between the gas valve and the side panel to allow easy removal of the burner for service purposes.

IMPORTANT

ALWAYS USE A BACKUP WRENCH TO PREVENT TWISTING OF THE CONTROL ASSEMBLY AND GAS VALVE. ANY STRAINS ON THE GAS VALVE CAN AFFECT POSITIONING OF THE ORIFICES RELATIVE TO THE BURNERS. THIS COULD RESULT IN FAULTY BURNER OPERATION.

Install a manual gas shutoff valve and drip leg as close to the furnace as possible. Some local codes call for the manual gas shutoff valve to be located between 4 to 5 feet above floor level to prevent tampering by small children. Ensure that the valve is readily accessible.

If local codes allow the use of a flexible gas appliance connector, always use a new listed connector. Do not use a connector which has previously serviced another gas appliance.

⚠ CAUTION ⚠

ENSURE THAT THE MANUAL SHUTOFF VALVE AND GAS VALVE ARE NOT SUBJECTED TO HIGH PRESSURES.

DISCONNECT THE MANUAL SHUTOFF VALVE AND GAS VALVE DURING ANY PRESSURE TESTING THAT EXCEEDS 1/2 P.S.I.G. (3.45 KPA).

The natural gas inlet supply pressure should be 5 to 10.5 inches water column (w.c.); 7 inches w.c. is recommended.

The L.P. gas inlet supply pressure should be 11 to 13 inches w.c.; 12 inches w.c. is recommended.

These pressures must be maintained while all other gas fired appliances are operating at maximum conditions.

Do not exceed 13 inches w.c. inlet pressure with LP. Do not exceed 10.5 inches w.c. inlet pressure with NG.

The gas valve has an adjustable internal regulator for controlling burner manifold pressure. Burner manifold pressure is listed on the furnace rating plate.

Leak Testing

All new gas piping installations should be pressure tested as specified by CAN/CGA-B149 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 the manual shutoff valve to the furnace gas valve for example, should be leak tested using an electronic combustible gas detector, a commercially prepared leak detector such as Gas Leak Detector® or Search®, or other locally approved method. A leak detector solution can be prepared by mixing a small quantity of dish detergent with water and daubing it onto the gas piping and connections.

⚠ WARNING ⚠

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 ADHERE TO THIS WARNING CAN CAUSE A FIRE OR EXPLOSION RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY, OR LOSS OF LIFE.

CONVERSIONS

High Altitude

In the United States, the modifications for high altitude are based on a 4 percent reduction of input capacity for every 1000 feet above sea level. Table on page 30 illustrates the impact of altitude for selected elevations. Ratings shown apply to the highest elevation in range.

Consult with local fuel suppliers or authorities to determine local regulations or customs.

In Canada, the furnace may be converted for high altitude (2000 - 4500 feet) by changing the burner orifices. see Table on page 30.

Natural to L.P. Gas

This series furnace is manufactured as a natural gas (sea level) appliance. It may be converted to L.P. gas with the use of Kit (contact manufacturer for availability).

The kit contains the orifices needed for all models, the regulator spring for the gas valve, and a label to affix adjacent to the appliance rating plate to alert subsequent service technicians of the conversion.

L.P. to Natural Gas

Although the furnace is manufactured initially as a natural gas appliance, if after an L.P. Gas conversion it becomes necessary to convert back to natural gas, and if the original parts are unavailable, Kit may be purchased. It is similar in nature and content to the L.P. Gas conversion kit.

Conversion Steps

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

Turn off gas supply to the furnace if applicable.

1. Shut off electrical power to the furnace if applicable.
2. Remove the upper front door to expose the gas train and burner assembly.
3. Unfasten the ground joint union between the gas valve and gas supply piping if applicable.
4. Unfasten the burner manifold pipe from the burner assembly. It is held in place by 2 screws on either end of the manifold pipe.
5. Remove the existing orifices with a 7/16 inch socket, box or open-end wrench. Install the replacement orifices. The orifice spuds are brass, and do not normally require pipe dope. A light grease may be used to lubricate the threads. The orifice spuds have tapered threads; do not over-tighten them.

If completing a fuel conversion, remove the protective screw cap from the gas valve regulator adjustment. Remove the regulator adjustment screw by turning it counterclockwise. Remove the existing regulator springs.

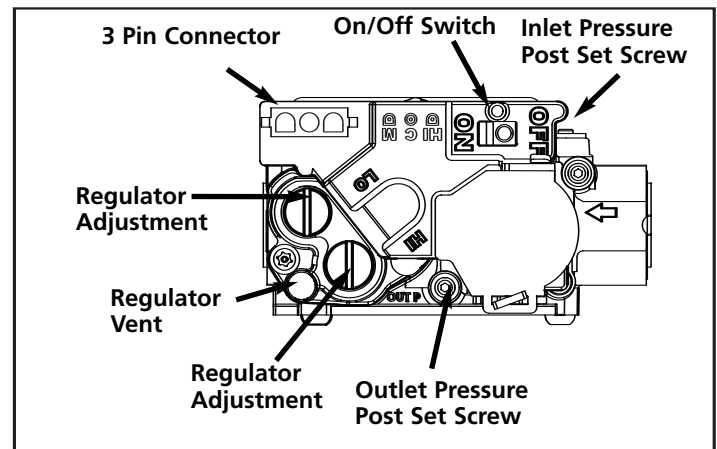
6. Install the new regulator springs.

NOTE

If converting the gas valve, the regulator spring is tapered. The tapered end (small end) is inserted back into the gas valve regulator adjustment cavity.

7. Reinstall the adjustment screw. Give it 3 full clockwise turns initially. Do not reinstall the protective screw cap yet.
8. Reinstall the burner manifold pipe assembly following steps 4, 5, and 6 in reverse order.

GAS VALVE



For USA

HIGH ALTITUDE SPECIFICATIONS

Rating Plate Input BTU/hr	Altitude(ft)	High Fire		Low Fire		Orifice		Qty
		Input (BTU/hr)	Output (BTU/hr)	Input (BTU/hr)	Output (BTU/hr)	Natural Gas (mm)*	LP Gas (mm)**	
54,000	0-2000	54000	51300	35100	33350	1.95mm	1.20mm	3
	2000-3000	47520	45144	30888	29344	1.90mm	1.15mm	
	3000-4000	45360	43092	29484	28010	1.90mm	1.10mm	
	4000-5000	43200	41040	28080	26676	1.85mm	1.10mm	
	5000-6000	41040	38988	26676	25342	1.85mm	1.10mm	
72,000	0-2000	72000	68400	46800	44460	1.95mm	1.20mm	4
	2000-3000	63360	60192	41184	39125	1.90mm	1.15mm	
	3000-4000	60480	57456	39312	37346	1.90mm	1.10mm	
	4000-5000	57600	54720	37440	35568	1.85mm	1.10mm	
	5000-6000	54720	51984	35568	33790	1.85mm	1.10mm	
90,000	0-2000	90000	85500	58500	55600	1.95mm	1.20mm	5
	2000-3000	79200	75240	51480	48906	1.90mm	1.15mm	
	3000-4000	75600	71820	49140	46683	1.90mm	1.10mm	
	4000-5000	72000	68400	46800	44460	1.85mm	1.10mm	
	5000-6000	68400	64980	44460	42237	1.85mm	1.10mm	
108,000	0-2000	108000	102600	70200	66690	1.95mm	1.20mm	6
	2000-3000	95040	90288	61776	58687	1.90mm	1.15mm	
	3000-4000	90720	86184	58968	56020	1.90mm	1.10mm	
	4000-5000	86400	82080	56160	53352	1.85mm	1.10mm	
	5000-6000	82080	77976	53352	50684	1.85mm	1.10mm	

*MANIFOLD PRESSURE NATURAL GAS=3.5 INWC

**MANIFOLD PRESSURE L.P. GAS=10.5 INWC

For- CANADA

HIGH ALTITUDE SPECIFICATIONS

Rating Plate Input BTU/hr	Altitude(ft)	High Fire		Low Fire		Orifice		Qty
		Input (BTU/hr)	Output (BTU/hr)	Input (BTU/hr)	Output (BTU/hr)	Natural Gas (mm)*	LP Gas (mm)**	
54,000	0-2000	54000	51300	35100	33350	1.95mm	1.20mm	3
	2001-4500	48600	46170	31590	30011	1.90mm	1.15mm	
72,000	0-2000	72000	68400	46800	44460	1.95mm	1.20mm	4
	2001-4500	64800	61560	42120	40014	1.90mm	1.15mm	
90,000	0-2000	90000	85500	58500	55560	1.95mm	1.20mm	5
	2001-4500	81000	76950	52650	50018	1.90mm	1.15mm	
108,000	0-2000	108000	102600	70200	66690	1.95mm	1.20mm	6
	2001-4500	97200	92340	63180	60021	1.90mm	1.15mm	

*MANIFOLD PRESSURE NATURAL GAS=3.5 INWC

**MANIFOLD PRESSURE L.P. GAS=10.5 INWC

SETTING THE MANIFOLD (Outlet) GAS PRESSURE (36G Valve Pressure Check Kit)

The manifold outlet pressure is specified on the rating plate.

1. Shut off the gas upstream of valve and move valve switch to OFF.
2. Using the 3/32 inch hex wrench that is included in the valve pressure check kit, rotate outlet pressure tap screw one revolution counter-clockwise.
3. Attach the 5/16 inch hose that is included in the valve pre check kit to the outlet pressure boss of the valve. Hose should overlap boss 3/8 inch.
4. Connect 5/16 inch side of connector that is included in the valve pressure check kit to the hose on outlet boss. Connect 1/4 inch side of connector to manometer hose.
5. Turn on gas supply to valve and move valve switch to the ON position.
6. Turn on furnace. For the two stage valve the low rate must be adjusted first and then the high rate. This can be done by wiring the Thermostat so that only low fire runs. Turn off the 1-stage T-stat mode on the control board if set!

Remove regulator cover screw from the high or low outlet pressure regulator adjust tower and turn screw clockwise to increase pressure, or counterclockwise decrease pressure. Always adjust regulator as specified on the furnace rating label.

Natural Gas: Low outlet pressure is limited to 1 to 4" W.C. range and high outlet pressure 2 to 5" W.C. range. The valve cannot be adjusted outside this range and the high outlet pressure setting must always be set at least 1" above the low outlet pressure setting.

LP Gas: Low outlet pressure is limited to 6 to 10" W.C. range and high outlet pressure in the 8 to 12" W.C. range. The valve cannot be adjusted outside this range and the high outlet pressure setting must always be set at least 2" above the low outlet pressure setting.

7. Using a leak detection solution check for leaks at hose connections.

DANGER

SHUT OFF GAS AND FIX LEAKS IMMEDIATELY BEFORE PROCEEDING.

8. Read manometer. This reading is the system outlet/supply pressure.
9. Follow manufacturer's instructions to adjust outlet/supply pressure, if necessary.
10. Shut-off gas supply upstream of valve and move the valve switch to the OFF position.
11. Remove manometer and hose from outlet boss.

12. Turn outlet pressure tap screw clockwise to seal the pressure point using the supplied hex wrench. Tighten to 13 in-lbs. minimum. Return all pressure regulator caps.
13. Turn on gas supply to valve and move valve switch to the ON position.
14. Turn on furnace following manufacturer instructions.
15. Using leak detection solution check for leaks at outlet pressure tap. Shut off gas and fix all leaks immediately before proceeding.

If problems were encountered with obtaining enough pressure on the manifold, first examine the gas piping system to ensure that it is correctly sized. Pipe sizing is specified in ANSI Z223.1/ NFPA 54 in the U.S., or the B148 Natural Gas and Propane Installation Code in Canada.

SETTING THE SUPPLY GAS PRESSURE (36G Valve Pressure Check Kit)

1. Back inlet pressure test screw (inlet/outlet pressure boss) out one turn (counterclockwise, not more than one turn) with a 3/32 inch Allen wrench.
2. Attach a hose and manometer to the inlet pressure boss of the valve. The manometer should be capable of reading 0 -15 inches water column.
3. Turn on the gas supply and electrical power to the furnace.
4. Start the furnace, and any other gas burning appliances on the same gas piping system.
5. Note the gas inlet pressure. It should be: Natural Gas: 5 to 10.5 inches water column L.P. Gas: 11 to 13 inches water column.
6. If working on a natural gas system, contact the gas utility. They may insist on any service regulator adjustments being made by their own staff.
7. Adjustments are made in a similar fashion as the gas valve regulator. Turn the adjustment screw clockwise to increase manifold pressure, or counter clockwise to reduce manifold pressure. When the correct pressure has been established, securely replace the service regulator protective screw cap.
8. Shut off the gas at the manual valve and remove manometer hose from inlet pressure boss.

DANGER

A TRAINED, QUALIFIED TECHNICIAN MUST DO ALL REGULATOR ADJUSTMENTS. IMPROPER MODIFICATIONS OR ADJUSTMENTS CAN RESULT IN FIRE OR EXPLOSION CAUSING PROPERTY DAMAGE, SEVERE PERSONAL INJURY OR LOSS OF LIFE.

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

ELECTRICAL SPECIFICATIONS

Before proceeding with the electrical connections, ensure that the available electrical supply is compatible with the voltage, frequency, and phase listed on the appliance rating plate.

All furnaces are rated 120 VAC, 60 Hz, 1 phase. The amperage rating is indicated on the furnace rating plate.

Each furnace requires a dedicated overcurrent device either a circuit breaker or a Type D, time delay fuse. It is permissible to connect furnace accessories such as humidifier transformers, condensate pumps and electronic air cleaners. If adding accessory equipment to the furnace circuit, ensure that the combined amperages listed on the appliance rating plates do not exceed the rating of the over current device.

DANGER

SHUT OFF ELECTRICAL POWER AT THE FUSE BOX OR SERVICE PANEL BEFORE MAKING ANY ELECTRICAL CONNECTIONS. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

DANGER

THE FURNACE CABINET MUST HAVE AN UNINTERRUPTED GROUND.

A GROUND WIRE IS PROVIDED IN THE ELECTRICAL JUNCTION BOX.

DO NOT USE GAS PIPING AS A GROUND.

FAILING TO GROUND THE FURNACE PROPERLY CAN RESULT IN ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR DEATH.

In the United States, all electrical work must be in accordance with the latest edition of the National Electrical Code, ANSI / NFPA 70, in 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.

Although a suitably located circuit breaker may serve as a service switch, a separate service switch is recommended.

A separate service switch is necessary if the circuit breaker is in a location where accessing it would require getting close to the furnace, or if the furnace is located between the main electrical panel and the entry to the furnace room. The furnace switch (service switch) should be clearly labeled and installed in a location where it is not likely to be mistaken as being a light switch or similar control.

Furnace Connection

120V: The furnace is shipped fully wired except for the connections to the house wiring. The furnace power connections are made in a junction box inside the blower compartment. The junction box is factory installed on the left hand side; however, it may be moved to the right hand side. The junction box contains a BLACK wire to be connected with L1 (hot), a WHITE wire to be connected with L2, the Neutral, and a GREEN wire to be connected to the ground.

IMPORTANT

USE COPPER CONDUCTORS ONLY

If the junction box must be moved to the right hand side:

1. Unfasten the junction box from the left hand side.
2. Remove the right side panel knockout.
3. Remove the junction box cover hook screw and reinstall it on the opposite side of the box.
4. Fasten the junction box to the right hand panel.

IMPORTANT

L1 (hot) and L2 (Neutral) polarity must be observed when making field connections to the furnace. The ignition control may not sense flame if L1 and L2 are reversed. The ground is also essential.

IMPORTANT

The furnace shall be installed so the electrical components are protected from water.

WARNING

THIS FURNACE IS EQUIPPED WITH A BLOWER DOOR SAFETY SWITCH. DO NOT DISABLE THIS SWITCH. FAILURE TO FOLLOW THIS WARNING CAN RESULT IN ELECTRICAL SHOCK, PERSONAL INJURY, OR LOSS OF LIFE.

CAUTION

ELECTRICAL WIRING AND COMPONENTS MUST BE PROTECTED FROM MOISTURE, INCLUDING WATER AND CONDENSATE.

Low Voltage Wiring

The low voltage terminals are located on the control board mounted to the blower assembly; see Figure 15 on page 37.

The furnace is prewired for air conditioning. Insert the thermostat and air conditioner contactor low voltage wiring through the bushing provided in the side panel. Route the control wiring through the blower compartment to the 24 volt terminal screws.

Thermostat

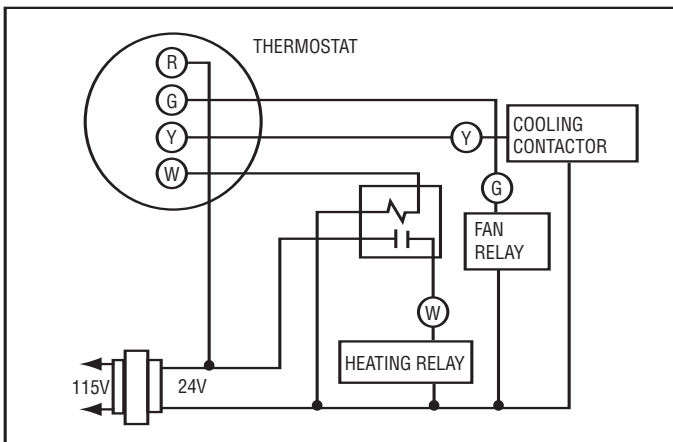
The room thermostat must be compatible with the integrated control in the furnace. Electromechanical thermostats should be rated 30 V / 1.5 amps.

Most electronic or microprocessor based thermostats except those with "current robbing" circuits should work satisfactorily. Consult the instructions of the thermostat manufacturer for technical and installation details.

Most compatibility problems can be overcome by the use of an isolation relay. The isolation relay should be SPST with a 24-volt coil. The switch ratings should be a minimum of 0.5 amps; see figure on next page.

The thermostat and control wiring should be a 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.

ISOLATION RELAY



THERMOSTAT LOCATION

The thermostat should be located approximately 5 feet above the floor, on an inside wall where there is good natural air circulation, and where the thermostat will be exposed to average room temperatures. Avoid locations where the thermostat will be exposed to cold drafts, heat from nearby lamps or appliances, exposure to sunlight, heat from inside wall stacks, etc.

THERMOSTAT HEAT ANTICIPATOR SETTING: 0.45 AMP (White-Rodgers) See page 39 for information on connecting optional accessories such as electronic air cleaners and power humidifiers.

ELECTRICAL WIRING AND COMPONENTS MUST BE PROTECTED FROM MOISTURE, INCLUDING WATER AND CONDENSATE.

DEHUMIDIFICATION OPTION

The controller has a dehumidification option. When high humidity is sensed (requires a 24 volt Humidistat that opens on high humidity) the air flow is reduced to increase condensing. To activate, the jumper labeled "DEHUM" must be moved to the "yes" position.

AIRFLOW

⚠ WARNING ⚠

ALL CONTROLLER JUMPER CHANGES MUST BE MADE WITH POWER DISCONNECTED TO THE FURNACE.

The ECM TM blower is preprogrammed from the factory to hold constant flow. (Replacement motors must have the correct part number and can only be ordered from the furnace manufacturer.) Changing the Taps allow adjustment for various size A/C tonnage as well as an adjustment in flow. Changing the Heating Tap changes the Temperature Rise in about 5 F increments. The Taps are in a row of jumper labeled "COOL", "HEAT" and "ADJUST".

Table on page 36 shows the recommended taps for heating and cooling speed. Heating Tap A is factory set for heating speed. If the Adjust Tap is used for cooling then the heating speed should be adjusted to counter the effects of the adjustment tap. Rule of thumb: The Heating Tap will be the same as the "ADJUST" Tap.

⚠ WARNING ⚠

Make adjustments to the controller with the electrical power off.

START UP PROCEDURES

This furnace is equipped with a hot surface ignition (HSI) device. Each time that the room thermostat calls for heat, the HSI lights the main burners directly. See the lighting instructions on the furnace.

To Start The Furnace:

1. Remove the burner compartment access door.
2. Shut off the electrical power to the furnace and set the room thermostat to its lowest setting.
3. Ensure that the ignition system control switch on the gas valve is in the "ON" position.
4. Replace the burner compartment access door.
5. Restore electrical power to the furnace.
6. Set the room thermostat to a point above room temperature to light the furnace.
7. After the burners are lit, set the room thermostat to the desired temperature.

To Shut Down The Furnace:

1. Set the room thermostat to its lowest setting.
2. Remove the burner compartment access door.
3. The ignition system control switch on the gas valve may be switched to the "OFF" position.
4. The furnace appliance shutoff valve may be closed if desired.

⚠ WARNING ⚠

SHOULD OVER HEATING OCCUR, OR THE GAS BURNERS FAIL TO SHUT OFF, CLOSE THE MANUAL GAS VALVE FOR THE FURNACE BEFORE SHUTTING OFF THE ELECTRICAL POWER TO THE FURNACE. FAILURE TO DO SO CAN CAUSE AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

Sequence of Operation

1. Room temperature drops causing the room thermostat heating W1 contacts to close.
2. The inducer blower is energized at high speed and the control waits for the low pressure switch contacts to close.
3. Once the low pressure switch contacts close, a 15-second pre-purge is initiated. Then the inducer changes to low speed and the 120VAC ignitor is powered.
4. After the prepurge period, the hot surface ignitor heats up; 10 seconds on a first try, maximum 14 seconds on a subsequent retry.

6. The circulating fan begins 30 seconds after flame is sensed.
7. Furnace continues to run in this state until a call for second stage heat (W1 and W2) after a call for first stage heat will energize the inducer at high speed and the circulator high heat. The second stage pressure switch contacts will close and energize the second stage gas valve (high fire).

8. When the second stage of the thermostat is satisfied, the inducer motor is reduced to low speed and the second stage gas valve is de-energized. When the first stage of the thermostat is satisfied, the first stage gas valve is de-energized and the HEAT delay-to-fan-off begins timing.

With the thermostat heating contacts open, the burner flames extinguish immediately, the induced blower stops after a 5 second postpurge period. The pressure switch contacts open.

9. The circulating fan continues to run until timed out, depending on the program settings.

Sequence if the furnace does not light up or detect flame:

1. If flame is not detected during the trial-for-ignition period, the gas valve is de-energized, the ignitor is turned off, and the control goes into the "retry" sequence.

The "retry" sequence provides a 30-second wait with the inducer interpurge following an unsuccessful ignition attempt (flame not detected). After this wait, the ignition attempt is restarted. Two retries will be attempted before the control goes into system lockout.

If the flame is established for more than ten seconds after ignition, the controller will clear the ignition attempt (or retry) counter. If flame is lost after 10 seconds, the control will restart the ignition sequence.

A momentary loss of gas supply, flame blowout, or a shorted or open condition in the flame probe circuit will be sensed within 2 seconds. The gas valve will de-energize and the control will restart the ignition sequence. Recycles will begin and the burner will operate normally if the gas supply returns, or the fault condition is corrected, before the last ignition attempt. Otherwise, the control will go into system lockout.

If the control has gone into system lockout, it may be possible to reset the control by a momentary power interruption of 10 seconds or longer.

Room temperature drops causing the room thermostat heating contacts to close.

2. If pressure switch contacts are closed; and have failed to open since the last cycle, all subsequent steps will fail to occur.
3. The induced blower begins a prepurge cycle of 15 seconds.
4. The pressure switch contacts close. The pressure switch contacts must close within 30 seconds. If they fail to do so, the induced blower will shut off for a five minute period, then the sequence will begin again at Step 2.

5. After the prepurge period, and after pressure switch contacts have closed, the hot surface igniter heats up; 5 seconds on a first try, 10 seconds on a subsequent retry.

Additional information is available in the Troubleshooting section that starts on page 38 of this manual.

Checking Furnace Input

- The natural gas supply pressure should be a maximum of 10.5 inches w.c. and minimum of 5 inches w.c.
- The burner manifold pressure is normally set to 3.5 inches for high fire input, 1.8 inches for low fire input
- The input rating of the furnace is based on 1075 BTU/ ft³ gas with a specific gravity of 0.60

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

For example, natural gas with a 1000 BTU/ ft³ heating value will reduce the input to 93% of the rated input. Natural gas with a 1100 BTU/ ft³ heating value will increase the input to approximately 103% of the rated input. This is not usually a problem; however, adjustments to compensate for this can be made by minor adjustments to the burner manifold pressure or by changing the burner orifice size.

In the previous example where the heating value of the gas is 1100 BTU/ ft³, the burner manifold pressure can be reduced .3" w.c. to 3.4" w.c. which is within the ± 0.30 inches w.c. specification to bring the input into compliance. Refer also to *Setting the Gas Pressure* section, and contact the fuel supplier for specific gas heating content values.

If using a gas meter to check the furnace input, be sure that all gas fired appliances other than the furnace are off during the test.

Any adjustments to the burner manifold pressure should be carried out with the use of a manometer or calibrated magnehelic gauge. Do not adjust the gas valve pressure regulator more than ± 0.30 inches water column.

(See next page for formula.)

The formula for determining the furnace input via the gas meter test dial is:

$$\text{Input} = \frac{\text{Heating Value of Gas} \times 3000}{\text{Time in Sec. for 1 cu. ft.}}$$

Where:

Input is expressed in BTU/Hr.

Heating value of the gas is expressed in BTU/ ft³

Time means time required for the test dial to indicate 1 ft³/sec.

If using a gas meter with SI (metric) units:

$$1 \text{ ft}^3 = 0.0283 \text{ m}^3$$

$$1 \text{ m}^3 = 35.315 \text{ ft}^3$$

$$0.01 \text{ m}^3 = 0.3531 \text{ ft}^3$$

$$0.5 \text{ m}^3 = 1.766 \text{ ft}^3$$

IMPORTANT: NEVER ADJUST THE INPUT OF THE FURNACE TO EXCEED THE INPUT SHOWN ON THE RATING PLATE.

Circulating Air Blower And Temperature Rise Check

The HG95E series 2-stage gas furnace is supplied with a variable speed circulation air blower motor that will supply a constant airflow when operated within the external static pressure limits of the unit. One of the benefits of a variable speed circulation air blower is soft starting and stopping. The motor will ramp up to normal operating speed gradually. This will minimize noise and increase comfort by eliminating the initial blasts of cooler air encountered with constant speed motors. At the end of a heating or cooling cycle, the variable speed motor will slowly ramp down after the blower off delay timer expires. If the fan is set to operate as a continuous blower, the motor will slowly ramp down to the airflow set for that mode.

Temperature Rise Check

When the duct system is complete and the air filters are in place, determine the air temperature rise of the furnace.

Insert a duct thermometer in the supply air duct. The thermometer should be placed as close as practical to the furnace, but out of the "line of sight" of the heat exchanger so to prevent a false reading due to radiated heat. Ensure that the thermometer is within the duct air-stream. Avoid locations such as the inside radius of an elbow, etc.

Insert a duct thermometer into the return duct as close to the furnace as possible. Ensure that the thermometer location will be unaffected by humidifier bypass ducts, etc. Choose a location that ensures the thermometer will be within the air-stream of the duct. Operate the furnace long enough to obtain a steady state condition.

When the two thermometers have stabilized, compare the two readings. Subtract the return air duct temperature from the supply air duct temperature. This difference is the temperature rise.

A temperature rise within 35-65 degrees F is acceptable when the furnace is operating with both stages of heat on. If a higher temperature rise is desired, refer to the dip switch settings for "Heating". This can be adjusted to Nominal-Plus to reduce the air temperature rise or Nominal-minus to increase the air temperature rise.

AIRFLOW

For proper furnace operation, airflow over the heat exchanger is of utmost importance. Insufficient airflow accelerates metal fatigue and failure in the heat exchanger and excessive airflow promotes accelerated corrosion of the heat exchanger.

IMPORTANT: Do not bypass this step of the start up procedures.

Calculating Airflow

There are circumstances where it may be desirable to know the airflow delivery through the duct system, such as when estimating the amount of airflow available for air conditioning. This can be done by direct measurement with electronic or sloped manometers and velometers, or by using the formula below.

$$\text{Airflow (CFM)} = \frac{\text{Bonnet Output}}{1.085 \times \Delta T}$$

Where:

CFM is airflow in cubic feet per minute

ΔT is the temperature rise

Bonnet output is the furnace output capacity from the rating plate.

NOTE: The bonnet output will vary directly with the input. If the actual input is below the stated input, the output will be reduced in the same ratio.

Adjusting Dip Switches

If the blower speeds require adjusting, follow these steps:

WARNING

DISCONNECT THE ELECTRICAL SUPPLY TO THE FURNACE BEFORE ATTEMPTING TO CHANGE THE BLOWER SPEED. FAILURE TO DO SO COULD RESULT IN ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

1. Remove the blower compartment door.
2. Refer to the tables next page for adjusting DIP switches/jumpers and select the appropriate settings
3. DIP switches or jumpers are found on the integrated furnace control board.
NOTE: some integrated furnace controls are equipped with jumpers for blower adjustments. Please reference "Letter" on adjustment table and control board when making adjustment.
4. Re-install the blower compartment door.
5. Upon completion, recheck the furnace temperature rise to ensure that the desired condition exists.

DIP Switch Configurations

Rating Plate Input BTU/hr	Switch Description	Cool Jumper	AC Tonnage	
			ADJUST (NORM)	ADJUST (-)
54,000	Cool	A	3.0	2.5
		B	2.5	2.0
		C	2.0	1.5
		D	1.5	1.0
72,000	Cool	A	3.5	3.0
		B	3.0	2.5
		C	2.0	1.5
		D	1.0	1.0
90,000	Cool	A	5.0	4.0
		B	3.5	3.0
		C	2.5	2.0
		D	1.5	1.0
108,000	Cool	A	5.0	4.0
		B	3.5	3.0
		C	2.5	2.0
		D	1.5	1.0

Rating Plate Input BTU/hr	Heating Jumper	Rise
54,000	A	50
	B	45
	C	55
	D	60
72,000	A	50
	B	45
	C	55
	D	60
90,000	A	50
	B	45
	C	55
	D	60
108,000	A	50
	B	45
	C	55
	D	60

To obtain the correct airflow for the cooling mode, please refer to the table above.

Note the position of the delay tap.

It is recommended that the heating airflow be set for the Nominal-Plus setting when the furnace is matched for this cooling capacity.

Furnace is set at the factory for maximum cooling capacity and DIP switches must be field configured to match the cooling system.

ADJUSTING BLOWER SPEEDS

Cooling Mode

The unit is factory set to provide the highest airflow. Adjustments can be made to match the furnace with a smaller cooling coil by changing the DIP switch or jumper settings, located on the integrated ignition control board. Refer to the Cooling DIP switch or jumper settings table for instructions on how to set the switches. Please note that if the furnace is to be matched to the lowest airflow for cooling, the "Adjust" DIP switches or jumper setting must be set to the decreased setting. When using this setting, it is recommended that the Heating DIP switches or jumper setting be set for Nominal-Plus.

Heating Mode

The unit is set from the factory to operate at the center of the temperature rise range. For this model furnace, the air temperature rise is between 35 and 65 degrees F. Heating airflow can be increased or decreased by changing the heating mode DIP switches or jumpers, located on the integrated ignition control board, to the Nominal-plus/minus settings. Please note that Nominal-plus will decrease the air temperature rise and the Nominal-minus will increase the air temperature rise. At the end of a call for heat, the main blower has a fixed off delay at a reduced airflow to remove residual heat from the heat exchanger.

⚠ WARNING ⚠

Make adjustments to the controller with the electrical power off.

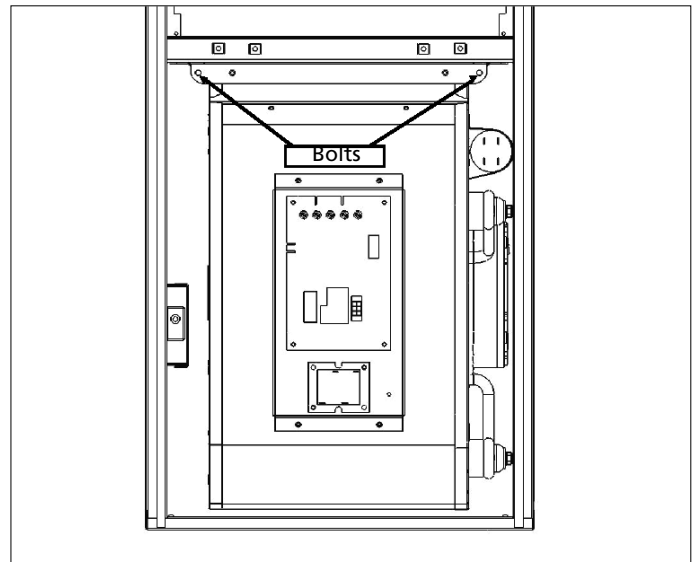
How To Install The Blower

1. Place blower into blower compartment.
2. Keep blower assembly tight to top of blower compartment. Line up blower assembly to slide into blower rails. Push blower assembly towards back of furnace ensuring blower assembly is correctly placed in blower rails. Insert blower shroud on the front of the blower housing. Insert blower housing bolts and tighten.
3. Connect thermostat wiring to the integrated furnace control.
4. Connect L1, Neutral and Ground connections between the integrated furnace control and the furnace electrical connection junction box.
5. Connect 12 pin male molex connector to female connection point, and ground connection to the integrated furnace control.
6. Turn on power to the furnace.

⚠ WARNING ⚠

Ensure that there is a drip bend in the connect wires to the blower motor to prevent condensate from following the wire into the connector.

FIGURE 15
BLOWER BOLTS



How To Remove The Blower

1. Disconnect power from furnace.
2. Remove thermostat wiring from the integrated furnace control.
3. Remove L1, Neutral and Ground connections between the integrated furnace control and the Furnace electrical connection junction box.
4. Remove 12 pin male molex connector from female connection point, and ground connection from integrated furnace control.
5. Unscrew 2 blower housing bolts located in the front blower shroud as indicated in figure 15 (right). Remove front blower shroud from furnace.
6. Slide blower assembly towards front of furnace. Blower is mounted on rail system, and will slide forward about 10 inches before blower is clear of rails.

MAINTENANCE

⚠ WARNING ⚠

DISCONNECT THE ELECTRICAL POWER SUPPLY TO THE FURNACE BEFORE ATTEMPTING ANY MAINTENANCE. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

Air Filter

The filter should be inspected frequently and cleaned as necessary. We recommend a monthly inspection at first, perhaps coinciding with the arrival of the monthly fuel bill as a reminder. The frequency may be increased or decreased depending on experience and conditions.

⚠ CAUTION ⚠

DO NOT OPERATE THE FURNACE WITHOUT AN AIR FILTER.

Lubrication

Both the induced draft blower motor and circulating fan motor are ball bearing type motors. Neither requires routine lubrication.

IMPORTANT

The motor bearings were prelubricated by the motor manufacturer. Do not attempt to lubricate them. Excess lubrication will void the warranty, shorten the service life of the motors, and will attract the buildup of dust and dirt.

The induced blower motor and circulating fan motor must be cleaned on a periodic basis by a qualified service technician. Dust buildup in the ventilation ports of the motor will cause the motor to not dissipate heat properly resulting in reduced service life.

Vent Connector

The exhaust venting between the furnace vent box and chimney should be inspected periodically for sags, pitting, evidence of leakage etc. If any of these conditions exist, contact your installation contractor, service agency or fuel supplier.

⚠ WARNING ⚠

HOLES IN THE EXHAUST PIPING OR FURNACE HEAT EXCHANGER CAN ALLOW TOXIC FUMES TO ENTER THE HOME AND CIRCULATE THROUGH THE DUCT SYSTEM RESULTING IN CARBON MONOXIDE POISONING OR DEATH. IF LEAKS ARE FOUND IN THE FURNACE HEAT EXCHANGER, IT MUST BE REPLACED.

Operating Tips

1. Clean air filters maximize efficiency and reduce heating costs.
2. During the heating season, keep windows and doors closed to reduce the heating load on the system.
3. Avoid excessive use of kitchen exhaust hoods and other exhaust fans to reduce the heating load on the system.
4. Arrange the furniture and drapes so that the supply air registers and return air grilles are unobstructed.
5. If you have a perimeter duct system, ideally, the warm air should bathe the cold exterior walls. Avoid the use of plastic deflectors on the supply air registers that tend to short circuit the warm air straight into the return air grilles. These deflectors are often the cause of cool draughts across the floor.

6. Avoid placing heat producing appliances such as televisions, radios, lamps, etc. in a location to influence the thermostat.
7. Keep combustible articles at least 3 feet away from the furnace. Do not block access for servicing the furnace. Do not use the vent connector as a hanger for clothes or anything else.
8. Never attempt to operate the furnace without the blower door in place.

ANNUAL INSPECTION / SERVICE

A qualified installation contractor, service agency or fuel supplier must inspect the furnace annually.

Your annual inspection will normally cover the following:

Heat Exchanger

The heat exchanger should be inspected for corrosion. The flue passages (heat exchanger tubes) should be free of scale or excessive corrosion. Observe the burner flames. If there appears to be flame distortion, check venting for blockage. Also check for signs of inadequate combustion air supply. If flame distortion continues after eliminating the blockage in the venting as the cause, it may be necessary to replace the tubular heat exchanger. The tubular heat exchanger cannot be field cleaned. If the tubular heat exchanger is blocked by soot or excess scale, replace it. Check NOX baffles (installed in heat exchanger tubes) for any distortion. If distorted, replace NOX baffles.

Burners

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

⚠ CAUTION ⚠

BE CAREFUL WHEN WORKING ON THE BURNER ASSEMBLY. THE HOT SURFACE IGNITER IS FRAGILE AND CAN BREAK EASILY.

The flame sensor should be inspected and cleaned with fine steel wool or Scotch-Brite™ scrubbing pad. The wiring connection should be checked to ensure that it is tight and corrosion free.

IMPORTANT

This is a critical connection. Small amounts of corrosion can significantly increase the internal resistance of the connection. A relatively small increase in resistance can result in a large decrease in flame signal.

Induced Blower

The induced blower motor should be inspected and cleaned if necessary. Clear any dust buildup from the ventilation ports.

Circulating Fan

The condition of the circulating fan should be checked to ensure that it is free of excessive dust buildup, debris, etc. The mechanical fasteners should be inspected and checked for proper tightness and parts alignment. The motor ventilation ports should be cleaned if necessary to prevent restriction to cooling by air over the motor.

Electrical

⚠ WARNING ⚠

DISCONNECT THE ELECTRICAL POWER SUPPLY TO THE FURNACE BEFORE ATTEMPTING THIS MAINTENANCE PROCEDURE. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

All electrical connections should be examined to ensure that they are tight and corrosion free. Repair any connections that have become loose or corroded.

⚠ CAUTION ⚠

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

Always verify proper operation after servicing.

Furnace Operation

The furnace should be cycled during the annual inspection and servicing to:

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

FIELD SUPPLIED AND INSTALLED OPTIONAL ACCESSORIES

Electronic Air Cleaner

The integrated furnace control has provisions to supply power and control an electronic air cleaner rated at 120vac, 1.0 amp max.

Line voltage for an electronic air cleaner may be picked up from the "EAC-N". 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating or cooling modes.

Humidifiers/ Electronic Air Cleaners

The integrated furnace control has provisions to supply power and to control a line voltage humidifier or the primary of a 120 / 24 volt humidifier step down transformer, rated at 120vac, 1.0 amp max.

Line voltage for a humidifier may be picked up from the "HUM-H" terminal and from the "HUM-N" terminal. 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating mode.

IMPORTANT

All HUM (humidifier) and EAC (electronic air cleaner) terminals are 120v. Do not directly connect 24v equipment to them.

IMPORTANT

All furnace and furnace accessory wiring shall conform to the temperature limitations of 63°F (35°C) rise.

⚠ WARNING ⚠

ALL WIRING INSIDE THE FURNACE MUST HAVE A MINIMUM TEMPERATURE RATING OF 105C.

Troubleshooting

Page 41, Table 9, Page 42, Table 10 and Figure (trouble shooting) will aid in trouble shooting.

The controller ignites the furnace in low heat and high inducer (only the low pressure switch is required to make) and after a 60 second warm-up period adjusts either the gas or inducer to heat demand. With the single stage thermostat option, there is a selectable low heat period before high heat. If there is a problem with high or low heat the UTEC 1170-25 controller will attempt to continue to supply heat in one of three alternate firing scenarios.

Scenario one:

- if, after the warm-up period and the low heat period with a single stage thermostat, or with a two stage T-stat the demand for heat is high and the high heat pressure switch fails to make, the furnace will run in low gas and high inducer until the high pressure switch makes.

The second scenario;

If the low heat fails after the warm-up period, the controller will wait 3 minutes before ignition retrial and then after the warm-up period go to high heat. Most likely the failure of the low heat is temporary and may be due to a combination of high wind and long vent length and low voltage. If there is a blocked drain the furnace will not turn the igniter or gas on. If there is an air trap in the heat exchanger drain tube the furnace will cycle and flash code for pressure switch failed to close.

The third scenario;

If the low heat fails after the warm-up period, and when the next trial for high fails to make the high pressure switch, the unit will stay in low heat and high inducer (as long as the low pressure switch is made). If, during this period, the high pressure switch makes, the gas valve will switch to high. A loss of high pressure switch will force the gas valve to low. If there is ice in the vent the continuous heat should free it. Note: When the inducer is in high and the gas low the flame noise sounds deceptively like high heat.

The fourth scenario:

If there is a demand for high heat (low heat firing period is finished) and during the trial for ignition the high pressure switch does not pull in the controller will continue in low heat and make a retrial for high every 5 or 10 minutes.

TROUBLESHOOTING

SEQUENCE OF OPERATION: UTEC INTEGRATED FURNACE CONTROL WITH TWO STAGE GAS VALVE

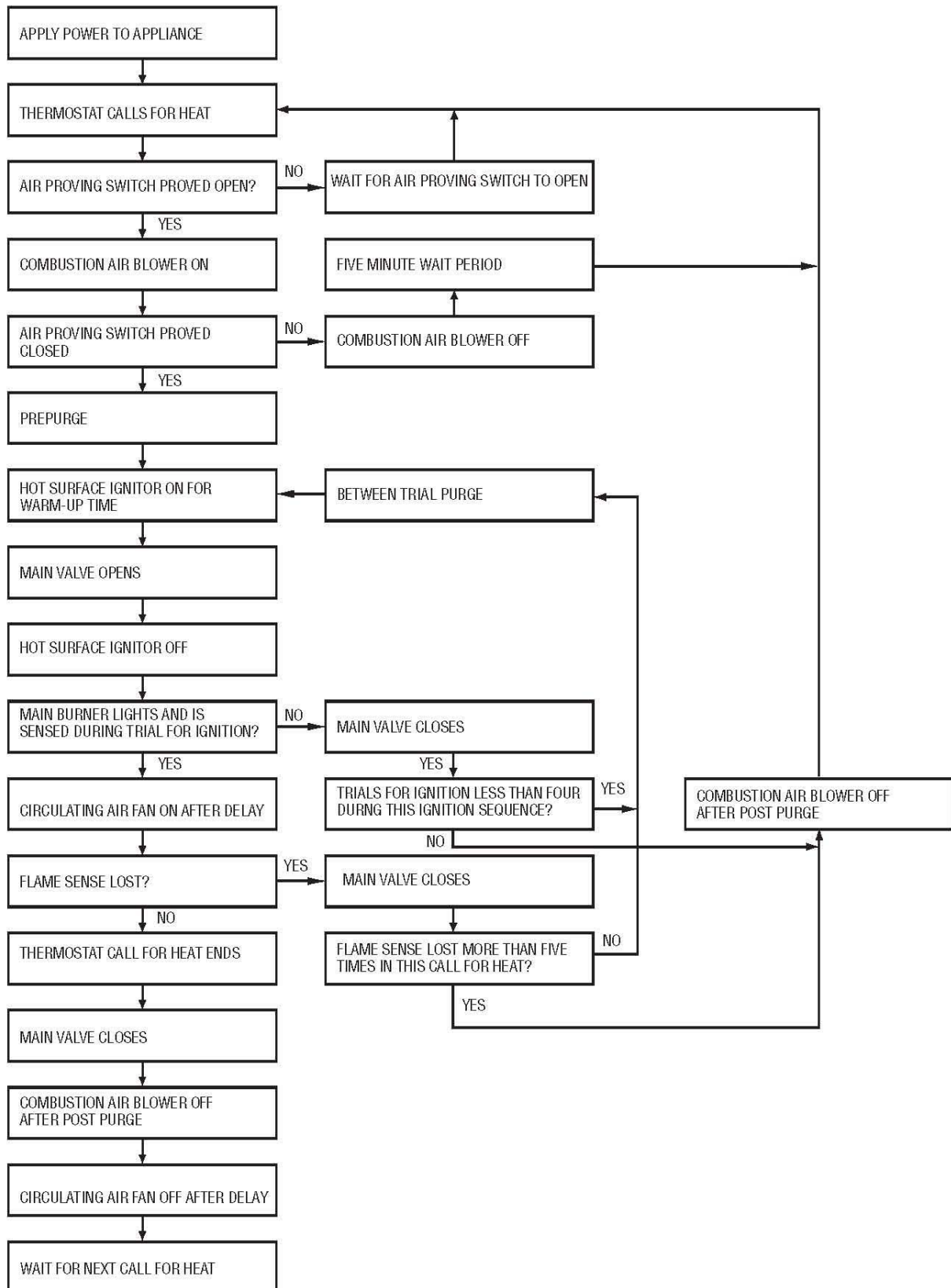
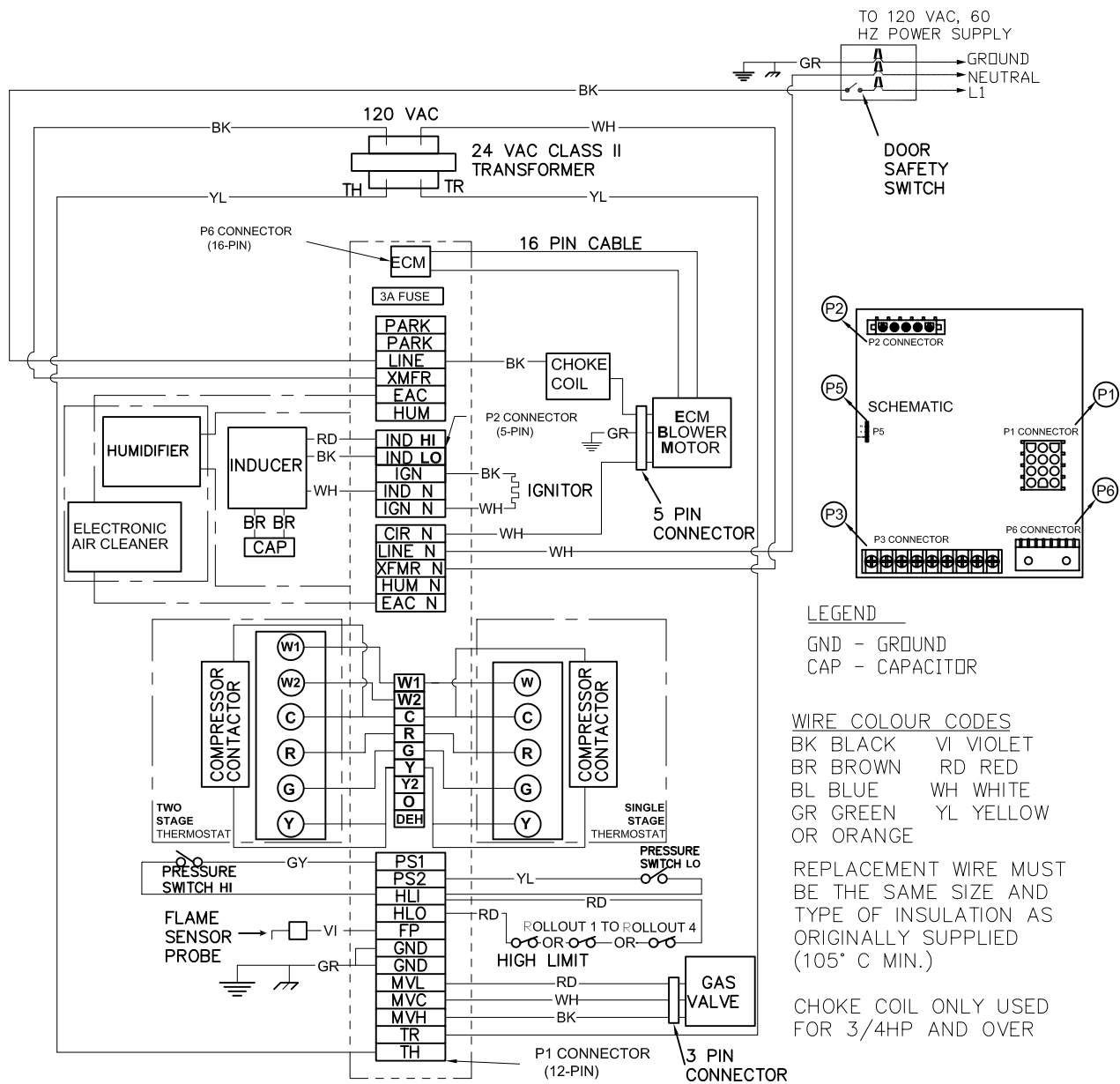


TABLE 9

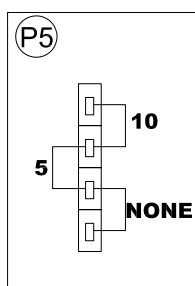
LED FLASH(ES)	INDICATES (UTEC 1170-25 CONTROLLER)	CHECK and REPAIR
Green Off	Internal controller or Room Air Fan failure. DO NOT operate on heat until Fan failure cleared. Roll-out open. Cycle power to reset.	1. Replace Integrated Furnace Control. 2. Rollouts or Fan failure– see 5 Red Flashes.
1 Red	Flame sensed with gas valve de-energized.	Mis-wiring is probable cause.
2 Red	Pressure switch(es) remains open. Combustion Blower cycles until low pressure switch closes. If running, high pressure switch is open.	1. Pressure switch failure. 2. Pressure switch tubing, and wiring. 3. Obstructions in air intake or exhaust flue system that prevent proper combustion air flow.
3 Red	Pressure switch(es) remains closed. Combustion Blower will not operate until switch(es) opened.	1. Pressure switch(es) failure. 2. Pressure switch(es) mis-wired or jumpered.
4 Red	Open high room air limit switch.	Dirty filter or room air vents closed.
5 Red	Room Air Fan failed or rollout switch(es) open. System lockout reset by recycling power. Caution: Do not run on heat until fan operational.	1. Wiring in good condition and securely connected. Drip leg at Motor connector. 2. Check Room Air Fan by running A/C or Fan (not heat). 3. Blockage in heat exchanger or venting.
6 Red	115 Volt AC power reversed or improper ground.	Line voltage polarity, and earth ground.
7 Red	Low flame sense signal. 1 hour lockout.	1. Flame at burner. 2. Dirty or cracked flame sensor.
8 Red	Too many high air temperature limit trips. 1 hour lockout.	See 4 Red Flashes
9 Red	Too many low pressure switch trips after ignition. 1 hour lockout	See 2 Red Flashes.
10 Red	1 hour lockout. Reset by cycling power or thermostat.	1. Gas supply off or at too low pressure. 2. Smell gas? Igniter failure. 3. Earth grounded.

TABLE 10 : GENERAL TROUBLESHOOTING INTEGRATED FAN CONTROL

IF	AND	CHECK or REPAIR
Induced blower does not energize	3 Flash code does not come on	1. Induced blower wiring. 2. Induced blower.
Induced blower does not energize	3 Flash code does come on	1. Pressure switch stuck closed. 2. Pressure switch is mis-wired or jumpered.
Induced blower is energized	2 Flash code does not come on	Wait for the pre-purge to expire.
2 Flash code comes on	Induced blower turns off	1. Pressure switch stuck in the open position. 2. Pressure switch, tubing and wiring. 3. Obstruction in furnace venting that is preventing proper combustion airflow.
Pre-purge time has expired	HSI element does not glow red within 10 seconds.	1. Broken or damaged HSI element. 2. Broken or damaged HSI element leadwires.
HSI element is glowing red.	No other visible control system action	Wait for HSI element warm up time to expire.
HSI element warm up time has expired and main valve has been energized.	Main valve does not light within trial for ignition period	1. Induced blower moving main burner gas away from the HSI element. 2. Inlet gas pressure too low for main burner ignition. 3. Input line voltage too low to heat HSI element. 4. HSI element incorrectly positioned. 5. Clogged or incorrect main burner orifice.
Main burner lights within trial for ignition period.	Main valve is de-energized at the end of the trial for ignition period. If main flame is not sensed during trial for ignition, system will shut off HSI element and main gas flow, then go through another purge period and initiate another ignition trial. A total of 4 ignition trials will be attempted before the system goes into lockout.	1. Line voltage to L1 terminal of integrated furnace control must be 120 volts with reference to furnace chassis. 2. Furnace must be reliably connected to earth ground. 3. Induced blower moving main burner flame away from the flame sensor rod. 4. Inlet gas pressure too low for proper flame sensing. 5. Flame sensor rod contaminated or in incorrect position.
Main burner stays on after the end of the trial for ignition period.	Circulating fan is not turned on after 30-second time delay.	1. Wiring between system control and integrated furnace control. 2. Proper operation of integrated furnace control.
Main burner goes out before thermostat call for heat ends.	4 Flash code comes on	1. Open high limit switch. 2. High limit wiring in good condition and securely connected.
Main burner goes out before thermostat call for heat ends.	4 Flash code does not come on	1. Induced blower moving main burner flame away from flame sensor rod. 2. Pressure switch has opened. 3. Flame sensor rod ceramic or leadwire overheated. 4. Gas supply / flow reduced or interrupted.
5 Flash code comes on.	Green LED off	1. Open flame rollout switch 2. Rollout switch wiring in good condition 3. Broken or damaged blower



NOTE:



THE CONTROL PROVIDES A MOVABLE JUMPER TO SELECT BETWEEN AUTOMATIC STAGING, 5 MINUTE AND 10 MINUTE STAGING.

1. FACTORY DEFAULT SETTING: AUTOMATIC STAGING (USE WITH TWO STAGE THERMOSTAT).

2. FOR SINGLE STAGE THERMOSTAT, JUMPER NEEDS TO BE SET TO 5 MINUTE, OR 10 MINUTE STAGING.

a). JUMPER AT 5 MINUTE STAGING: CONTROL WILL AUTOMATICALLY START HIGH HEAT AFTER 5 MINUTES OF CONTINUOUS LOW HEAT OPERATION.

b). JUMPER AT 10 MINUTE STAGING: CONTROL WILL AUTOMATICALLY START HIGH HEAT AFTER 10 MINUTES OF CONTINUOUS LOW HEAT OPERATION.

User's Information Manual

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READ THESE INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING TO OPERATE THIS FURNACE.

This furnace has been designed to deliver many years of efficient, dependable service. With regular maintenance, some of which requires the attention of a qualified installer, service agency or gas supplier, some of which you may do yourself, the furnace will operate satisfactorily over many heating seasons.

Please read this manual to familiarize yourself with safety procedures, operation, and routine maintenance procedures.

WARNING

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
- LEAVE THE BUILDING IMMEDIATELY
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A PHONE OUTSIDE THE BUILDING. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT
- INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER

DO NOT USE THIS FURNACE IF ANY PART HAS BEEN UNDER WATER. A FLOOD DAMAGED FURNACE IS EXTREMELY DANGEROUS. ATTEMPTS TO USE THE FURNACE CAN RESULT IN FIRE OR EXPLOSION. A QUALIFIED SERVICE AGENCY SHOULD BE CONTACTED TO INSPECT THE FURNACE AND TO REPLACE ALL GAS CONTROLS, CONTROL SYSTEM PARTS, ELECTRICAL PARTS THAT HAVE BEEN WET OR THE FURNACE IF DEEMED NECESSARY.

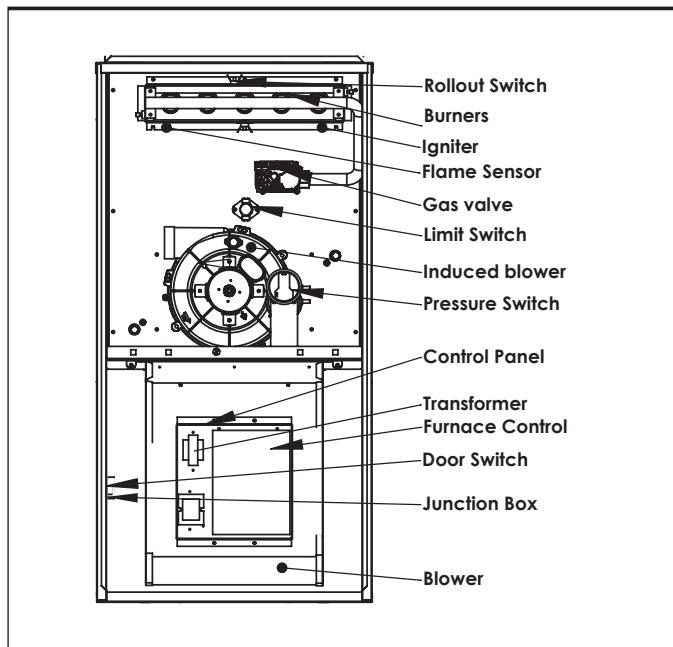
FIRE OR EXPLOSION HAZARD

DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.

FAILURE TO FOLLOW SAFETY WARNINGS EXACTLY COULD RESULT IN SERIOUS INJURY, DEATH, OR PROPERTY DAMAGE.

FURNACE COMPONENTS

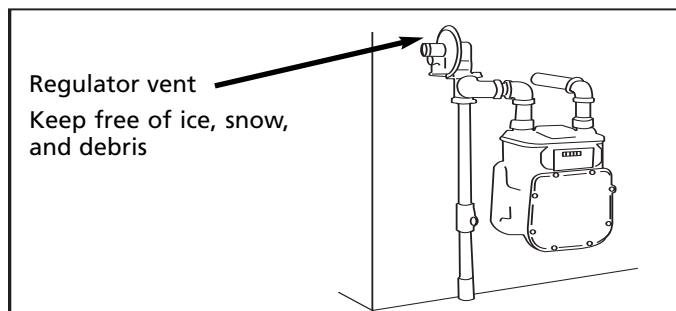
FIGURE 1
FURNACE COMPONENTS



REGULATOR VENT

Most natural gas systems and all LP gas systems have a service regulator located near the point where the gas piping enters the building. The propane tank will normally have an additional first stage regulator located at the tank outlet valve. All of these regulators (located outdoors) will have a vent; see Fig. 2 (below).

FIGURE 2
GAS REGULATOR VENT



It is important for these vents to remain clear. Do not allow moisture, which could freeze, to build up in the vent. If you see moisture building up in the regulator vent, contact your gas supplier.

Your gas supplier should periodically inspect and clean the air vent screen to prevent any obstruction. Keep the protective regulator cover in place, as exposure to the elements can cause ice buildup and a regulator failure.

⚠ WARNING ⚠

AN OBSTRUCTED AIR VENT ON AN LP (PROPANE) CYLINDER OR TANK REGULATOR CAN CAUSE EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY OR DEATH.

GENERAL SAFETY RULES

1. Combustible materials should not be stored against or around the furnace. Keep the furnace area clear and free from all combustible materials such as newspapers, rags, cardboard, clothing, etc. This applies especially to gasoline and other flammable vapors and liquids.
2. A furnace needs adequate amounts of combustion and ventilation air to operate properly. Do not block or obstruct air openings on the furnace, or air openings supplying combustion or ventilation air to the area where the furnace is installed. There are many areas from which your furnace could be receiving combustion and ventilation air including from within the heated area (inside air), from outdoors, from an attic or crawl space. If renovations are done, be sure that air supply openings are not inadvertently covered over with insulation, vapor barrier, or similar construction material.
3. All doors and panels must be in place during normal furnace operation. Attempting to operate the furnace with missing doors or panels could lead to the creation of carbon monoxide gas.
4. If the furnace is installed in a confined space or if you intend to build a furnace room where insulation is present, be aware that some insulating materials are combustible. Do not allow building insulating materials to come into contact with the furnace.
5. Any additions, alterations or conversions required in order for the furnace to properly match the application requirements must be done by a qualified installation contractor, service agency or gas supplier, using factory specified or approved parts.
6. Familiarize yourself with the location of the furnace gas manual shutoff valve and any electrical switches, fuse or circuit breaker associated with the furnace.
7. For your protection, the furnace is equipped with manually reset flame rollout switches. If either switch trips frequently, do not ignore this, call your installation contractor, service agency or gas supplier.
8. Should the gas supply fail to shut off or if overheating occurs, shut off the gas valve to the furnace before shutting off the electrical supply.
9. Familiarize yourself with the location of your furnace filter or filters. A blocked air filter will reduce efficiency, increase fuel consumption, raise the furnace operating temperature, and shorten the life of furnace components.
10. Do not cover return air grilles and supply air registers with drapes, curtains, throw rugs, etc.
11. Avoid shutting off supply air registers in the interests of saving heat. The furnace requires a sufficient quantity of air passing over the heat exchanger to operate within design temperatures, (system temperature rise). Reducing the availability of supply air registers may have the unforeseen consequence of raising the furnace operating temperature above design, thereby reducing furnace efficiency, and shortening the life of the furnace components.

FURNACE OPERATION INFORMATION

During the heating season, the operation of the furnace is fully automatic.

To Start The Furnace:

1. First read these instructions and safety notices thoroughly.
2. Set the thermostat to the lowest setting.
3. Ensure that all supply air registers and return air grilles are open.
4. Turn off the electric power to the furnace.
5. Remove the burner access door.
6. Ensure that the appliance manual shutoff valve is in the "ON" position. The valve handle is normally in-line with the gas pipe and valve body when it is in the "ON" position perpendicular to the gas piping and valve body when it is in the "OFF" position.
7. Wait 5 minutes to clear out any gas. If, after this time you smell gas, STOP. Turn the appliance manual shutoff valve to the "OFF" position. If burning propane or other LP gas, smell for gas near the floor since propane and butane are both heavier than air. If after this time you do not smell gas, continue to the next step.
8. Gas valve: Ensure that the Gas Valve Control is in the "ON" position, see Figure 3 at right.
9. Replace the burner access door, ensuring that it is properly in place.
10. Restore the electric power to the furnace.
11. Adjust the thermostat to the desired setting. If the thermostat also controls an air conditioning system, ensure that the thermostat system switch is in the "HEAT" or "AUTO" mode.

If this is the first time that the furnace has undergone a trial ignition since installation, or if there has been work done on the gas lines, the furnace might not light because of air trapped in the gas supply line.

Simply turn the thermostat down to its lowest setting, wait five minutes, then adjust the thermostat to the desired setting. If the problem persists, proceed to the *Furnace Shut Down Procedure* and call your installer, service agency or gas supplier.

If you intend to be away from home for lengthy periods of time during the non-heating season, it is advisable to follow the furnace shut down procedure.

⚠ WARNING ⚠

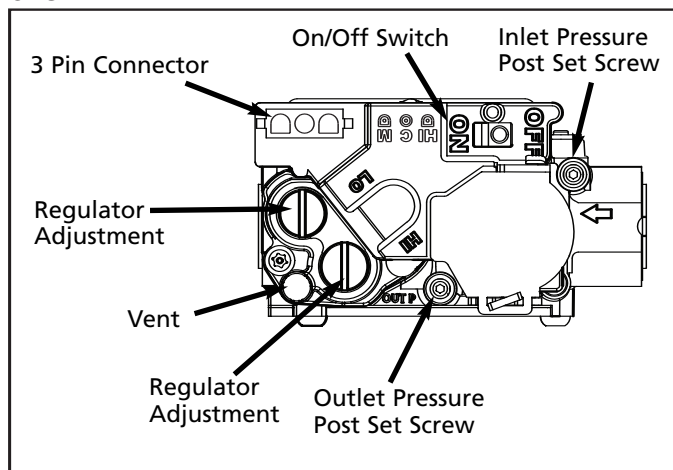
NEVER USE TOOLS TO TURN A MANUAL GAS CONTROL HANDLE. IF THE CONTROL HANDLE WILL NOT TURN BY HAND, DO NOT ATTEMPT TO FORCE IT. DOING SO COULD RESULT IN FIRE OR EXPLOSION RESULTING IN SERIOUS PERSONAL INJURY OR DEATH, OR PROPERTY DAMAGE. CALL A QUALIFIED INSTALLATION CONTRACTOR, SERVICE AGENCY OR GAS SUPPLIER.

Furnace Shutdown Procedure

1. Set the thermostat to its lowest setting.
2. Shut off electric power to the furnace.
3. Turn the appliance manual shutoff valve to the "OFF" position.
4. Remove the burner access door, move the manual gas control switch to the "OFF" position, then reinstall the burner access door.

If you intend to be away from home for lengthy periods of time during the nonheating season, it is advisable to follow the furnace shutdown procedure.

FIGURE 3
GAS VALVE



⚠ WARNING ⚠

DEVICES ATTACHED TO EITHER THE VENT OR COMBUSTION AIR INTAKE FOR THE PURPOSES OF EXCEEDING THE LIMITATIONS DESCRIBED IN THE INSTALLATION MANUAL, INCLUDING FIELD INSTALLED INDUCED BLOWER FANS HAVE NOT BEEN TESTED AND ARE NOT INCLUDED IN THE DESIGN CERTIFICATION OF THE FURNACE.

THE MANUFACTURER CANNOT AND WILL NOT SPECULATE ON THE EFFECTS OF SUCH MODIFICATIONS, AND CANNOT AND WILL NOT BE RESPONSIBLE FOR INJURY OR DAMAGE CAUSED BY THE USE OF SUCH UNTESTED AND/OR UNCERTIFIED DEVICES, ACCESSORIES OR COMPONENTS.

⚠ WARNING ⚠

IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH
FOR ASSISTANCE OR ADDITIONAL INFORMATION, CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY, OR YOUR GAS SUPPLIER.

MAINTENANCE

Replacing Air Filter

1. Disconnect electrical power to the furnace.
2. Pull the filter out the front.
3. Replace with a fresh filter and reconnect power to the furnace. The filter will have an arrow indicating proper airflow direction.

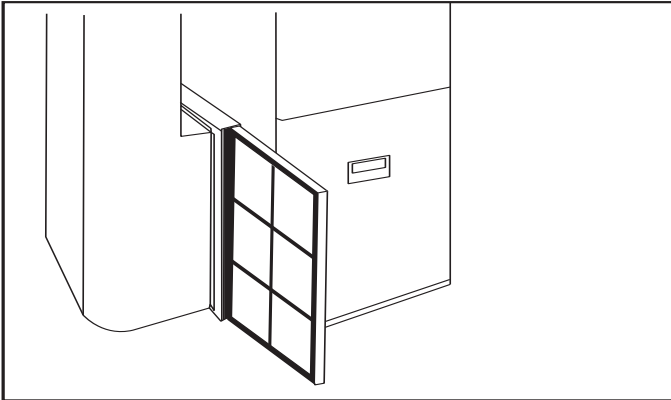
DO NOT OPERATE YOUR FURNACE (OR AIR CONDITIONER) WITHOUT AN AIR FILTER.

⚠ WARNING ⚠

DISCONNECT THE ELECTRICAL POWER TO THE FURNACE BEFORE ATTEMPTING ANY MAINTENANCE. FAILURE TO DO SO MAY CAUSE ELECTRICAL SHOCK RESULTING IN SEVERE PERSONAL INJURY OR DEATH.

Consult your installation contractor or service technician if you have any questions on filters.

FIGURE 4
AIR FILTER



Lubrication

Minimal lubrication is required for your furnace. The induced blower assembly motors have sealed bearings. The bearings contain permanent special purpose lubricants. Attempting to force common oil into the induced blower motor bearings will deteriorate the original lubricant and shorten bearing life.

Routine Examination

It is good practice to give a quick inspection of your furnace each time you inspect or clean the air filter. Things to check:

- All areas around the vent connector and chimney should be clear and free of obstructions.
- Check the venting to ensure that it is still fastened to the furnace. It should not sag and should have a slope upwards to the chimney. It should be physically sound, without holes or excessive corrosion.
- The return air duct connection must be sound and securely fastened to the furnace casing. In most cases, the filter rack provides the means to connect the return air to the furnace. There should be no return air inlets in the vicinity of the furnace.
- All ductwork should be secured to the furnace, and all ductwork should be solidly supported throughout the heating system.

- The furnace should be well supported on a level floor or by the means used to suspend the furnace in a horizontal configuration. Base support should be physically sound without sagging, cracks, gaps, etc. around the base so as to provide a seal between the support and the base.
- Check the furnace for obvious signs of deterioration.
- The gas burner should be observed from time to time during the heating season to ensure that the flames are clean and blue. A bit of orange color in the flame is not likely to be a problem and is probably dust particles burning. If you observe lazy yellow flames, call your heating or service contractor immediately. The yellow flames inevitably lead to soot buildup.

Furnace Appearance

The furnace exterior finish is a durable automotive-like coating. It may be washed with mild soap if necessary. Galvanized metal surfaces require no maintenance.

Cleaning

It is advisable to keep dust buildup on warm surfaces to a minimum, since dust, in some cases, can be combustible.

Dust buildup in the circulating fan can impair blower performance; therefore, reduce efficiency. Because the blower wheel is fastened directly to the blower motor, we recommend that major cleaning be left to your service contractor.

⚠ CAUTION ⚠

DO NOT PERMIT WATER OR CLEANING SOLUTIONS TO ENTER THE ELECTRIC MOTOR.

The burner area should be inspected and cleaned periodically. Be careful when cleaning around the burner area. The hot surface igniter is fragile and will break easily. Do not touch the hot surface igniter or flame rod.

⚠ WARNING ⚠

NEVER ATTEMPT TO CLEAN THE BURNER AREA WHILE THE BURNERS ARE OPERATING. DOING SO MAY RESULT IN EXPLOSION OR FIRE RESULTING IN SEVERE PERSONAL INJURY OR DEATH.

⚠ WARNING ⚠

ALWAYS DISCONNECT THE ELECTRICAL SUPPLY TO THE FURNACE BEFORE REMOVING THE BURNER COMPARTMENT ACCESS DOOR.

⚠ CAUTION ⚠

THE FURNACE SHOULD BE OPERATED WITH ALL PANELS IN PLACE. NEVER OPERATE THE FURNACE WITH THE BLOWER DOOR REMOVED EXCEPT FOR SERVICE PURPOSES.

The furnace achieves its mid-efficiency in two general areas. First, there is no wasteful standing pilot. The furnace consumes no gas in between cycles. Secondly, the furnace is designed to allow very small amounts of excess air in the combustion process. Older furnaces had heat exchangers that were commonly 40% larger than necessary for complete combustion. While this prevented the creation of carbon monoxide, the heated excess air was expelled up the chimney where it could not benefit the interior of the home. Special safety controls now prevent the formation of carbon monoxide.

IMPORTANT: Your furnace should be cleaned and inspected annually by a trained and qualified service technician.

Your service technician has the knowledge and test equipment to determine the condition of your furnace.

⚠ WARNING ⚠

THE EXHAUST GASES FROM THIS FURNACE CONTAIN CHEMICALS, WHICH ON SOME OCCASIONS MAY INCLUDE CARBON MONOXIDE (CO). CARBON MONOXIDE IS AN ODORLESS, TASTELESS, CLEAR COLORLESS GAS, WHICH IS HIGHLY TOXIC. EVEN LOW CONCENTRATIONS ARE SUSPECTED OF CAUSING BIRTH DEFECTS AND OTHER REPRODUCTIVE HARM.

UL AND CUL RECOGNIZED CO DETECTORS ARE RECOMMENDED FOR ALL BUILDINGS EQUIPPED WITH FOSSIL FUEL BURNING APPLIANCES. ALL CO DETECTORS SHOULD BE INSTALLED IN ACCORDANCE WITH THEIR MANUFACTURER'S INSTRUCTIONS AND APPLICABLE LOCAL BUILDING CODES.

Sequence Of Operation

1. Thermostat, responding to cool room, calls for heat.
2. Combustion air blower begins.
3. After 15 second prepurge, hot surface igniter warms up.
4. After approximately 5 seconds, the gas valve will open, and the burners ignite.
5. Thirty seconds after the burners ignite and flame sense is proven, the main blower starts on the heating speed.
6. System remains in this state until the room air temperature rises causing the thermostat to terminate its call for heat.
7. The gas valve shuts off; the burners extinguish.
8. After brief postpurge period, (5 seconds), the combustion air fan stops. The main blower continues to run. Elapsed time ranges from 60 seconds to 180 seconds, depending on the manufacturer's requirement.
9. The furnace remains idle until the next call for heat.

Variations

If your system includes air conditioning, your thermostat (supplied by the installer) will likely have two switches. The first switch is the system switch. The switch settings usually include HEAT, COOL, and OFF. Some thermostats have system switches which include HEAT, COOL, AUTO, and OFF. The system switch must be in the HEAT or AUTO position for the furnace to run.

The second switch is the fan switch. It usually has settings of ON and AUTO. The fan switch may be in either position when using the furnace. If the fan switch is set to ON, the main blower will run continuously, and the blower delays mentioned in the sequence of operation points 5 and 9 will be ignored.

Illustrations cover the general appearance of the units at the time of publication and the manufacturer reserves the right to make changes in design and construction at any time without notice.