

# INSTALLATION AND SERVICE MANUAL



## **Power-Fin® 4:1** HOT WATER HEATING BOILERS DOMESTIC HOT WATER SUPPLY BOILERS 1,500,000, 1,700,000 and 2,000,000 Btu/hr MODELS

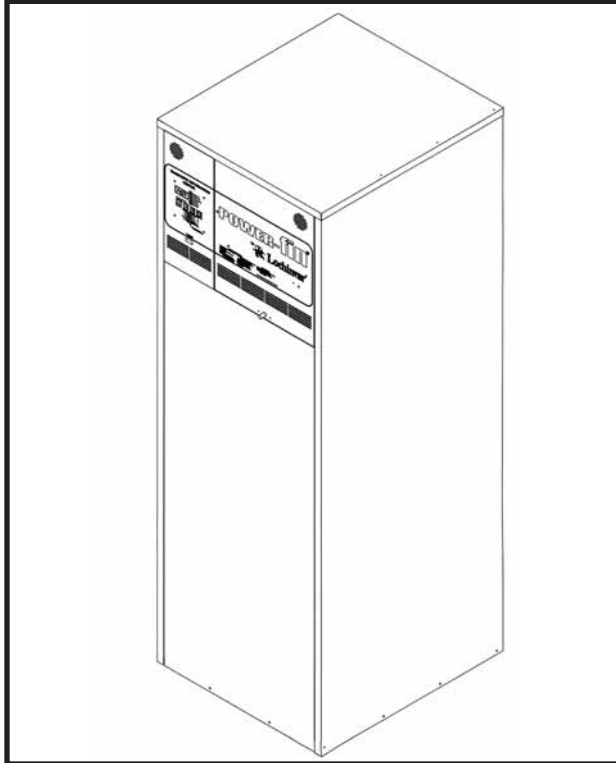


FIG. 1 Front View 1,500,000 - 2,000,000 Btu/hr Models

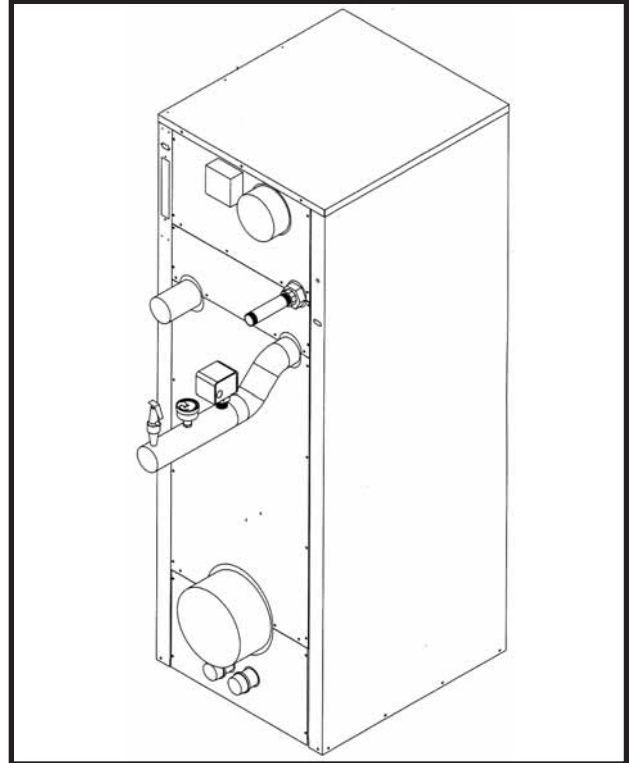


FIG. 2 Rear View 1,500,000 - 2,000,000 Btu/hr Models

### WARRANTY

Installation and service must be performed by a qualified service installer, service agency or the gas supplier.

Factory warranty (shipped with unit) does not apply to units improperly installed or improperly operated.

Experience has shown that improper installation or system design, rather than faulty equipment, is the cause of most operating problems.

1. Excessive water hardness causing a lime/scale build-up in the copper tube is not the fault of the equipment and is not covered under the manufacturer's warranty (See Water Treatment and Water Chemistry).
2. Excessive pitting and erosion on the inside of the copper tube may be caused by too much water velocity through the tubes and is not covered by the manufacturer's warranty (See Boiler Flow Rates and Temperature Rise for flow requirements).

### SPECIAL INSTRUCTIONS TO OWNER

**NOTE:** *Retain this manual for future reference.*

This manual supplies information for the installation, operation and servicing of the appliance. It is strongly recommended that this manual be reviewed completely before proceeding with an installation.

### WARNING: ⚠

**IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE** can cause injury or property damage. Refer to this manual. For assistance or additional information, consult a qualified installer, service agency or the gas supplier.

## CHECKING EQUIPMENT

Upon receiving equipment, check for signs of shipping damage. Pay particular attention to parts accompanying the boiler, which may show signs of being hit or otherwise being mishandled. Verify total number of pieces shown on packing slip with those actually received. In case there is damage or a shortage, immediately notify carrier.

### ***DO NOT:***

**DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. THE POSSIBLE DAMAGE TO A FLOODED APPLIANCE CAN BE EXTENSIVE AND PRESENT NUMEROUS SAFETY HAZARDS. ANY APPLIANCE THAT HAS BEEN UNDER WATER MUST BE REPLACED.**

### **WARNING:**

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

This appliance **MUST NOT** be installed in any location where gasoline or flammable vapors are likely to be present, unless the installation is such to eliminate the probable ignition of gasoline or flammable vapors.

#### **WHAT TO DO IF YOU SMELL GAS**

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbors phone. 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.**

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## OWNER WARNING: ⚠

The information contained in this manual is intended for use by qualified professional installers, service technicians or gas suppliers. Consult your local expert for proper installation or service procedures.

## IMPORTANT:

Consult and follow local Building and Fire Regulations and other Safety Codes that apply to this installation. Consult local gas utility company to authorize and inspect all gas and flue connections.

A gas appliance that draws combustion air from the equipment room where it is installed must have a supply of fresh air circulating around it during burner operation for proper gas combustion and proper venting.

## WARNING: ⚠

Should overheating occur or the gas supply fail to shut off, **DO NOT** turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.

## WARNING: ⚠

To minimize the possibility of serious personal injury, fire or damage to your appliance, never violate the following safety rules.

1. **Boilers and water heaters are heat producing appliances. To avoid damage or injury, do not store materials against the appliance or the vent-air intake system. Use proper care to avoid unnecessary contact (especially children) with the appliance and vent-air intake components.**
2. **Never cover your appliance, lean anything against it, store trash or debris near it, stand on it or in any way block the flow of fresh air to your appliance.**
3. **UNDER NO CIRCUMSTANCES must flammable materials such as gasoline or paint thinner be used or stored in the vicinity of this appliance, vent-air intake system or any location from which fumes could reach the appliance or vent-air intake system.**

## CODES

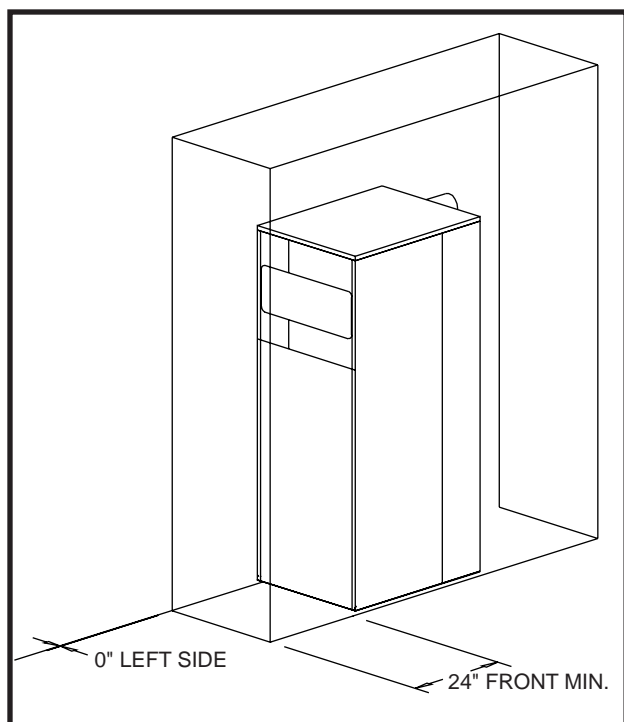
The equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made. In the absence

of such requirements, the installation shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1. Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, ASME CSD-1. All boilers conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV. Where required by the authority having jurisdiction, the installation must comply with the Canadian Gas Association Code, CAN/CGA-B149.1 and/or B149.2 and/or local codes. This appliance meets the safe lighting performance criteria with the gas manifold and control assembly provided, as specified in the ANSI standards for gas-fired units, ANSI Z21.13.

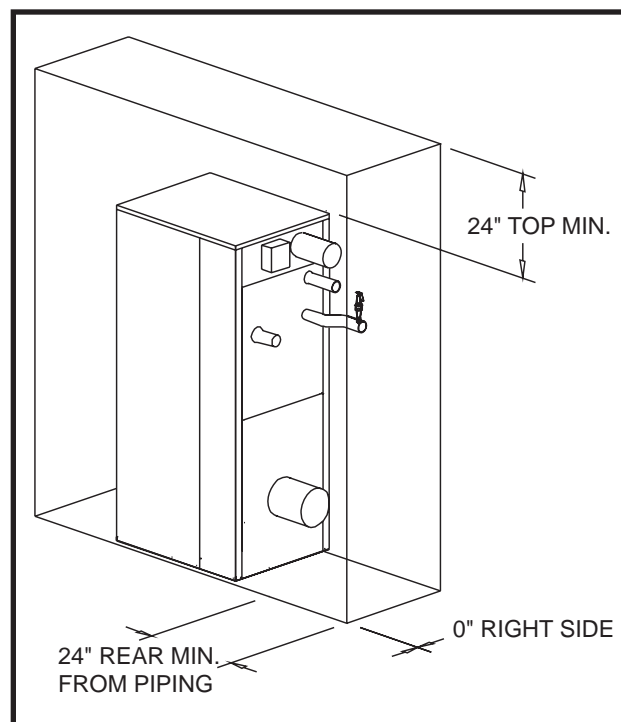
## INSTALLATION PROCEDURE LOCATION OF UNIT

1. Locate the appliance so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the unit. The pan must not restrict combustion airflow. Under no circumstances is the manufacturer to be held responsible for water damage in connection with this unit, or any of its components.
2. The appliance must be installed so that the ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.).
3. Appliances located in a residential garage and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit must be installed so that all burners and burner ignition devices have a minimum clearance of not less than 18" (46cm) above the floor. The appliance must be located or protected so that it is not subject to physical damage by a moving vehicle.
4. **DO NOT** install this appliance in any location where gasoline or flammable vapors are likely to be present.
5. The appliance must be installed on a level floor. Combustible floor locations may be used. Maintain required clearances from combustible surfaces.
6. The appliance must not be installed on carpet.
7. The appliance must be installed indoors where it is protected from exposure to wind, rain and weather.
8. This appliance may condense the products of combustion when operating at water temperatures below 140°F (60°C). Ensure that the appliance is located near an acceptable drain where condensate that may form in the venting system may be properly collected and disposed.

## CLEARANCES FROM COMBUSTIBLE CONSTRUCTION



**FIG. 3 Clearances from Combustible Construction - Front**



**FIG. 4 Clearances from Combustible Construction - Rear**

### TABLE — A Clearances from Combustible Construction:

Right Side - 0"  
 Rear - 6" (15cm) (Minimum 24" (0.61m) suggested for service to pump and components)  
 Left Side - 0"  
 Front - ALCOVE\* (Minimum 24" (0.61m) suggested for service)  
 Top - 6" (15cm) (Minimum 24" (0.61m) suggested for service)  
 Flue - 2" (51mm)  
 Hot Water Pipes - 1" (25.4mm)

\*An ALCOVE is a closet without a door.

#### NOTE:

**Clearances from combustible construction are noted on the appliance rating plate.**

Maintain minimum specified clearances for adequate operation. All installations must allow sufficient space for servicing the vent connections, water pipe connections, piping and other auxiliary equipment, as well as the

appliance. The clearance labels on each appliance note the same service and combustible clearance requirements as shown above.

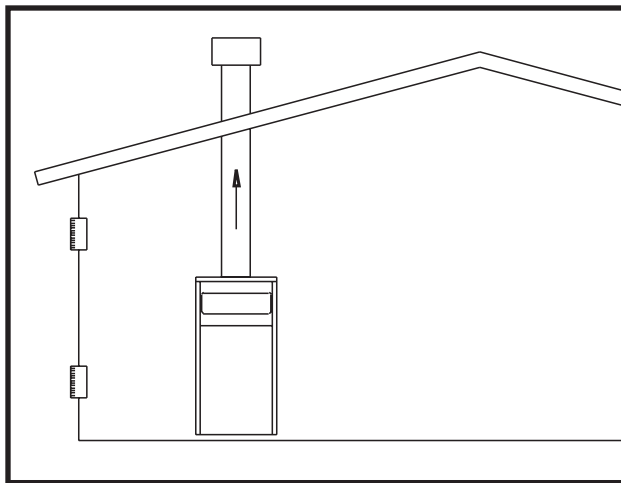
Multiple appliances may be installed in a modular boiler or water heater installation. Multiple appliances may be installed side by side with no clearance between adjacent appliances because this appliance is approved for zero clearance from combustible surfaces and no service access is required from the sides.

Consult the venting section of the manual for specific installation instructions for appropriate type of venting system that you will be using. Direct Vent and DirectAir venting systems require installation with **Category IV** flue pipe, sealed air inlet pipe and air inlet caps, which must meet the manufacturer's specifications.

### COMBUSTION AND VENTILATION AIR REQUIREMENTS FOR APPLIANCES DRAWING AIR FROM THE EQUIPMENT ROOM

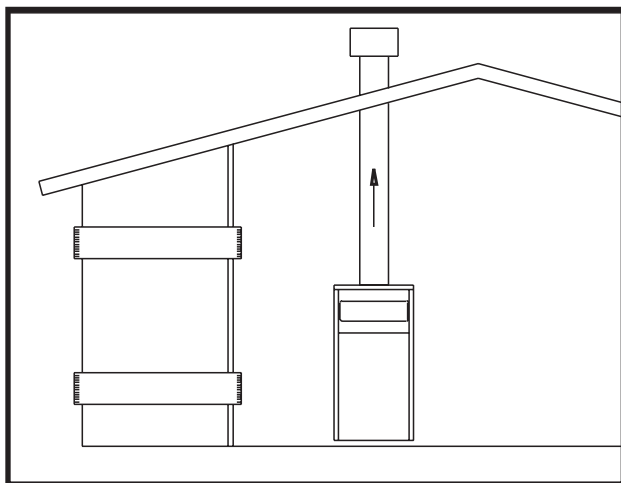
Provisions for combustion and ventilation air must be in accordance with Section 5.3, Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

The equipment room **MUST** be provided with properly sized openings to assure adequate combustion air and proper ventilation when the unit is installed with a basic **Category IV** venting system.



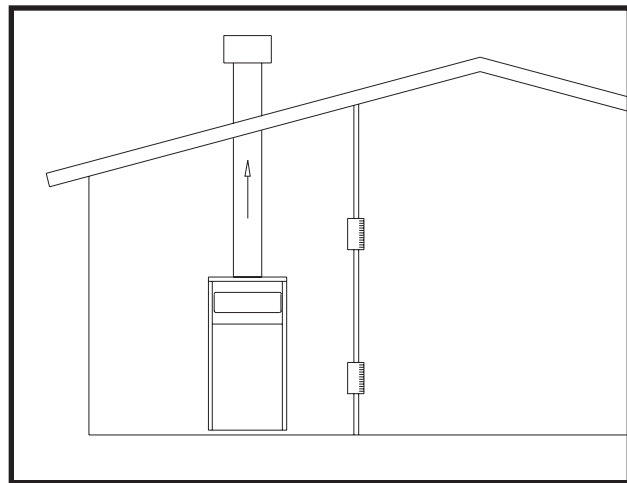
**FIG. 5 Combustion Air Direct from Outside**

1. If air is taken directly from outside the building with no duct, provide two permanent openings:
  - a. Combustion air opening, with a minimum free area of one square inch per 4000 Btu input (5.5 cm<sup>2</sup> per kW). This opening must be located within 12" (30 cm) of the bottom of the enclosure.
  - b. Ventilation air opening, with a minimum free area of one square inch per 4000 Btu input (5.5 cm<sup>2</sup> per kW). This opening must be located within 12 inches (30 cm) of the top of the enclosure.



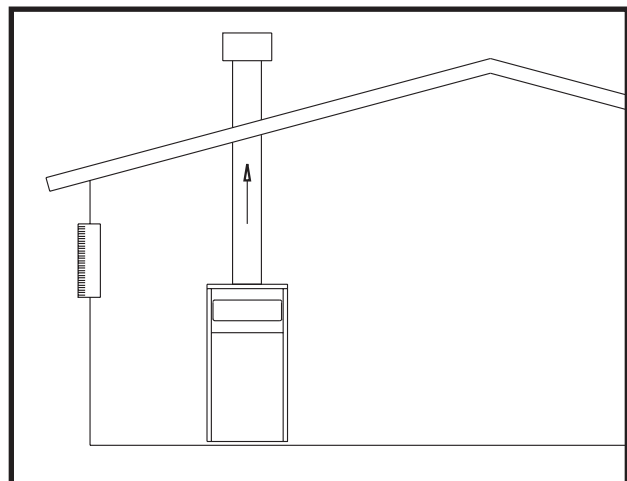
**FIG. 6 Combustion Air Through Ducts**

2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the mechanical room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 Btu (11 cm<sup>2</sup> per kW) of input.



**FIG. 7 Combustion Air from Interior Space**

3. If air is taken from another interior space, each of the two openings specified above should have a net free area of one square inch for each 1000 Btu (22 cm<sup>2</sup> per kW) of input, but not less than 100 square inches (645 cm<sup>2</sup>).



**FIG. 8 Combustion Air from Outside - Single Opening**

4. If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 Btu (7 cm<sup>2</sup> per kW). This opening must be located within 12 inches (30 cm) of the top of the enclosure.



**TABLE — B**  
**Minimum Recommended Combustion Air Supply to Equipment Room**

<b>COMBUSTION AIR SOURCE</b>			
<b>Boiler Input</b>	<b>Outside Air* 2 - Openings</b>	<b>Outside Air* 1 - Opening</b>	<b>Inside Air 2 - Openings</b>
<b>1,500,000</b>	<b>375 in<sup>2</sup> (2,419 cm<sup>2</sup>)</b>	<b>500 in<sup>2</sup> (3,226 cm<sup>2</sup>)</b>	<b>1500 in<sup>2</sup> (9,677 cm<sup>2</sup>)</b>
<b>1,700,000</b>	<b>425 in<sup>2</sup> (2,742 cm<sup>2</sup>)</b>	<b>567 in<sup>2</sup> (3,658 cm<sup>2</sup>)</b>	<b>1700 in<sup>2</sup> (10,968 cm<sup>2</sup>)</b>
<b>2,000,000</b>	<b>500 in<sup>2</sup> (3,226 cm<sup>2</sup>)</b>	<b>667 in<sup>2</sup> (4,303 cm<sup>2</sup>)</b>	<b>2000 in<sup>2</sup> (12,903 cm<sup>2</sup>)</b>

\*Outside air openings shall directly communicate with the outdoors. When combustion air is drawn from the outside through a duct, the net free area of each of the two openings must have twice (2 times) the free area required for Outside Air/2 Openings. The above requirements are for the boiler only; additional gas fired appliances in the equipment room will require an increase in the net free area to supply adequate combustion air for all appliances. Combustion air requirements are based on the latest edition of the National Fuel Gas Code, ANSI Z223.1; in Canada refer to the latest edition of CGA Standard CAN B149.1 or .2. Check all local code requirements for combustion air.

All dimensions based on net free area in square inches. Metal louvers or screens reduce the free area of a combustion air opening a minimum of approximately 25%. Check with louver manufacturers for exact net free area of louvers. Where two openings are provided, one must be within 12 inches (30 cm) of the ceiling and one must be within 12 inches (30 cm) of the floor of the mechanical room. Each opening must have net free area as specified in the chart above. Single openings shall commence within 12 inches (30 cm) of the ceiling.

The combustion air supply must be completely free of any flammable vapors that may ignite or chemical fumes which may be corrosive to the appliance. Common corrosive chemical fumes which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as Freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the heat exchanger finned tubes, headers, flue collectors, and the vent system. The result is improper combustion and a non-warrantable, premature appliance failure.

### **CAUTION**

Under no circumstances should the mechanical room ever be under a negative pressure. Particular care should be taken where exhaust fans, attic fans, clothes dryers, compressors, air handling units, etc., may take away air from the unit.

**EXHAUST FANS:** Any fan or equipment which exhausts air from the equipment room may deplete the combustion air supply and/or cause a down draft in the venting system. Spillage of flue products from the venting system into an occupied living space can cause a very hazardous condition that must be immediately corrected. If a fan is used to supply combustion air to the equipment room, the installer must make sure that it does not cause drafts that could lead to nuisance operational problems with the appliance.

## CONSTRUCTION AIR FILTER

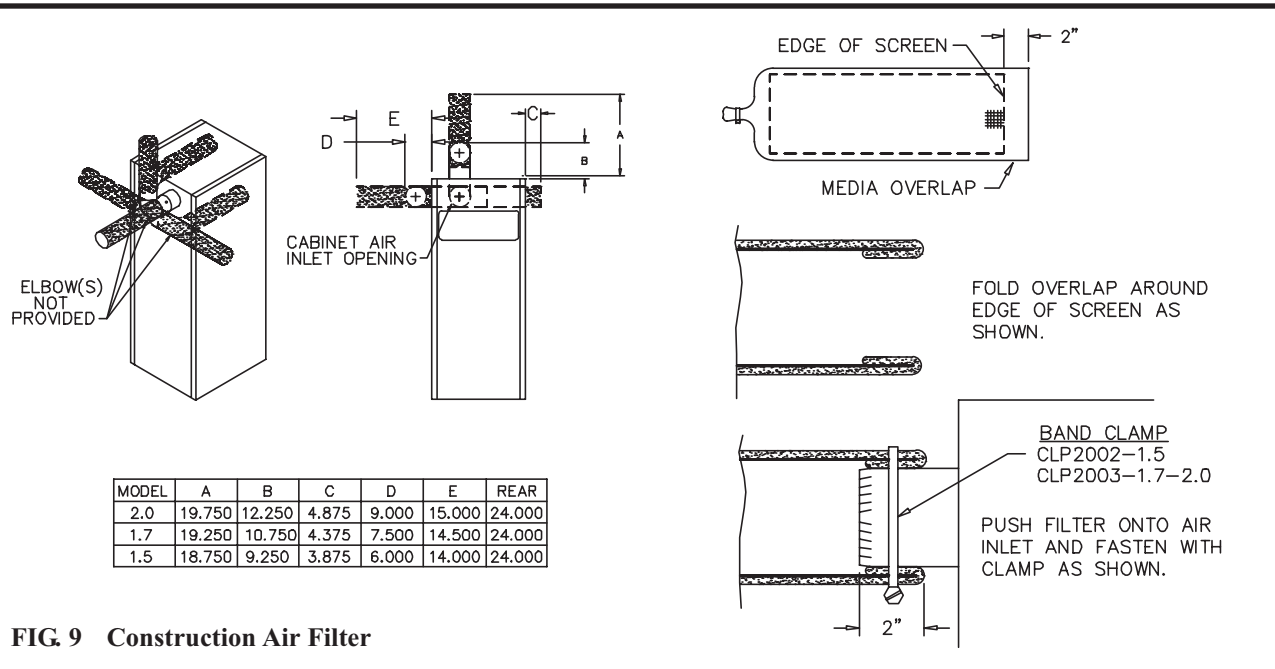


FIG. 9 Construction Air Filter

A construction air filter is provided with the appliance as shipped. An air filter is provided for installation on the combustion air inlet located at the rear of the appliance. This filter is **For Temporary Use Only** on an appliance that must be operated for temporary heat or hot water when a building is under construction. The filter will provide a temporary means to remove airborne dust, dirt and particulate matter generated by construction. The filter prevents air borne particulate contaminants from being drawn into the burner with the combustion air. The filter can be cleaned routinely during construction if necessary. Remove the filter to clean. Wash the filter with water. A flow of water from the inside to the outside should remove most particulate mater. Allow the filter to dry before reinstalling. Unfiltered combustion air from a construction site can contain contaminants that will collect in the burner reducing the firing rate. A burner that becomes clogged with air borne particulate contaminants must be removed and cleaned to restore proper operation to the burner. Sustained operation of an appliance with a clogged burner may result in nuisance operational problems, bad combustion and non-warrantable component failures. The combustion air filter **MUST** be removed from the appliance's air inlet before the appliance is placed in normal operation. Once the construction air filter is removed, ensure that either the equipment room is supplied with combustion air from properly sized combustion and ventilation air openings or a combustion air duct from a Direct Vent or DirectAir system is connected to the appliance.

The optional **Direct Vent** and **DirectAir** venting systems have specific requirements for a special combustion air duct from the outside that is directly connected to the appliance. See the requirements for this combustion air duct in the venting section for each specialized vent system.

**TABLE — C**  
**Construction Air Filter Kits**

Input Btu/hr	Construction Air Filter Kit
1,500,000	KIT4000
1,700,000	KIT4001
2,000,000	KIT4002

## VENTING

### Vent Systems Options

This appliance has three venting system options. They are: (A) **Category IV Venting** system with vertical roof top termination or sidewall termination of the flue and combustion air supplied from the mechanical room. (B) **Direct Vent** with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Direct Vent system terminates both the flue and air inlet in the same pressure zone. The flue outlet and combustion air intake may terminate on either the sidewall or with a rooftop termination. (C) **DirectAir** with a **Category IV** flue and a separate combustion air pipe to the outdoors. The DirectAir vent system terminates the flue and the combustion air inlet pipe in different pressure zones. The DirectAir vent system may terminate the flue on the roof top and combustion air intake on the sidewall, the flue on the sidewall and combustion air from the rooftop or the flue on the sidewall and combustion air from a different



sidewall. All appliances are shipped from the factory equipped for **Category IV** venting. The optional *Direct Vent* and *DirectAire* venting systems will require the installation of specific vent kits and venting materials. The following is a detailed explanation of the installation requirements for each venting system, components used and part numbers of vent kits for each model.

### General

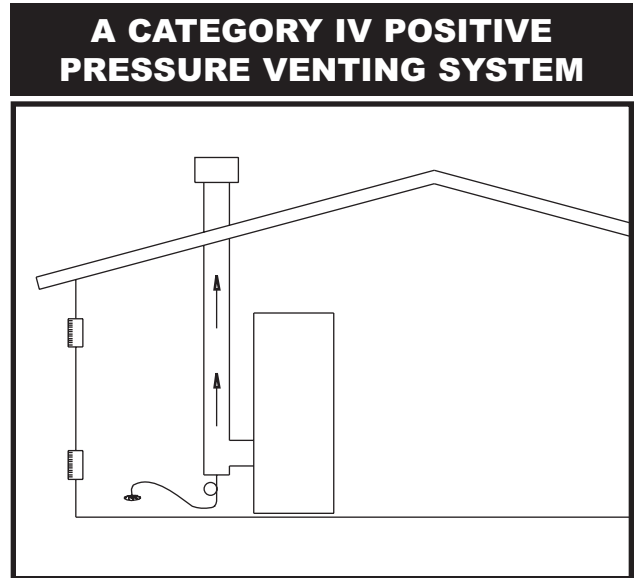
Vent installations for connection to gas vents or chimneys must be in accordance with Part 7, "Venting of Equipment," of the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Codes for Gas Burning Appliances and Equipment or applicable provisions of the local building codes.

Adequate combustion and ventilation air must be supplied to the equipment room in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Codes for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

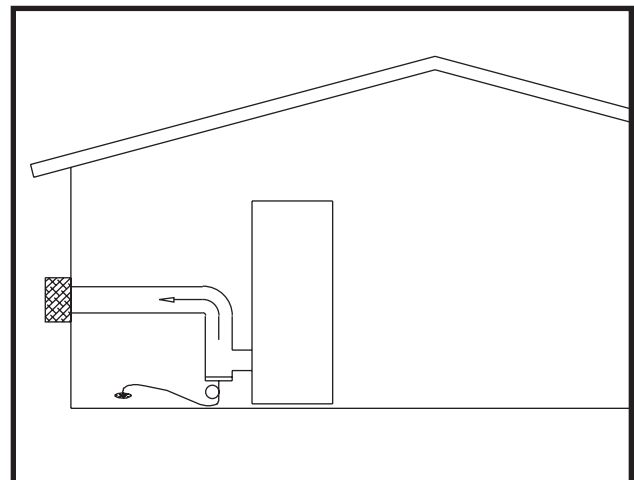
The distance of the vent terminal from adjacent buildings, windows that open and building openings **MUST** comply with the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Codes for Gas Burning Appliances and Equipment.

Vent connection is made directly to flue outlet opening on the back of the unit. The connection from the appliance vent to the stack must be made as direct as possible.

### Category IV Venting



**FIG. 10 Basic Category IV Venting - Vertical Termination with Combustion Air Louvers**



**FIG. 11 Basic Category IV Venting - Horizontal Termination with Combustion Air Louvers**

### IMPORTANT

Examine the venting system at least once a year. Check all joints and vent pipe connections for tightness. Also check for corrosion or deterioration. Immediately correct any problems observed in the venting system.

**TABLE — D**  
**The Category IV Flue**  
**Pipe Sizes Are:**

Input Btu/hr	Flue Size
1,500,000	8"
1,700,000	8"
2,000,000	10"

A **Category IV** venting system for the flue products is required on all models of this appliance. A **Category IV** venting system operates with a positive pressure in the vent. This positive pressure is generated by the internal combustion air blower which operates the combustion process and also exhausts the flue products from the building. The **Category IV** flue from this appliance can **NOT** be combined with the vent from any other appliance. The **Category IV** flues from multiple appliances can **NOT** be combined into a common vent. The **Category IV** flue from this appliance must be a dedicated stack, there is one exception however. The flues from multiple Power-Fin appliances may only be combined when using an engineered vent system incorporating an induced draft fan to ensure that flue products will be properly exhausted from the building at all times. Failure to use a properly sized induced draft fan on a combined vent installation may

result in a hazardous condition where flue gases spill into an occupied living space. Consult the induced draft fan manufacturer to size the induced draft fan and to determine the diameter of the common vent pipe required for a combined vent installation. The flue from this **Category IV** appliance must have all vent joints and seams sealed gas-tight. A **Category IV** vent system has specific vent material and installation requirements.

The flue products in the vent system may be cooled below their dew point and form condensate in the flue. The materials used for a **Category IV** vent must be resistant to any corrosive damage from flue gas condensate. The flue from a **Category IV** vent system must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the venting system.

### ***Category IV Flue Pipe Materials***

Select venting material from the following specified vent materials:

**Heat-Fab Inc.** Saf-T CI Vent with AL29-4C stainless steel (Call 1-800-772-0739 for nearest distributor)

**Protech Systems Inc.** Fas N Seal Vent with AL29-4C stainless steel (Call 1-800-766-3473 for nearest distributor)

**Metal-Fab Inc.** Corr/Guard Vent with AL29-4C stainless steel (Call 1-800-835-2830 for nearest distributor)

**Z-Flex** Z-Vent with AL29-4C stainless steel (Call 1-800-654-5600 for nearest distributor)

Or other listed **Category IV** vent systems suitable for a condensing, positive pressure gas fired appliance.

### ***Venting Guidelines for a Category IV Vent***

The connection from the appliance vent to the stack or vent termination outside the building **MUST** be made with listed **Category IV** vent system and must be direct as possible with no reduction in diameter. The **Category IV** vent and accessories, such as firestop spacers, thimbles, caps, etc., **MUST** be installed in accordance with the vent manufacturers instructions. The vent connector and firestop must provide correct spacing to combustible surfaces and seal to the vent connector on the upper and lower sides of each floor or ceiling through which the vent connector passes.

Each appliance must have a dedicated flue with no other appliance interconnected to any part of the dedicated flue. Each appliance **MUST** also connect to the dedicated flue stack using a properly sealed vent adapter provided by the vent manufacturer.

Any vent materials specified must be listed by a nationally recognized test agency for use as a **Category IV** vent material.

The venting system must be planned so as to avoid possible contact with concealed plumbing or electrical wiring inside walls, floors or ceilings.

Locate the appliance as close as possible to chimney or gas vent.

There shall be no reductions in vent diameter.

Horizontal portions of the venting system shall be supported to prevent sagging. Horizontal runs should slope upwards not less than 1/4 inch per foot (21 mm/m) from the drain tee installed in the flue to the vertical portion of the flue or to the vent terminal on sidewall venting installations. This ensures proper removal of any condensate that may form in the flue. Follow the installation instructions from the vent material manufacturer.

Do not use an existing chimney as a raceway if another appliance or fireplace is vented through the chimney.

The weight of the venting system must not rest on the unit. Adequate support of the venting system must be provided in compliance with local codes and other applicable codes. All connections should be secured and sealed per the vent manufacturers specifications.

Vent connectors serving appliances vented by natural draft shall not be connected to any portion of the **Category IV** positive pressure vent system used by this appliance. Connection of a negative draft flue into the positive pressure stack from this appliance may cause flue products to be discharged into an occupied living space causing serious health injury.

When a **Category IV** vent system is disconnected for any reason, the flue must be reassembled and resealed according to the vent manufacturer's instructions.

The installed length of the **Category IV** flue from the appliance to the point of termination, outside of the building, must not exceed a **maximum of 50 equivalent feet (15.2 m) in length**. Subtract 5 feet (1.5 m) of equivalent length for each 90° elbow installed in the vent. Subtract 2-1/2 feet (0.7 m) of equivalent length for each 45° elbow installed in the vent.

The flue may terminate either vertically at the roof top or horizontally on a sidewall. See the information about the specific vent termination location for recommended location and clearances.

### ***General Category IV Vent Termination Clearances***

The vent cap should have a minimum clearance of 4 feet (1.2 m) horizontally from and in no case above or below, unless a 4 foot (1.2 m) horizontal distance is maintained from electric meters, gas meters, regulators and relief equipment.

The venting system shall terminate at least 3 feet (0.9 m) above any forced air inlet within 10 feet (3.05 m).

The venting system shall terminate at least 4 feet (1.2 m) below, 4 feet (1.2 m) horizontally from, or 1 foot (30 cm) above any door, window or gravity air inlet into any building.

Do not terminate the vent in a window well, stairwell, alcove, courtyard or other recessed area. **The vent can not terminate below grade.** The bottom of the vent terminal shall be located at least 12 inches (30 cm) above grade and above normal snow levels.

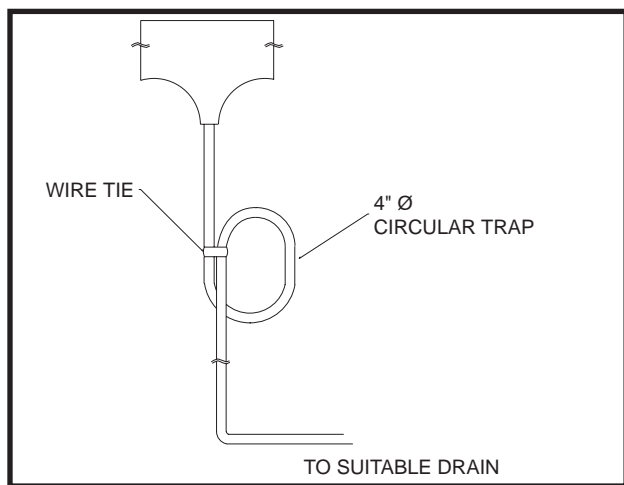
To avoid a blocked flue condition, keep the vent cap clear of snow, ice, leaves, debris, etc.

Flue gases from this appliance may contain large amounts of water vapor that will form a white plume in winter. Plume could obstruct a window view.

Flue gas condensate can freeze on exterior surfaces or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Flue gas condensate can cause discoloration of exterior building surfaces. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

The manufacturer shall **NOT** be held liable for any personal injury or property damage due to ice formation or the dislodging of ice from the vent system or the vent termination.

### Drain Tee Installation



**FIG. 12 Drain Tee Installed In Category IV Venting**

A drain tee **MUST** be installed in the **Category IV** vent pipe to collect and dispose of any condensate that may occur in the vent system. The drain tee should be installed at the point where the flue turns vertical for a roof top termination or as one of the first fitting in a horizontal flue that will terminate on a sidewall. Ensure that horizontal portions of the vent are properly sloped to allow condensate to be evacuated at the drain tee. See the typical vent installation drawings. Plastic drain tubing, sized per

the vent manufacturer's instructions, shall be provided as a drain line from the tee. The drain tubing must have a trap provided by a 4 inches (10.2 cm) diameter circular trap loop in the drain tubing. Prime the trap loop by pouring a small quantity of water into the drain hose before assembly to the vent. Secure the trap loop in position with nylon wire ties. Use caution not to collapse or restrict the condensate drain line with the nylon wire ties. The condensate drain must be routed to the condensate neutralization system or a suitable drain for disposal of condensate that may occur in the **Category IV** vent system. Refer to the condensate drain installation instructions as supplied by the manufacturer of the vent material. Ensure that the drain from the condensate tee is not exposed to freezing temperatures. See "Freeze Protection" for more information.

## MASONRY CHIMNEY INSTALLATIONS

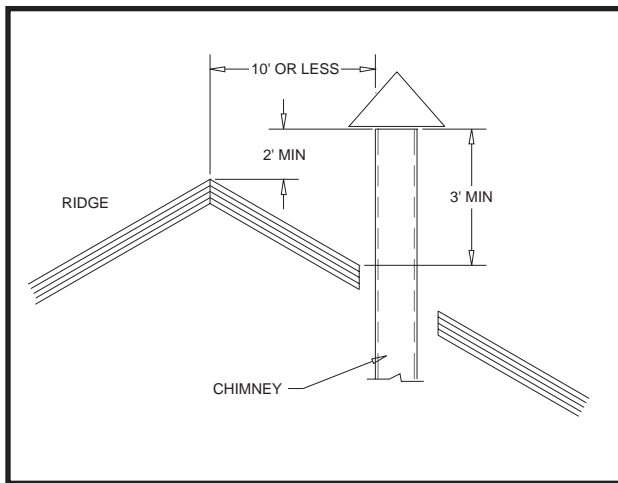
A standard masonry chimney must **NOT** be used to vent the products of combustion from the flue of a **Category IV**, positive pressure appliance. **If a masonry chimney is to be used, the chimney MUST use a sealed, metallic, corrosion resistant liner system to vent flue products from this high efficiency appliance. Sealed, metallic, corrosion resistant liner systems (single wall, double-wall, or flexible or rigid metallic liners) must be rated for use with a high efficiency, Category IV, positive pressure vent system.** Corrosion resistant chimney liner systems are typically made from a high grade of corrosion resistant stainless steel such as AL29-4C. The corrosion resistant liner must be properly sized and fully sealed throughout the entire length if the flue is contained within the masonry chimney. Both the top and the bottom of the masonry chimney must be capped and sealed to provide a dead air space around the sealed corrosion resistant metallic liner. **Consult with local code officials to determine code requirements or the advisability of using a masonry chimney with a sealed corrosion resistant liner system.**

## CAUTION: ⚠

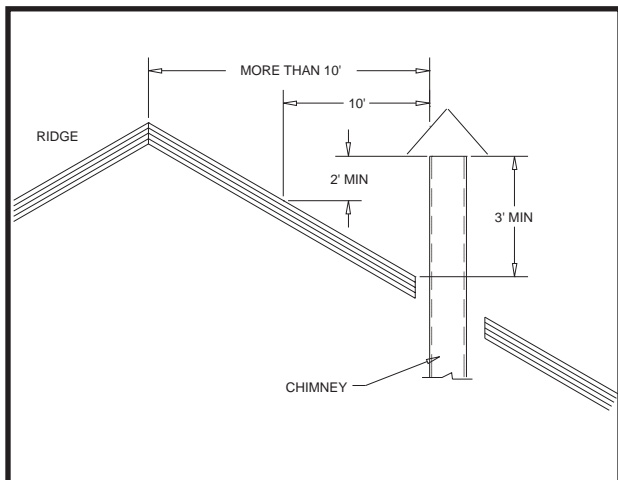
Venting of a high efficiency **Category IV** appliance into a masonry chimney without a sealed stainless steel liner can result in operational and safety problems. Any breaks, leaks or damage to the masonry flue/tile will allow spillage of the positive pressure flue products from the chimney. These flue products can easily escape into an occupied living space causing a health hazard. If there is any doubt about the condition of a masonry chimney, or its acceptability for use after insertion of a corrosion resistant liner system, consult with local code officials.

## VERTICAL VENTING TERMINATIONS

Follow all General **Category IV** Vent Termination Clearances.



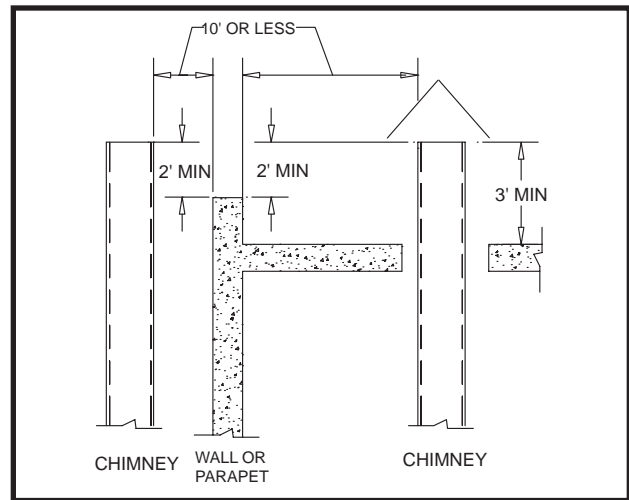
**FIG. 13 Vent Termination from Peaked Roof - 10' or Less From Ridge**



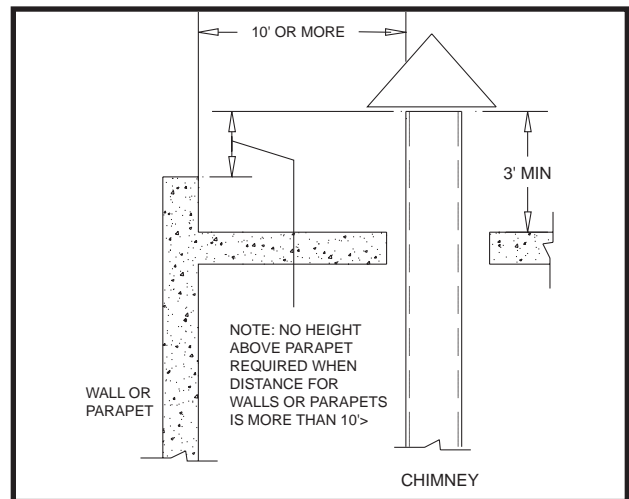
**FIG. 14 Vent Termination from Peaked Roof More Than 10' From Ridge**

The vent terminal should be vertical and exhaust outside the building at least 2 feet (0.61 m) above the highest point of the roof within a 10 foot (3.05 m) radius of the termination.

The vertical termination must be a minimum of 3 feet (0.91 m) above the point of exit.



**FIG. 15 Vent Termination from Flat Roof 10' or Less from Parapet Wall**

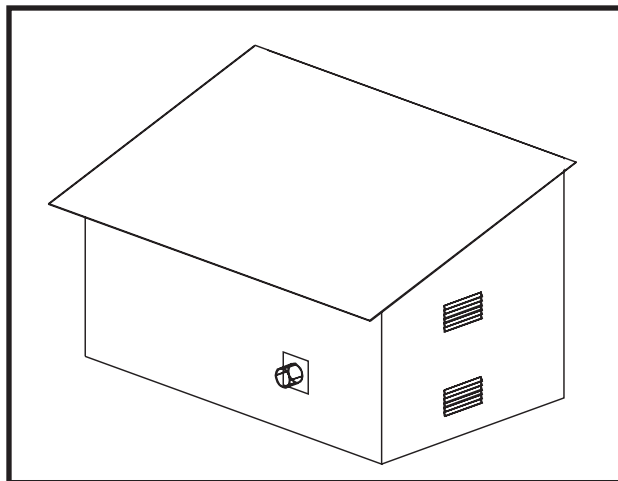


**FIG. 16 Vent Termination from Flat Roof More Than 10' from Parapet Wall**

A vertical termination less than 10 feet (3.05 m) from a parapet wall must be a minimum of 2 feet (0.61 m) higher than the parapet wall.

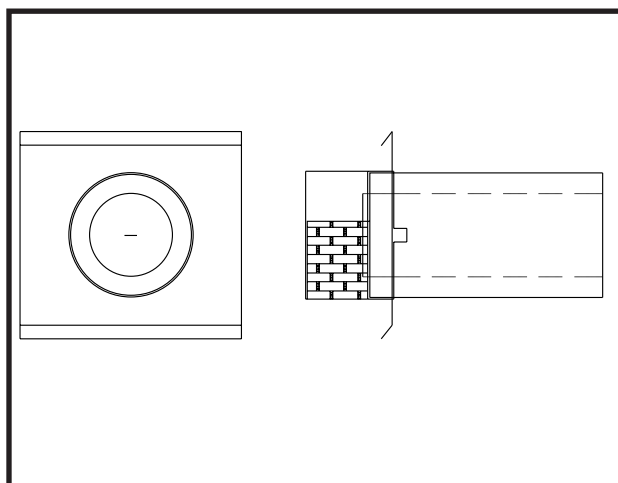
## SIDEWALL VENTING TERMINATIONS

This venting system uses the appliance's internal combustion air blower to force the flue products out of a horizontally-terminated flue. This blower generates a positive pressure in the flue. Combustion air is drawn from the equipment room (see Combustion and Ventilation Air Requirements) unless the appliance is equipped with an optional Direct Vent or DirectAire vent system.



**FIG. 17 Sidewall Venting Installation**

The connection from the appliance flue outlet to the sidewall vent cap **MUST** be made with listed type **Category IV** vent materials and accessories. The installer must supply suitable vent pipe material. The sidewall vent cap is available from the appliance manufacturer as a vent kit.



**FIG. 18 Sidewall Vent Cap**

<b>TABLE — E</b>		
<b>Sidewall Vent Cap Kits</b>		
<b>Input Btu/hr</b>	<b>Flue Size</b>	<b>Sidewall Vent Cap Kit</b>
1,500,000	8"	SVK3028
1,700,000	8"	SVK3028
2,000,000	10"	SVK3029

The sidewall vent cap kit includes the wall penetration assembly and the discharge screen assembly. All required **Category IV** vent pipe and fittings must be purchased locally. The installed sidewall vent cap assembly may be painted to match the exterior décor.

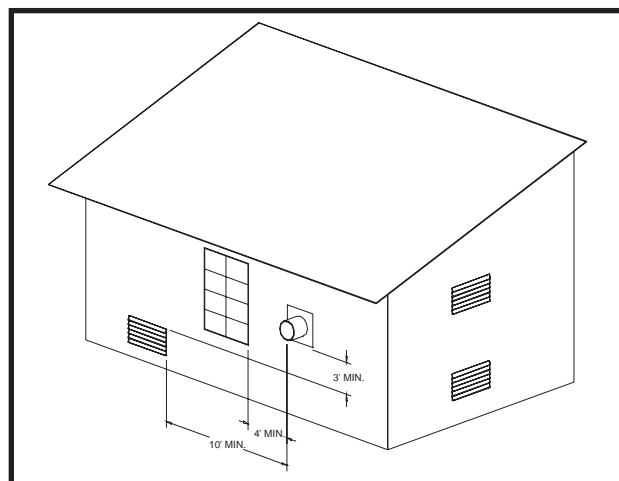
The opening through the wall for installation of the sidewall vent cap must provide an air space clearance of 2 inches (5.1 cm) around the flue pipe. The diameter of the opening for installation of the sidewall cap will be 4 inches (10.2 cm) larger (minimum) than the nominal diameter of the installed vent pipe to the sidewall cap.

The sidewall cap is installed from the outside and mounted to the wall with four screws or wall anchors. Seal under the screw heads with caulking. Install the screen assembly using the stainless steel screws provided in the kit. Install the **Category IV** vent pipe from the appliance to the vent cap. The installed vent pipe must protrude at least 2 inches (5.1 cm) into the screen area beyond the thimble portion of the sidewall cap assembly. See detailed instructions packed with the sidewall vent kit.

Follow all requirements in the General **Category IV** Venting sections for venting flue products to the outdoors. See the Combustion and Ventilation Air Requirements section to ensure that adequate combustion and ventilation air is supplied to the equipment room. All other general installation requirements must be followed.

## LOCATION OF A SIDEWALL VENT TERMINATION

Follow all General **Category IV** Vent Termination Clearances.



**FIG. 19 Sidewall Venting Installation with Clearances From Vent Cap**

The vent cap shall terminate at least 3 feet (0.91 m) above any forced air inlet within 10 feet (3.05 m).

The vent shall terminate at least 4 feet (1.22 m) below, 4 feet (1.22 m) horizontally from or 1 foot (0.30 m) above and 2 feet (0.60 m) horizontally from any door, window or gravity air inlet to the building.



The sidewall vent termination must be at least 8 feet (2.4 m) horizontally from any combustion air intake located above the sidewall termination cap.

Do not terminate the vent in a window well, stairwell, alcove, courtyard or other recessed area. The vent can not terminate below grade.

The vent shall not terminate directly above a public walkway due to the normal formation of water vapor in the combustion process. Horizontal terminations must not be located over areas of pedestrian or vehicular traffic.

The vent system shall terminate at least 1 foot (0.30 m) above grade, above normal snow levels and at least 7 feet (2.13 m) above grade when located adjacent to public walkways.

The vent terminal shall not be installed closer than 3 feet (0.91m) from an inside corner of an L-shaped structure.

The vent cap should have a minimum clearance of 4 feet (1.22 m) horizontally from and in no case above or below, unless a 4-foot (1.22 m) horizontal distance is maintained from electric meters, gas meters, regulators and relief equipment.

Flue gas condensate can freeze on exterior walls or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Some discoloration to exterior building surfaces can be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

The sidewall vent system **MUST** use the sidewall vent cap kit provided by the appliance manufacturer for installation on a sidewall termination.

The sidewall vent cap **MUST** be purchased as a kit from the appliance manufacturer to ensure proper operation. Locally purchased or fabricated sidewall vent caps should not be used

## DIRECT VENT AND DIRECTAIRE VENT SYSTEMS

Direct Vent and DirectAire Vent Systems are installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Direct Vent System terminates both the flue and combustion air inlet in the same pressure zone. The DirectAire Vent System terminates the flue and combustion air inlet in different pressure zones. The flue outlet and combustion air intake may terminate with either a sidewall or a rooftop termination.

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting of flue products vertically or horizontally to the outdoors. All other general installation requirements must be followed.

The Direct Vent and Intelli-Vent Systems require the installation of an additional pipe to supply combustion air from outdoors directly to the appliance.

In cold climates, the use of type “B” double wall vent pipe or an insulated single wall pipe for combustion air is recommended to help prevent moisture in the cool incoming air from condensing and leaking from the inlet pipe.

Termination point for the flue products must follow the clearance requirements in the Vertical or Horizontal Vent Termination sections of the **Category IV** Venting.

### CAUTION: ⚠

Appliances that are shut down or will not operate may experience freezing due to convective airflow in the air inlet pipe connected to the appliance.

**TABLE — F**  
**Direct Vent and DirectAire Flue and Air Inlet Pipe Sizes**

Input Btu/hr	Flue Size	Air Inlet Pipe Size
1,500,000	8"	6"
1,700,000	8"	7"*
2,000,000	10"	8"

\*Piping from the appliance to the air inlet cap may be either 7" or 8". An 8" diameter sidewall air inlet cap is provided in the venting kit.

### *Length of Air Inlet Pipe*

The **maximum total length of the sidewall or vertical rooftop combustion air inlet pipe as installed from the appliance to the air inlet cap must not exceed 50 equivalent feet (15.2 m) in length.** Subtract 5 feet (1.52 m) of equivalent length for each 90° elbow installed in the air inlet pipe system. Subtract 2 1/2 feet (0.7 m) of equivalent length for each 45° elbow installed in the air inlet pipe system.

Do not exceed limits for the combustion air inlet piping lengths.

### *Air Inlet Pipe Materials*

The air inlet pipe(s) must be sealed. Choose acceptable combustion air inlet pipe materials from those specified in this section.



Select air inlet pipe material from the following specified materials:

PVC, CPVC or ABS (6", 7" or 8" I.D.)\*

Dryer Vent or Sealed Flexible Duct (not recommended for roof top air inlet)

Galvanized steel vent pipe with joints and seams sealed as specified below.

Type "B" double wall vent with joints and seams sealed as specified below

\* Plastic pipe may require an adapter (not provided) to transition between the air inlet connection on the appliance and the plastic air inlet pipe.

### **WARNING: ⚠**

Using vent or air intake materials other than those specified, failure to properly seal all seams and joints or failure to follow vent pipe manufacturer's instructions can result in personal injury, death or property damage. Mixing of venting materials will void the warranty and certification of the appliance.

### **NOTE:**

The use of double wall vent or insulated material for the combustion air inlet pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

#### **Sealing of Type "B" double wall vent material or galvanized vent pipe material used for air inlet pipe on a sidewall or vertical roof top Combustion Air Supply System.**

- Seal all joints and seams of the air inlet pipe using either Aluminum Foil Duct Tape meeting UL Standard 723 or 181A-P or a high quality UL Listed silicon sealant such as those manufactured by Dow Corning or General Electric.
- Do not install seams of vent pipe on the bottom of horizontal runs.
- Secure all joints with a minimum of three sheet metal screws or pop rivets. Apply aluminum foil duct tape or silicone sealant to all screws or rivets installed in the vent pipe.
- Ensure that the air inlet pipes are properly supported.

The PVC, CPVC or ABS air inlet pipe should be cleaned and sealed with the pipe manufacturers recommended solvents and standard commercial pipe cement for the

material used. The PVC, CPVC, ABS, Dryer Vent or Flex Duct air inlet pipe should use a silicone sealant to ensure a proper seal at the appliance connection and the air inlet cap connection. Dryer vent or flex duct should use a screw type clamp to seal the vent to the appliance air inlet and the air inlet cap. Proper sealing of the air inlet pipe ensures that combustion air will be free of contaminants and supplied in proper volume.

When a sidewall or vertical roof top combustion air supply system is disconnected for any reason, the air inlet pipe must be resealed to ensure that combustion air will be free of contaminants and supplied in proper volume.

### **DANGER: ⚠**

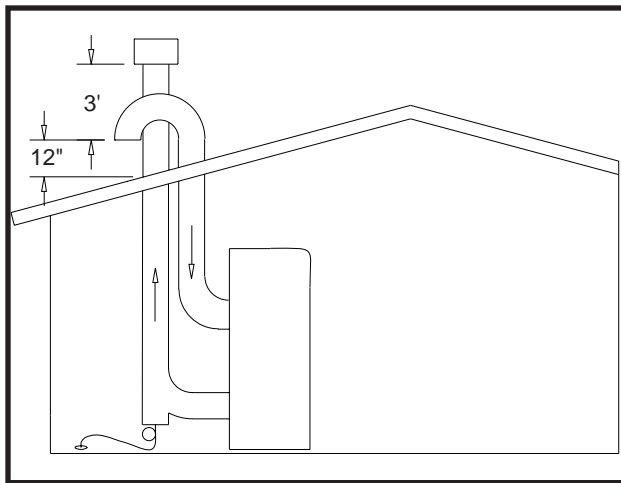
Failure to properly seal all joints and seams as required in the air inlet piping may result in flue gas recirculation, spillage of flue products and carbon monoxide emissions causing severe personal injury or death.

#### ***Combined Combustion Air Inlet Points***

The air inlet pipes from multiple appliances can be combined to a single common connection if the common air inlet pipe has a cross sectional area equal to or larger than the total area of all air inlet pipes connected to the common air inlet pipe. [Example: two 8" (20.3 cm) air inlet pipes (50.3 in<sup>2</sup> (324.5 cm<sup>2</sup>) area each) have a total area of 100.6 in<sup>2</sup> (645.2 cm<sup>2</sup>) requires a 12 inches (30.5 cm) (113.1 in<sup>2</sup> area) (729.7 cm<sup>2</sup>) common air inlet pipe.] The air inlet point for multiple boiler air inlets must be provided with an exterior opening which has a free area equal to or greater than the total area of all air inlet pipes connected to the common air inlet. This exterior opening for combustion air must connect directly to the outdoors. The total length of the combined air inlet pipe must not exceed a maximum of 50 (15.2 m) equivalent feet. You must deduct the restriction in area provided by any screens, grills or louvers installed in the common air inlet point. These are common on the sidewall air inlet openings and some rooftop terminations. Screens, grills or louvers installed in the common air inlet can reduce the free area of the opening from 25% to 75% based on the materials used.

### **VERTICAL DIRECT VENT SYSTEMS**

A Vertical Direct Vent System is installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Direct Vent system terminates both the flue and air inlet in the same pressure zone. The flue outlet and combustion air intake must both terminate on the rooftop.



**FIG. 20 Vertical Direct Vent Installation with Rooftop Combustion Air Inlet**

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products vertically to the outdoors. All other general installation requirements must be followed.

The Direct Vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. The air inlet pipe must use one of the specified materials.

The **maximum installed length of the air inlet pipe from the appliance to the air inlet cap is 50 equivalent feet (15.2 m)** in length. The **maximum installed length of the flue pipe from the appliance to the termination cap is 50 equivalent feet (15.2 m)** in length. Subtract 5 feet (1.52 m) of equivalent length for each 90° elbow installed in either the flue pipe or the air inlet pipe.

Termination point for the flue products must follow the clearance requirements in the Vertical Vent Termination sections of the **Category IV** Venting.

The air inlet cap for the vertical roof top air inlet is assembled from components purchased locally. The air inlet cap consist of two 90° elbows installed at the point of termination for the air inlet pipe. The first 90° elbow is installed on the rooftop at the highest vertical point of the air inlet pipe and turned horizontal, the second 90° elbow is installed on the horizontal outlet of the first elbow and turned down. A 90° elbow and a 90° street elbow may be used to make this assembly. If a straight piece of pipe is used between the two elbows, it should not exceed 6 inches (152 mm) in length. The termination elbow on the air inlet must be located a minimum of 12" (0.30 m) above the roof or above normal levels of snow accumulation.

The point of termination for the combustion air inlet cap **MUST** be at least 3 feet (0.91 m) below the point of flue gas termination (vent cap) if it is located within a 10 foot (3.05 m) radius of the flue outlet. Use care to ensure that the 90° elbow assembly is properly installed on the air inlet pipe.

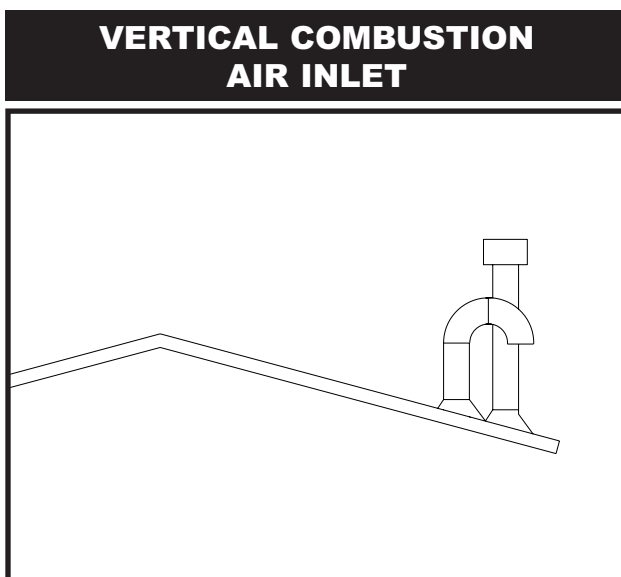
The combustion air inlet cap must not be installed closer than 10 feet (3.05 m) from an inside corner of an L-shaped structure.

The termination point of the combustion air inlet cap must be installed at least one foot (0.30 m) above the rooftop and above normal snow levels.

The combustion air cap assembly used **MUST** adequately protect the combustion air inlet from wind and weather.

The combustion air cap and flue gas outlet **MUST** be located on the same roof top surface and in the same pressure zone.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products in to the combustion air inlet, follow all instructions in this section.



**FIG. 21 Air Inlet Cap for Rooftop Termination**

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death or property damage.

## Multiple Vertical Direct Vent Installations

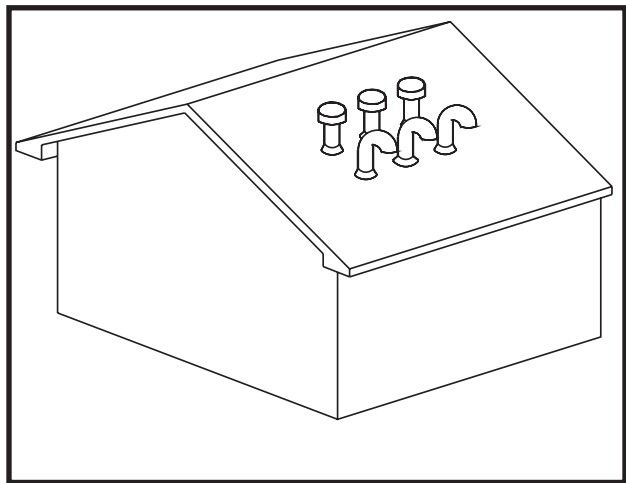


FIG. 22 Multiple Vertical Direct Vent Installations

The combustion air inlet caps for multiple appliance installations must maintain the minimum 3 foot (0.91 m) clearance below the closest vertical flue outlet if within 10 feet (3.05 m). Multiple flue outlet caps may be installed side by side and multiple air inlet caps may be installed side by side but the air inlet must always be at least 3 feet (0.91 m) below the closest flue outlet if the outlet is within 10 feet (3.05 m). All clearance and installation requirements in this section and the applicable portions of the general **Category IV** venting section must be maintained on multiple appliance installations.

## HORIZONTAL DIRECT VENT

For venting flue products horizontally to the outdoors, follow all requirements in the installation instructions for sidewall venting. Termination point for the flue products must follow the clearance requirements in the Sidewall Vent Termination section of **Category IV** Venting.

A Horizontal Direct Vent System is installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Direct Vent system terminates both the flue and air inlet in the same pressure zone. The flue outlet and combustion air intake must both terminate on the same sidewall.

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products to the outdoors with a sidewall termination. All other general installation requirements must be followed.

The Direct Vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. The air inlet pipe must use one of the specified materials.

The maximum installed length of the air inlet pipe from the appliance to the air inlet cap is 50 equivalent feet (15.2 m) in length. The maximum installed length of the flue pipe from the appliance to the termination cap is 50 equivalent feet (15.2 m) in length. Subtract 5 feet (1.52 m) of equivalent length for each 90° elbow installed in either the flue pipe or the air inlet pipe. Subtract 2 1/2 feet (0.7 m) of equivalent length for each 45° elbow installed in either the flue or the air inlet pipe.

Termination point for the flue products must follow the clearance requirements in the Sidewall Venting Termination sections of the **Category IV** Venting.

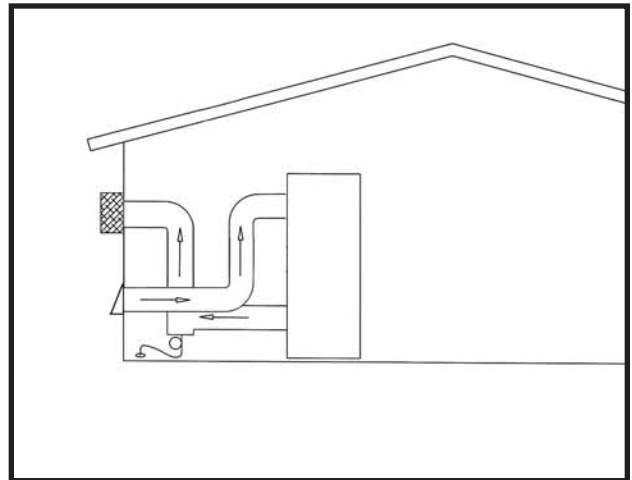


FIG. 23 Horizontal Direct Vent Installation with Sidewall Combustion Air Inlet

## SIDEWALL COMBUSTION AIR INLET

Horizontal Direct Vent systems installed with sidewall terminations for both combustion air and flue products must purchase the termination caps from the appliance manufacturer. The sidewall air inlet cap and sidewall vent cap for flue products are available as a vent kit.

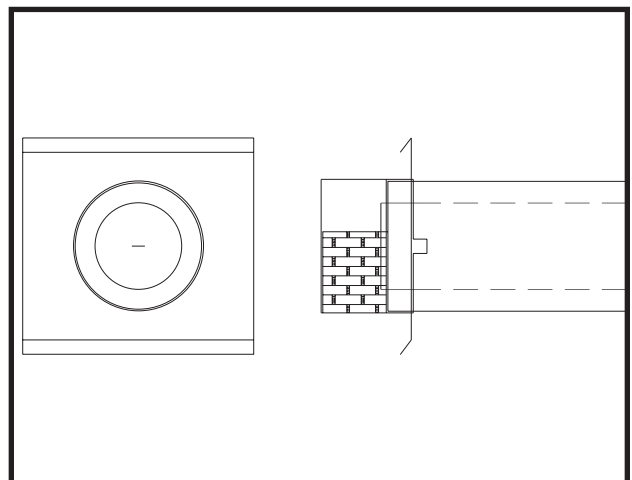


FIG. 24 Sidewall Vent Cap

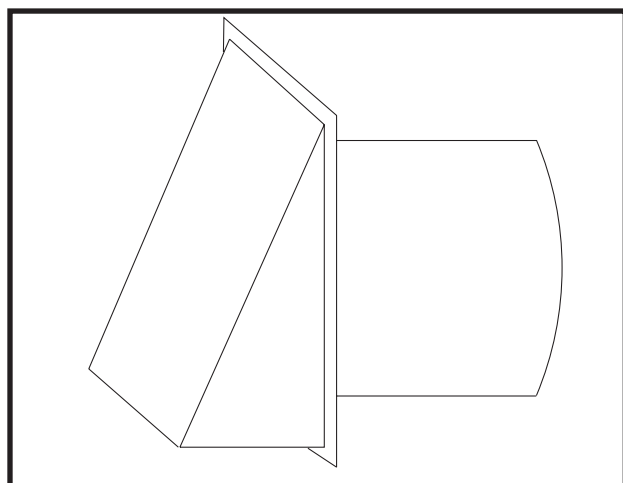
The part numbers for the required sidewall air inlet cap kit are listed by unit size. The manufacturer, in accordance with CSA/CGA requirements, must furnish the sidewall air inlet cap. Each kit includes the special combustion air inlet cap for installation on an exterior sidewall. The sidewall air inlet cap supplied in the kit is sized to provide combustion air for a single appliance only.

<b>TABLE — G</b> <b>Horizontal Direct Vent Kits</b>			
<b>Input Btu/hr</b>	<b>Flue Cap Size</b>	<b>Air Inlet Cap Size</b>	<b>Sidewall Air Inlet Flue Cap Kit</b>
1,500,000	8"	6"	HDK3021
1,700,000	8"	8"*	HDK3022
2,000,000	10"	8"	HDK3023

\*Piping from the appliance to the air inlet cap may be either 7" or 8" connecting to an 8" sidewall cap provided in the kit.

### *Location of a Sidewall Air Inlet Cap*

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death or property damage



**FIG. 25 Air Inlet Cap for Sidewall Termination**

The termination point of the sidewall air inlet must be installed a minimum of 12 inches (0.30 m) above ground level and above normal levels of snow accumulation.

The point of termination for the sidewall combustion air inlet cap **MUST** be located a minimum of 3 feet (0.91 m)

horizontally and 12 inches (0.30 m) below the point of flue gas termination (vent cap) if it is located within a 10 foot (3.05 m) radius of the flue outlet.

The sidewall combustion air inlet cap **MUST NOT** be installed above the sidewall flue outlet if it is located within a 10 foot (3.05 m) radius of the flue outlet.

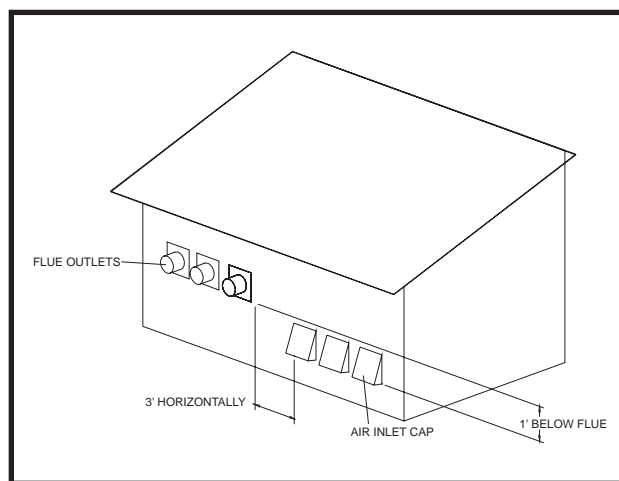
The sidewall combustion air inlet cap must not be installed closer than 10 feet (3.05 m) from an inside corner of an L-shaped structure.

The sidewall combustion air cap assembly used **MUST** adequately protect the combustion air inlet from wind and weather.

The sidewall combustion air inlet cap and flue gas outlet **MUST** be located on the same sidewall surface and in the same pressure zone.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products in to the combustion air inlet, follow all instructions in this section.

### *Multiple Horizontal Direct Vent Installations*



**FIG. 26 Multiple Horizontal Direct Vent Caps Installed on a Sidewall**

The combustion air inlet caps for multiple appliance installations must maintain the same minimum clearance from the closest vent cap installed within a 10 foot radius of the point of flue gas termination as specified in single appliance installations. Multiple flue outlet caps may be installed side by side and multiple air inlet caps may be installed side by side but, the minimum clearance of a 3 feet (0.91 m) horizontal radius and 12 inches (0.30 m) below the closest flue outlet to the air inlet cap must be maintained. All clearance and installation requirements in this section and the applicable portions of the general **Category IV** venting section must be maintained on multiple appliance installations.

## DIRECTAIRE VENT SYSTEMS

A DirectAire vent system is a **Category IV** flue installed with a separate combustion air pipe to the outdoors. The DirectAire vent system terminates the flue and the combustion air inlet pipe in different pressure zones. The DirectAire vent system may terminate the flue and combustion air in any one of three configurations. These are: (1) the flue on the roof top and combustion air intake on the sidewall; (2) the flue on the sidewall and combustion air from the rooftop; (3) the flue on the sidewall and the combustion air on a sidewall other than the sidewall where the flue is located. All appliances are shipped from the factory equipped for **Category IV** venting system. The optional DirectAire vent systems require the installation of specific venting materials that are purchased locally. Sidewall termination caps for flue products and combustion air must be purchased from the manufacturer. The sidewall caps for combustion air and flue products are available as vent kits. The following is a detailed explanation of the installation requirements for each venting system, components used and part numbers of vent kits for each model.

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products to the outdoors with either a rooftop or a sidewall termination. All other general installation requirements must be followed.

The DirectAire vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. The air inlet pipe must use one of the specified materials.

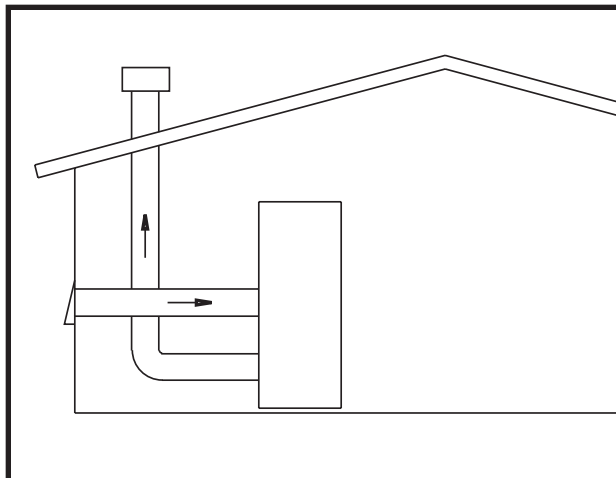
### *Combined Air Inlet Points*

The air inlet pipes from multiple appliances installed with a DirectAire vent system can be combined to a single common connection based on the cross sectional area of the common pipe as defined in the Direct-Vent basic information section.

### *Maximum Length of a DirectAire Vent System*

The **maximum installed length of the air inlet pipe from the appliance to the air inlet cap is 50 equivalent feet (15.2 m) in length.** The **maximum installed length of the flue pipe from the appliance to the termination cap is 50 equivalent feet (15.2 m) in length.** Subtract 5 feet (1.52 m) of equivalent length for each 90° elbow installed in either the flue pipe or the air inlet pipe. Subtract 2 1/2 feet (0.7 m) of equivalent length for each 45° elbow installed in either the flue pipe or the air inlet pipe.

## VERTICAL DIRECTAIRE WITH SIDEWALL COMBUSTION AIR



**FIG. 27 Vertical DirectAire Installation with Sidewall Combustion Air Inlet**

DirectAire vent systems are installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Vertical DirectAire vent system terminates the flue at the rooftop and air inlet at the sidewall. The flue outlet and combustion air intake terminate in different pressure zones.

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products vertically to the outdoors. All other general installation requirements must be followed.

The DirectAire vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance.

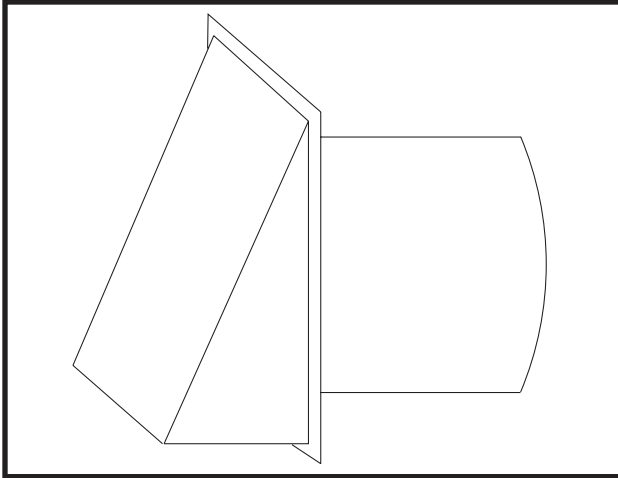
Termination point for the flue products must follow the clearance requirements in the Vertical Vent Termination section of the **Category IV** Venting.

### **CAUTION: ⚠**

Appliances that are shut down or will not operate may experience freezing due to convective airflow in the air inlet pipe connected to the appliance.



## SIDEWALL COMBUSTION AIR INLET



**FIG. 28 Air Inlet Cap for Sidewall Termination**

The air inlet cap for the sidewall air inlet must be purchased from the appliance manufacturer.

The part numbers for the required sidewall air inlet cap kit are listed by unit size. The appliance manufacturer, in accordance with CSA/CGA requirements, must furnish the sidewall air inlet cap. Each kit includes the special combustion air inlet cap for installation on an exterior sidewall.

**TABLE — H  
Sidewall Air Inlet Cap Kits**

Input Btu/hr	Flue Size	Air Inlet Pipe Size	Sidewall Air Inlet Cap Kit
1,500,000	8"	6"	SAK3000
1,700,000	8"	7"*	SAK3001
2,000,000	10"	8"	SAK3001

\*Piping from the appliance to the air inlet cap may be either 7" or 8" connecting to an 8" sidewall cap provided in the kit.

### *Location of a Sidewall Air Inlet Cap*

Installation, location and clearance requirements for the sidewall air inlet cap in an DirectAire vent application are the same as the installation, location and clearance requirements for the sidewall air inlet cap in the Horizontal Direct Vent section of the venting instructions.

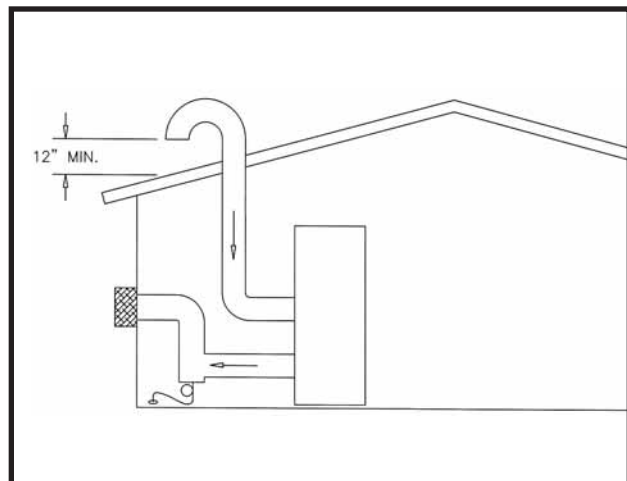
The sidewall combustion air inlet cap and the rooftop flue gas outlet are located in different pressure zones in a DirectAire system.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products in to the combustion air inlet, follow all instructions in this section.

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death or property damage.

## HORIZONTAL DIRECTAIRE WITH VERTICAL COMBUSTION AIR

DirectAire vent systems are installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Horizontal DirectAire system terminates the flue at the sidewall and air inlet at the rooftop. The flue outlet and combustion air intake terminate in different pressure zones.



**FIG. 29 Horizontal DirectAire Installation with Rooftop Combustion Air Inlet**

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products horizontally to the outdoors. All other general installation requirements must be followed.

The DirectAire vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance.

In cold climates, the use of type "B" double wall vent pipe or an insulated single wall pipe is recommended to help prevent moisture in the cool incoming air from condensing and leaking from the inlet pipe.

Termination point for the flue products must follow the clearance requirements in the Horizontal Sidewall Vent Termination section of the **Category IV** Venting.



### CAUTION: ⚠

Appliances that are shut down or will not operate may experience freezing due to convective airflow in the air inlet pipe connected to the appliance.

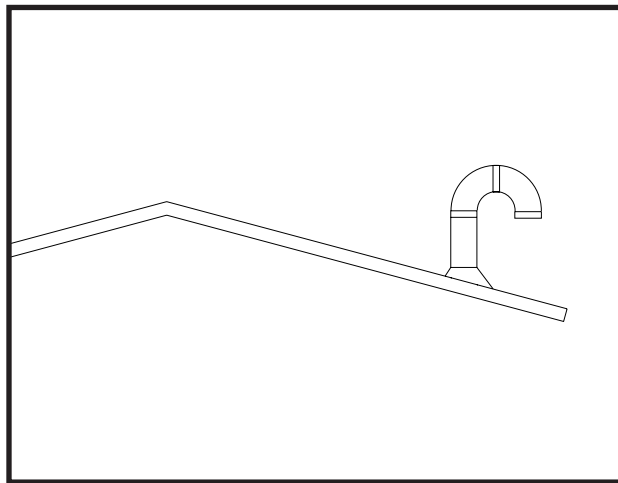
The flue and air inlet duct sizes for a Horizontal DirectAire Installation with Rooftop Combustion Air Inlet are listed by unit size. The sidewall vent cap must be purchased from the appliance manufacturer as a vent kit.

**TABLE — I**  
**Sidewall Vent Cap Kits**

Input Btu/hr	Flue Size	Air Inlet Pipe Size	Sidewall Vent Cap Kit
1,500,000	8"	6"	SVK3028
1,700,000	8"	7"*	SVK3028
2,000,000	10"	8"	SVK3029

\*Piping from the appliance to the air inlet cap may be either 7" or 8" connecting to an 8" sidewall cap provided in the kit.

### VERTICAL COMBUSTION AIR INLET



**FIG. 30** Air Inlet Cap for Rooftop Termination

The air inlet cap for the vertical roof top air inlet is assembled from components purchased locally. The air inlet cap consist of two 90° elbows installed at the point of termination for the air inlet pipe. The first 90° elbow is installed on the rooftop at the highest vertical point of the air inlet pipe and turned horizontal, the second 90° elbow is installed on the horizontal outlet of the first elbow and turned down. A 90° elbow and a 90° street elbow may be used to make this assembly. If a straight piece of pipe is used between the two elbows, it should not exceed 6 inches (152 mm) in length. The termination elbow on the air inlet must

be located a minimum of 12 inches (0.30 m) above the roof or above normal levels of snow accumulation.

### *Location of a Rooftop Air Inlet Cap*

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death or property damage

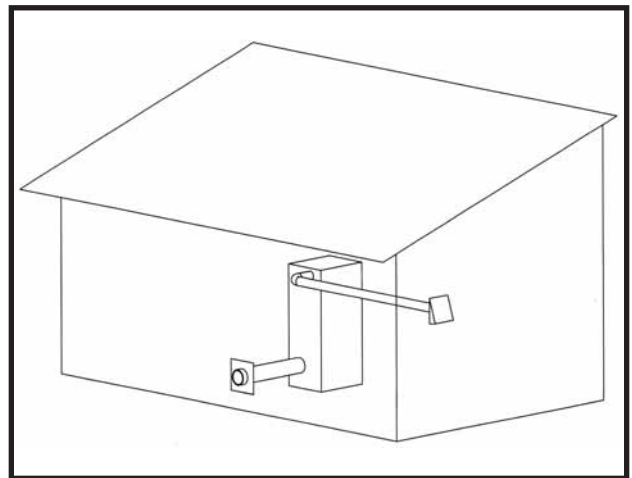
Installation, location and clearance requirements for the rooftop air inlet cap in an DirectAire application are the same as the installation, location and clearance requirements for the rooftop air inlet cap in the Vertical Direct Vent section of the venting instructions.

The rooftop combustion air inlet cap and the sidewall flue gas outlet are located in different pressure zones in a DirectAire vent system.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products in to the combustion air inlet, follow all instructions in this section and related Direct Vent sections.

### HORIZONTAL DIRECTAIRE WITH SIDEWALL COMBUSTION AIR

DirectAire systems are installed with a **Category IV** flue and a separate combustion air pipe to the outdoors. The Horizontal DirectAire system terminates the flue at the sidewall and the combustion air on a sidewall other than the sidewall where the flue is located. The sidewall flue outlet and sidewall combustion air intake must terminate in different pressure zones.



**FIG. 31** Horizontal DirectAire Installation with Sidewall Combustion Air Inlet in a Different Pressure Zone

Follow all requirements in the General **Category IV** Venting sections for proper installation and of venting flue products horizontally to the outdoors. All other general installation requirements must be followed.

The DirectAire System requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance.

In cold climates, the use of type “B” double wall vent pipe or an insulated single wall pipe is recommended to help prevent moisture in the cool incoming air from condensing and leaking from the inlet pipe.

Termination point for the flue products must follow the clearance requirements in the Horizontal Sidewall Vent Termination section of the **Category IV** Venting.

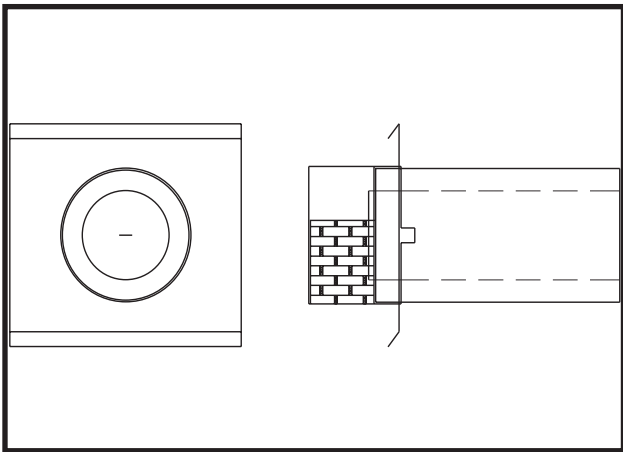
**CAUTION: ⚠**

Appliances that are shut down or will not operate may experience freezing due to convective airflow in the air inlet pipe connected to the appliance.

The flue and air inlet duct sizes for a Horizontal DirectAire Installation with Sidewall Combustion Air Inlet are listed by unit size.

**SIDEWALL COMBUSTION AIR INLET**

DirectAire systems installed with sidewall terminations for both combustion air and flue products must purchase the termination caps from the appliance manufacturer. The sidewall air inlet cap and sidewall vent cap for flue products are available as a vent kit.



**FIG. 32 Sidewall Vent Cap**

The part numbers for the required sidewall air inlet and flue cap kit are listed by unit size. The manufacturer, in

accordance with CSA/CGA requirements, must furnish both the sidewall air inlet and flue cap. Each kit includes the both the special combustion air inlet cap and the sidewall flue cap for installation on an exterior sidewall. The sidewall air inlet cap supplied in the kit is sized to provide combustion air for a single appliance only.

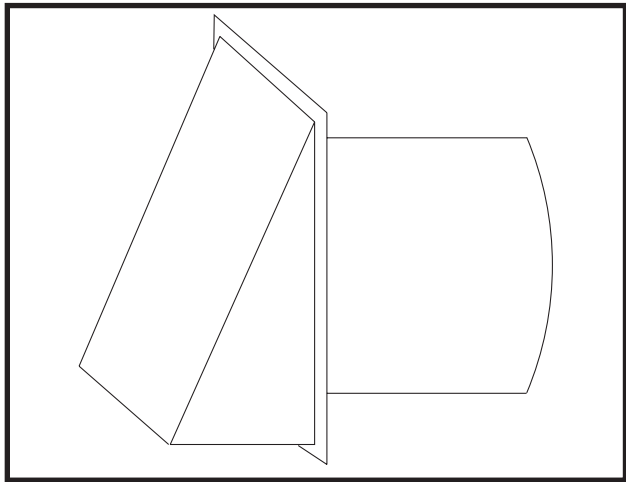
**TABLE — J  
Sidewall Air Inlet & Flue Cap Kits**

Input Btu/hr	Flue Cap Size	Air Inlet Cap Size	Sidewall Air Inlet & Flue Cap Kit
1,500,000	8"	6"	HDK3021
1,700,000	8"	8"*	HDK3022
2,000,000	10"	8"	HDK3023

\*Piping from the appliance to the air inlet cap may be either 7" or 8" connecting to an 8" sidewall cap provided in the kit.

*Location of a Sidewall Air Inlet Cap*

Installation, location and clearance requirements for the sidewall air inlet cap in an DirectAire vent application are the same as the installation, location and clearance requirements for the sidewall air inlet cap in the Horizontal Direct Vent section of the venting instructions.



**FIG. 33 Air Inlet Cap for Sidewall Termination**

The sidewall combustion air inlet cap and the rooftop flue gas outlet are located in different pressure zones in a DirectAire vent system.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products in to the combustion air inlet, follow all instructions in this and related sections. Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in

incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death or property damage.

## GAS SUPPLY

Verify that the appliance is supplied with type gas specified on rating plate. This appliance is orificed for operation up to 4000 feet altitude. Consult factory for installations above 4000 feet elevation. An appliance supplied for operation at altitude will be clearly marked to indicate suitability for high altitude operation.

**INLET GAS PRESSURE:** Measured at the inlet pressure tap on the appliance gas manifold. The pressure tap is located upstream of the redundant gas valve and down stream of the field installed gas cock.

TABLE — K Inlet Gas Pressure		
	Nat. Gas	LPG
Max. (Inches Water Column)	10.5" w.c.	13.0" w.c.
Min. (Inches Water Column)	4.0" w.c.	4.0" w.c.

Maximum inlet gas pressure must not exceed the value specified. Minimum value listed is for the purposes of input adjustment.

**MANIFOLD PRESSURE:** Manifold pressure is a differential pressure measurement made between the pressure taps at the gas orifice and the pressure in the transition chamber where the gas is supplied to the inlet of the combustion air blower. All manifold gas pressures are noted at full firing rate. The controls on this appliance may fire the burner from 25% up to 100% of rated input, based on system demand. Manifold gas pressure will be reduced as burner input is reduced. All reference gas pressure measurements must be made at 100% of rated burner input. The gas manifold pressure is pre-set at the factory by the ratio gas valve. Adjustment of manifold pressure is not normally required for proper operation. The adjustment point on the ratio gas valve is set at the factory and sealed. **Do not attempt to adjust the settings on the ratio gas valve.** Improper adjustment of the ratio gas valve may cause incomplete combustion or non-warrantable burner damage.

**TABLE — L  
Manifold Gas Pressure  
Manifold Pressure  
Settings at Full Fire**

Input Btu/hr	Nat. Gas	LPG
1,500,000 - 2,000,000	3.5" w.c.	3.5" w.c.

## GAS PRESSURE TEST

1. The appliance must be disconnected from the gas supply piping system during any pressure testing of that system at a test pressure in excess of 2 PSIG (3.5 kPa).
2. The appliance must be isolated from the gas supply piping system by closing a manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 2 PSIG (3.5 kPa).
3. The appliance and its gas connection must be leak tested before placing it in operation.

## GAS CONNECTION

1. Safe operation of unit requires properly sized gas supply piping. See gas line sizing data.
2. Gas pipe size may be larger than appliance connection.
3. Installation of a union at the appliance gas line connection is required for ease of service and removal of the gas train.
4. Install a manual main gas shutoff valve, outside of the appliance gas connection and before the gas valve, when local codes require.
5. A trap (drip leg) **MUST** be provided in the inlet of the gas connection to the appliance.
6. The diaphragm gas valve has a bleed port that may require venting to atmosphere, outside the building, when required by local codes.
7. Optional gas controls may require routing of bleeds and vents to the atmosphere, outside the building when required by local codes.

**TABLE — M  
Fittings to Equivalent Straight Pipe**

Diameter Pipe (inches)							
3/4"	1"	1 1/4"	1 1/2"	2"	3"	4"	5"
Equivalent Length of Straight Pipe (feet)							
2'	2'	3'	4'	5'	10'	14'	20'

**TABLE — N**  
**Recommended Gas Pipe Size**  
**Single Appliance Installations**

BTU INPUT	Distance from Meter				
	0 - 50 ft.	51 ft. - 100 ft.	101 ft. - 200 ft.	201 ft. - 300 ft.	301 ft. - 500 ft.
1,500,000	2"	2 1/2"	3"	3"	3 1/2"
1,700,000	2 1/2"	2 1/2"	3"	3"	3 1/2"
2,000,000	2 1/2"	3"	3"	3 1/2"	4"

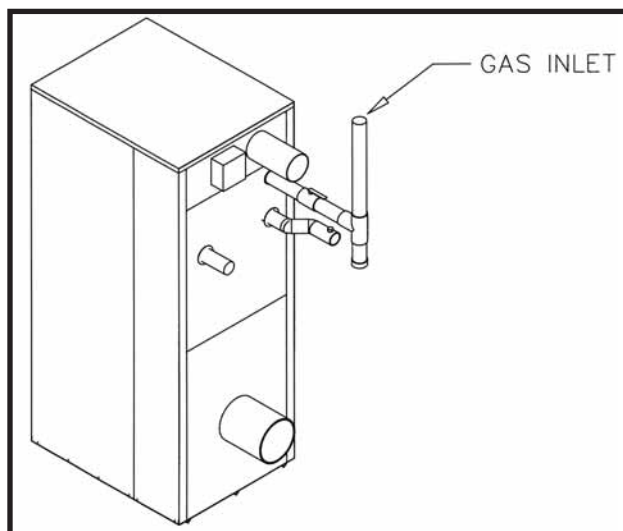
For each elbow or tee, add equivalent straight pipe to total length from table below.

**TABLE — O**  
**Gas Piping Size Chart**  
**Multiple Appliance Installations**

Nominal Iron Pipe Size, Inches	Length of Pipe in Straight Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/4	369	256	205	174	155	141	128	121	113	106	95	86	79	74
1	697	477	384	328	292	267	246	256	210	200	179	164	149	138
1 1/4	1,400	974	789	677	595	543	502	472	441	410	369	333	308	287
1 1/2	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441
2	4,100	2,820	2,260	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820
2 1/2	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300
3	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,300	3,000	2,720	2,500	2,340
4	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720

Maximum Capacity of Pipe in Thousands of Btu's per hour for gas pressures of 14 Inches Water Column (0.5 PSIG) or less and a pressure drop of 0.5 Inch Water Column (Based on NAT GAS, 1025 Btu's per Cubic Foot of Gas and 0.60 Specific Gravity)

## GAS PIPING



**FIG. 34 Gas Line Connection with Sediment Trap and Manual Main Gas Shut-off Valve**

All gas connections must be made with pipe joint compound resistant to the action of liquefied petroleum and natural gas. All piping must comply with local codes and ordinances. Tubing installations must comply with approved standards and practices.

### *Install Piping to Control*

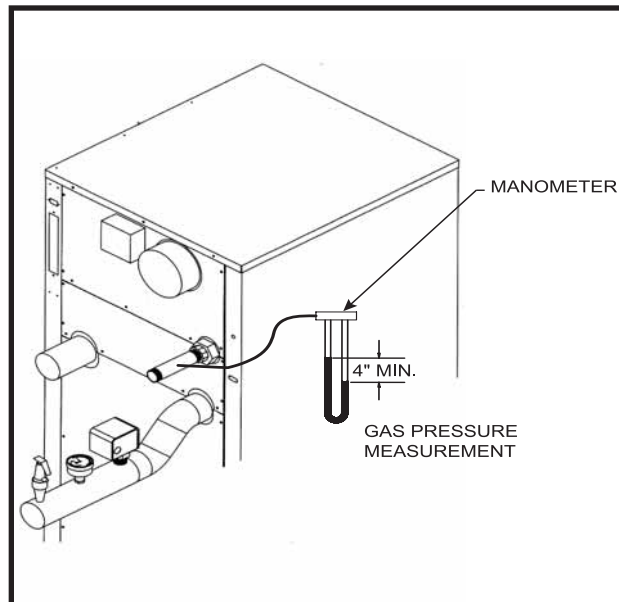
1. The gas line should be a separate line direct from the meter unless the existing gas line is of sufficient capacity. Verify pipe size with your gas supplier.
2. Use new, properly threaded black iron pipe free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation. Avoid flexible gas connections. Internal diameter of flexible gas lines may not provide appliance with proper volume of gas.
3. Install a manual main gas shutoff valve at the units gas inlet, outside of the appliance and before the gas valve. Install a union at the appliance gas line connection for ease of service and removal of the gas train.

4. Run pipe or tubing to the units gas inlet. If tubing is used, obtain a tube to pipe coupling to connect the tubing to the units gas inlet.
5. Install a sediment trap in the supply line to the units gas inlet. (See Fig. 34)
6. Remove seal over gas inlet to the appliance
7. Apply a moderate amount of good quality pipe compound (**DO NOT** use Teflon tape) to pipe only, leaving two end threads bare.
8. Connect gas pipe to inlet of appliance. Use wrench to support gas manifold on the appliance.
9. For LP gas, consult your LP gas supplier for expert installation.

## GAS MANIFOLD PRESSURE ADJUSTMENT

The manifold gas pressure on the Power-Fin appliance is not field adjustable. The ratio gas valve has been factory set with an internal bias adjustment to ensure a 1:1 air/gas ratio on operation. The adjustment point on the valve actuator has been sealed. **Tampering or breaking this adjustment seal will void the warranty on the gas valve assembly and the burner.** A Power-Fin supplied with a properly sized gas line, properly sized meter and a minimum of 4 inches water column of gas supply pressure while firing at full rate will ensure full burner input. The manifold pressure supplied to the burner is a differential pressure. This pressure is the result of the difference in two gas pressure measurements. A differential manifold gas pressure measurement should not be made until you have measured the gas supply pressure. Gas supply pressure must be a minimum of 4 inches water column with all appliances on the gas line firing at full rate before a manifold pressure measurement is made. Use the following procedure to check gas supply pressure with a manometer connected to the inlet pressure tap on the gas line connection at the rear of the appliance.

## CHECKING GAS SUPPLY PRESSURE



**FIG. 35 Gas Supply Pressure Measurement**

1. Turn the main power switch to “OFF” position.
2. Shut off gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is LP gas, shut off gas supply at the tank.
3. Remove the 1/8" hex plug from the gas pressure test port located on the inlet gas supply connection at the rear of the appliance. Install a fitting in the inlet pressure tapping suitable to connect to a manometer or magnahelic gauge. Range of scale should be 14" w.c. or greater to check inlet pressure.
4. Turn on gas supply at the field installed manual gas cock, turn on LP gas at tank if required.
5. Turn the power switch to “ON” position.
6. Adjust the temperature setpoint on the Diagnostic Information Center to call for heat.
7. Observe the gas supply pressure as the burner fires at 100% of rated input. Percent of burner input will be displayed in the Diagnostic Information Center.
8. Ensure inlet pressure is within specified range. Minimum and Maximum gas supply pressures are specified in Gas Supply section of this manual.
9. If gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine necessary steps to provide proper gas pressure to the control.

10. If gas supply pressure is within normal range, proceed to remove gas manometer and replace pressure tap fittings in the gas piping to the appliance.
11. Turn the power switch to “OFF” position.
12. Shut off gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is LP gas, shut off gas supply at the tank.
13. Remove the manometer and related fittings from gas pressure test port at the inlet gas supply connection to the appliance. Replace 1/8" plug in gas pressure test port and tighten.
14. Turn on gas supply at the manual valve, turn on LP gas at tank if required.
15. Turn the power switch to “ON” position.
16. Adjust the temperature setpoint in the Diagnostic Information Center to the desired water temperature so the appliance will call for heat.
17. Check burner performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame pattern should be stable, see “Maintenance-Normal Flame Pattern.” Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

## IMPORTANT:

Upon completion of any testing on the gas system, leak test all gas connections with a soap solution while the main burner is firing. Immediately repair any leak found in the gas train or related components. **Do Not** operate an appliance with a leak in the gas train, valves or related gas piping.

## CHECKING MANIFOLD GAS PRESSURE

There is a pressure test tree located in the top chamber of the appliance. This pressure test point can be accessed by removing the large access panel on the front of the appliance. The pressure test tree is mounted on the front edge of the combustion air blower. It consists of an angle support and four test cocks. There is one cock for positive air and one for negative air, one cock for positive gas and one for negative gas. Manifold pressure measurement will utilize both the positive and negative test points for gas.

1. Remove the large front access panel. Locate the pressure test tree on the front edge of the combustion air blower. The positive and negative gas pressure terminals will be used to check differential gas pressure from the gas manifold and the air box. Each gas pressure connection point will have a small manual cock to attach a hose.
2. Connect a hose from the positive gas and the negative gas to each of the two sides of a manometer. This will allow the two pressure points to be measured at the same time. Open the two gas pressure test point cocks.

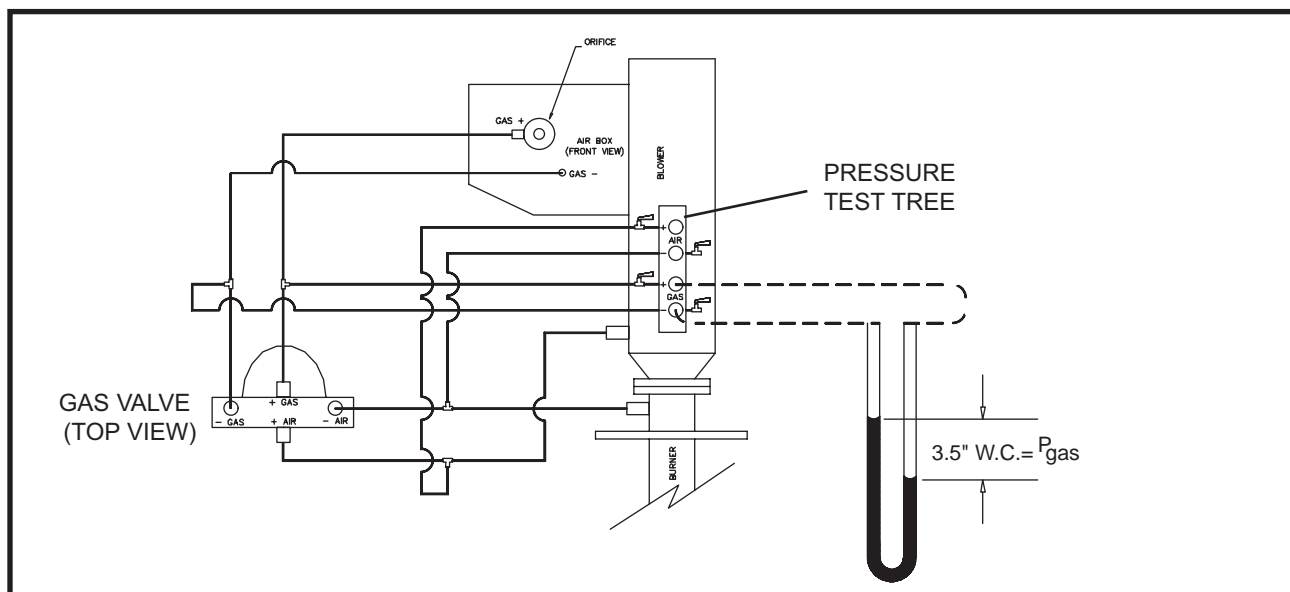


FIG. 36 Manifold Gas Pressure Measurement



3. Set the Diagnostic Information Center to a setpoint which will fire the burner at 100% of rated input.
4. As the appliance comes on and fires, record the inches of water column of displacement on both sides of the manometer. The sum of these two readings as they are effected by the two gas pressures is the differential manifold pressure.
5. The differential manifold gas pressure should be 3.5 inches of water column (+0.1" w.c.) when the burner is firing at 100% of rated input.
6. If the differential manifold pressure is not 3.5 inches water column (+0.1" w.c.), recheck the gas supply pressure and adjust to ensure a supply pressure between 4.0 and 10.5 inches water column natural gas (13.0" w.c. for propane) while the appliance is firing at 100% of rated input.
7. This is a reference pressure only and is not field adjustable, An appliance supplied with a minimum of 4 inches water column of gas supply pressure will operate at the correct manifold pressure as the burner input varies with temperature demand.
8. Close the two gas pressure test cocks on the pressure test tree and remove the hoses to the manometer.
9. Replace the large front access panel.

### IMPORTANT:

Upon completion of any testing on the gas system, leak test all gas connections with a soap solution while the main burner is firing. Immediately repair any leak found in the gas train or related components. **Do Not operate an appliance with a leak in the gas train, valves or related gas piping.**

### WATER CONNECTIONS

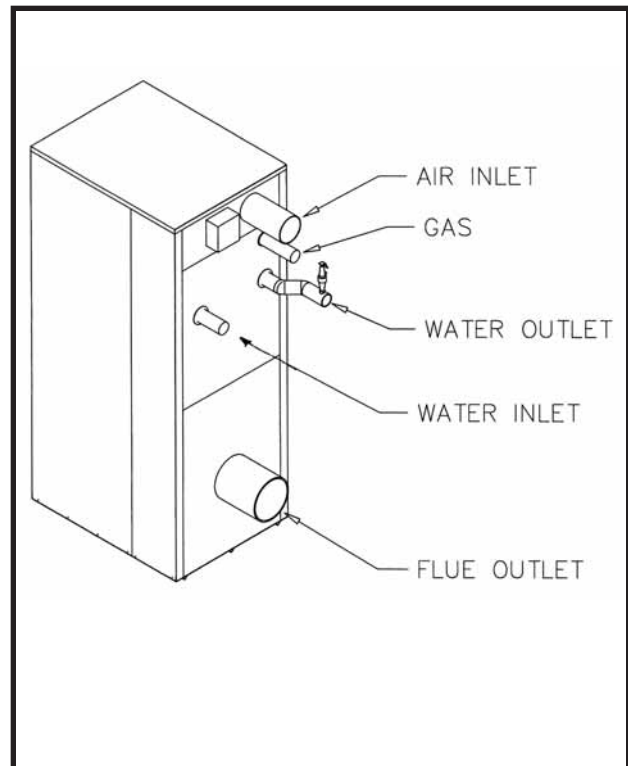
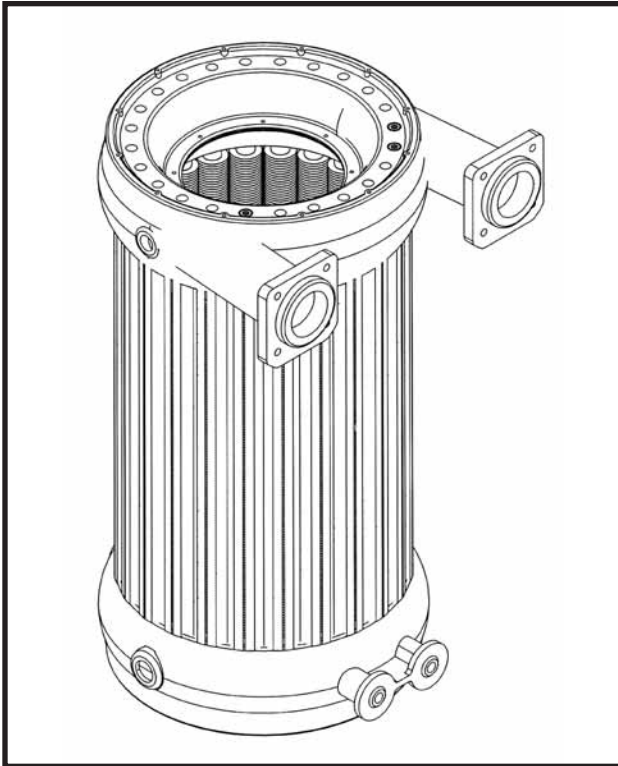


FIG. 37 Water Connections

### *Inlet and Outlet Connections*

For ease of service, install unions on inlet and outlet of the appliance. The connection to the appliance marked "Inlet" on the header should be used for return from the system. The connection on the header marked "Outlet" is to be connected to the supply side of the system. Minimum water pipe connections to this appliance are 2-1/2 inches (63.5 mm) pipe. See the piping requirements in the heating boiler or water heater section of this manual for multiple appliance installations.

## HEAT EXCHANGER



**FIG. 38 Heat Exchanger**

This appliance uses a finned copper tube heat exchanger to maximize the heat transfer process. The heat exchanger is mounted in the inner jacket on the front side of the appliance. The heat exchanger is composed of two circular, glass lined, and cast iron headers with 24 vertical finned copper tubes. A series of "V" shaped baffles are installed between the individual tubes to control the movement of the flue products over the finned copper surface and increase heat transfer. Water enters the heat exchanger and makes four passes over the area exposed to direct heat from the burner. A circulating pump **MUST** be installed to ensure proper water flow over the heat transfer surfaces during burner operation. Water temperatures in the heat exchanger are determined by water flow.

### *Initial Set-up of Maximum Water Flow*

On initial start-up of the Power-Fin, the maximum water flow to the heat exchanger must be checked and manually limited with a valve or bypass before normal operation begins.

## MINIMUM WATER TEMPERATURES

A minimum return water temperature of 140°F (60°C) has been established to control condensate formation based on the Btu/hr output at rated burner input. Maintaining inlet water temperatures to the appliance equal to or higher than the specified minimum temperature ensures proper operation of the appliance and prevents condensate

formation on the heat exchanger. An appliance allowed to sustain operation at water temperatures lower than the specified minimum temperature may not provide enough heat from the burner to maintain water temperatures in the heat exchanger above the 140°F (60°C) dew point of flue products. Operation of the appliance at a temperature below the specified minimum setpoint will result in non-warrantable operational problems from the condensate formation on the primary heat exchanger

## CAUTION: ⚠

An appliance allowed to operate at return temperatures below the specified minimum setting may experience problems with the operating controls, safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion and possible flue gas spillage. Sustained operation at lower than specified water temperatures may cause hazardous conditions that may result in personal injury or non-warrantable damage to the appliance.

A boiler installed above radiation level must be provided with a low water cutoff device either as part of the unit or at the time of installation.

## WATER FLOW SWITCH

A water flow switch is factory installed in the outlet piping on all heating boilers, hot water supply boilers and water heaters. The flow switch is wired in series with the 24 VAC safety control circuit. This wiring connection installs the flow switch in the 24 VAC safety circuit to prove water flow before main burner ignition. The flow switch requires a minimum flow of 26 GPM to make the flow switch and start burner operation. A water flow switch meets most code requirements for a low-water cut off device on boilers requiring forced circulation for operation. A fault alarm LED for **Low Water** will be indicated in the Diagnostic Information Center on a low water condition as sensed by the flow switch.

## LOW WATER CUTOFF (IF EQUIPPED)

If this boiler is installed above radiation level, a low water cut-off device must be installed at the time of boiler installation. Electronic or float type low water cut-offs are available as a factory supplied option on all models. Low water cut-offs should be inspected every six months, including flushing of float types. A fault alarm LED for Low Water will be indicated in the Diagnostic Information Center on a low water condition as sensed by a low water cutoff.

## RELIEF VALVE

This unit is supplied with a relief valve(s) sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers"). The relief valve(s) is installed in the vertical position and mounted in the hot water outlet. No valve is to be placed between the relief valve, and the unit. To prevent water damage, the discharge from the relief valve shall be piped to a suitable floor drain for disposal when relief occurs. No reducing couplings or other restrictions shall be installed in the discharge line. The discharge line shall allow complete drainage of the valve and line. Relief valves should be manually operated at least once a year.

### CAUTION: ⚠

Avoid contact with hot discharge water.

### NOTE:

The gas train and controls assembly provided on this unit have been tested under the applicable American National Standard to meet minimum safety and performance criteria such as safe lighting, combustion and safety shutdown operation.

## RATIO GAS VALVE

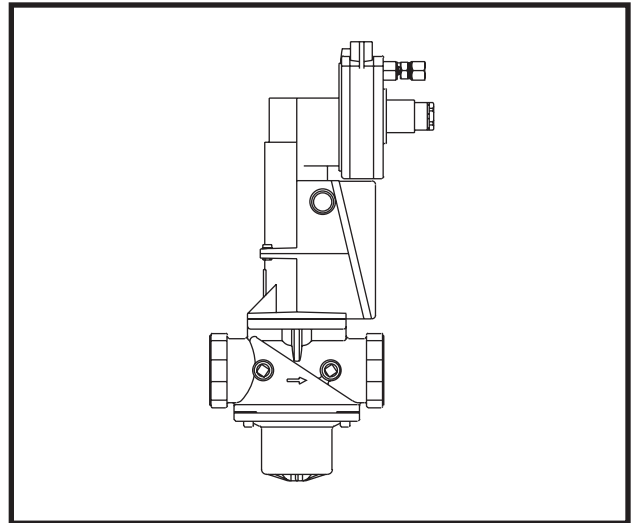


FIG. 40 Ratio Gas Valve

The main gas valve supplying gas to the burner on this appliance utilizes a pressure regulating electro-hydraulic actuator providing a slow opening, fast closing safety shut off and air/gas ratio control for the gas combustion process. This gas valve controls the pressure difference across the restriction in the gas supply line as a function of the pressure difference across the combustion air supply to the burner. The actuator maintains a constant air to gas ratio as the volume of air changes based on the operation of the combustion air blower. The valve is a 1:1 differential pressure air/gas ratio controller. The valve adjusts the same pressure difference on the gas side as it senses on the air side. The valve performs the functions of safety shutoff, constant pressure regulation and air/gas ratio control. Slow opening and safety shutoff is accomplished by operation of an electro-hydraulic cylinder. Full closing of the valve seat occurs in less than 0.8 seconds when the valve is de-energized. A visual stroke position indicator is

## GAS TRAIN AND CONTROLS

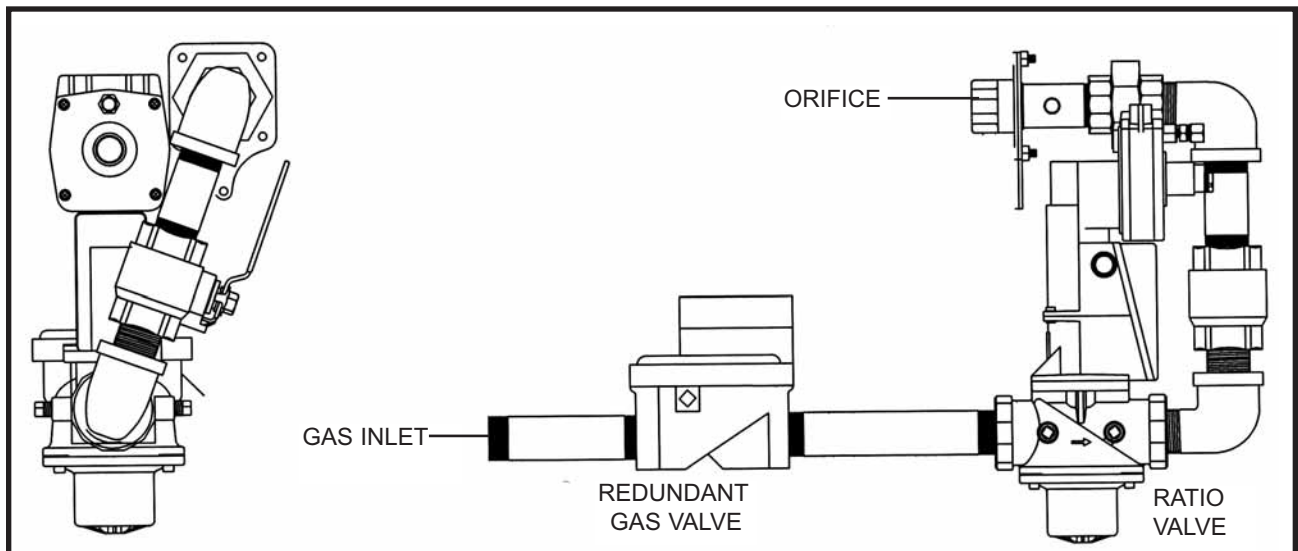
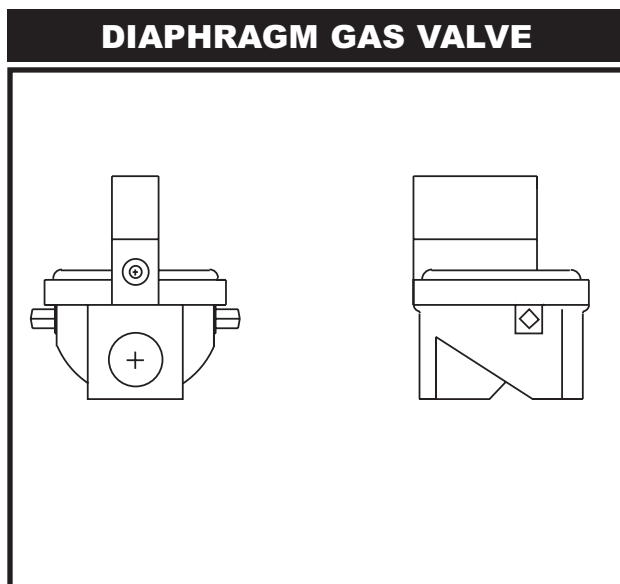


Fig. 39 Gas Train Assembly

provided on the valve assembly to indicate the position of the valve seat. Operation of the gas valve in combination with the combustion air blower allows the burner input rate to vary from 25% to 100% based on temperature demand. There is no need for an additional upstream constant gas pressure regulator internally to the appliance as long as the gas supply is maintained within the specified minimum and maximum pressures.

The manifold pressure is preset at the factory and adjustment is not usually required if gas supply pressure is maintained within the specified range. If the manifold pressure is to be measured, follow the “Gas Manifold Pressure Measurement Procedure” for proper measurement.

There are no serviceable parts on the ratio gas valve actuator.



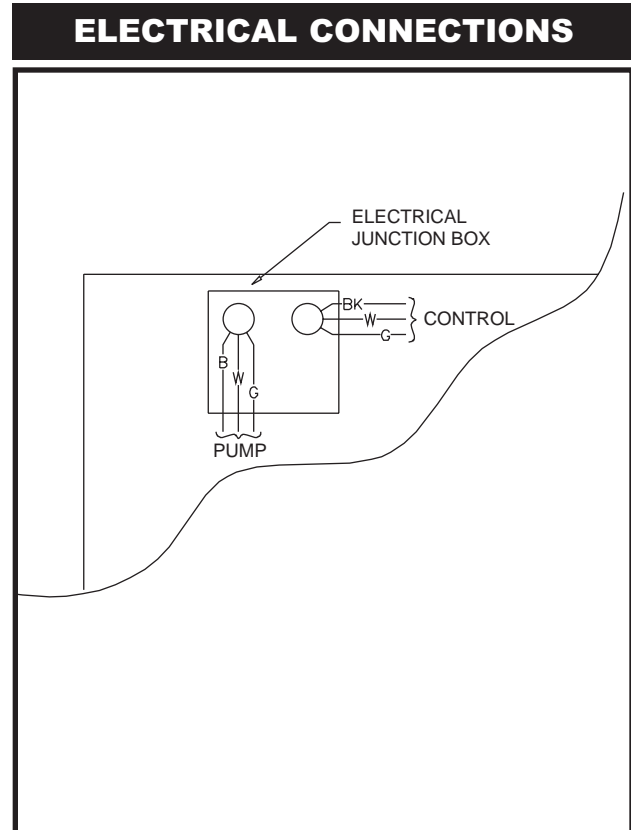
**FIG. 41 Diaphragm Gas Valve**

A diaphragm type gas valve is also provided in the gas train. As the second valve seat in the gas train, it supplies a redundant safety shutoff valve seat in the gas supply to the burner to ensure safe operation in the remote event of a gas valve failure. The diaphragm gas valve is energized with 24 VAC power at the same time the ratio gas valve is powered in the operational sequence to ignite the burner.

### ***Venting of Gas Valves and Pressure Switches***

The diaphragm type gas valve and optional gas pressure switches are provided with threaded termination points to be vented to the atmosphere, outside the building, if required by local codes. The gas pressure regulation function is provided by the ratio gas valve which does not require installation of a vent line. The diaphragm gas valve and optional gas pressure switches are installed in the upper chamber of the appliance. Threaded vent line

connections from components requiring an external vent line are provided on the component. These vent line connection points may be accessed by removing the top jacket panels. Local codes may require the routing of these bleeds and vents to the atmosphere, outside the building. Proper routing of vent lines to the atmosphere from the factory supplied termination points is the responsibility of the installing contractor.



**FIG. 42 Electric Power Connections - Controls and Pump**

A 120 VAC, 15 Amp, 1 ph, 60 Hz circuit is required for operation of the appliance controls. The combustion air blower motor operates on 230 VAC, 3 ph, 60 Hz. This three phase voltage is generated by the variable frequency drive (VFD) and supplied directly to the blower motor. **NOTE: No 230 VAC electrical service is required for operation of the combustion air blower.**

The appliance, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or in the absence of such requirements, with the latest edition of the National Electrical Code ANSI/NFPA No. 70. When the unit is installed in Canada, it must conform to the CAE C22.1, Canadian Electrical Code, Part 1 and/or local Electrical Codes.

1. All wiring between the appliance and field installed devices shall be made with type T wire [63°F (35°C) rise].
2. Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
3. The circulating pump must run continuously when appliance is being fired.
4. To avoid serious damage, **DO NOT** energize the appliance until the system is full of water. Ensure that all air is removed from the heat exchanger and piping before beginning initial operation. Serious damage may result if the appliance is operated without proper flow.
5. Provide the appliance with proper overload protection.

## JACKET ASSEMBLY

**Inner Jacket** - The inner jacket assembly is constructed from a special corrosion resistant stainless steel. Screws and fasteners that penetrate the inner jacket chamber are stainless steel. The stainless steel screws are identified by a sealing washer mounted on each screw. **Do not mix stainless steel and standard plated fasteners when disassembling and reassembling the inner jacket sheet metal components. Standard plated fasteners may be damaged by the flue product condensate when used on the inner jacket assemblies.**

**Outer Jacket** - The outer jacket assembly is constructed from steel, galvanized on both sides. The galvanized surface is specially prepared and phosphate coated to allow application of a multiple coat enamel paint process. This coating process ensures a long life from the jacket assembly.

**TABLE — P**  
**AMP Draw Data**  
**1,500,000 through 2,000,000**  
**Btu/hr Models**

Btu/hr Input	Blower & Controls	Pump FLA*	Approximate Total Amps @ 120 VAC
1,500,000	6.7	8.8	15.5
1,700,000	6.7	8.8	15.5
2,000,000	6.7	8.8	15.5

\* Standard Pump Supplied with Water Heaters Only

## ACCESS TO COMPONENTS AND CONTROLS

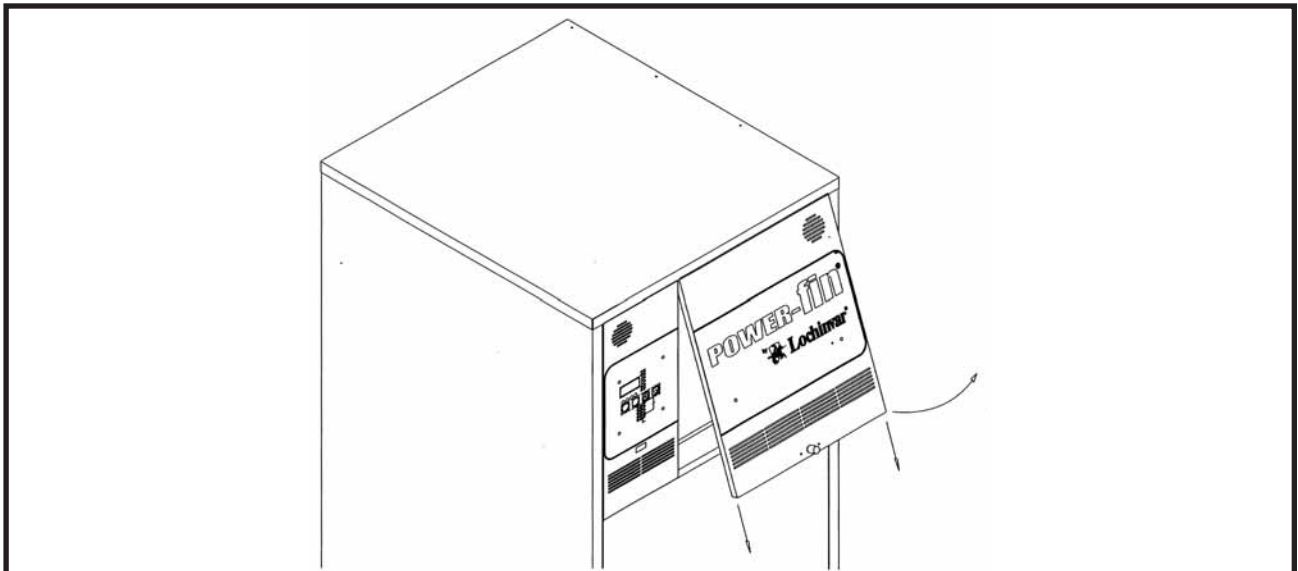
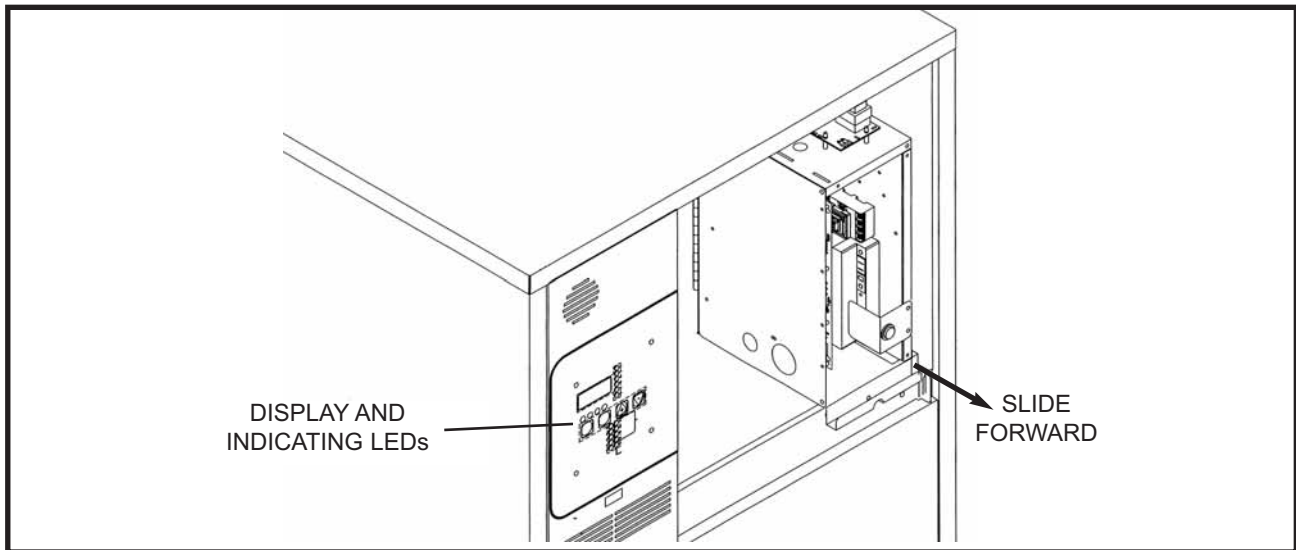
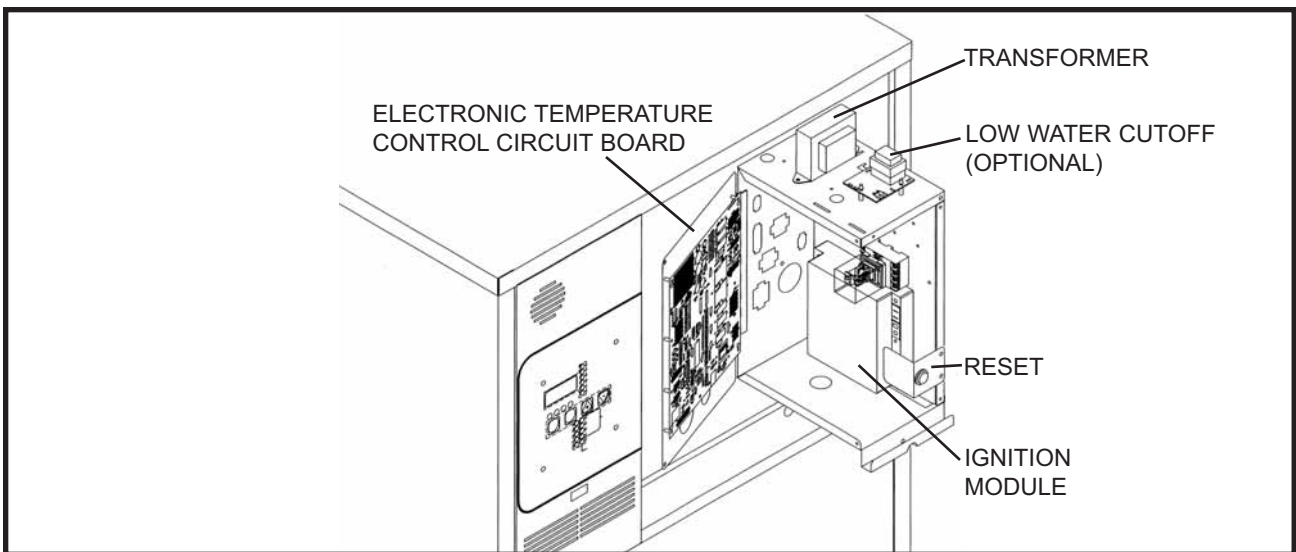


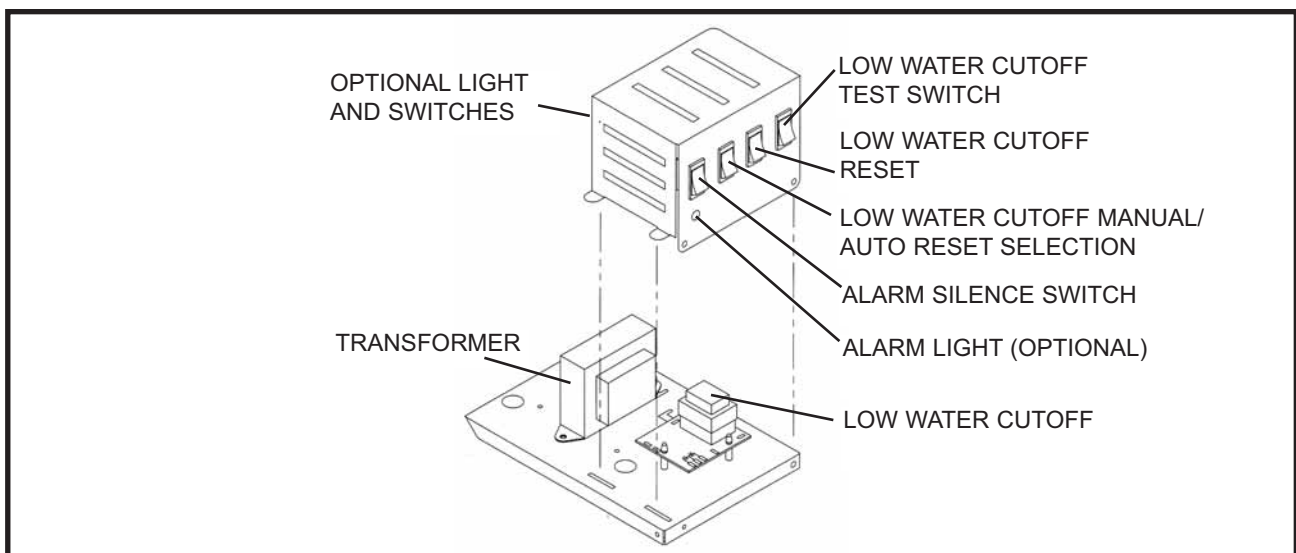
FIG. 43 Front Control Panel Access Drawing



**FIG. 44 Internal Control Panel Component Access Drawing**



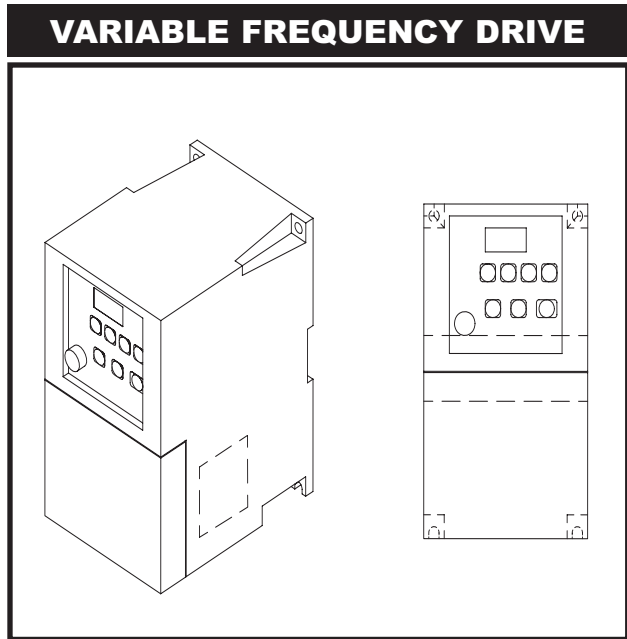
**FIG. 45 Transformer, Circuit Boards and Relay Locations**



**FIG. 46 Component and Auxiliary Controls Connections**



A component, transformer and relay mounting control panel is located along the right front control panel, along the right side of the exterior jacket panel. This panel contains a 75 VA transformer to drop 120 VAC to 24 VAC for internal control operation, an optional electronic low water cut-off, VFD, switching relays (gas valve relay, pump relay, louver relay and VFD power relay), main control circuit board, and ignition module.



**FIG. 47 Variable Frequency Drive**

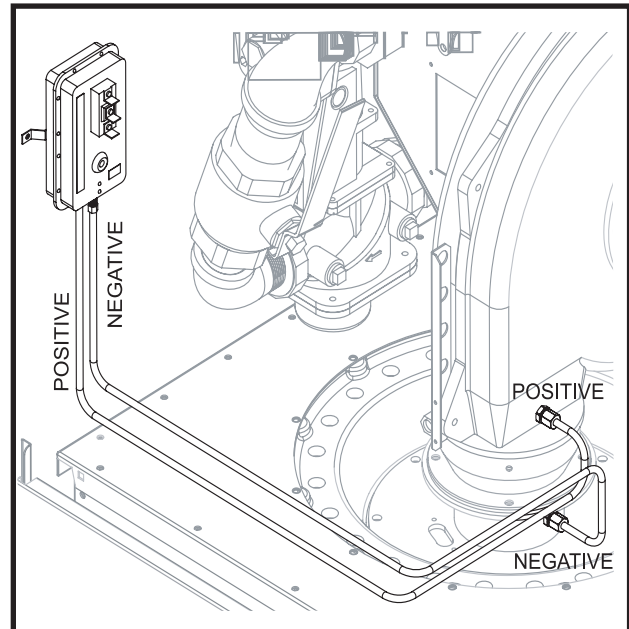
This appliance uses a variable frequency drive to control operation of the combustion air blower motor. The variable frequency drive is supplied with 120 VAC power. The blower motor operates on 230 VAC 3 phase power. This three phase voltage is generated by the variable frequency drive (VFD) and supplied directly to the blower motor. The variable frequency drive receives a signal from the temperature controller based on water temperature to vary the frequency of the voltage supplied to the blower motor from 15 Hz up to 60 Hz. This varies the output of the combustion air blower from 25% up to 100% of capacity corresponding to the same variation in burner input. The output from the temperature controller to the variable frequency drive ensures that combustion air and gas are always supplied in the proper ratio for clean combustion. The variable frequency drive is driven to 100% during the pre-purge portion of the start-up sequence. The variable frequency drive is then provided a signal to operate at 50% for initial burner ignition. After main burner ignition is established, the temperature controller will use the variable frequency drive to vary the blower speed based on desired water temperature setpoint, the variation in actual water temperature from the desired setpoint and the various operating characteristics programmed into the control's software.

When removing the variable frequency drive from the appliance, disconnect the power wires to the combustion air blower at the terminals on the variable frequency drive. **Do not disconnect the power wires at the blower motor.** Note the marking of the wires for proper reinstallation of the three phase power wires to the VFD. Both the wires and the VFD terminals are marked for proper location of wire terminals. **Incorrect installation of the wires may reverse rotation of the blower motor resulting in major operational problems or non-warrantable component failures.**

### CAUTION: ⚠

The voltage output from the variable frequency drive to the combustion air blower is 230 volt 3 phase. Avoid contact with high voltage wiring.

### LOW AIR PRESSURE SWITCH



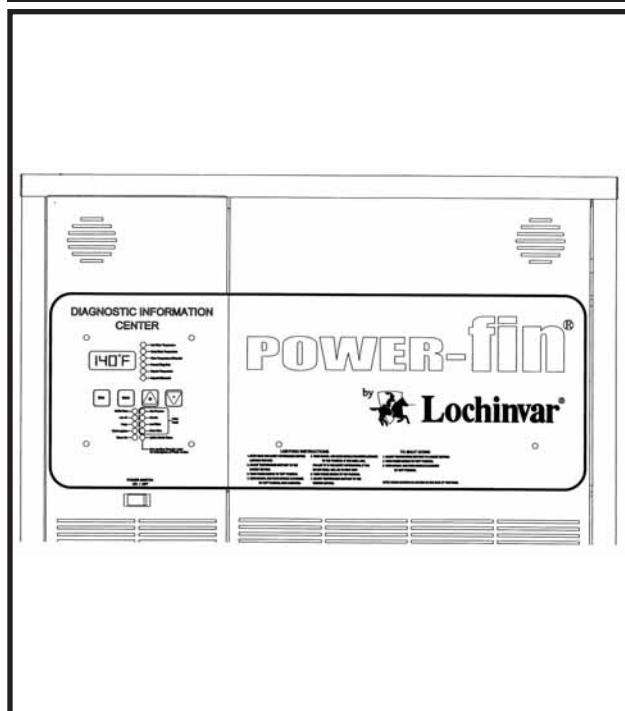
**FIG. 48 Low Air Pressure Switch Location**

A differential air pressure switch is used to prove operation of the combustion air blower. The pressure switch sensing points are installed across the point of pressure drop as the air moves into the inlet of the burner. This switch measures pressure drop points similar to those used by the ratio gas valve to adjust manifold gas pressure. Correct differential pressure across the sensing points of the pressure switch proves operation of the combustion air blower to the control. A fault alarm LED for **Low Air** will be indicated in the Diagnostic Information Center and the appliance will shut down operation when the differential pressure switch detects a sustained low air condition.

## HIGH GAS PRESSURE SWITCH/ LOW GAS PRESSURE SWITCH (OPTIONAL)

High and/or low gas pressure switches are available as an option on this appliance. The high gas pressure switch is used to monitor the maximum gas supply pressure supplied to the gas train. If gas pressure exceeds the maximum setting of the pressure switch, the appliance will shut down and a gas pressure fault will be indicated by a fault alarm LED in the Diagnostic Information Center. The low gas pressure switch is used to monitor the minimum gas supply pressure supplied to the gas train. If gas pressure falls below the minimum setting of the pressure switch, the appliance will shut down and a gas pressure fault will be indicated by a fault alarm LED in the Digital Display. The **Gas Pressure LED** will illuminate in the Diagnostic Information Center for either a high or low gas pressure problem.

## ELECTRONIC TEMPERATURE CONTROL



**FIG. 49 Electronic Temperature Control Display Module**

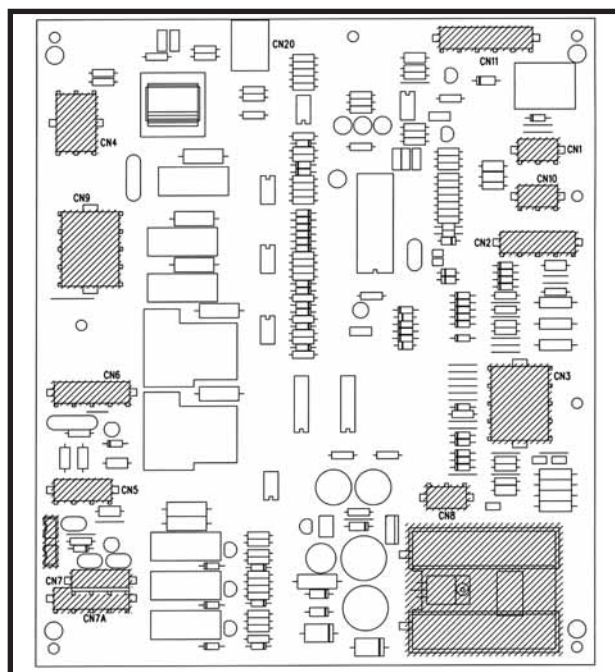
**Electronic Temperature Control** - The temperature controller for this appliance is based on an electronic controller platform with software customized for operation of the Lochinvar Power-Fin. All of the appliances internal safety, operating and ignition controls interface with the electronic controller. Local communication, programming, display of operational sequence LED's, display of fault indicating LED's and a digital display of the appliance temperature functions are accessible through a Diagnostic

Information Center. The display and LED's for the Diagnostic Information Center is mounted on the front control panel of the appliance.

The Temperature Control Module serves as the operating temperature control to regulate the amount of heat added to the water system for both heating boilers and potable water heaters. Software programmed into the controller will determine the proper operating profile for your specific application.

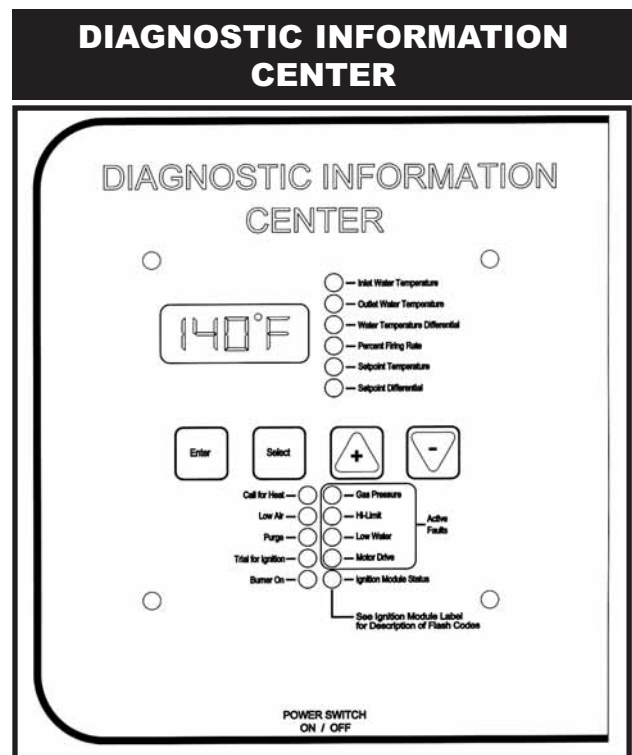
The Electronic Temperature Control provides on/off control of the gas supply to the burner, operation of a VFD to control a variable speed combustion air blower, interface with the ignition control system, control of water temperature setpoints, and monitoring of all safety functions. The operation and status of these and all related functions are displayed on the Diagnostic Information Center.

The Electronic Temperature Control and related components are mounted on a slide out panel mounted behind the upper right jacket panel. The slide out panel is hinged to expose the circuit boards and other components for viewing and service. All connections from the appliance safety and operating controls to the Electronic Temperature Control are accomplished with multiple wiring harnesses. Each wiring harness is connected by unique multiple pin terminations to ensure proper connection of all components. Multiple termination points are located on the printed circuit board for the Electronic Temperature Control. Use caution when connecting or disconnecting wires at the plug in terminals to prevent damage to the printed circuit board.



**FIG. 50 Electronic Temperature Control Module Circuit Board and Wire Terminals**

The Electronic Temperature Control may have default values for the control points specified at the time the appliance is tested at the factory. Job site specific values may be programmed into the control at the time the appliance is commissioned for start-up.



**FIG. 51 External Diagnostic Information Center Display Panel (Standard)**

The Diagnostic Information Center provides a communication interface with the Electronic Temperature Control via a digital display screen. The digital display screen has four keys mounted below the display to allow adjustment of the display and settings. The keys are: Enter, Select, Up Arrow Key and Down Arrow Key.

**SELECT:** When pressed, this key is used to scroll to any one of up to 10 LED's that serve to identify the type of information being displayed in the display. At a minimum, 6 selectable LED's will be accessible via the select key. 4 additional LED's may also be selectable on displays of units equipped with an optional outdoor air reset feature. The select key must be pressed and released to advance from one illuminated LED to the next LED in succession.

**ENTER:** When pressed, this key is used to permanently store changed settings into the controller's memory.

**UP:** When pressed, this key increases the value of any currently displayed setpoints or allows scrolling through non-numeric changeable parameters such as those of the pump and controlling sensor selections.

**DOWN:** When pressed, this key decreases the value of any currently displayed setpoints or allows scrolling through non-numeric changeable parameters such as those of the pump and controlling sensor selections.

## DATA POINTS VISIBLE FROM THE DIAGNOSTIC INFORMATION CENTER

The following data points can be readily displayed by pressing the select key until the corresponding LED is illuminate. There are up to ten LED's that can be selected to indicate data that can be shown in the digital display. The following data points indicate operation or temperature functions that are not user adjustable.

**Inlet Temperature:** When the inlet temperature LED is illuminated, the display shows the water temperature at the inlet sensor. On water heaters, the sensor may be located in the tank.

**Outlet Temperature:** When the outlet temperature LED is illuminated, the display shows the water temperature at the outlet sensor.

**Water Temperature Differential:** When the water temperature differential LED is illuminated, the display shows the difference in temperature between the inlet and outlet sensors.

**Percent Modulation:** When the percent modulation LED is illuminated, the display shows the percent modulation of the appliance. Note: The display will only show a percent modulation when the controller is receiving a gas valve "ON" input. If the gas valve is not on, the percent modulation will always be 0% .

**O. A. Temperature:** When the outdoor air temperature LED is illuminated, the display shows the temperature at the outdoor air sensor. *Note: Optional feature available on heating boilers only.*

## CHANGEABLE DATA POINTS VISIBLE FROM THE DIAGNOSTIC INFORMATION CENTER

The following data point may be selected for viewing and adjusted by the user to meet specific operational requirements.

**Setpoint Temperature:** This is the user-entered setpoint of a water heater or boiler without any adjustment from the optional outdoor air reset function.

**Setpoint Differential:** On water heaters and boilers, this is the number of degrees that the water temperature must fall below the setpoint temperature before a call for heat initiates. On boilers, this is also the number of degrees that the water temperature must rise above the setpoint temperature before a call for heat ends.

**Outdoor Air Maximum Reset:** *(optional feature)* When provided, this is the highest temperature that the boiler setpoint will be allowed to rise to when the outdoor temperature reaches the minimum temperature. *NOTE: This adjustment is only available when the control is equipped with the optional outdoor reset feature.*

**Outdoor Air Maximum Temperature:** *(optional feature)* When provided, this is the highest outdoor air temperature that will be used to reset the boiler. Typically, this would be 60°F, which would mean that the actual setpoint would begin to increase, when the outdoor air temperature falls below this setting. *NOTE: This adjustment is only available when the control is equipped with the optional outdoor reset feature.*

**Outdoor Air Minimum Temperature:** *(optional feature)* When provided, this is the lowest outdoor air temperature that will be used to reset the boiler. Typically, this would be -10°F, which would mean that the actual setpoint would be equal to the Maximum Reset Temperature when the outdoor air temperature falls below this setting. *NOTE: This adjustment is only available when the control is equipped with the optional outdoor reset feature.*

## STATUS LED'S

The Diagnostic Information Center has a series of LED's that detail the operational mode of the appliance or in the event of a control sensed failure, indicate an active fault. The fault LED's indicate the reason for a control sensed shut down of the appliance.

## OPERATIONAL STATUS LED'S

**Call For Heat:** This LED indicates when the controller is currently calling for heat. When illuminated, the ignition enable relay is also energized.

**Low Air:** This LED indicates the status of the air pressure switch when a call for heat is present. When continuously illuminated, a low air, blocked flue, failed louver switch or other air problem may exist. *NOTE: It is normal for a low air condition to exist for a brief period during initial startup.*

**Purge:** This LED indicates the operation of the ignition module in the pre-purge mode.

**Trial for Ignition:** This LED indicates that the hot surface igniter is turned on and the blower speed needs to be reduced for normal ignition. When illuminated, the ignition module is providing power to the hot surface igniter.

**Burner On:** This LED indicates that the gas valve is turned on and modulation may now occur. When illuminated, the ignition module is providing power to the gas valve.

**Ignition Status:** This LED indicates the various flash codes that reflect the actual status of the ignition module. See the Diagnostic Information Center Display information in the Ignition Module section for a complete description of the flash codes.

## FAULT STATUS LED'S

**Four Fault Status LED's are located on the Diagnostic Information Center and serve to indicate operational problems.**

**Gas Pressure:** This LED indicates the status of an optional low and/or high gas pressure switch. When illuminated, either low or high gas condition(s) exist(s).

**Hi-Limit:** This LED indicates that the water temperature has exceeded the maximum temperature setting of the high water temperature limit control.

**Low Water:** This LED indicates the status of a low water cutoff, flow switch or both when provided. When illuminated, it indicates problems with water level, flow or both.

**Motor Drive:** This LED indicates the status of the variable frequency drive used to control blower speed. When illuminated, it indicates that the VFD is experiencing a fault condition and should be checked.

## POWER-UP DEFAULT DISPLAY OF THE DIAGNOSTIC INFORMATION CENTER

Upon power up, the display will always default to showing the designated controlling sensor's temperature (of either the inlet or outlet sensor). This display can be temporarily changed to continuously show other non-changeable items by merely pressing the SELECT key until the desired item's LED is illuminated and its' respective information is shown in the display and no additional keys are pressed. Outdoor air temperature may only be selected for temporary display. After 5 seconds of displaying outdoor air temperature the display will revert back to the power up default display. Only Inlet Water Temperature, Outlet Water Temperature, Water Temperature Differential or Percent Modulation displays can be selected as temporary default displays.

Power interruptions of more than a few seconds will result in the loss of any temporary display. Long power interruptions will reset the microprocessor and result in the display showing the power up default display.



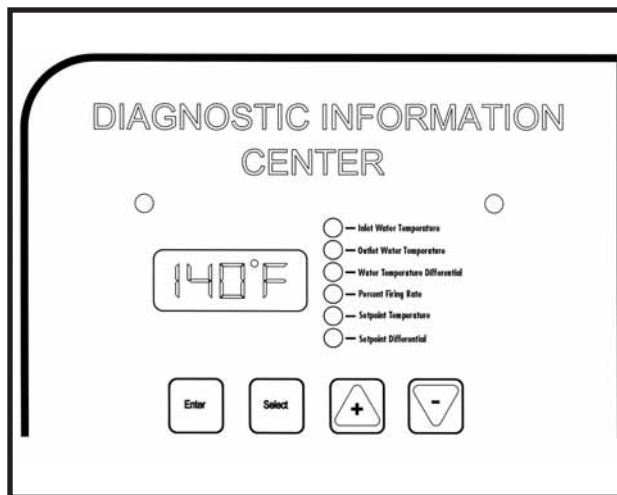


FIG. 52 Diagnostic Information Center Display Panel

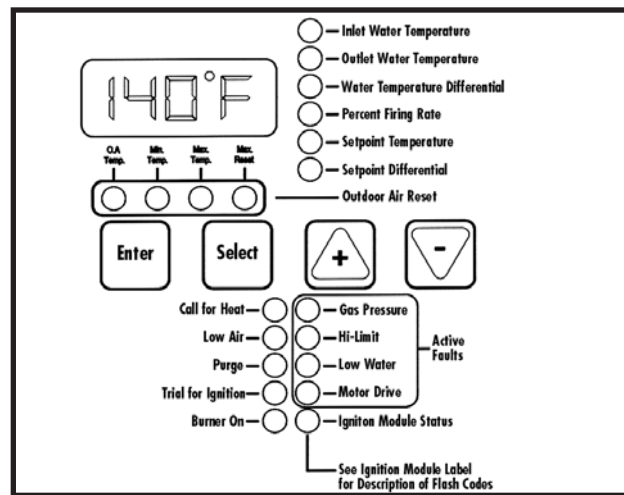


FIG. 53 Diagnostic Information Center Display Panel (with Outdoor Air Reset Function)

## TEMPERATURE ADJUSTMENT PROCEDURE

- (1) Press the **SELECT** key until the desired adjustable item's LED is illuminated and its' current setting is displayed.
- (2) Within 5 seconds of releasing the select key, press either an **UP** or **DOWN** key to increase or decrease the displayed setpoint value.
- (3) Within 5 seconds of releasing either the up or down key, press the **ENTER** key to permanently store the new setpoint into the controller's memory.

Failure to press the enter key within 5 seconds after changing the display value will result in the display reverting back to its' default power up display mode and any new setting being lost.

Pressing the select key at any time during the adjustment process will advance the display to the next illuminated LED's value and result in the loss of any settings not previously entered with the enter key.

If at anytime, during the adjustment process there is no key activity for more than 5 seconds the display will revert back to the power up default mode and all information not previously entered by the enter key will be lost. Each press of an up or down key within the 5 second time out period will reset the timer to 5 seconds.

The control may be adjusted any time regardless of call for heat status. When pressing the enter key to enter any new setpoints, the controller will immediately begin controlling based on the new setpoint.

## OUTDOOR RESET FUNCTION SELECTIONS (OPTIONAL ON HEATING BOILERS ONLY)

As an option, the Electronic Temperature Controller may be equipped with an outdoor reset function. This function uses a sensor to measure the outdoor temperature and automatically adjust the boiler setpoint temperature to compensate for colder outdoor temperatures. **Outdoor Air Maximum Reset, Outdoor Air Maximum Temperature and Outdoor Air Minimum Temperature** are changeable points from the Diagnostic Information Center. These additional values required by the Electronic Temperature controller to properly operate the reset function must be entered by the user before the boiler is placed into service. Default values will be programmed into the Diagnostic Information Center at the factory. The operating parameters for the reset function are:

**Outdoor Air Maximum Reset:** This is the highest temperature that the boiler setpoint will be allowed to rise to when the outdoor temperature reaches the minimum temperature.

**Outdoor Air Maximum Temperature:** This is the highest outdoor air temperature that will be used to reset the boiler. Typically, this would be 60°F, which would mean that the actual setpoint would begin to increase, when the outdoor air temperature falls below this setting.

**Outdoor Air Minimum Temperature:** This is the lowest outdoor air temperature that will be used to reset the boiler. Typically, this would be -10°F, which would mean that the actual setpoint would be equal to the Maximum Reset Temperature when the outdoor air temperature falls below this setting.

**Outdoor Air Temperature:** This is the actual outdoor air temperature that will be used to reset the boiler.

## NOTE:

**Outdoor Air Reset function not available on a water heater application.**

These functions are shown in the screens of the Diagnostic Information Center. Where noted, these settings are changeable from the Diagnostic Information Center to configure boiler operation to the building heat load and weather conditions in a specific geographic area.

## USER LOCK OUT PROCEDURE

The controller has a method to discourage the casual or otherwise inadvertent changing of established settings by an unauthorized person.

- (1) Press and hold both **UP** and **DOWN** keys for more than 5 seconds to toggle the control between unlocked and locked adjustment modes.
- (2) If currently unlocked, the display will show "Loc" to indicate that control had been set to the locked mode.
- (3) If currently locked, the display will show "UnL" to indicate that the control has been set to the unlocked mode.

When unlocked, basic setpoint adjustments are possible. When locked, all of the temperature setpoints will be viewable, but can't be changed. Any attempt to use either the up or down key to change a setpoint setting while the control is locked will result in the display showing "Loc" for as long as the key is depressed. Upon releasing either key, the display will immediately revert back to showing the changeable temperature's current setting. This indicates that the display is in a locked mode and must be unlocked before adjustments are made to the controller.

Continuous pressing and holding both the UP and DOWN keys for an extended period of time will result in the display toggling back and forth between the "UnL" and "Loc" modes every 5 seconds until either one or both of the keys are released. The final mode will then have been permanently stored into memory and will be displayed for 5 seconds before the display reverts back to the power up default display mode.

When the value is permanently stored in memory, any power outages long enough to cause the controller to reset, will result in the controller maintaining its' current lockout status. The controller can be toggled between locked and unlocked any time it is in any default display mode. If the controller is in the limited access mode, it must first be returned to a display default mode prior to toggling lockout condition. The factory default will typically be the unlocked mode.

## LIMITED ACCESS MODE

The limited access mode allows the user to make configuration changes to the controller or display after the

appliance leaves the factory. It is also intended to keep certain critical operating parameters from being inadvertently changed while making basic adjustments.

## LIMITED ACCESS FEATURES

Limited access features are features or settings that may significantly affect the operation of the controller and display of information if they are set incorrectly. These features include:

**Pump Modes:** This feature allows the selection of both continuous or intermittent pump operation and the selection of multiple run times after the call for heat. Intermittent pump operation may select pump delay run times of 30, 60, 90 seconds after the setpoint is satisfied or continuous On. *Note: Even though the display may show this feature, it is not active unless the intermittent pump option is ordered from the factory and all additional control components required for this option are installed on the appliance.*

**Controlling Sensor:** This feature allows the user to designate either the Inlet (Return) sensor or the Outlet (Supply) sensor to be used by the controller as the controlling sensor. The selection would be "In S" (Inlet Sensor) or "Ou S" (Outlet Sensor).

**°F or °C Temp Units:** This feature allows the user to select between degrees Celsius and degrees Fahrenheit. The selection would display temperatures in either °F or °C as selected.

**Outdoor Air Reset:** This feature allows the user to enable or disable the O. A. Reset function of the controller. The selection would be either "OA E" (outdoor air enabled) or "OA d" (outdoor air disabled). Access to and adjustment of the O. A. settings would only be possible when O. A. Reset function is enabled. When disabled, the 4 LED's associated with the O. A. Reset function are not available via the SELECT key. *NOTE: Only boilers may be equipped with the optional outdoor air reset feature.*

## LIMITED ACCESS FEATURE SETTING PROCEDURE

In order to gain access to the limited access features of the controller, the user must press and hold both the ENTER and SELECT keys simultaneously for more than 5 seconds. This may be done at any time the controller is powered up, regardless of the controller's mode or whether the basic adjustment temperatures are locked out. Continued pressing and holding of the keys will toggle the display between limited access mode and basic display/adjustment modes.

When the limited access feature is opened and no other keys are pressed for 60 seconds, the display will revert back to the power up default display mode. As long as adjustments are being made (keys being pressed) the limited access feature may be kept active. This should provide adequate time to make necessary adjustments



without having to unnecessarily re-enter the limited access mode before completing controller and display settings. The following are the feature settings that can be changed with the limited access feature:

**Pump Modes:** When the limited access mode is first entered, "PU" will be indicated in the display. Pressing an UP or DOWN key while "PU" is in the display will result in the current pump setting being displayed. Press the UP or DOWN key to scroll through all available pump settings (On, 30, 60 or 90). Repeated pressing and releasing of a single key will slowly step the display through all available settings. Pressing ENTER once after the desired pump setting has been made will enter the new setting into the controller's memory and return the display to showing "PU". Pressing the SELECT key at anytime prior to pressing the ENTER key will cancel any changes and return the display to "PU". Press the SELECT key to advance to the next feature.

**Controlling Sensor:** Pressing the SELECT key while "PU" is displayed will change the display to "SEnS". Pressing an UP or DOWN key while "SEnS" is in the display will result in the current controlling sensor being displayed. Additional presses of the UP or DOWN keys will toggle the display between "In S" where the inlet sensor controls operation and "Ou S" where the outlet sensor controls operation. Pressing ENTER once after the desired controlling sensor selection has been made will enter that sensors selection into the controller's memory as the controlling sensor and the display will show "SEnS ". Pressing the SELECT key at anytime prior to pressing the ENTER key will cancel any changes and return the display to "SEnS". Press the SELECT key to advance to the next feature.

**"F or C" Temp Units:** Pressing the SELECT key while "SEnS" is displayed will change the display to "F or C". Pressing an UP or DOWN key while "F or C" is in the display will result in the display showing the current temperature unit. Additional presses of the UP or DOWN keys will toggle the display between °F and °C. Pressing ENTER once after the desired unit has been selected will store the new unit into the controller's memory and the display again show "F or C". Pressing the SELECT key at anytime prior to pressing ENTER key will cancel any changes and return the display to "F or C". Press the SELECT key to advance to the next feature.

**Outdoor Air Reset:** Pressing the SELECT key while "F or C" is being displayed will change the display to "OA r". Pressing an UP or DOWN key while "OA r" is in the display will switch the display between "OA E" where outdoor air option is enabled and "OA d" where outdoor air option is disabled. Pressing ENTER once after enabling or disabling the desired outdoor air feature will store the new choice into the controller's memory and the display will again show "OA r" or press the SELECT key to advance to the next feature.

Pressing the SELECT key while "OA r" is displayed will change the display to "OLoc". Pressing an UP or DOWN

key while "OLoc" is in the display will show the current outdoor air lockout setting. When the outdoor air temperature is greater than the outdoor air lockout setting and the outdoor air reset is enabled, the appliance will turn OFF. When the outdoor air temperature falls 2°F below the outdoor air lockout setting, the appliance will operate normally. Pressing and holding an UP or DOWN key while the outdoor air lockout setting is being displayed will cause the setting to increase or decrease. Pressing ENTER once after changing the outdoor air lockout setting will store the new setting into the controller's memory and the display will again show "OLoc". Press the SELECT key to advance to the next feature.

**Mode Cancellation:** Pressing ENTER once while either "PU", "SEnS", "F or C" "OA r" or "OLoc" is being displayed will return the display to the power up default display mode. Upon exiting the limited access mode, the controller and display will begin controlling temperature and displaying data based on the settings stored in memory.

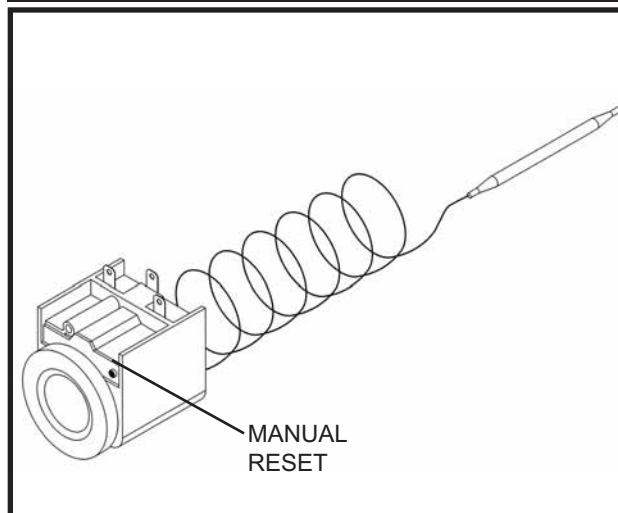
## ERROR DISPLAYS

The digital display in the Diagnostic Information Center may indicate an error display if there is a failure of the inlet sensor, outlet sensor or the outdoor air sensor. If the failure of a sensor is indicated, first carefully check all wiring and connections to the sensor. If defective, the sensor must be replaced with an OEM sensor from the manufacturer.

**TABLE — Q**  
**Error Displays**

Display	Description
InSF	indicates inlet sensor failure
OuSF	indicates outlet sensor failure
OASF	indicates outdoor air sensor failure

## HIGH WATER TEMPERATURE LIMIT CONTROL



**FIG. 54 High Water Temperature Limit Control**

A Manual Reset High Limit control is located on the inside of the left front control panel, behind the display. The setting of this control knob limits maximum discharge water temperature. A red reset button, located beside the knob, must be pushed whenever water temperature has exceeded the setpoint of manual reset limit. The temperature of the water in the heat exchanger must drop a minimum of 15°F (8.3°C) below the setting of the manual reset high limit control before the reset function can be activated. A status fault LED for **High Limit** will be illuminated in the Diagnostic Information Center when water temperature exceeds the High Water Temperature Limit Control Setpoint .

#### NOTE:

The high limit control will not reset until the water temperature has dropped below the setpoint of the high limit.

### CONDENSATE TRAP

#### *Condensate Trap Installation*

1. Locate the condensate trap kit shipped loose with the appliance. The kit includes a sheet metal mounting base, two (2) nuts and the condensate trap.
2. Install the condensate trap mounting base on the rear of the appliance in the lower left-hand corner as depicted in FIG. 55 on page 41. Use the pre-drilled holes on the appliance to secure the mounting base to the appliance.
3. Secure the condensate trap to the base using the two (2) nuts supplied with the kit. The trap should be oriented so that the barb connections are pointing toward the appliance (FIG. 55).
4. Use a level to ensure that the condensate trap is level on its base. Failure to keep the condensate trap level can result in the spillage of flue products from the condensate trap.
5. Locate the two hoses exiting the back of the appliance. Attach the larger hose on the appliance to the lower barb connection on the condensate trap. Secure the hose to the barb with a field supplied hose clamp (FIG. 55).
6. Attach the smaller hose on the unit to the upper barb connection on the condensate trap. Secure the hose to the barb with a field supplied hose clamp (FIG. 55).
7. Route the 2-pin wiring harness from the condensate trap to the matching connector on the lower back of the appliance as shown in FIG. 55. This is the blocked drain safety switch. This switch will shut the appliance off if the condensate trap becomes too full of liquid.

8. Place the appliance in operation. While the appliance is firing, check the 1/2" connection on the condensate trap for flue gas spillage. If spillage is detected, check the routing of the hoses from the appliance to the condensate trap and verify that the trap is level.
9. If spillage is still occurring, shut the appliance off. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (FIG. 55).
10. Locate the plastic ball inside the float tube. The ball prevents flue gas spillage from the condensate trap when there is not enough liquid in the trap to raise it and drain. Verify there is nothing under the ball causing it to not seat properly.
11. Replace the top cover on the condensate trap. Re-install the four (4) screws removed in Step 9 to secure the top cover.
12. A 1/2" pipe connection is supplied on the condensate trap. Connect a suitable pipe or tube to this connection (see FIG. 55).

#### WARNING: ⚠

Use a level to ensure that the condensate trap is level on its base. Failure to keep the condensate trap level can result in the spillage of flue products from the condensate trap.

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

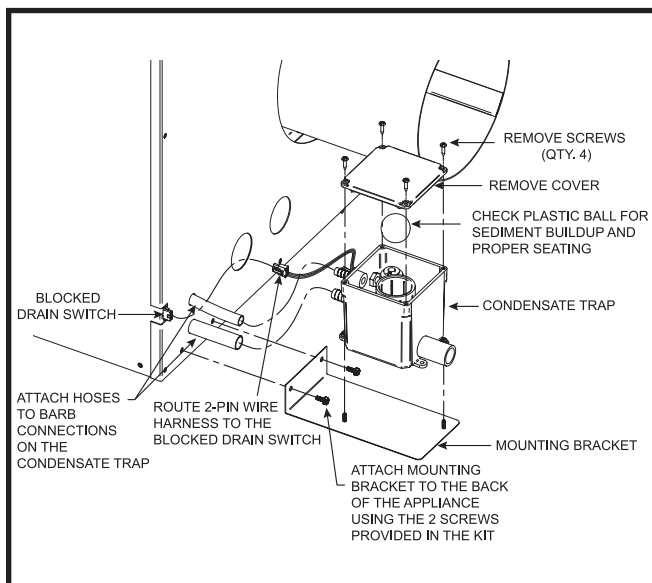
#### NOTE:

Use materials approved by the authority having jurisdiction. In the absence of other authority, PVC and CPVC pipe must comply with ASTM D1785 or D2845. Cement and primer must comply with ASME D2564 or F493. For Canada use CSA or ULC certified PVC or CPVC pipe, fittings, and cement.

13. Slope the condensate line down and away from the appliance into a drain or condensate neutralizing filter. Do not expose the condensate line to freezing temperatures.

#### NOTE:

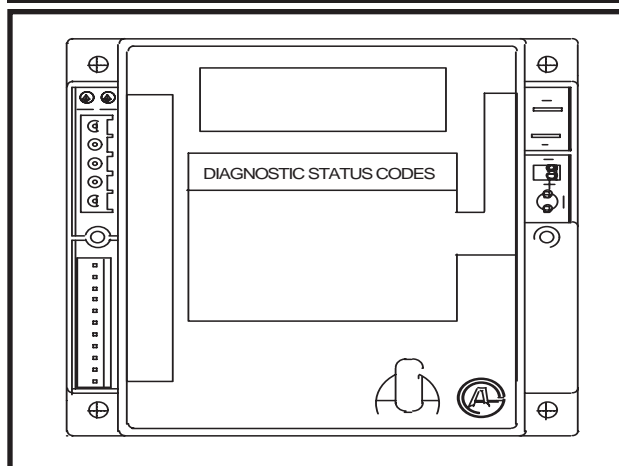
The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, the blocked drain safety switch will prevent the appliance from firing.



**FIG. 55 Install Condensate Trap**

## HOT SURFACE IGNITION SYSTEM

### IGNITION CONTROL MODULE

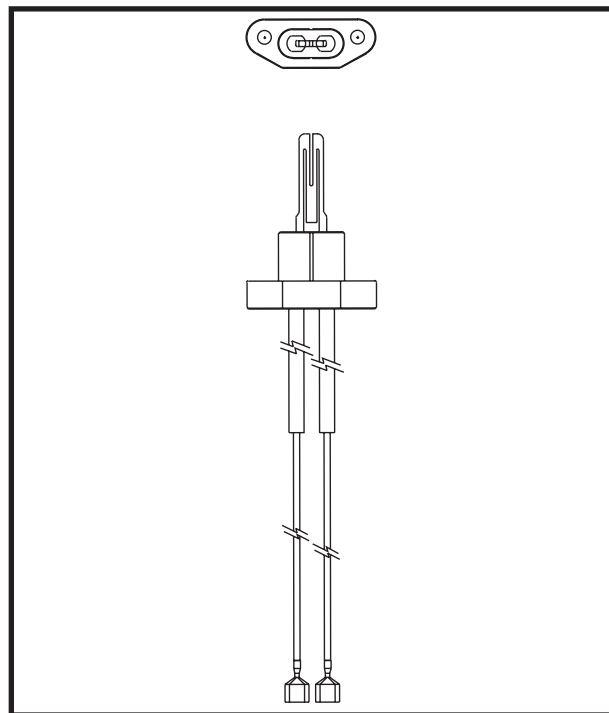


**FIG. 56 Hot Surface Ignition Control Module**

This appliance uses a proven hot surface ignition control system. The operation of the electronic control module for the hot surface igniter proves the presence of an ignition source much like a proven standing pilot before the gas valves are energized. The ignition control module starts and proves the operation of the combustion air blower, proves the presence of the proper ignition temperatures from the hot surface igniter, energizes the main gas valves, proves the presence of main burner flame, provides for soft lockouts on control sensed faults, provides a hard lockout on flame failure and controls the pre and post purge timings of the combustion air blower. An ignition status LED is provided on the front Diagnostic Information Center to display the flash codes for ignition module failure modes.

## Service Parts

This appliance uses a proven electronic ignition control module and a hot surface igniter. The electronic ignition module is not repairable. Any modification or repairs will invalidate the warranty and may create hazardous conditions that result in property damage, personal injury, fire, explosion and/or toxic gases. A faulty hot surface igniter or ignition module **MUST** be replaced with a new OEM unit only. An OEM specification igniter and ignition control module for this specific unit are available from your local distributor. **DO NOT** use general purpose field replacement ignition modules or igniters. Each appliance has one ignition module and one hot surface igniter.



**FIG. 57 Hot Surface Igniter**

## Ignition Module Lockout Functions

The ignition module may lockout in either a hard lockout condition requiring pushing of the reset button to recycle the control or a soft lockout condition which may recycle in a fixed time period to check for correction of the fault condition. A typical hard lockout fault is a flame failure condition. Pushing the reset button for the ignition control is the only way to reset an ignition module that is in a hard lockout condition. The reset button is located on the inside front control panel. The reset button is active after the post purge cycle when there is a hard lockout condition as indicated by the Ignition Module Status LED. Turning main power "OFF" and then "ON" or cycling the thermostat will not reset a hard lockout condition. Wait five seconds after turning on main power before pushing the reset button when the ignition module is in a hard lockout. The ignition module will go into a soft lockout in conditions of low air, low voltage or low hot surface igniter current. A soft lockout condition will operate the combustion air blower for the post purge cycle and then the

ignition module will pause for a fixed time period. The timed length of the pause is based on the type of fault sensed by the control module. At the end of this timed pause, the ignition module will attempt a new trial for ignition sequence. If the soft lockout fault condition has subsided or has been corrected at the end of the timed pause, main burner ignition should be achieved with the resumption of the normal trial for ignition sequence. If the control sensed fault is not corrected, the ignition module will continue in the soft lockout condition. If the electronic thermostat opens during the soft lockout period, the ignition module will exit soft lockout and wait for a new call for heat from the thermostat. A soft lockout condition may also be reset by manually cycling the electronic thermostat or turning the main power switch "OFF" and then "ON" after the control sensed fault has been corrected.

### Diagnostic Status Indication

The Diagnostic Information Center has an Ignition Module Status LED that indicates the status of the ignition safety circuits. The flashing operation of this LED indicates the diagnostic status of the ignition control module. The following listing gives the flashing diagnostic status codes as signaled by the ignition module.

TABLE — R	
Ignition Module Status LED Diagnostic Codes	
Code Sequence	Condition
Constant ON	System OK, no faults present.
Constant OFF	Possible control fault, check power; LED may be defective, do not replace control if all operational sequences function properly - see Trouble Shooting Guide.
One Flash	Low Air, check air pressure switch and hoses to pressure sensing points, blower start-up/ proving blower, venting and sealing of pressurized chamber. Blocked Drain, check condensate drain and ball float in trap for obstructions. Note: Brief flashing normal on blower start-up.
Two Flashes	Flame without call for heat, check for a gas valve stuck in the open position, air, venting, burners and the combustion process. Blower will remain on.
Three Flashes	Lockout due to flame failure, push reset button on inner control panel after correcting ignition problem. Initial heater start-up without properly bleeding air from the gas line may require multiple reset functions to achieve proper ignition.
Four Flashes	Igniter failure, igniter will not maintain minimum 2.9 amp current draw caused by low voltage, bad wiring/continuity, high resistance or igniter failure.
Five Flashes	Power supply problem, check for low supply voltage or transformer output less than 18VAC.
Six Flashes	Replace ignition module, internal fault.

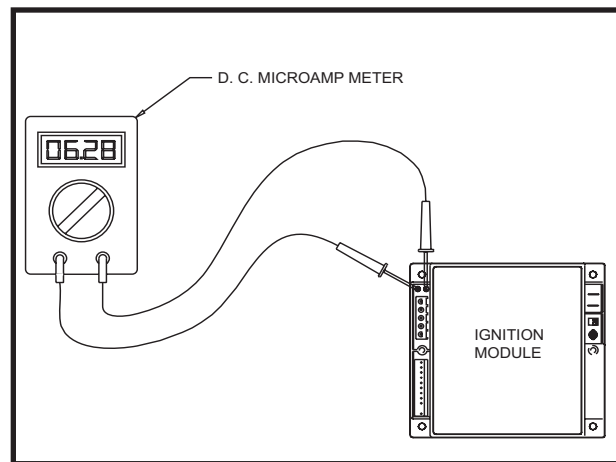


FIG. 58 Flame Current Measurement with the HSI Module

**TABLE — S**  
**Ignition and Control Timings**

<b>Proven Pilot Hot Surface Ignition System</b>
<b>Pre-purge</b>
- 15 Seconds
<b>Hot Surface Igniter Heat-up Time</b>
- 25 - 35 Seconds
<b>Main Burner Flame Establishing Period</b>
- 4 Seconds
<b>Failure Response Time</b>
- 0.8 Seconds at < 0.5 $\mu$ A flame current
<b>Post-purge</b>
- 30 Seconds

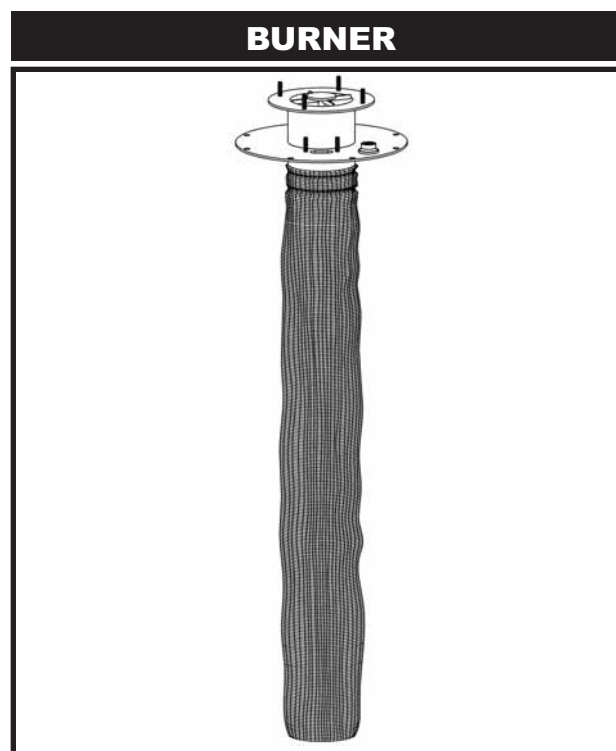


FIG. 59 Burner Assembly



This appliance uses a single cylindrical burner installed vertically into the cavity located in the center of the primary heat exchanger. There is a unique burner for each one of the three models. **Burners may NOT be changed between different Btu/hr input models.** The burner consists of a round mounting flange welded to a mixing tube. The top side of the mixing tube provides the transition which mounts the discharge from the combustion air blower into the burner. The bottom side of the mixing tube is attached to a stainless steel perforated sleeve. This stainless steel sleeve is covered with a loose fitting, woven alloy material that forms the burner port surface. The woven burner port material is called Alcromesh which is a unique alloy of iron, chrome, aluminum and several rare earth metals. This alloy is designed to operate stress free as a burner port surface. The Alcromesh burner port surface can sustain operation from a blue flame down to infrared conditions as the burner input varies. Internally, the burner has a cone and distribution baffles to balance the air/gas mixture over the surface of the burner. The burner mounting flange provides a flame view port and the mounting point for the Hot Surface Igniter. The hot surface igniter is removable from the burner mounting flange without removing the burner assembly from the heat exchanger.

#### NOTE:

**An index mark is provided on the burner flange to ensure proper orientation when removing and reinstalling the burner. A properly indexed burner will ensure correct location of the combustion air blower and adequate clearances from other components in the top jacket chamber.**

The burner is designed to operate from 100% of rated input down to 25% of rated input in normal operation. Burner operation at input rates above 25% may include some slight infrared visible on the tips of the woven burner port material. This is normal burner operation.

#### COMBUSTION AIR BLOWER

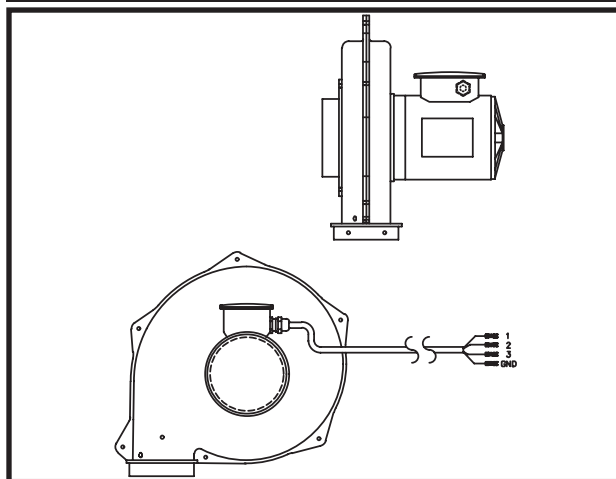


FIG. 60 Combustion Air Blower

This appliance uses a sealed air blower to provide combustion air for the burner and operate the **Category IV** venting system. The blower assembly consists of a sealed housing and blower wheel constructed from cast aluminum. The blower is operated by a fully enclosed 230 VAC, 3 Phase electric motor. This motor has a 1/2 HP rating on the 1,500,000, 1,700,000 and 2,000,000 Btu/hr models. The blower housing and motor assembly is fully sealed and **CAN NOT** be field serviced.

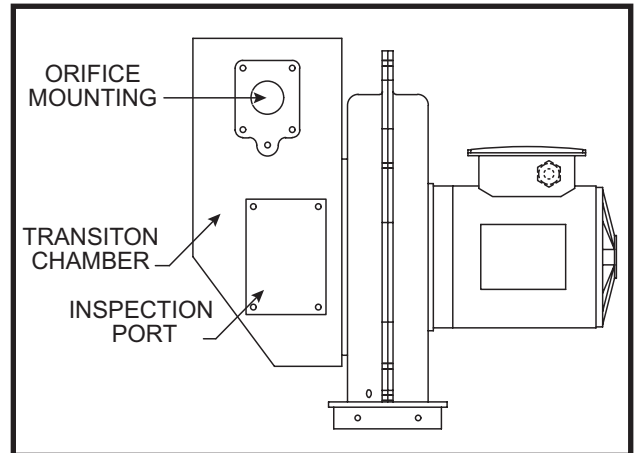


FIG. 61 Combustion Air Blower and Transition Chamber Assembly Drawing

A sealed transition chamber is mounted on the inlet to the combustion air blower. This chamber contains the gas orifice and a sensing point for operation of the ratio gas valve. Inside the transition chamber, at the inlet to the combustion air blower there is a filter to prevent particulate matter and small foreign objects from entering the blower and burner. This filter should be checked and cleaned on a six month interval or more often in a contaminated environment. An inspection port is provided on the side of the transition chamber to allow access to the internal filter for inspection and cleaning. If cleaning is required, remove the filter through the inspection port and clean with soapy water or compressed air.

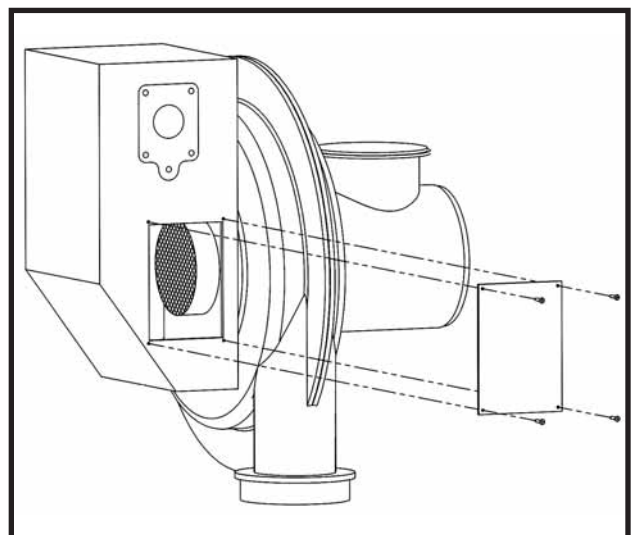


FIG. 62 Cleaning the Internal Combustion Air Blower Inlet Filter

## LIGHTING INSTRUCTIONS

### FOR YOUR SAFETY, READ BEFORE OPERATING

#### WARNING: ⚠

If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
- B. **BEFORE OPERATING**, smell around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle to the floor.

#### WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
  - Do not touch any electric switch; do not use any phone in your building.
  - Immediately call your gas supplier from a neighbors phone.
  - Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to turn the gas control handle. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the boiler. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

## LIGHTING INSTRUCTIONS

1. **STOP** - Read the safety information.
2. Set the Setpoint Temperature function of the Diagnostic Information Center to the lowest setting.
3. Turn Off all electrical power to the appliance.

4. This appliance is equipped with an ignition device, which automatically lights the burner.
5. **DO NOT try to light the burner by hand.**
6. Turn the main manual gas cock handle clockwise ↻ to the "OFF" position.

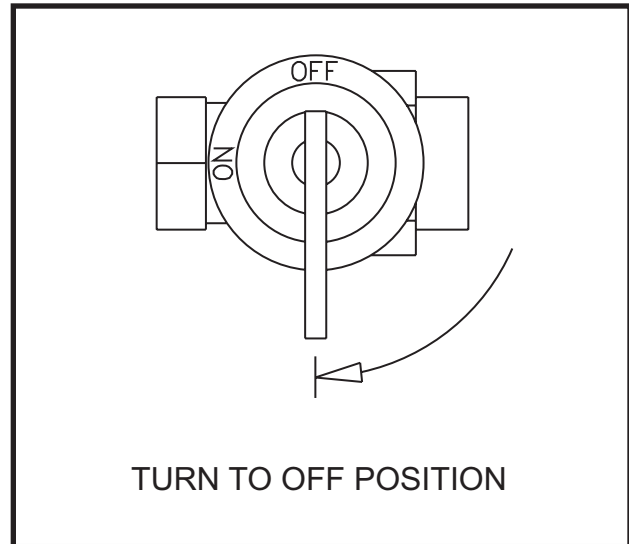


FIG. 63 Picture of Gas Cock with handle in "Off" position

7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP Follow "B" in the safety information. If you don't smell gas, go on to the next step.
8. Turn the main manual gas cock handle counterclockwise ↻ to the "ON" position.

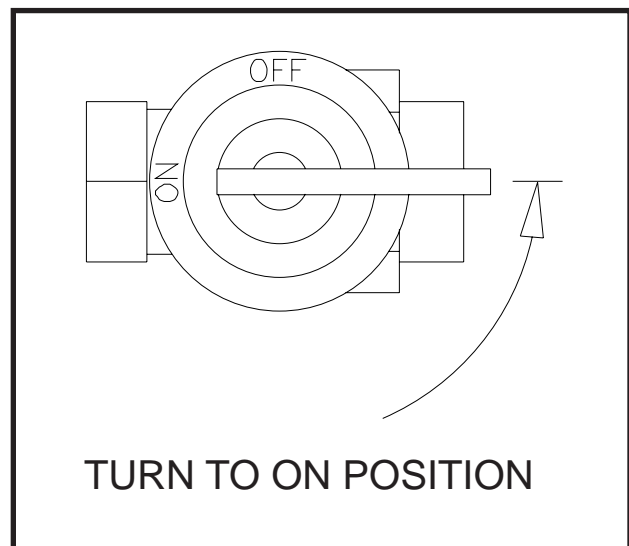



FIG. 64 Picture of Gas Cock with handle in "ON" position

9. Turn on all electric power to the appliance.
10. Set the Temperature Setpoint function of the Diagnostic Information Center to the desired setting.



11. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

### TO TURN OFF GAS TO APPLIANCE

1. Set the Setpoint Temperature function of the Diagnostic Information Center to the lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Turn the main manual gas cock handle clockwise  to the "OFF" position.

### WARNING: ⚠

**Should overheating occur or the gas fail to shut off, turn off the manual gas control valve to the appliance.**

### IGNITION SYSTEM CHECKOUT

1. Set power switch to "OFF" position.
2. Turn off gas supply to appliance.
3. Set the Setpoint Temperature function of the Diagnostic Information Center and high limit controls to the highest setting
4. Set power switch to "ON" position.
5. Ensure that the circulating pump is operating and safety switches prove.
6. The igniter will cycle on trial for ignition.
7. The ignition module will lock out and indicate a flame failure through the appropriate flash code in the Ignition Module Status LED.
8. Readjust Setpoint Temperature of the Digital Display and high limit to normal settings.
9. Turn on gas supply.
10. Push the reset button on the internal control housing, beside the ignition module to reset ignition module.
11. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

### SEQUENCE OF OPERATION

1. The power switch is placed in the "ON" position.
2. 120 VAC Power supplied to the control junction box and to the external circulating pump (if installed in a primary/secondary boiler system or as a water heater).
3. 120 VAC Power supplied to the control Transformer, Ignition Module and Electronic Temperature Controller.
4. 120 VAC is supplied to the VFD.
5. 24 VAC is supplied to all low voltage controls.
6. Water flow from the circulating pump is proven by a Flow Switch.
7. Diagnostic Information Center Setpoint Temperature (Operating Temperature) is set to call for heat.
8. Electronic Temperature Controller initiates a start-up sequence by checking the Temperature Sensors and input signals from the safety controls.
9. Electronic Temperature Controller enables the Ignition Module.
10. Ignition Module enables the Variable Frequency Drive via a relay.
11. Electronic Temperature Controller drives the Variable Frequency Drive.
12. The Variable Frequency Drive supplies the Combustion Air Blower with 230 VAC 3Ø power.
13. Combustion Air Blower starts operation and drives to 100% speed for prepurge.
14. Blower makes the low air switch contacts to enable the Ignition Module.
15. Blower cycles down to 50% speed and the Ignition Module initiates the heat-up sequence of the Hot Surface Igniter.
16. Hot Surface Igniter proves 1800°F Ignition Temperature by current draw through the Ignition Module.
17. The Ignition Module supplies 24 VAC to the Variable Ratio Gas Valve Relay and the Redundant Gas Valve.
18. Operation of the Igniter, Gas Valves and Safety Switches are proven to the Electronic Temperature Controller.

19. Variable Ratio Gas Valve senses the pressure from the Combustion Air Blower and supplies gas to the orifice and into the Blower inlet to pre-mix.
20. The Gas/Air mixture is forced into the Burner and out of the Burner Ports under pressure.
21. Hot Surface Igniter lights the Gas/Air mixture and then serves as a flame sensor to prove Main Burner Flame by rectification.
22. Burner is now in a soft start firing at 50% of rated input.
23. Electronic Temperature Controller signals the Variable Frequency Drive to adjust blower speed based on desired water Setpoint Temperature.
24. Burner input rate is variable down to 25% of rate or up to 100% of rate as required to satisfy the Setpoint Temperature programmed into the Diagnostic Information Center.

### ***Heat Transfer Process***

25. Burner Input will decrease as water temperature reaches the Setpoint temperature.
26. Burner Input may stabilize at a fixed rate where demand equals input.
27. Burner Input will decrease rate when water temperature exceeds temperature Setpoint and demand.
28. Heated products of combustion pass over the Heat Exchanger transferring heat to the water.
29. Rate of flue product movement is controlled by "V" Baffles on the heat exchanger to maximize heat transfer.
30. Flue products pass into the flue collector and are exhausted from the unit.

### ***End of Sequence***

31. Setpoint temperature is satisfied.
32. Power to the gas valves is turned off.
33. Combustion Air Blower ramps up to 100% speed and runs for a 30 second post purge timing and turns off.
34. Electronic Temperature Controller is now in a standby mode waiting for the next "Call for Heat".

## **MAINTENANCE**

Listed below are items that must be checked to ensure safe reliable operations. Verify proper operation after servicing.

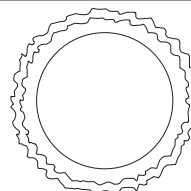
## **CAUTION: ⚠**

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

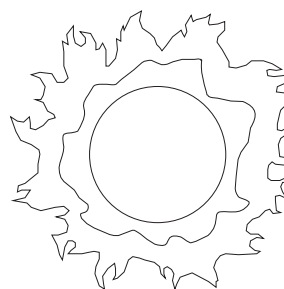
1. **EXAMINE THE VENTING SYSTEM** at least once a year. Check more often in first year to determine inspection interval. Check all joints and pipe connections for tightness, corrosion or deterioration. Flush the condensate drain hose with water to clean. Clean screens in the venting air intake system as required. Have the entire system, including the venting system, periodically inspected by a qualified service agency.
2. **VISUALLY CHECK MAIN BURNER FLAMES** at each start up after long shutdown periods or at least every six months. A burner viewport is located on the burner mounting flange.

## **WARNING: ⚠**

**The area around the burner viewport is hot and direct contact could result in burns.**



**NORMAL BURNER FLAME**



**ABNORMAL BURNER FLAME**

**FIG. 65 Flame Pattern Illustration**

- a. **Normal Flame:** A normal flame at 100% of burner input is blue, with slight yellow tips, a well defined flame and no flame lifting.
- b. **Yellow Tip:** Yellow tipping can be caused by blockage or partial obstruction of air flow to the burner.
- c. **Yellow Flames:** Yellow flames can be caused by blockage of primary air flow to the burner or excessive gas input. This condition **MUST** be corrected immediately.
- d. **Lifting Flames:** Lifting flames can be caused by over firing the burner, excessive primary air or high draft.

If improper flame is observed, examine the venting system, ensure proper gas supply and adequate supply of combustion and ventilation air.

- 3. **FLUE GAS PASSAGEWAYS CLEANING PROCEDURES:** Any sign of soot around the inner jacket, outer jacket, flue pipe connections, burner or in the areas between the fins on the copper heat exchanger indicates a need for cleaning. The following cleaning procedure must only be performed by a qualified serviceman or installer. Proper service is required to maintain safe operation. Properly installed and adjusted units seldom need flue cleaning.

#### NOTE:

All gaskets/sealant on disassembled components or jacket panels must be replaced with new gaskets/sealant on re-assembly. Gasket and sealant kits are available from your distributor.

#### CAUTION: ⚠

When a **Category IV** vent system is disconnected for any reason, the flue must be reassembled and resealed according to the vent manufacturer's instructions.

#### 4. BURNER MAINTENANCE

The burner should be removed for inspection and cleaning on an annual basis. An appliance installed in a dust or dirt contaminated environment may require cleaning of the burner on a 3 to 6 month schedule or more often, based on severity of the contamination. The fan assisted combustion process may force airborne dust and dirt contaminants, contained in the combustion air, into the burner. With sustained operation, non-combustible contaminants may reduce burner port area, reduce burner input or cause non-warrantable damage to the burner.

Use extreme care when operating an appliance for temporary heat during new construction. Airborne contaminants such as dust, dirt, concrete dust or dry wall dust can be drawn into the burner with the combustion air and block the burner port area. An external combustion air filter is provided with the appliance. The combustion air filter is for **Temporary Use Only** and **MUST** be removed when the appliance is placed in normal service. An additional filter is located inside the transition chamber, at the inlet to the combustion air blower, to also prevent particulate matter and small foreign objects from entering the blower and burner. This internal filter should be checked and cleaned on a six month interval or more often in a contaminated environment. See the Combustion Air Blower section of this manual for cleaning instructions. The burner of an appliance used for temporary heat without a combustion air filter installed will probably require a thorough cleaning before the unit is placed into normal service.

### BURNER REMOVAL AND CLEANING

All gaskets/sealant on disassembled components or jacket panels must be replaced with new gaskets/sealant on re-assembly. Gasket and sealant kits are available from your distributor.

*Access to the burner will require the following steps:*

1. Turn off main electrical power to the appliance.
2. Turn off main manual gas shutoff to the appliance.
3. Remove the front outer control panel covers. Slide out the inner control panel to increase service clearances and carefully remove the multi-pin wiring connectors on the back of the control panel. Remove the screws along the front and rear edge of the top outer jacket panel to remove the jacket top. Remove the control panel to allow access to the components in the top of the appliance.
4. Disconnect the gas supply connection to the internal gas train at the field installed union.
5. Remove the air inlet pipe connection to the boiler/water heater.
6. Remove the insulation blanket on top of the heat exchanger. *Note: Take care not to tear insulation blanket on removal.*
7. Disconnect the power wires to the gas valves, flow switch, VFD and pressure switches (if equipped). Multiple pin connectors are used at all of these components for ease of service.

8. Remove the sensing tubes from the air ratio gas valve to the combustion air blower.
9. Remove the 6 nuts holding the blower assembly to the blower and remove the blower assembly.
10. Disconnect the power wires to the hot surface igniter.
11. Remove the hot surface igniter. The hot surface igniter is fragile. Use care to prevent impact damage to the silicon carbide igniter surface when removing the igniter.
12. Remove the 8 nuts holding the burner to the heat exchanger.
13. The burner can now be lifted vertically out of the heat exchanger cavity.
14. Use care to prevent damage to the woven burner port surface on removal.

#### **NOTE:**

When the combustion air blower is removed for any reason, the inlet to the burner must be covered to prevent foreign objects from falling into the burner. A foreign object such as a nut, bolt, wire or other metallic items will cause a rapid non-warrantable failure of the burner on operation.

#### **NOTE:**

**Use care when removing and handling the burner. Sharp objects or impact may damage or tear the woven burner flame surface.**

### ***Burner Cleaning Procedure***

Remove any visible dust or dirt blockage from the surface of the burner with a vacuum. Compressed air may also be blown across the burner surface to clean the "pores" of the woven burner port material.

The burner may best be cleaned by immersing the burner port area in a solution of dishwashing detergent and hot water. **Do not** use chlorine based solvents or cleaning agents on the burner. Allow the burner to remain in the solution for a short period of time to remove dust, dirt and oil or grease laden contaminants. Rinse the burner thoroughly with clean water to remove any residue from the detergent cleaner. The burner should be air dried quickly after removal from the cleaning solution and rinsing to prevent any oxidation or rusting of the ferrous components in the burner port material.

### **5. CHANGING THE HOT SURFACE IGNITER**

1. Turn off main electrical power to the appliance.
2. Turn off main manual gas shutoff to the appliance.
3. Carefully pull back the insulation flaps to expose the burner mounting flange.
4. Locate the Hot Surface Igniter.
5. Disconnect the two power leads to the hot surface igniter.
6. Loosen and remove the two wing nuts that mount the igniter.
7. Lift the igniter vertically out of the burner mounting flange. Use care, do not hit or break the silicon carbide igniter. Do not contaminate the igniter by handling with oily or dirty hands.
8. Check the replacement igniter for cracks or damage before installing.
9. Ensure that the fiber gasket used to seal the base of the igniter to the burner flange is reinstalled to seal the base of the replacement igniter.
10. Carefully insert the igniter into the mounting point on the burner flange and position on the mounting studs.
11. Reinstall the 2 wing nuts and tighten by hand only. Over tightening the wing nuts may break the ceramic mounting flange.
12. Ensure that the igniter gasket is properly installed and seals the point of contact between the igniter and burner mounting flange.
13. Reconnect the power leads to the igniter.
14. Replace the insulation blanket flaps.
15. Turn on main gas supply.
16. Turn on main power.
17. Test fire the appliance to ensure proper operation.

## 6. HEAT EXCHANGER INSPECTION

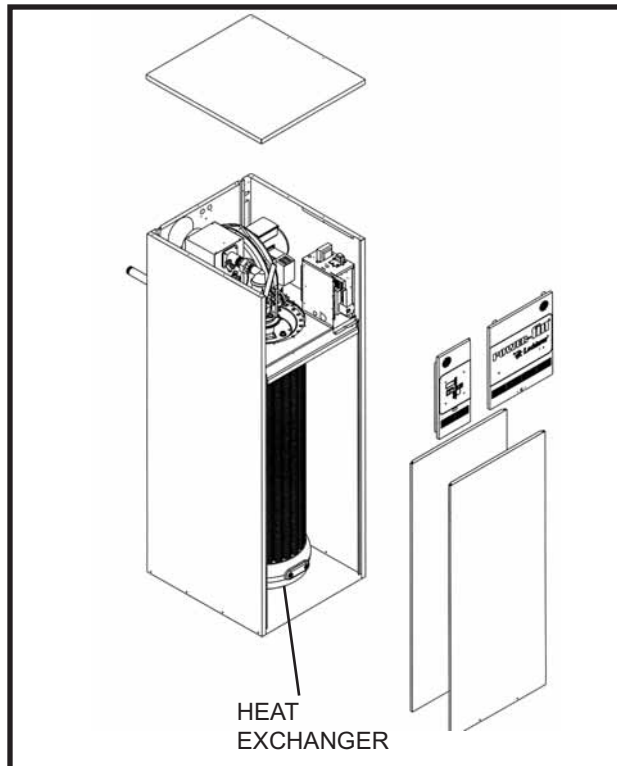


FIG. 66 Location of Heat Exchanger Inside of Jacket

### NOTE:

All gaskets or sealant on disassembled components or jacket panels must be replaced with new gaskets or sealant on re-assembly. Gasket and sealant kits are available from your distributor.

1. Turn off all power to the appliance.
2. Turn off main gas to appliance.
3. Remove the front outer jacket door.
4. Remove the front, upper inner jacket door.
5. Check the heat exchanger surface for soot. If soot is present, heat exchanger must be cleaned and problem corrected.
6. Remove front, lower inner jacket door if heat exchanger cleaning is required.
7. Remove burner as described in Burner Maintenance procedure.
8. Check "V" baffles on the exchanger. Remove and clean if necessary.
9. Remove soot from heat exchanger with a stiff

bristle brush. Use a vacuum to remove loose soot from surfaces and inner chamber.

10. The heat exchanger can be removed by disconnecting all water piping to the heat exchanger, removing the screws holding the heat exchanger to the top of the inner jacket and sliding the heat exchanger towards the front of the appliance. Once the heat exchanger is removed, a garden hose can be used to wash the tubes to ensure that all soot is removed from the heat exchanger surfaces. *NOTE: Do not wet the insulation blankets on the inside of the outer jacket panels.*
11. Ensure that any soot present on the burner is removed. See Burner Cleaning Procedure.
12. Carefully reinstall the heat exchanger and "V" baffles if removed from the appliance.
13. Reinstall inner jacket panels, burner, manifolds, wires and hoses. Use new gasket material to ensure a proper air seal.
14. Reassemble all gas and water piping. Test for gas leaks.
15. Reassemble outer jacket panels.
16. Cycle unit and check for proper operation.

## 7. LUBRICATION

**Combustion Air Blower:** Each combustion air blower should be checked every 6 months. Clean internal filter as required when installed in a dust or dirt contaminated location. See Combustion Air Blower in the component section for cleaning procedure. The motor and bearings on the combustion air blower are sealed and permanently lubricated requiring no addition of oil or lubricants.

**Water Circulating Pump (If equipped):** Inspect pump every 6 months and oil as necessary. Use SAE 30 non-detergent oil or lubricant specified by pump manufacturer.

## 8. COMBUSTION AND VENTILATION AIR

Check frequently to be sure the flow of combustion and ventilation air to the boiler is not obstructed. Combustion and ventilation air must be provided to the mechanical room with openings sized per the requirements of the National Fuel Gas Code when the appliance is installed with a standard **Category IV** vent system. The optional Direct-Vent and DirectAire use a separate combustion air pipe to bring in combustion air from the outdoors directly to the appliance. Ensure that the external construction air filter is **NOT** used for continuous service after the construction phase.

## 9. CONTROL CIRCUIT VOLTAGE

This appliance uses a transformer to supply a low voltage control circuit. The voltage on the secondary side should be be 24 to 28 VAC when measured with a voltmeter. A secondary voltage of 18 VAC or less supplied to 24 VAC components may cause operational problems.

## 10. CONDENSATE TRAP

1. Inspect the condensate line, condensate fittings, and condensate trap on an annual basis.
2. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (reference FIG. 55 on page 41).
3. Remove any sediment in the trap.
4. Locate the plastic ball in the float tube (FIG. 55). The ball prevents flue gas spillage from the condensate trap when there is not enough liquid in the trap to raise it and drain. Verify that there is nothing under the ball causing it to not seat properly.
5. Replace the top cover on the condensate trap.

## 11. COMBUSTION AIR MEASUREMENT

This appliance uses a variable speed combustion air blower to operate the combustion process and venting system. A single combustion air blower is used to supply combustion air to the burner. The discharge air from the blower is factory pre-set and is **not field adjustable**. The blower and transition are mounted on the top of the burner. The blower is enclosed inside of the top chamber.

There is a pressure test tree located in the top chamber of the appliance. This pressure test point tree can be accessed by removing the front access panel. The pressure test tree is mounted on the front edge of the combustion air blower. It consists of an angle support and four labeled test cocks. There is one cock for positive air and one for negative air, one cock for positive gas and one for negative gas. Differential air pressure measurement at the combustion air blower will utilize both the positive air and negative air test points.

1. Remove the front access panel. Locate the pressure test tree on the front edge of the combustion air blower. The positive and negative air pressure terminals will be used to check differential air pressure from the blower discharge to the burner inlet. Each air pressure connection point will have a small manual cock to attach a hose.
2. Connect a hose from the positive air and the negative air to each of the two sides of a manometer. This will allow the two pressure points to be measured at the same time. Open the two air pressure test point cocks.

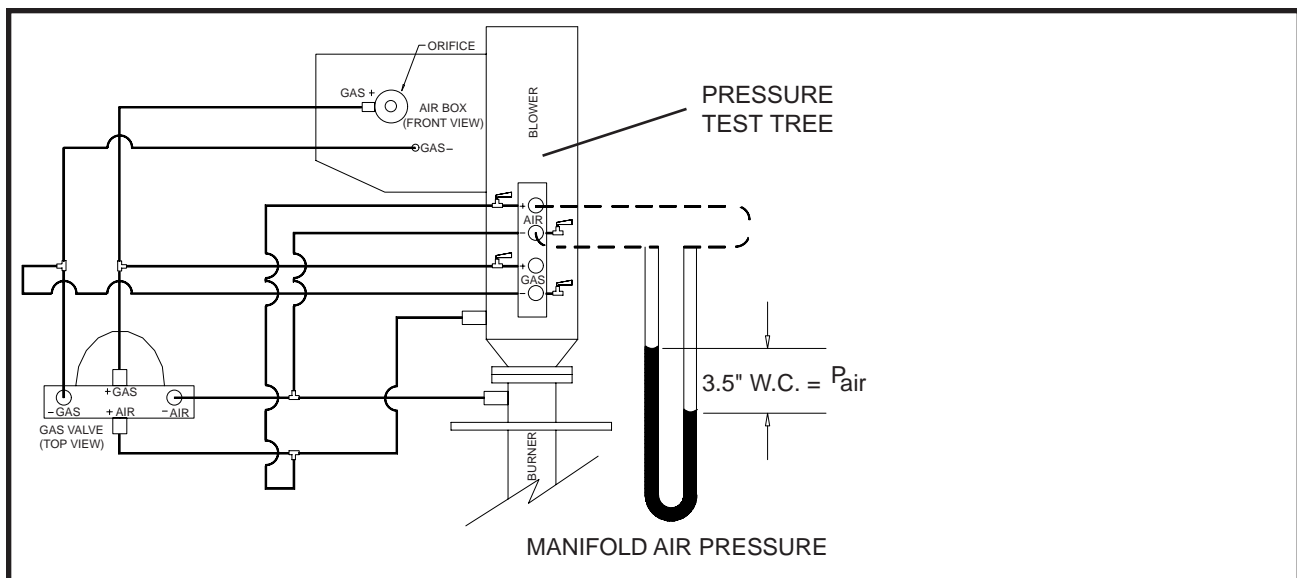


FIG. 67 Differential Air Pressure Sensing Hoses



3. Set the Command Display to a setpoint which will fire the burner at 100% of rated input.
4. As the appliance comes on and fires, record the inches of water column of displacement on both sides of the manometer. The sum of these two readings as they are effected by the two air pressures is the differential air pressure.
5. The differential air pressure should be 3.5 inches of water column (+/- 0.1" w.c.) when the burner is firing at 100% of rated input.
6. If the differential air pressure is not 3.5 inches water column (+/- 0.1" w.c.), review the installation. Check for proper installation of the venting system. Review the venting requirements in this manual for the specific venting system installed with this appliance. Correct as required. Ensure that an adequate supply of combustion air is supplied to the appliance. If a separate pipe is used to supply combustion air, ensure that it is installed per the combustion air pipe requirements contained in the venting section of this manual. Correct as required. Check the air inlet screen to the combustion air blower. Clean as required. Check the burner for dirt or contamination and clean as required. Recheck for correct differential air pressure after correcting an installation related problem or after cleaning an obstructed component. Ensure that a combustion air differential of 3.5 inches water column (+/- 0.1" w.c.) is present while the appliance is firing at 100% of rated input.
7. This is a reference pressure only and is **not field adjustable**. An appliance supplied with an unrestricted supply of combustion air from a incorrectly sized combustion air opening or separate direct vent combustion air pipe will operate at the correct air pressure differential as the burner input varies with temperature demand.
8. Close the two air pressure test cocks on the pressure test tree and remove the hoses to the manometer.
9. Replace the front access panel.

## COMBUSTIBLE MATERIALS

### CAUTION: ⚠

Keep appliance area clear and free from combustible materials, gasoline and other flammable vapors and liquids.

## FREEZE PROTECTION

Installations are not recommended in areas where the danger of freezing exists. Proper freeze protection must be provided for appliances installed in unheated mechanical

rooms or where temperatures may drop to the freezing point or lower. If freeze protection is not provided for the system, a low ambient temperature alarm is recommended for the mechanical room. **Damage to the appliance by freezing is non-warrantable.**

1. Pump Operation - **MOST IMPORTANT** - This appliance is designed for continuous pump operation when the burners are firing. The circulating pump **MUST** run continuously when the power switch is in the "ON" position. As an optional feature, an intermittent pump control system can be provided. The intermittent pump option allows the circulating pump to be cycled on at each call for heat and cycled off when the Setpoint is satisfied. The intermittent pump will operate for a timed period after the burner cycles off to remove residual heat from the combustion chamber area. A boiler equipped with the intermittent pump option will energize the pump relay when the inlet or outlet temperatures sensor is less than 40°F (4.4°C). The pump relay will remain energized until the controller senses a temperature greater than 45°F (7.3°C) to help prevent freezing.
2. Location - Heating boilers, hot water supply boilers or water heaters must be located in a room having a temperature safely above freezing [32°F(0°C)].
3. Caution - A mechanical room operating under a negative pressure may experience a down draft in the flue of an appliance that is not firing. The cold outside air may be pulled down the flue and freeze a heat exchanger. This condition must be corrected to provide adequate freeze protection.
4. A motor driven damper may be installed in the air inlet to prevent cold air movement in cold climates. The damper **MUST** be interlocked with boiler/water heater controls to open and prove on a call for heat.
5. Freeze protection for a heating boiler or hot water supply boiler using an indirect coil can be provided by using hydronic system antifreeze. Follow the manufacturers instructions. **DO NOT** use undiluted or automotive type antifreeze.
6. Shut-down and Draining - If for any reason, the unit is to be shut off, the following precautionary measures must be taken:
  - (a) Shut off gas supply
  - (b) Shut off water supply.
  - (c) Shut off electrical supply
  - (d) Drain the unit completely. Remove both caps from the two drains located on the rear of the appliance. Open the relief valve to allow air into the system so the water will drain out. Ensure that the pump and connecting piping are fully drained.

## FREEZE PROTECTION FOR A HEATING BOILER SYSTEM (IF REQUIRED)

1. Use only properly diluted inhibited glycol antifreeze designed for hydronic systems. Inhibited propylene glycol is recommended for systems where incidental contact with drinking water or any potable water is possible.

### CAUTION: ⚠

**DO NOT use undiluted or automotive type antifreeze.**

2. A solution of 50% antifreeze will provide maximum protection of approximately -30°F.
3. Follow the instructions from the antifreeze manufacturer. Quantity of antifreeze required is based on total system volume including expansion tank volume.
4. Glycol is denser than water and changes the viscosity of the system. The addition of glycol will decrease heat transfer and increase frictional loss in the boiler and related piping. An increased flow rate through the boiler heat exchanger may be required to achieve proper heat transfer rates in a glycol system. Reduced flow in a boiler due to a high percentage of glycol in the system may result in boiler noise or flashing to steam.
5. Local codes may require a back flow preventer or actual disconnect from city water supply when antifreeze is added to the system.

## WATER TREATMENT

In hard water areas, water treatment should be used to reduce the introduction of minerals to the system. Minerals in the water can collect in the heat exchanger tubes and cause noise on operation. Excessive build up of minerals in the heat exchanger can cause a non-warrantable failure.

### WARNING: ⚠

**Do not attempt to fire this appliance without completely filling the heat exchangers and all related system piping. Ensure that all air is properly bled from the system before firing. Failure to properly fill the boiler and related piping before firing may result in personal injury or non-warrantable property damage.**

## HEATING BOILER INSTALLATIONS

### PIPING OF THE BOILER SYSTEM

The drawings in this section show typical boiler piping installations. Before beginning the installation, consult local codes for specific plumbing requirements. The installation should provide unions and valves at the inlet and outlet of the boiler so it can be isolated for service. An air separation device must be supplied in the installation piping to eliminate trapped air in the system. Locate a system air vent at the highest point in the system. The system must also have a properly sized expansion tank installed. Typically, an air charged diaphragm-type expansion tank is used. The expansion tank must be installed close to the boiler and on the suction side of the system pump to ensure proper operation. **Caution: This boiler system should not be operated at less than 12 PSIG.** Hot water piping must be supported by suitable hangers or floor stands, **NOT** by the boiler. Copper pipe systems will be subject to considerable expansion and contraction. Rigid pipe hangers could allow the pipe to slide in the hanger resulting in noise transmitted into the system. Padding is recommended on rigid hangers installed with a copper system. The boiler pressure relief valve must be piped to suitable floor drain. See the relief valve section in the Installation and Service Manual.

### CAUTION: ⚠

**A leak in a boiler “system” will cause the “system” to intake fresh water constantly, which will cause the tubes to accumulate a lime/scale build up. This will cause a Non-Warrantable Failure.**

## WATER CONNECTIONS HEATING BOILERS ONLY

All boilers have 2-1/2 inch copper pipe inlet and outlet connections. Installed piping to and from the boiler must be a minimum of 2-1/2 inch diameter. **Caution: Field installed reducing bushings must not be used.** Any reduction in pipe size may decrease flow resulting in high water temperatures, boiler noise, flashing to steam and non-warrantable heat exchanger damage.

The boiler may be installed with either a primary/secondary piping system or with full system flow provided to the boiler. It is important to guarantee that adequate flow is provided to properly dissipate heat from the boiler and also ensure that flow through the boiler does not exceed the maximum recommended flow rate of 90 GPM for a boiler equipped with a copper heat exchanger.

## BOILER CIRCULATOR REQUIREMENTS

This is a low mass, high efficiency hot water boiler which must have adequate flow for quiet, efficient operation. Pump selection is critical to achieve proper operation. A pump should be selected to achieve proper system design water temperature rise. A system pump may provide full flow through the boiler or a separate pump may be installed in a secondary loop to the boiler. Pipe diameter and length are critical to ensure proper flow through the boiler. A heat exchanger head-loss chart is provided to assist in proper pump selection. Also provided is a System Temperature Rise Chart. This table provides GPM and boiler head-loss at various temperature rises for each model based on Btu/hr input. Temperature rise is the difference in boiler inlet temperature and boiler outlet temperature while the boiler is firing at full rate. Example: The boiler inlet temperature is 160°F (71.1°C) and the boiler outlet temperature is 180°F (82.2°C). This means that there is a 20°F (11.1°C) temperature rise across the boiler. The boiler temperature rise is visible in the Diagnostic Information Center as water temperature differential on the boiler's front control panel.

## CIRCULATOR PUMP SPECIFICATIONS

1. Maximum operating pressure for pump must exceed system operating pressure.
2. Maximum water temperature should not exceed nameplate rating.
3. Cast iron circulators may be used for closed loop systems.
4. A properly sized expansion tank must be installed near the boiler and on the suction side of the pump.

## CIRCULATOR PUMP OPERATION (HEATING BOILERS ONLY)

The boiler pump should run continuously when the boiler is firing. Separate power supplies to the pump and boiler controls can be provided or the two circuits (pump and controls) can be combined for connection to one circuit, properly sized for both.

## INTERMITTENT PUMP OPERATION (OPTIONAL)

An intermittent pump operation feature is available as an option. When equipped with this option, the boiler's circulating pump will cycle on at each call for heat, before

the burner fires. The pump will continue operate while the burner is firing. The pump will run for a minimum 30 second period after the temperature setpoint is satisfied. This timing is selectable from the Diagnostic Information Center. This timing will remove of any residual heat from the combustion chamber before turning the pump off. See wiring diagram shipped with the unit.

**PUMP MAINTENANCE:** Inspect pump every 6 months and oil as necessary. Use SAE 30 non-detergent oil or lubricant specified by pump manufacturer.

## PRIMARY/SECONDARY BOILER PIPING

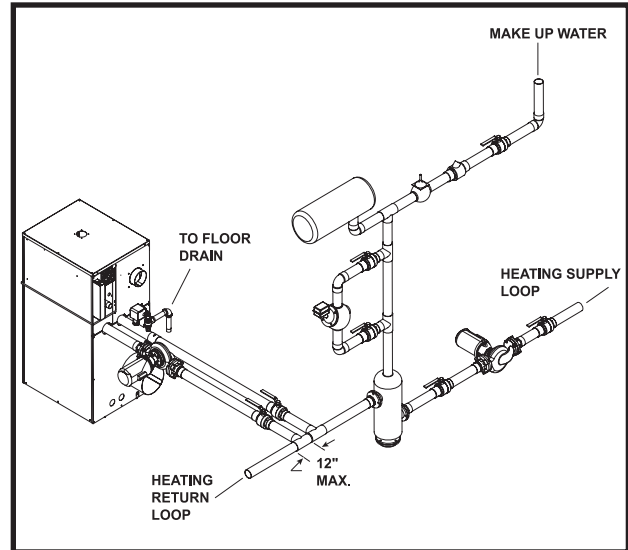


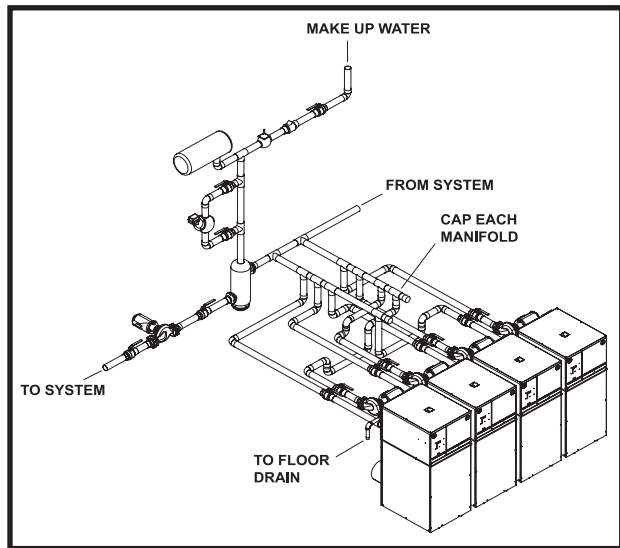
FIG. 68 Primary/Secondary Piping of a Single Boiler

This boiler is recommended for installation in a primary/secondary piping system. This type of system uses a separate boiler circulating pump to supply flow to and from the boiler only. The secondary pump is sized based on the head loss of the boiler and related pipe and fittings in the secondary loop only.

A properly sized primary system pump provides adequate flow to carry the heated boiler water to radiation, air over coils, etc. The fittings that connect the boiler to the primary system should be installed a maximum of 12 inches (0.30 m) (or 4 pipe diameters) apart to ensure connection at a point of zero pressure drop in the primary system. There should be a minimum of 10 pipe diameters of straight pipe before and after the boiler secondary loop connections to prevent turbulent flow at the secondary loop connections. The secondary loop piping to and from the boiler must have a fully ported ball valve installed in both the supply and return side piping. The ball valves must be fully ported having the same inside diameter as the installed piping. The ball valve in the piping supplying water to the boiler will only be used as a service valve. The ball valve installed in the discharge from the boiler back to the primary system will be used to adjust boiler flow and temperature rise to ensure proper performance.

The boiler primary piping system must have a circulator installed in the main system loop to carry the heated boiler water to the point of use in the main system.

Multiple boilers may also be installed with a primary/secondary manifold system. Multiple boilers should be connected to the common manifold in reverse return to assist in balancing flow to multiple boilers.



**FIG. 69 Primary/Secondary Piping of Multiple Boilers**

The installer must ensure that the boiler has adequate flow without excessive temperature rise. Low system flow can result in overheating of the boiler water which can cause short burner cycles, system noise, relief valve discharge and in extreme cases, a knocking flash to steam. These conditions indicate the need to increase boiler flow to and from the boiler. This is generally accomplished by either increasing the size of the boiler pump or by increasing the diameter of the piping that connects the boiler to the primary system. A larger diameter pipe reduces head loss and increases flow.

### CAUTION: ⚠

At no time should the system pressure be less than 12 PSIG.

## MINIMUM BOILER WATER TEMPERATURES

Inlet water temperatures below the specified minimum of 140°F (60°C) can excessively cool the products of combustion resulting in condensation on the heat exchanger. Condensation on the heat exchanger can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the related components. See “Low Temperature Bypass Requirements” for boiler system applications below the minimum specified temperature.

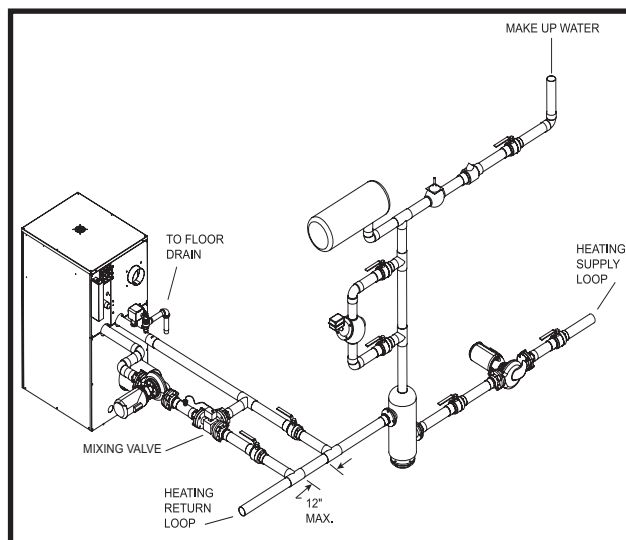
## LOW TEMPERATURE BYPASS REQUIREMENTS

To prevent condensation problems, a boiler **MUST NOT** be operated (other than for brief periods during initial system startup) with an inlet water temperature of less than 140°F (60°C). If normal system return temperatures are less than the required 140°F (60°C) boiler inlet requirement, a method of low return water temperature protection **MUST BE** provided to protect the boiler.

For Example: *Night Setback* of the secondary loop water temperature, *Night Shutdown* and *Weekend Shutdown* of the entire boiler / heating system, and *Indoor / Outdoor Air Reset* of the secondary loop water temperature. If any of these Building Management System control functions are being utilized on the hydronic heating system, some type of low return water protection **MUST BE** provided.

If the boiler heating system will be used on a Water Source Heat Pump System, Radiant Floor Heating System, Snow Melting Heating System, etc., some type of low return water protection must be provided.

Condensation can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the vent system and related components.



**FIG. 70 Boiler with Low Temperature Bypass Piping - Using a Thermostatic Mixing Valve Required for M9 Modulation Units**

To prevent the system return water temperature below 140°F (60°C) from entering the boiler inlet, a quick acting self contained mixing valve, set at 140°F (60°C) or an electric actuated mixing valve with a sensor located on the boiler inlet pipe must be provided. To prevent manual reset high limit problems, mixing valve minimum flow stops or a valve leak-through should be evaluated. The installation of this mixing valve in the piping system as shown in FIG. 69 should not restrict or vary the water flow through



the boiler. Constant water flow through the boiler must be provided at all times when the boiler is operating.

The boiler's operating temperature sensor can be remote mounted in a bulbwell installed in the system water flow to control boiler operation at a low temperature range. The lowest temperature setpoint available from the Digital Temperature Control is 60°F (15.6°C).

### CAUTION: ⚠

A boiler allowed to operate at setpoint temperatures below the specified minimum settings may experience operational problems with the operating controls and safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion and possible flue gas spillage. Operation at lower than specified water temperatures may cause hazardous conditions that result in non-warrantable damage to the appliance.

### THREE WAY VALVES IN SYSTEM

The installation of a three way valve on this boiler is not generally recommended because most piping methods allow the three way valve to vary flow to the boiler. This boiler is a low mass, high efficiency unit which **requires a constant water flow rate for proper operation**. Low flow rates can result in overheating of the boiler water which can cause short burner cycles, system noise, relief valve discharge and in extreme cases, a knocking flash to steam. These conditions can cause operational problems and non-warrantable failures of the boiler.

### RADIANT FLOOR AND SNOW MELT HEATING SYSTEMS

This type of heating boiler application operates in a low temperature range which requires a boiler bypass as described under Low Temperature Bypass Requirements. A non-metallic rubber or plastic tubing installed in a radiant (in floor) system must have an oxygen barrier to prevent oxygen from entering the system through the walls of the installed tubing. Excessive oxygen absorption into the system will result in an accelerated rate of corrosion causing a sludge buildup. This excessive corrosion will also damage the boiler and system components. Sludge formed as the result of excessive oxygen in the system can restrict water flow resulting in a premature boiler failure. Any boiler damage due to excessive oxygenation is non-warrantable.

### TABLE — T Maximum Flow for Heating Boiler

#### CAUTION:

The maximum flow rate through the boiler with a copper heat exchanger must not exceed the following:

Model	Maximum Flow
1,500,000 - 2,000,000 Btu/hr	90 GPM

If higher flow rates are required through the boiler, an optional Cupro-Nickel heat exchanger is available. Consult the factory for specific application requirements.

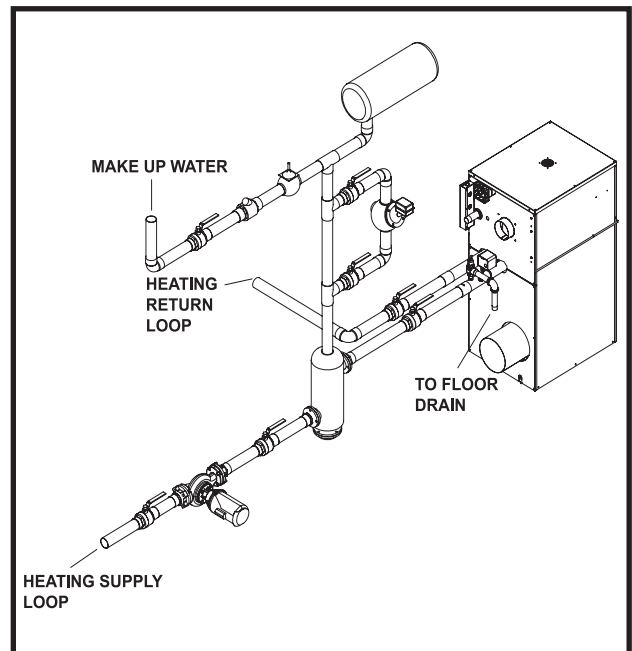
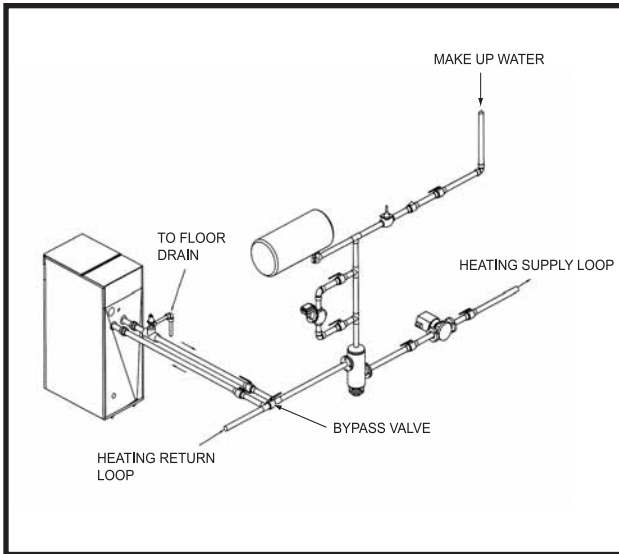


FIG. 71 Boiler Piping with Full System Flow

The heat exchanger is capable of operating within the design flow rates for boiler applications. In high flow applications, a bypass may be required to divert a portion of the flow in the main system loop to the boiler. Erosion of the finned copper tubes may occur if the flow rate exceeds the maximum allowable flow rate through the boiler. Maximum flow is 90 GPM. Flow rate can be determined by measuring the temperature rise through the boiler when it is firing at full rate input.

## BOILER BYPASS REQUIREMENTS



**FIG. 72 Boiler Bypass Piping for High Flow Systems**

The installer must ensure that the boiler is supplied with adequate flow without excessive temperature rise. It is recommended that this boiler be installed with a bypass in the piping if the maximum recommended flow rate is exceeded. The bypass will help to ensure that the boiler can be supplied with adequate water flow. Flow rates exceeding the maximum recommended flow will result in erosion of the boiler tubes. A typical bypass with a valve as shown in FIG. 72 will allow control of boiler flow.

**TABLE — U**  
**Boiler Temperature Rise at**  
**Maximum Flow**

**Temperature Rise at Full Rate Fire**  
**and 90 GPM Maximum Flow**

Btu/hr Input	Temperature Rise
1,500,000	29°F (16.1°C)
1,700,000	33°F (18.3°C)
2,000,000	39°F (21.7°C)



## SYSTEM TEMPERATURE RISE CHART

**TABLE — V**  
**Temperature Rise and Head Loss Based on Boiler Output in BTU/hr**

Btu/hr		30° ΔT		35° ΔT		40° ΔT		45° ΔT		50° ΔT		55° ΔT		60° ΔT	
Input	Output	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd
1,500,000	1,305,000	87.9	9.8	75.3	7.7	65.9	6.3	58.6	5.2	52.9	4.2	47.9	3.3	43.9	2.7
1,700,000	1,479,000	99.6*	14.1	85.4	10.2	74.7	7.9	66.4	6.5	59.8	5.3	54.3	4.6	49.8	3.9
2,000,000	1,740,000	117.2*	20.2	100.4*	14.9	87.9	11.9	78.1	9.2	70.3	7.2	63.9	6.4	58.6	5.2

\* Cupro-Nickel Heat Exchanger Required at Flows Above 90 GPM

### TEMPERATURE/PRESSURE GAUGE

This boiler is equipped with a dial type temperature/pressure gauge. This gauge is factory installed in the outlet side of the boiler piping. The gauge has one scale to read system pressure and a separate scale to read water temperature in degrees Fahrenheit. The temperature/pressure gauge is provided to meet code requirements. Water temperatures can be more accurately monitored from the data provided in the digital display in the Diagnostic Information Center.

### TYPICAL HEATING BOILER INSTALLATIONS

#### General Plumbing Rules

1. Check all local codes.
2. For serviceability of boiler, always install unions.
3. Always pipe pressure relief valve to an open drain.
4. Locate system air vents at highest point of system.
5. Expansion tank must be installed near the boiler and on the suction side of the system pump.
6. Support all water piping.
3. Ensure that the boiler drains and all vent system condensate drains are properly routed to an acceptable floor drain.
4. Ensure that an optional vent condensate neutralization system is properly installed if required by codes.
5. Review the vent termination point for proper location and clearances.
6. Ensure that proper volumes of combustion and ventilation air are provided to the mechanical room. If a separate combustion air pipe is used, ensure that it is properly sized, sealed and terminated.
7. Review the water piping to the boiler to the system. Ensure that there are no reductions in pipe diameter that might reduce flow. Ensure that a properly sized expansion tank is installed.
8. Ensure that a properly sized pump is installed to provide constant flow through the boiler while firing.
9. If installed in a primary/secondary piping system, ensure that properly sized secondary and primary pumps are installed.
10. If installed with full system flow through the boiler, ensure that system flow does not exceed maximum recommended flow.

### PLACING THE BOILER IN OPERATION

#### Pre-Start Check List

1. Review the location of the boiler, clearances from combustible surfaces and available service clearances.
2. Review the installed Vent System. Ensure that all vent components are **Category IV** material with adequate clearance from combustibles.
11. Check system pressure. Ensure a minimum of 12 PSI and not more than the rated pressure of the relief valve.
12. Review the installed gas piping from the meter to the boiler. Ensure that the gas pipe, meter and any regulators are adequately sized.
13. Review the field wiring and electrical service for both the boiler controls and pump. Ensure that the electrical service(s) is adequately sized.

14. Review wiring to an energy management system and wiring to any remote temperature sensors.

### **Boiler Set-Up**

15. Ensure that the boiler and piping system are full of water. Bleed all air from the boiler and related piping.
16. Check system for any water leaks.
17. Check system for installation of glycol or water treatment.
18. Turn on power to the boiler pump(s) and verify operation.

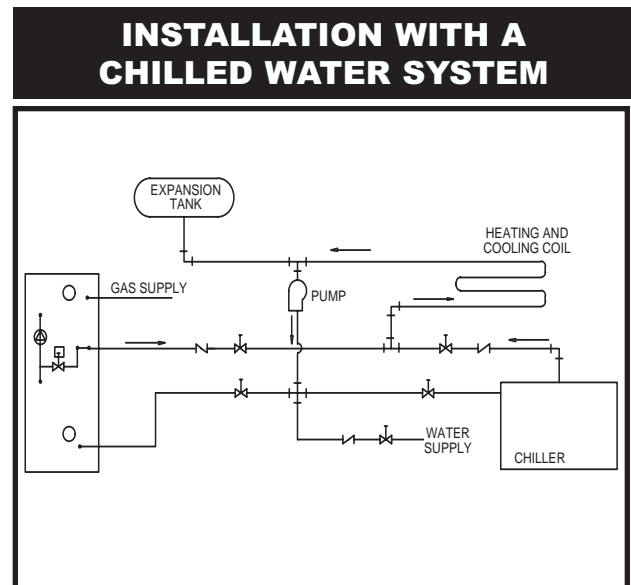
### **Boiler Operational Checks**

19. Turn the boiler main power switch to the "ON" position.
20. Verify operation of the Electronic Temperature controller and Diagnostic Information Center.
21. Program the adjustable points from the Diagnostic Information Center.
22. Push the resets for low water level (if equipped), high water temperature and flame failure.
23. Ensure that maximum flow to the boiler does not exceed 90 GPM. Verify by checking temperature rise while burner is firing at 100% of rated input.
24. Install a manometer on the gas supply to the boiler and verify minimum gas supply pressure as the burner fires at 100% of rated input.
25. Verify operation of safeties as necessary (low water cut-off, high limit, gas pressure, etc.)
26. Verify that all adjustable points in the Diagnostic Information Center are set as required.

### **Boiler Operation**

27. Push the resets for low water level (if equipped), high water temperature and flame failure.
28. Boiler should begin the start-up process for the sequence of operation.
29. The boiler will fire at 25% of rated input on initial start-up and adjust input as required to meet system demand.

30. Ensure that inlet water temperature does not fall below the specified minimum for the boiler.
31. Based on system demand, the boiler may run for an extended period of time at a reduced rate of input to maximize efficiency.
32. As system demand is satisfied, the burner will cycle off and the combustion air blower will run for a post purge operation before the boiler shuts down.



**FIG. 73 Installation with a Chilled Water System**

Pipe refrigeration systems in parallel. Install duct coil downstream at cooling coil. Where the hot water heating boiler is connected to a heating coil located in the air handling units which may be exposed to refrigeration air circulation, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. The coil must be vented at the high point and hot water from the boiler must enter the coil at this point. Due to the fast heating capacity of the boiler, it is not necessary to provide a ductstat to delay circulator operation. Also, omit thermostat flow checks as the boiler is cold when heating thermostat is satisfied. This provides greater economy over maintaining standby heat.

### **BOILER OPERATING TEMPERATURE CONTROL**

The operating temperature control for the boiler is the Electronic Temperature Controller. It is located on the inside of the control panel, behind the front access door. Access to adjust the temperature Setpoint and other owner/operator adjustable points is made through the Diagnostic Information Center located on the right front access door. The sensing element for the operator is placed

in a bulbwell installed in the inlet side of the heat exchanger top header. The outlet sensor is located in a bulbwell on the outlet side of the heat exchanger top header. Carefully observe the discharge water temperature on the initial cycles. The location of the temperature sensor may generally require a lower temperature setpoint on the operating control to achieve the desired discharge water temperature from the boiler. The return/inlet sensing element location allows a boiler to sustain longer burner on cycles.

The location of the operating sensor, inlet or outlet, is selectable from the screen in the Diagnostic Information Center .

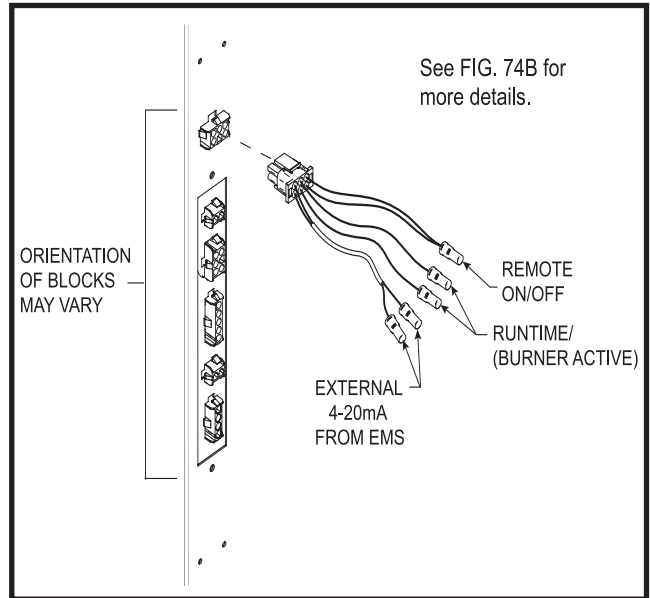
The exact temperature setpoint is based on your system's requirements. Set the control setpoint(s) to the desired operating water temperature. Observe the boiler discharge temperature after each setpoint adjustment to ensure proper operation.

The maximum temperature setpoint that can be programmed into the standard Electronic Temperature Controller from the Diagnostic Information Center on a heating boiler is 220°F (104.4°C). The Manual Reset High Limit control for a heating boiler is adjustable up to a fixed maximum setting of 230°F (110°C). Higher maximum temperature settings are available on special order, consult factory.

## EMS OR REMOTE THERMOSTAT CONNECTION

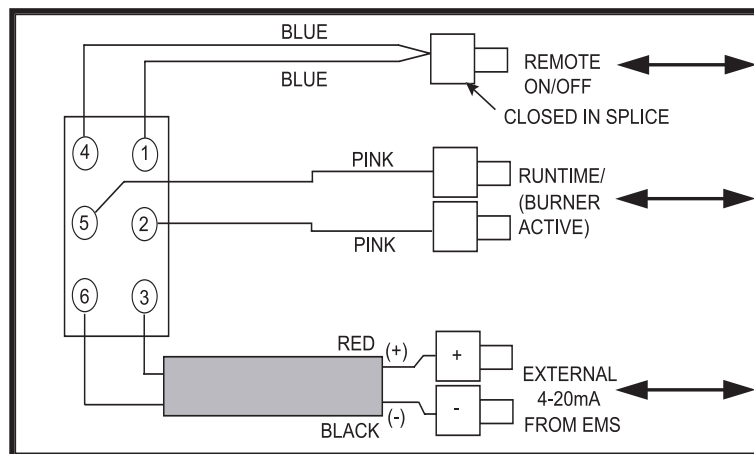
An EMS, remote thermostat or other remote temperature control may be connected to the boiler. Follow the manufacturers instructions supplied with the remote temperature control for proper installation and adjustment. A pair of wires is provided on the rear of the boiler to allow easy connection of a remote device. These wires are connected using a closed end splice at the factory to allow standalone operation of the boiler. A pair of wires is located in the 6-pin housing on the rear of the jacket (see FIG. 74A). Connection of a set of dry switching contacts or

a remote on/off thermostat to these wires will allow the unit to be switched on and off by making or breaking a 24 VAC control circuit.



**FIG. 74A Remote ON/OFF Wire Connection - Located on the rear of the jacket**

To connect an external controller to the unit, first locate the pair of blue wires spliced together in the 6-pin connector on the rear of the unit. Cut off the closed end splice while leaving enough wire length to allow connection of external control wires (see FIG. 74B). Once the splice is removed, each wire can then be spliced to one of the two external control wires. Ensure that all wiring used to connect the switching contacts of the remote temperature controller to the wires in the 6-pin connector are a minimum of 22 gauge and have a maximum installed length of 300 feet (91.4m). Connection to these wires with a set of dry switching contacts or the contacts of the remote temperature control will allow the boiler to be switched on and off based on the remotely sensed temperature requirements. Set the boiler's digital temperature control to a setpoint temperature slightly higher than the setting of the remote temperature control. This will ensure that the remote temperature controller functions as the operating control for the boiler.



**FIG. 74B Pin Connections Diagram**

# DOMESTIC HOT WATER SUPPLY BOILER

This section applies only to those appliances used to supply domestic hot water, installed with a storage tank(s). A circulating pump **MUST** be installed in piping assembly to the storage tank and valves used to control water velocity through the appliance. Proper water velocity is important for correct operation of your water heater or hot water supply boiler.

## WATER HEATERS

1,500,000 - 2,000,000 Btu/hr Models

## DOMESTIC HOT WATER SUPPLY BOILERS

1,500,000 - 2,000,000 Btu/hr Models

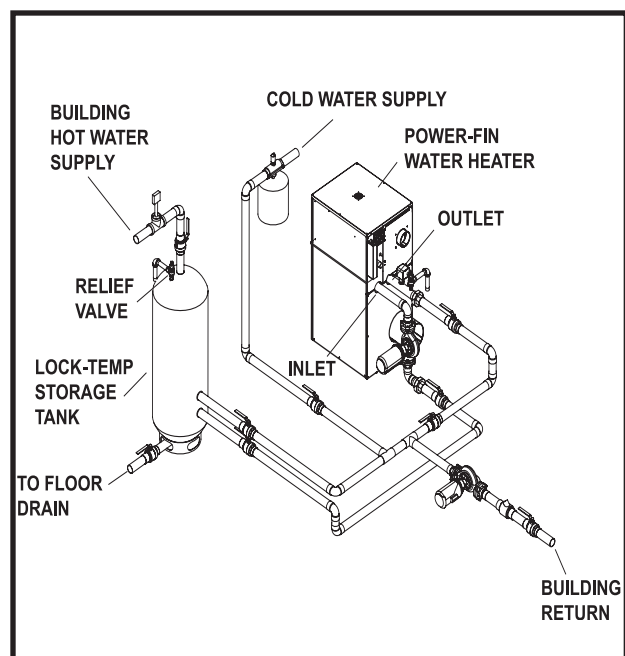


FIG. 75 Typical Water Heater Piping with Storage Tank

This section contains specific instructions for those appliances used to supply domestic hot water. All warnings, cautions, notes and instructions in the general installation and service sections apply to these instructions. Hot water supply boilers and water heaters are designed for installation with a storage tank. The operation of the circulating pump, proper sizing of the piping between the tank and heater and the control of water velocity, as explained in this section, are important for correct operation of your water heater or hot water supply boiler.

### WATER VELOCITY CONTROL

**IMPORTANT** - To ensure proper velocity through the heat exchanger, it is necessary to regulate the temperature rise across the heat exchanger from inlet to outlet. This must be done on initial installation and periodically rechecked. With the correct temperature rise across the heat exchanger when the water heater is firing at 100% of rated input, you may be assured of the proper velocity in the tubes. This will yield long life and economical operation from your water heater or hot water supply boiler.

Excessive lime/scale build-up in the heat exchanger tubes is a result of restricted flow and too little velocity in the tubes. Excessive pitting or erosion in the tube is caused by high water flow and too much velocity through the tubes. Care should be taken to measure temperature rise and maintain velocity as follows:

#### *Initial Set-up of Maximum Water Flow*

On initial start-up of the Power-Fin the maximum water flow through the heat exchanger must be manually set before normal operation begins.

#### TABLE — W Maximum Water Flow

##### CAUTION:

The maximum flow rate through a Power-Fin water heater with a copper heat exchanger must be set to provide and not exceed the following flow:

Model	Maximum Flow
1,500,000 - 2,000,000 Btu/hr	90 GPM

If higher flow rates are required through the water heater, an optional Cupro-Nickel heat exchanger is available. Consult the factory for specific application requirements.

The heat exchanger is capable of operating within the design flow rates required for the water heater, storage tank(s) and connecting piping. Erosion of the finned copper tubes may occur if the flow rate exceeds the maximum allowable flow rate through the water heater. The maximum flow through the water heater must be adjusted. Maximum flow is 90 GPM. Flow rate can be determined by measuring the temperature rise through the water heater when it is firing at full rate input.

<b>TABLE — X</b>	
<b>Temperature Rise At Full Rate Fire and 90 GPM Flow</b>	
<b>Btu/hr Input</b>	<b>Temperature Rise</b>
<b>1,500,000</b>	<b>29°F (16.1°C)</b>
<b>1,700,000</b>	<b>33°F (18.3°C)</b>
<b>2,000,000</b>	<b>39°F (21.7°C)</b>

1. The pump must run continuously when the burner is firing.
2. With the pump running and the burner in the water heater or hot water supply boiler in the off cycle, the Inlet Water Temperature and Outlet Water Temperature readings on the Diagnostic Information Center should read approximately the same temperatures. Water Temperature Differential on the Diagnostic Information Center should read zero.
3. Turn the water heater or hot water supply boiler on and allow time for the temperature to stabilize. Check the water temperature differential (rise) in the Diagnostic Information Center when the burner is firing at 100% or rated input.
4. Compare the water temperature differential (rise) in the Diagnostic Information Center with the required temperature rise. Should adjustment be needed, proceed as follows:

**If the temperature rise is too high, the water velocity is too low. Adjust as follows:**

1. Check for restrictions in the outlet of the water heater or hot water supply boiler.
2. Be sure all valves are open between the water heater or hot water supply boiler and the storage tank. Ensure that all ball valves are fully ported.
3. Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.

4. Check diameter and length of the piping between the storage tank and water heater against the head capacity of the circulating pump.
5. Be sure the pipes between the water heater or hot water supply boiler and storage tank are not less than 2-1/2 inch (63.5 mm) diameter. To increase flow and decrease temperature rise, increase the piping to 3 inch (76.2 mm) diameter to decrease head loss in the piping to the storage tank.
6. Common manifold piping for multiple unit installations will require larger minimum pipe sizes and tank circulating tappings to ensure proper flow.

**If the temperature rise is too low, the water velocity is too high. Adjust as follows:**

1. Temperature rise can be increased by slowly closing the field-installed ball valve in the outlet piping from the water heater to the storage tank to achieve the proper temperature rise.
2. Sustained high water velocity and low temperature rise may result in pitting or erosion of the copper tubes in the heat exchanger. This is a non-warrantable failure. Temperature rise must be properly adjusted to achieve the specified flow rate.
3. Once temperature rise has been properly set, turn power on to allow normal operation.

### **CAUTION: ⚠**

**Temperature rise can not be adjusted when the burner is firing at less than 100% of rated input.**

## **WATER CHEMISTRY**

### **NOTE:**

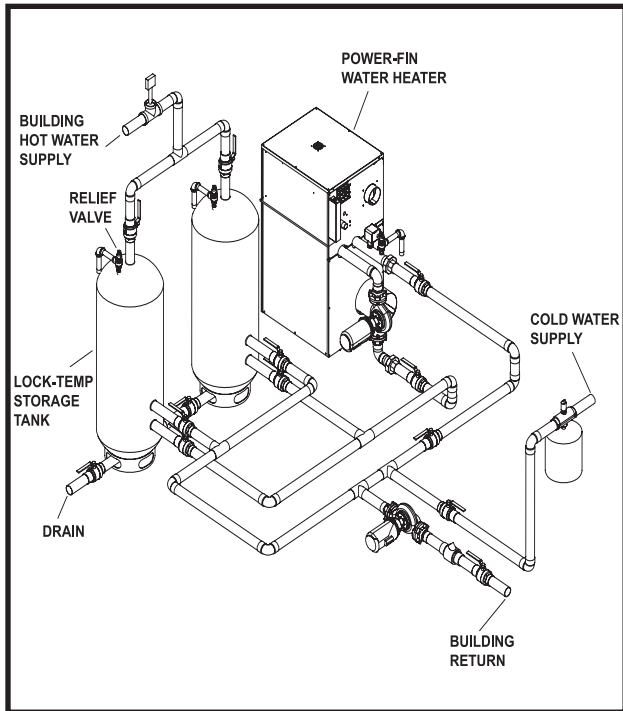
**Water temperature rise and maximum flow data is based on heating potable water with a hardness of 5 to 25 grains per gallon and total dissolved solids not exceeding 350 ppm.**

The required temperature rise and the standard circulating pump are sized based on the heating of potable water with a hardness of 5 to 25 grains per gallon and a total dissolved solids not exceeding 350 ppm. Consult the manufacturer when heating potable water exceeding these specifications. Heating of high hardness and/or high total dissolved solids water may require a larger circulating pump, an optional cupro-nickel heat exchanger and a revised temperature rise specification based on the water chemistry of the water to



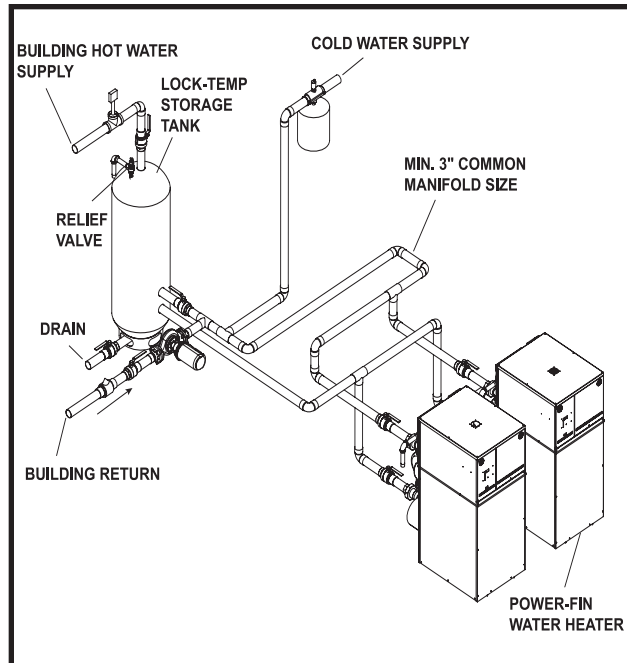
be heated. Water with a hardness of less than 5 grains per gallon will usually have a low pH which can be aggressive and corrosive causing non-warrantable damage to the heater, pump and associated piping. Corrosion due to water chemistry generally shows up first in the hot water system because heated water increases the rate of corrosive chemical reactions.

## MULTIPLE STORAGE TANK INSTALLATIONS

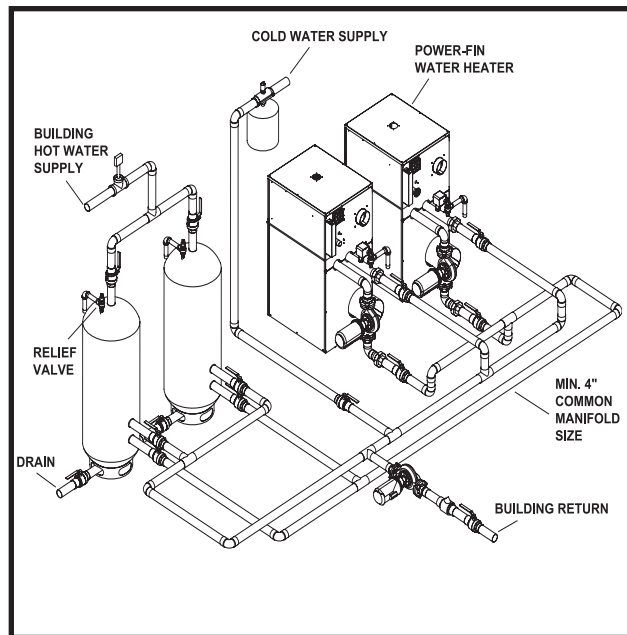


**FIG. 76** Single Water Heater Piping with Two Storage Tanks

## MULTIPLE WATER HEATER INSTALLATIONS



**FIG. 77** Multiple Water Heater Piping with a Single Storage Tank



**FIG. 78** Multiple Water Heater Piping with a Multiple Storage Tanks

**TABLE — Y**  
**Common Water Manifold Size for Multiple Water Heater or Hot Water Supply Boiler Installations**

Pipe sizing chart provides minimum pipe size for common manifold piping to ensure adequate flow.

Number of Water Heaters	Common Manifold Size (Min.)
1	2 1/2"
2	4"
3	4"
4	5"
5	6"
6	6"

## PUMP OPERATION

1. The water heater or hot water supply boiler must have properly sized circulating pump. This pump is sized to circulate water between the heater and storage tank only.
2. The pump is sized to the heater input and water chemistry specifications noted in "Water Chemistry."
3. The diameter and length of the piping installed between the storage tank(s) and water heater must be properly sized based on the capacity of the circulating pump.
4. The pump must run continuously when the water heater or hot water supply boiler is energized. This is the standard operating system for a water heater or hot water supply boiler.

An intermittent pump control function with an all bronze pump is installed as standard equipment on all water heater systems. The pump will operate only while there is a "Call for Heat" and for a timed period after the water temperature setpoint is satisfied to remove any residual heat from the combustion chamber.

5. Lubricate pump to manufacturers recommendations. Pump damage due to inadequate lubrication is non-warrantable.
6. The operating temperature sensor for a water heater or hot water supply boiler is installed in inlet piping to the water heater or hot water supply boiler.

The operating sensor must be installed in the tapping provided in the lower 25% of the storage tank to achieve

proper operation. As shipped from the factory, the operating sensor is installed in a bulbwell mounted in the inlet piping to the water heater. When the pump cycles off in normal operation, this sensor location may not adequately sense a quick drop in temperature from a draw of hot water from the storage tank. Placing the sensor in the tapping provided on the storage tank will improve temperature response and prevent short cycles of operation when a water heater is equipped with the optional intermittent pump feature.

The standard circulating pump on this water heater is sized based on installation of a single storage tank and heater in close proximity. If the number of fittings and straight pipe exceeds the specified maximum equivalent number of straight feet for a specified diameter of pipe, non-warrantable operational problems may be experienced.

**1,500,000-2,000,000 Btu/hr Models**  
**3/4 HP, 120 VAC, 8.8 Amp**

The standard pump selection is based on the following pipe and fittings from the water heater to the storage tank:

6 - 90° elbows                      2 - ball valves  
 2 - unions                              1 - cold water tee

Not more than 45 feet of straight pipe.

For every elbow and tee in excess of those shown above, DEDUCT 6.5 FEET from maximum allowable straight pipe in heater to tank circulating loop.

**TABLE — Z**  
**Minimum Pump Performance**  
**Based on heating potable water with a hardness of 5 to 25 grains per gallon and total dissolved solids not exceeding 350 ppm. See "Water Chemistry."**

Btu/hr Input	GPM	Ft. Hd.
1,500,000 - 2,000,000	90	15

When installing multiple water heaters and/or multiple storage tanks, the diameter of the inter-connecting pipe and all fittings must be increased. An increase in pipe diameter will decrease head loss in the system piping and ensure proper flow. Proper pipe size between the heater and storage tank **MUST** be maintained to ensure that the standard pump supplied on the water heater will maintain desired flow.

## HEAT EXCHANGER

This is a highly sophisticated heat exchanger designed to carry water in such a way that it generates a scouring action which keeps all interior surfaces free from build-up of impurities. The straight-line, four pass design of the tubes sends water into the headers at a properly rated velocity. The configuration of the headers, in turn, creates a high degree of turbulence which is sufficient to keep all contaminants in suspension. This "scouring action" provides greater cost savings for owners. Tubes are always able to transfer heat at peak efficiency. Every surface within this water containing section is of a non-ferrous material, providing clear, clean, rust-free hot water. Straight copper tubes-finned on the outside for maximum heat transfer and glass lined, cast iron, one piece, cored headers make up an entirely rust-proof unit. On all models, header inspection plugs in the heat exchanger can be removed for field inspection and cleaning of copper tubes. The heat exchanger may be removed from the unit.

## THERMOSTAT SETTINGS

1. **Electronic Temperature Controller is adjusted to a low test setting when shipped from the factory.**
2. **Using the Diagnostic Information Center, adjust the temperature setpoint to the lowest settings which will satisfy hot water demands and prevent a risk of scald injury.**

## THERMOSTAT ADJUSTMENT PROCEDURE

- (1) Press the SELECT key until the desired adjustable item's LED is illuminated and its' current setting is displayed.
- (2) Within 5 seconds of releasing the SELECT key, press either an UP or DOWN key to increase or decrease the displayed setpoint value.
- (3) Within 5 seconds of releasing either the up or down key, press the ENTER key to permanently store the new setpoint into the controller's memory.

Failure to press the enter key within 5 seconds after changing the display value will result in the display reverting back to its' default power up display mode and any new setting being lost.

Pressing the select key at any time during the adjustment process will advance the display to the next illuminated LED's value and result in the loss of any settings not previously entered with the enter key.

If at anytime, during the adjustment process there is no key activity for more than 5 seconds the display will revert back to the power up default mode and all information not previously entered by the enter key will be lost. Each press of an up or down key within the 5 second time out period will reset the timer to 5 seconds.

The control may be adjusted any time regardless of call for heat status. When pressing the enter key to enter any new setpoints, the controller will immediately begin controlling based on the new setpoint.

## MINIMUM WATER TEMPERATURES (Domestic Hot Water Use)

### Domestic Water Temperatures:

This high efficiency water heater/hot water supply boiler should be operated at a temperature setting high enough to prevent condensing of the products of combustion on the unit's heat exchanger or in the attached venting system. Use extreme caution when storing water at elevated temperatures. A water temperature setting maintained above the dew point of the products of gas combustion should prevent condensate formation and ensure proper performance of the venting system. The manufacturer recommends the use of a properly sized thermostatic mixing valve to supply domestic hot water at temperatures less than 140°F (60°C). Storing the water at a higher temperature and thermostatically mixing the water will increase the available quantity of mixed hot water, greatly reducing the possibility of condensate formation on the heat exchanger or in the venting system and help prevent the growth of water born bacteria.

### NOTE:

Adequate care **MUST** be taken to prevent a potential scald injury when storing water at elevated temperatures for domestic use.

Inlet water temperatures below the specified minimum recommendations can excessively cool the products of combustion resulting in condensation on the heat exchanger. Condensation on the heat exchanger can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the related components.

### CAUTION: ⚠

An appliance allowed to operate at return temperatures below the specified minimum setting may experience problems with the operating controls, safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion and possible flue gas spillage. Sustained operation at lower than specified water temperatures may cause hazardous conditions that may result in personal injury or non-warrantable damage to the appliance.

The maximum temperature setpoint that can be programmed into the Electronic Temperature Controller from the Diagnostic Information Center for water heater operation is 200°F (93°C). The control is factory pre-set at approximately 120°F (48.9°C). Facilities with small children or invalids may require 120°F (48.9°C) or lower temperature setting to reduce risk of scald injury. Some states may require a lower temperature setting. Check with your gas supplier for local requirements governing the temperature setting. Remember, no water heating system will provide exact temperature at all times. Allow a few days of operation at this setting to determine the correct temperature setting consistent with your needs.

### NOTE:

(1) This water heater, when set at the lower temperature setting, is not capable of producing hot water of sufficient temperature for sanitizing purposes. (2) Higher stored water temperature increases the ability of the water heater to supply desired quantities of hot water, however remember-

### CAUTION: ⚠

Hotter water increases the risk of scald injury.

#### Location of Cold Water Supply Piping Connections

Incorrect piping of the cold water supply to the system may result in excessive low temperature operation causing condensate formation on the primary heat exchanger and operational problems. The cold water supply piping must be installed in the discharge piping from the heater to the storage tank. This allows the cold water to be tempered in the storage tank before entering the heater. See typical installation drawings provided with the unit for correct piping. Higher water temperatures reduce the volume of condensate formed.

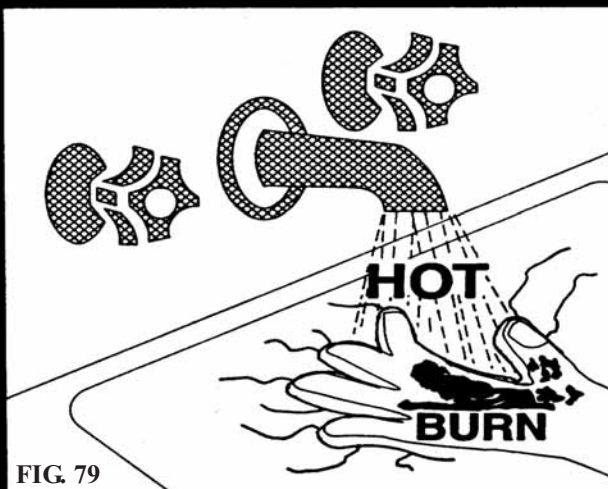
### CAUTION: ⚠

Setting the temperature selector to higher settings provides hotter water, which increases the risk of scald injury.

### WARNING: ⚠

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, DO NOT TURN OFF OR DISCONNECT THE ELECTRICAL SUPPLY TO THE PUMP. INSTEAD, SHUT OFF THE GAS SUPPLY AT A LOCATION EXTERNAL TO THE APPLIANCE.

## ! D A N G E R



Water temperature over 125°F (52.8°C) can cause severe burns instantly or death from scalds.

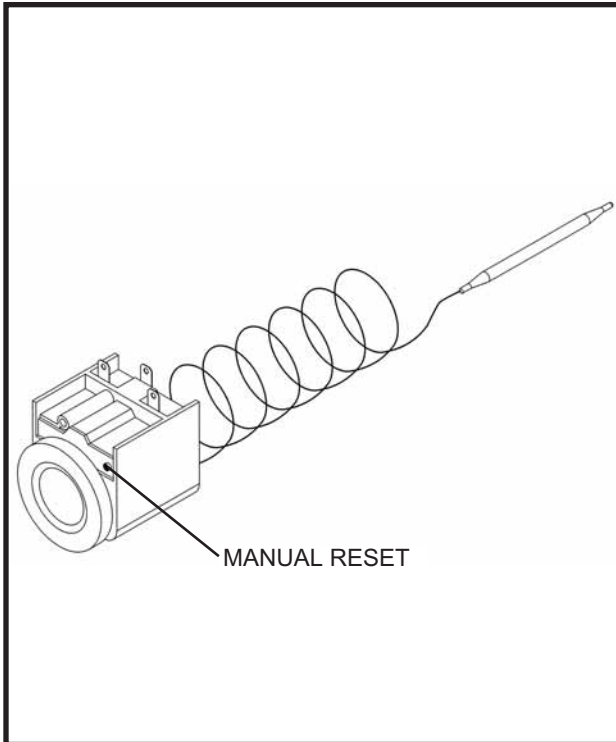
Children, disabled and elderly are at highest risk of being scalded.

See instruction manual before setting temperature at heating appliance.

Feel water before bathing or showering.

If this appliance is used to produce water that could scald if too hot, such as domestic hot water use, adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F (52.8°C).

## HIGH WATER TEMPERATURE LIMIT CONTROL



**FIG. 80 High Water Temperature Limit Control**

A Manual Reset High Limit control is located on the inside of the right front control panel, behind the display. The setting of this control knob limits maximum discharge water temperature. The water heater or hot water supply boiler temperature limit control is adjustable up to a fixed maximum setting of 200°F (93°C). A red reset button, located beside the knob, must be pushed whenever water temperature has exceeded the setpoint of the manual reset limit. The temperature of the water in the heat exchanger must drop a minimum of 15°F (8.3°C) below the setting of the manual reset high limit control before the reset function can be activated. A red indicating light is illuminated when the water temperature exceeds the setting of the high limit control. Additional switches, alarm indicating lights and optional low water cut-off control switches are located on a panel above the control housing. A status fault LED for High Limit will be illuminated in the Diagnostic Information Center when water temperature exceeds the High Water Temperature Limit Control Setpoint .

### NOTE:

The high limit control will not reset until the water temperature has dropped below the setpoint of the high limit.

## OPTIONAL RELIEF VALVE

This water heater or hot water supply boiler is normally supplied with a temperature and pressure relief valve sized in accordance with applicable codes. Units may be supplied with an optional pressure only relief valve. When a water heater or hot water supply boiler equipped with this optional relief valve and is piped to a separate storage vessel, the storage vessel must have a properly installed temperature and pressure relief valve which complies with local codes.

## THERMAL EXPANSION

A relief valve that discharges periodically may be due to thermal expansion in a closed system. A water heater or hot water supply boiler installed in a closed system, such as one with a backflow preventer or check valve installed in the cold water supply, shall be provided with means to control expansion. Contact the water supplier or local plumbing inspector on how to correct this situation. Do not plug or cap the relief valve discharge

## CATHODIC PROTECTION

Hydrogen gas can be produced in a hot water system that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To prevent the possibility of injury under these conditions, we recommend the hot water faucet be open for several minutes at the kitchen sink before you use any electrical appliance which is connected to the hot water system. If hydrogen is present, there will be an unusual sound such as air escaping through the pipe as the hot water begins to flow. There should be no smoking or open flames near the faucet at the time it is open.



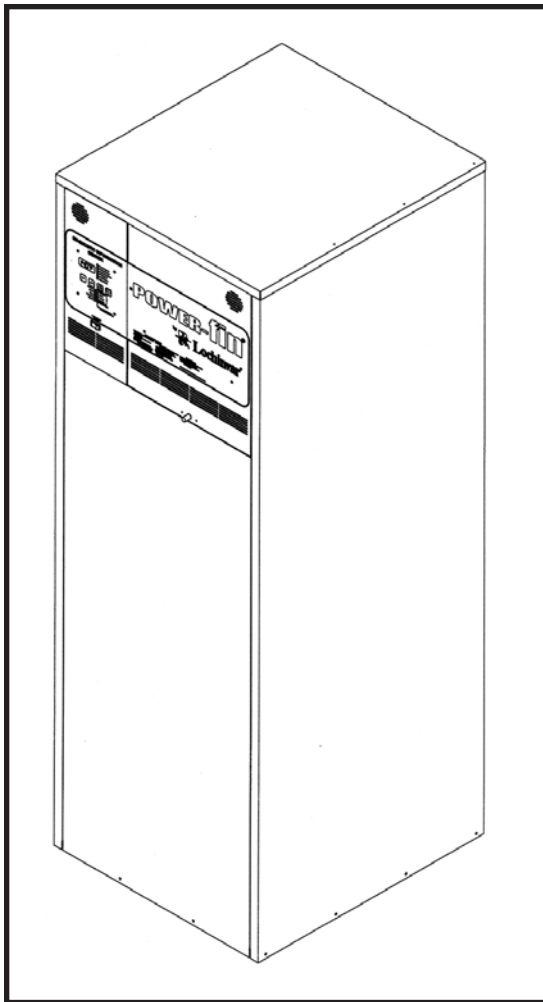


Fig. 81 Component Location Drawing - Front

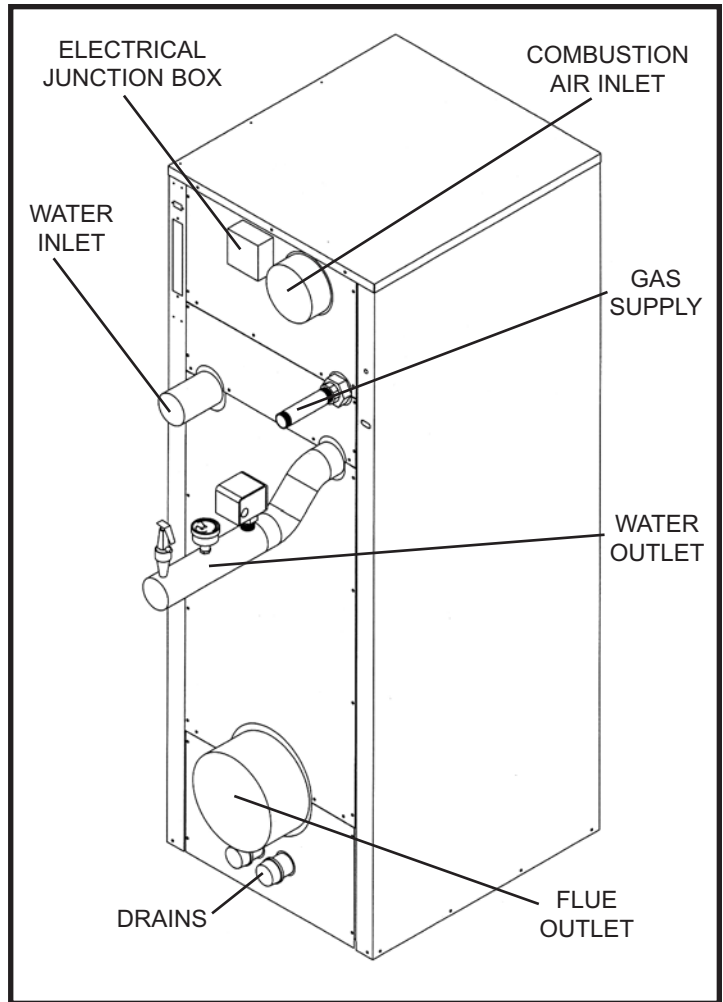


Fig. 82 Component Location Drawing - Rear

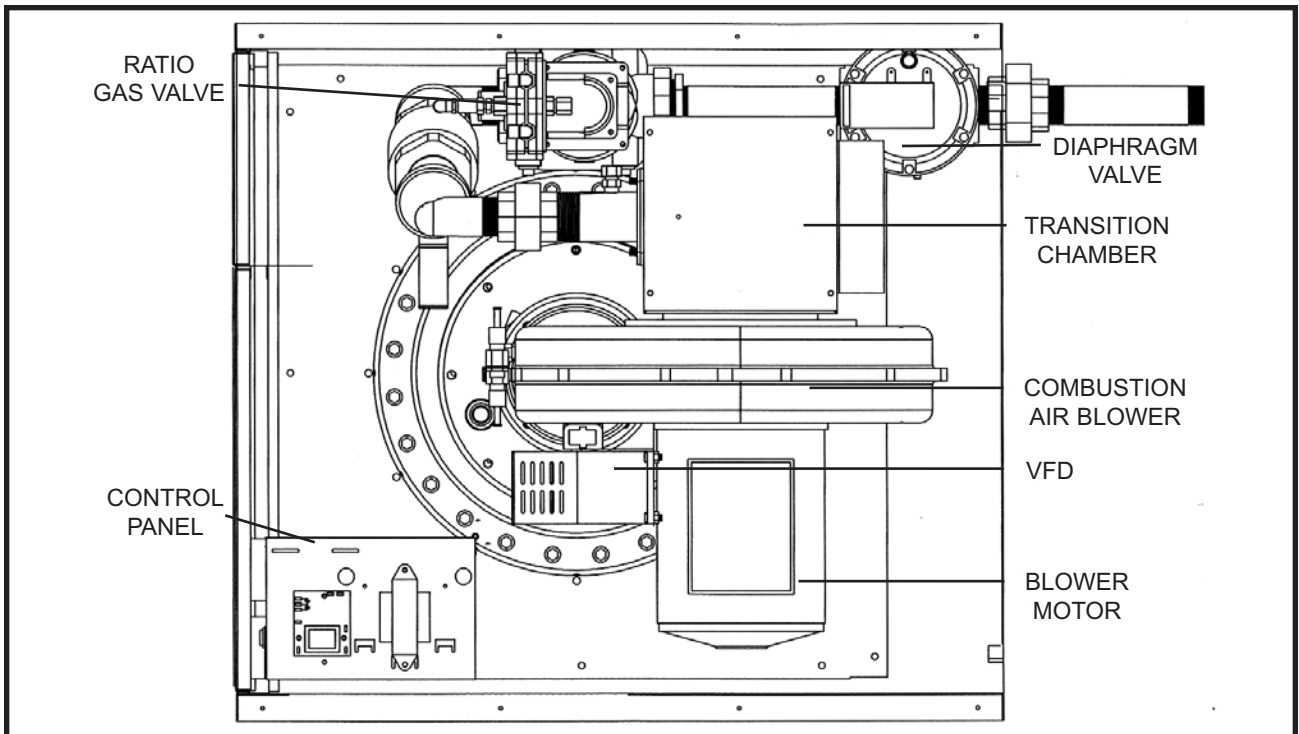


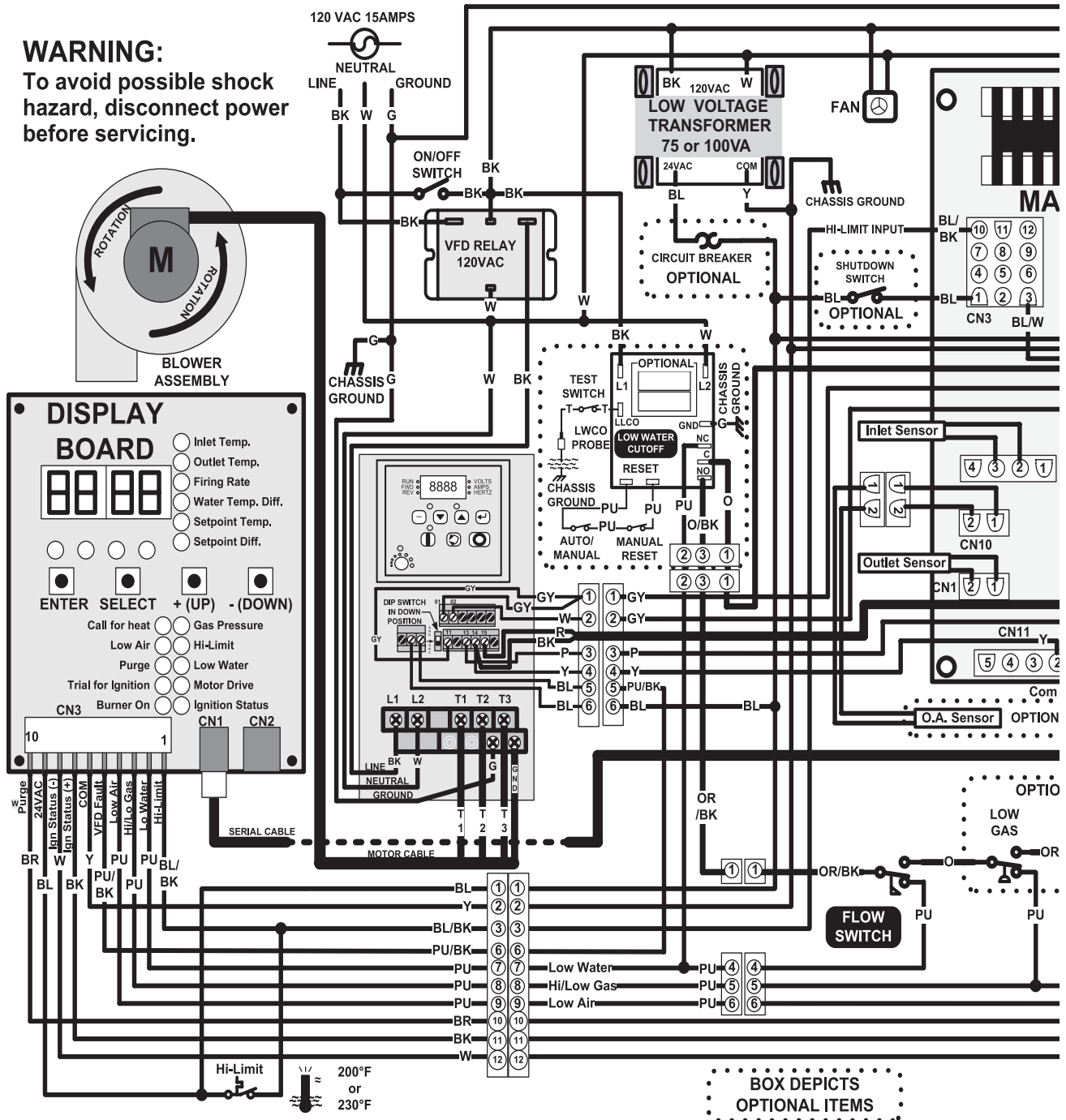
Fig. 83 Component Location Drawing - Top

# Wiring Diagram

1,500,000, 1,700,000 and 2,000,000 Btu/hr Models

## WARNING:

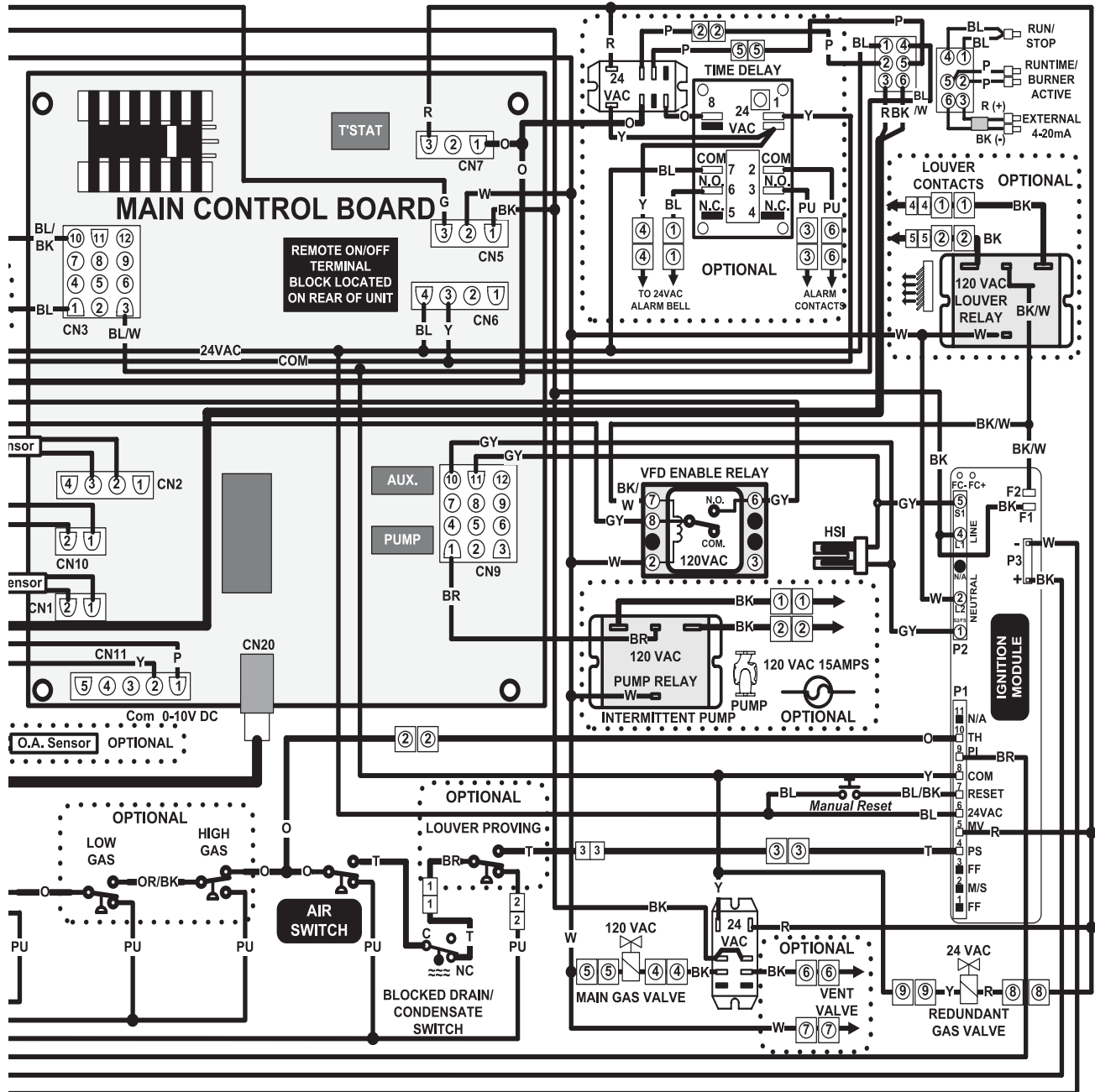
To avoid possible shock hazard, disconnect power before servicing.



# Wiring Diagram

(continued)

1,500,000, 1,700,000 and 2,000,000 Btu/hr Models



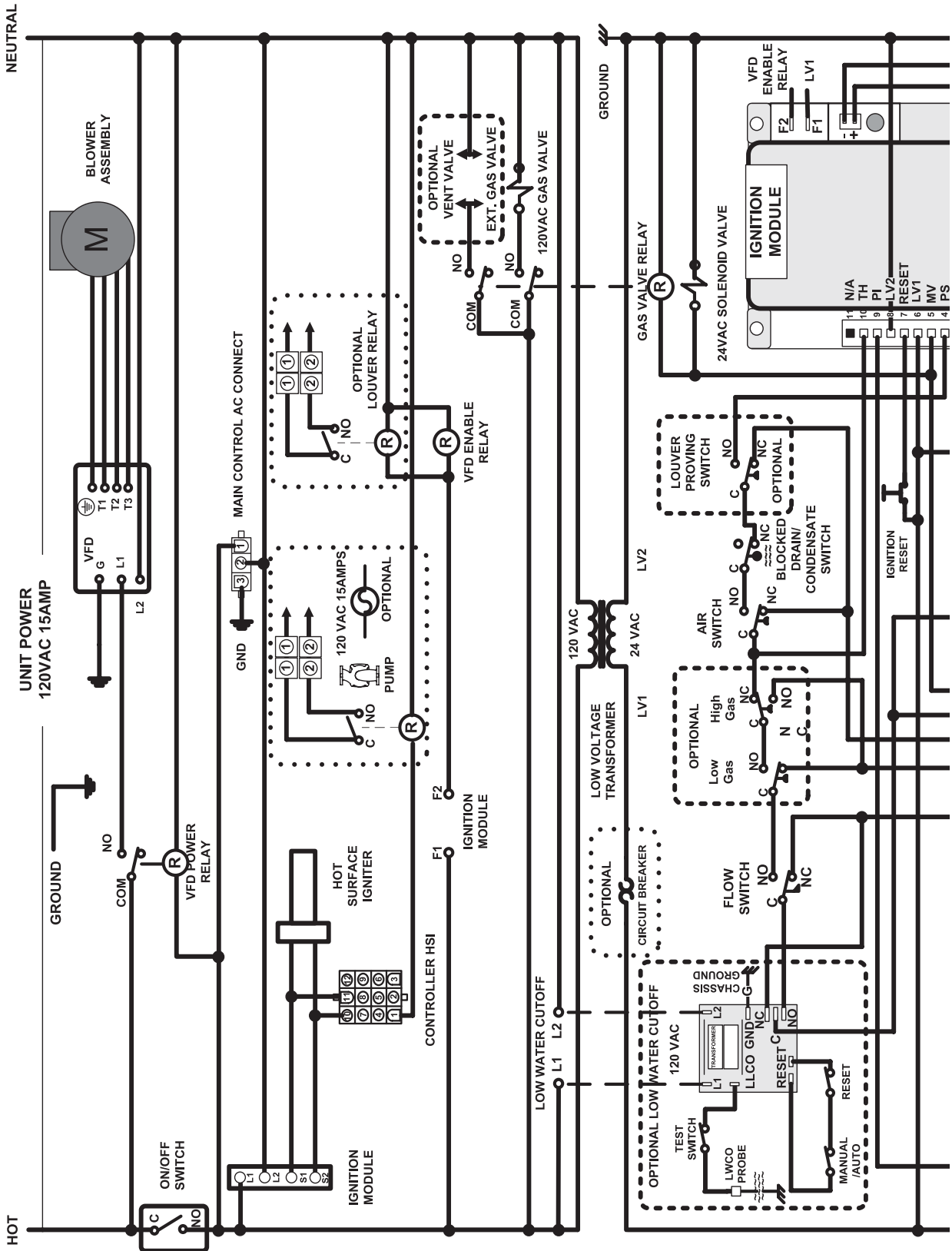
## NOTES:

- (1) Diagram is wiring/schematic diagram.
- (2) When replacing wiring, use wire of equal or higher temperature and gage.
- (3) Pump delay is standard on water heaters.

1500-2000MBTU  
LBL2137 REV F

# Ladder Diagram

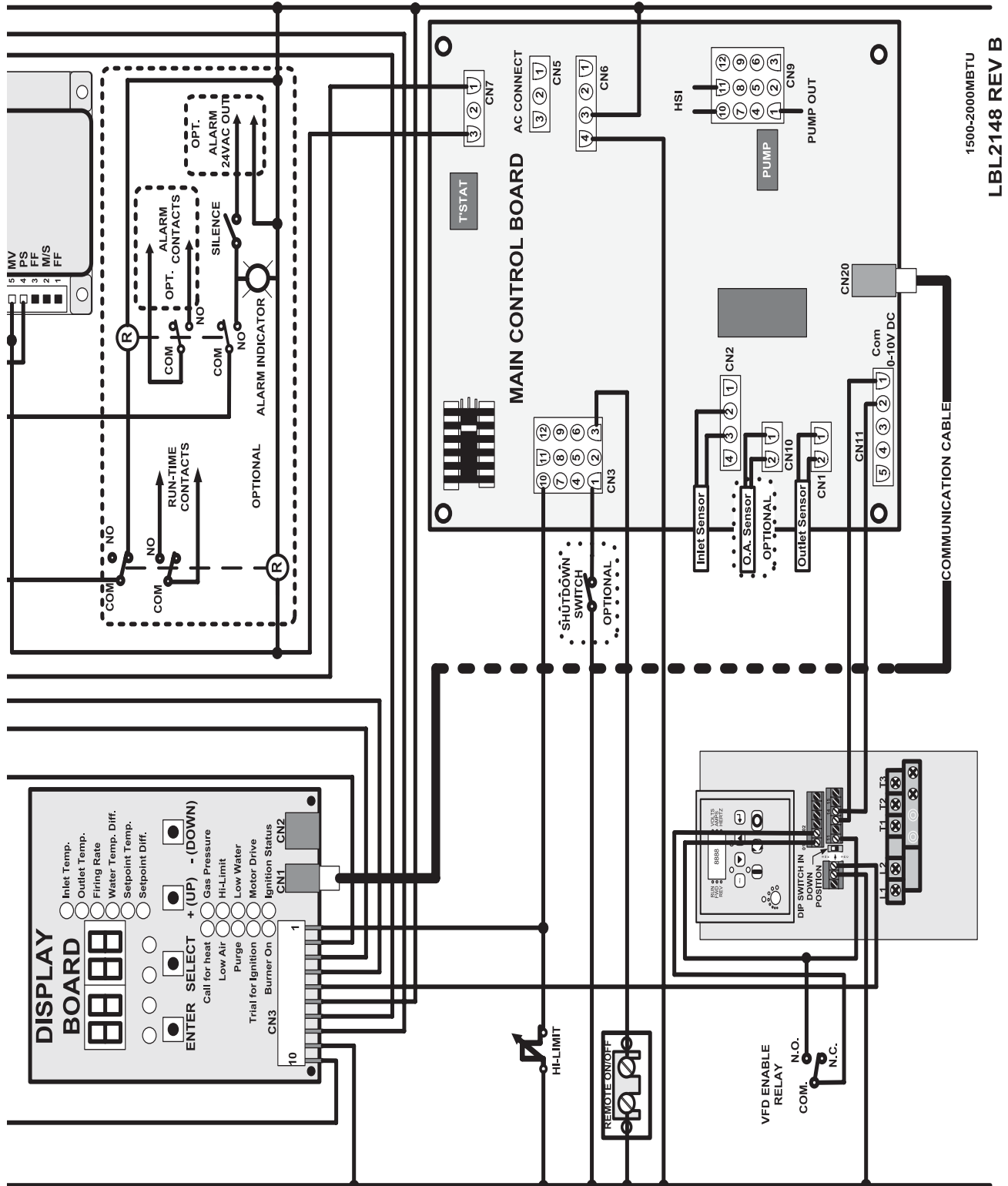
## 1,500,000, 1,700,000 and 2,000,000 Btu/hr Models



# Ladder Diagram

(continued)

1,500,000, 1,700,000 and 2,000,000 Btu/hr Models



1500-2000MBTU

LBL2148 REV B



