INSTALLATION AND SERVICE MANUAL

Power-Fin®

HOT WATER HEATING BOILERS
DOMESTIC WATER HEATERS
500,000, 750,000, 1,000,000 and 1,300,000 Btu/hr MODELS

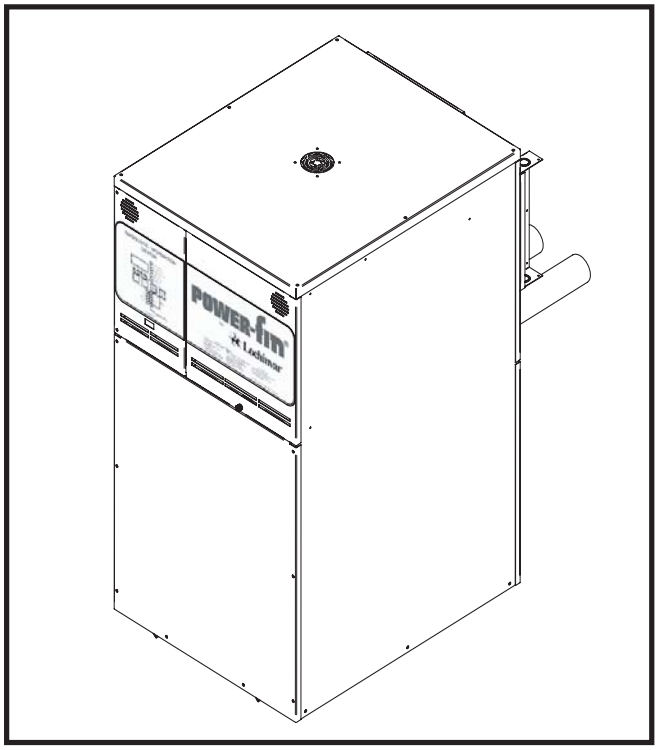


FIG. 1 Front View

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.

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.

CONTENTS

⚠ 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.

NOTE:

The words "Appliance" and "Unit" are used interchangeably throughout this manual.

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. **Always keep the area around your appliance free of combustible materials, gasoline, and other flammable liquids and vapors.**
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 garage or parking structure shall be installed so that all burners and burner ignition devices have a minimum clearance of 18" (46cm) above the floor. The appliance shall be located or protected so that it is not subject to physical damage by a moving vehicle.

4. The appliance must be installed on a level floor. Combustible floor locations may be used. Maintain required clearances from combustible surfaces.

5. The appliance must not be installed on carpet.

6. The appliance must be installed indoors where it is protected from exposure to wind, rain and weather.

CLEARANCES FROM COMBUSTIBLE CONSTRUCTION

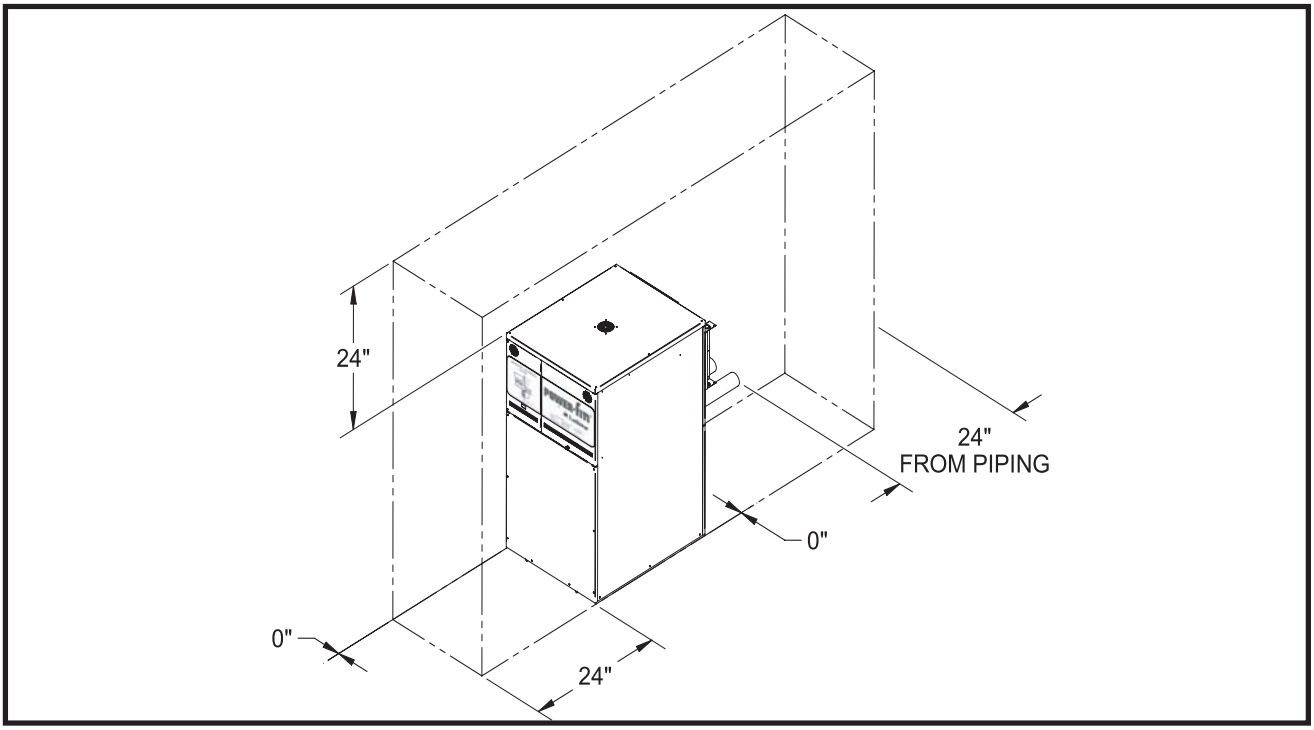


FIG. 2 Clearances from Combustible Construction - Front & Rear View

7. 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.

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.

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.

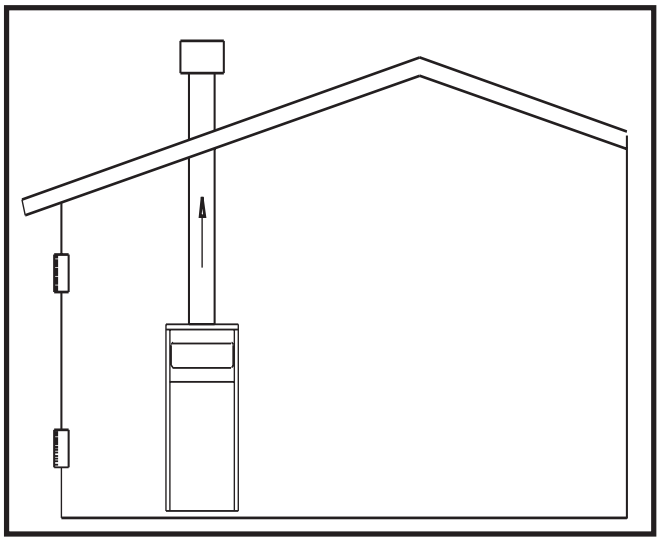


FIG. 3 Combustion Air Direct from Outside

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^2 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^2 per kW). This opening must be located within 12 inches (30 cm) of the top of the enclosure.

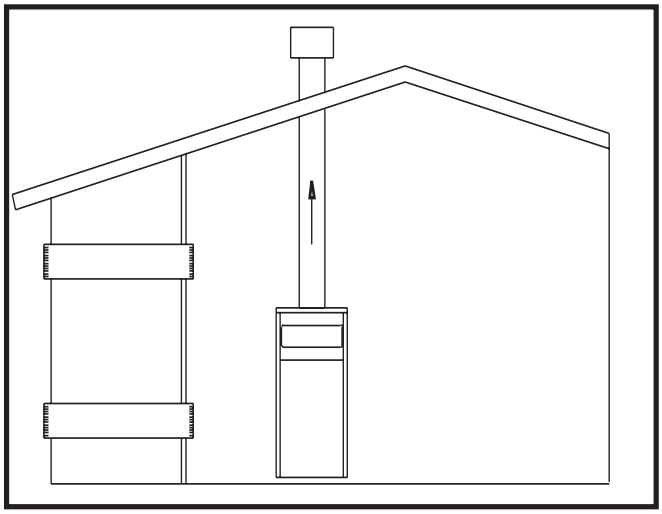


FIG. 4 Combustion Air Through Ducts

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

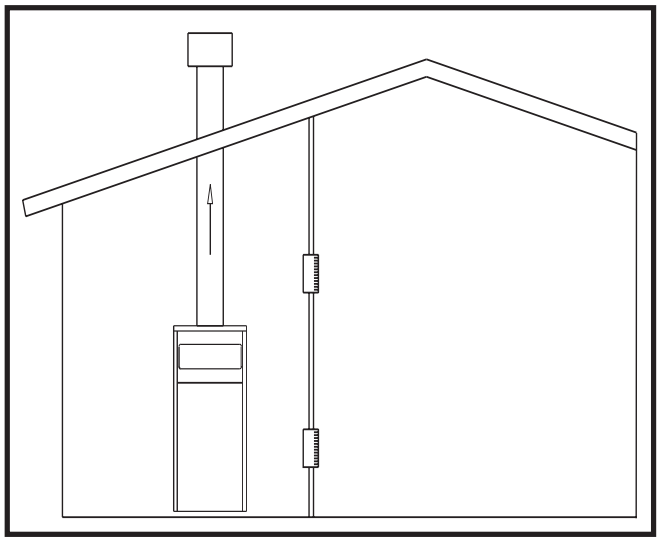


FIG. 5 Combustion Air from Interior Space

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^2 per kW) of input, but not less than 100 square inches (645 cm^2).

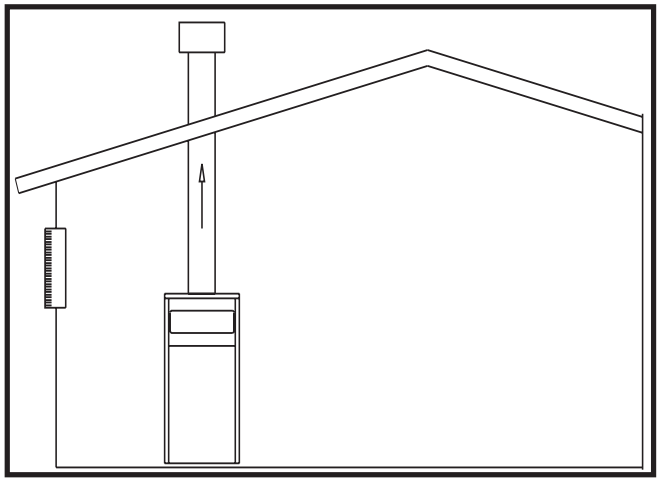


FIG. 6 Combustion Air from Outside - Single Opening

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^2 per kW). This opening must be located within 12 inches (30 cm) of the top of the enclosure.

All dimensions are 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 on page 6. Single openings shall commence within 12 inches (30 cm) of the ceiling.

TABLE — B Minimum Recommended Combustion Air Supply to Equipment Room			
COMBUSTION AIR SOURCE			
Boiler Input	**Outside Air* 2 - Openings**	**Outside Air* 1 - Opening**	**Inside Air 2 - Openings**
500,000	**125 in² (806 cm²)**	**167 in² (1,077 cm²)**	**(500 in²) (3,226 cm²)**
750,000	**188 in² (1,213 cm²)**	**250 in² (1,613 cm²)**	**(750 in²) (4,839 cm²)**
1,000,000	**250 in² (1,613 cm²)**	**334 in² (2,155 cm²)**	**(1000 in²) (6,452 cm²)**
1,300,000	**325 in² (2,097 cm²)**	**434 in² (2,800 cm²)**	**(1300 in²) (8,387 cm²)**

*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.

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.

COMBUSTION AIR SUPPLIED TO THE EQUIPMENT ROOM BY A FAN

5. A gas fired boiler, water heater, or combination of units may be installed in an equipment room and have the required combustion and ventilation air supplied by a mechanical fan. The total Btu/hr input of all gas appliances in the equipment room must be considered to properly size a combustion air fan. Per the latest edition of the National Fuel Gas Code, a fan used to mechanically supply air to the equipment room must be sized to provide a minimum of 0.35 ft^3 per minute per 1000 Btu/hr of the total gas input in the equipment room.

⚠ 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.

The optional **Direct Vent** and **DirectAire** 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.

VENTING

Vent Systems Options

This appliance has six venting options. They are:

(1) ***Conventional Vertical Negative Draft Venting using a Category I double-wall flue*** with a vertical rooftop termination and combustion air supplied from the equipment room. These units operate with on/off burner firing and are identified with an "F" prefix on the firing controls.

(2) ***Vertical Negative Draft Venting using a Category II corrosion resistant flue*** with a vertical rooftop termination and combustion air supplied from the equipment room. These units operate with modulating burner firing and are identified with an "M" prefix on the firing controls.

(3) ***Sidewall Venting*** which uses the unit's internal fan to exhaust the flue products out to a sidewall vent termination with a sealed **Category IV** flue and combustion air supplied from the equipment room.

(4) ***Vertical DirectAire Venting*** which uses a vertical negative draft flue with a rooftop termination for flue products and a combustion air pipe from the sidewall or rooftop.

(5) ***Horizontal DirectAire Venting*** which uses the unit's internal fan to exhaust the flue products out a sidewall vent termination with a sealed **Category IV** flue and a combustion air pipe from the rooftop or from a sidewall other than the one where the flue terminates.

(6) ***Direct Venting*** with a sealed **Category IV** flue and a separate combustion air pipe to the outdoors. This system terminates both the flue and combustion air inlet in the same pressure zone. Both the flue outlet and combustion air intake may terminate at either a sidewall (horizontal) or the rooftop (vertical).

All units are shipped from the factory equipped for a vertical negative draft venting system. All other optional vent systems require the installation of specific vent kits and venting materials. The following is a detailed explanation of the installation requirements for each type of venting system, components used, and part numbers of vent kits for each model.

General Venting Information

TABLE — C
Minimum Flue Pipe & Optional Air Inlet Pipe Sizes Are:

Input Btu/hr	Flue Size	Air Inlet Pipe Size
500,000	7"	5"
750,000	9"	5"
1,000,000	10"	6"
1,300,000	12"	6"

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.

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 CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment or applicable provisions of the local building codes.

All venting applications where combustion air is drawn from the equipment room must have adequate combustion and ventilation air 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 Code 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 minimum clearances stated in this manual and the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.

Vent connection is made directly to the 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 with no reduction in diameter.

The negative draft in the flue of a Category I or II vent installation must be within the range of a negative 0.02 to 0.08 inches water column to ensure proper operation. All draft readings are made while the unit is in stable operation (approximately 2 to 5 minutes). If draft exceeds the maximum specified, a barometric damper must be installed to regulate draft. Mount the barometric damper in the vertical flue at least three feet above the connection to the unit's flue outlet.

Use the National Fuel Gas Code venting tables to properly size all vent connectors and stacks for all Category I and II systems. The vent and accessories, such as firestop spacers, thimbles, caps, etc., MUST be installed in accordance with the manufacturer's 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.

Any vent materials specified must be listed by a nationally recognized test agency for use as vent material appropriate for the specified vent category.

Follow the installation instructions from the manufacturer of the vent material.

Locate units as close as possible to a chimney or gas vent. When planning the venting system, avoid possible contact with plumbing or electrical wiring inside walls, ceilings and floors.

Provide adequate clearance from combustibles for the vent connector and firestop.

Avoid long horizontal runs of the vent pipe, 90° elbows, reductions and restrictions. Horizontal portions of the venting system shall be supported to prevent sagging.

Horizontal runs of vent pipe must slope upwards not less than 1/4 inch per foot (21 mm/m) from the appliance to the vent terminal. Vent systems equipped with a drain tee must slope upward from the drain to ensure proper removal of any condensate that may form in the flue.

ROOFTOP VENT TERMINATION CLEARANCES

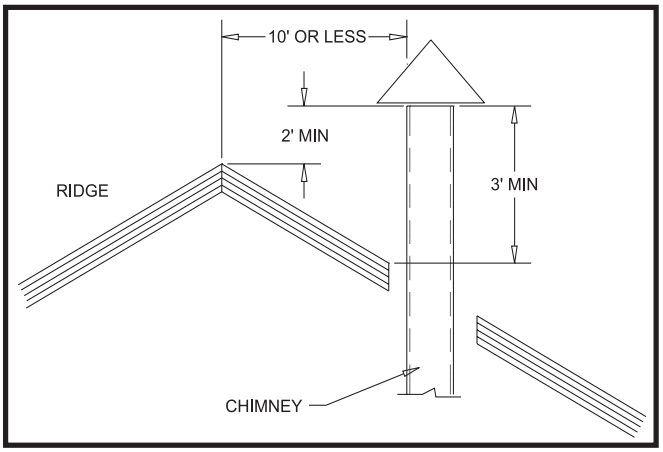


FIG. 7 Vent Termination from Peaked Roof - 10' or Less from Ridge

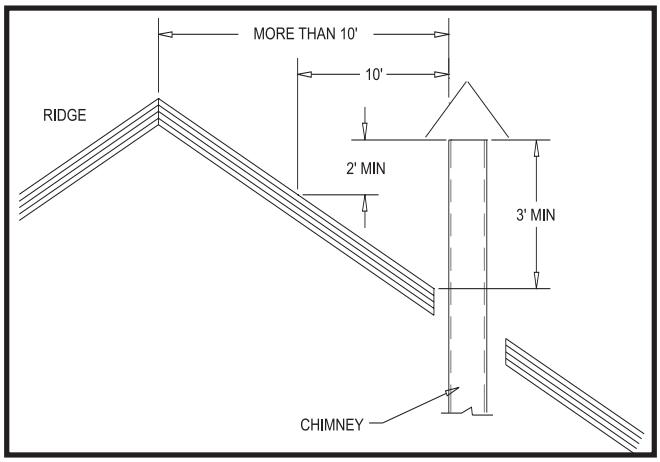


FIG. 8 Vent Termination from Peaked Roof More than 10' from Ridge

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

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

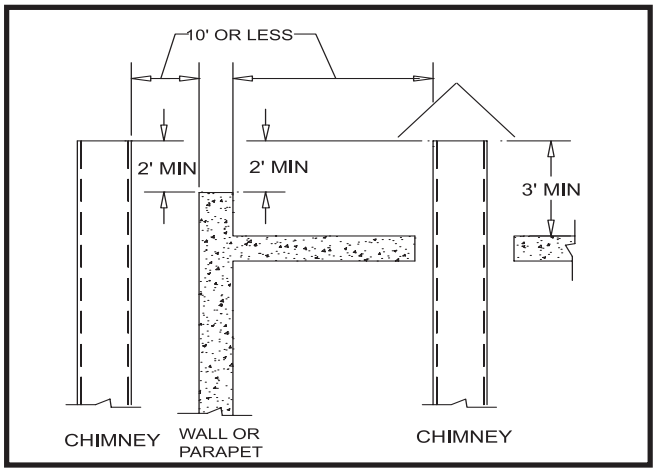


FIG. 9 Vent Termination from Flat Roof 10' or Less from Parapet Wall

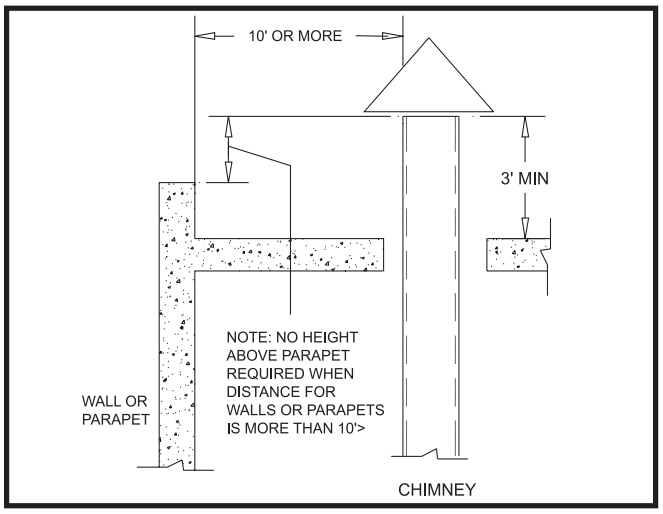


FIG. 10 Vent Termination from Flat Roof More Than 10' from Parapet Wall

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

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

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

The venting system shall terminate at least 4 feet (1.2m) below, 4 feet (1.2m) horizontally from, or 1 foot (30cm) 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 cannot terminate below grade. The bottom of the vent terminal shall be located at least 12 inches (30cm) above the roof or 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 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 dislodging of ice from the vent system or vent termination.

Common Venting Systems

When this appliance is equipped with a Category I flue and an F-9 firing system the flue may be combined with the flue from any other negative draft, Category I appliance. Common venting of multiple negative draft appliances requires that you MUST install a barometric damper on each unit to regulate draft. Install per the requirements of the latest edition of the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA-B149 Installation Code.

Common venting systems may be too large when an existing unit is removed. At the time of removal of an existing appliance, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while other appliances remaining connected to the common venting system are not in operation.

a.) Seal any unused opening in the common venting system.

b.) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other unsafe condition.

c.) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any other appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

d). Place in operation the appliance being inspected. Follow the lighting instructions in this manual. Adjust thermostat so appliance will operate continuously.

e.) Test for spillage at the draft hood / relief opening after five (5) minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

f.) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as above, return doors, windows, exhaust fans, fireplace dampers, and other gas burning appliances to their previous conditions of use.

g.) Any improper operation of the common venting system should be corrected so that the installation conforms to 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. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in 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.

MASONRY CHIMNEY INSTALLATION

A standard masonry chimney must NOT be used to vent the products of combustion from this appliance. A sealed, metallic, corrosion resistant liner system (single-wall, double-wall, flexible or rigid metallic liners) rated for use with a high efficiency, Category IV, positive pressure vent system MUST be installed in a masonry chimney to vent this appliance. 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 contained within the masonry chimney. Both the top and bottom of the masonry chimney must be capped and sealed to provide a dead air space around the liner.

⚠ WARNING

Do not vent the flue products of this high efficiency appliance into a masonry chimney without a sealed stainless steel liner. This can result in operational and safety problems. Any breaks, leaks, or damage to the masonry flue/tile will allow spillage of the flue products from the chimney and into occupied living spaces. This could cause serious injury or death due to carbon monoxide poisoning and other harmful flue products.

IMPORTANT

Check with local code officials to determine code requirements or the advisability of using a masonry chimney with a sealed corrosion resistant liner system.

(1) A CONVENTIONAL VERTICAL CATEGORY I NEGATIVE DRAFT VENTING SYSTEM

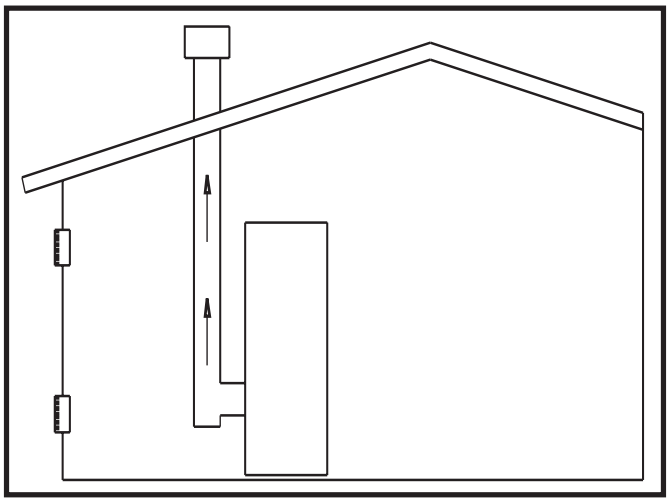


FIG. 11 Conventional Negative Draft Vertical Venting with Combustion Air Supplied to the Equipment Room

Units that may be vented with a Category I, Type "B" vent material operate with ON/OFF burner firing. A unit with ON/OFF burner operation can be identified by the "Category I and the "F" prefix on the firing controls as noted on the unit's rating plate. These are the only units that can be vented with standard double-wall vent material. See the *General Venting Section* in this manual. The flue must terminate at the rooftop. Combustion air is supplied from the equipment room. The installation of the vent must conform to 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.

(2) A VERTICAL CATEGORY II NEGATIVE DRAFT VENTING SYSTEM

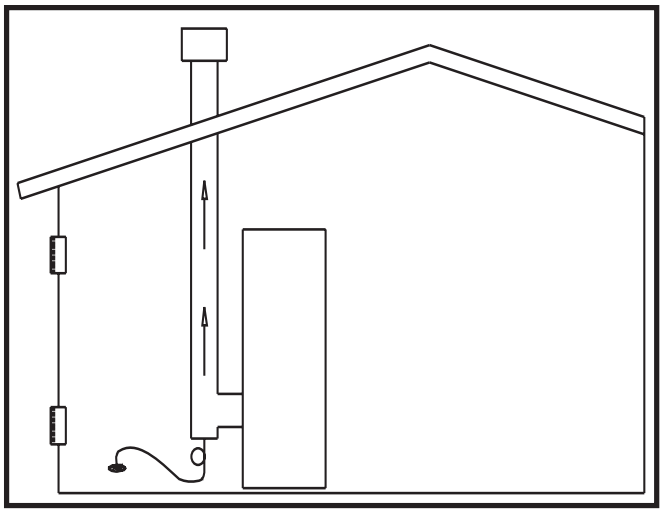


FIG. 12 Vertical Category II Negative Draft Venting with Combustion Air Supplied to the Equipment Room

Units that must be vented with a Category II corrosion resistant vent material operate with modulating burner firing. The unit can be identified by the "Category II" and the "M" prefix on the firing controls as noted on the unit's rating plate. Vent connection is made directly to the back of the unit using an AL29-4C corrosion resistant vent pipe. The flue must terminate at the rooftop. Combustion air is supplied from the equipment room. The modulating burner may result in flue gas temperatures below their dew point forming condensate in the flue. The vent materials must be corrosion resistant. Materials used for a Category IV vent are also corrosion resistant. The system must maintain a negative draft within the specified range. Use a barometric damper if system has excess draft.

Vent Materials: The connection from the vent to the stack or vertical vent termination outside the building MUST be made with a listed Category II corrosion resistant vent material (or equivalent) and must be direct as possible with no reduction in diameter. Currently there are not any vent manufacturers producing Category II vent material, a Category IV vent material may be used to meet material requirements for this venting option.

Category IV Flue Pipe Materials

Select venting material from the following specified vent distributors:

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)
Flex-L International Inc., StaR 34 Vent with AL29-4C stainless steel (Call 1-800-561-1980 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.

A Category IV flue MUST have all vent joints and seams sealed gastight and have provisions for a drain to properly collect and dispose of condensate that may occur in the venting system.

Drain Tee Installation

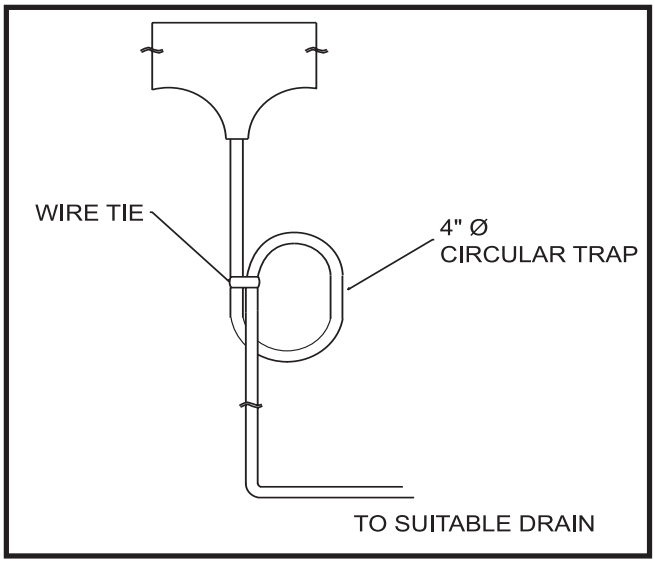


FIG. 13 Drain Tee Installed in Category II or IV Venting

The drain tee should be installed at the point where the flue turns vertical for a rooftop termination or as one of the first fittings in a horizontal flue connector 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. 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" (10.2cm) 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 a condensate neutralization system or a suitable drain for disposal. Ensure that the drain from the condensate tee is not exposed to freezing temperatures. See *"Freeze Protection"* for more information.

Common Venting System

You can combine the flue with the vent from other negative draft Category II appliances ONLY. The vent from other Category I appliances CANNOT be combined with the flue from Category II appliances unless the entire vent system for all units use Category IV vent materials. A barometric damper must be installed on each unit when common venting multiple negative draft Category II appliances.

(3) SIDEWALL VENTING

This venting system option uses the unit's internal combustion fan to force the flue products out of a sidewall vent cap assembly. The unit's internal fan generates a positive draft pressure to exhaust the flue products. Combustion air is drawn from the equipment room (see *Combustion and Ventilation Air Requirements* section).

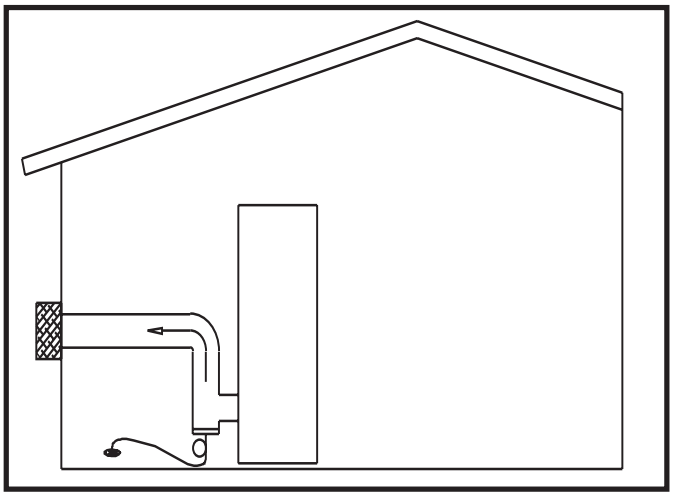


FIG. 14 Sidewall Venting Installation

The connection from the appliance flue outlet to the sidewall vent cap MUST be made with listed type Category IV vent materials and accessories. See Category IV flue pipe material specifications. The installer must supply suitable vent pipe material. The sidewall vent cap is available from the appliance manufacturer as a vent kit. Alternate Sidewall Vent Kits with reduced vent sizes are also approved and available from the manufacturer. These kits include a vent reducer, as well as a reduced diameter vent cap. See Table D for Standard and Alternate Sidewall Vent Kit numbers. Each appliance must have a dedicated flue with no other appliance interconnected to any part of the dedicated flue.

⚠ WARNING

The Category IV flue from this appliance CANNOT be combined with the vent from any other appliance. The Category IV flue from this appliance must be a dedicated stack and the flue from this appliance must have all vent joints and seams sealed gastight. A Category IV vent system has specific vent material and installation requirements.

Maximum Vent Length

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 (15.2m) in length. Subtract 5 feet (1.5m) of equivalent length for each 90° elbow installed in the vent. Subtract 2 1/2 feet (0.7m) of equivalent length for each 45° elbow installed in the vent.

TABLE — D
Sidewall Vent Kits

Input Btu/hr	Flue Size	Sidewall Vent Kit	Alt. Flue Size	Alt. Sidewall Vent Kit
500,000	7"	SVK3027	4"	SVK3056
750,000	9"	SVK3049	5"	SVK3057
1,000,000	10"	SVK3029	6"	SVK3058
1,300,000	12"	SVK3050	8"	SVK3059

All connections should be secured and sealed per the vent manufacturer's 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 flue for a sidewall venting system must terminate horizontally on a sidewall. See specific information concerning vent termination location for recommended clearances and location.

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 (5.1cm) around the flue pipe. The diameter of the opening for installation of the sidewall cap will be 4 inches (10.2cm) 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 (4) 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 (5.1cm) 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 for the installation of a Category IV vent for flue products. 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 requirements in the *General Venting* section.

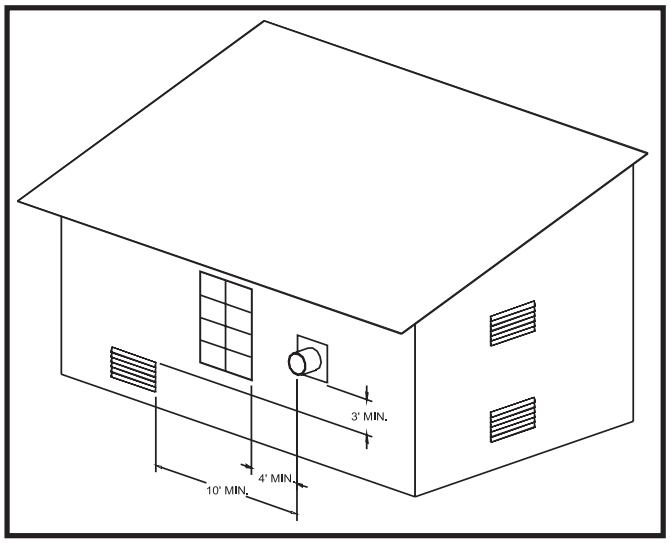


FIG. 15 Sidewall Venting Installation with Clearances from Vent Cap

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

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

The sidewall vent termination must be at least 8 feet (2.4m) 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 cannot 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 (0.30m) above grade, above normal snow levels and at least 7 feet (2.13m) 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 (1.22m) horizontally from and in no case above or below, unless a 4 foot (1.22m) 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 specific flue pipe material requirements based on the type of firing controls used on the unit. Direct Vent and DirectAire systems both use 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 may terminate 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 based on the specific venting option selected.

Follow all requirements for the specific venting option selected to determine vent material requirements and proper installation to discharge the flue products vertically or horizontally to the outdoors. All other general installation requirements must be followed.

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

⚠ WARNING

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.

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 (15.2m) in length. Subtract 5 feet (1.52m) of equivalent length for each 90° elbow installed in the air inlet pipe system. Subtract 2 1/2 feet (0.7m) 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 the following list:

PVC, CPVC or ABS (5" or 6" I.D.)*
Dryer Vent or Sealed Flexible Duct (not recommended for rooftop 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 piping on a sidewall or vertical rooftop Combustion Air Supply System:

a. 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 silicone sealant such as those manufactured by Dow Corning or General Electric.

b. Do not install seams of vent pipe on the bottom of horizontal runs.

c. 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.

d. 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 manufacturer’s 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 rooftop 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.

(4) DIRECTAIRE VENT SYSTEMS

A DirectAire vent system uses a flue to the sidewall or rooftop with a separate combustion air pipe to the outdoors. The DirectAire vent system may terminate the flue and the combustion air inlet pipe in different pressure zones in any one of four configurations. These are: (1) The flue on the rooftop and combustion air intake on the sidewall. (2) Both the flue and air inlet terminated on the rooftop using a Category I flue for single stage burner units. (3) The flue terminated on the sidewall and combustion air from the rooftop. (4) The flue terminated on the sidewall and the combustion air intake on a sidewall other than the sidewall where the flue is located. All appliances are shipped from the factory with a flue outlet that allows the connection of Category I or Category IV venting systems. Check the vent category rating on your unit to ensure that proper vent material is used. The optional DirectAire vent systems require the installation of specific venting materials that are purchased locally. Rooftop termination caps for flue products and combustion air must be 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 for type of vent materials used with your unit.

A Category I vertical flue must follow the requirements in *Conventional Negative Draft Vertical Venting*. A Category II or IV flue must follow the requirements under *Category IV Positive Pressure Venting* sections. All other General Venting installation requirements must be followed.

The DirectAire vent system always 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 materials specified in the *"Air Inlet Pipe Materials"* section.

Combined Combustion Air Inlet Points for DirectAire Systems Only

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 5" (12.7cm) air inlet pipes (19.63 in^2 (126.6 cm^2) area each) have a total area of 39.26 in^2 (253.3 cm^2) requires an 8" (20.3 cm) (50.26 in^2 area) 324.3 cm^2) 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 (15.2m) equivalent feet. You must deduct the restriction in area provided by any screens, grills or louvers installed in the common air inlet point. 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.

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

(4a) VERTICAL DIRECTAIRE WITH SIDEWALL COMBUSTION AIR

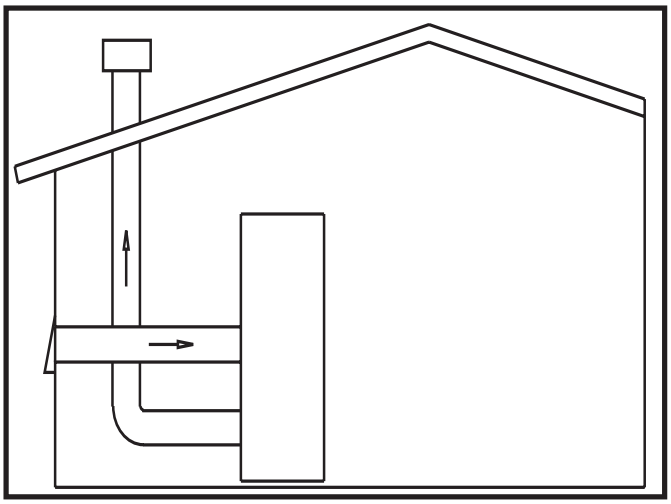


FIG. 16 Vertical DirectAire Installation with Sidewall Combustion Air Inlet

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

Flue Requirements - Single Stage Burner Operation
This unit, which operates with an on/off burner firing, may be vented to the rooftop with a Type "B" vent material. These units will be marked as **Category I** and have an "F" prefix on the firing controls as noted on the rating plate. The flue must be installed per all requirements in the *Conventional Vertical Negative Draft Venting* section for a **Category I** vent. Follow all requirements in the *Conventional Vertical Negative Draft Venting* section for the materials required to ensure that flue products are properly vented vertically to the outdoors. All other general installation requirements must be followed.

Flue Requirements - Modulating Burner Operation
A unit, which operates with a modulating burner firing, may be vented to the rooftop with a Category II vent material or equivalent (Category IV) vent material. These units will be marked as **Category II** and have an "M" prefix on the firing controls as noted on the rating plate. The flue must be installed per all requirements in the Vertical Negative Draft Venting using a Category II corrosion resistant flue or equivalent. Follow all requirements in the *Vertical Negative Draft Venting* section for the Category II materials required to ensure that flue products are properly vented vertically to the outdoors. All other general installation requirements must be followed.

Alternate Vertical Venting with reduced vent sizes is also approved by the manufacturer. Refer to Table E - Vertical DirectAire Vent Kits for the alternate flue sizes approved and the vent reducer part number available from the manufacturer. Use the appropriate Category IV venting materials to ensure that flue products are properly vented vertically to the outdoors.

Sidewall Combustion Air Inlet

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 International / CGA requirements, must furnish the sidewall air inlet cap. Each kit includes the special combustion air inlet cap for installation on an exterior sidewall for operation of a single appliance only.

Flue piping from the appliance to the rooftop termination may be increased to 8" or 10" based on field availability of 7" and 9" flue material.

TABLE — E
Vertical DirectAire Vent Kits

Input Btu/hr	Flue Size	Alt. Flue Size	Vent Reducer	Air Inlet Pipe Size	DirectAire Sidewall Inlet Cap Kit
500,000	7"	4"	DRH2435	5"	SAK3003
750,000	9"	5"	DRH2436	5"	SAK3003
1,000,000	10"	6"	DRH2437	6"	SAK3000
1,300,000	12"	8"	DRH2438	6"	SAK3000

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.

The termination point of the sidewall air inlet must be installed a minimum of 12 inches (0.30m) 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 (0.91m) horizontally and 12 inches (0.30m) below any point of flue gas termination (vent cap) if it is located within a 10 foot (3.05m) 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 (3.05m) radius of the flue outlet.

The sidewall combustion air inlet cap must not be installed closer than 10 feet (3.05m) 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 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 into the combustion air inlet, follow all instructions in this section.

For clearances between multiple vent caps, see the *Multiple Horizontal Direct Vent Installations* section.

(4b) VERTICAL DIRECTAIRE VENTING WITH ROOFTOP COMBUSTION

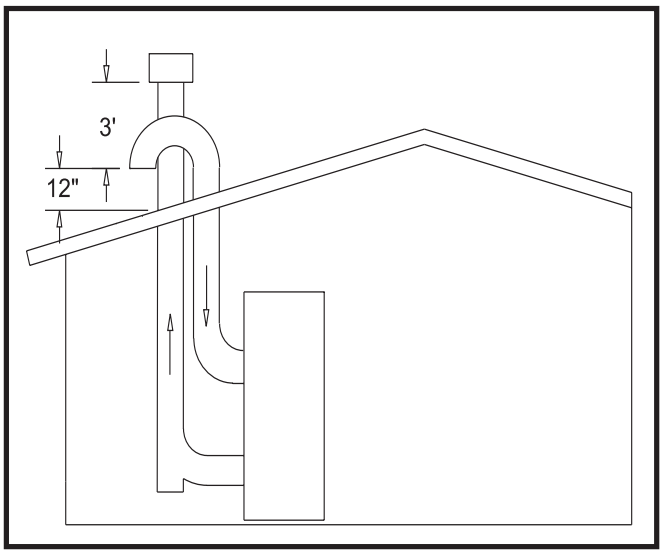


FIG. 17 Vertical DirectAire Installation with Rooftop Combustion Air Inlet

This venting option is only for units that operate with single stage on/off burner firing. These units will be noted as Category I on the rating plate. This venting option uses a Category I Type "B" double-wall vent material terminated at the rooftop and a separate combustion air pipe also terminating at the rooftop. The flue must be installed per all requirements in the *Conventional Vertical Negative Draft Venting* section for a Category I vent. Follow all requirements in the *Conventional Vertical Negative Draft Venting* section for the materials required to ensure that flue products are properly vented vertically to the outdoors. All other general installation requirements must be followed. The flue outlet and combustion air intake terminate in the same pressure zones, but because of the use of a Category I flue it does not meet the specifications for a direct vent system.

The maximum installed length of the flue pipe from the appliance to the termination cap is limited only by the requirement to maintain a negative draft within the limits specified in the Conventional Vertical Negative Draft Venting section.

Air Inlet Pipe Materials: A DirectAire vent system always 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 materials specified in *"Air Inlet Pipe Materials"* section.

Vertical Combustion Air Inlet

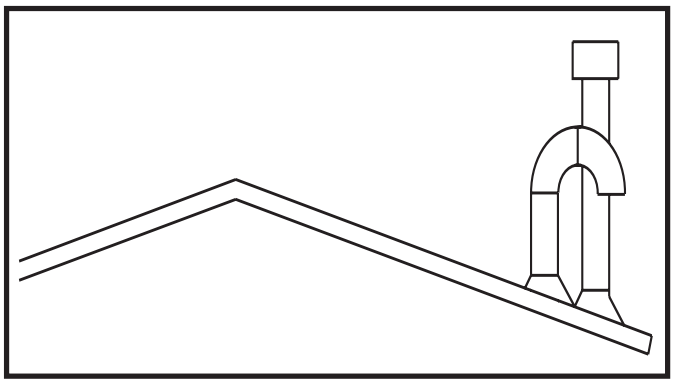


FIG. 18 Air Inlet Cap for Rooftop Termination

The air inlet cap for the vertical rooftop inlet is assembled from components purchased locally. The air inlet cap consists 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" (51mm) in length. The termination ell on the air inlet must be located a minimum of 12" (0.30m) above the roof or above normal levels of snow accumulation.

Location of a Rooftop Air Inlet Cap

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

The combustion air inlet cap must not be installed closer than 10 feet (3.05m) 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 (0.30m) 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.

Combustion air supplied from outdoors must be free of contaminants (see *Combustion and Ventilation Air*). To prevent recirculation of flue products into 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.

For clearances between multiple vent caps, see *Multiple Vertical Direct Vent Installations* section.

(5a) HORIZONTAL DIRECTAIRE WITH VERTICAL COMBUSTION AIR

The Horizontal DirectAire system terminates the flue at the sidewall using Category IV vent materials and a combustion air inlet pipe to draw air from the rooftop. Horizontal DirectAire vent systems are installed with the flue outlet and combustion air intake located in different pressure zones.

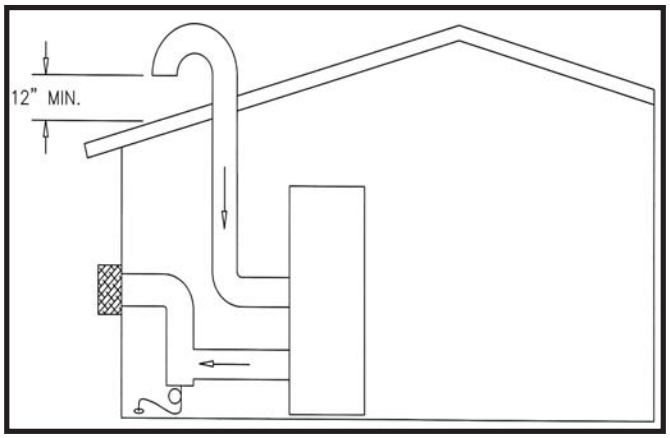


FIG. 19 Horizontal DirectAire Installation with Rooftop Combustion Air Inlet

Follow all requirements in the *Sidewall Venting* and *Venting Guidelines for Category IV Vents* sections for proper installation and for venting flue products horizontally out a sidewall to the outdoors. All other general installation requirements must be followed.

Air Inlet Materials: A DirectAire Vent System always 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 materials specified in the *"Air Inlet Pipe Materials"* section.

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 *Sidewall Venting* section for use with 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. This venting option uses the Sidewall Venting Kit with the combustion air inlet system constructed from materials purchased locally by the installer.

TABLE — F
Sidewall Vent Cap Kit for use with a DirectAire with Rooftop Combustion Air

Input Btu/hr	Sidewall Flue Size	Vertical Air Inlet Pipe Size	Sidewall Vent Kit	Alt. Flue Size	Alt. Sidewall Vent Kit
500,000	7"	5"	SVK3027	4"	SVK3056
750,000	9"	5"	SVK3049	5"	SVK3057
1,000,000	10"	6"	SVK3029	6"	SVK3058
1,300,000	12"	6"	SVK3050	8"	SVK3059

The sidewall vent cap kit includes the wall penetration assembly and the discharge screen assembly. Alternate Sidewall Vent Kits with reduced vent sizes are also approved and available from the manufacturer. These kits include a vent reducer, as well as a reduced diameter vent cap. See Table F for Standard and Alternate Sidewall Vent Kit numbers. 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.

Vertical Combustion Air Inlet

Follow the vertical combustion air inlet material and location requirements as listed in the *Vertical DirectAire Venting with Rooftop Combustion Air* section.

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

(5b) HORIZONTAL DIRECTAIRE WITH SIDEWALL COMBUSTION AIR

This vent system is 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 terminate in different pressure zones.

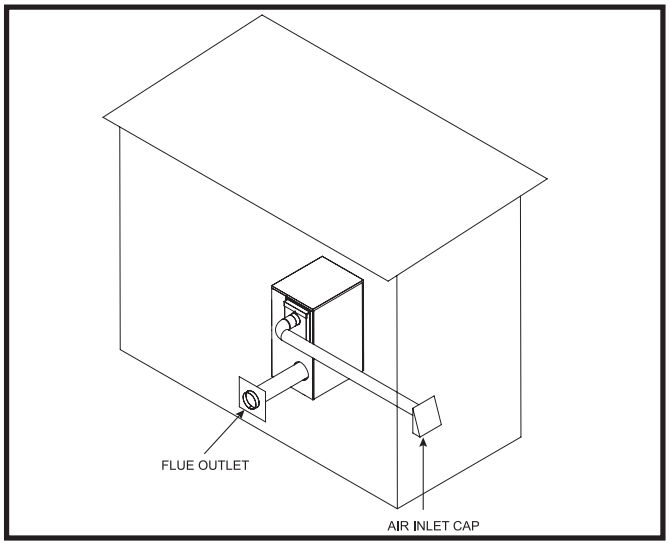


FIG. 20 Horizontal DirectAire Installation with Sidewall Combustion Air in a Different Pressure Zone

Follow all requirements in the *Horizontal Direct Vent* section for proper installation and venting of flue products horizontally to the outdoors. The dimensions of the flue and air inlet are the same as specified in Table G. See the Category IV Flue Pipe Materials for flue pipe specifications. The air inlet pipe must use one of the materials specified in the *Air Inlet Pipe Materials* section. 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 cool incoming air from condensing and leaking from the inlet pipe. The maximum installed lengths of the flue and air inlet pipe must not exceed the 50 equivalent feet as specified in the *Horizontal Direct Vent* section. The termination point of the flue and air inlet must follow the clearance requirements in the *Sidewall Venting and Horizontal Direct Vent* sections.

⚠ 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.

(6a) 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 combustion air cap and flue gas outlet MUST be located on the same rooftop surface and in the same pressure zone.

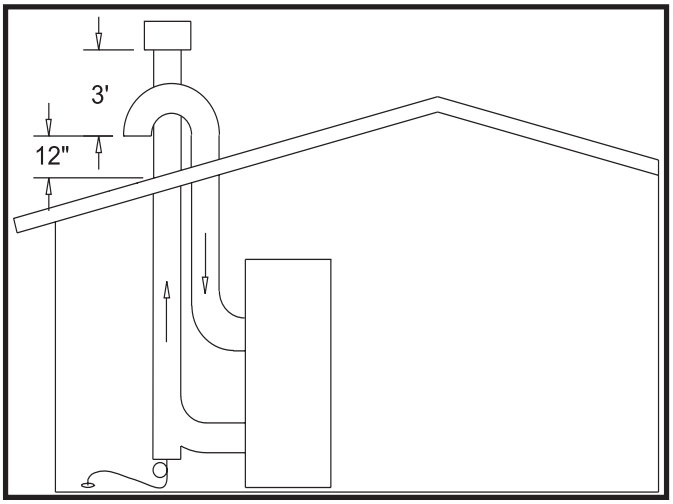


FIG. 21 Vertical Direct Vent Installation with Rooftop Combustion Air Inlet

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

Alternate Vertical Venting with reduced vent sizes is also approved by the manufacturer. Refer to the Vertical DirectAire Table for the alternate flue sizes approved and the vent reducer part number available from the manufacturer. Use the appropriate Category IV venting materials to ensure that flue products are properly vented vertically to the outdoors.

The Direct Vent System always 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 materials specified in the *"Air Inlet Pipe Materials"* section.
The maximum installed length of the air inlet pipe from the appliance to the air inlet cap is 50 equivalent feet (15.2m) in length. The maximum installed length of the flue pipe from the appliance to the termination cap is 50 equivalent feet (15.2m) in length. Subtract 5 feet (1.52m) 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.

Vertical Combustion Air Inlet

Follow the vertical combustion air inlet material and location requirements as listed in the *Vertical DirectAire Venting with Rooftop Combustion Air* section.

Multiple Vertical Direct Vent Installations

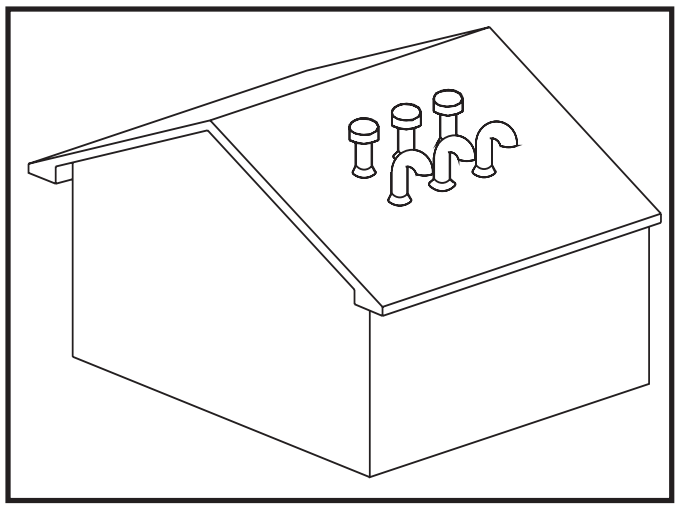


FIG. 22 Multiple Vertical Direct Vent Installations

The combustion air inlet caps for multiple appliance installations must maintain the minimum 3 foot (0.91m) clearance below the closest vertical flue outlet if within 10 feet (3.05m). 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 (0.91m) below the closest flue outlet if the outlet is within 10 feet (3.05m). 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.

(6b) HORIZONTAL DIRECT VENT

A Direct Vent system MUST have a dedicated air intake pipe. Pipes for multiple units CANNOT be combined.

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 the 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 always 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 materials specified in the *"Air Inlet Pipe Materials"* section.

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

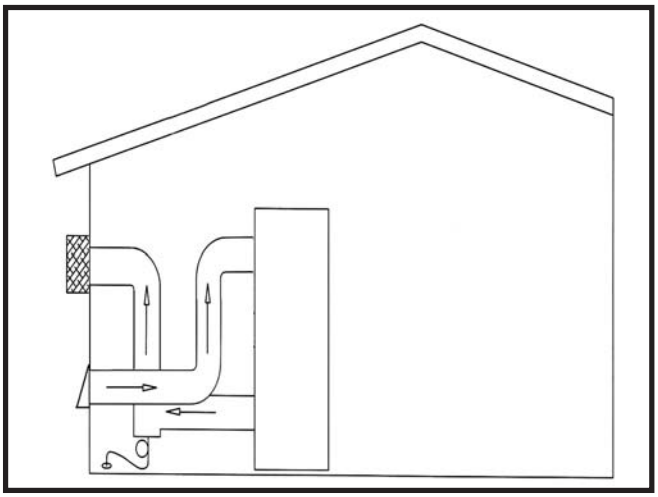


FIG. 23 Horizontal Direct Vent Installation with Sidewall Combustion Air Inlet

Sidewall Combustion Air Inlet

Follow the sidewall combustion air inlet material and location requirements as listed in the *Vertical DirectAire Venting with Sidewall Combustion Air* section.

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.

The part numbers for the required sidewall air inlet cap kit are listed by unit size. The manufacturer, in accordance with CSA International/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. Alternate Horizontal Direct Vent Kits with reduced vent sizes are also approved and available from the manufacturer. These kits include the inlet air cap, a vent reducer, and a reduced diameter vent cap. See Table G for Standard and Alternate Horizontal Direct Vent Kit numbers.

TABLE — G
Horizontal Direct Vent Kits

Input Btu/hr	Air Inlet Size	Flue Cap Size	Horizontal DV Kit	Alt. Flue Size	Alt. Horizontal DV Kit
500,000	5"	7"	HDK3033	4"	HDK3040
750,000	5"	9"	HDK3034	5"	HDK3041
1,000,000	6"	10"	HDK3035	6"	HDK3042
1,300,000	6"	12"	HDK3036	8"	HDK3043

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

Multiple Horizontal Direct Vent Installations

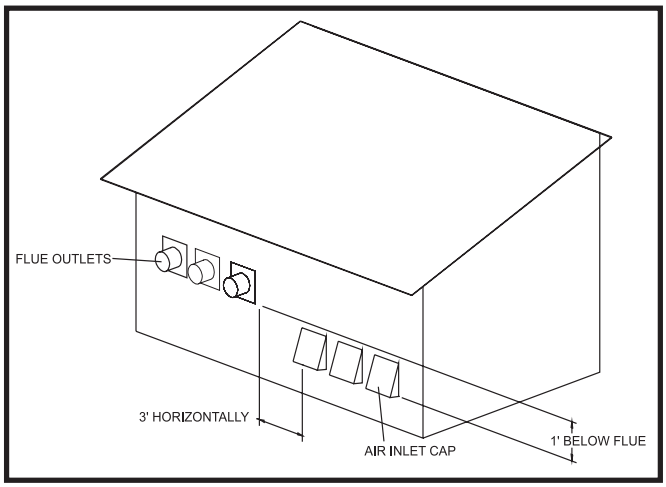


FIG. 24 Multiple Horizontal Direct Vent Caps Installed on a Sidewall

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 (0.91m) horizontal radius and 12 inches (0.30m) 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.

A Direct Vent system MUST have a dedicated air intake pipe. Pipes for multiple units CANNOT be combined.

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 — H
Inlet Gas Pressure

	Nat. Gas	LPG
Max. (Inches Water Column)	10.5"w.c.	13.0"w.c.
Min. (Inches Water Column) M9	4.0" w.c.	11.0"w.c.
Min. (Inches Water Column) F9	4.2" w.c.	11.0" 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 — I
Manifold Gas Pressure - Single Stage F9

	Manifold Pressure Settings at Full Fire	
Input Btu/hr	Nat. Gas	LPG
500,000 - 1,300,000	3.2" w.c.	10.0" 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 1/2 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 1/2 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 the 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.
8. All secondary regulators MUST BE of the lock-up type and spaced a minimum of 6' from the appliance.

TABLE — J
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'

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. 27).
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 TRAIN AND CONTROLS

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.

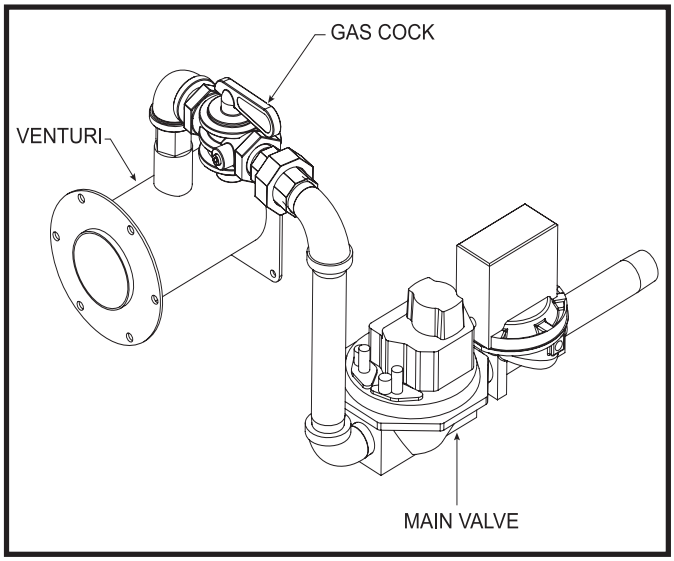


FIG. 25 Gas Train Assembly - F9

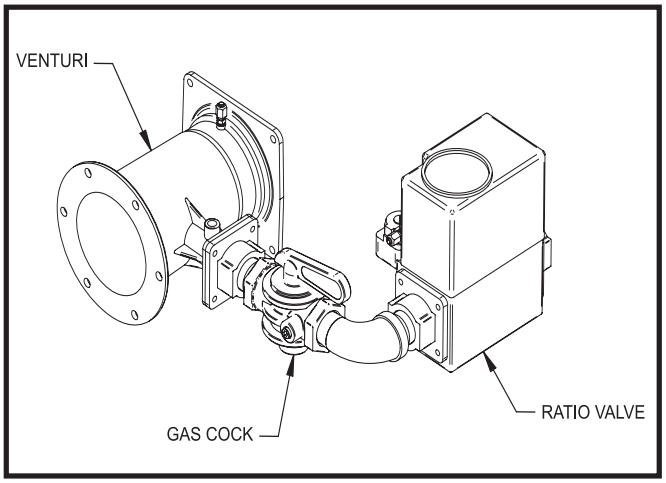


FIG. 26 Gas Train Assembly - M9

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.

GAS PIPING

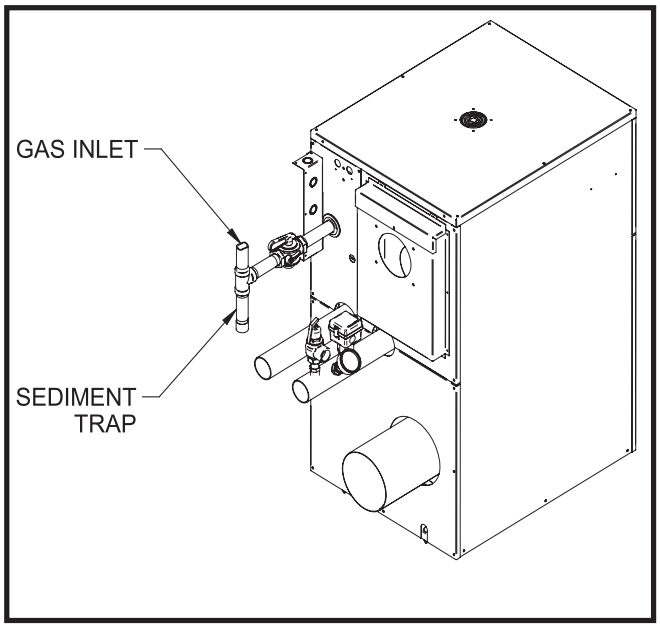


FIG. 27 Gas Line Connection with Sediment Trap and Manual Main Gas Shut-off Valve

TABLE — K
Gas Piping Size Chart

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)

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.

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

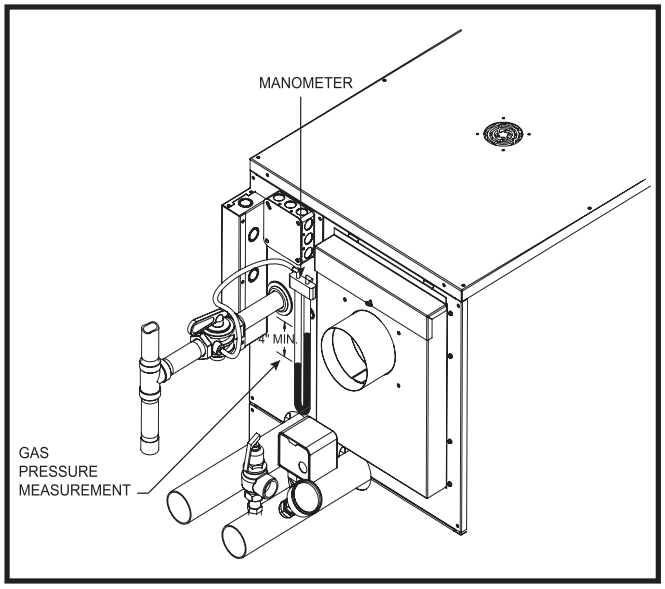


FIG. 28 Gas Supply Pressure Measurement

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 set point 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 on units with a modulating burner.

8. Ensure inlet pressure is within specified range. Minimum and Maximum gas supply pressures are specified in the 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" hex 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 set point 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

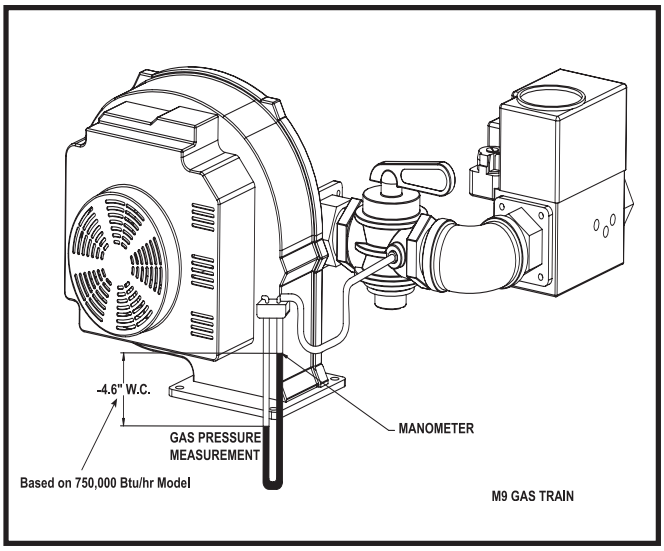


FIG. 29 Manifold Gas Pressure Measurement - M9

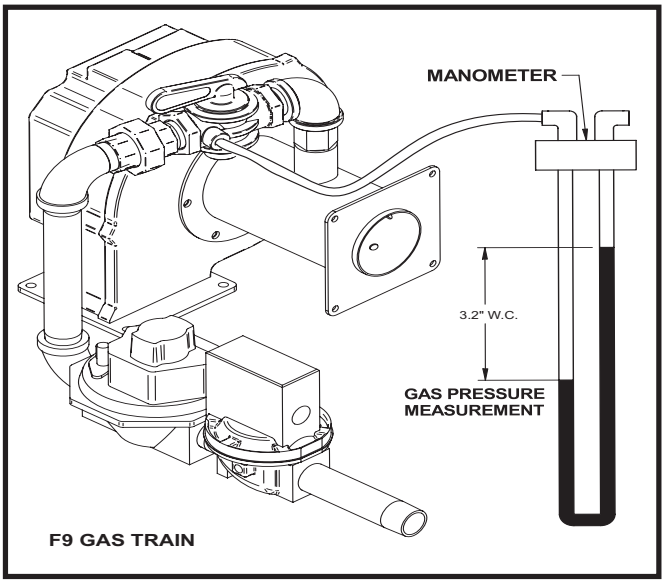


FIG. 30 Manifold Gas Pressure Measurement - F9

The gas manifold pressure tap is located on the manual gas shutoff valve of the gas manifold assembly. The manifold gas pressure test point can be accessed by removing the upper right access panel on the front of the appliance.

1. Turn the appliance power switch to the "OFF" position.
2. Loosen the thumbscrew on the upper right access panel and then remove the panel.
3. Remove the 1/8" hex plug from the manual gas shutoff valve of the gas manifold assembly. Install a fitting in the gas shutoff valve, this allows connection to a manometer to read gas manifold pressure.
4. Turn the appliance power switch to the "ON" position.
5. Set the Diagnostic Information Center to a set point which will fire the burner at 100% of rated input.

6. 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 will be the gas manifold pressure.
7. The manifold gas pressures for the single-stage (F9) and modulating (M9) models are shown below in Table L.
8. Turn the appliance power switch to the “OFF” position.
9. Remove the manometer and related fittings from the manual gas shutoff valve and replace the 1/8" hex plug.
10. Turn the appliance power switch to the “ON” position.
11. Replace the upper right access panel.

TABLE — L
Manifold Gas Pressure Measurements

Btu/hr Input	Natural Gas (w.c.)	LP Gas
Single Stage (F9) All Models	**+3.2"**	**+10.0"**
Modulating (M9) 500,000	**-8.3"**	**-9.7"**
750,000	**-4.6"**	**-5.5"**
1,000,000	**-7.1"**	**-9.3"**
1,300,000	**-6.8"**	**-9.5"**

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

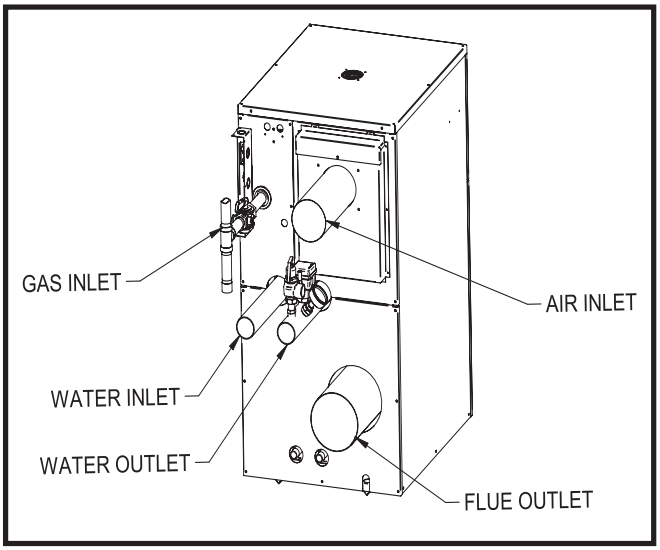


FIG. 31 Water Connections

HEAT EXCHANGER

The heat exchanger is composed of two circular, glass lined, and cast iron headers with 24 vertical finned copper tubes.

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 set point 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.

LOW WATER CUTOFF DEVICES

A water flow switch is factory installed in the outlet piping on all heating boilers, and water heaters. A water flow switch meets most code requirements for a low-water cut off device on boilers requiring forced circulation for operation.

Electronic or float type low water cut-offs are available as a factory supplied option on all models.

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.

ELECTRICAL CONNECTIONS

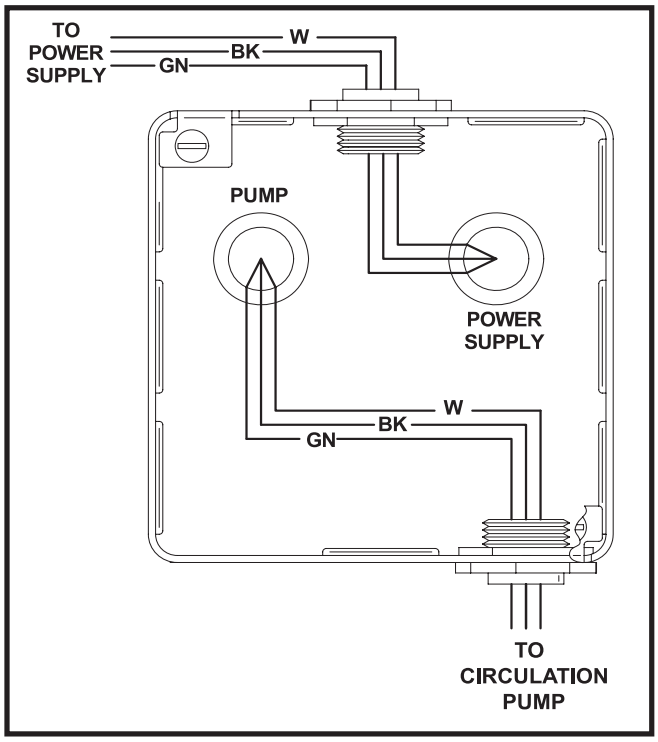


FIG. 32 Electric Power Connections - Controls and Pump

A 120 VAC, 15 Amp, 1 ph, 60 Hz circuit is required for operation of the appliance controls.

The 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 [63ºF (35ºC) 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.

TABLE — M
AMP Draw Data
500,000 through 1,300,000 Btu/hr Models

Btu/hr Input	Blower & Controls	Pump FLA*	Approximate Total Amps @ 120 VAC
500,000	6.7	8.8	15.5
750,000	6.7	8.8	15.5
1,000,000	6.7	8.8	15.5
1,300,000	6.7	8.8	15.5

*** Standard Pump Supplied with Water Heaters Only**

ACCESS TO COMPONENTS AND CONTROLS

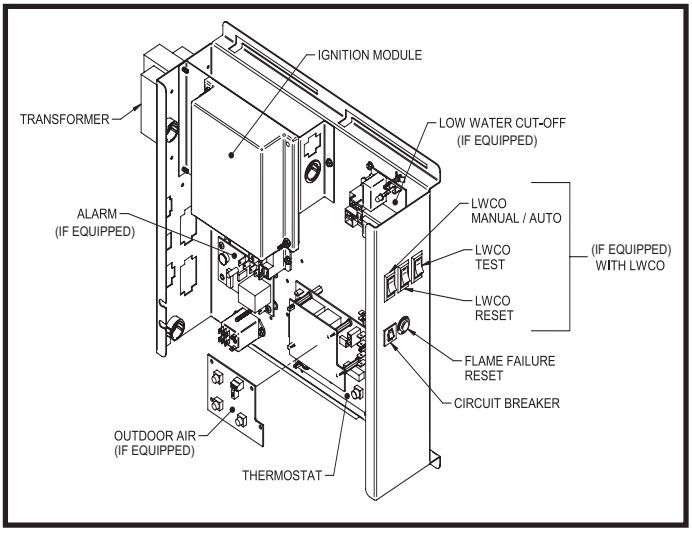


FIG. 33 F9 Slide Out Control Panel Opened to Show Component Locations

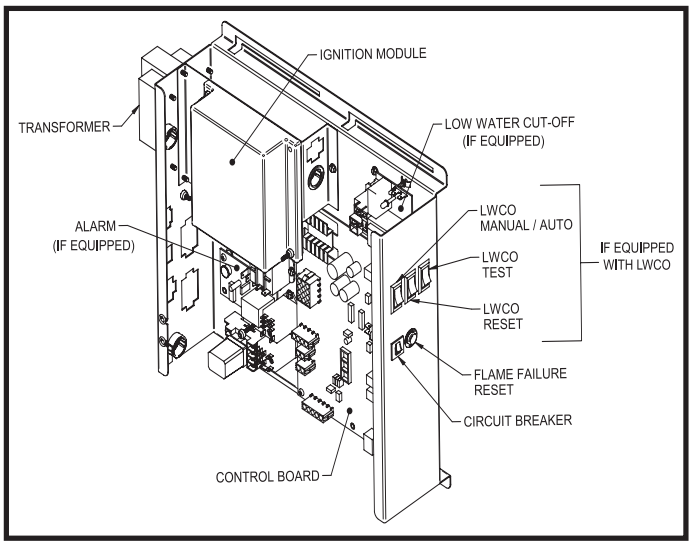


FIG. 34 M9 Slide Out Control Panel Opened to Show Component Locations

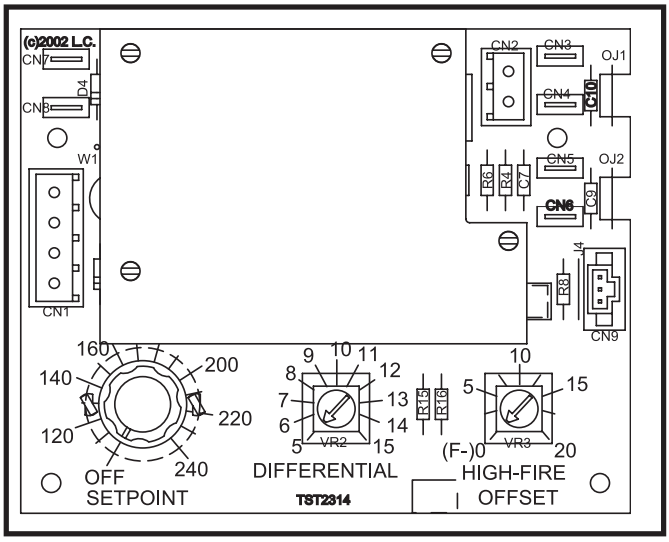


FIG. 35 Temperature Control Setting Knobs

A component, transformer and relay mounting control panel is located along the right side of the exterior jacket panel. This panel contains a 75VA transformer to drop 120 VAC to 24 VAC for internal control operation.

SETTING TEMPERATURE CONTROL - F9

Note: The temperature controller is pre-set at the factory with test settings. You may need to adjust the settings to meet your specific needs.

⚠ WARNING

Return water temperatures must not be less than 140°F. If lower return water temperatures are required, follow the instructions in the *Low Temperature Bypass Requirements* section.

Temperature Control Settings - F9

There are three setting knobs on the temperature control unless your unit is specified as a heating boiler with an outdoor air reset option. If your boiler is equipped with the outdoor air reset option, there are additional control settings for this option. They are explained under the *Outdoor Air Reset Option* section.

The three setting knobs on the temperature control are for Set Point, Differential, and High-Fire Offset (Figure 35).

Maximum Set Point Determination: The maximum set point for the control is factory set. Boilers are set to 240°F max., water heaters are set to 190°F max., and specialty state and local codes to 200°F max.

These maximum set points are established by not cutting/cutting the OJ1 and OJ2 jumpers located on the right side of the temperature controller (Figure 35). The maximum set point is established by which jumpers are cut, OJ1 and OJ2, see TABLE-N below.

TABLE N
Maximum Set point Determination

OJ1	OJ2	Max. Set Point
Connected	Connected	230°F
Cut	Connected	190°F
Connected	Cut	200°F
Cut	Cut	160°F

Note: Anytime that OJ1 is the only jumper cut, a new overlay is required under the Set Point knob on the temperature controller because the scale has changed to a maximum of 190°F.

Anytime the OJ2 jumper is cut (with or without OJ1), a new overlay is required under the Set Point knob on the temperature controller because the scale has changed to a maximum of 200°F.

Set Point: The Set Point knob specifies the target water temperature. The temperature markings for the dial on the circuit board are in degrees, Fahrenheit. After the water temperature reaches the set point, the temperature control shuts off the burner.

Differential: The Differential specifies the number of degrees below the set point that the control will allow the water temperature to drop before it brings the unit back on again.

High-Fire Offset: High-Fire Offset is an optional function of this control board to operate a two-stage firing system. This function is not used. All units equipped with this temperature control will operate with a single stage ON/OFF burner operation. The High-Fire offset knob should be set at 0°F. Setting the knob to another setting will not effect operation.

Outdoor Air Reset Option: For heating boilers ordered with the Outdoor Air Reset option, there is an additional control (see Figure 36). There are three knobs to set temperature for Shutdown, Outdoor Air Max. Temperature and Reset Ratio. An O.A. Sensor is also included.

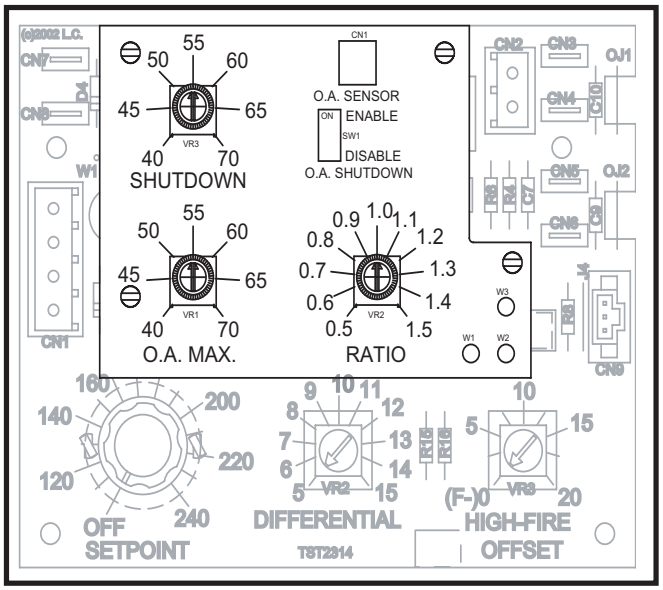


FIG. 36 Optional Outdoor Air Reset Control

Shutdown: The Shutdown knob specifies the outdoor air lockout temperature at which the control would prevent the unit from operating. This feature can be disabled / enabled with the O.A. shutdown switch.

Outdoor Air Max Temperature (O.A. Max): The O. A. Max knob allows a reset up to the maximum outdoor air temperature specified by this knob setting. Any outdoor air temperature above the specified setting, the unit will not reset but will continue to run at the set point temperature.

Ratio: The Ratio knob allows control over the reset ratio to be used during Outdoor Air Reset. The allowable ratios are as low as 0.5:1 or as high as 1.5:1.

Selecting the 0.5:1 ratio will increase the set point 0.5°F for every 1.0°F drop in outdoor air temperature up to the maximum set point temperature.

Selecting the 1.5:1 ratio will increase the set point 1.5°F for every 1.0°F drop in outdoor air temperature up to the maximum set point temperature.

See Figure 37 for an outdoor air reset chart example.

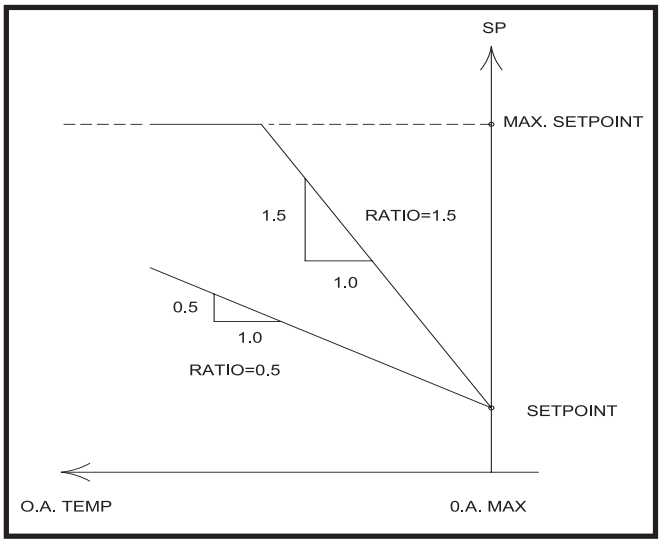


FIG. 37 Outdoor Air Reset Chart Example

Temperature Control Sensors: This controller is set to operate as a single stage temperature control that controls the burner ignition, pump, and alarm functions. This temperature controller can measure up to three different sensor inputs, depending upon how the unit is set up. They are as follows:

1. Inlet Water Temperature Sensor
2. Remote Temperature Sensor
3. Outside Air Temperature Sensor

Inlet Water Temperature Sensor: This sensor measures the inlet water temperature coming into the unit.

Remote Temperature Sensor: Depending upon how your unit is set up, this sensor can be used as a system sensor for a heating boiler or a tank sensor for a water heater.

Outdoor Air Temperature Sensor: This sensor is only available on heating boilers with the outdoor air reset option. This allows you to tie boiler operation to the outdoor air temperature. As outside temperatures drop, the control will increase the temperature setting of the boiler. As outdoor temperatures rise, the control will decrease the temperature setting of the boiler. You can set the control to shut the boiler off when a desired outdoor air temperature level is reached.

Boiler Application: Standard units are shipped with three sensors; an inlet water temperature sensor, an outlet water temperature sensor and a remote water temperature sensor. The inlet and outlet sensors are factory installed in the wells furnished in the factory supplied piping. The remote temperature sensor is supplied for field installation into the boiler system if required. The remote sensor should be used as a boiler system sensor. Boilers with the outdoor air reset option also have an outside air temperature sensor.

Water Heater Application: Water heater units are shipped with three sensors; the inlet water temperature sensor, an outlet water temperature sensor and a remote temperature sensor to be used as a tank sensor.

Placement of Sensors

Inlet / Outlet Temperature Sensors: The inlet and outlet water temperature sensors are placed into the bulbwells located on the water inlet piping and water outlet from the unit. These sensors are installed by the factory in new units. Make sure the sensors are inserted all the way into the bulbwells, leaving no air pockets between the front surface of the sensor and the back of the bulbwell. Air pockets are thermally non-conductive and will cause sensors to have an inaccurate reading.

System Sensor: This is used for boiler applications. This remote mounted sensor will control the boiler operation based upon the water temperature within the building loop.

Tank Sensor: This is used in water heating applications. Place the remote sensor in the water storage tank to measure stored water temperature. For more information on mounting the sensor, see the *Domestic Water Heater* section.

Outside Air Temperature Sensor: The outside air temperature sensor will only be used for heating boiler systems. The outside air sensor is optional. You must purchase the sensor from the appliance manufacturer. The sensor comes with a housing that helps protect the sensor from the elements. Mount the air sensor housing under the eve of the roof. Make sure the housing is out of direct sunlight. This will ensure that the sensor will accurately read the true outdoor temperature. For more information on mounting the sensor, see *Remote Mounting of Sensors*, below.

Remote Mounting of Sensor: You must mount the outside air temperature sensor outside the building. To mount remote sensors, follow the guidelines below. Take care to correctly wire sensors to the unit. Erratic temperature readings can be caused by poor wiring practices. Twist the wires between the unit and the remote sensor. Turn wires at least three or four turns per linear foot of wiring. This provides common mode rejection of some types of electrical interferences.

1. Do not route temperature sensor wiring with building power wiring.
2. Do not locate temperature sensor wiring next to control contactors.
3. Do not locate temperature sensor wiring near electric motors.
4. Do not locate temperature sensor wiring near welding equipment.
5. Make sure good mechanical connections are made to the sensor, any interconnecting wiring and the controller.
6. Do not mount sensor with lead wire end pointing up in an area where condensation can occur.
7. Use shielded wiring to connect the sensor to the control when the possibility of an electrically noisy environment exists. Shielded cable is recommended on all cable runs of more than 25 feet in length.

NOTE: Ground the cable shield at the connection to the boiler temperature control only. Do not ground the shielded cable at the sensor end. To maintain temperature accuracy, sensor wires should be 18 AWG two conductors (18/2). Use shielded wire if required.

DIAGNOSTIC INFORMATION CENTER FOR ON/OFF BURNER CONTROL (F9)

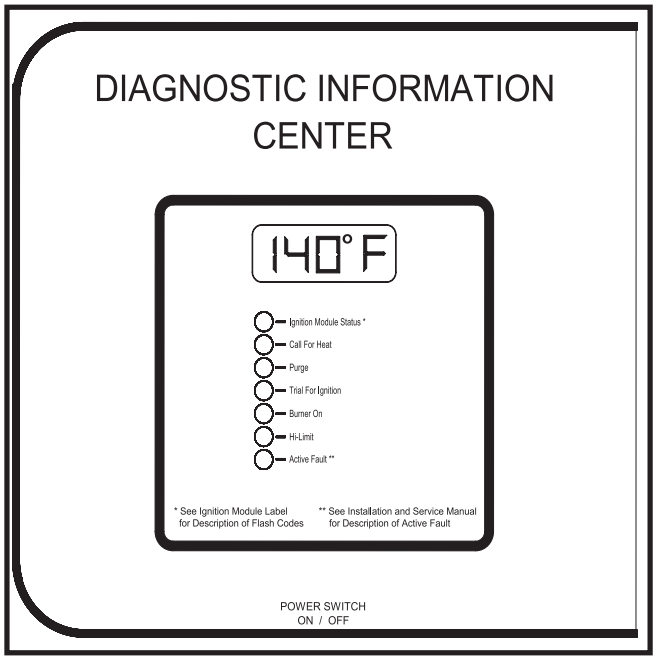


FIG. 38 External Diagnostic Information Center Display Panel - Staging (F9)

The Diagnostic Information Center (F9) provides temperature and status information via a digital display screen and a series of LED indicators. The digital display screen will continuously scroll through the temperatures of the various sensors.

DATA POINTS VISIBLE FROM THE DIAGNOSTIC INFORMATION CENTER

The following data points are shown in the digital display on the Diagnostic Information Center. The display will continuously scroll through the displayed temperatures.

Inlet Temperature: Displays the temperature of the incoming water to the boiler or water heater as measured at the inlet sensor. **Example: Displayed as In 140°F**

Outlet Temperature: Displays the temperature of the water leaving the boiler or water heater as measured at the outlet sensor. **Example: Displayed as Out 156° F**

Water Temperature Rise: Displays the temperature rise of the water leaving the boiler or water heater. This is the calculated difference in temperature between the inlet and outlet sensors. **Example: Displayed as riSE 16° F**

Remote Sensor Temperature: Displays the temperature of the water as measured by the remote sensor when used. In a water heater application this is the temperature at the tank sensor. In a heating boiler application this is the temperature at the system sensor. If a remote temperature sensor is not used there will be no temperature displayed for the sensor. **Example: Displayed as rSEn 145° F**

NOTE: Temperatures and settings from the optional outdoor air reset function are not shown in the display of the Diagnostic Information Center on an ON/OFF firing burner.

Selection of °F or °C in Temperature Display: Inside the control panel on the top corner of the enclosure for the digital display is a small switch. Moving the switch from side to side will select the temperature display from °F to °C. As shipped, the default setting is to display temperature in °F (Fahrenheit).

LED DISPLAY

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

Ignition Module Status: This green 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.

Call for Heat: This yellow LED indicates when the controller is currently calling for heat. When illuminated, the ignition module is also energized.

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

Trial for Ignition: This yellow LED indicates that the hot surface igniter is turned on for a normal ignition sequence. When illuminated, the ignition module is providing power to the hot surface igniter.

Burner On: This green LED indicates that the gas valve is energized. When illuminated, the ignition module is providing power to the gas valve.

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

Active Fault: This red LED indicates that a control sensed malfunction has shut down the unit due to an operational problem such as low water flow or the function of an optional safety control.

DEFAULT DISPLAY OF THE DIAGNOSTIC INFORMATION CENTER

The display will determine if an optional remote sensor is connected. If a remote sensor is not located there will be no display of the temperature from the remote sensor. If connected, the temperature at the sensor will also be displayed. If a remote sensor was connected then opens and shorts, the appropriate fault display will be shown.

SENSOR FAULTS SHOWN IN THE DIGITAL DISPLAY

Shrt: Indicates that the sensor has a short in the sensor circuit (wire or probe).

OPEn: Indicates that a sensor that is being displayed is disconnected or has an open circuit to the sensor.

ELECTRONIC TEMPERATURE CONTROL FOR MODULATING BURNER - M9

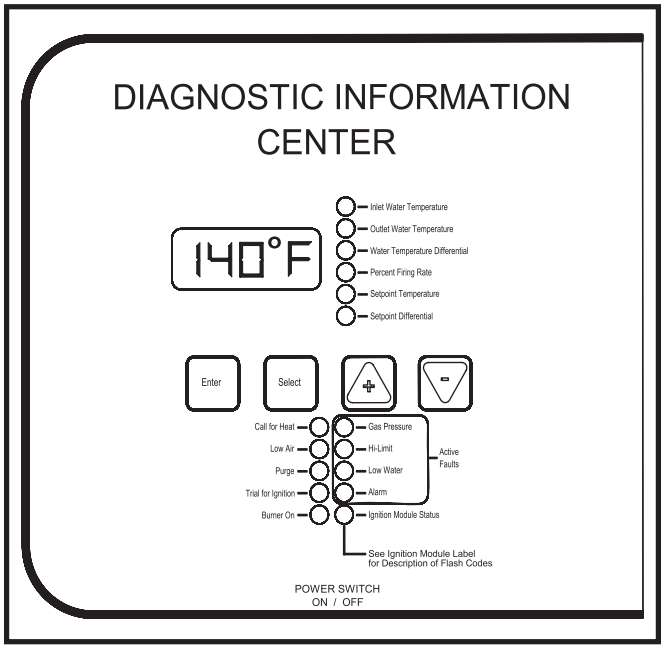


FIG. 39 External Diagnostic Information Center Display Panel - Modulating (M9)

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: Select, Enter, 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 corresponding information being displayed in the display. At a minimum, six (6) selectable LED's will be accessible via the select key. Four (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 set points 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 set points 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 illuminated. 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.

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 based on scaling of the PWM signal going to the blower motor. *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.

CHANGEABLE DATA POINTS VISIBLE FROM THE DIAGNOSTIC INFORMATION CENTER

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

Set Point Temperature: This is the user entered set point of a water heater or boiler without any adjustment for an optional outdoor air reset function.

Set Point Differential: This is the number of degrees that the water temperature must fall below the set point temperature before a call for heat is initiated.

Outdoor Air Maximum Reset: This is the highest temperature that the boiler set point 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 set point 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 set point would be equal to the Maximum Reset Temperature when the outdoor air temperature falls below this setting.

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 shutdown 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 Table P, Diagnostic Module Status LED Diagnostic Codes information in the Hot Surface Ignition System 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.

Alarm: This LED indicates the status of the alarm circuit. When illuminated, it indicates that the alarm circuit is active.

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.

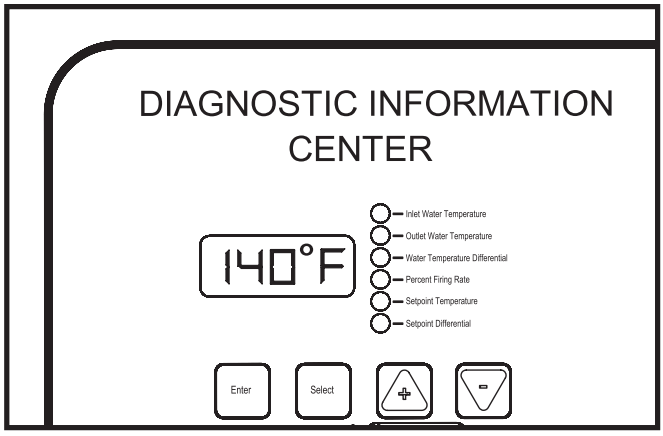


FIG. 40 Diagnostic Information Center Display Panel - M9

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 set point value.

(3) Within 5 seconds of releasing either the up or down key, press the **ENTER** key to permanently store the new set point 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 settings 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 set points, the controller will immediately begin controlling based on the new set point.

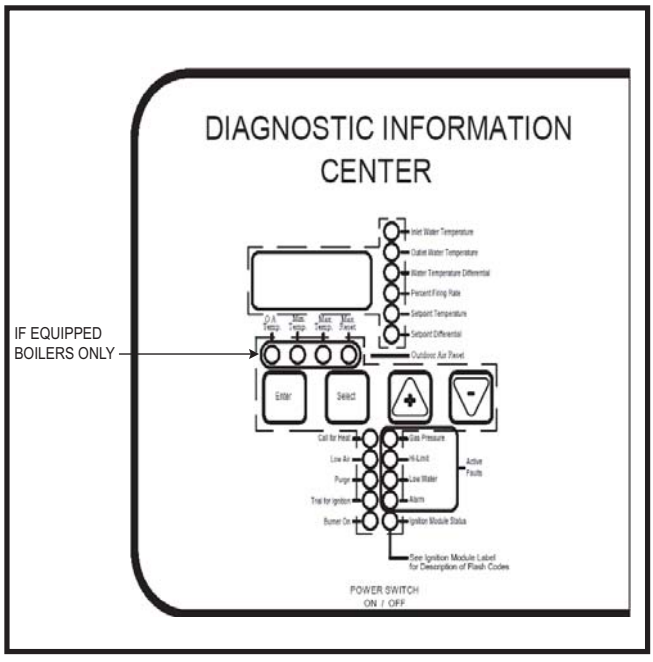


FIG. 41 Diagnostic Information Center Display Panel (with Outdoor Air Reset Function)

OUTDOOR RESET FUNCTION SELECTIONS

The Electronic Temperature Controller is equipped with an outdoor reset function. This function uses a sensor to measure the outdoor temperature and automatically adjust the boiler set point 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 set point 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 set point 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 set point 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.

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 has 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 set point adjustments are possible. When locked, all of the temperature set points will be viewable, but can't be changed. Any attempt to use either the up or down key to change a set point 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, or 90 seconds after the set point 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 four (4) LED's associated with the O. A. Reset function are not to be selectable via the SELECT key.

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 feature settings 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 will again show "F or C". Pressing the SELECT key at anytime prior to pressing the 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". Press the SELECT key to advance to the next feature.

Mode Cancellation: Pressing ENTER once while either "PU", "SEnS", "F or C" or "OA r" 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 — O
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

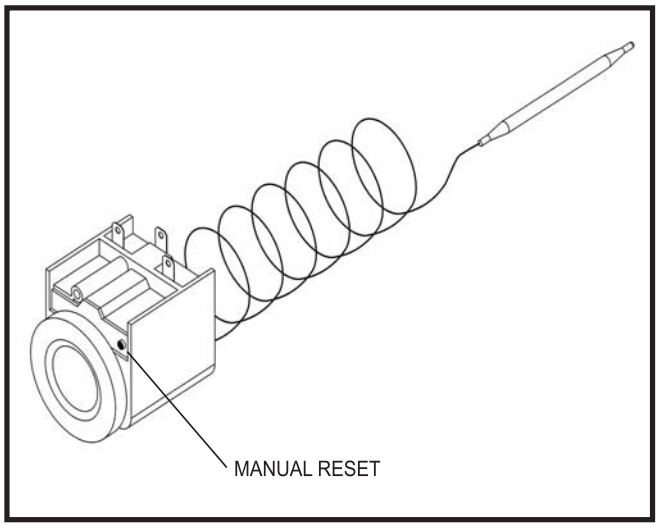


FIG. 42 High Water Temperature Limit Control

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 set point 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 Set Point.

NOTE:

The high limit control will not reset until the water temperature has dropped below the set point 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 Figure 43. 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 (Figure 43).
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 (Figure 43).
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 (Figure 43).
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 Figure 43. 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 (Figure 43).
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 Figure 43).

⚠ 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.

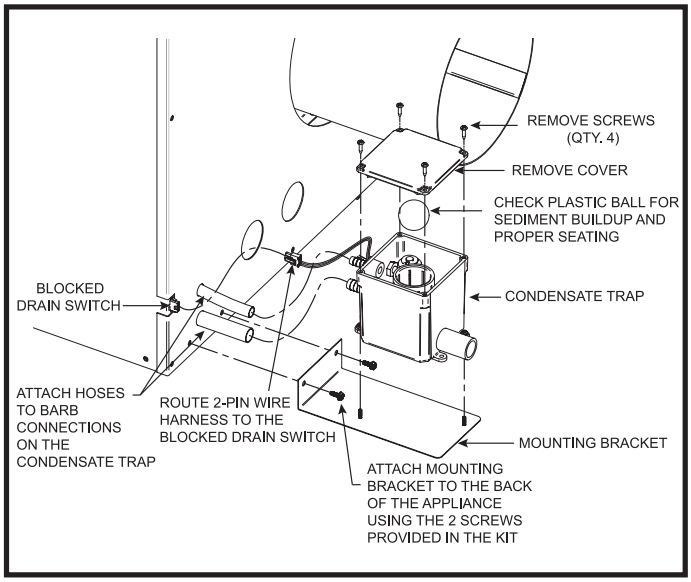


FIG. 43 Install Condensate Trap

HOT SURFACE IGNITION SYSTEM

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 — P
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 Troubleshooting 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.

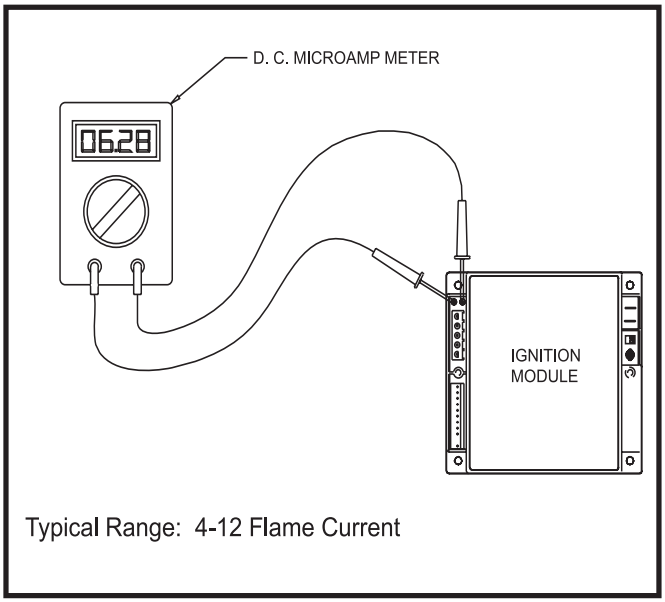


FIG. 44 Flame Current Measurement with the HSI Module

TABLE — Q
Ignition and Control Timings

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

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 Set point 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.

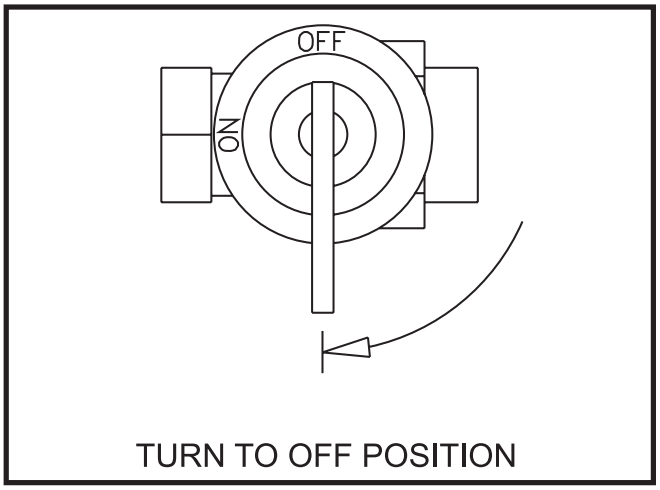


FIG. 45 Picture of Gas Cock with Handle in "OFF" Position

7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP Follow "B" in the safety information on page 37. 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.

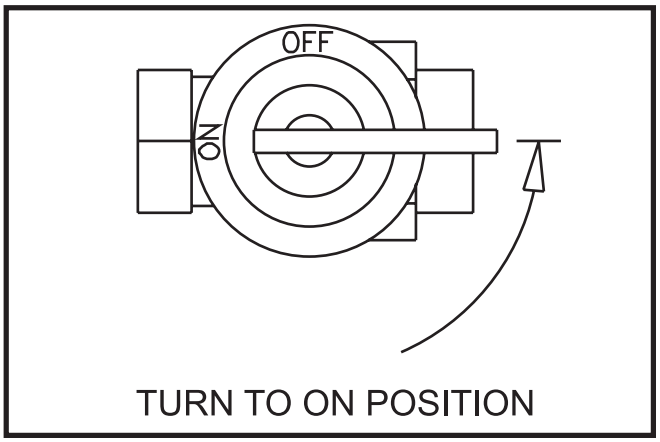


FIG. 46 Picture of Gas Cock with Handle in "ON" Position

9. Turn on all electric power to the appliance.
10. Set the Temperature Set point 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 Set point 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 “ON” position.
2. Turn off gas supply to appliance.
3. Set the Set point 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 Set point 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. 24 VAC is supplied to all low voltage controls.
5. Water flow from the circulating pump is proven by a Flow Switch.

6 Diagnostic Information Center Set Point Temperature (Operating Temperature) is set to call for heat.

7. Electronic Temperature Controller initiates a start-up sequence by checking the Temperature Sensors and input signals from the safety controls.
8. Electronic Temperature Controller enables the Ignition Module.
9. Combustion Air Blower starts operation and drives to 100% speed for prepurge.
10. Blower makes the low air switch contacts to enable the Ignition Module.

11. On M9 models the Blower cycles down to 75% speed and the Ignition Module initiates the heat-up sequence of the Hot Surface Igniter.
12. Hot Surface Igniter proves 1800°F Ignition Temperature by current draw through the Ignition Module.
13. The Ignition Module supplies 24 VAC to the Main Relay and Redundant Gas Valve.
14. Operation of the Igniter, Gas Valves and Safety Switches are proven to the Electronic Temperature Controller.
15. On M9 units the 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.

    On F9 units the Gas Valve opens and supplies gas to the Orifice Inlet to pre-mix.
16. The Gas/Air mixture is forced into the Burner and out of the Burner Ports under pressure.
17. The Hot Surface Igniter lights the Gas/Air mixture and then serves as a flame sensor to prove Main Burner Flame by rectification.
18. Burner is now in a soft start firing at 75% of rated input (M9 Only).
19. Electronic Temperature Controller adjusts blower speed based on desired water Set Point Temperature (M9 Only).
20. Burner input rate may vary from 25% to 100% of rate as required to satisfy the Set point Temperature programmed into the Diagnostic Information Center (M9 Only).

End of Sequence

21. Set Point temperature is satisfied.
22. Power to the gas valves is turned off.
23. Combustion Air Blower ramps up to 100% speed and runs for a 30 second post purge timing and turns off.
24. 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.

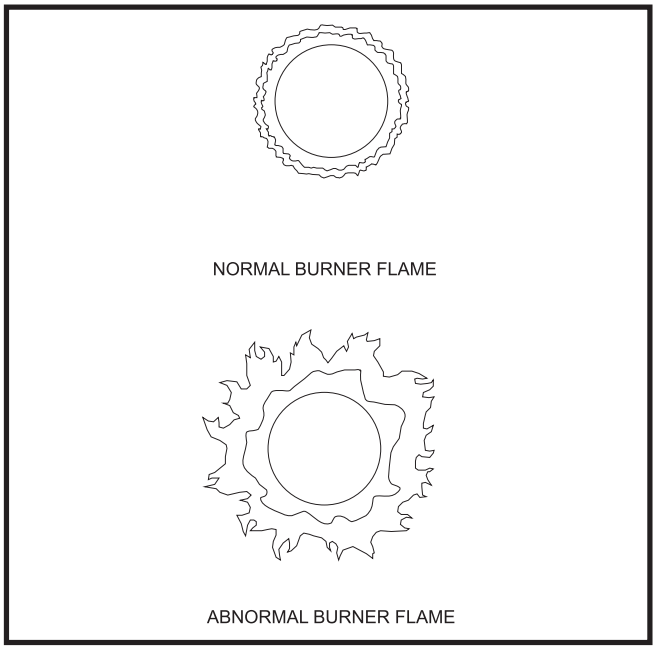


FIG. 47 Flame Pattern Illustration at Full Rate Firing

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

⚠ CAUTION

When a **Category II or 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 - How Do You Clean Your Burner?**

   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. This filter helps ensure clean air is used for the combustion process. Check this filter every month and replace when it becomes dirty. The filter size on the 500,000 - 1,300,000 Btu/hr units is 16" x 12" x 1" (40.6cm x 30.5cm x 2.5cm). You can find these commercially available filters at any home center or HVAC supply store. 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

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. Disconnect the power wires to the gas valves, flow switch, blower and pressure switches (if equipped). Multiple pin connectors are used at all of these components for ease of service.
7. Remove the sensing tube from the air ratio gas valve to the combustion air blower on M9 units and remove the pressure switch tube from the combustion air blower on F9 units.
8. Remove the band clamp holding the air hose to the blower. Push the air hose away from the Venturi before removing the blower.
9. On M9 units remove the four screws holding the gas train assembly to the blower assembly. On F9 units break the union connecting the gas train to the blower assembly.
10. Remove the six (6) nuts holding the blower assembly to the burner and remove the blower assembly.
11. Disconnect the power wires to the hot surface igniter.
12. 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.
13. Remove the six (6) nuts holding the burner to the heat exchanger.
14. The burner can now be lifted vertically out of the heat exchanger cavity.
15. Use care to prevent damage to the woven burner port surface, gasket(s) and air orifice plate on removal.
16. Reassemble in reverse order.

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.

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. Locate the Hot Surface Igniter.
4. Disconnect the two power leads to the hot surface igniter.
5. Loosen and remove the two wing nuts that mount the igniter.
6. 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.
7. Check the replacement igniter for cracks or damage before installing.

8. 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.
9. Carefully insert the igniter into the mounting point on the burner flange and position on the mounting studs.
10. Reinstall the two wing nuts and tighten by hand only. Over tightening the wing nuts may break the ceramic mounting flange.
11. Ensure that the igniter gasket is properly installed and seals the point of contact between the igniter and burner mounting flange.
12. Reconnect the power leads to the igniter.
13. Turn on main gas supply.
14. Turn on main power.
15. Test fire the appliance to ensure proper operation.

6. **HEAT EXCHANGER INSPECTION**

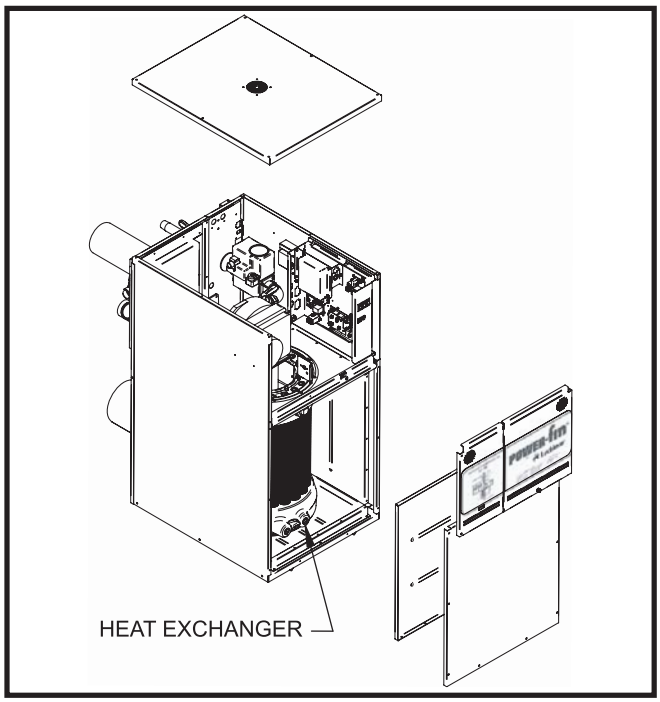


FIG. 48 Location of Heat Exchanger Inside of Jacket

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, the 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**

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 equipment room with openings sized per the requirements of the National Fuel Gas Code when the appliance is installed with a specified 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.

9. **CONTROL CIRCUIT VOLTAGE**

This appliance uses a transformer to supply a low voltage control circuit. The voltage on the secondary side should 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 Figure 43 on page 35).
3. Remove any sediment in the trap.
4. Locate the plastic ball in the float tube (Figure 43). 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.

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 equipment 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 equipment 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 intermittent pump allows the circulating pump to be cycled on at each call for heat and cycled off when the set point 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. The intermittent pump will energize the pump relay when either the inlet or remote temperature 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 and water heaters must be located in a room having a temperature safely above freezing [32°F(0°C)].

3. Caution - An equipment 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. Freeze protection for a heating boiler or water heater using an indirect coil can be provided by using hydronic system antifreeze. Follow the manufacturers instructions. **DO NOT** use undiluted or automotive type antifreeze.

5. 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

HEATING BOILERS

500,000 - 1,300,000 Btu/hr Models

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 a suitable floor drain. See the relief valve section in this 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 ½ inch copper pipe inlet and outlet connections. Installed piping to and from the boiler must be a minimum of 2 ½ 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 75 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. A System Temperature Rise Chart is also provided. 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.

PRIMARY/SECONDARY BOILER PIPING

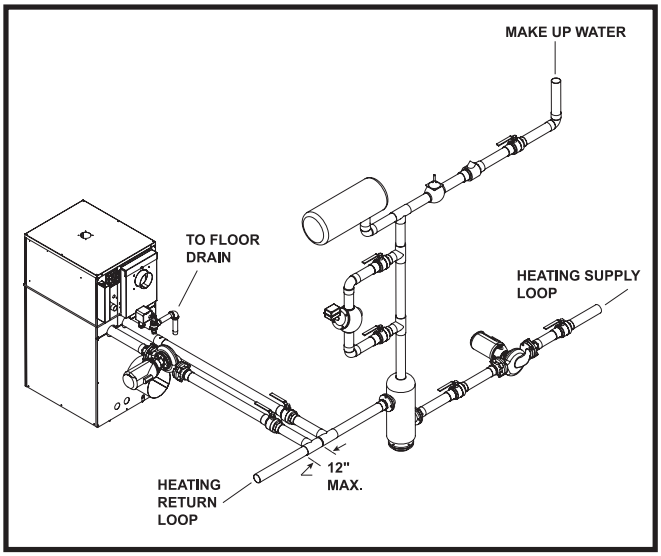


FIG. 49 Primary/Secondary Piping of a Single Boiler

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.

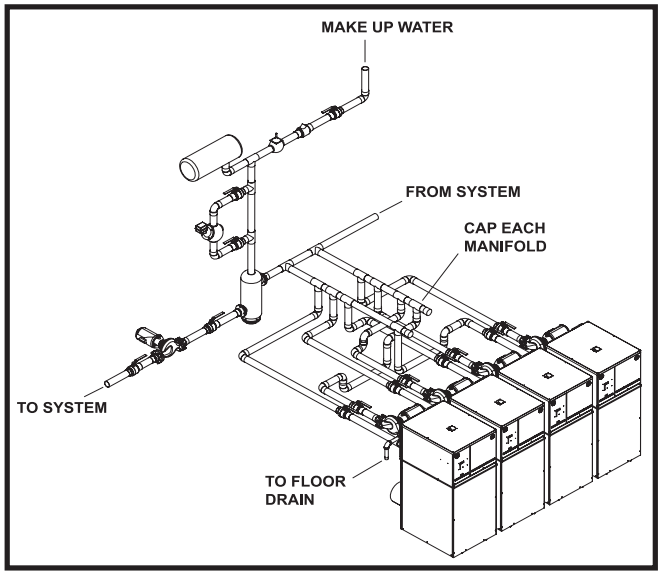


FIG. 50 Primary/Secondary Piping of Multiple Boilers

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

A boiler operated with an inlet temperature of less than 140°F (60°C) must have a bypass to prevent problems with condensation. 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.

An externally piped and pumped bypass system must be piped into the system at the time of installation. This piping is like a primary/secondary boiler installation with a bypass in the secondary boiler piping. Inlet water temperatures below 140°F (60°C) can excessively cool the products of combustion resulting in condensation on the heat exchanger and in the flue. The bypass allows part of the boiler discharge water to be mixed with the cooler boiler return water to increase the boiler inlet temperature above 140°F (60°C). This should prevent the products of combustion from condensing in most installations.

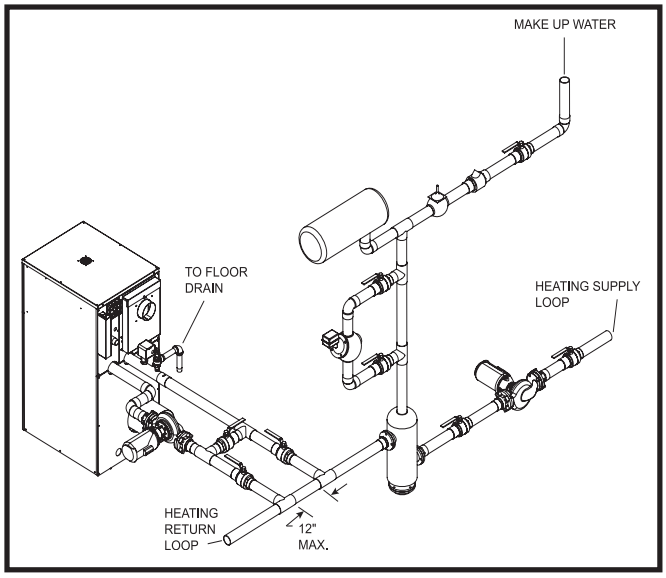


FIG. 51 Boiler with Low Temperature Bypass Piping with Manual Valves - F9 ON/OFF Firing ONLY

The bypass should be fully sized with a balancing valve to allow for proper adjustment as shown in Figure 51. A valve must also be provided on the boiler discharge, after the bypass. Closing this discharge valve forces water through the bypass. Start boiler adjustment with the bypass valve in the full open position and the boiler discharge valve half open. A small amount of the higher temperature boiler discharge water is mixed with the system water to maintain the desired lower system temperature.

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 set point available from the Digital Temperature Control is 60°F (15.6°C).

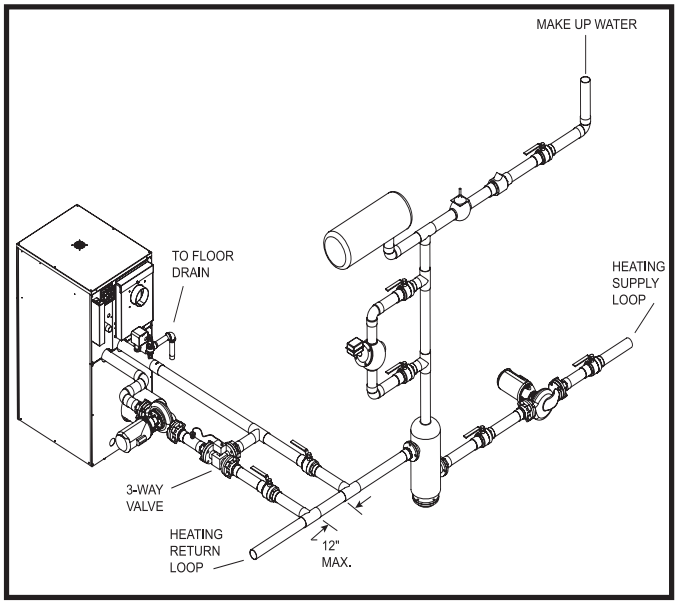


FIG. 52 Boiler with Low Temperature Bypass Piping - Using a Thermostatic Mixing Valve Required for M9 Modulation Units

To prevent the system return water temperature below 140° F from entering the boiler inlet, a quick acting self contained 3-way valve, set at 140°F or an electric actuated 3-way valve with a sensor located on the boiler inlet pipe must be provided. To prevent manual reset high limit problems, 3-way valve minimum flow stops or a valve leak-through should be evaluated. The installation of this 3-way valve in the piping system as shown in Figure 52 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 set point available from the Digital Temperature Control is 60°F (15.6°C).

⚠ CAUTION

A boiler allowed to operate at set point 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.

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 — R
Maximum Flow for Heating Boiler

⚠ CAUTION:

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

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

Btu/hr Input	Maximum Flow
500,000 - 1,300,000 Btu/hr	75 GPM

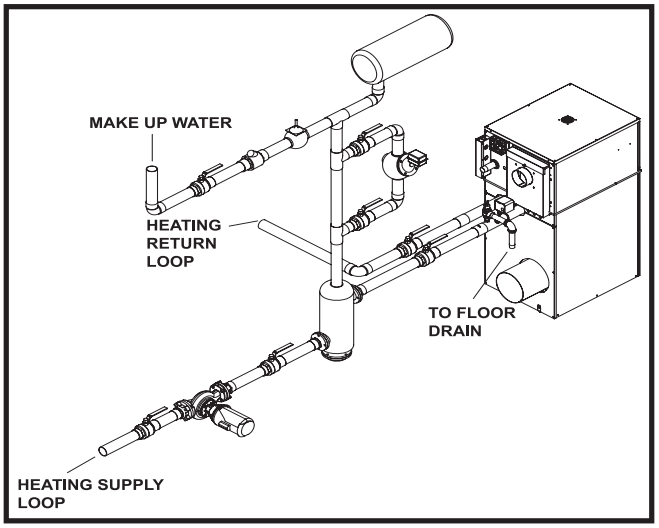


FIG. 53 Boiler Piping with Full System Flow

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.

TABLE — T
Boiler Temperature Rise at Maximum Flow

Temperature Rise at Full Rate Fire and 75 GPM Maximum Flow

Btu/hr Input	Temperature Rise
500,000	11°F (6.1°C)
750,000	17°F (9.4°C)
1,000,000	23°F (12.8°C)
1,300,000	30°F (16.7°C)

Maximum flow is 75 GPM. Flow rate can be determined by measuring the temperature rise through the boiler when it is firing at full rate input.

NOTE:

On 500,000 - 750,000 Btu/hr models, GPM flows that are below the minimum required to make the flow switch are not recommended.

Systems operating with more than 40°F temperature rise MUST BE carefully designed to ensure that there is not a problem with noise and short cycles of operation.

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.

SYSTEM TEMPERATURE RISE CHART
TABLE - S
Temperature Rise and Head Loss Based on Boiler Output in Btu/hr

BTU/Hr		20△T		25△T		30△T		35△T		40△T		45△T		50△T		55△T		60△T	
Input	Output	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd	GPM	Ft-Hd
500,000	435,000	43.5	2.0	34.8	1.3	29.0	0.9	24.9	0.7	21.8	0.5	19.3	0.4	17.4	0.3	15.8	0.2	14.5	0.1
750,000	652,500	65.3	6.0	52.2	3.3	43.5	2.1	37.3	1.8	32.6	1.3	29.0	1.0	26.1	0.8	23.7	0.7	21.8	0.6
1,000,000	870,000	87.0*	12.6	69.6	7.8	58.0	4.8	49.7	3.3	43.5	2.4	38.7	2.0	34.8	1.6	31.6	1.2	29.0	1.1
1,300,000	1,131,000	—	—	90.0*	14.8	75.4	9.8	64.7	6.9	56.6	4.6	50.3	3.6	45.3	2.9	41.1	2.2	37.7	1.9

*Cupro-Nickel Heat Exchanger Required at Flow Rates Above 75 GPM

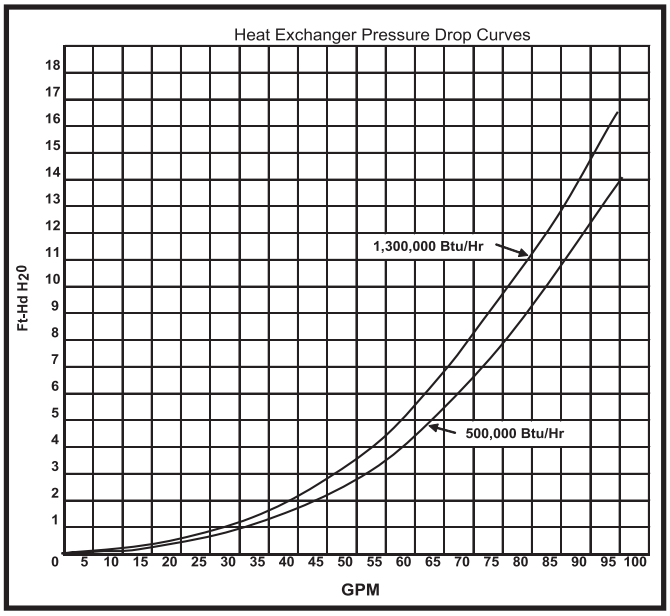


FIG. 54 Heat Exchanger Head Loss Chart

INSTALLATION WITH A CHILLED WATER SYSTEM

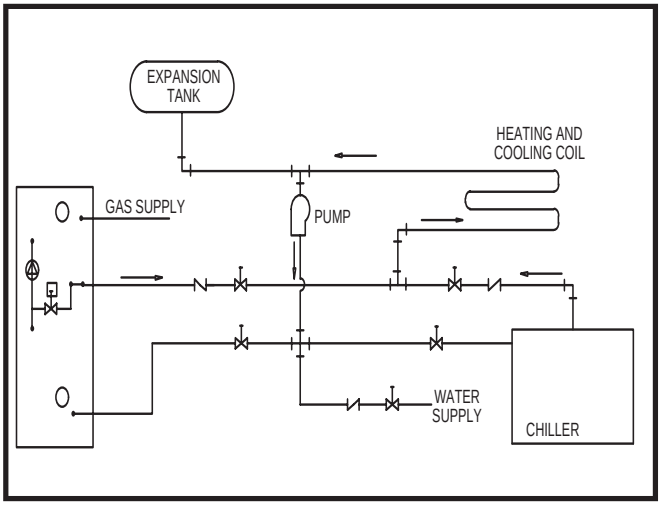


FIG. 55 Installation with a Chilled Water System

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.

REMOTE ENABLE CONNECTIONS

A remote enable control may be connected to the boiler. Follow the manufacturer's instructions supplied with the remote enable control for proper installation and adjustment.

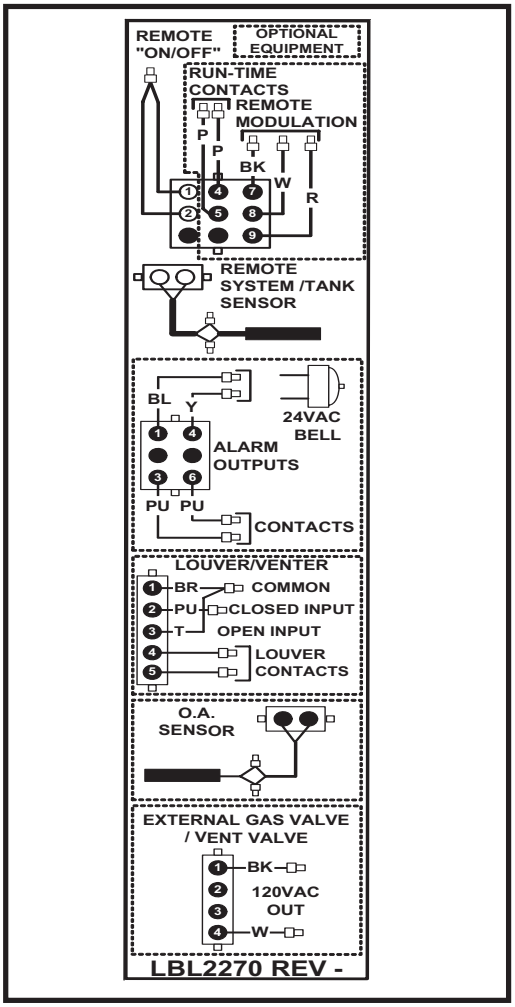


FIG. 56 Remote Enable Connections

DOMESTIC WATER HEATERS

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.

DOMESTIC WATER HEATERS

500,000 - 1,300,000 Btu/hr Models

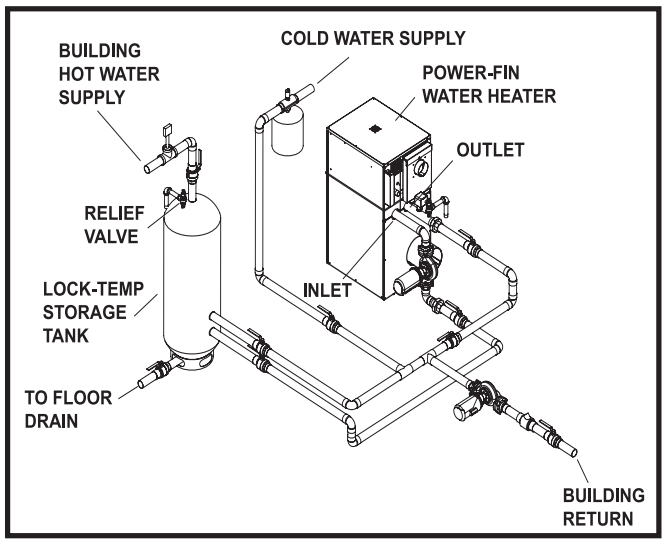


FIG. 57 Typical Water Heater Piping with Storage Tank

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. 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.

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.

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 — U
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:

Btu/hr Input	Maximum Flow
500,000 - 1,300,000 Btu/hr	75 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 75 GPM. Flow rate can be determined by measuring the temperature rise through the water heater when it is firing at full rate input.

TABLE — V
Temperature Rise At Full Rate Fire and 75 GPM Flow

Btu/hr Input	Temperature Rise
500,000	11°F (6.1°C)
750,000	17°F (9.4°C)
1,000,000	23°F (12.8°C)
1,300,000	30°F (16.7°C)

1. The pump must run continuously when the burner is firing.

2. With the pump running and no heat requirement from the water heater, 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 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% of 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.

2. Be sure all valves are open between the water heater 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 and/or storage tank are not less than 2 ½ inch (63.5 mm) diameter. To increase flow and decrease temperature rise, increase the piping to a 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 cannot 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 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

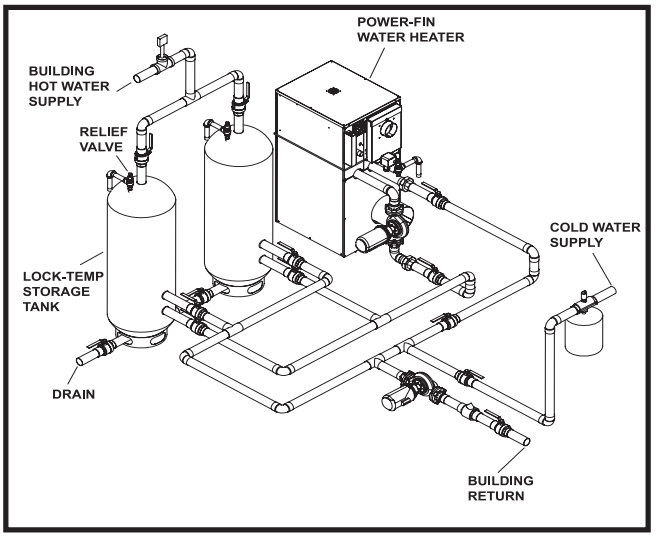


FIG. 58 Single Water Heater Piping with Two Storage Tanks

MULTIPLE WATER HEATER INSTALLATIONS

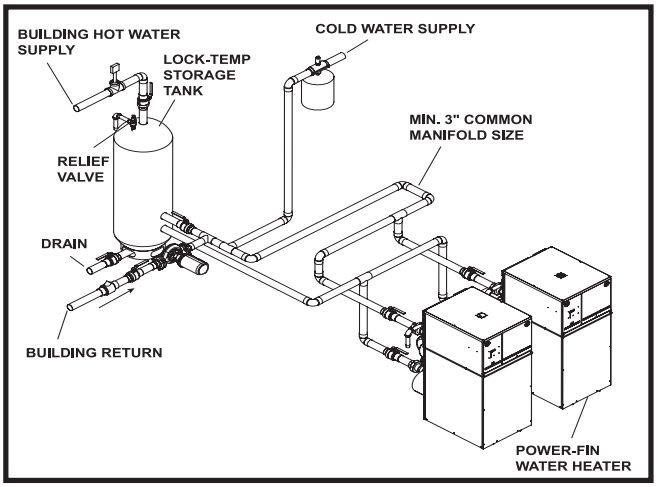


FIG. 59 Multiple Water Heater Piping with a Single Storage Tank

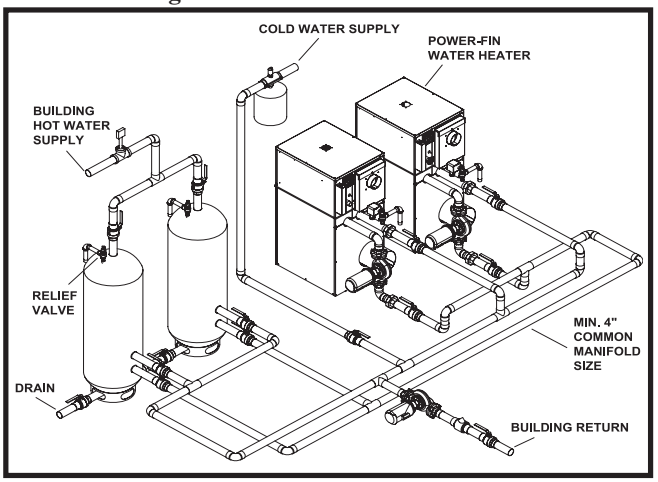


FIG. 60 Multiple Water Heater Piping with Multiple Storage Tanks

TABLE — W
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 must have a 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 the *"Water Chemistry"* section.

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 is firing. This is the standard operating system for a water heater.

An intermittent pump control function is provided with an all bronze pump. The pump will operate only while there is a "Call for Heat" and for a timed period after the water temperature set point 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 is installed in the inlet piping to the water heater.

With an intermittent pump control feature, 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.

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.

500,000 - 1,300,000 Btu/hr Models
1/2 HP, 120 VAC, 9.8 Amps

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 — X
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.
500,000 - 1,300,000	75	15

When installing multiple water heaters and/or multiple storage tanks, the diameter of the interconnecting 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.

THERMOSTAT SETTINGS

1. **The Electronic Temperature Controller is adjusted to a low test setting when shipped from the factory.**

2. **Using the Set Point knob (F9) or Diagnostic Information Center (M9), adjust the temperature set point to the lowest settings which will satisfy hot water demands and prevent a risk of scald injury.**

MINIMUM WATER TEMPERATURES
(Domestic Hot Water Use)

Domestic Water Temperatures:
This high efficiency water heater 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 reduce 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 that can be set with the Electronic Temperature Controller for water heater operation is 190°F (87.8°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.

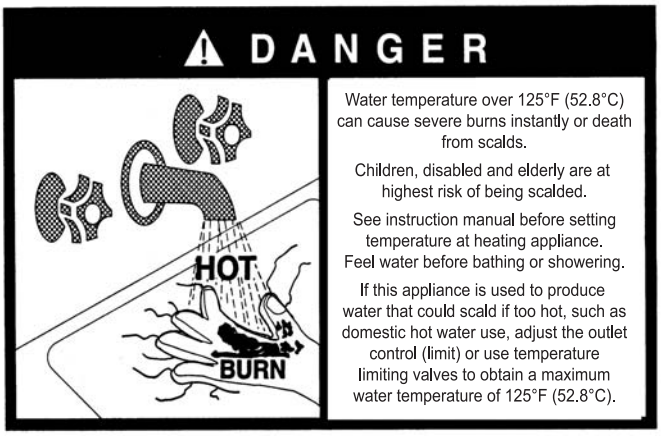


FIG. 61 Hot Water Danger Label

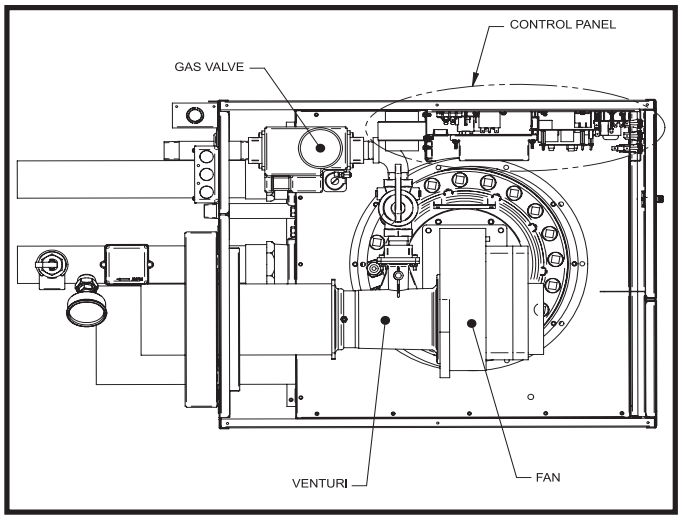


FIG. 62 Component Location Drawing - Top (M9 Shown)

⚠ 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.

NOTE:

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

OPTIONAL RELIEF VALVE

This water heater 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 is 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 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!

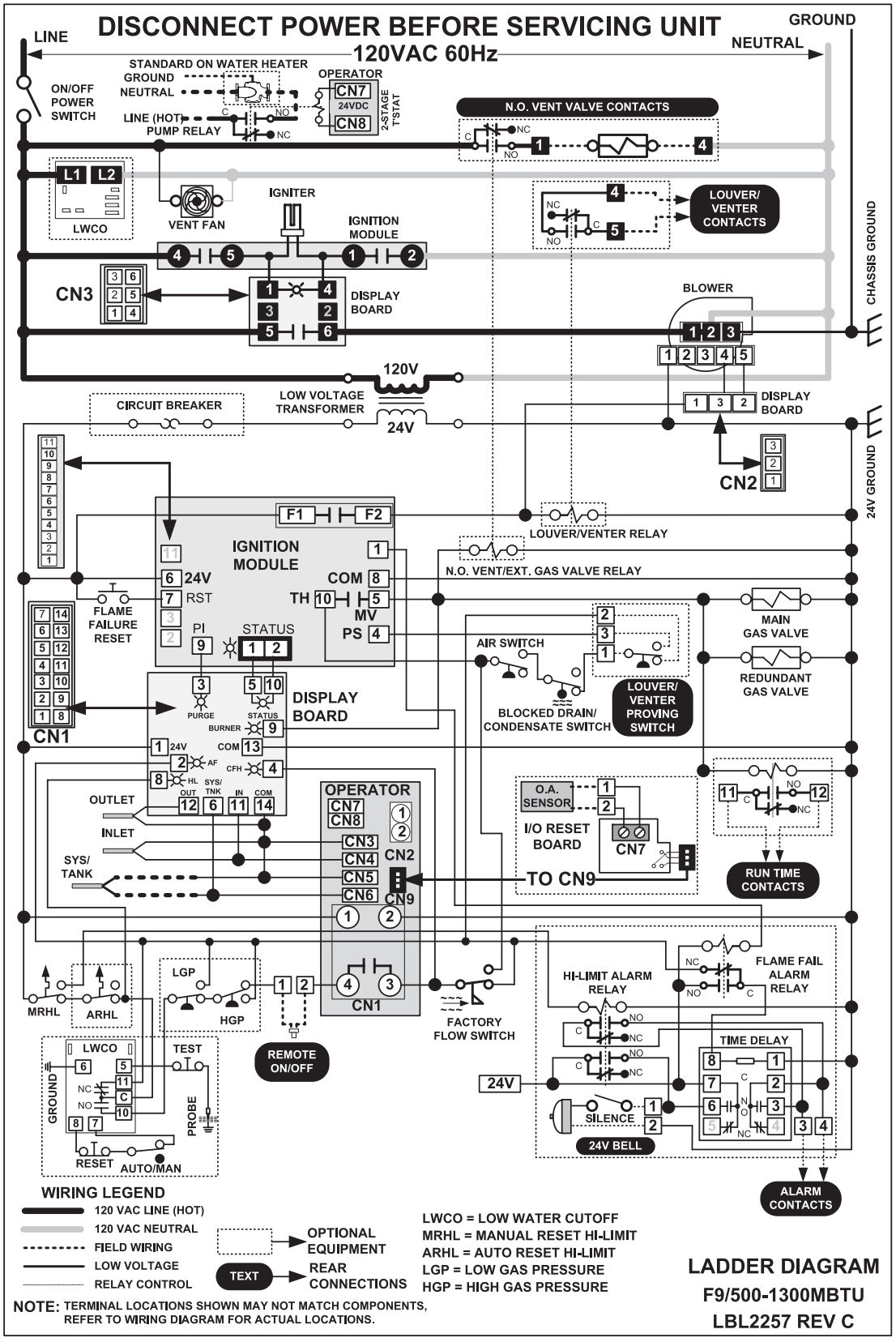
CATHODIC PROTECTION

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.

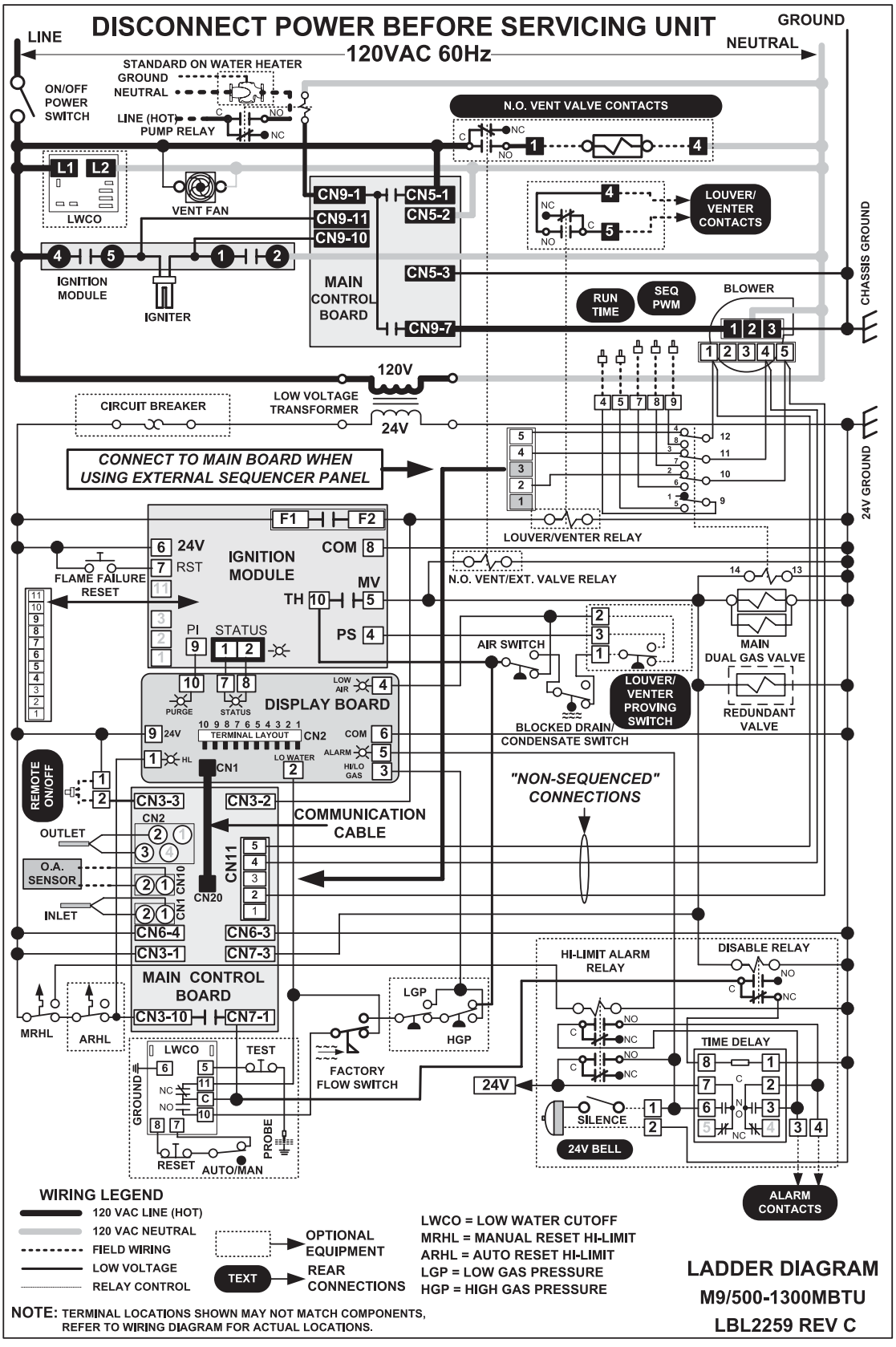
TROUBLESHOOTING GUIDE
500,000 - 1,300,000 Btu/hr Models
Boilers & Water Heaters F9/M9

SITUATION	CORRECTIVE ACTION
NO POWER	• Check circuit breaker / fuses. • Check wiring to Power-Fin. • Check ON / OFF switch operation.
NO CALL FOR HEAT / UNIT NOT FIRING	• Check setting of Electronic Temperature Control. • Check setting of Manual Reset High Limit. • Push the reset button on the Manual Reset High Limit. • Check for external Energy Management System or Sequencer. • Check control panel diagnostic lights for indication of control problem.
LOW WATER	• Make sure system is full of water. • Check piping for restrictions / proper sizing. • Check pump for proper installation / rotation. • If optional Low Water Cutoff is installed, push the reset button. • Check flow switch for operation. Switch needs approximately 26 GPM to function.
LOW AIR PRESSURE / NO FAN OPERATION	• Check for dirty air inlet filter or restriction in the air inlet pipe. • Check jacket for air leaks due to loose panels, seals, or shipping damage. • Check hoses to air pressure switch for damage. • Check 110 VAC to fan.
HIGH LIMIT	• Check piping for restrictions. • Check pump for proper operation. • Check setting of electronic thermostat. • Check setting of high limit.
HANGING ON TRIAL FOR IGNITION	• Check amp draw of igniter. Proper amp draw for igniter is 2.75 amps. • Replace ignition module. **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 is available from your local distributor. DO NOT use general purpose field replacement ignition modules or igniters.**
FLAME FAILURE	• Check for proper gas supply to unit. • Check for proper combustion air supplied to unit. • Check for proper venting of unit. • Check for proper electrical supply / ground to unit.

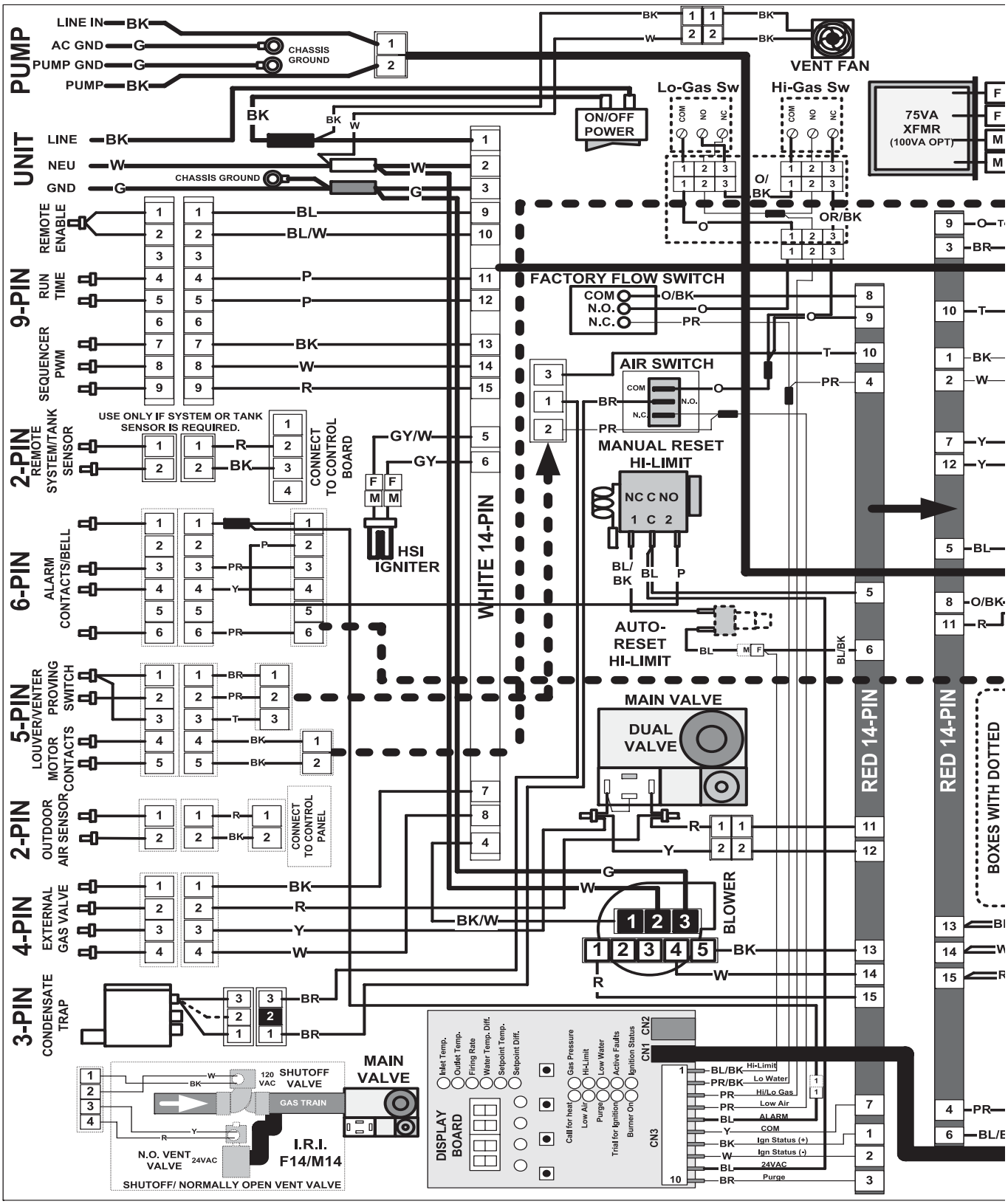
Ladder Diagram - F9 Unit
500,000 - 1,300,000 Btu/hr Models



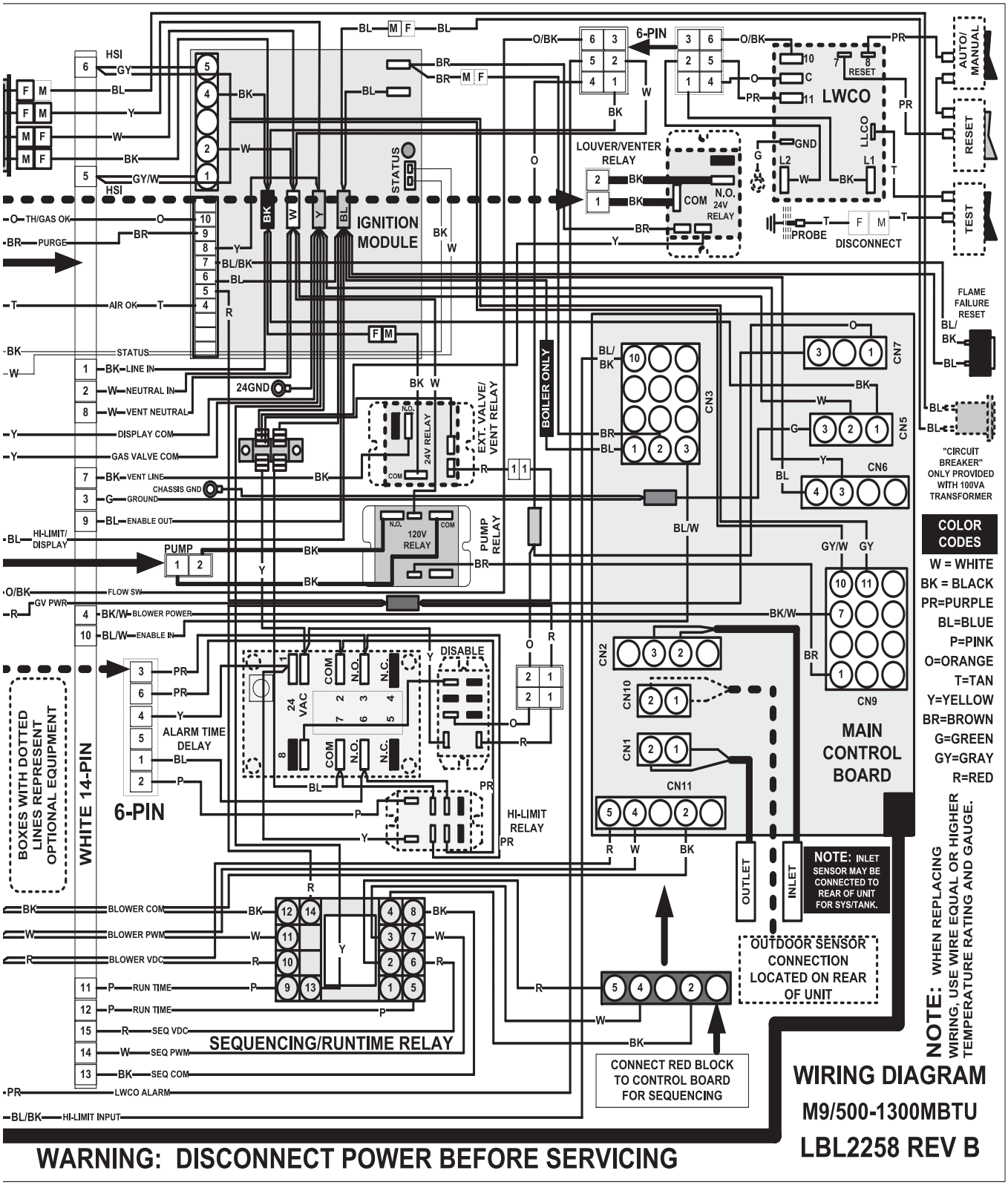
Ladder Diagram - M9 Unit
500,000 - 1,300,000 Btu/hr Models



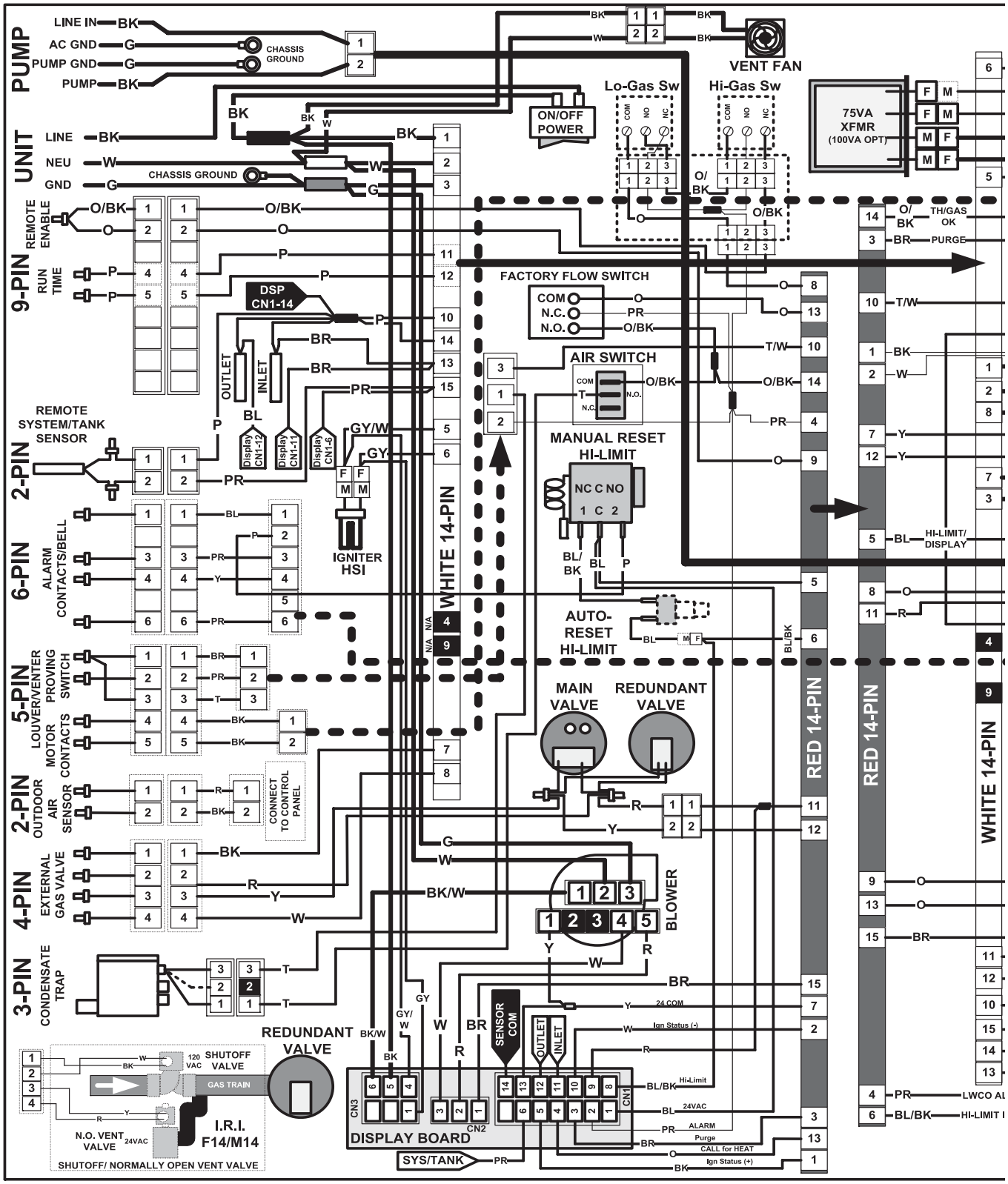
Wiring Diagram - M9 Unit
500,000 - 1,300,000 Btu/hr Models



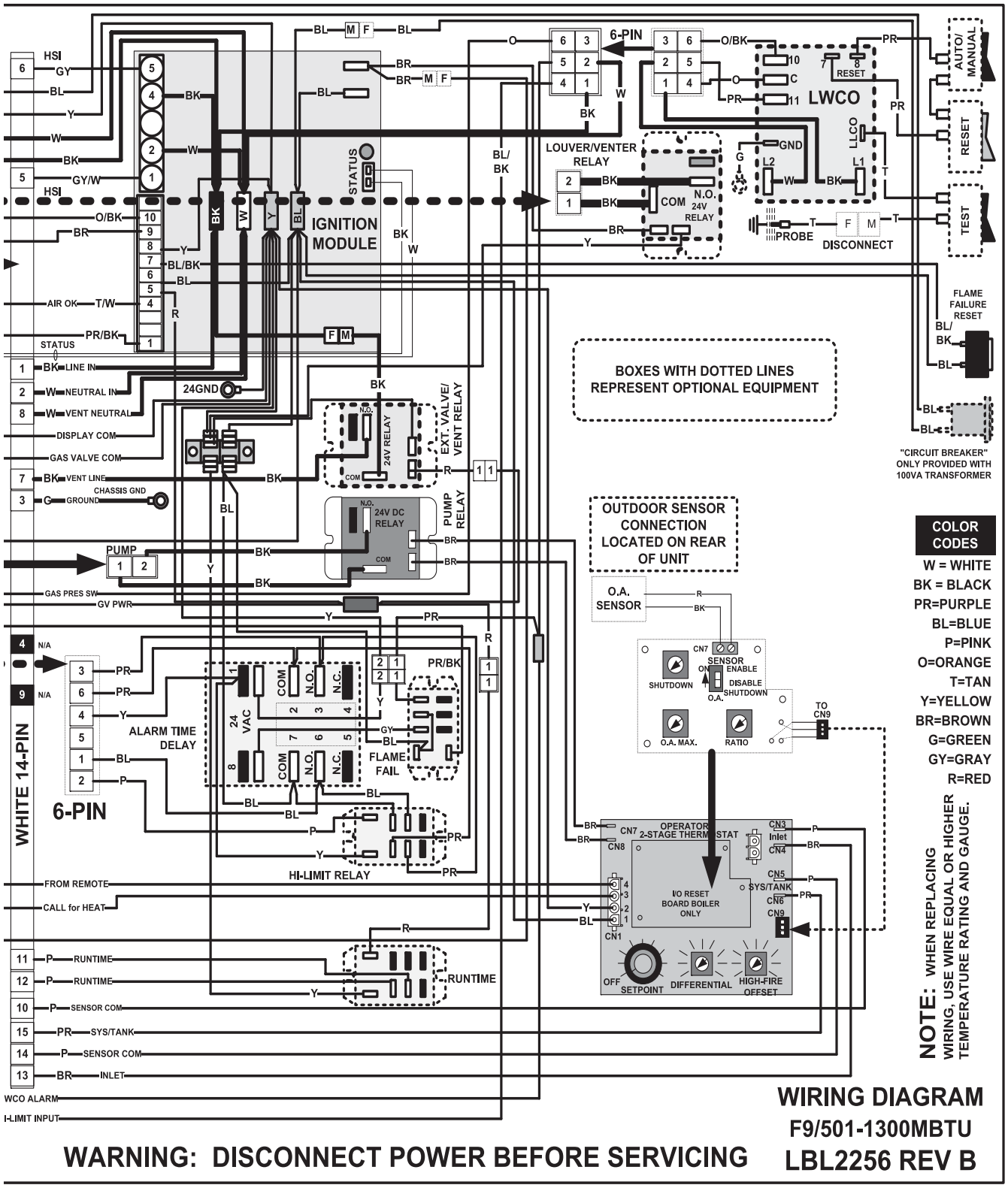
Wiring Diagram - M9 Unit
500,000 - 1,300,000 Btu/hr Models
(Continued)



Wiring Diagram - F9 Unit
500,000 - 1,300,000 Btu/hr Models



Wiring Diagram - F9 Unit
500,000 - 1,300,000 Btu/hr Models
(Continued)



WARNING: DISCONNECT POWER BEFORE SERVICING

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