INSTALLATION AND SERVICE MANUAL

Hot Water Heating Boilers
Domestic Hot Water Supply Boilers
300,000 and 990,000 — 2,070,000 • BTU Models

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

WARRANTY

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 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 the carrier.

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.

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

— 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.

CAUTION !!

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.

Your conventionally vented gas appliance 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 unit, 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 unit.

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 Z223.1and/or CNA/CGA-B149 Installation Code. 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, in Canada, the installation must comply with the CSA International CNA/CGA-B149 Installation Code and/or local codes.

INSTALLATION PROCEDURE

Front & Rear View
300,000 Btu/hr Models

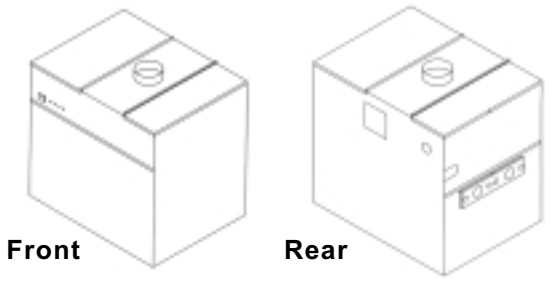


FIG. 1

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.

LOCATION OF UNIT

Front & Rear View
990,000 — 2,070,000 Btu/hr Models

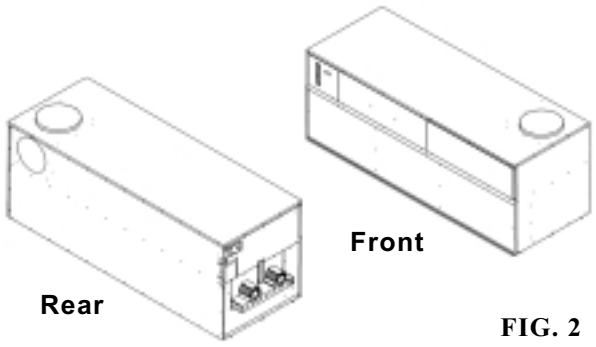


FIG. 2

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 air flow. Under no circumstances is the manufacturer to be held responsible for waterdamage in connection with this unit, or any of its components.

2. The indoor units must be installed so that the ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)

3. Units located in a residential garage shall be installed so that all burners and burner ignition devices have a minimum clearance of 18" (46cm) above the floor. The unit 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, non-combustible floor. Concrete over wood is not considered a non-combustible floor. Maintain required clearances from combustible surfaces.

5. The appliance must not be installed on carpet or other combustible material.

6. For installation on a combustible floor only when installed on the specified special base:

300,000 Btu/hr input units installed over a combustible floor **MUST** use the Special Combustible Floor Base. The unit must be centered on the base as show in FIG. 3. The correct part number for the required base is noted on the rating plate of each unit and listed below.

Special Combustible Floor Base
300,000 Btu/hr Model Only

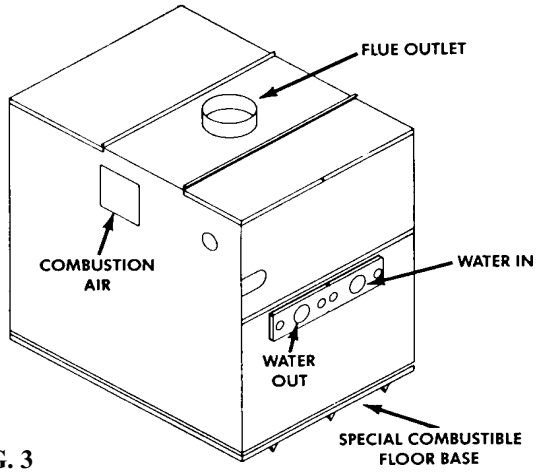


FIG. 3

TABLE — A COMBUSTIBLE FLOOR KITS	
Input Btu/hr	**Kit Number**
300,000	CFK3300

990,000 through 2,070,000 Btu/hr input units installed over a combustible floor **MUST** be provided with a base of hollow clay tile or concrete blocks from 8" to 12" thick and extending 24" beyond the sides. The blocks must be placed in line so that the holes line up horizontally to provide a clear passage through the blocks. A 1/2" fire-proof millboard with a 20 gage sheet metal cover shall be provided over the block base. The unit must be countered on the base. This procedure should also be followed if electrical conduit runs through the floor, and beneath the appliance. A field installed base must meet all local fire and safety code requirements.

7. Outdoor models require the installation of an optional vent cap. Instructions for mounting the vent cap are included in the venting section. Outdoor models must not be installed directly on the ground. The outdoor unit must be installed on a concrete, brick, block or other non-combustible pad. Outdoor models have additional special location and clearance equirements. These are specifically addressed in the venting section under outdoor installation. A windproof cabinet protects the unit from weather.

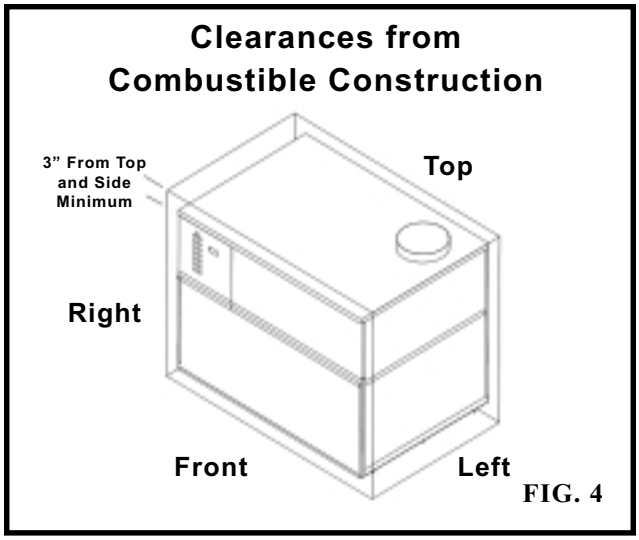


FIG. 4

Clearances from Combustible Construction:
Right Side - 3" (7.5cm)
Rear - 3" (7.5cm) (3" minimum from any surface)
Left Side - 6" (15cm) (24" (0.61m) suggested for service)
Front - ALCOVE* (30" (0.76m) suggested for service)
Top - 3" (7.5cm)
Flue - 1" (25.4mm)
Hot Water Pipes - 1" (25.4mm)
***An ALCOVE is a closet without a door.**

Maintain minimum specified clearances for adequate operation. Allow sufficient space for servicing pipe connections, pump and other auxiliary equipment, as well as the appliance. See rating plate for specific service clearance requirements.

COMBUSTION and VENTILATION AIR REQUIREMENTS FOR CONVENTIONALLY VENTED APPLIANCES and SIDEWALL VENTED APPLIANCES

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

The equipment room **MUST** be provided with properly sized openings to assure adequate combustion air and proper ventilation when the unit is installed with conventional venting or sidewall venting.

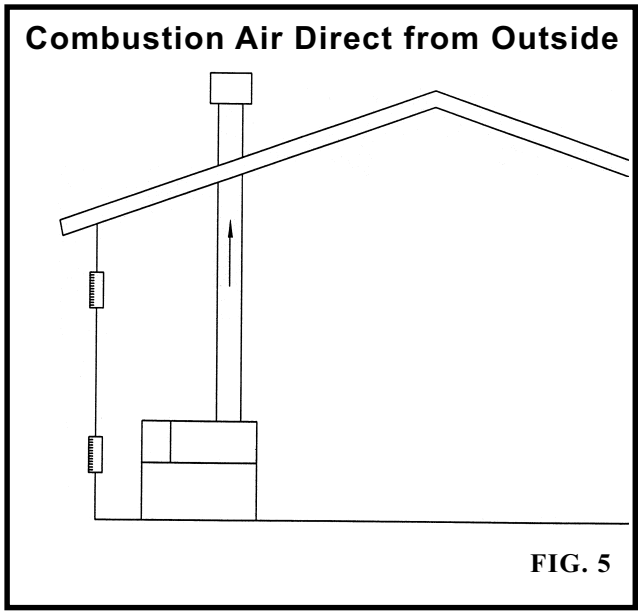


FIG. 5

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 (5.5cm^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 (5.5cm^2 per kW). This opening must be located within 12" (30cm) of the top of the enclosure.

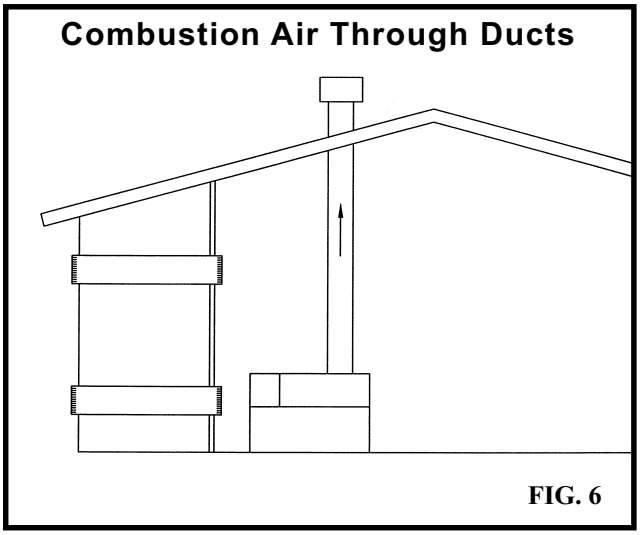


FIG. 6

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

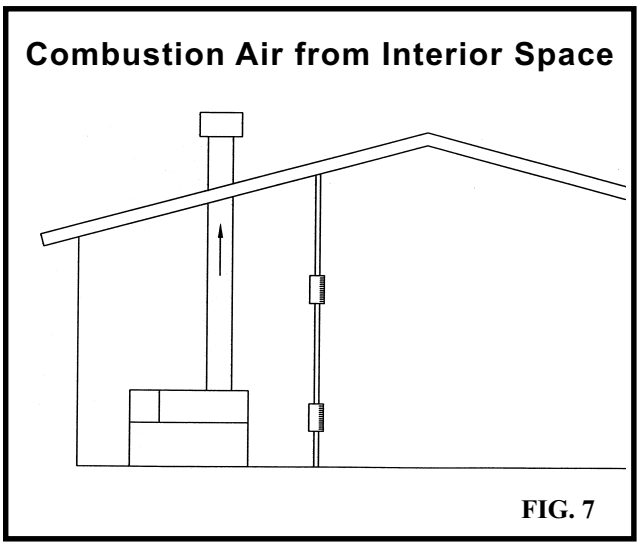


FIG. 7

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 (22cm^2 per kW) of input, but not less than 100 square inches (645 cm^2).

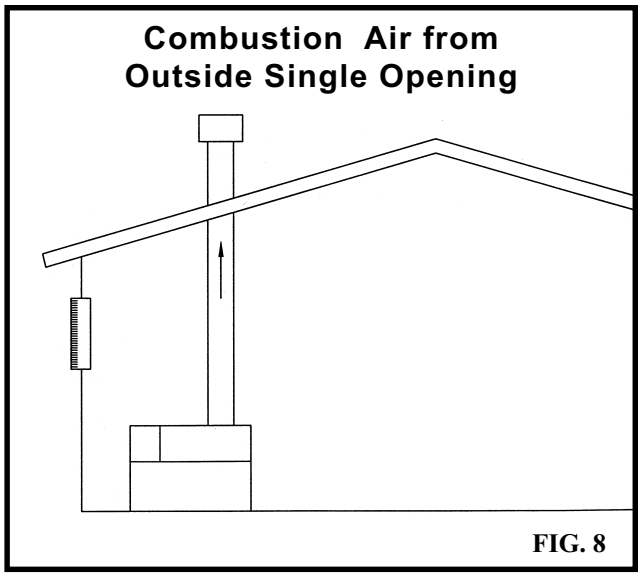


FIG. 8

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 (7cm^2 per kW). This opening must be located within 12" (30cm) of the top of the enclosure.

CAUTION !!

Under no circumstances should the equipment 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 rob air from the unit.

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" (30 cm) of the ceiling and one must be within 12" (30 cm) of the floor of the mechanical room. Each opening must have a minimum net free area as specified in Table B. Single openings shall be installed within 12" (30 cm) of the ceiling.

The combustion air supply must be completely free of any chemical fumes which may be corrosive to the boiler. Common chemical fumes which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or

TABLE — B
MINIMUM RECOMMENDED COMBUSTION AIR SUPPLY TO BOILER ROOM

	Combustion Air Source		
Boiler Input	**Outside Air*/2 Openings**	**Outside Air*/1 Opening**	**Inside Air/2 Openings**
300,000	**75 in^2 (484cm^2)**	**100 in^2 (645cm^2)**	**300 in^2 (1936cm^2)**
990,000	**248 in^2 (1600cm^2)**	**330 in^2 (2129cm^2)**	**990 in^2 (63886cm^2)**
1,260,000	**315 in^2 (2032cm^2)**	**420 in^2 (2710cm^2)**	**1260 in^2 (8130cm^2)**
1,440,000	**360 in^2 (2323cm^2)**	**480 in^2 (3097cm^2)**	**1440 in^2 (9291cm^2)**
1,800,000	**450 in^2 (2903cm^2)**	**600 in^2 (3871cm^2)**	**1800 in^2 (11,614cm^2)**
2,070,000	**518 in^2 (3342cm^2)**	**690 in^2 (4452cm^2)**	**2070 in^2 (13,356cm^2)**

* 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 boiler 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 CAN/CGA-B149 Installation Code. Check all local code requirements for combustion air.

solvents, such as Freon, trichlorethylene, perchloroethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the boiler tubes, tube sheets, flue collectors, and the boiler vent system. The result is improper combustion and a non-warrantable, premature boiler failure.

EXHAUST FANS: Any fan or equipment which exhausts air from the boiler 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 boiler room, the installer must make sure that it does not cause drafts which could lead to nuisance operational problems with the boiler.

DirectAire Vertical and **DirectAire Horizontal** venting systems have specific requirements for combustion air ducts from the outside which are directly connected to the boiler. See the requirements for this combustion air duct in the venting section for each specialized vent system.

VENTING

General

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

Conventional negative draft venting and sidewall venting applications, where outside air is used, must have adequate combustion and ventilation air supplied to the mechanical room in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA-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 latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA-B149 Installation Code for Gas Burning Appliances and Equipment.

Vent connection is made directly to the top of the unit. No additional draft diverter or barometric damper is required on single unit installations when a negative draft is maintained within the specified range. The connection from the appliance vent to the stack must be made as direct as possible.

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 SYSTEM OPTIONS

This boiler has five venting options. They are: **(1)** ***Conventional Negative Draft Venting*** with vertical rooftop flue termination and combustion air supplied from the mechanical room, **(2)** ***Sidewall Venting*** which uses a powered vent assembly to exhaust the flue products out a sidewall vent termination and combustion air supplied from the mechanical room, **(3)** ***Vertical DirectAire Venting*** with a vertical conventional vent for flue products and a combustion air pipe from either the sidewall or roof top, **(4)** ***Horizontal DirectAire Venting*** with a powered vent assembly to exhaust the flue products out a sidewall and a combustion air pipe from the sidewall, **(5)** ***Outdoor Installation*** with the installation of a special air inlet/vent cap on top of the unit. All boilers are shipped from the factory equipped for conventional negative draft venting. 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 venting system, components used and part numbers of vent kits for each model.

Conventional Negative Draft Vertical Venting with Combustion Air Louvers

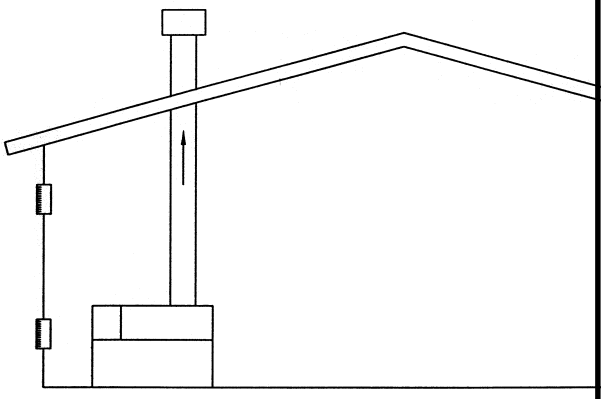


FIG. 9

A CONVENTIONAL NEGATIVE DRAFT VENTING SYSTEM

Conventional Venting

The negative draft in a conventional vent installation must be within the range of a negative 0.02 to 0.08 inches water to insure proper operation. All draft readings are made while unit is in stable operation (approximately 2 to 5 minutes).

Vent connection is made directly to the top of the unit. No additional draft diverter or barometric damper is required on single unit installations with a dedicated stack and a negative draft within the specified range of a negative 0.02 to 0.08 inches water. If the draft in a dedicated stack for a single unit installation exceeds the maximum specified draft, a barometric damper must be installed to control draft. Multiple unit installations with combined venting or common venting with other Category I negative draft appliances require that each boiler must have a barometric damper installed to regulate draft within the proper range.

The flue pipe sizes are:

TABLE — C

Input Btu/hr	Flue Size
300,000	5”
990,000	10”
1,260,000	12”
1,440,000	12”
1,800,000	14”
2,070,000	14”

On a conventionally vented, negative draft unit, the connection from the vent to the stack or vent termination outside the building **MUST** be made with listed Type “B” double wall (or equivalent) vent connectors and must be direct as possible with no reduction in diameter. Use the National Fuel Gas Code venting tables for double wall vent to properly size all vent connectors and stacks. The Type “B” vent and accessories, such as firestop spacers, thimbles, caps, etc., **MUST** be installed in accordance with the manufacturers instructions. The vent connector and firestop must provide correct spacing to combustible surfaces and seal to the vent connector on the upper and lower sides of each floor or ceiling through which the vent connector passes.

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

Locate units as close as possible to chimney or gas vent.

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 must slope upwards not less than 1/4”

per foot (21 mm/m) from the appliance to the vent terminal. Follow manufacturers instructions.

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

The weight of the venting system must not rest on the unit. Adequate support of the venting system must be provided in compliance with local codes and other applicable codes. All connections should be secured with rustproof sheet metal screws.

Vent connectors serving appliances vented by natural draft shall not be connected to any portion of a mechanical draft system operating under positive pressure. Connection to a positive pressure stack may cause flue products to be discharged into the living space causing serious health injury.

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 not blockage or restriction, leakage, corrosion and other unsafe conditions.

(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. Adjust thermostat so appliance will operate continuously.

(e) Test for spillage at the draft hood/relief opening after 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 CAN/CGA-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 Part II of the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA-B149 Installation Code for Gas Burning Appliances and Equipment.

VERTICAL VENTING TERMINATION

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.

Vent Termination from Peaked Roof 10' or Less from Ridge

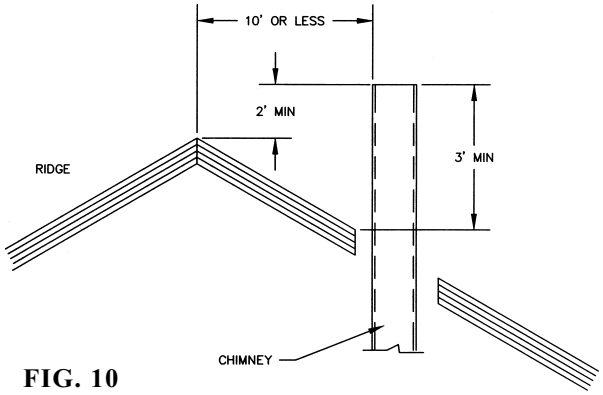


FIG. 10

Vent Termination from Peaked Roof More Than 10' from Ridge

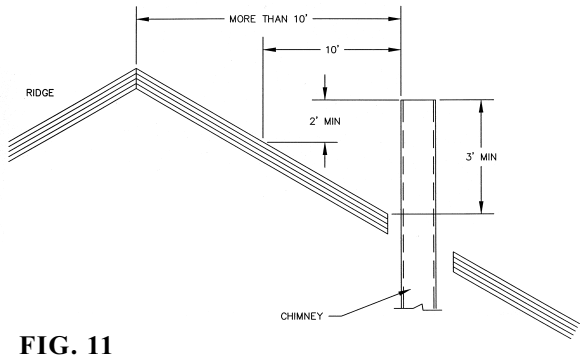


FIG. 11

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.

Vent Termination from Flat Roof 10' or Less from Parapet Wall

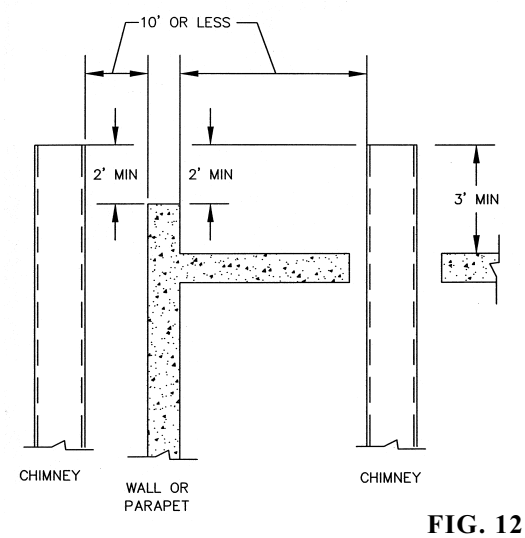


FIG. 12

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

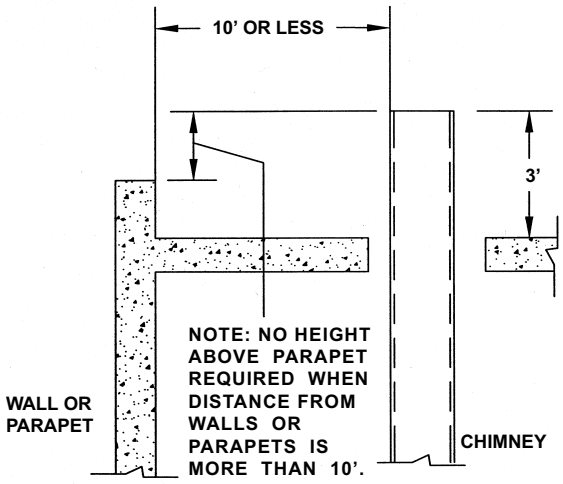


FIG. 13

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 can not terminate below grade.** The bottom of the vent terminal shall be located at least 12 inches (30cm) above grade.

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

Flue gases 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.

MASONRY CHIMNEY INSTALLATION

A masonry chimney must be properly sized for the installation of a high efficiency gas fired appliance. Venting of a high efficiency appliance into a cold or oversized masonry chimney can result in operational and safety problems. Exterior masonry chimneys, with one or more sides exposed to cold outdoor temperatures, are more likely to have venting problems. The temperature of the flue products from a high efficiency appliance may not be able to sufficiently heat the masonry structure of the chimney to generate proper draft. This will result in condensing of flue products, damage the masonry flue/tile, insufficient draft and possible spillage of flue products into an occupied living space. Carefully inspect all chimney systems before installation. If there is any doubt about the sizing or condition of a masonry chimney, it must be relined with a properly sized and approved chimney liner system.

Inspection of a Masonry Chimney

A masonry chimney must be carefully inspected to determine its suitability for the venting of flue products. A clay tile lined chimney must be structurally sound, straight and free of misaligned tile, gaps between liner sections, missing sections of liner or any signs of condensate drainage at the breeching or clean out. If there is any doubt about the condition of a masonry chimney, it must be relined. **An unlined masonry chimney must not be used** to vent flue products from this high efficiency appliance. An unlined chimney must be relined with an approved chimney liner system when a new appliance is being attached to it. Metallic liner systems (Type "B" double-wall or flexible or rigid metallic liners) are recommended. Consult with local code officials to determine code requirements or the advisability of using or relining a masonry chimney.

SIDEWALL VENTING WITH A POWERED VENT CAP

The Sidewall Venting System

This venting system uses a powered vent assembly which pulls the flue products out of the stack. This fan generates a negative draft at the unit. Combustion air is drawn from the mechanical room (see Combustion and Ventilation Air Requirements).

Sidewall Venting Installation with Powered Vent Cap

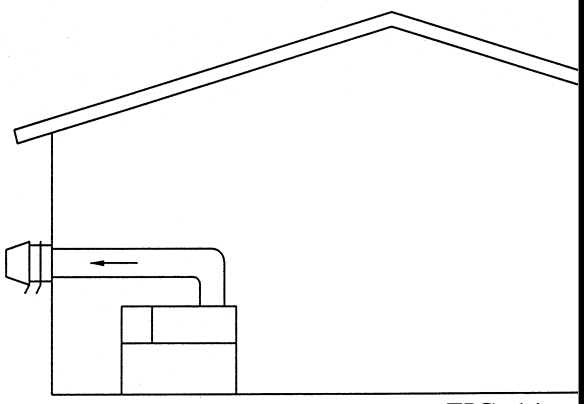


FIG. 14

300,000 Btu/hr Models

The sidewall fan is mounted in a vent cap which is installed on an exterior wall. The sidewall fan and accessories are included in a venting kit which must be furnished by the manufacturer in accordance with CSA International requirements. This venting kit includes the sidewall fan/cap, proving switch and all necessary relays to interlock with the heaters control system. The internal damper on the sidewall fan must be adjusted to supply a negative draft within the range of 0.04 to 0.08 inches water negative while unit is operating.

The maximum total equivalent length of the sidewall vent pipe cannot exceed 50 equivalent feet (15.24m). Subtract 5 feet (1.52m) for each elbow in the vent. Do not exceed the limit for total equivalent vent pipe length.

Sidewall Venting Installation with and Induced Draft Fan and Sidewall Vent

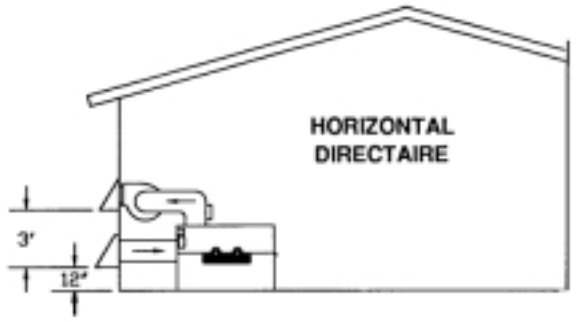


FIG. 15

990,000 through 2,070,000 Btu/hr Models

The sidewall fan is mounted on the inside with a with a sidewall vent hood installed on the exterior wall. The sidewall fan and accessories are included in a venting kit which must furnished by the manufacturer in accordance with CSA International requirements. The venting kit includes the sidewall fan, vent hood, tapered vent adaptor, barometric damper, proving switch and all necessary relays to interlock with the heaters control system. The tapered vent adaptor reduces the vent size at the inlet to the fan. There should be no reduction in vent diameter from the unit's flue outlet to the sidewall fan. The barometric damper must be installed on the flue and adjusted to supply a negative draft within the range of 0.04 to 0.08 inches water negative while unit is operating.

The maximum total equivalent length of the sidewall vent pipe cannot exceed 100 equivalent feet (30.48m). Subtract 5 feet (1.52m) for each elbow in the vent. Do not exceed the limit for total equivalent vent pipe length.

Sidewall Vent Cap

The sidewall vent cap must be installed on an exterior sidewall. The sidewall fan/powered sidewall vent cap and accessories are included in a venting kit which must be furnished by the manufacturer in accordance with CSA International requirements. This venting kit includes the powered sidewall fan/cap, proving switch and all necessary relays to interlock with the heaters control system.

The sidewall fan/powered vent cap **MUST** be interlocked with the units control system to start the fan on a call for heat and prove fan operation before the boiler fires. Plug-in and terminal strip connections are provided on the unit for easy connection of the factory supplied vent kit and control package for the sidewall vent fan. See the installation instructions provided with the vent kit.

Sidewall Vent Pipe Requirements

The connection from the vent to the powered sidewall fan/cap **MUST** be made with listed Type "B" double wall (or equivalent) vent and accessories. There shall be no reduction in vent size from the boiler's flue outlet to the inlet of the sidewall vent fan. Vent pipe material must be supplied by the installer.

Follow all requirements in the General Venting and Sidewall Vent Terminations sections for venting flue products to the outdoors. See the Combustion and Ventilation Air Requirements section to insure that adequate combustion and ventilation air is supplied to the mechanical room. All other general installation requirements must be followed.

Sidewall Vent Termination

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

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

Do not terminate the sidewall vent in a window well, stairwell, alcove courtyard or other recessed area, The (0.30m) above grade.

The sidewall vent system shall terminate at least 1 foot (0.30m) above normal snow levels and at least 7 feet (2.13m) above grade when located adjacent to public walkways. The sidewall vent shall not terminate directly above a public walkway.

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

The sidewall 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.

Sidewall Vent Kits

The Sidewall Vent Kit **MUST** be ordered from the boiler manufacturer. The part number for each kit is listed by unit size. Each kit includes a powered sidewall fan/ cap assembly, control relay, proving switch and instructions for proper installation.

TABLE — D

Input Btu/hr	Flue Size	Sidewall Vent Cap Kit
300,000	5"	SVK3005
990,000	10"	SVK3009
1,260,000	12"	SVK3010
1,440,000	12"	SVK3010
1,800,000	14”	SVK3012
2,070,000	14”	SVK3012

CAUTION !!

Boilers which are shut down or will not operate may experience freezing due to convective air flow in flue pipe or from negative pressure in the mechanical room. In cold climates, continuous pump operation is recommended to help prevent freezing of boiler water. Proper freeze protection must be provided. See Freeze Protection.

A CONVENTIONAL VERTICAL NEGATIVE DRAFT VENTING SYSTEM WITH A COMBUSTION AIR PIPE FROM A SIDEWALL OR ROOF TOP INLET CAP

The Vertical DirectAire™ Vent System:

Follow all requirements in the General Venting section and Conventional Negative Draft Venting for venting flue products to the outdoors and general installation instructions in the Installation and Service Manual.

The ***Vertical DirectAire*** vent system requires the installation of two vent pipes directly to the unit, one vertical pipe with a roof top termination for the flue products and one pipe for combustion air. The combustion air pipe may terminate horizontally with a sidewall air inlet or vertically with a roof top air inlet. Vent connection is made directly to the top of the unit. No additional draft diverter or barometric damper is required on single unit installations with a dedicated stack and a negative draft maintained between 0.02 to 0.08 inches water. The flue may be combined with the vent from any other negative draft, Category I appliances. Multiple unit installations common vented with other negative draft appliances require that each boiler must have a barometric damper installed to regulate draft within the proper range. The common vent and connectors from multiple boilers must be sized per the requirements of the venting tables for Type “B” double wall vents in the latest edition of the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA-B149 Installation Code.

The sidewall or vertical roof top ***DirectAire*** combustion air supply system has specific vent material and installation requirements. The air inlet pipe connects directly to the boiler to supply combustion air. In most installations, the combustion air inlet pipe will be a dedicated system with one air inlet pipe per boiler. Multiple air inlets may be combined if the guidelines in “Combined Air Inlet Points” are followed. The air inlet pipe will be connected to a combustion air inlet cap as specified in this section.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air of the Installation and Service Manual).

Vertical DirectAire™ Installation with Sidewall Combustion Air

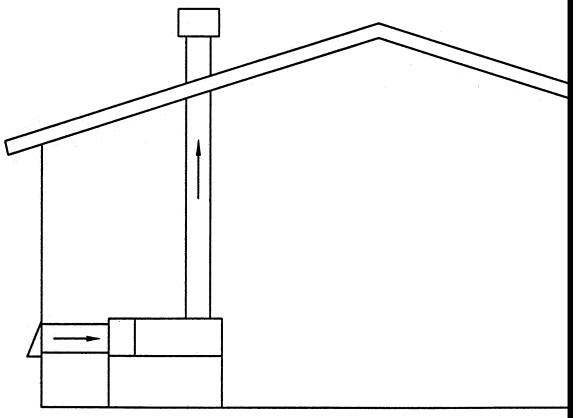


FIG. 16

Vertical DirectAire™ Installation with Roof Top Combustion Air

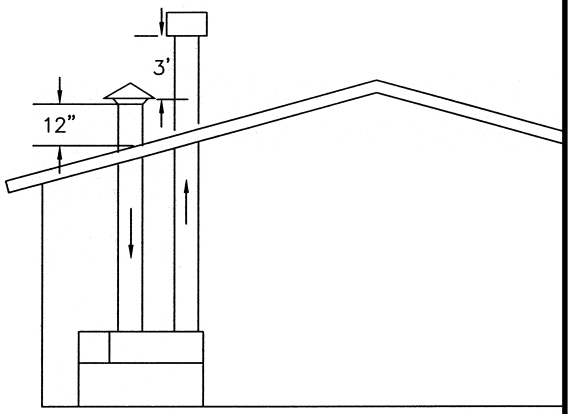


FIG. 18

Sidewall Air Inlet

The sidewall air inlet cap is supplied in the ***Vertical DirectAire*** Sidewall Air Kit which must be ordered from the manufacturer. This sidewall cap will supply combustion air for a single boiler only.

Air Inlet Cap for Sidewall Termination

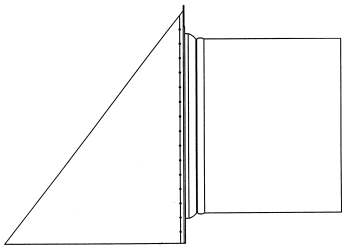


FIG. 17

Locate boiler as close as possible to sidewall where the combustion air supply system will be installed.

To prevent recirculation of flue products from an adjacent vent cap into the combustion air inlet, follow all applicable clearance requirements in the latest edition of the National Fuel Gas Code and/or CAN/CGA-B149 Installation Code and instructions in this manual.

The combustion air inlet cap must be installed at least one foot (0.30m) above ground level and above normal snow levels.

Vertical Roof Top Air Inlet

The air inlet cap for the vertical roof top air inlet is supplied in the ***Vertical DirectAire*** Roof Top Air Kit which must be ordered from the manufacturer. This roof top cap will supply combustion air for a single boiler only.

Air Inlet Cap for Roof Top Termination

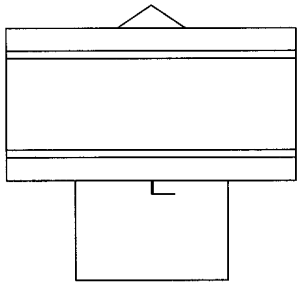


FIG. 19

The point of termination for the combustion air inlet cap **MUST** be at least 3 feet (0.91m) below the point of flue gas termination (vent cap) if it is located within 10' (3.05m) of the flue outlet.

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

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

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

Combined Air Inlet Points

The air inlet pipes from multiple boilers 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 10" air inlet pipes (78.5 in^2 area each) have a total area of 157 in^2 and will require a 15"(176.7 in^2 area) 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 (15.25m) equivalent feet. Subtract 5 feet (1.52m) for each elbow in the air inlet pipe. You must deduct the restriction in area provided by any screens, grills or louvers installed in the common air inlet point. These are common on the sidewall air inlet openings. 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.

Air Inlet Pipe Materials

The ***Vertical DirectAire*** system requires installation of a single wall pipe to supply combustion air from outdoors directly to the unit.

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

Length of Air Inlet Pipe

The total equivalent length of the sidewall or vertical roof top ***DirectAire*** combustion air inlet pipe must not exceed a maximum of 50 (15.24m) equivalent feet in length. Subtract 5 feet (1.52m) for each elbow in the air intake system. Do not exceed limits for the combustion air inlet piping length.

Vent Kits

The ***Vertical DirectAire Vent Kit*** for sidewall or roof top air inlet **MUST** be ordered from the boiler manufacturer for single unit installations. The part number for each kit is listed by unit size. Each kit includes either a sidewall or roof top combustion air inlet cap to supply air to a single boiler and instructions for proper installation. The flue pipe and roof top vent cap for the flue and air inlet pipe are purchased locally. **You must specify if the air inlet cap is for a vertical roof top termination or a sidewall termination.** The air inlet cap for the combined air supply from multiple boilers must be purchased locally.

The air inlet cap supplied in the ***Vertical DirectAire Vent Kit*** is used to supply combustion air to a single boiler. The roof top vent cap for flue products should be a standard commercial cap purchased locally. The use of a sidewall or roof top air inlet cap other than the manufacturers recommended cap for single boiler installations or use of a common air inlet cap for multiple boilers with insufficient free area and/or protection from wind and weather may result in

TABLE — E

Input Btu/hr	Conventional Vent Flue Size	Air Inlet Pipe*	Sidewall Air Inlet Kit	Rooftop Air Inlet Kit
300,000	5"	5"	SVK3005	VDK3005
990,000	10"	10"	SVK3013	VDK3009
1,260,000	12"	12"	SVK3014	VDK3008
1,440,000	12"	12"	SVK3014	VDK3008
1,800,000	14"	12"	SVK3014	VDK3012
2,070,000	14"	12"	SVK3014	VDK3012

* Minimum diameter, installer may increase diameter one pipe size for ease of installation if needed. A 6" diameter air inlet cap may be ordered for rooftop air inlet as ***Rooftop Air Inlet Kit*** VDK3006.

operational problems with the boiler or potentially hazardous spillage of flue products which can cause personal injury, death or property damage.

Venting of Flue Products

For venting flue products vertically to the outdoors, follow all requirements in the installation instructions for conventional venting in the Installation and Service Manual.

Termination point for the flue products must follow the clearance requirements in the Vertical Vent Termination section of Conventional Venting in the Installation and Service Manual.

A barometric damper is **NOT** required in the flue on ***Vertical DirectAire*** installations if the draft is within the 0.02 to 0.08 inches water negative required for proper operation. If the draft exceeds this range, a barometric damper must be installed.

CAUTION !!

Boilers which are shut down or will not operate may experience freezing due to convective air flow in the air inlet pipe connected to the unit. In cold climates, continuous pump operation is recommended to help prevent freezing of boiler water on DirectAire systems.

Proper freeze protection must be provided. See Freeze Protection in the Installation and Service Manual.

Horizontal DirectAire Installation

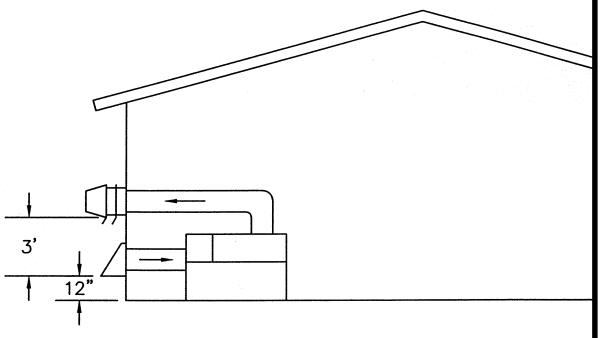


FIG. 20

HORIZONTAL DIRECTAIRE™ WITH A SIDEWALL FLUE AND SIDEWALL AIR INLET

The Horizontal DirectAire Vent System

Follow all requirements in the General Venting section and Sidewall Venting for venting flue products to the outdoors and general installation instructions.

The ***Horizontal DirectAire*** vent system requires the installation of two vent pipes directly to the unit, one pipe for flue products and one for combustion air. Both vent pipes are installed horizontally with a sidewall termination point. Vent connection is made directly to the top of the unit. No additional draft diverter or barometric damper is required on single unit installations with a dedicated stack and a negative draft maintained between 0.04 to 0.08 inches water.

The ***Horizontal DirectAire*** combustion air supply system has specific vent material and installation requirements. The air inlet pipe connects directly to the boiler to supply combustion air. The combustion air inlet pipe will be a dedicated system with one air inlet pipe per boiler. The air inlet pipe must be connected to a combustion air inlet cap as specified in this section. Combustion air supply pipes for multiple boiler installations can **NOT** be combined into a single pipe and inlet termination point.

Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air).

Air Inlet Cap for Sidewall Termination

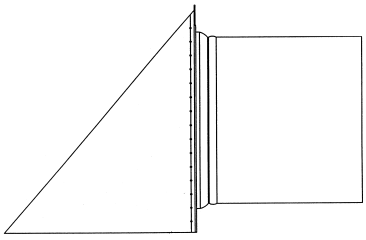


FIG. 21

Sidewall Air Inlet

The sidewall air inlet cap is supplied in the ***Horizontal DirectAire Vent Kit*** which must be ordered from the manufacturer. This sidewall cap will supply combustion air for a single unit only.

Locate units as close as possible to sidewall where the combustion air supply system will be installed.

To prevent recirculation of flue products from an adjacent vent cap into the combustion air inlet, follow all applicable clearance requirements in the latest edition of the National Fuel Gas Code and/or CAN/CGA-B149 Installation Code and instructions in this manual.

The combustion air inlet cap must be installed at least one foot (0.30m) above ground level and above normal snow levels.

The point of termination for the combustion air inlet cap **MUST** be at least 3 feet (0.91m) below the point of flue gas termination (powered vent cap) if it is located within 10' (3.05m) of the flue outlet from the powered vent cap. Use care to insure that the air inlet cap assembly is properly installed on the air inlet pipe.

The combustion air inlet cap and the powered vent cap **MUST** be installed on the same wall and in the same pressure zone.

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

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

Air Inlet Pipe Materials

The ***Horizontal DirectAire*** system requires installation of a single wall pipe to supply combustion air from outdoors directly to the boiler.

NOTE: **The use of double wall vent material for the combustion air inlet pipe is recommended in cold climates to prevent the condensation of airborne mositure in the incoming combustion air.**

Length of Air Inlet Pipe

The total equivalent length of the ***Horizontal DirectAire*** combustion air inlet pipe must not exceed a maximum of 50 (15.24m) equivalent feet in length. Subtract 5 feet (1.52m) for each elbow in the air intake system. Do not exceed limits for the combustion air inlet piping lengths.

Vent Kits

The ***Horizontal DirectAire Vent Kit*** for sidewall installation **MUST** be ordered from the boiler manufacturer. The part number for each kit is listed by unit size. Each kit includes a sidewall powered vent cap, proving switch, controls, combustion air inlet cap to supply air to a single boiler and instructions for proper installation. The flue pipe and air inlet pipe are purchased locally.

TABLE — F

Input Btu/hr	Flue Size	DiectAire Inlet Pipe*	Horizontal DirectAire Kit
300,000	5"	5"	HDK3005
990,000	10"	10"	HDK3009
1,260,000	12"	12"	HDK3010
1,440,000	12"	12"	HDK3010
1,800,000	14”	12”	HDK3012
2,070,000	14”	12”	HDK3012

*Minimum diameter, installer may increase diameter one pipe size for ease of installation if needed.

The sidewall air inlet cap supplied in the ***Horizontal DirectAire Vent*** Kit is used to supply combustion air to a single boiler. Combustion air supply pipes from multiple units can **NOT** be combined into a single air inlet pipe and inlet point. The use of a sidewall air inlet cap other than the manufacturers recommended cap may result in operational problems with the boiler or potentially hazardous spillage of flue products which can cause personal injury, death or property damage.

Venting of Flue Products

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 Sidewall Venting.

A barometric damper is **NOT** required in the flue on ***Horizontal DirectAire*** installations if the draft is within the 0.02 to 0.08 inches water negative required for proper operation. If the draft exceeds this range, a barometric damper must be installed.

CAUTION !!

Boilers which are shut down or will not operate may experience freezing due to convective air flow in the air inlet pipe connected to the unit. In cold climates, continuous pump operation is recommended to help prevent freezing of boiler water on Horizontal DirectAire systems. Proper freeze protection must be provided. See Freeze Protection.

Outdoor Installation

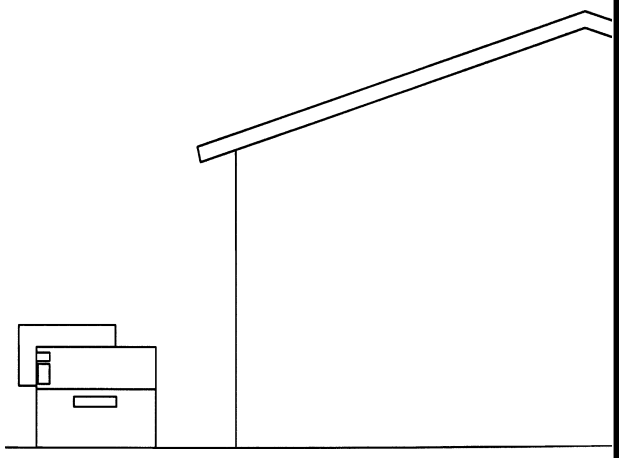


FIG. 22

OUTDOOR INSTALLATION

The Outdoor Vent System

Units are self venting and can be used outdoors when installed with the optional Outdoor Cap. This cap mounts directly to the top of the boiler and covers the flue outlet and combustion air inlet openings on the jacket. No additional vent piping is required.

WARNING: **Outdoor models MUST be installed outdoors and MUST use the vent cap supplied by the manufacturer. Personal injury or product damage may result if any other cap is used or if an outdoor model is used indoors. All covers, doors and jacket panels must be properly installed to insure proper operation and prevent a hazardous condition.**

CAUTION !!

Boilers which are shut down or will not operate may experience freezing due to convective air flow in the outdoor vent cap installed on the unit. In cold climates, continuous pump operation is recommended to help prevent freezing of boiler water on Outdoor systems. Proper freeze protection must be provided. See Freeze Protection.

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

Outdoor Vent/Air Inlet Location

The venting areas must never be obstructed. Keep area clean and free of combustible and flammable materials. Maintain a minimum clearance of 3"(76 mm) to combustible surfaces and a minimum of 3" (76 mm) clearance to the air inlet. To avoid a blocked air inlet or blocked flue condition, keep the outdoor cap air inlet, flue outlet and drain slot clear of snow, ice, leaves debris, etc.

A unit should not be located so that high winds can deflect off of adjacent walls, buildings or shrubbery causing recirculation. Recirculation of flue products may cause operational problems, bad combustion or damage to controls. The unit should be located at least 3 feet (0.19m) from any wall or vertical surface to prevent adverse wind conditions from affecting performance.

Multiple unit outdoor installations require 48" (1.22m) clearance between each vent cap.

The outdoor cap must be located 4 feet (1.22m) below and 4 feet (1.22m) horizontally from any window, door, walkway or gravity air intake.

The combustion air inlet of the outdoor cap must be located at least one foot (0.30m) above grade and above normal snow levels.

The unit must be at least 10 feet (3.05m) away from any forced air inlet.

The unit must be at least 3 feet (0.91m) outside any overhang.

Clearances around outdoor installations can change with time. Do not allow the growth of trees, shrubs or other plants to obstruct the proper operation of the outdoor vent system.

Do not install in locations where rain from building runoff drains will spill onto the boiler.

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 or unit surfaces can be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

Outdoor Vent Cap

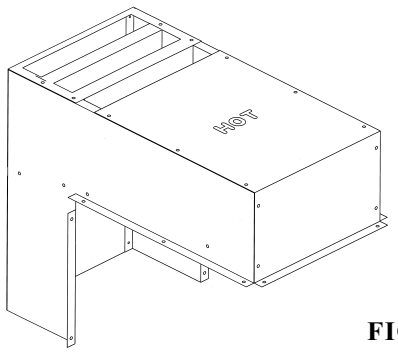


FIG. 23

Outdoor Vent Cap Installed on Unit

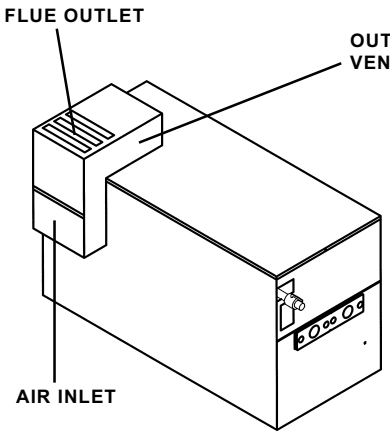


FIG. 24

The Outdoor Vent Cap Kit

The required outdoor cap part numbers are listed by unit size. The venting kit must be furnished by the manufacturer in accordance with CSA International requirements. Each kit includes the flue products outlet/combustion air inlet assembly and gasket.

TABLE — G

Input Btu/hr	Outdoor Cap Kit Number
300,000	ODK3003
990,000	ODK3009
1,260,000	ODK3010
1,440,000	ODK3010
1,800,000	ODK3011
2,070,000	ODK3011

CAUTION !!

Boilers which are shut down or will not operate may experience freezing due to convective air flow down the vent cap installed on the unit. Proper freeze protection must be provided. See Freeze Protection.

GAS SUPPLY

Verify unit is supplied with type gas specified on rating plate. This unit is orificed for operation up to 4000 feet altitude. Consult factory for installations above 4000 feet elevation. The unit will be marked to indicate suitability for high altitude operation.

INLET PRESSURE: Measured at the inlet pressure tap located upstream of the combination gas valve.

TABLE — H
SUPPLY PRESSURE

	Nat. Gas	LPG
Max. (Inches-Water Column)	10.5"w.c.	13"w.c.
Min. (Inches-Water column)	5.0"w.c.	11"w.c.

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

MANIFOLD PRESSURE: Measured at the pressure tap on the downstream side of the combination gas valve. The gas regulator on the boiler's combination gas valve is adjustable to supply proper manifold pressure for normal operation. If adjustment of regulator pressure is required, see Manifold Adjustment Procedure. **Do not increase regulator pressure beyond specified pressure setting.**

TABLE — I

Btu/hr Input	Regulator Settings Natural Gas	L.P.Gas
300,000	4.0"	10"
990,000 - 2,070,000	3.5"	10"

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** (3.5kPa).

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** (3.5kPa).

3. The boiler and its gas connection must be leak-tested before placing it in operation.

GAS CONNECTION

1. Safe operation of unit requires properly sized gas supply piping. See data below.

2. Gas pipe size may be larger than heater connection.

3. Installation of a union is suggested for ease of service.

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 unit.

6. The combination gas valve has an integral vent limiting device and does not require venting to atmosphere, outside the building. The unit will not operate properly if the reference hose is removed or a vent to atmosphere is installed.

7. Optional gas controls may require routing of bleeds and vents to the atmosphere, outside the building when required by local codes.

SINGLE UNIT INSTALLATIONS

TABLE — J
SUGGESTED GAS PIPE SIZE
SINGLE UNIT INSTALLATIONS

BTU INPUT	DISTANCE FROM METER				
	0-50'	51'-100'	101'-200'	201'-300'	301'-500'
300,000	1 1/4"	1 1/4"	1 1/2"	1 1/2"	2"
990,000	2"	2"	2 1/2"	2 1/2"	3"
1,260,000	2"	2 1/2"	2 1/2"	3"	3"
1,440,000	2"	2 1/2"	3"	3"	3 1/2"
1,800,000	2 1/2"	2 1/2"	3"	3 1/2"	4"
2,070,000	2 1/2"	3"	3"	3"	3 1/2"

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

TABLE — K
FITTINGS TO
EQUIVALENT STRAIGHT PIPE

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

TABLE — L
MULTIPLE UNIT INSTALLATIONS 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 (0.05 PSIG) or less and a pressure drop of 0.05 Inch Water Column (Based on NAT GAS, 1025•BTU's per Cubic Foot of Gas and 0.60 Specific Gravity).

GAS PIPING

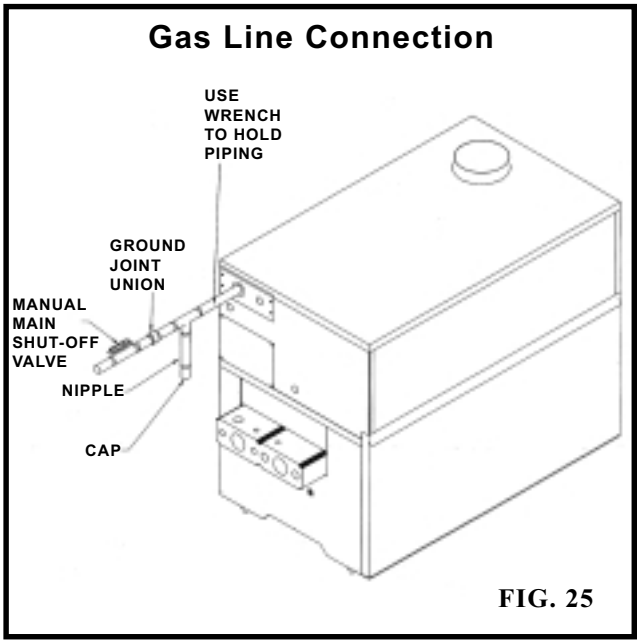


FIG. 25

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

Install Piping to Control

1. The gas line should be a separate line direct from the meter unless the existing gas line is of sufficient capacity. Verify pipe size with your gas supplier.

2. Use new, properly threaded black iron pipe free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation. Avoid flexible gas connections. Internal diameter of flexible lines may not provide unit with proper volume of gas.

3. Install a manual main gas shutoff valve at the boiler gas inlet, outside of the boiler and before the gas valve.

4. Run pipe or tubing to the boiler's gas inlet. If tubing is used, obtain a tube to pipe coupling to connect the tubing to the boiler's gas inlet.

5. Install a sediment trap in the supply line to the boiler's gas inlet. (See Figure 25)

6. Apply a moderate amount of good quality pipe compound (**DO NOT** use Teflon tape) to pipe only, leaving two end threads bare.

7. Remove seal over gas inlet to boiler.

8. Connect gas pipe to inlet of unit. Use wrench to support gas manifold on the unit.

9. For L.P. gas, consult your L.P. gas supplier for expert installation.

10. Insure that all air is properly bled from the gas line before starting the ignition sequence. Startup without properly bleeding air from the gas line may require multiple reset functions of the ignition control module to achieve proper ignition.

GAS MANIFOLD PRESSURE ADJUSTMENT PROCEDURE

IMPORTANT: **The combination gas valve has an adjustable gas regulator to control manifold pressure. A manometer or magnahelic gauge legible in 0.1" increments up to 10" water column is required to check and adjust the manifold pressure. The regulator cover screw on the gas valve must be in place and tight for the appliance to operate properly.**

1. Turn the power switch to the "OFF" position.

2. Remove the top front jacket panels.

3. Turn gas valve knob(s) and manual gas cock to "OFF" position.

Manifold Gas Pressure Measurement 300,000 Btu/hr Model

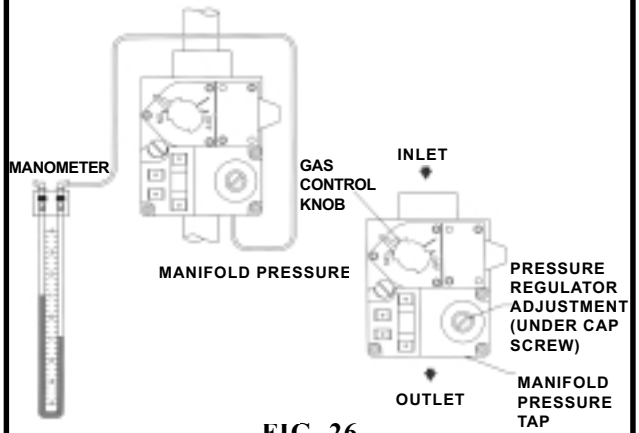


FIG. 26

Manifold Gas Pressure Measurement 990,000 — 2,070,000 Btu/hr Models

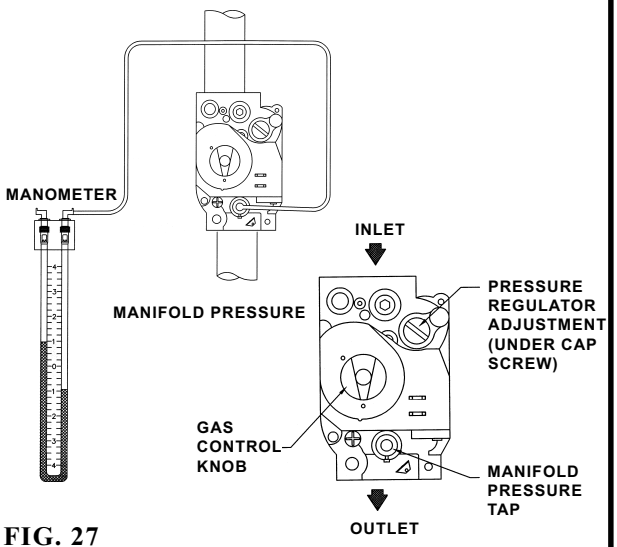


FIG. 27

4. Remove the "hex plug, located on manifold piping to burners (300,000 Btu/hr models) or on the "outlet" side of the gas valve (990,000-2,070,000 Btu/hr models) and install a fitting suitable to connect to a manometer or magnahelic gauge. See Figure 26 and 27. Minimum range of scale should be up to 5A" w.c. for natural gas and 10**"** w.c. for propane gas.

5. Remove pressure regulator adjustment cap screw. See Figure 35 and 36 for location.

6. Turn the power switch to "ON" position.

7. Turn gas valve knob(s) and manual gas cock to "ON" position.

8. Set the thermostat(s) or electronic temperature control to call for heat.

9. Observe gas regulator pressure when burners are firing at full rate input. Models with inputs of 990,000 through 2,070,000 Btu/hr will have multiple gas valves and regulators. Each regulator must be adjusted when the individual stage is firing. See Manifold Pressure for proper setting. **Do not increase regulator pressure beyond specified pressure setting.**

10. If adjustment is necessary, turn regulator adjustment screw clockwise to raise regulator gas pressure, counter clockwise to lower gas pressure, to proper setting.

NOTE: **Adjustment fitting is plastic and may require slightly greater turning force than a metal fitting.**

11. Turn the power switch to "OFF" position.

12. Turn gas valve knob(s) and manual gas cock to "OFF" position.

13. Remove fitting from the gas valve and replace with 1/8" hex plug (that was previously removed) and tighten.

14. Turn the gas valve knob(s) and manual gas cock to "ON" position.

15. Turn the power switch to "NO" position. The appliance is now ready to operate.

If manifold pressure can not be properly adjusted, use the following procedure to check gas supply pressure with a manometer connected to the inlet pressure tap on the gas control.

CHECKING GAS SUPPLY PRESSURE

1. Turn the main power switch to the "OFF" position.

2. Turn gas valve knobs to the "OFF" position.

3. Shut off gas supply at the field installed manual gas cock in the gas piping to the appliance. If fuel supply is L.P. gas, shut off gas supply at the tank.

Gas Supply Pressure Measurement at Combination Gas Valve

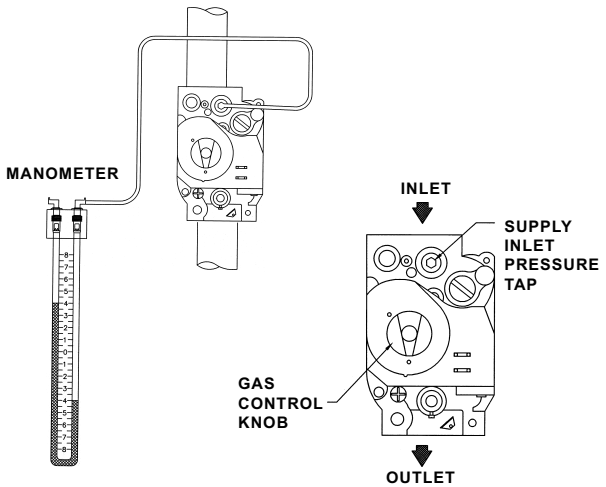


FIG. 28

4. Remove the 1/8" hex plug, located on "inlet" side of the gas valve. An inlet pressure tapping is located on the top side of the valve body, beside the gas control knob on the redundant seated combination valves. A tapping on the field installed main manual gas cock may also be used. 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.

5. Turn on gas supply at the manual gas cock, turn on L.P. gas at tank if required.

6. Turn the power switch to the "ON" position.

7. Turn the gas valve knobs to the "ON" position. Set the electronic temperature control or thermostat to call for heat.

8. Observe the gas supply pressure as all burners are firing. Insure that inlet pressure is within the specified range. Minimum and Maximum Gas Supply Pressures are specified in Gas Supply Section.

9. If gas supply pressure is out of range, contact 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 control.

11. Turn the power switch to the "OFF" position.

12. Turn gas valve knob to the "OFF" position.

13. Shut off gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is L.P. gas, shut off gas supply at the tank.

14. Remove the manometer and related fittings from "inlet" side of the gas valve, replace 1/8" hex plug in gas valve and tighten.

15. Turn on gas supply at the manual valve, turn on L.P. gas at tank if required.

16. Turn the power switch to the "ON" position.

17. Turn the gas valve knob to the "ON" position.

18. Set the electronic temperature control or thermostat to call for heat. If proper ignition and burner operation is not achieved after checking gas supply pressure and setting the correct net manifold pressure, see the Maintenance section for Combustion Air Adjustment. Follow the procedure to adjust the combustion air fan.

If proper ignition and burner operation is not achieved after checking gas supply pressure and setting the correct net manifold pressure, see the Maintenance section for Combustion Air Adjustment. Follow the procedure to adjust the combustion air fan.

IMPORTANT: Upon completion of any testing on the gas system, leak test all gas connections with a soap solution while main burners are operating. 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 piping.

Check burner performance by cycling the system while you observe burner response. Burners should ignite promptly. Flame pattern should be stable, see "Maintenance-Normal Flame Pattern." Turn system off and allow burners to cool, then cycle burners again to insure proper ignition and flame characteristics.

WATER CONNECTIONS

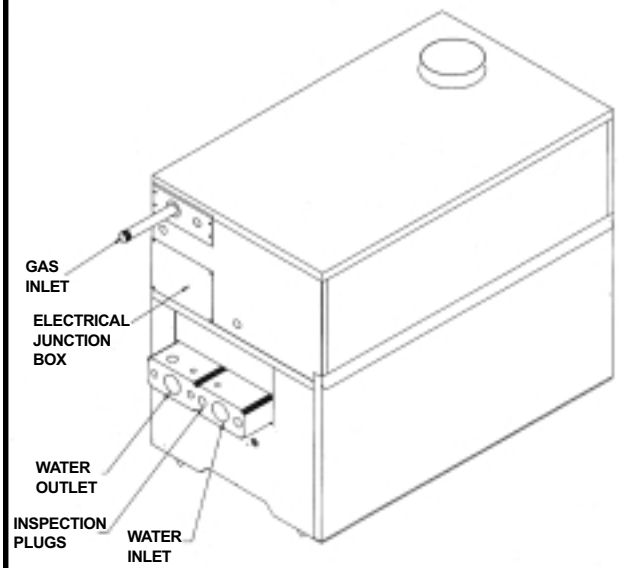


FIG. 29

Inlet and Outlet Connections

For ease of service, install unions on inlet and outlet of the unit. The connection to the unit marked "Inlet" on the header should be used for return from the system. The connection on the header marked "Outlet" is to be connected to the supply side of the system.

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.

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

WATER FLOW SWITCH (IF EQUIPPED)

A water flow switch is factory installed on the 300,000 Btu/hr and 990,000 through 2,070,000 Btu/hr heating boilers and hot water supply boiler. The flow switch is wired in series with the 24 VAC safety control circuit at the boiler's terminal strip. This wiring connection installs the flow switch in the 24 VAC safety circuit to prove water flow before main burner ignition. The factory supplied flow switch is installed in the outlet side of the front header. The 300,000 Btu/hr model requires a minimum flow of 19 GPM to make the switch and start burner operation and the 990,000 through 2,070,000 Btu/hr models require a minimum flow of 26 GPM to make the flow switch and start burner operation. Insure that the pump installed on the boiler will supply adequate flow to make the flow switch contacts and operate the boiler. A water flow switch meets most code requirements for a low-water cut off device on boilers requiring forced circulation for operation.

LOW WATER CUTOFF (IF EQUIPPED)

If this boiler is installed above radiation level, a low water cut-off device must be installed at the time of boiler installation. Electronic or float type low water cut-offs are available as a factory supplied option on all units. Low water cut-offs should be inspected every six months, including flushing of float types.

COMBINATION GAS VALVES

300,000 Btu/hr Input:

This unit has a single combination gas valve to cycle the gas supply on and off and regulate gas to the burners. The combination valve consists of a gas regulator and two valve seats to meet the requirements for redundant gas valves. The valve has a gas control knob that must remain in the open position at all times when the unit is in service. The gas control valve has pressure taps located on the inlet and discharge sides of the valve. Manifold pressure is adjusted using the regulator located on the valve.

990,000 through 2,070,000 Btu/hr Input:

These models fire in multiple stages of burner input. Each stage of burner operation has a single combination gas valve(s) to cycle the gas supply on and off and regulate gas to the burners. Each combination valve consists of a gas regulator and two valve seats to meet the requirements for redundant gas valves. The valve has a gas control knob that must remain in the open position at all times when the unit is in service. The gas control valve has pressure taps located on the inlet and discharge sides of the valve. Manifold pressure is adjusted using the regulator located on the valve. A manifold gas pressure tap for each burner stage is located on the discharge side of the valve.

The manifold pressure is preset at the factory and adjustment is not usually required. If the manifold pressure is to be adjusted, follow the "Gas Manifold Pressure Adjustment Procedure" for proper adjustment.

Venting of Combination Gas Valves

The combination gas valve/regulator used on all models is equipped with an integral vent limiting orifice per ANSI Z21.78. This vent limiter insures that the volume of gas emitted from the valve does not exceed the maximum safe leakage rate allowed by agency requirements. Combination gas valve/regulators equipped with integral vent limiters are not required to have vent or relief lines piped to the outdoors. The termination of the vent limited opening on the combination gas valve/regulator complies with the safety code requirements of CSD-1, CF-190 (a) as shipped from the manufacturer without the installation of additional vent lines.

ELECTRICAL CONNECTIONS

This appliance is wired for 120 VAC service. The unit, 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 unit and field installed devices shall be made with type T wire [63^{o} F (35^{o} C) rise].

2. Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.

3. The pump must run continuously when unit is being fired (hot water heating boilers or hot water supply boilers must use the optional pump delay or intermittent pump controller if the pump is to be cycled. See Freeze Protection when cycling the pump).

4. To avoid serious damage, DO NOT energize the boiler until the system is full of water. Serious damage may result.

5. Provide the boiler with proper overload protection.

TABLE — M AMP DRAW DATA 300,000 through 2,070,000 Btu/hr Models			
Btu / hr Input	Fan	Controls	Approximate Total AMPS @ 120 VAC
300,000	3.6	2.6	6.2
990,000	7.2	7.2	14.4
1,260,000	7.2	7.2	14.4
1,440,000	7.2	7.2	14.4
1,800,000	10.8	7.2	18.0
2,070,000	10.8	7.2	18.0

manual reset function is available. A small red reset button, located beside the knob, must be pushed whenever water temperature has exceeded the set point of the manual reset limit.

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

Component Location Drawing of Control Panel
300,000 Btu/hr Model

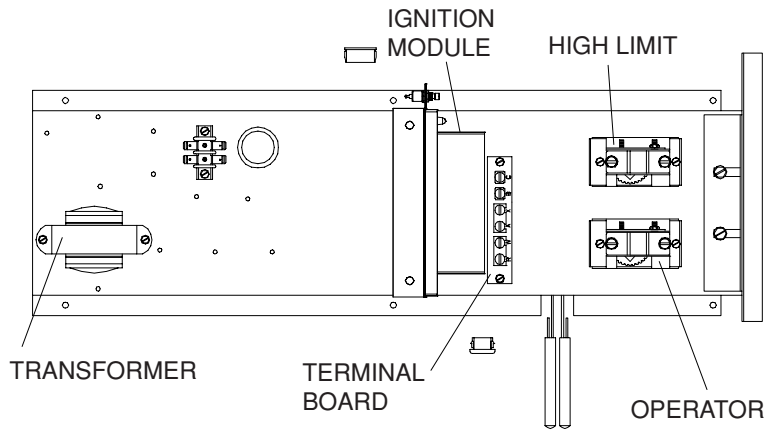


FIG. 30

TEMPERATURE ADJUSTMENT

300,000 Btu/hr Models:

Operating Temperature Control

An adjustable immersion operating control is located beneath top jacket panel on the control panel. The control uses a remote sensing bulb mounted in the inlet side of the front header. Turn the control setpoint dial to adjust the desired operating water temperature of the unit.

High Water Temperature Limit Control

An adjustable high limit control(s) is located beneath the top jacket panel, on control panel beside the temperature control. The setting of this control(s) limits maximum discharge water temperature. An optional

ELECTRONIC OPERATING TEMPERATURE CONTROL

990,000 through 2,070,000 Btu/hr Models

These units use an adjustable electronic temperature control to provide staged ON/OFF control. Operation is based on temperature input from two immersion sensors. Each sensor is a positive coefficient platinum thermistor. Sensor A is placed in the inlet side of the front header and sensor B is placed in the outlet side of the front header. A liquid crystal display is provided to indicate sensed temperature and operating parameters. The temperature control for the 990,000 Btu/hr units operates with three (3) stages of control, 1,260,000 through 2,070,000 Btu/hr units operate with four (4) stages of control. Heating boilers may be supplied with an optional electronic control with an outdoor reset function which will operate the boiler in two (2) stages, see Electronic Operating Control with Outdoor Reset Function.

Component Location Drawing of Control Panel
990,000 - 2,070,000 Btu/hr Models

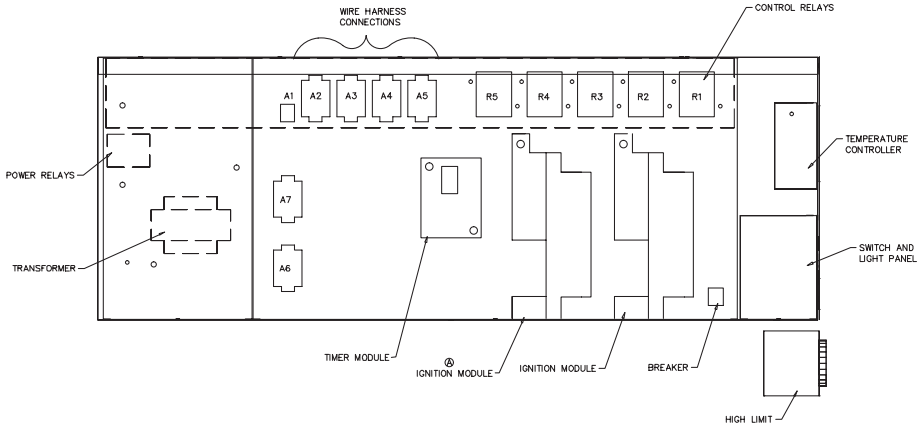


FIG. 31

Electronic Temperature Control, LCD Display and Programming Keys T775

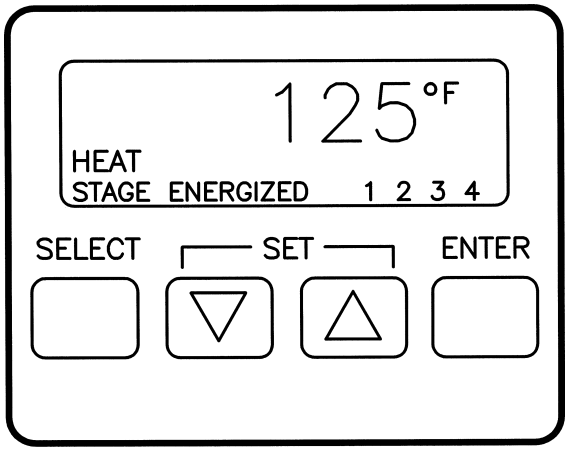


FIG. 32

SPECIFICATIONS

Set Point Adjustment Range: Max setting 220° F.
Temperature Accuracy: +/- 1° F.
Display Resolution: 1°F via Liquid Crystal Display
Sensor: Thermistor 4.8 ohms/° F.
Operating Humidity: 5 - 95% RH Noncondensing.
Operating Ambient Temperature: -30° to 125° F.

Access to the control is achieved by removing the jacket panel covering the diagnostic control lights. Four programming keys are provided to program set point and differential values for each stage and to control the display. The four keys are **Select, Up** arrow, **Down** arrow and **Enter.**

Select Key - Sequentially prompts the user as to what parameter is being displayed: set point, differential, stage energized, operation mode (heat), indication of assigned stage (1,2,3). Once the last parameter value has been viewed, pressing the **Select** key will display the control values again from the beginning of the display loop.

Up and Down Arrow Keys - Allow the displayed parameter to be increased or decreased. After pressing the **Select** key, a control value can be changed by using the **Arrow** keys. Control values will be increased or decreased by 1° F for each time the **Arrow** keys are depressed.

Enter Key - Places the new value into the memory of the microprocessor.

IMPORTANT:

A control value or operation will not be entered in the memory of the microprocessor until the Enter key is pressed.

Control values and operation selection will remain in the device memory even after power is removed.

Select and Enter Keys simultaneously pressed - changes operation mode of the control from heat to cool mode. **DO NOT CHANGE THIS SETTING**. This control must always be in the "heat" position for proper operation of the boiler.

When all stages have been programmed the display will revert back to sensed temperature and load energized status.

DISPLAY

Once power is applied to the temperature controller, the display will count down from 210 until the display reads zero. All outputs are de-energized at this time. This countdown process will repeat each time main power is interrupted. To avoid viewing this entire countdown, press the **Select** key. The display will now show normal readings: load (sensed) temperature, stages energized, and which sensor is being read (Sensor A or Sensor B). At any time during the programming procedure, the display will revert back to showing the sensed temperature and stage status indication 60 seconds after the last programming key is pushed.

The display can be configured with three options to show sensed temperature. The display can lock on Sensor A temperature, lock on Sensor B temperature, or be configured to alternatively indicate "Sensor A" and "Sensor B" sensed temperature at a 5 second rate. This allows comparison of temperatures to determine temperature rise.

This selection is accomplished by stopping at "Sensor A" or "Sensor B" sensed temperature points in the **Select** key scrolling loop. To lock on to either sensor, the user must scroll the **Select** key through the loop to the sensed temperature prompt of interest. The display will stick to that parameter until the **Select** key is activated to advance the loop. When the loop is stopped at any other prompt, the display will alternatively indicate "Sensor A" and "Sensor B" sensed temperature after 60 seconds from the last key closure or immediately after the **Select** key has been pressed at the end of the programming sequence.

SELECTION OF OPERATING SENSOR

The control, as shipped from the factory, is preset to use Sensor A to operate a heating boiler or a hot water supply boiler. Sensor B to provides a discharge thermometer function. Adjustment of these internal settings on the temperature controller should not be made without consulting the factory. Improper adjustment can allow over temperature operation which may cause personal injury or property damage.

SETUP OF THE TEMPERATURE CONTROLLER

Each stage on the controller has its own independent set point and differential which are determined by the programming keys. Each stage of heating is de-energized as the sensed temperature reaches the programmed set point. Each available stage of heating is energized as the sensed temperature reaches the set point minus the differential.

EXAMPLE:

Using stage one of the control as an example, the corresponding load would be energized and de-energized at the following temperatures based on the programmed settings.

Settings

Set point: 160° F

Differential: 8° F

Output Energized

Stage One: Energized at 152° F

Output De-energized

Stage One: De-energized at 160° F

Each available stage of operation must be programmed with a set point and a differential. If two stages are programmed with the same set point and differential the control will sequence both stages on and off with only a slight delay between switching of the stages. The control is normally programmed with a few degrees difference between the set point of each stage to sequence individual stages on as required by demand. This will allow input to be balanced to system demand. The exact settings will be determined by your system heat requirements. The set point minus differential should not be lower than 140° F to prevent sweat and condensate formation on the heat exchanger. See Low Water Temperature Systems section for applications at lower temperatures.

Based on your system requirements, determine the set point and switching differential for each stage of operation and enter into the worksheet below.

These values will be programmed into the temperature controller.

PROGRAMMING WORKSHEET

Stage 1:
Set Point 1 _____ Off at _____
Differential 1 _____ On at _____
Stage 2:
Set Point 2 _____ Off at _____
Differential 2 _____ On at _____
Stage 3:
Set Point 3 _____ Off at _____
Differential 3 _____ On at _____
Stage 4:
Set Point 4 _____ Off at _____
Differential 4 _____ On at _____

PROGRAMMING

NOTE: **When power is initially applied to a new boiler the control points will be pre-programmed. The factory final quality test sets the unit for test firing.**

The preset values are as follows:

Stage	Set Point	Differential
1	125° F	2° F
2	123° F	2° F
3	121° F	2° F
4	120° F	2° F

Re-program the set points and differentials to meet your system requirements.

The operating control uses an Liquid Crystal Display for interactive prompting during programming and display of sensed and assigned set point and differential values. Programming is accomplished through the use of the four programming keys.

1. Verify that the boiler is properly applied as either a heating boiler or hot water supply boiler, and the model number on the rating plate correctly identifies the boiler.

2. Turn the power switch to the ON position. The control will begin counting down from 210. This countdown sequence will last for approximately 3-1/2 minutes.

3. To override this time delay, press **Select.**

4. Press **Select** to display the current stage set point.

5. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired set point.

6. Press **Enter** to enter the displayed value into memory.

7. Press **Select** to display the current stage switching differential.

8. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired switching differential.

9. Press **Enter** to enter the displayed value into memory.

10. Repeat steps 4 thru 9 to program each additional stage.

11. Press **Select Select Select Select** (4 times) to return to stage 1 parameters. Scroll through the programming loop a second time to confirm that the appropriate values have been entered into memory by pressing Select.

12. Press **Select** after viewing the switching differential for the final stage to display Sensor A temperature only (inlet water temperature).

13. Press **Select** again to display Sensor B temperature only (outlet water temperature).

14. Press **Select** again to alternate the display between Sensor A temperature and Sensor B temperature at approximately 5 second intervals (to determine temperature rise).

NOTE: **The control values programmed into memory will not be lost because of a power failure.**

ELECTRONIC OPERATING CONTROL WITH OUTDOOR RESET FUNCTION (Optional on Heating Boilers)

The temperature control is now ready for operation.

This boiler is available with an optional adjustable electronic temperature control to provide staged ON/OFF control and an adjustable reset function based

on outdoor temperature. Operation as a reset controller is based on temperature input from two sensors, one immersion sensor for boiler water and one for outdoor air reset. Each sensor is a positive coefficient platinum thermistor. Sensor A is the boiler water temperature sensor and sensor B is outdoor air temperature sensor. A liquid crystal display is provided to indicate sensed temperature and operating parameters. The temperature control with the outdoor reset function operates with two (2) stages of control.

Outdoor Reset Electronic Temperature Control Display And Programming Keys

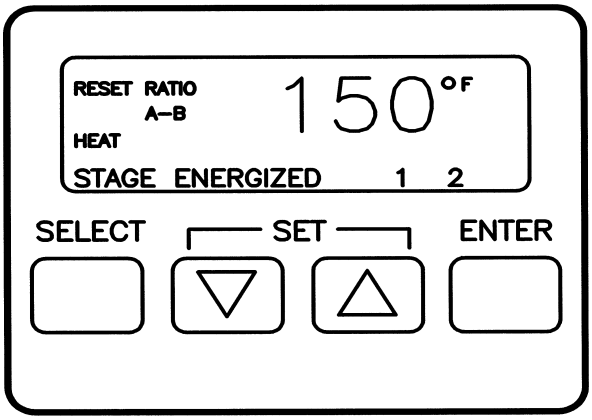


FIG. 33

SPECIFICATIONS

Set Point Adjustment Range: Max setting 220° F.
Temperature Accuracy: +/- 1° F.
Display Resolution: 1º F via Liquid Crystal Display
Sensor: Thermistor 4.8 ohms/° F.
Operating Humidity: 5 - 95% RH Noncondensing.
Operating Ambient Temperature: -30° to 140° F.

Access to the control is achieved by removing the jacket panel covering the diagnostic control lights. Four programming keys are provided to program set point and differential values for each stage and to control the display. The four keys are **Select, Up** arrow, **Down** arrow and **Enter.**

Select Key - Sequentially prompts the user as to what parameter is being displayed: set point, differential, stage energized, operation mode (heat), indication of assigned stage (1,2). Once the last parameter value has been viewed, pressing the **Select** key will display the control values again from the beginning of the display loop.

Up and Down Arrow Keys - Allow the displayed parameter to be increased or decreased. After pressing the **Select** key, a control value can be changed by using the **Arrow** keys. Control values will be increased or decreased by 1° F for each time the **Arrow** keys are depressed.

Enter Key - Places the new value into the memory of the microprocessor.

IMPORTANT:

A control value or operation will not be entered in the memory of the microprocessor until the **Enter** key is pressed.

Control values and operation selection will remain in the device memory even after power is removed.

Select and Enter Keys simultaneously pressed - Changes operation mode of the control from heat to cool mode. **DO NOT CHANGE THIS SETTING.** This control must always be in the **"heat"** position for proper operation of the boiler.

When all stages have been programmed the display will revert back to sensed temperature and load energized status.

DISPLAY

Once power is applied to the temperature controller the display will countdown from 210 until the display reads zero. All outputs are de-energized at this time. This countdown process will repeat each time main power is interrupted. To avoid viewing this entire countdown, press the **Select** key. The display will now show normal readings: load (sensed) temperature, stages energized, and which sensor is being read (Sensor A or Sensor B). At any time during the programming procedure, the display will revert back to showing the sensed temperature and stage status indication 60 seconds after the last programming key is pushed.

The display can be configured with three options to show sensed temperature. The display can lock on Sensor A temperature, lock on Sensor B temperature, or be configured to alternatively indicate "Sensor A" and "Sensor B" sensed temperature at a 5 second rate. This allows comparison of boiler water temperature and outdoor temperature to check reset operation.

This selection is accomplished by stopping at "Sensor A" or "Sensor B" sensed temperature points in the **Select** key scrolling loop. To lock on to either sensor, the user must scroll the **Select** key through the loop to the sensed temperature prompt of interest. The display will stick to that parameter until the **Select** key is activated to advance the loop. When the loop is stopped at any other prompt, the display will alternatively indicate "Sensor A" and "Sensor B" sensed temperature after 60 seconds from the last key closure or immediately after the **Select** key has been pressed at the end of the programming sequence.

OPERATING SENSORS

The control is configured to use Sensor A as the heating boiler water temperature sensor and Sensor B as outdoor air temperature sensor for the controls reset function.

SETUP OF THE TEMPERATURE CONTROLLER

Each stage on the controller has its own independent set point and differential which are determined by the programming keys. Each stage of heating is de-energized as the sensed temperature reaches the programmed set point. Each available stage of heating is energized as the sensed temperature reaches the set point minus the differential.

EXAMPLE:

Using stage one of the control as an example, the corresponding load would be energized and de-energized at the following temperatures based on the programmed settings.

Settings
Set point: 160° F
Differential: 8° F
Output Energized
Stage One: Energized at 152° F
Output De-energized
Stage One: De-energized at 160° F

Each available stage of operation must be programmed with a setpoint and a differential. If two stages are programmed with the same setpoint and differential the control will sequence both stages on and off with only a slight delay between switching of the stages. The control is normally programmed with a few degrees difference between the set point of each stage to sequence individual stages on as required by demand. This will allow input to be balanced to system demand. The exact settings will be determined by your system heat requirements. The set point minus differential should not be lower than 140° F (60° C) to prevent sweat and condensate formation on the heat exchanger. See Low Water Temperature Systems section for applications at lower temperatures.

Based on your system requirements, determine the set point and switching differential for each of the two stages of operation and enter them into the worksheet below.

PROGRAMMING WORKSHEET

Stage 1:
Set Point 1 _____ Off at _____
Differential 1 _____ On at _____

Stage 2:
Set Point 2 _____ Off at _____
Differential 2 _____ On at _____

RESET CONTROL ALGORITHM

The reset control is capable of providing two stages of burner input based on programmed setpoints and the reset configuration. The reset ratio expresses the amount of change in the heating control point caused by a change in the outdoor temperature. The reset ratio is preset to function in an inverse ratio (as the outdoor temperature goes down, the control temperature goes up).

Determining the Reset Ratio

$$\frac{\text{Change in Outside Temperature}}{\text{Change in Control Temperature}} = \frac{B}{A}$$

Example of how the Reset Ratio is calculated:

When the outdoor temperature is 70° F (21° C) the desired boiler water temperature is 140° F (60° C), when the outdoor temperature drops to -10° F (-23° C) the boiler water temperature needs to be 200° F (93° C).

$$\frac{70^\circ - (-10^\circ)}{200^\circ - 140^\circ} = \frac{80^\circ}{60^\circ} = \frac{8^\circ}{6^\circ}$$

Therefore, the reset ratio is 8:6. The values for the reset ratio must be whole numbers from 1 to 30 to achieve proper operation.

CAUTION !!

A reset ratio lower than one can result in unstable control. Widening the differential will minimize this effect.

These values will be programmed into the temperature controller.

PROGRAMMING

NOTE: **When power is initially applied to a new heating boiler the control points will be pre-programmed. The factory final quality test sets the unit for test firing. The preset values are as follows:**

Stage	Set Point	Differential
1	150°F	2°F
2	145°F	2°F

Re-program the set points and differentials to meet your system requirements.

The operating control uses a Liquid Crystal Display for interactive prompting during programming and display of sensed and assigned set point and differential values. Programming is accomplished through the use of the four programming keys.

1. Verify that the boiler is properly applied as either a heating boiler and the model number on the rating plate correctly identifies the boiler.

2. Turn the power switch to the ON position. The control will begin counting down from 10. This count down sequence will last for approximately 3-1/2 minutes.

3. To override this time delay, press **Select.**

4. Press **Select** to display the current stage set point.

5. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired set point.

6. Press **Enter** to enter the displayed value into memory.

7. Press **Select** to display the current stage switching differential.

8. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired switching differential.

9. Press **Enter** to enter the displayed value into memory.

10. Repeat steps 4 through 9 to program the second stage of burner operation.

11. Press **Select** to display the current reset compensation setpoint for the outdoor sensor

.

12. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the Reset Compensation Setpoint for the Outdoor Sensor (Sensor B) - Remember this value is the outdoor temperature at which the boiler control setpoint will begin to be increased as the outdoor temperature falls.

13. Press **Enter** to enter the desired value into memory.

14. Press **Select** to display the Reset Ratio B value.

15. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the numerical value for the Reset Ratio B. Remember this value is the Change in Outside Temperature (for the example enter 8).

16. Press **Select** to display the Reset Ratio A value.

17. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the numerical value for the Reset Ratio A. Remember this value is the Change in Control Temperature (for the example enter 6).

18. Press **Select Select Select Select** (4 times) to return to stage 1 parameters. Scroll through the programming loop a second time to confirm that the appropriate values have been entered into memory by pressing Select.

The electronic temperature control has three options for displaying the sensed temperatures.

1. Sensor A only.
2. Sensor B only
3. Alternating between Sensor A and Sensor B.

19. Press **Select** after viewing the switching differential for the final stage to display Sensor A temperature only (boiler water temperature).

20. Press **Select** again to display Sensor B temperature only (Reset Compensation Setpoint).

21. Press **Select** again to alternate the display between Sensor A temperature and Sensor B temperature at approximately 5 second intervals.

The temperature control is now ready for operation.

NOTE:

The control values programmed into memory will not be lost because of a power failure.

REMOTE MOUNTING OF THE SENSORS FOR THE BOILER'S ELECTRONIC TEMPERATURE CONTROL

The operating sensor (Sensor A) may need to be installed in the system piping on low temperature application, outdoor reset controls or other specialized applications. Use care when remote mounting the operating temperature sensor or outdoor reset sensor from the boiler's electronic temperature control. The outdoor temperature sensor (Sensor B) on an electronic temperature control with the optional outdoor reset function must be installed outside the building. Erratic temperature readings can be caused by poor wiring practices that must be avoided to assure proper operation.

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 both the sensor, any interconnecting wiring and the controller.

6. Do not mount sensor with leadwire 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/electronic temperature control only. DO NOT ground the shielded cable at the sensor end.

To maintain temperature accuracy, sensor wires should be 18 AWG two conductor (18/2). Use shielded wire if required. If the length of the sensor wire to a remote mounted sensor exceeds 400 feet, recalibration may be necessary to maintain accuracy. Sensor wire lengths of 400 to 599 feet will require a 1°F calibration offset, 600 to 799 feet will require a 2°F calibration offset and 800 to 1000 feet will require a 3°F calibration offset. This temperature offset should be added to the desired temperature setpoint for these applications.

ERROR MESSAGES DISPLAYED BY THE ELECTRONIC TEMPERATURE CONTROL

There are seven error messages that can be displayed in response to software or hardware problems with the boiler's internal electronic temperature control. The error codes that may be seen flashing on the display are:

SF - Sensor Failure

The display flashing SF indicates an out-of-range or defective sensor. Make sure sensors are properly installed, wired and connected to the control. Correct sensor installation or replace sensor.

EF- EEPROM Failure

The values read form the EEPROM are not the same as the values written into the EEPROM. This error cannot be field repaired. Replace the boiler's electronic temperature control.

CF - Calibration Failure

The calibration resistor reading was not within the range of the Analog to Digital converter. This error cannot be field repaired. Replace the boiler's electronic temperature control.

OF - Stray Interrupt Failure

An unused interrupt occurred. This error cannot be field repaired. Replace the boiler's electronic temperature control.

CE - Configuration Error

The device hardware was configured to an nonexistent device. This error cannot be field repaired. Replace the boiler's electronic temperature control.

OE - ROM Error

The internal ROM of the microprocessor in the boiler's electronic temperature control is defective. This error cannot be field repaired. Replace the boiler's electronic temperature control.

AE - RAM Error

The internal RAM of the microprocessor in the boiler's electronic temperature control is defective. This error can not be field repaired. Replace the boiler's electronic temperature control.

HIGH WATER TEMPERATURE LIMIT CONTROL

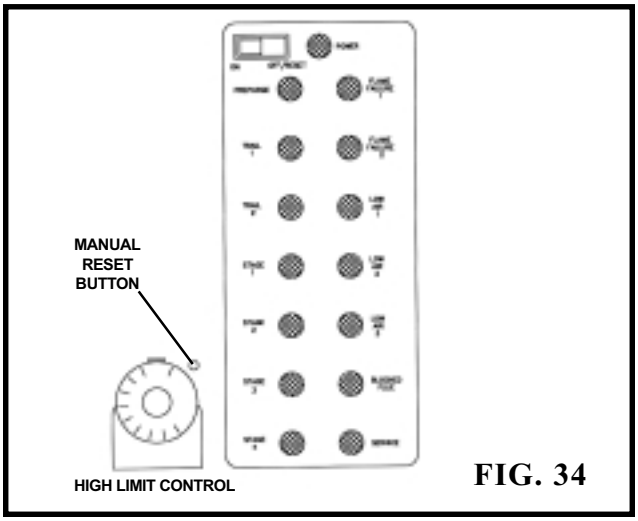


FIG. 34

High Water Temperature Limit Control

990,000 through 2,070,000 Btu/hr models

An adjustable high limit control is located behind the front control panel, beside the temperature control and indicating lights. The setting of this control limits maximum discharge water temperature. An optional manual reset function is available. A small red reset button, located beside the knob, must be pushed whenever water temperature has exceeded the set point of manual reset limit.

NOTE:

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

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 willsettle 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 neighbor's phone.
- Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Never use tools. If the knob 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 boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler. The possible damage to a flooded boiler can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

LIGHTING INSTRUCTIONS

300,000 Btu/hr MODELS

1. **STOP!** Read the safety information.

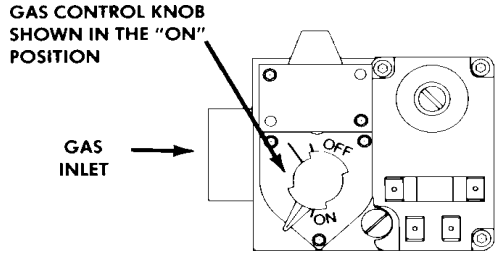
2. Turn Off all electrical power to the appliance.

3. Open the left top jacket panel to access the controls.

4. Set the thermostat to the lowest setting.

5. This appliance is equipped with an ignition device which automatically lights the burners. **DO NOT** try to light the burners by hand.

6. Push in the gas control knob slightly and turn clockwise to the "OFF" position.



GAS VALVE 300,000 Btu/hr MODELS

FIG. 35

NOTE: **On the 39C valve, knob cannot be turned to "OFF" unless knob is pushed in slightly. Do Not Force.**

7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP! Follow "B" in the safety information. If you don't smell gas go on to the next step.

8. Turn the gas control knob counterclockwise to the "ON" position.

9. Set the thermostat to the desired setting.

10. Replace control access panel.

11. Turn on all electric power to the appliance and press the ignition reset button.

12. 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. Turn off all electric power to the appliance if service is to be performed.

2. Open the top left jacket panel to access controls.

3. Push in the gas control knob slightly and turn clockwise to the "OFF" position. Do not force.

4. Replace control access panel.

LIGHTING INSTRUCTIONS

990,000 through 2,070,000 Btu/hr Models

1. **STOP!** Read the safety information.

2. Open the front access panel to program temperature control.

3. Set each stage of control to the lowest setting (See Temperature Adjustment).

4. Turn Off all electrical power to the appliance.

5. This appliance is equipped with an ignition device which automatically lights the burners. **DO NOT** try to light the burners by hand.

Combination Gas Valve for 990,000 — 2,070,000 Btu/hr Models

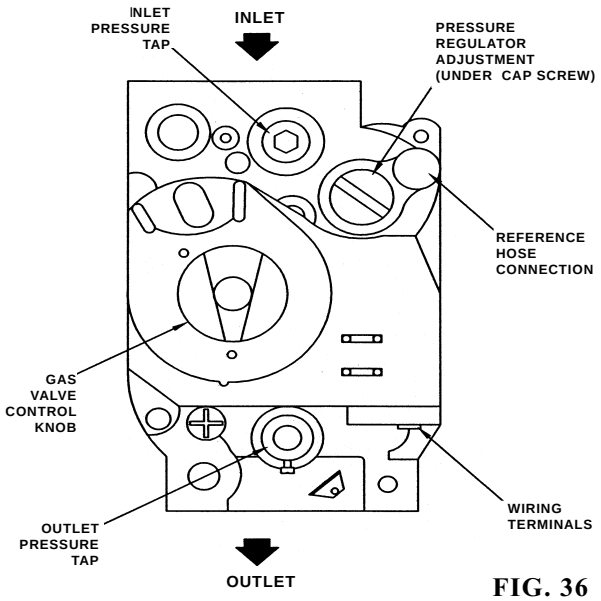


FIG. 36

6. Turn the manual gas cock clockwise ↷ to the "OFF" position.

7. Wait five (5) minutes to clear out any gas. If you smell gas, **STOP!** Follow "B" in the safety information. If you don't smell gas go on to the next step.

8. Turn the manual gas cock counterclockwise ↶ to the "ON" position.

9. Turn on all electric power to the appliance and press the ignition reset button.

10. Program the temperature control to the desired settings.

11. Close the control access panel.

12. 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. Turn off all electric power to the appliance if service is to be performed.

2. Turn the manual gas cock 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

300,000 Btu/hr Models

1. Turn off gas supply to unit.

2. Turn thermostat and high limit controls to highest setting.

3. Turn electric power on.

4. The ignition module will lock out.

5. Readjust thermostat and high limit to normal setting.

6. Turn on gas supply.

7. Turn power off then press the ignition reset button to reset module.

8. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

990,000 through 2,070,000 Btu/hr Models

1. Turn off gas supply to unit.

2. Turn electric power on.

3. Program each stage of the temperature control to settings above water temperature or to highest safe setting.

4. Each ignitor will cycle on trial(s) for ignition.

5. Each ignition module will lock out and turn on the flame failure lights.

6. Program each stage of temperature control to desired temperature set points.

7. Turn on gas supply.

8. Turn power off then on to reset ignition modules.

9. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

HOT SURFACE IGNITION SYSTEM

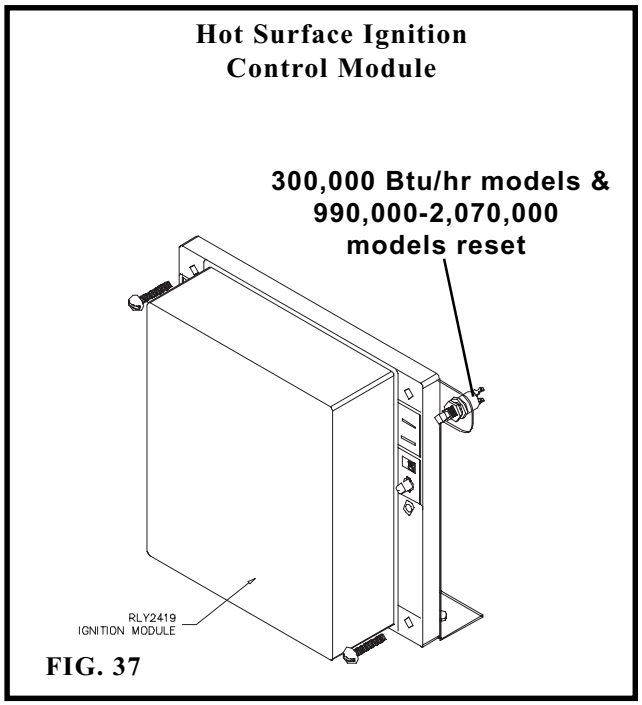


FIG. 37

Service Parts

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

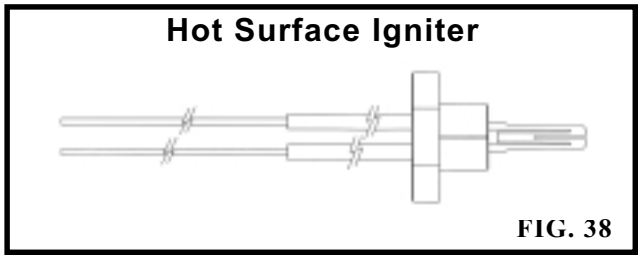


FIG. 38

Hot Surface Igniter and Ignition Module

The 300,000 Btu/hr models have one ignition module and one hot surface igniter. The 990,000 through 2,070,000 Btu/hr models have two ignition modules and two hot surface igniters.

HOT SURFACE IGNITION CONTROL MODULE

Ignition Module Lockout Functions

The ignition module(s) 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. An ignition module that is in a hard lockout condition may only be reset by pushing the reset button for the ignition control. The reset button is located inside front control panel on the side of the ignition module. The reset button is active after the post purge cycle when there is hard lockout condition as indicated by the 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 fan 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 ignition module has an LED which indicates the status of the safety circuits. A remote Ignition Module Status indicating light(s) is wired from the ignition module Status LED and mounted on the front control panel (990,000 through 2,070,000 Btu/hr models). The flashing operation of this light/LED indicates the diagnostic status of the ignition control module. The status LED, mounted on the ignition module, flashes a code sequence from the Ignition Module to indicate the status of the ignition process. The following listing gives the flashing diagnostic status codes as signaled by the ignition module.

Status LED Diagnostic Codes

Code Sequence	Condition
Constant ON	- System OK, no faults present.
Constant OFF	- Possible control fault, check power; LED may be defective, do not replace control if all operational sequences function properly - see Trouble Shooting Guide.
One Flash	- Low Air, check air pressure switch and hoses to pressure sensing points, fan, venting and sealing of pressurized chamber. Note: Brief flashing normal on fan start-up/proving.
Two Flashes	- Flame without call for heat, check for a gas valve stuck in the open position, air, venting, burners and the combustion process. Fan 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 the gas line may require multiple reset functions to achieve proper ignition.
Four Flashes	- Igniter failure, igniter will not maintain minimum 3.1 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.

Access to Internal Control Panel

The interior control panel is accessed by turning the mounting screw located at the bottom center of the exterior control panel. Pull the panel out at the bottom and slide down to remove. The outer control panel has a Mylar label attached to the exterior surface which indicates the function of each of the boiler's indicating lights and a clear window to view the digital temperature display from the electronic temperature control. A typical wiring diagram is attached to the inside surface of the exterior control panel. Removal of the exterior panel reveals the interior control panel. The interior control panel allows access to the individual indicating lights for each stage of operation; the Status LED for control sensed malfunctions from the ignition module (See Operation and Diagnostic Lights); the manual ON/OFF power switch; the reset button for a hard lockout condition from the ignition module (See Ignition Module Lockout Functions); and the LCD display and programming buttons for the electronic temperature control (See Electronic Operating Temperature Control). The control panel assembly is mounted on a slide out chassis to allow easy access to the components on the panel. Remove shipping bracket to slide out. The control panel contains the ignition module, transformer for the 24 VAC control circuit, circuit breaker for the control circuit (990,000 through 2,070,000 Btu/hr models only), switching relays for component operation and wiring harness connections to the boiler's components. The control panels for the 990,000 through 2,070,000 Btu/hr models are common and may be switched between these boilers for trouble shooting. The control panels for the 300,000 Btu/hr model is unique to this model and may only be switched between 300,000 Btu/hr models for trouble shooting.

IGNITION AND CONTROL TIMINGS

Proven Pilot Hot Surface Ignition System

F-9 on 300,000 Btu/hr Models with a Single Hot Surface Ignition Module

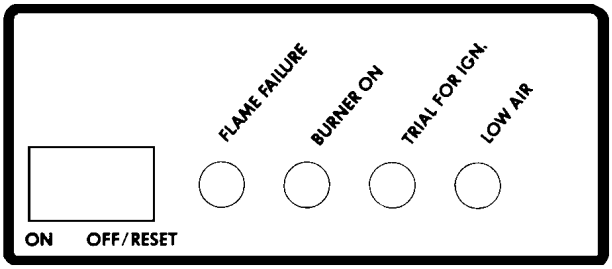
M-9 on 990,000 through 2,070,000 Btu/hr Models with Two Hot Surface Ignition Modules

Hot Surface Ignition Module Timings
Prepurge : 15 Seconds
Hot Surface Ignitor Heat-up Time : 25- 35 seconds
Main Burner Flame Establishing Period : 4 Seconds
Failure Response Time : 0.8 Seconds at less than 0.5 μA flame current
Flame Current : 5 - 15 μA
Time Delay Between Stages 1&2 and 3&4 - 15 Seconds (990,000 through 2,070,000 Btu/hr Models only)
Post-purge : 30 seconds

Pump Delay Timing : 30 Seconds after burner shutdown (on boilers equipped with an optional, factory supplied pump delay or intermittent pump control system only).

OPERATION AND DIAGNOSTIC LIGHTS
300,000 BTU/HR MODELS

OPERATIONAL/DIAGNOSTIC LIGHTS



300,000 BTU Model

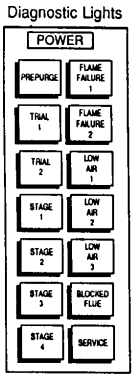
FIG. 39

The control panel has an ON/OFF power switch and 4 indicating lights to show operation and control sensed malfunctions.

TABLE — O
OPERATION and DIAGNOSTIC LIGHTS

Indicating Light	Function
Power On	- Power switch in on position
Flame Failure	- Ignition module unable to properly prove ignition
Burner On	- Burners operating
Trial for Ignition	- Hot surface ignitor prepared to light burners.
Low Air	- Improper level of combustion air provided or a blockage in the flue.

990,000 through 2,070,000 Btu/hr Models



990,000 - 2,070,000 BTU Models

FIG. 40

The control panel has an ON/OFF power switch and 15 indicating and diagnostic lights to show all major steps of operation and control sensed malfunctions.

NOTE: **It is normal for the Low Air 2 light to be illuminated when only Stage 1 is firing. The Low Air 2 light will turn off when Stage 2 calls for heat, the second combustion air fan turns on and the low air switch proves proper operation.**

Interior Control Panel with Operation/ Diagnostic Lights, LCD Display and Reset

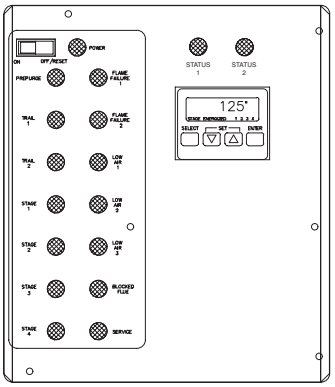


FIG. 41

TABLE — P
Status LED Diagnostic Codes

Code Sequence	Condition
Indicating Light	Function
Power On	-Power switch in on position
Prepurge	-Operation of combustion air fan before ignition
Trial for Ignition 1	-Hot surface ignitor 1 prepared to light burners.
Trial for Ignition 2	-Hot surface ignitor 2 prepared to light burners.
Stage 1 On	-Burners for stage 1 operating.
Stage 2 On	-Burners for stage 2 operating.
Stage 3 On	-Burners for stage 3 operating.
Stage 4 On	-Burners for stage 4 operating (if equipped).
Flame Failure 1	-Ignition module 1 unable to properly prove ignition.
Flame Failure 2	-Ignition module 2 unable to properly prove ignition.
Low Air 1	-Improper level of combustion air provided by fan 1.
Low Air 2	-Improper level of combustion air provided by fan 2.(See Note)
Low Air 3	-Improper level of combustion air provided by fan 3 (if equipped).
Blocked Flue	-Improper operation of flue (blockage).
Service	-Improper operation of optional device (if equipped).
Status 1	- Remote status light for ignition module #1
Status 2	- Remote status light for ignition module #2

IGNITION and CONTROL TIMINGS

F-9 Proven Pilot Hot Surface Ignition Models - 300,000 Btu/hr
Single Hot Surface Ignition Module

Prepurge - 15 Seconds
Hot Surface Ignitor Heat-up Time - 20- 45 seconds
Main Burner Flame Establishing Period - 4 Seconds
Failure Response Time - 0.8 Seconds at 0.5 μA flame current
Post-purge - 30 seconds

M-9 Proven Pilot Hot Surface Ignition Models 990,000 through 2,070,000 Btu/hr
Two Hot Surface Ignition Modules

Prepurge - 15 Seconds
Hot Surface Ignitor Heat-up Time - 20- 45 seconds
Main Burner Flame Establishing Period - 4 Seconds
Failure Response Time - 0.8 Seconds at 0.5 μA flame current
Time Delay Between Stages 1&2 and 3&4 - 15 Seconds
Post-purge - 30 Seconds

Pump Delay Timing - 30 Seconds after burner shutdown (on units equipped with an optional, factory supplied pump delay or intermittent pump control system only).

FREEZE PROTECTION

Although these units are CSA International design certified for outdoor installations - such installations are not recommended in areas where the danger of freezing exists. Proper freeze protection must be provided for outdoor installations, units installed in unheated mechanical rooms or where temperatures may drop to the freezing point or lower. If freeze protection is not provided for the system, a low ambient temperature alarm is recommended for the mechanical room. Damage to the unit by freezing is non-warrantable.

1. Pump Operation - **MOST IMPORTANT** - This boiler is designed for continuous pump operation when the burners are firing. If the system pump does not run continuously an additional pump must be installed to provide constant circulation through the unit. This flow of warm boiler water can help prevent freezing.
2. Location - Indoor boilers and hot water supply boilers must be located in a room having a temperature safely above freezing [32° F(0° C)].
3. Caution - A mechanical room operating under a negative pressure may experience a down draft in the flue of a boiler which is not firing. The cold outside air pulled down the flue may freeze a heat exchanger. This condition must be corrected to provide adequate freeze protection.
4. Freeze protection for a heating boiler or hot water supply boiler using an indirect coil can be provided by using hydronic system antifreeze. Follow the manufacturers instructions. **DO NOT** use undiluted or automotive type antifreeze.
5. Outdoor Boiler Installation - Adequate hydronic system antifreeze must be used. A snow screen should be installed to prevent snow and ice accumulation around the boiler or its venting system.
6. Shut-down and Draining - If for any reason, the boiler 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 boiler completely. Remove one threaded plug or bulb well from the inlet side of the front header and one from the outlet side of the front header on the heat exchanger. Blow all water out of the heater exchanger. (See Figure 29).
   (e) Drain pump and piping.

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 is possible.

CAUTION !!

DO NOT use undiluted or automotive type attifreeze.

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. A larger pump with more capacity (15% to 25% more) may be required to maintain desired flow rates and prevent a noise problem in a glycol system.

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.

MAINTENANCE

Listed below are items that must be checked to insure 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. 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 startup after long shutdown periods or at least every six months. A burner viewport is located on the left side of the boiler, below the water connections on the front header.

WARNING:

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

Flame Pattern Illustration

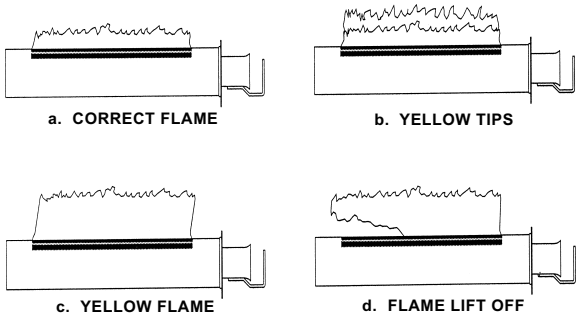


FIG. 42

a. **Normal Flame:** A normal flame is blue, with slight yellow tips, with a well defined inner cone and no flame lifting.

b. **Yellow Tip:** Yellow tip can be caused by blockage or partial obstruction of air flow to the burner(s).

c. **Yellow Flames:** Yellow flames can be caused by blockage of primary air flow to the burner(s) or excessive gas input. This condition **MUST** be corrected immediately.

d. **Lifting Flames:** Lifting flames can be caused by over firing the burner(s), excessive primary air or high draft.

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

3. Flue Gas Passageways Cleaning Procedures: Any sign of soot around the outer jacket, at the burners 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.

All gaskets on disassembled components must be replaced with new gaskets on reassembly. Gasket kits are available from your distributor.

BURNER REMOVAL and CLEANING

a. Turn off main power to boiler.

b. Turn off main manual gas shutoff to boiler.

c. Remove the front outer jacket panels.

d. Disconnect manifold from gas train using union(s) just below each gas valve(s).

e. Remove mounting screws from manifold mounting brackets. Pull the manifold/orifice assembly away from burners. Repeat for each manifold assembly on 990,000 Btu/hr and larger units.

f. Remove two mounting screws from burner and slide burner out toward front of boiler. Use caution to prevent damage to burners, refractory, hot surface ignitor or wiring.

g. Remove soot from burners with a stiff bristle brush. Dirt may be removed from burner ports by rinsing the burner thoroughly with water. Drain and dry burners before re-installing. Damaged burners must be replaced.

A unit installed in a dust or dirt contaminated atmosphere will require cleaning of the burners on a 3 to 6 month schedule or more often, based on severity of contamination. Contaminants can be drawn in with the combustion air. Non-combustible particulate matter such as dust, dirt, concrete dust or dry wall dust can block burner ports and cause non-warrantable failure. Use extreme care when operating a boiler for temporary heat during new construction. The burners will probably require a thorough cleaning before the boiler is placed in service.

HEAT EXCHANGER CLEANING

h. While burners are removed, check the heat exchanger surface for sooting. If soot is present, heat exchanger must be cleaned and problem corrected. Proceed as follows.

i. Remove gas manifold(s)/orifice assemblies as described in steps a. through e. in "Burner Removal."

j. Disconnect wiring from hot surface ignitor(s) and hoses from burner pressure tap.

k. Remove inner jacket panel mounting screws and slide burner/door assembly out toward front of the boiler. Use caution to prevent damage to the refractory and hot surface ignitor.

l. Check "V" baffles on top of heat exchanger. Remove and clean if necessary.

m. Remove soot from heat exchanger with a stiff bristle brush. Use a vacuum to remove loose soot from surfaces and inner chamber.

n. The heat exchanger can be removed by disconnecting all water piping and sliding towards the front of the boiler. Once the heat exchanger is removed from the boiler, a garden hose can be used to wash the tubes to insure that all soot is removed from the heat exchanger surfaces. **NOTE: Do not wet the boiler's refractory.**

o. Insure that all burner ports are cleaned to remove any soot. See Burner Cleaning Procedure.

p. Carefully reinstall the heat exchanger and "V" baffles if removed from the boiler.

q. Carefully reinstall inner jacket panels, burners, manifolds, wires and hoses. Use new gasket material to insure a proper air seal.

r. Reassemble all gas and water piping. Test for gas leaks.

s. Reassemble outer jacket panels.

t. Cycle unit and check for proper operation.

4. Combustion Air Fan: The combustion air fan should be checked every 6 months. Clean fan as required when installed in a dust or dirt contaminated location.

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

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

7. Check frequently to be sure the flow of combustion and ventilation air to the boiler is not obstructed.

8. This boiler 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 volt meter. The 990,000 through 2,070,000 Btu/hr models have a 7 AMP circuit breaker provided on the secondary side of the transformer. A tripped circuit breaker indicates a short in the 24VAC controls that must be corrected.

9. Combustion Air Adjustment: This unit uses a fan assisted combustion process. The 300,000 Btu/hr model has one combustion air fan, 990,000 through 2.070,000 Btu/hr models have multiple fans to supply combustion air to the burners. They are factory pre-set and should not need adjustment in most cases. The 300,000 Btu/hr model has a fan located in the right side of the top chamber, 990,000 thru 2,070,000 Btu/hr models have fans located left, center and right (if equipped) in the top chamber. Units with three fans will not have a low air light on the "right" fan until the low air condition on the left and center fans have been corrected. It is normal for the Low Air 2 light to be illuminated when only Stage 1 is firing. Follow the steps below to adjust fan if a continuous Low Air Light condition is observed:

   a. Check for proper installation and draft in venting system. Correct as required.

   b. Single fan units hae one low air light. On units with multiple fans, determine which fan is to be adjusted by observing the low air lights. On two fan units, Low Air 1 indicates left fan and Low Air 2 indicates right fan. On three fan units, Low air 2 indicates center fan and Low Air 3 indicates right fan.

   c. Open the right top jacket panel to access the fan on single fan units. Remove the top front jacket panel (s) to access the combustion air fans on units with multiple fans.

   d. Fan air shutter adjustment:

COMBUSTION AIR ADJUSTMENT
300,000 Btu/hr Model

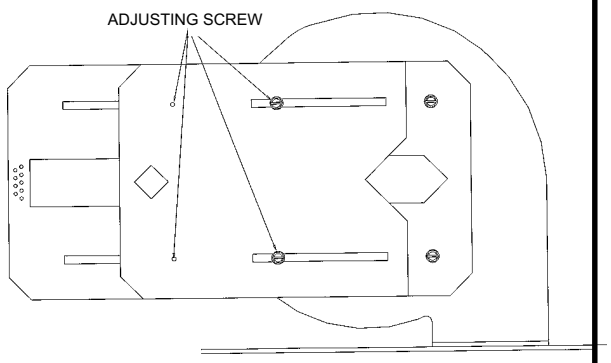


FIG. 43

300,000 Btu/hr Models - Loosen the four (4) screws holding the air shutter in place. With the fan running, slowly close the air shutter until the low air light comes on. Slowly open the air shutter until the low air light goes off, plus an extra 1/8". Retighten the four (4) holding screws.

Combustion Air Adjustment
990,000 - 2,070,000 Btu/hr Models

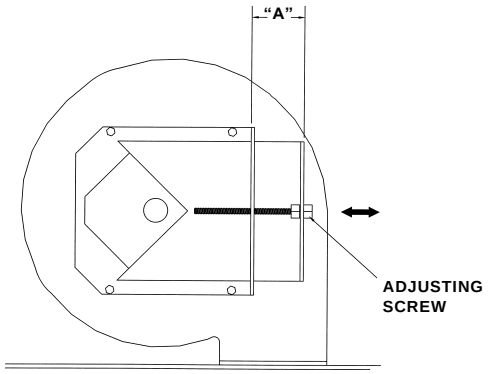


FIG. 44

990,000 through 2,070,000 Btu/hr Models - The following is a recommended method for setting the differential air pressure (ΔP) for each fan on models with multiple fans.

Beside each fan is a low air pressure switch with a large and small tube delivering pressure from points inside the unit. The positive pressure in the large tube and the negative pressure in the small tube act together to make the pressure switch. By disconnecting the tubes from the switch and

connecting them to either side of a manometer, you can read the differential pressure to the switch. This procedure and the noted pressure requirements are for 990,000 through 2,070,000 Btu/hr models with a serial number beginning at F001353.

SETUP PROCEDURE:

Remove the upper front jacket from the unit to access the fan(s). Remove the electrical access door under the gas train entrance to the jacket and locate the terminal strip below the gas train. Disconnect the wires or remove the jumper across terminals X and B. This will interrupt the firing process and allow the fans to run continuously without firing the main burner. Note: if the appliance has been firing recently, allow the appliance to cool for five minutes with the fans running before beginning the adjustment procedure.

ADJUSTMENT PROCEDURE

990,000 through 1,440,000 Btu/hr Models

Combustion Air Adjustment with a Manometer to set Differential Pressure

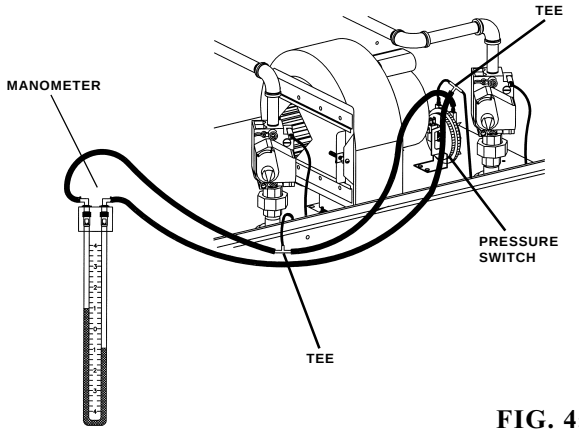


FIG. 45

The **"⊕"** connection on the manometer connects to the tubing from the units front chamber and the **"⊖"** connection on the manometer connects to the tubing from the burner venturi.

1. Remove the large and small black tubing from the pressure switch beside each fan. Beginning with the fan on the far left, connect these tubes to either side of your manometer. Disable the fan on the right side by disconnecting the fan's 2-pin molex plug (black & white wires).

2. Adjust the air shutter on the left fan until the differential pressure is 1.35 inches water column. (See Figure 44 for air shutter adjustment procedure)

3. Reconnect the wires to the fan on the right. Connect the tubing from the matching low air switch to either side of your manometer.

4. Adjust the air shutter on the right fan until the differential pressure is 1.35" w.c. Note: the left fan must be running as you set the right fan. Also, the DP of the left fan will increase above 1.35" w.c. with the right fan on. This is normal.

5. Once the adjustment procedure is complete, reconnect the tubing to the pressure switches and check all tubing and wire connections for snug fit. Reconnect wire or jumper to the X and B terminals on the terminal strip.Test fire the unit. Install upper panel and access door.

ADJUSTMENT PROCEDURE

1,800,000 and 2,070,000 Btu/hr Models

1. Remove the large and small black tubing from each pressure switch beside each fan. Beginning with the fan on the far left, connect these tubes to either side of your manometer. Disable the fan on the right side by disconnecting the fan's 2-pin molex plug (black & white wires).

2. Adjust the air shutter on the left fan until the differential pressure is 1.35 inches water column. Then move the manometer to the tubing for the center fan; adjust the air shutter on the center fan until the differential pressure is 1.35" w.c. Go back to the left fan, check the pressure and, if necessary, readjust the pressure to 1.35" w.c. Note: you may need to switch back and forth between the left and center fan to fine tune both to 1.35" w.c. (See Figure 44 for air shutter adjustment procedure)

3. Reconnect the wires to the fan on the right. Connect the tubing from the matching low air switch and connect to either side of your manometer.

4. Adjust the air shutter on the right fan until the differential pressure is 1.35" w.c. Note: the left and center fans must be running as you set the right fan. Also, the ΔP of the left and center fans will increase above 1.35" w.c. with the right fan on. This is normal.

5. Once the adjustment procedure is complete, reconnect the tubing to the pressure switches and check all tubing and wire connections for snug fit. Reconnect wire or jumper to the X and B terminals on the terminal strip. Test fire the unit. Install upper panel and access door.

GAS TRAIN AND CONTROLS

Gas Train Drawing
300,000 Btu Model

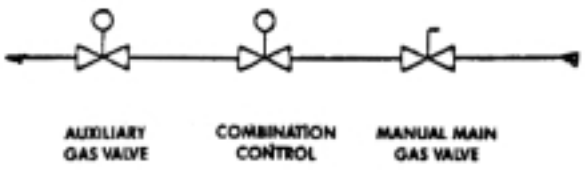


FIG. 46

Gas Train Drawing
990,000 - 2,070,000 Btu Models

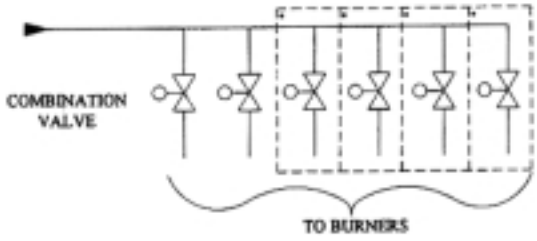


FIG. 47

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.**

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 compression tank is used. The expansion tank must be installed close to the boiler and on the suction side of the system pump to insure proper operation. **Caution: this boiler system should not be operated at less than 12 PSIG.** Hot water piping must be supported by suitable hangers or floor stands, NOT by the boiler. Copper pipe systems will be subject to considerable expansion and contraction. Rigid pipe hangers could allow the pipe to slide in the hanger resulting in noise transmitted into the system. Padding is recommended on rigid hangers installed with a copper system. The boiler pressure relief valve must be piped to suitable floor drain. See the relief valve section in the Installation and Service Manual.

CAUTION !!

A leak in 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

The 300,000 Btu/hr boiler has 2" NPT inlet and outlet connections. The 990,000-2,070,000 Btu/hr input boilers have 2 1/2" NPT inlet and outlet connections. **Caution:** field installed reducing bushings may decrease flow resulting in boiler noise or flashing to steam**.**

CIRCULATOR PUMP REQUIRMENTS

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 heat exchanger head-loss chart (FIG. 48 & 49) is provided to assist in proper pump selection. Also provided is a System Temperature Rise Chart (Table S). This table provides GPM and boiler head-loss at various temperature rises for each boiler based on Btu/hr input. Temperature rise is the difference in boiler inlet temperature and boiler outlet temperature while the boiler is firing. Example: The boiler inlet temperature is 160°F (71°C) and the boiler outlet temperature is 180°F, (82°C) this means that there is a 20°F (11°C) temperature rise across the boiler.

HEAT EXCHANGER PRESSURE DROP CHART

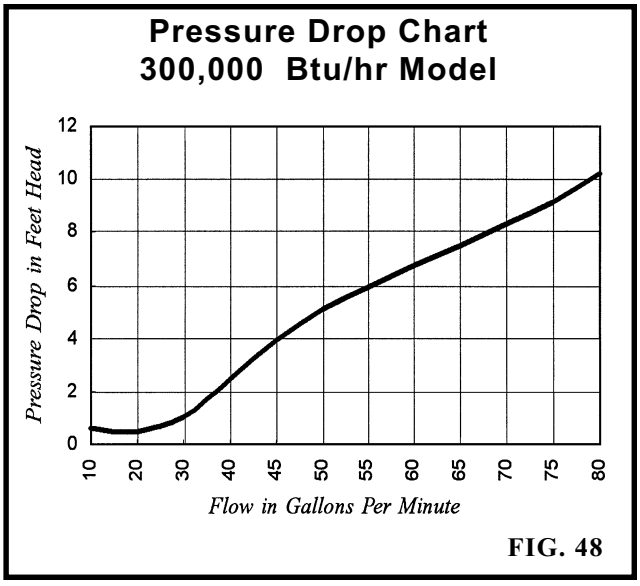


FIG. 48

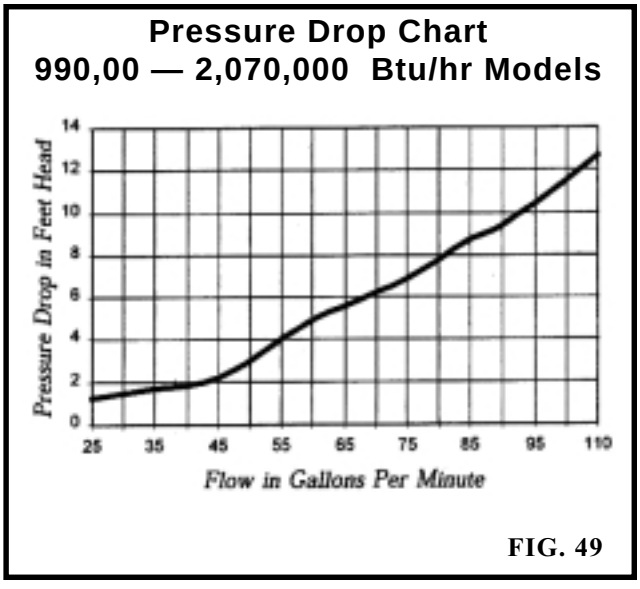


FIG. 49

CIRCULATOR PUMP SPECIFICATIONS

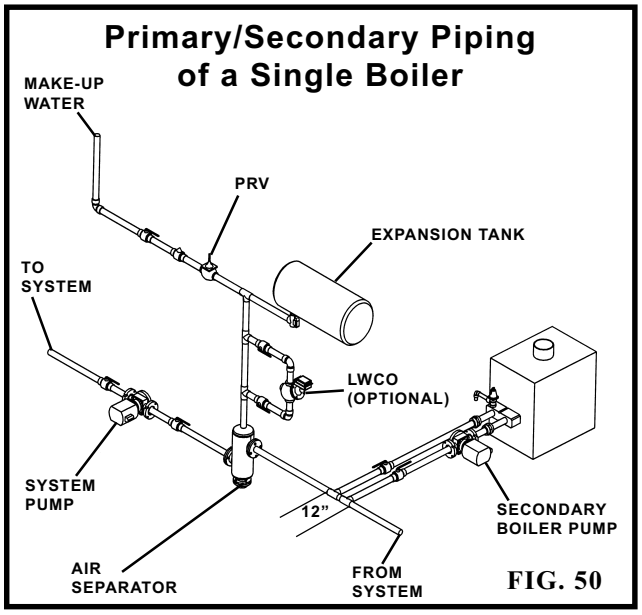
1. Maximum operating pressure for pump must exceed system operating pressure.
2. Maximum water temperature should not exceed nameplate rating.
3. Cast iron circulators may be used for closed loop systems.
4. A properly sized expansion tank must be installed near the boiler and on the suction side of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

CIRCULATOR PUMP OPERATION (Heating Boilers Only)

The boiler pump should run continuously unless the boiler is provided with the optional intermittent pump or pump delay control system. These optional pump control systems are available as factory installed options. These pump control systems consist of a relay and a time delay wired into the control circuit of each heating boiler. External wire leads are furnished with this option to allow the power supply for the pump to be switched across the normally open contacts of the relay, allowing the control relay to cycle the pump on each call for heat. The field installed boiler pump using the optional factory supplied pump control system must not exceed 10 AMPS at 120VAC. As shipped from the factory, the optional control systems are is set to cycle the boiler pump on at each call for heat before the burners fire and run the pump for a 30 second period after the thermostat is satisfied. This will remove any residual heat from the combustion chamber before turning the pump off. See wiring diagram shipped with the unit.

PUMP INSTALLATION AND MAINTENANCE:
For installation and maintenance information on the circulator pump, refer to pump manufacturers instructions included in the instruction package.

PRIMARY/SECONDARY BOILER PIPING



Boiler installations with a primary/secondary piping system as shown in FIG. 50 are recommended. This type of system uses a dedicated pump to supply flow to the boiler only. This secondary pump is sized based on desired boiler flow rate, boiler head loss and head loss in the secondary system piping only. A properly sized system pump provides adequate flow to carry the heated boiler water to radiation, air over coils, etc. The points of connection to the primary system should be a maximum of 12" (or 4 pipe diameters) apart to insure connection at a point of zero pressure drop in the primary system. Multiple boilers may also be installed with a primary /secondary manifold system as shown in FIG. 51. The multiple boilers are connected to the manifold in reverse return to assist in balancing flow to multiple boilers.

The installer must insure 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 on cycles, system noise and in extreme cases, a knocking flash to steam. These conditions indicate the need to increase boiler flow by installation of a larger circulator pump or the installation of a system bypass. System noise may also indicate an oversized boiler.

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

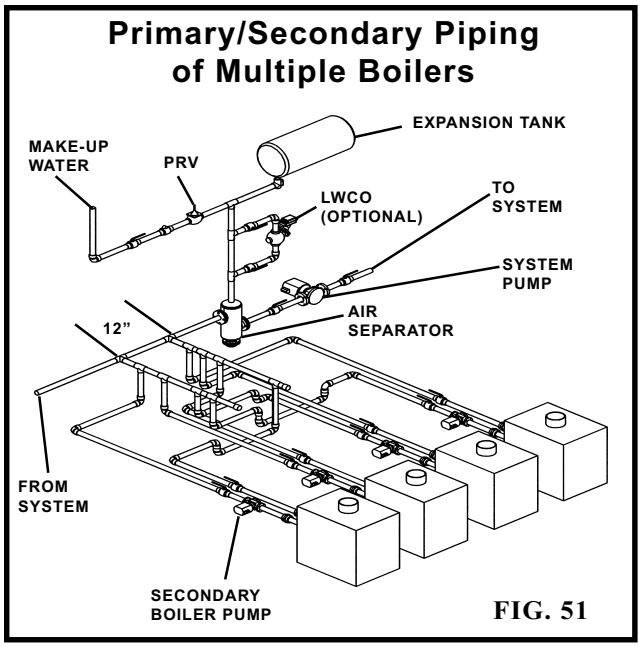
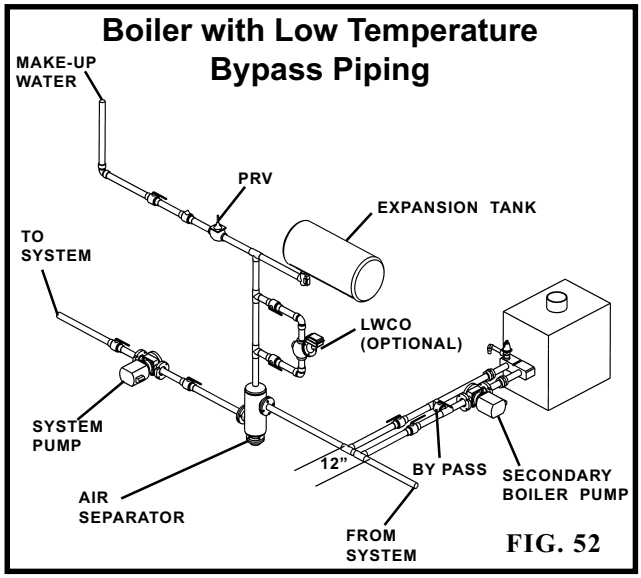


FIG. 52 must be piped into the system at the time of installation. this piping is like a primary/ secondary boiler installation with a bypass in the secondary boiler pieping. Inlet water temperatures below 140°F (60°C) can excessively cool the heat exchanger and in the flue. Condensation can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the vent system and related components. The bypass allows part of the boiler discharge water to be mixed with

CAUTION !!

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

LOW TEMPERATURE BYPASS REQUIREMENTS



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. The bypass should be fully sized with a balancing valve to allow for proper adjustment. 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. A remote low temperature range operator is recommended to control the boiler operation based on the lower system temperature. This remote operator should be wired across the R and W terminals (See Thermostat Connection and Terminal Strip instructions).

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-mettallic 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 oxygen in the system can restrict water flow resulting in a premature boiler failure. Any boiler damage due to excessive oxygenation is non-warrantable.

THREE WAY VALVES

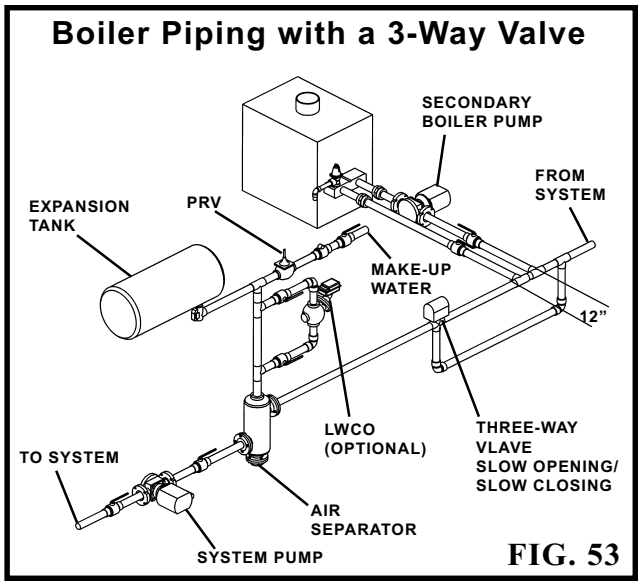


FIG. 53

The installation of a three way valve on this boiler is not generally recommended because most piping methods allow the three way valve to vary flow to the boiler. This boiler is a low mass, high efficiency unit which requires a constant water flow rate for proper operation. Low flow rates can result in overheating of the boiler water which can cause short burner on cycles, system noise and in extreme cases, a knocking flash to steam. These conditions can cause operational problems and non-warrantable failures of the boiler. If a three way valve must be installed, please pipe in a primary/secondary system as shown in FIG. 53. Based on boiler sizing and system flow requirements, this piping may still result in boiler short cycling.

TABLE — S
SYSTEM TEMPERATURE RISE CHART
Based on Btu Input

		ΔT 10º		ΔT 20º		ΔT 30º		ΔT 40º		ΔT 50º		ΔT 60º	
Input	Output	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD
300,000	252,000	51	5.2	26	1.3	17	0.6	13	0.6	10	0.6	9	0.5
990,000	831,600	166+	*	83	5.4	55	2.6	42	1.5	33	1.0	28	0.9
1,260,000	1,058,400	212+	*	106	*	71	4.4	53	2.7	42	1.7	35	1.2
1,440,000	1,209,000	242+	*	121+	*	81	6.3	61	3.8	48	2.3	40	1.8
1,800,000	1,512,000	303+	*	151+	*	101+	*	76	6.6	61	4.4	50	3.0
2,070,000	1,738,800	348+	*	174+	*	116+	*	87	9.0	70	6.2	58	4.6

+These flow rates exceed recommended flow rates of boiler. If these system temperature rises are used, an external piping by-pass must be installed.
*These foot head calculations exceed the maximum allowable flow rate of the boiler.

MAXIMUM REQUIRED FLOW FOR HEATING BOILER

CAUTION !!

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

Input-Btu/hr	Maximum Flow
300,000	60 GPM
990,000 - 2,070,000	90 GPM

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

The heat exchanger is generally capable of operating within the design flow rates of the building heating system. Should the flow rate exceed the maximum allowable flow rate through the boiler an external bypass must be installed. The bypass should be fully sized with a balancing valve to allow for proper adjustment of flow. Flow rate can be determined by measuring the temperature rise through the boiler.

BOILER BYPASS REQUIREMENTS

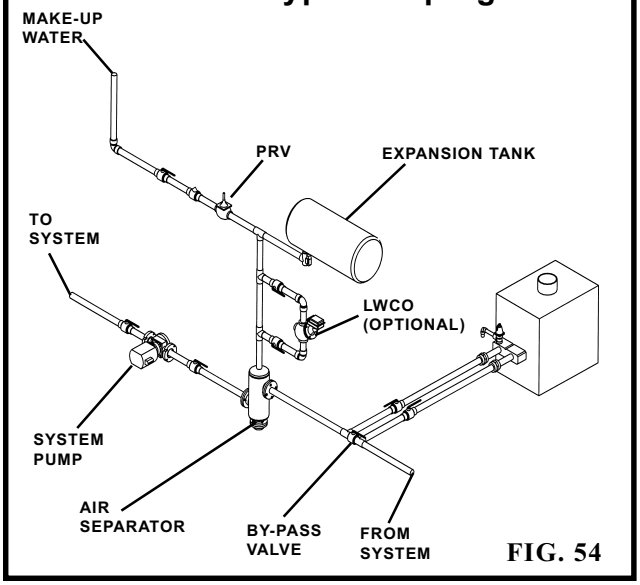


FIG. 54

The installer must insure that the boiler is supplied with adequate flow without excessive temperature rise. It is recommended that this boiler be installed with a bypass in the piping if the maximum recommended flow rate is exceeded. The bypass will help to insure that the boiler can be supplied with adequate water flow. Flow rates exceeding the maximum recommended flow will result in erosion of the boiler tubes. A typical bypass with a valve is shown in FIG. 54 will allow control of boiler flow.

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 heat exchanger. The gauge has one scale to read system pressure and a separate scale to read water temperature in °F. The temperature/pressure gauge can be used to determine temperature rise by first recording the temperature of the boiler water with the boiler off. Record the temperature of the boiler water as the boiler fires and the discharge temperature stabilizes. Subtract the boiler water temperature with the boiler off from the stable outlet water temperature with the boiler firing. This temperature difference is the temperature rise.

TYPICAL HEATING BOILER INSTALLATIONS

General Plumbing Rules

1. Check all local codes.
2. For serviceability of boiler, always install unions.
3. Always pipe pressure relief valve to an open drain.
4. Locate system air vents at highest point of system.
5. Expansion tank must be installed near the boiler and **on the suction side of the pump**.
6. Support all water piping.

PLACING THE BOILER IN OPERATION

Filling the System: All air must be purged from the system for proper operation. An air scoop and air vent must be located close to the boiler outlet and there should be a minimum distance between the cold water feed and the system purge valve.

1. Close all drain cocks and air vents.

2. Open the makeup water valve and slowly fill the system.

3. If a makeup water pump is employed, adjust the pressure to provide a minimum of 12 psi at the highest point in the system. If a pressure regulator is also installed in the line, it should be adjusted to the same pressure.

4. Close all valves. Purge one circuit at a time as follows:

   A. Open one circuit drain valve and let the water drain for at least five minutes. Ensure that there are no air bubbles visible in the water stream before closing the drain valve.

   B. Repeat this procedure for each circuit.

5. Open all valves after all circuits have been purged. Make sure there are no system leaks.

NOTE: **Do not use petroleum based stop leak products. All system leaks must be repaired. The constant addition of make-up water can cause damage to the boiler heat exchanger due to scale accumulation. Scale reduces flow and heat transfer, causing overheating of the heat exchanger.**

6. Run the system circulating pump for a minimum of 30 minutes with the boiler turned off.

7. Open all strainers in the system and check for debris.

8. Recheck all air vents as described in step 4 above.

9. Inspect the liquid level in the expansion tank. The system must be full and under normal operating pressure to insure proper water level in the expansion tank. Ensure that diaphragm type expansion tanks are properly charged and not water logged.

10. Start the boiler according to the "Start-Up Instructions" in the Installation and Service Manual. Operate the system, including the pump, boiler and radiation units, for one hour.

11. Recheck the water level in the expansion tank. If it exceeds half the tank volume, open the tank to reduce the water level. Recheck pressure charge on diaphragm type tanks.

12. Shut down the entire system and vent all radiation units and high points in the system.

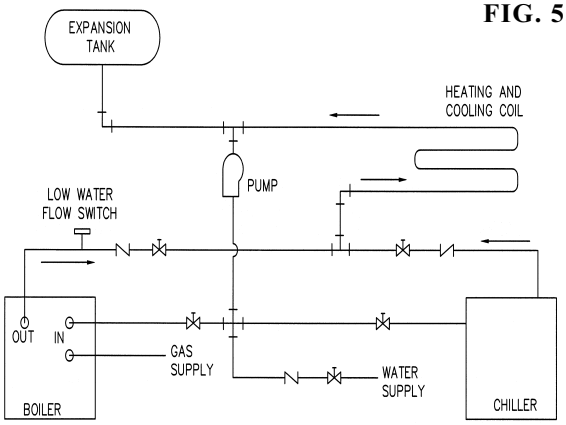
13. Close the water makeup valve and check the strainer and pressure reducing valve for sediment or debris. Reopen the water makeup valve.

14. Verify system pressure with the boiler pressure gauge before beginning regular operation.

15. Within three days of startup, recheck and bleed all air vents and the expansion tank using these instructions.

INSTALLATION WITH A CHILLED WATER SYSTEM

FIG. 55



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. (See FIG. 55)

BOILER OPERATING TEMPERATURE CONTROL

The operating temperature control for the 300,000 Btu/hr model is located on the control panel, inside of the top of the unit. The digital electronic operating temperature control for the 990,000 thru 2,070,000 Btu/hr models is located in the front control panel, behind the front access door. The sensing element for the unit's operator is placed in a bulb well installed in the inlet side of the heat exchanger front header. The operating sensor for the digital electronic temperature control may be remote mounted in the system piping if required. See "Remote Mounting of Sensor" instructions in this manual. Carefully observe the discharge water temperature on the initial boiler on cycles. The location of the temperature sensor will generally require a lower temperature set point on the operating control to achieve the desired discharge water temperature from the boiler. This sensing element location allows a boiler operating with a low to moderate flow rate to sustain longer burner on cycles, preventing short boiler "ON" cycles based on high discharge water temperatures. For example, a boiler operating with a 180°F (82° C) discharge and a 20°F (11° C) temperature rise would require approximately a 160°F (71° C) to 165°F (74° C) set point with the temperature sensor installed on the inlet side of the heat exchanger. The exact temperature set point is based on your system's requirements. Set the control set point(s) to the desired operating water temperature. Observe the boiler discharge temperature after each set point adjustment to insure proper operation.

EMS or REMOTE THERMOSTAT CONNECTION TO TERMINAL STRIP

An EMS, remote thermostat or other remote temperature control may be connected to the boiler. Follow the manufacturers instructions supplied with the remote thermostat for proper installation and adjustment. The boiler is equipped with a terminal strip to allow easy connection of a remote device. The terminal strip on a 300,000 Btu/hr unit is located on the control panel. The terminal strip on a 990,000 thru 2,070,00 Btu/hr unit is located in the electrical junction box, below the main gas connection. Connection of a set of dry switching contacts or a remote thermostat to the R and W terminals will allow the unit to be switched on and off by making and breaking the 24 VAC control circuit.

Remove the jumper between the R and W terminals on the terminal strip. Refer to the chart in this section to determine maximum allowable length and wire gauge recommended to connect the switching contacts of the remote thermostat to the R and W terminals on the terminal strip. Connection to the terminal strip will allow the remote thermostat to make and break the 24 VAC boiler control circuit turning the boiler on and off based on the remotely sensed temperature requirements. Set the boiler operating temperature control as a high limit when a remote thermostat or EMS is used as the operating control.

Terminal Strip
300,000 Btu Models

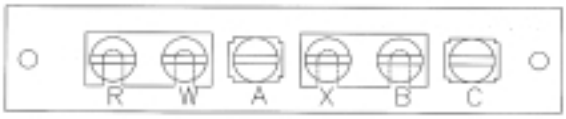


FIG. 56

EMS Terminal Strip
990,000 — 2.070,000 Btu Models

FIG. 57

EXTERNAL ENERGY MANAGEMENT SYSTEM CONNECTION TO TERMINAL STRIP FOR CONTROL OF STAGE FIRING OF BURNERS ON 990,000 THRU 2,070,000 BTU/HR MODELS

The 990,000 thru 2,070,000 Btu/hr models are equipped with a factory installed terminal strip for connection of a energy management system (EMS) to the burner stages. The EMS terminal strip is located in the unit's junction box. The terminal strip has up to three pairs of terminal connections for operation of the 990,000 Btu/hr model and four pairs of terminal connections for operation of the 1,260,000 thru 2,070,000 Btu/hr models. There is one pair of terminal connections for each stage of burner operation. Connection to these terminals requires a set of dry switching contacts to be used for each stage of burner operation. The jumper installed between the C and NO terminals of each stage MUST be removed when making connection to the EMS dry switching contacts for each stage. The connection to the stages on the terminal strip must always sequence on the stages in increasing order (1,2,3,4) and sequence off in reverse order (4,3,2,1). Insure that all wiring used for connection to this terminal strip is properly sized per the recommendations in Table T. When connecting an EMS to this terminal strip to sequence on each stage of burner operation, the unit's internal thermostat or electronic sequencer should be set as an additional high limit control. This will prevent problems between the set points of the EMS and the boiler's internal controller.

TABLE — T
REMOTE WIRE CONNECTION

Wire Gauge	Maximum Allowable Length
12 GA	100 ft
14 GA	75 ft
16 GA	50 ft
18 GA	30 ft

DOMESTIC HOT WATER SUPPLY BOILERS

300,000 and 990,000 - 2,070,000 Btu/hr Models

This section applies only to those units used to supply potable hot water for domestic use. The hot water supply boiler must be installed with a storage tank.

This section contains specific instructions for those units used to supply domestic hot water. All warnings, cautions, notes and instructions in the general installation and service sections apply to these instructions. Hot water supply boilers are designed for installation with a properly sized storage tank. The use of a properly sized pump and the control of water velocity, as explained below, are important for correct operation of your water heater or hot water supply boiler.

WATER VELOCITY CONTROL

IMPORTANT: **To insure 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, you may be assured of the proper velocity in the tubes. This will yield long life and economical operation from your hot water supply boiler.Excessive lime build-up in the tube is a result of too little velocity in the tubes. Excessive pitting or erosion in the tube is caused by too much velocity through the tubes. Care should be taken to measure temperature rise and maintain a velocity as follows:**

1. The pump must run continuously unless equipped with a factory supplied optional intermittent pump control or pump delay system.

2. With the pump running and the water heater or hot water supply boiler off, the inlet and outlet thermometers should read the same temperatures. If they do not, an adjustment must be made to your final calculation.

3. Turn the water heater or hot water supply boiler on and allow time for the temperature to stabilize. Record the difference between the inlet and outlet temperatures. This difference will be the "temperature rise."

4. Compare the temperature rise on the heater with the required temperature rise in Table U. Should adjustment be needed, proceed as follows:

If the temperature rise is too high, the water velocity is too low. Check the following:

1. Check for restrictions in the outlet of the water heater or hot water supply boiler.

2. Be sure all valves are open between the water heater or hot water supply boiler and the tank.

3. Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.

4. Be sure the installed circulation pipes between the water heater or hot water supply boiler and storage tank are not less than: 2" diameter - for a single 300,000 Btu/hr unit; 2 1/2" Diameter - for a single 990,000 through 2,070,000 Btu/hr unit

5. Common manifold piping for multiple unit installations will require larger minimum pipe sizes and tank circulating tappings to insure proper flow. See Table V.

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

1. Slowly throttle the valve on the outlet side of the water heater or hot water supply boiler until the temperature rise is steady at the required temperature rise as noted in Table U.

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.

REQUIRED TEMPERATURE RISE

Based on heating potable water with a hardness of 5 to 25 grains per gallon and/or total dissolved solids not exceeding 350 ppm. See "Water Chemistry."

TABLE — U

Btu/hr Input	Temperature Rise °F
300,000	9°
990,000	19°
1,260,000	24°
1,440,000	27°
1,800,000	34°
2,070,000	39°

WATER CHEMISTRY

The required temperature rise and the standard pump sizing are based on the heating of potable water with a hardness of 5 to 25 grains per gallon and a total dissolved solids not exceeding 350 ppm. Consult the manufacturer when heating potable water exceeding these specifications. Heating of high hardness and/or high total dissolved solids water will 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.

Typical Water Heater Piping with Storage Tank

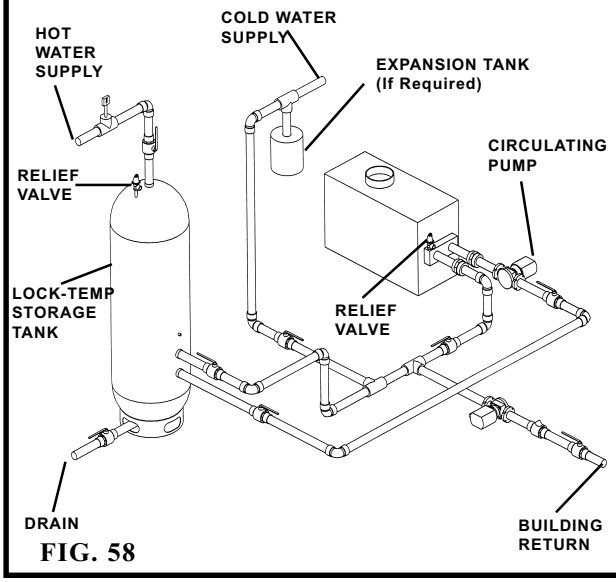


FIG. 58

COMMON WATER MANIFOLD SIZE FOR MULTIPLE HOT WATER SUPPLY BOILLER INSTALLATIONS

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

TABLE — V

Number of Units 300,000 Btu/hr	Common Manifold Size (Min)
1	2"
2	3"
3	3 1/2"
4	4"
5	5"
6	5"
Number of Units 990,000 - 2,070,000 Btu/hr	**Common Manifold Size (Min)**
1	2 1/2"
2	4"
3	4"
4	5"
5	6"
6	6"

PUMP OPERATION

1. The water heater or hot water supply boiler must be connected to a properly sized pump that circulates water between the heater and storage tank.

2. Pump is sized to heater input and water hardness. Care should be taken to size pump correctly. See "Water Chemistry."

3. The pump must run continuously unless the water heater or hot water supply boiler is equipped with a factory supplied optional intermittent pump control or pump delay system.

4. Lubricate pump to manufacturers recommendations. Pump damage due to inadequate lubrication is non-warrantable.

5. Standard water heaters or hot water supply boilers are furnished with the following circulating pump to be mounted on the units inlet water connection.

300,000 Btu/hr Models
1/4 HP, 120 VAC, 5.8 Amp

990,000 -2,070,000 Btu/hr Models
1/2 HP, 120 VAC, 7.4 Amp

This pump 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 quantities shown in this section, a larger pump will be required.

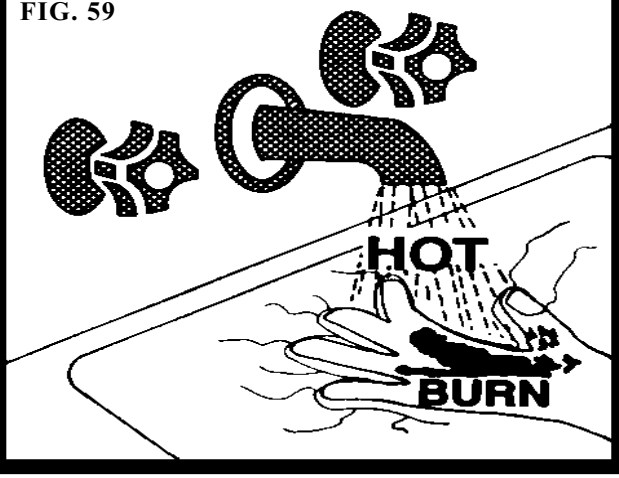
The standard pump selection is based on the following pipe and fittings from the unit to the storage tank:

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 5 FEET from maximum allowable straight pipe in heater to tank circulating loop.

⚠ DANGER

FIG. 59



Water temperature over 125ºF can cause severe burns instantly or death from scalds.

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

See instruction manual before setting temperature at heating appliance.

Feel water before bathing or showering.

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

MINIMUM PUMP PERFORMANCE

Based on heating potable water with a hardness of 5 to 25 grains per gallon and/or total dissolved solids not exceeding 350 ppm. See "Water Chemistry."

BTU/HR INPUT	GPM	Ft. Hd.
300,000	55	10
990,000 - 2,070,000	90	15

HEAT EXCHANGER

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

TEMPERATURE CONTROL SETTINGS FOR POTABLE HOT WATER

Domestic Water Temperatures:

This high efficiency hot water supply boiler should be operated at a temperature setting high enough to prevent condensing of the products of combustion on the unit's heat exchanger or in the attached venting system. A minimum water temperature setting of 140° F (60°C) is recommended to keep flue products from cooling to their dew point and condensing. 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 insure proper performance of the venting system. **A properly sized thermostatic mixing valve MUST be used to supply domestic hot water at temperatures less than 140° F to prevent a risk of scald injury.** 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.

CAUTION!!

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

300,000 Btu/hr Models:
This unit is equipped with an adjustable immersion thermostat to control potable water temperatures. The thermostat is adjusted to a low test setting when shipped from the factory. Turn the temperature adjustment knob to the desired setting that will supply hot water suitable for your application. When water is stored at temperatures above 130°F, (54°C) a thermostatic mixing valve **MUST** be installed on the hot water outlet from the tank to supply lower temperature water and prevent the risk of a scald injury when supplying hot water for domestic use.

990,000 through 2,070,000 Btu/hr Models:

1. These units are equipped with an electronic operating temperature control.

2. The electronic control set points are pre-programmed to a low test setting when shipped from the factory.

3. Reprogram the temperature set points to the lowest settings which will satisfy hot water demands, eliminate a possible condensate problem and prevent a risk of scald injury.

4. The temperature set points for all stages should be set at the same temperature when supplying potable hot water for domestic use.

5. Stage firing is achieved by setting the differentials at approximately 3°F, 5°F, 7°F and 9°F for stages 1, 2, 3, and 4. Stage firing of a potable water heater should only be used to replace system standby heat loss.

6. All stages of burner operation should fire when there is a major draw from the potable hot water storage system. This prevents possible condensate problems and insures a rapid recovery of the hot water used.

When water is stored at temperatures above 130°F, (54°C) a thermostatic mixing valve **MUST** be installed on the hot water outlet from the storage tank to supply lower temperature water and prevent the risk of a scald injury when supplying hot water for domestic use.

CAUTION!!

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

DOMESTIC HOT WATER TEMPERATUARES

This unit has an adjustable temperature control to maintain the desired water temperature set point. See temperature adjustment procedure in the general section of the manual for instructions to program the digital temperature control on 990,000 through 2,070,000 Btu/hr models. The immersion thermostat or electronic control is factory pre-set at approximately 125° F (52°C) or less. Households with small children or invalids may require 120° F (40°C) or lower temperature hot water to reduce risk of scald injury. A thermostatic mixing valve **MUST** be used to provide domestic hot water at temperatures lower than 140° F (60°C). Some states may require a lower water temperature setting for specific applications. Check with local codes or your gas supplier for local specifications governing the temperature requirements for domestic hot water. Remember, no water heating system will provide exact temperature at all times. Allow a few days of operation at the settings you have programmed into the control to determine the correct temperature setting consistent with your needs.

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

CAUTION !!

Hotter water increases the risk of scald injury.

Location of Cold Water Supply Piping Connections

Incorrect piping of the cold water supply to the system may result in excessive low temperature operation causing condensate formation on the heat exchanger and operational problems. The cold water supply piping must be installed in the discharge piping from the heater to the storage tank. This allows the cold water to be tempered in the storage tank before entering the heater. See FIG. 58 and typical installation drawings provided with the unit for correct piping. Higher water temperatures reduce condensate formation.

WARNING:

Should overheating occur or the gas fail to shut off, turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.

HIGH WATER TEMPERATURE LIMIT CONTROL

The unit is equipped with an adjustable setting, auto-reset high water temperature limit control. This water heater or hot water supply boiler temperature and limit control has a maximum limit setting 200°F (93°). If water temperature exceeds the set point, the limit will break the control circuit and shut down the unit. The limit control will only be reset after the water temperature has cooled below the set point of the limit. The high water temperature limit control is mounted in the outlet side fo the front header. A manual reset high water temperature limit control is available as an optional control.

OPTIONAL RELIEF VALVE

This water heater or hot water supply boiler is normally supplied with a temperature and pressure relief valve(s) sized in accordance with applicable codes. Units may be supplied with an optional pressure only relief valve(s). When a water heater or hot water supply boiler equipped with this optional relief valve 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 which discharges periodically may be due to thermal expansion in a closed system. A hot water supply boiler installed in a closed system, such as one with a backflow preventer or check valve installed in the cold water supply, shall be provided with means to control expansion. Contact the water supplier or local plumbing inspector on how to correct this situation. Do not plug or cap the relief valve discharge!

CATHODIC PROTECTION

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

Component Location Drawing
300,000 Btu/hr Models

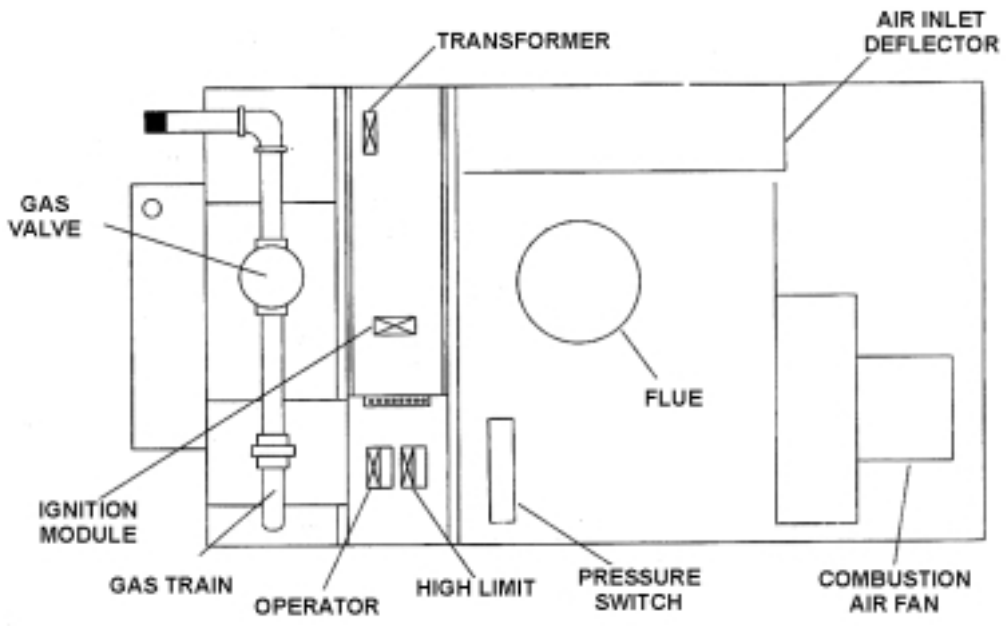


FIG. 61

Component Location Drawing
990,000 through 2,070,000 Btu/hr Models

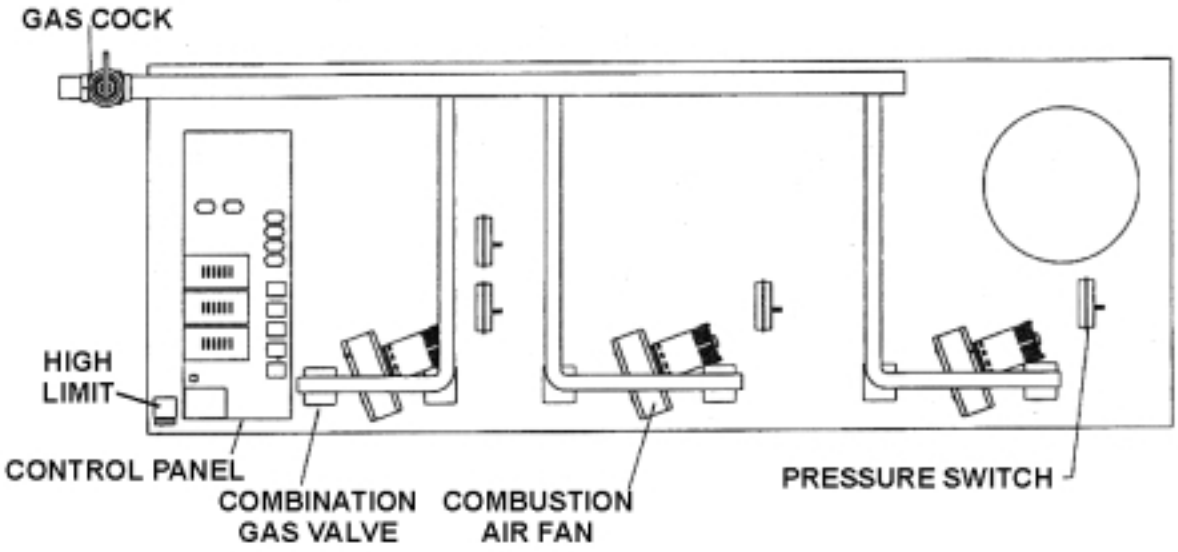


FIG. 62

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