

INSTALLATION AND SERVICE MANUAL



Hot Water Heating Boilers Domestic Hot Water Supply Boilers 399,999 — 750,000 Btu/hr 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.

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OWNER WARNING

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

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 unit 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 our unit, never violate the following safety rules.

1. Always keep the area around your boiler free of combustible materials, gasoline, and other flammable liquids and vapors.
2. Never cover your unit, 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.

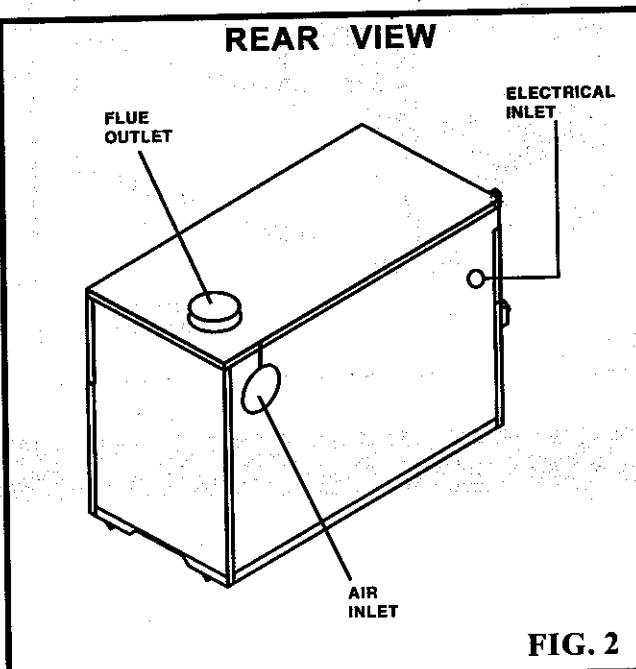
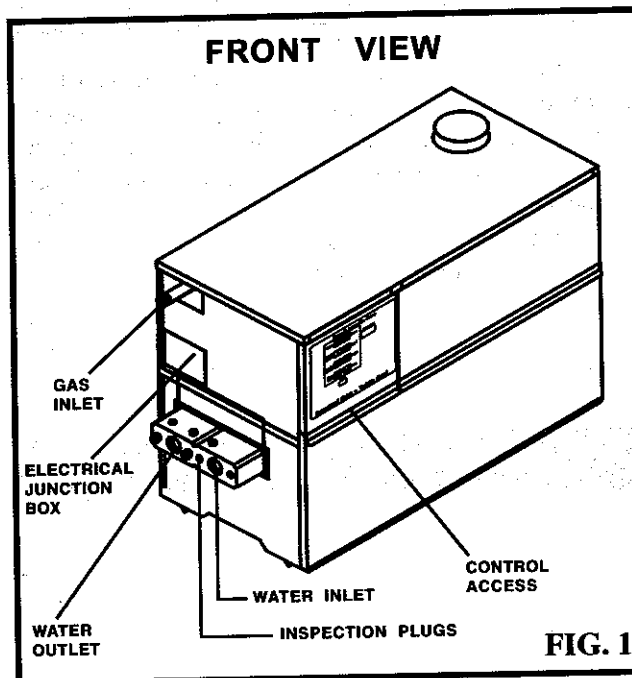
CODES

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 for any installations not covered by these instructions.

Automatically Fired Boilers, ASME CSD-1. All boilers conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV. Where required by the authority having jurisdiction, the installation must comply with the Canadian Association Code, CAN/CGA-B149 Installation Code and/or local codes.

This appliance meets the safe lighting performance criteria with the gas manifold and control assembly provided, as specified in the ANSI standards for gas-fired units, ANSI Z21.13.

INSTALLATION PROCEDURE



LOCATION OF UNIT

1. Locate the unit 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 water damage 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, noncombustible floor. Concrete over wood is not considered a noncombustible 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 special base:

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 in Table A.

SPECIAL COMBUSTIBLE FLOOR BASE

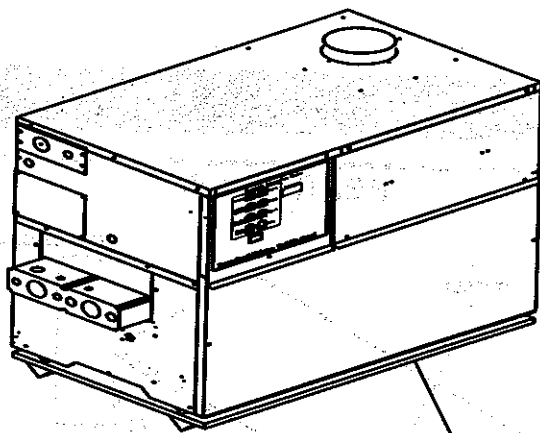


FIG. 3

COMBUSTIBLE
FLOOR BASE

TABLE A COMBUSTIBLE FLOOR KITS

| Input Btu/hr | Kit Number |
|--------------|------------|
| 399,999 | CFK3301 |
| 500,000 | CFK3302 |
| 650,000 | CFK3303 |
| 750,000 | CFK3304 |

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 noncombustible pad. Outdoor models have additional special location and clearance requirements. These are specifically addressed in the venting section under outdoor installation. A windproof cabinet protects the unit from weather.

CLEARANCES FROM COMBUSTIBLE CONSTRUCTION

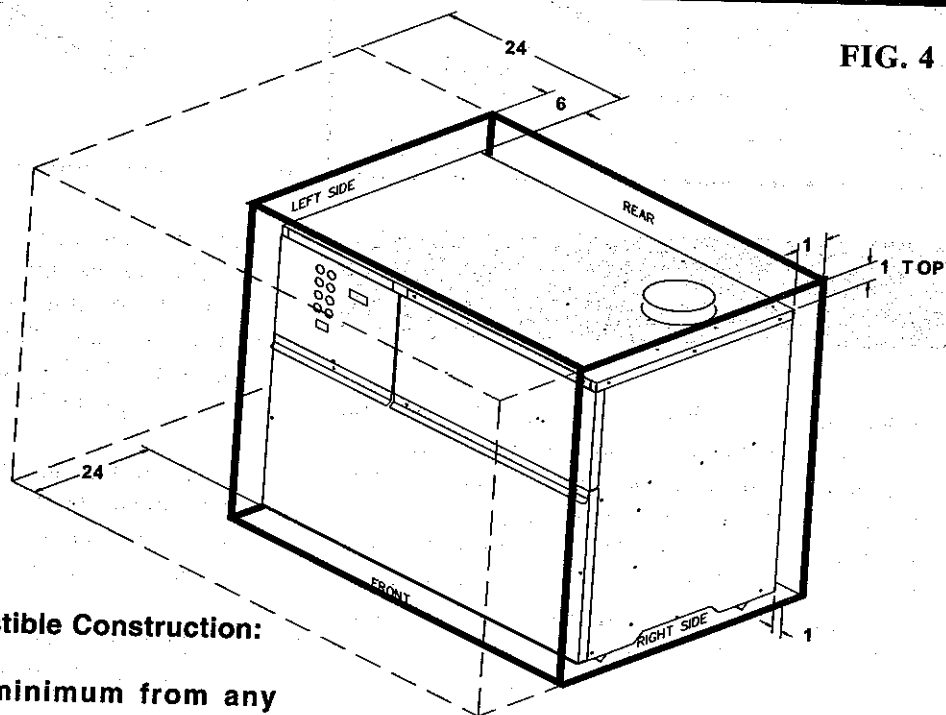


FIG. 4

Clearances from Combustible Construction:

Right Side - 1" (2.5cm)

Rear - 1" (2.5cm) (1" minimum from any surface)

Left Side - 6" (15cm) (24" (0.61m) suggested for service)

Front - ALCOVE* (24" (0.61m) suggested for service)

Top - 1" (2.5cm)

Flue - 1" (25.4mm)

Hot Water Pipes - 1" (25.4mm)

*An ALCOVE is a closet without a door.

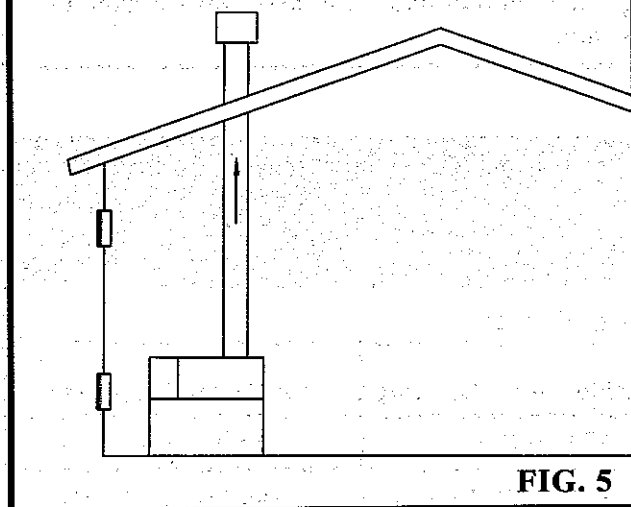
Maintain minimum specified clearances for adequate operation. Allow sufficient space for servicing pipe connections, pump and other auxiliary equipment, as well as the appliance. See rating plate for specific service clearance requirements.

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

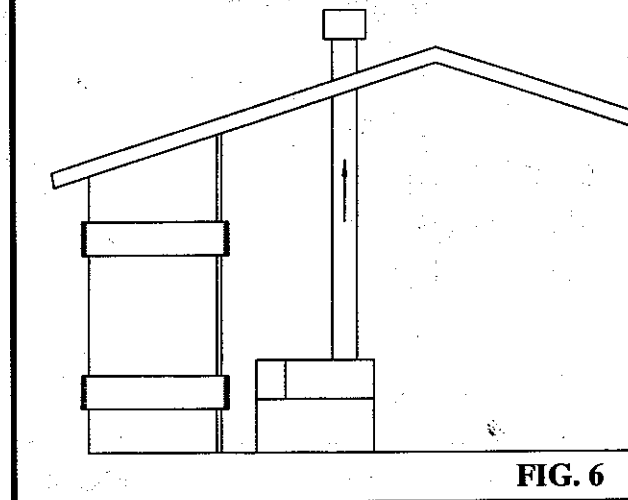
The equipment room MUST be provided with properly sized openings to assure adequate combustion air and proper ventilation when the unit is installed with conventional venting or sidewall venting.

Combustion Air Direct from Outside



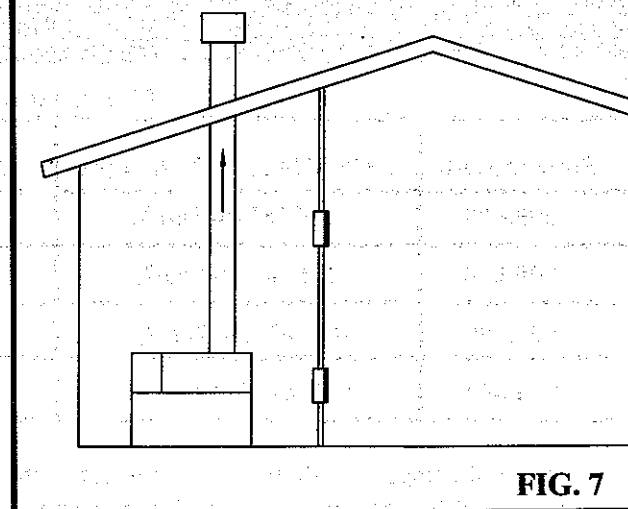
1. If air is taken directly from outside the building with no duct, provide two permanent openings:
 - a. Combustion air opening, with a minimum free area of one square inch per 4000 Btu input (5.5cm^2 per kW). This opening must be located within 12" (30 cm) of the bottom of the enclosure.
 - b. Ventilation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

Combustion Air Through Ducts



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

Combustion Air from Interior Space



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

Combustion Air from Outside Single Opening

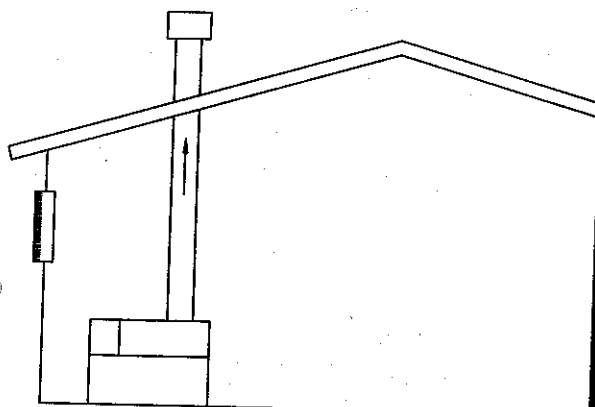


FIG. 8

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 (7cm² per kW). This opening must be located within 12" (30cm) of the top of the enclosure.

Standard CAN/CGA B149 Installation Code Check all local code requirements for combustion air.

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 net free area as specified in the chart above. Single openings shall be installed within 12" (30 cm) of the ceiling.

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.

TABLE — B
MINIMUM RECOMMENDED COMBUSTION
AIR SUPPLY TO EQUIPMENT ROOM

| Combustion Air Source | | | |
|-----------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| Boiler Input | Outside Air*/2 Openings | Outside Air*/1 Opening | Inside Air/2 Openings |
| 399,999 | 100 in ² (645cm ²) | 133 in ² (858cm ²) | 400 in ² (2581cm ²) |
| 500,000 | 125 in ² (806cm ²) | 167 in ² (1077cm ²) | 500 in ² (3226cm ²) |
| 650,000 | 163 in ² (1052cm ²) | 217 in ² (1400cm ²) | 650 in ² (4194cm ²) |
| 750,000 | 188 in ² (1213cm ²) | 250 in ² (1613cm ²) | 750 in ² (4839cm 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 National

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 solvents, such as Freon, trichlorethylene, perchlorethylene, 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 Standard 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 Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

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

Vent connection is made directly to the 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.

NOTE:

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

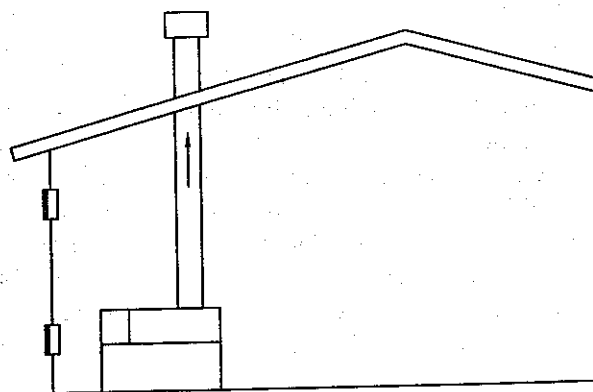


FIG. 9

A CONVENTIONAL NEGATIVE DRAFT VENTING SYSTEM

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.

**FLUE PIPE SIZES
TABLE C**

| Input Btu/hr | Flue Size |
|--------------|-----------|
| 399,999 | 6" |
| 500,000 | 6" |
| 650,000 | 8" |
| 750,000 | 8" |

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 boilers 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 inch 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 through the chimney.

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

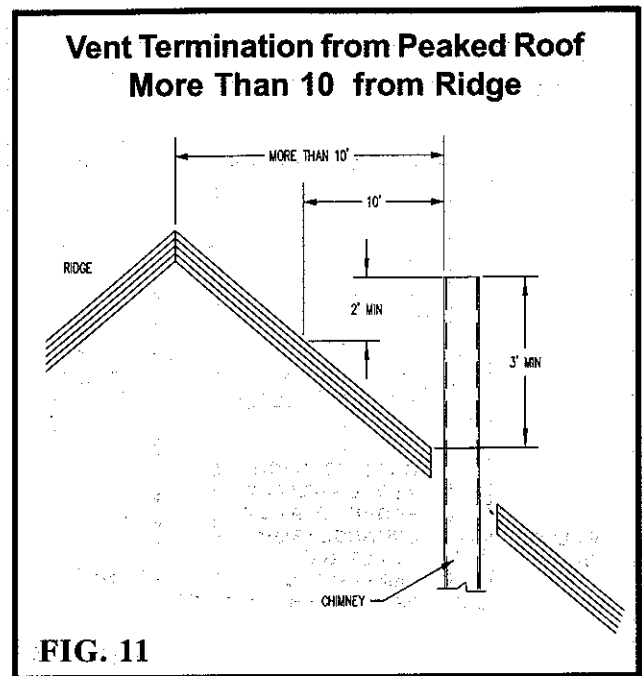
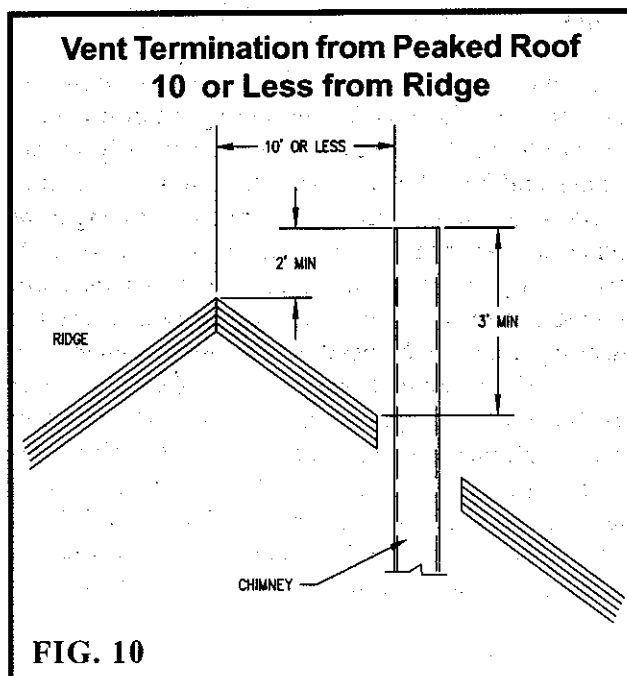
Vent connectors serving appliances vented by natural draft shall not be connected to any portion of a mechanical draft system operating under positive pressure. Connection to a positive pressure stack may cause flue products to be discharged into the living space causing serious health injury.

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.

- Seal any unused opening in the common venting system.
- 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.
- 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.
- Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

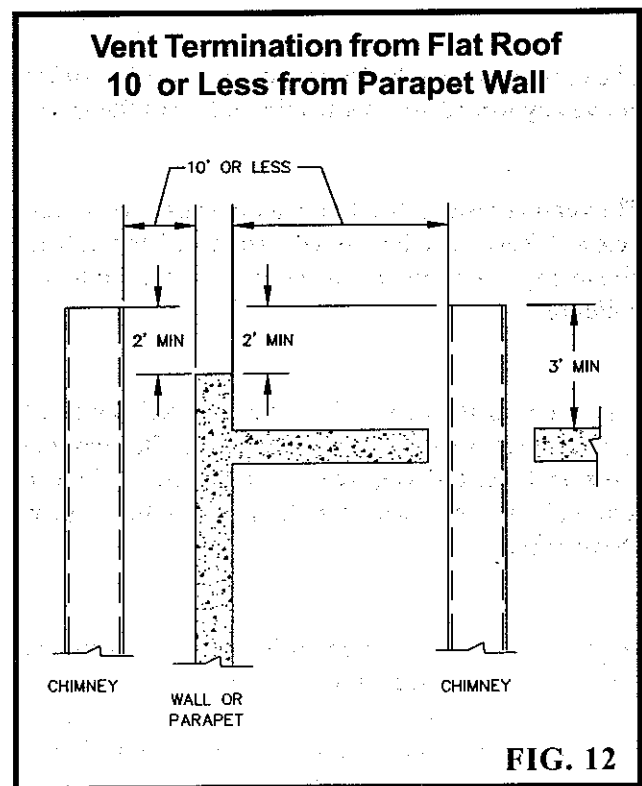
- (e) Test for spillage at the draft hood/relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
- (f) After it has been determined that each appliance remaining connected to the common venting system properly vents when 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 Standard B149 Installation Code for Gas Burning Appliances and Equipment. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CNA/CGA Standard 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 Flat Roof More Than 10 from Parapet Wall

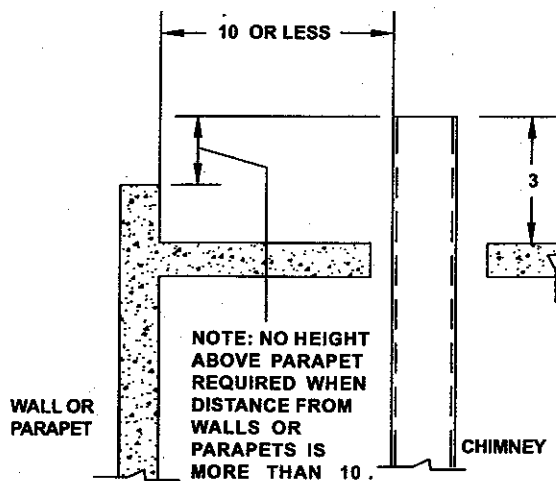


FIG. 13

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

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

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

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

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

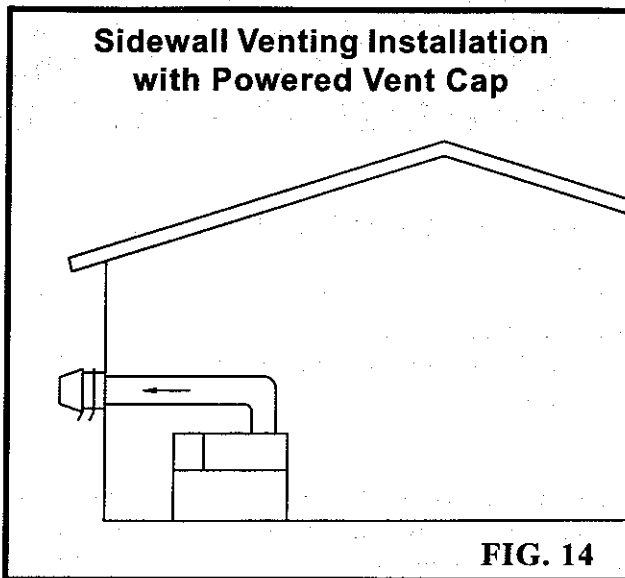
MASONRY CHIMNEY INSTALLATION

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

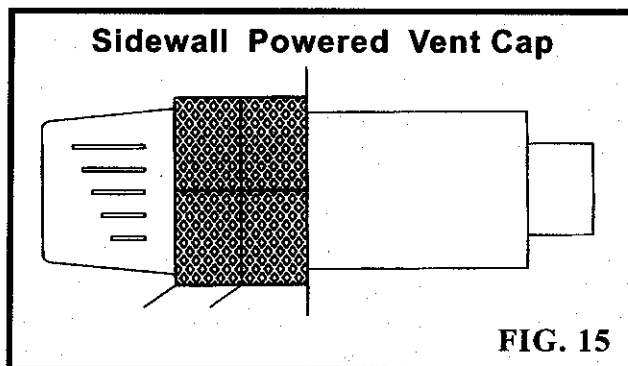
A masonry chimney must be carefully inspected to determine its suitability for the venting of flue products. A clay tile lined chimney must be structurally sound, straight and free of misaligned tile, gaps between liner sections, missing sections of liner or any signs of condensate drainage at the breaching 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.

The Sidewall Venting System



SIDEWALL VENTING WITH A POWERED VENT CAP

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



Sidewall Vent Cap for 399,999 through 750,000 Btu/hr Models

The powered vent cap has a fan mounted in the vent cap which must be installed on an exterior sidewall. The 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 boiler's control system.

The fan in the powered vent cap **MUST** be interlocked with the boiler's 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.

The internal damper on the sidewall fan must be adjusted to supply a negative draft within the range of 0.02 to 0.08 inches water negative while unit is operating.

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.

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 vent pipe lengths.

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 sidewall vent system shall terminate at least 1 foot (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 |
|-----------------|--------------|-----------------------------|
| 399,999 | 6" | SVK3006 |
| 500,000 | 6" | SVK3006 |
| 650,000 | 8" | SVK3008 |
| 750,000 | 8" | SVK3008 |

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.

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.

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).

Vertical DirectAire™ Installation with Sidewall Combustion Air

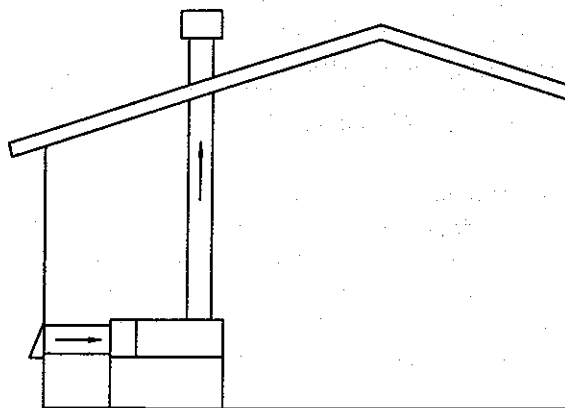


FIG. 16

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.

Vertical DirectAire™ Installation with Roof Top Combustion Air

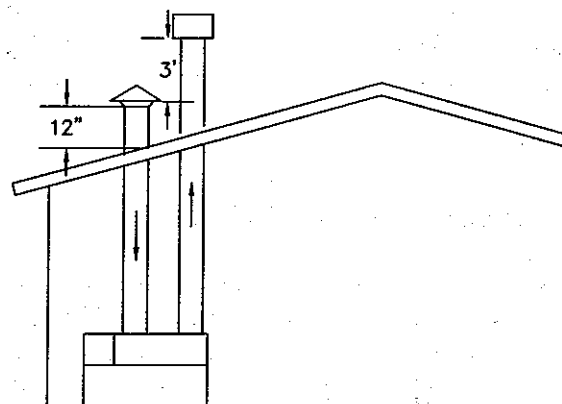


FIG. 18

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 Sidewall Termination

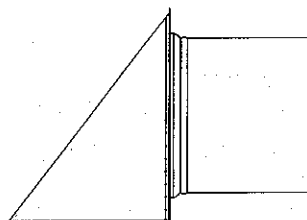


FIG. 17

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 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.

Air Inlet Cap for Roof Top Termination

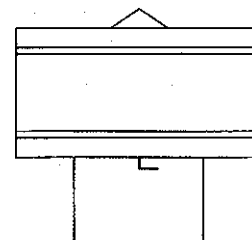


FIG. 19


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 feet (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 an 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

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 **DirectAir** combustion air inlet pipe must not exceed a maximum of 50 equivalent feet (15.24m) 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 **Vertical DirectAir 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 DirectAir 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 operational problems with the boiler or potentially hazardous 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 8" air inlet pipes (50.3 in² area each) have a total area of 100.6 in² and will require a 12" (113.1 in² 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 DirectAir** system requires installation of a single wall pipe to supply combustion air from outdoors directly to the unit.

TABLE E

| Input Btu/hr | Conventional Vent Flue Size | Air Inlet Pipe* | Sidewall Air Inlet Kit | Rooftop Air Inlet Kit |
|--------------|-----------------------------|-----------------|------------------------|-----------------------|
| 399,999 | 6" | 6" | SVK3015 | VDK3006 |
| 500,000 | 6" | 6" | SVK3015 | VDK3006 |
| 650,000 | 8" | 8" | SVK3016 | VDK3008 |
| 750,000 | 8 | 8" | SVK3016 | VDK3008 |

* Minimum diameter, installer may increase diameter one pipe size for ease of installation if needed. A 10" diameter air inlet cap may be ordered for sidewall air inlet as *Sidewall Air Inlet Kit* SVK3017 and for rooftop air inlet as *Rooftop Air Inlet Kit* VDK3009.

Venting of Flue Products

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

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

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.

The Horizontal DirectAire Vent System

Horizontal DirectAire Installation

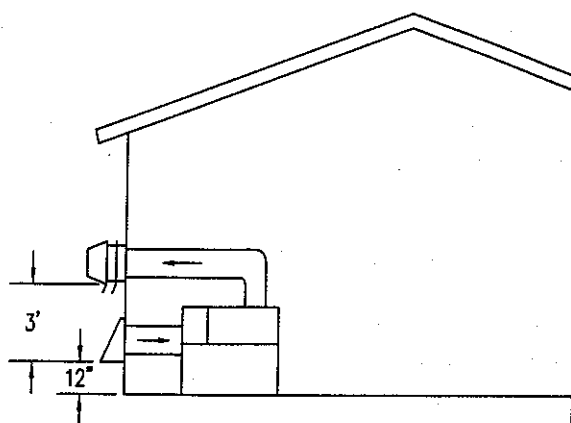


FIG. 20

HORIZONTAL DIRECTAIRE™ WITH A SIDEWALL FLUE AND SIDEWALL AIR INLET

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 0.02 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

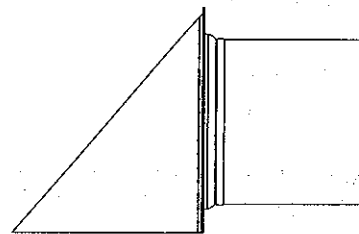


FIG. 21

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 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 DirectAir* 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 moisture in the incoming combustion air.

Length of Air Inlet Pipe

The total equivalent length of the *Horizontal DirectAir* 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 DirectAir 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 pipes are purchased locally.

| TABLE F | | | |
|-----------------|--------------|--------------------------|---------------------------------|
| Input Btu/hr | Flue Size | DirectAir Inlet Pipe* | Horizontal DirectAir Kits |
| 399,999 | 6" | 6" | HDK3006 |
| 500,000 | 6" | 6" | HDK3006 |
| 650,000 | 8" | 8" | HDK3008 |
| 750,000 | 8" | 8" | HDK3008 |

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

The sidewall air inlet cap supplied in the *Horizontal DirectAir 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.

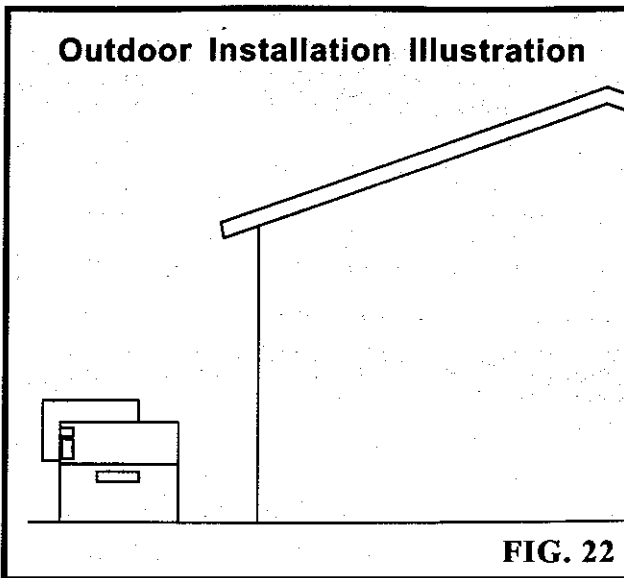
Termination point for the flue products must follow the clearance requirements in the Sidewall Vent Termination section of Sidewall Venting.

A barometric damper is **NOT** required in the flue on *Horizontal DirectAir* 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 DirectAir* systems. Proper freeze protection must be provided. See Freeze Protection.

The Outdoor Vent System



OUTDOOR INSTALLATION

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 (0.91m) 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.

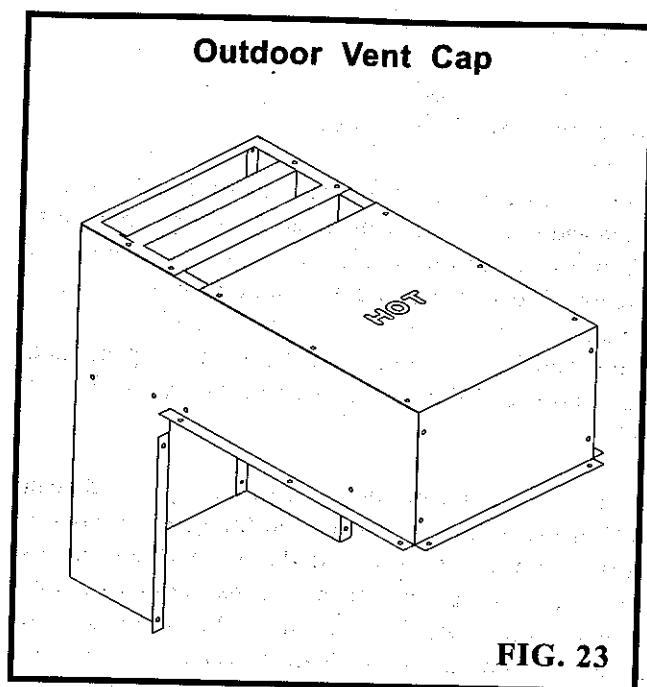
The boiler must be at least 10 feet (3.05m) away from any forced air inlet.

The boiler 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.

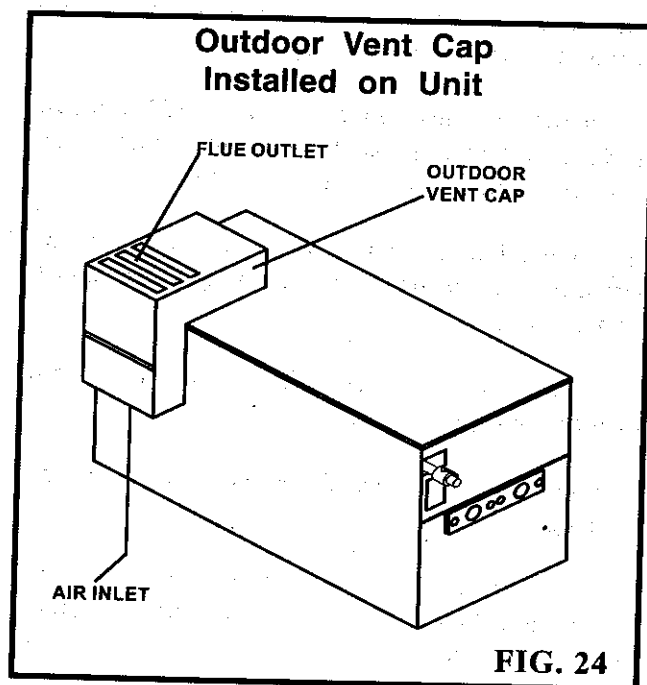
Flue gas condensate can freeze on exterior walls or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Some discoloration to exterior building or unit surfaces can be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal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



| TABLE G | |
|-----------------|---------------------------|
| Input Btu/hr | Outdoor Cap Kit Number |
| 399,999 | ODK3019 |
| 500,000 | ODK3020 |
| 650,000 | ODK3021 |
| 750,000 | ODK3022 |

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) | 4.5"w.c. | 8"w.c. |

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

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.

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 referenced to the fan pressurized chamber in the jacket. The regulator pressure must be added to the chamber pressure to obtain actual manifold pressure for normal operation. Chamber pressure may vary

based on elevation, vent length and model. For information on chamber pressure, see Combustion Air Adjustment. If adjustment of regulator pressure is required, see Manifold Adjustment Procedure. **Do not increase regulator pressure beyond specified pressure setting.**

TABLE I
NET MANIFOLD PRESSURE
Regulator Pressure Less
Front Chamber Pressure

| Type of Gas | Net Manifold Pressure Setting |
|-------------|-------------------------------|
| Natural Gas | 1.8" w.c. |
| L.P. Gas | 4.6" w.c. |

GAS PRESSURE TEST

1. The boiler 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 boiler 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.

APPLIANCE GAS CONNECTION PIPE SIZE

| Input Btu/hr | Pipe Connection |
|-------------------|-----------------|
| 399,999 - 500,000 | 1" |
| 650,000 - 750,000 | 1 1/4" |

TABLE J
SUGGESTED GAS PIPE SIZE
SINGLE UNIT INSTALLATIONS

| BTU INPUT | DISTANCE FROM METER | | | | |
|--------------|---------------------|----------|-----------|-----------|-----------|
| | 0-50' | 51'-100' | 101'-200' | 201'-300' | 301'-500' |
| 399,999 | 1 1/4" | 1 1/4" | 1 1/2" | 2" | 2 1/2" |
| 500,000 | 1 1/4" | 1 1/2" | 2" | 2" | 2 1/2" |
| 650,000 | 1 1/2" | 2" | 2" | 2 1/2" | 2 1/2" |
| 750,000 | 1 1/2" | 2" | 2" | 2 1/2" | 3" |

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

TABLE K
FITTINGS TO
EQUIVALENT STRAIGHT PIPE

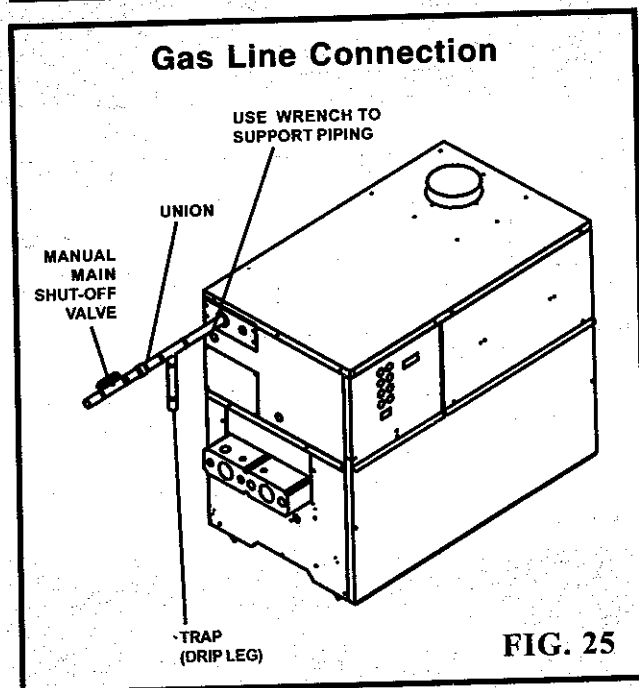
| Diameter Pipe (inches) | | | | | | | | |
|-------------------------------------------|----|--------|--------|----|-----|-----|-----|--|
| 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 3" | 4" | 5" | |
| Equivalent length of Straight Pipe (feet) | | | | | | | | |
| 2' | 2' | 3' | 4' | 5' | 10' | 14' | 20' | |

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



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 gas valve is referenced to the fan pressurized chamber by a hose connected from the vent of the gas valve regulator to the chamber pressure tap located on the front inside portion of the jacket. Reference the drawings in this section for component location and connection points for pressure measurement. The referenced chamber pressure must be subtracted from the manifold pressure to obtain actual net manifold pressure for normal operation. 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.

Front Chamber Pressure 399,999 — 750,000 Btu Models

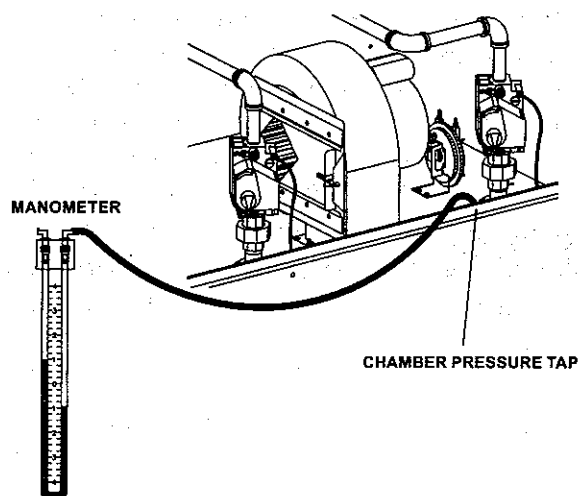


FIG. 26

1. Turn the power switch to the OFF position.
2. Remove the top front jacket panels.
3. Locate the air pressure switch located to the right of the combustion air fan. Trace the hose from the air pressure switch to the barb located in the top right front corner of the upper chamber. See Fig.26. Remove the hose from this barb and connect the hose from the manometer or magnahelic to this barb to measure the air pressure in the front chamber.
4. Turn the power switch to the "ON" position.
5. Push the ignition control reset button located on the front of the inner control panel.
6. Set the electronic temperature control to call for heat. The fan should start.
7. While the combustion air fan is running for the prepurge cycle and the pressure in the front chamber stabilizes, record the pressure in the front chamber. This pressure will be used to calculate the net manifold pressure.
8. Turn the power switch to the "OFF" position.
9. Remove the manometer or magnahelic hose from the front chamber barb and reinstall the hose from the air pressure switch to the barb.
10. Turn all gas valve knobs and the manual gas cock to the "OFF" position.

Manifold Gas Pressure Measurement 399,999 — 750,000 Btu Models

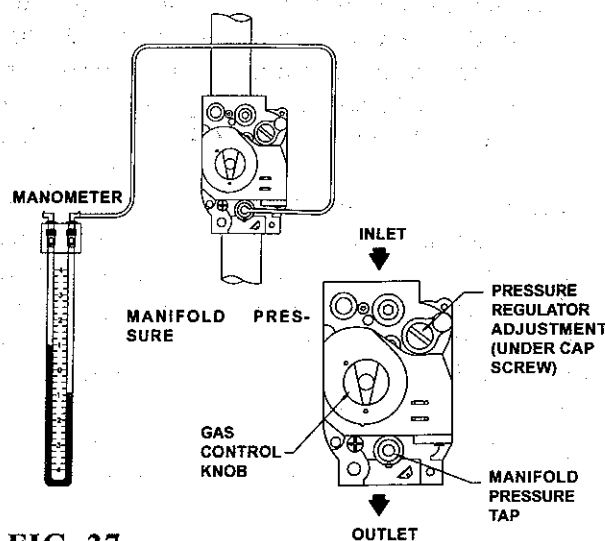


FIG. 27

11. Remove the 1/8" hex plug, located on outlet side of the gas valve and install a fitting suitable to connect to a manometer or magnahelic gauge. See Fig. 27. Minimum range of scale should be up to 5" w.c. for natural gas and 10" w.c. for propane gas.

12. A reference pressure hose is factory installed from the barbed connection on the gas valve regulator to the fan pressurized front chamber. All manifold pressure measurements made with the reference hose in place will be the sum of the net manifold pressure and the air pressure in the front chamber.

13. Turn the power switch to the ON position.

14. Push the reset button for the ignition control.

15. Turn all gas valve knobs to the ON position.

16. Set the electronic temperature control to call for heat.


17. Before the valve opens, the manometer or magnahelic gauge will read a positive air pressure of 1.4" w.c. to 1.8" w.c. in the jacket as supplied by the combustion air fan on high speed in the prepurge cycle. There is no gas flow at this point. This air pressure reading is normal.

18. The gas valve will open at the end of the trial for ignition stage and remain open as the burners fire. Observe the gas manifold pressure when valves open. If insufficient gas pressure is supplied to the burners, the burners will not fire. Record the gas pressure indicated on the manometer or magnahelic. Subtract the air pressure in the front chamber (as recorded in step 7) from the gross manifold pressure observed at the end of trial for ignition and when the burners are firing. The gross manifold pressure will typically be within the range of 3.4" w.c. to 3.9" w.c. for Natural Gas and 6.1" w.c. to 6.7" w.c. for L.P. Gas at full fire. The difference in the gross manifold pressure and the front chamber pressure is the net manifold pressure setting of the gas valve's regulator. Compare the net setting to the setting specified for the type of gas used. Models with inputs of 399,999 thru 750,000 Btu/hr will have multiple gas valves and regulators. The pressure at each regulator must be observed when the individual stage gas valve is energized in the trial for ignition and burner on stages of operation. Adjust each regulator as required. Set the electronic temperature control to a setting lower

than the boiler's water temperature to turn the burners off. Allow unit to run through the post purge sequence. Turn the power switch to the OFF position.

TABLE M
NET MANIFOLD PRESSURE
Regulator Pressure Less
Front Chamber Pressure


| Type of Gas | Net Manifold Pressure Setting |
|-------------|-------------------------------|
| Natural Gas | 1.8" w.c. |
| L.P. Gas | 4.6" w.c. |

NOTE:  The front chamber pressure must be subtracted from the gross regulator pressure to obtain actual net manifold pressure for normal operation. The front chamber pressure may vary based on elevation, stages of operation, vent length and model. For information on chamber pressure, see Combustion Air Adjustment. **Do not increase net manifold pressure beyond the specified pressure setting.**

19. If adjustment is necessary, remove the regulator cover screw on the gas valve.

20. Turn regulator adjustment screw clockwise to raise regulator gas pressure, counter clockwise to lower the regulator gas pressure. Turn regulator adjustment screw \varnothing turn in the desired rotation and cycle the burners on in the sequence listed below and record the observed chamber and regulator settings. Subtract to determine the net manifold pressure setting. Repeat as necessary to achieve the specified net manifold pressure setting.

21. Replace cover screw on the regulator and turn the power switch to the "ON" position. Set the electronic temperature control or thermostat to call for heat. Observe gas regulator pressure again at the burner "ON" stages. Repeat this sequence until the proper regulator setting has been obtained.

NOTE:  If the regulator cover screw is not in place and tight, the unit will not function properly.

22. Turn the power switch to the OFF position.

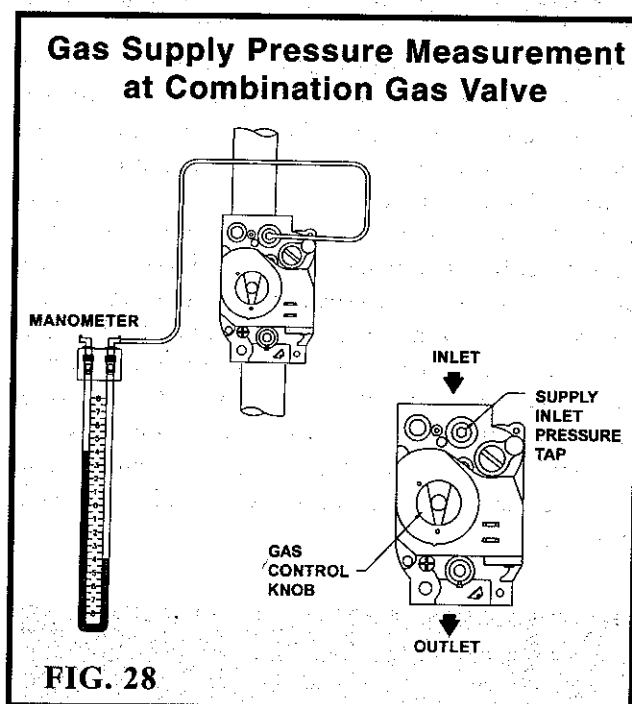
23. Turn gas valves and manual gas cock knob to the OFF position.

24. Remove the gas pressure fitting from the gas valve and replace with the 1/8" hex plug (that was previously removed) and tighten.
25. Insure that the chamber pressure reference hose is properly connected to the gas valve.
26. Turn the gas valve knobs to the ON position.
27. Turn the power switch to the ON position and replace the jacket panels. The appliance is now ready to operate.

If manifold pressure can not be properly maintained, 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.



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 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. Push the reset button for the ignition control.
8. Turn the gas valve knobs to the "ON" position. Set the electronic temperature control or thermostat to call for heat.
9. 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.
10. If gas 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.
11. If gas pressure is within normal range, proceed to remove gas manometer and replace pressure tap fittings in the gas control.
12. Turn the power switch to the "OFF" position.
13. Turn gas valve knob to the "OFF" position.
14. 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.
15. Remove the manometer and related fittings from inlet side of the gas valve, replace 1/8" hex plug in gas valve and tighten.
16. Turn on gas supply at the manual valve, turn on L.P. gas at tank if required.
17. Turn the power switch to the "ON" position.
18. Push the reset button for the ignition control.
19. Turn the gas valve knob to the "ON" position.
20. 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.

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

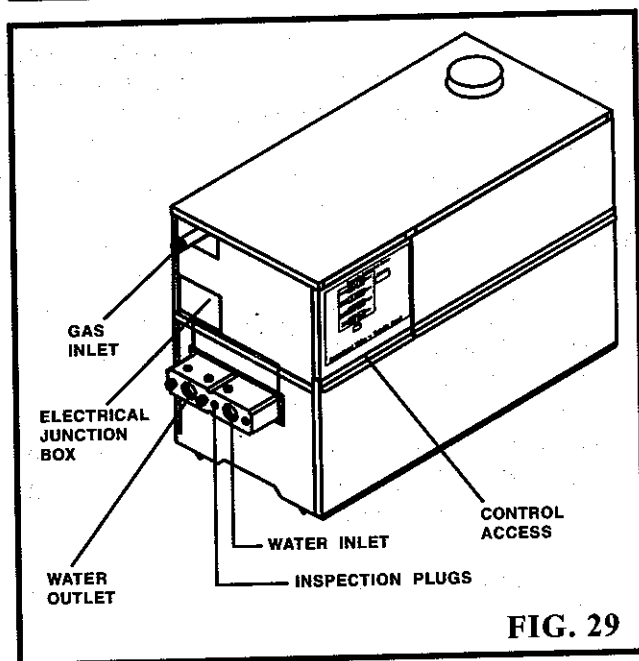


FIG. 29

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 available as a factory installed option on the 399,999 through 750,000 Btu/hr heating boilers and hot water supply boilers. 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. A factory supplied flow switch installed in the outlet connection requires a minimum flow of 19 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 cutoff device must be installed at the time of boiler installation. Electronic or float type low water cutoffs are available as a factory supplied option on all units. Low water cutoffs should be inspected every six months, including flushing of float types.

COMBINATION GAS VALVES

399,999 through 750,000 Btu/hr Input:

The 399,000 and 500,000 Btu/hr models fire in two stages of burner input, the 650,000 and 750,000 Btu/hr models fire in three stages of burner input. Each stage has a single combination gas valve 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 adjustment screw located under the cover screw.

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 is minimal, should a rupture of the diaphragm occur. Combination gas valve/regulators equipped with integral vent limiters are not required to have vent or relief lines piped to the outdoors. A barbed connection is provided at the vent termination point on the valve to connect the pressure hose from the fan pressurized chamber to the regulator. The hose connection prevents stoppage of the vent limiter by foreign material. 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° F (35° C) rise].
2. Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
3. The 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.

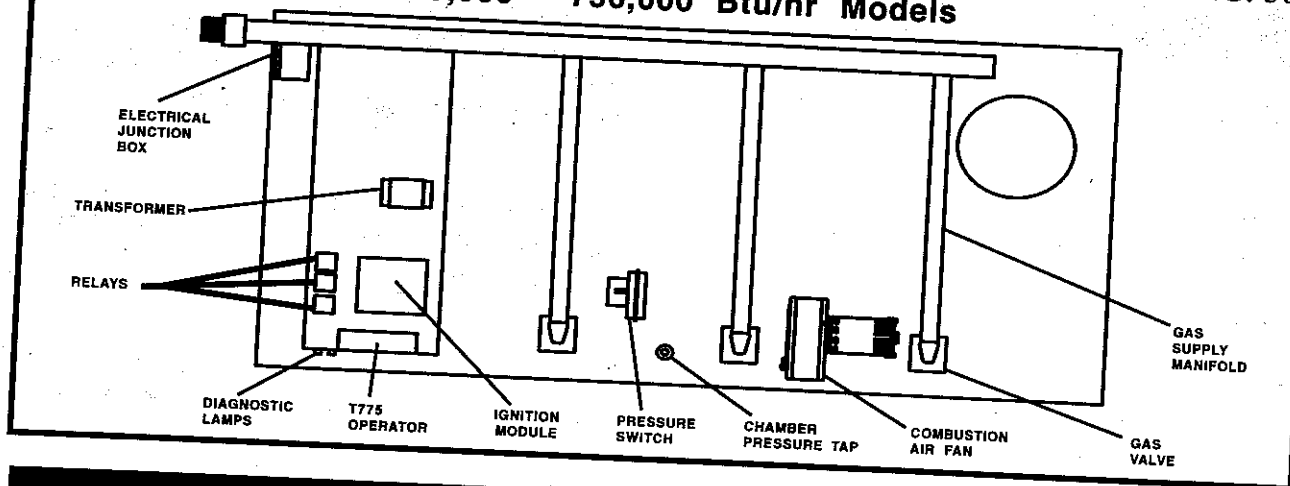
TABLE N

AMP DRAW DATA
399,999 through 750,000
Btu/hr Models

| Btu/hr Input | Fan | Controls | Approximate Total AMPS @ 120 VAC |
|--------------|-----|----------|----------------------------------|
| 399,999 | 3.6 | 2.7 | 6.3 |
| 500,000 | 3.6 | 2.7 | 6.3 |
| 650,000 | 5.4 | 3.4 | 8.8 |
| 750,000 | 5.4 | 3.4 | 8.8 |

Component Location Drawing 399,999 — 750,000 Btu/hr Models

FIG. 30



TEMPERATURE ADJUSTMENT

399,999 through 750,000 Btu/hr Models:

ELECTRONIC OPERATING TEMPERATURE CONTROL

These boilers 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 399,999 and 500,000 Btu/hr units operates with two (2) stages of control, 650,000 and 750,000 Btu/hr units operate with three (3) 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.

Electronic Temperature Control, LCD Display and Programming Keys T775

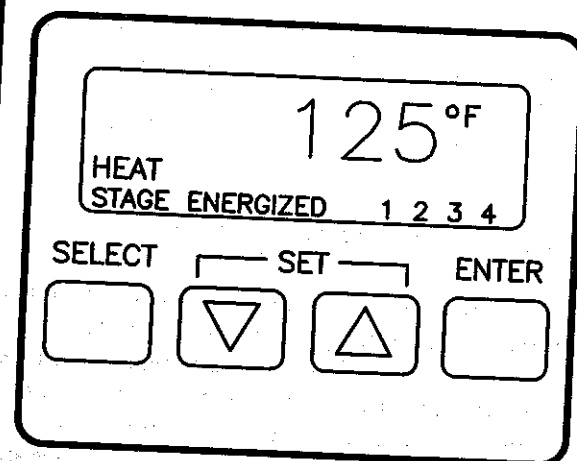


FIG. 31

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.

IMPORTANT:

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 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.

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 _____

These values will be programmed into the temperature controller.

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:

| <u>Stage</u> | <u>Set Point</u> | <u>Differential</u> |
|--------------|------------------|---------------------|
| 1 | 125° F | 2° F |
| 2 | 123° F | 2° F |
| 3 | 121° F | 2° F |

Reprogram 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 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 through 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).

The temperature control is now ready for operation.

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)

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

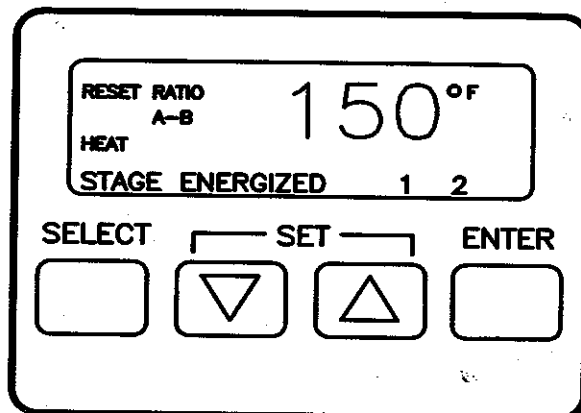


FIG. 32

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 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 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 of the two stages of operation and enter them 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 _____

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 |

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 the desired boiler water temperature is 140° F, when the outdoor temperature drops to -10° F the boiler water temperature needs to be 200° F.

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

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.

Reprogram 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 from 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 cannot be field repaired. Replace the boiler's electronic temperature control.

HIGH WATER TEMPERATURE LIMIT CONTROL

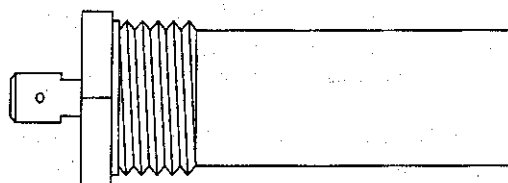


FIG. 33

High Water Temperature Limit Control

The unit is equipped with a fixed setting, auto-reset high water temperature limit control. The heating boiler temperature limit control has a fixed limit setting of 240°F (115°C); the hot water supply boiler temperature limit control has a fixed limit setting of 200°F (93°C). If water temperature exceeds the set point, the limit will break the control circuit and shut down the boiler. 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 of the front header.

Manual Reset High Water Temperature Limit Control (Optional)

The unit may be optionally equipped with a manual reset high water temperature limit control. This manual reset temperature limit control may be either a fixed or adjustable limit with a maximum setting of 230°F

(110°C). If water temperature exceeds the set point, the limit will break the control circuit and shut down the unit. The limit control can only be reset after the water temperature has cooled below the set point of the limit. Reset of the limit control is accomplished by pushing the **Red Reset Button** located on the side of the limit control.

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 will settle to the floor.

WHAT TO DO IF YOU SMELL GAS

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

- C. Use only your hand to turn the gas control knob. 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

399,999 THROUGH 750,000 Btu/hr MODELS

1. **STOP!** Read the safety information.
2. Open the front jacket panels to program temperature control and adjust gas valve control knobs.
3. Set stage one of the 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
399,999 — 750,000 Btu/hr Models**

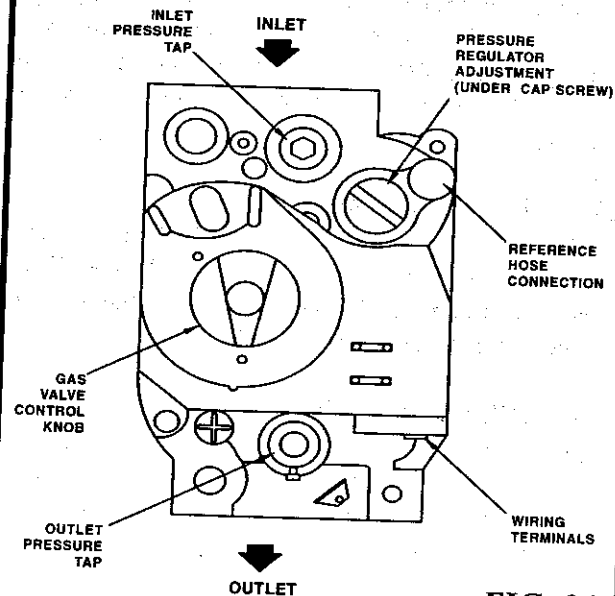




FIG. 34

6. Turn all manual gas valve control knobs 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 all manual gas valve control knobs 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 jacket access panels to the controls.
 12. If the appliance will not operate, follow the instructions To Turn Off Gas To Appliance and call your service technician or gas supplier.
7. Turn on gas supply.
 8. Press the reset button for the ignition module.
 9. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Turn the field installed 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

399,999 through 750,000 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. The ignitor will cycle on trial for ignition.
5. The ignition module will lock out and turn on the flame failure light.
6. Program each stage of temperature control to desired temperature set points.

HOT SURFACE IGNITION SYSTEM

Hot Surface Ignition Control Module

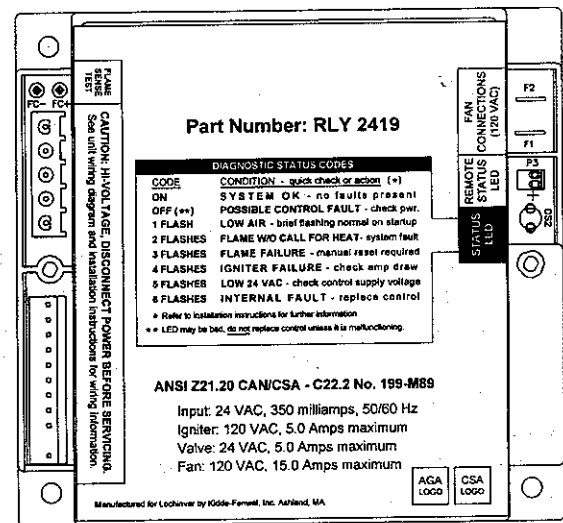


FIG. 35

Service Parts

This boiler uses a proven electronic ignition module and a hot surface igniter. The 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 igniter only. An OEM specification igniter and ignition module for this specific unit are available from your local distributor. **DO NOT** use general purpose field replacement ignition modules or igniters. Each boiler has one ignition module and one hot surface igniter.

Ignition Module Lockout Functions

The ignition module may lockout in either a hard lockout condition requiring pushing of the reset button to recycle the control or a soft lockout condition which may recycle in a fixed time period to check for

correction of the fault condition. A typical hard lockout fault is a flame failure condition. 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 on the inside front control panel. The reset button is active after the post purge cycle when there is a hard lockout condition as indicated by the Status LED/Light. 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 control 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.

OPERATION and DIAGNOSTIC LIGHTS

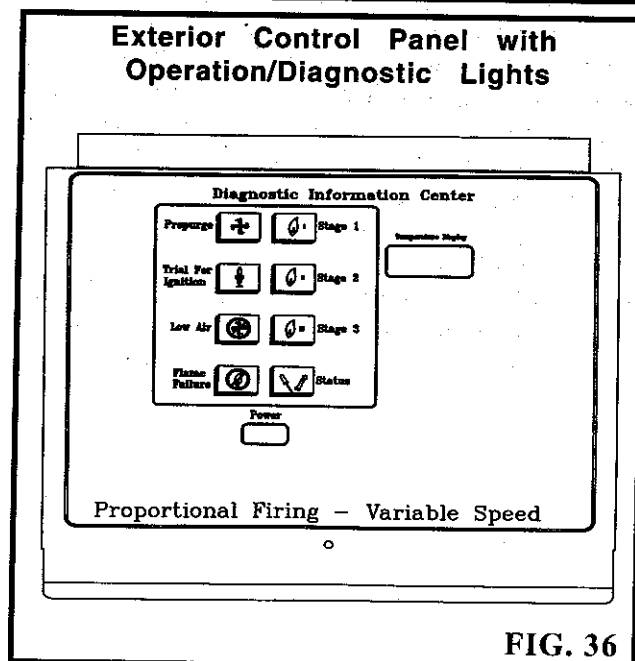


FIG. 36

Diagnostic Status Indication

The ignition module has an LED which indicates the status of the ignition module safety circuits. A remote Ignition Module Status indicating light is wired from the ignition module Status LED and is mounted on the front control panel. The flashing operation of this light/LED indicates the diagnostic status of the ignition control module. See the Operation and Diagnostic Lights section for a complete description of the Status LED flash codes as signaled from the ignition module.

TABLE O
OPERATION and DIAGNOSTIC
LIGHTS

| Indicating Light | Function |
|--------------------|--------------------------------------------------------------------------------------------------------|
| Power On | Lighted rocker switch in the ON position |
| Prepurge | Operation of combustion air fan before ignition |
| Trial for Ignition | Hot surface igniter preparing 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 (if equipped). |
| Flame Failure | Ignition module unable to properly prove ignition |
| Low Air | Improper level of combustion air provided by fan or a blockage in the flue. |
| Status | Flashing code sequence to indicate the status of the boiler's ignition control module safety circuits. |

A Status LED mounted on the ignition module also flashes the same code sequence as the Ignition Module Status light on the front of the panel. The following listing gives the flashing diagnostic status codes as signaled by the ignition control module.

TABLE P
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, 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 from the gas line may require multiple reset functions to achieve proper ignition. |
| Four Flashes | Igniter failure, igniter will not maintain minimum 2.7 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 control module, internal fault. |

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

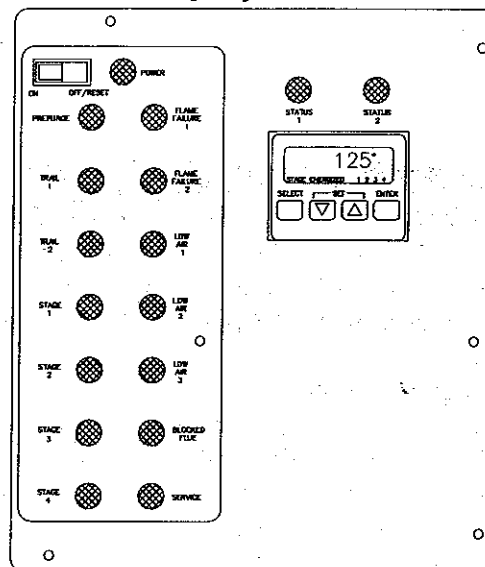


FIG. 37

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 and the status LED for control sensed malfunctions (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 Function) and 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 control 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, switching relays for component operation and wiring harness connections to the boiler's components. The control panels for the 399,999 and 500,000 Btu/hr models are common and may be switched between

these boilers for trouble shooting. The control panels for the 650,000 and 750,000 Btu/hr models are common and may be switched between these boilers for trouble shooting.

IGNITION and CONTROL TIMINGS

M-9 Proven Pilot Hot Surface Ignition System, 399,999 thru 750,000 Btu/hr Models Single Hot Surface Ignition Module

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 $< 0.5 \mu A$
Flame Current: 5 - 15 μA
Post-purge: 30 seconds
Pump Delay Timing: 30 Seconds after burner shutdown (on boiler s equipped with an optional, factory supplied pump delay or intermittent pump control system only).

FREEZE PROTECTION

Although these boilers 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 [$32^{\circ} F (0^{\circ} C)$].
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. Shutdown 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 heat 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 antifreeze.

2. A solution of 50% antifreeze will provide maximum protection of approximately $-30^{\circ} F$.
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 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 buildup 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. flush drain hose with water to clean. Clean screens in the venting air intake system as required. Have the entire system, including the venting system, periodically inspected by a qualified service agency.
2. Visually check main burner flames at each start up after long shutdown periods or at least every six months. A burner viewport is located on the 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

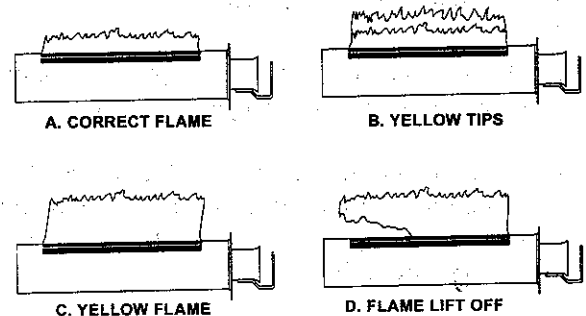


FIG. 38

- 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.