INSTALLATION & SERVICE MANUAL

HOT WATER HEATING BOILER
300,000 - 2,070,000 BTU MODELS

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

WARRANTY

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

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

1. Excessive water hardness causing a lime build-up in the copper tube is not the fault of the equipment and is not covered under the manufacturer's warranty. (See Application Instructions).
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 Application Instructions for proper pump performance).

SPECIAL INSTRUCTIONS TO OWNER

NOTE: Retain this manual for future reference.

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

WARNING: IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE INJURY OR PROPERTY DAMAGE. REFER TO THIS MANUAL. FOR ASSISTANCE OR ADDITIONAL INFORMATION CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

CHECKING EQUIPMENT

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

DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE UNIT AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

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

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

CONTENTS

CODES

The equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made. In the absence of such requirements, the installation shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1. Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, No.(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-B149.1 and/or B149.2 and or local codes.

LOCATION

These units are suitable for indoor or outdoor installation. Venting options and configurations are illustrated in the venting section.

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. 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. The appliance must be placed on a level, non-combustible floor. Concrete over wood is not considered non-combustible.
4. The appliance must not be installed on carpet.
5. Installation over a combustible floor:

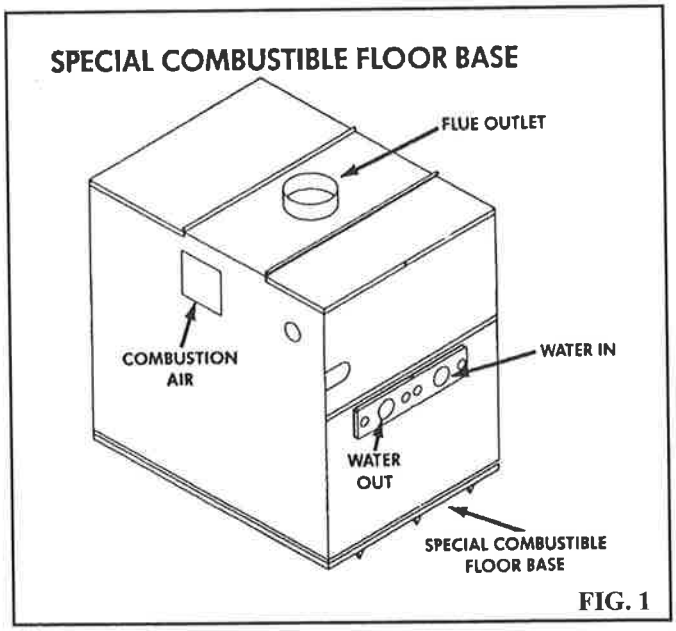


FIG. 1

300,000 thru 750,000 BTU input units installed over a combustible floor **MUST** use the Special Combustible Floor Base. The unit must be centered on the base as shown in Figure 1. The correct part number for the required base is noted on the rating plate of each unit and listed below.

COMBUSTIBLE FLOOR KITS

Input BTU/hr	Kit Number
300,000	CFK3300
400,000	CFK3301
500,000	CFK3302
650,000	CFK3303
750,000	CFK3304

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

6. Outdoor models require the installation of an optional vent cap. Instructions for mounting the vent cap are included in the venting section. Outdoor models have 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:	
Right Side	3"
Rear	3" (3" minimum from any surface)
Left Side	3" (24"for service)
Front	ALCOVE (30" for service)
Top	3"
Flue	1"
Hot Water Pipes	1"

Maintain 3" minimum clearance for adequate operation. Allow sufficient space for servicing pipe connections, pump and other auxiliary equipment, as well as the appliance.

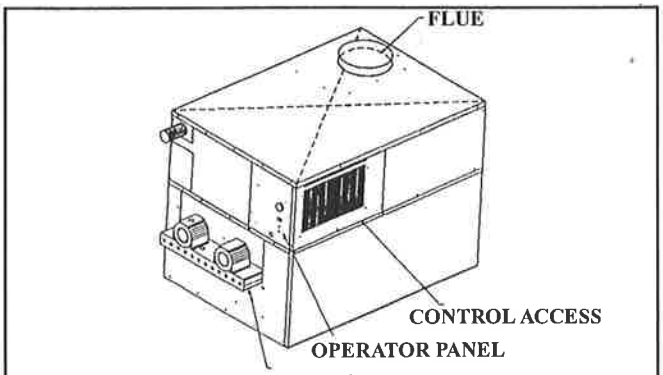


FIG. 2

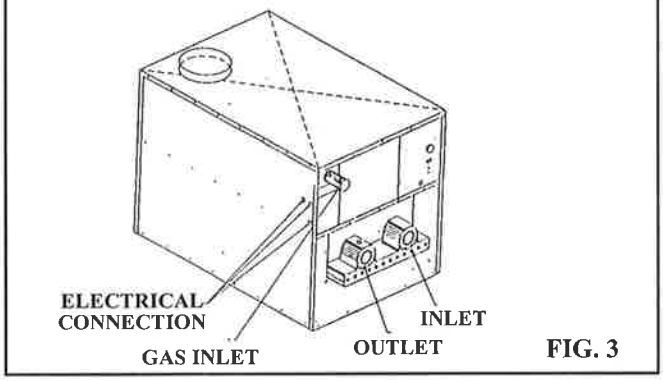


FIG. 3

COMBUSTION AND VENTILATION AIR

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

The equipment room MUST be provided with two openings to assure adequate combustion air and proper ventilation.

1. If air is taken directly from outside the building:
   a. Combustion air opening, one square inch per 2000 BTU input. This opening must be located near the floor.
   b. Ventilation air opening, one square inch per 2000 BTU input. This opening must be located near the ceiling.
2. If air is taken from another interior space: Each opening specified above should have a net free area of one square inch for each 1000 BTU of input.

CAUTION

Under no circumstances should the equipment room ever be under a negative pressure. Particular care should be taken when exhaust fans, compressors, air handling units, etc. may rob air from the boiler. 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 stack. The result is improper combustion and premature boiler failures.

NOTE: This unit may be installed with an optional venting system which uses a make-up air duct to draw combustion air directly from outdoors. (See DirectAire Venting Systems).

VENTING

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

Adequate combustion and ventilation air must be 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 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 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 is required on single unit installations. Multiple unit installations with combined venting require barometric dampers to regulate draft at each unit. A barometric damper is also used with the optional Sidewall and Horizontal DirectAire venting systems on units with inputs of 990,000 thru 2,070,000 BTU's.

The negative draft must be within the range of 0.01 to 0.08 inches water negative to insure proper operation. All draft readings are made while unit is in stable operation (approximately 2 to 5 minutes).

The flue sizes and combustion air pipe sizes are:

Input BTU/hr	Flue Size	DirectAire Inlet Size
300,000	5"	5"
399,999	6"	6"
500,000	6"	6"
650,000	8"	8"
750,000	8"	8"
990,000	10"	10"
1,260,000	12"	12"
1,440,000	12"	12"
1,800,000	14"	12"
2,070,000	14"	12"

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

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 boiler to the vent terminal. Follow manufacturer's instructions.

Vent connectors serving appliances vented by natural draft shall not be connected to any portion of a mechanical draft system operating under positive pressure.

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

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

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

a. Seal any unused opening in the common venting system.
b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other unsafe condition.
c. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any other appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fire place dampers.
d. Place in operation, the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
e. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as above, return doors, windows, exhaust fans, fireplace dampers and other gas burning appliances to their previous conditions of use.
g. Any improper operation of the common venting system should be corrected so that the installation conforms to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 In stallation Code for Gas Burning Appliances and Equipment.

This unit has five venting options. They are: (1) conventional negative draft venting, (2) powered sidewall venting, (3) horizontal DirectAire venting, (4) vertical DirectAire venting and (5) outdoor installation.

CONVENTIONAL VENTING

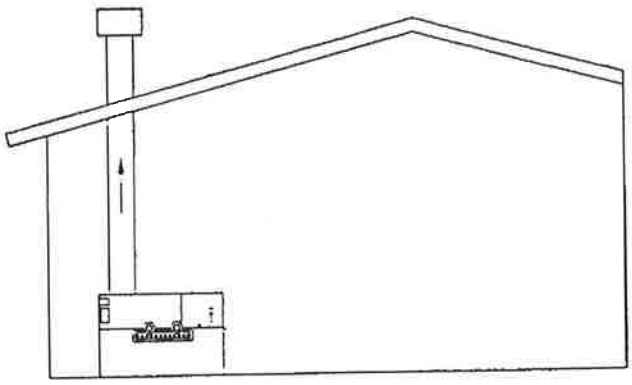


FIG. 4

CONVENTIONAL VENTING

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.

A vertical termination less than 10 feet (0.91m) 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.

Follow all requirements in the General Venting section for venting flue products to the outdoors, obtaining adequate combustion and ventilation air and general installation instructions.

SIDEWALL VENTING

This venting system uses a powered vent assembly which pulls the flue products out of the stack. This fan generates a negative draft at the unit.

SIDEWALL VENTING
300,000 - 750,000 BTUs

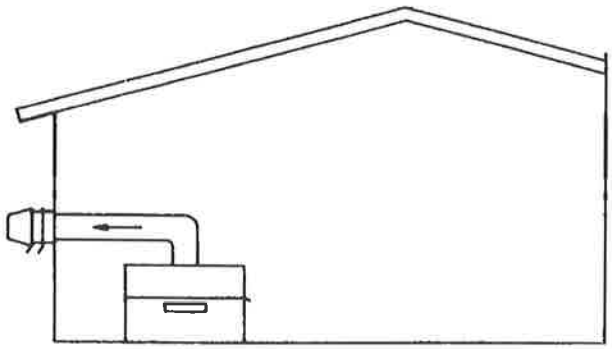


FIG. 5

300,000 BTU thru 750,000 Models

The sidewall fan is mounted in a vent cap which is mounted on an exterior wall. The sidewall fan and accessories are included in a venting kit which must be furnished by the manufacturer in accordance with A.G.A./C.G.A. requirements. This venting kit includes the sidewall fan/cap, proving switch and all necessary relays to interlock with the heaters control system. The internal damper on the sidewall fan must be adjusted to supply a negative draft within the range of 0.01 to 0.08 inches water negative while unit is operating. The maximum length of the sidewall vent pipe cannot exceed 50 equivalent feet (15.24m). Subtract 5 feet (1.52m) per elbow.

SIDEWALL VENTING
990,000 - 2,070,000 BTUs

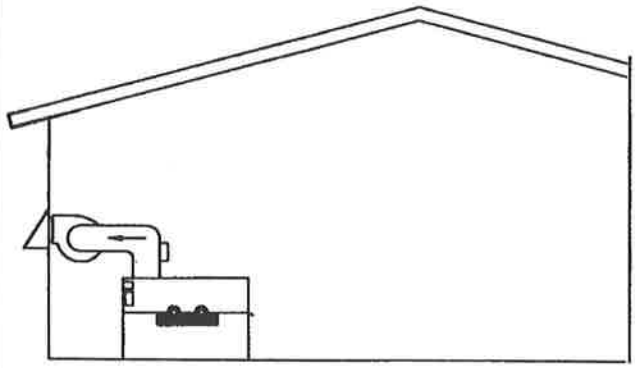


FIG. 6

990,000 BTU thru 2,070,000 BTU Models

The sidewall fan is mounted on the inside with a sidewall vent hood mounted on the exterior wall. The sidewall fan and accessories are included in a venting kit which must be furnished by the manufacturer in accordance with A.G.A./ C.G.A. requirements. The venting kit includes the sidewall fan, vent hood, tapered vent adaptor, barometric damper, proving switch and all necessary relays to interlock with the heaters control system. The barometric damper must be installed on the flue and adjusted to supply a negative draft within the range of 0.04 to 0.08 inches water negative while unit is operating. The maximum length of the sidewall vent pipe cannot exceed 100 equivalent feet (30.48m). Subtract 5 feet (1.52m) per elbow.

The connection from the vent to the draft fan and cap **MUST** be made with listed type "B" double wall (or equivalent) vent and accessories. Vent pipe material must be supplied by the installer.

The powered draft fan **MUST** be interlocked with the units control system to start the fan on a call for heat and prove fan operation.

Follow all requirements in the General Venting section for venting flue products to the outdoors, obtaining adequate combustion and ventilation air and general installation instructions.

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

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

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

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

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.

Input BTU/hr	Flue Size	Sidewall Vent Cap Kit
300,000	5"	SVK3005
399,999	6"	SVK3006
500,000	6"	SVK3006
650,000	8"	SVK3008
750,000	8"	SVK3008
990,000	10"	SVK3009
1,260,000	12"	SVK3010
1,440,000	12"	SVK3011
1,800,000	14"	SVK3012
2,070,000	14"	SVK3012

The sidewall vent kit part numbers are listed by unit size. Each kit includes a draft fan/cap, relay, proving switch and other required components.

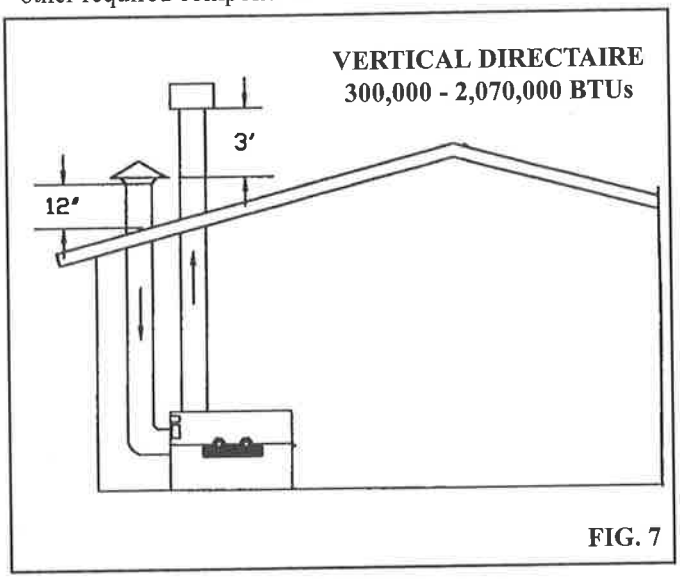


FIG. 7

VERTICAL DIRECTAIRE

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

The Vertical DirectAire system requires installation of a single wall pipe to supply combustion air from outdoors directly to the unit. The maximum length of this pipe is 50 equivalent feet (15.24m). Subtract 5 feet (1.52m) per elbow.

The factory supplied combustion air cap **MUST** be used to adequately protect the combustion air inlet from wind and weather. This vent cap must be connected to the field supplied single wall combustion air pipe and must terminate at least 3 feet (0.91m) lower than the flue gas outlet, if located within a 10 foot (3.05m) radius. The combustion air cap and flue gas outlet **MUST** be located on the same roof top surface and in the same pressure zone.

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

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

Combustion air pipes can **NOT** be combined into a single pipe for multiple unit installations. Each unit must have a separate flue and combustion air pipe. A barometric damper is **NOT** required in the flue on Vertical DirectAire installations if the draft is within the .01 to .08 inches water negative required for proper operation.

The required vertical DirectAire kit parts are listed by unit size. The venting kit must be furnished by the manufacturer in accordance with A.G.A./C.G.A. requirements. Each kit includes the special combustion air intake cap and the transition adaptor to attach the field supplied single wall air inlet pipe to the unit.

Input BTU/hr	Outdoor Cap Kit
300,000	VDK3005
399,999	VDK3006
500,000	VDK3006
650,000	VDK3008
750,000	VDK3008
990,000	VDK3009
1,260,000	VDK3010
1,440,000	VDK3010
1,800,000	VDK3010
2,070,000	VDK3010

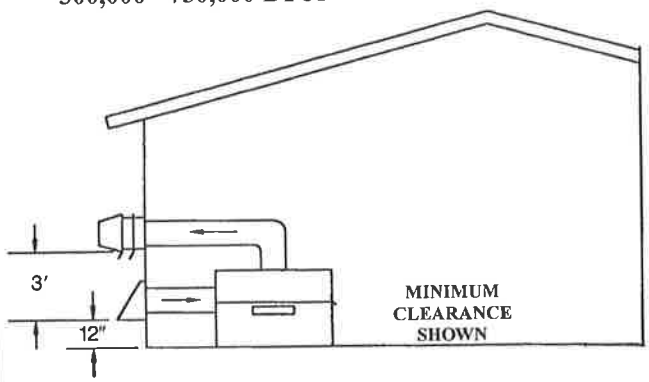


FIG. 8

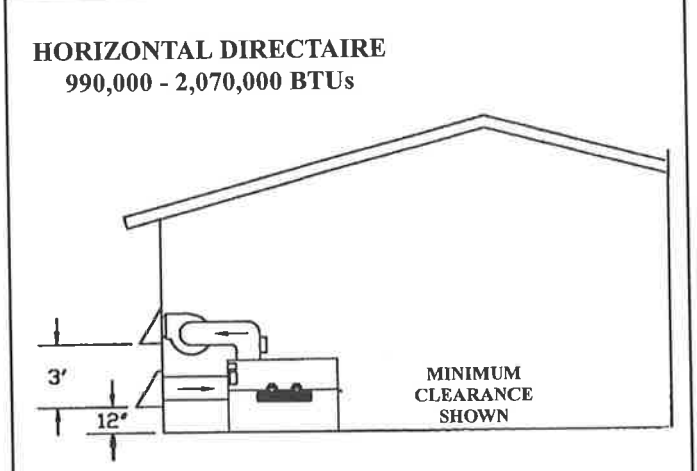


FIG. 9

HORIZONTAL DIRECTAIRE

For venting flue products horizontally to the outdoors, follow all requirements in the installation instructions for side wall venting.

The horizontal DirectAire system requires installation of a single wall pipe to supply combustion air from outdoors directly to the unit. The maximum length of this pipe is 50 equivalent feet (15.24m). Subtract 5 feet (1.52m) per elbow.

Combustion air supply pipes can **NOT** be combined into a single pipe for multiple unit installations. Each unit must have a separate flue and combustion air pipe.

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

The combustion air inlet cap must be at least 3 feet (0.91m) below the powered vent cap, if within 10 feet (3.05m). The combustion air cap and powered vent cap **MUST** be located on the same wall and in the same pressure zone.

The combustion air cap must not be installed closer than 3 feet (0.91m) from an inside corner of a L-shaped structure.

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

The required horizontal DirectAire kit part numbers are listed by unit size. The venting kit must be furnished by the manufacturer in accordance with A.G.A./C.G.A. requir ments. Each kit includes the special sidewall vent components for the flue, a combustion air intake cap for side wall mounting and the transition adaptor to attach the field supplied single wall air inlet pipe to the unit.

Input BTU/hr	Flue Size	Horizontal DirectAire Kit
300,000	5"	HDK3005
399,999	6"	HDK3006
500,000	6"	HDK3006
650,000	8"	HDK3008
750,000	8"	HDK3008
990,000	10"	HDK3009
1,260,000	12"	HDK3010
1,440,000	12"	HDK3011
1,800,000	14"	HDK3012
2,070,000	14"	HDK3012

OUTDOOR INSTALLATION

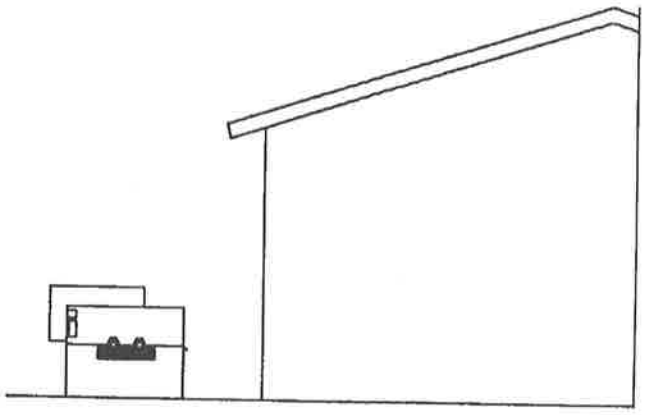


FIG. 10

OUTDOOR INSTALLATION

Units are self venting and can be used outdoors when installed with the optional Outdoor Cap. This cap mounts to the top of the unit and 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.

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.

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

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

Multiple unit outdoor installations require 48" (1.22m) clearance between caps.

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

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

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

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

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

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

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

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

Input BTU/hr	Outdoor Cap Kit
300,000	ODK3003
399,999	ODK3004
500,000	ODK3005
650,000	ODK3006
750,000	ODK3007
990,000	ODK3009
1,260,000	ODK3010
1,440,000	ODK3010
1,800,000	ODK3011
2,070,000	ODK3011

GAS SUPPLY

Verify unit is supplied with type gas specified on rating plate. This unit is orificed for operation up to 2000 feet altitude. Unit derated 4% per 1000 feet above 2000 feet elevation. Consult Factory for installations above 2000 feet elevation. Conversions authorized by factory personnel only. The rating plate will be marked to indicate high altitude rating of unit.

INLET PRESSURE: Measured at the inlet pressure tap located at the main gas cock. This is upstream of the combination gas valve(s) for each stage of operation.

	Nat. Gas	LPG
Max. (Inches-Water Column)	10.5"	13"
Min. (Inches-Water Column)	5"	11"

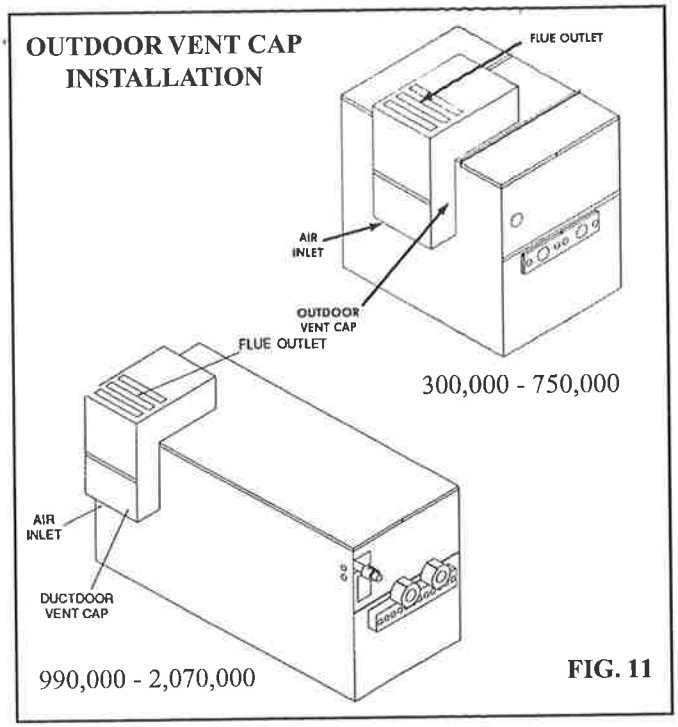


FIG. 11

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

MANIFOLD PRESSURE: Measured at the pressure tap on the downstream side of the combination gas valve for each stage of operation.

BTU Input	Nat. Gas	LPG
300,000 thru 750,000	4.0"	10"
990,000 thru 2,070,000	3.5"	10"

GAS PRESSURE TEST

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

GAS CONNECTION

1. Safe operation of unit requires properly sized gas supply piping. See 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. Route bleeds and vents to the atmosphere, outside the building when required by Local Codes.

6. Route bleeds and vents to the atmosphere, outside the building when required by Local Codes.

SINGLE UNIT INSTALLATIONS SUGGETED GAS PIPE SIZE TABLE C

BTU INPUT	DISTANCE FROM METER				
	0-50'	51'-100'	101'-200'	201'-300'	C301'-500'
300,000	1¼"	1¼"	1½"	1½"	2"
399,999	1¼"	1¼"	1½"	2"	2½"
500,000	1¼"	1½"	2"	2"	2½"
650,000	1½"	2"	2"	2½"	2½"
750,000	1½"	2"	2"	2½"	3"
990,000	2"	2"	2½"	2½"	2½"
1,260,000	2"	2½"	2½"	3"	3"
1,440,000	2"	2½"	3"	3"	3½"
1,800,000	2½"	2½"	3"	3"	3½"
2,070,000	2½"	3"	3"	3½"	4"

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

FITTINGS TO EQUIVALENT STRAIGHT PIPE TABLE D

Diameter Pipe (inches)	¾	1"	1¼"	1½"	2"	3"	4"	5"
Equivalent Length of Straight Pipe (Ft.)	2'	2'	3'	4'	5'	10'	14'	20'

WATER CONNECTIONS

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 hot water boiler is supplied with a pressure 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 hot water outlet. No valve is to be placed between the relief valve, and the hot water supply boiler. 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.

MULTIPLE UNIT INSTALLATIONS GAS PIPING SIZE CHART TABLE E

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).

WATER FLOW SWITCH (IF EQUIPPED)

990,000 thru 2,070,000 BTU models are equipped with a factory installed water flow switch in the discharge piping. A minimum of 26 GPM is required to make the flow switch and start burner operation. This flow switch and conduit are sealed for outdoor installations. A water flow switch meets most code requirements for a low-water cut off device on boilers requiring forced circulation for operation.

A water flow switch is also available as a factory installed option on 300,000 thru 750,000 BTU models.

LOW WATER CUTOFF (IF EQUIPPED)

Low water cutoffs should be inspected every six months, including flushing of float types.

COMBINATION GAS VALVES

300,000 thru 500,000 BTU Input:
Each unit has a combination gas valve to cycle the gas supply on and off and regulate gas to the burners. Each valve has an individual gas control knob that must remain in the open position at all times when the unit is in service. The manifold gas pressure tap is located on the gas manifold, down stream from the valve. A manifold pressure adjustment is located on the valve.

650,000 thru 750,000 BTU Input:
Each unit has two gas valves which cycle the gas supply on and off. One is a combination valve with a gas pressure regulator. The manifold gas pressure tap is located on the gas manifold, down stream from the valves. A manifold pressure adjustment is located on thecombination valve.

990,000 thru 2,070,000 BTU Input:
Each stage of burner operation has a combination gas valve to cycle the gas supply on and off and regulate gas to the burners. Each valve has an individual gas control knob that must remain in the open position at all times when the unit is in service. The manifold gas pressure tap for each burner stage is located at the discharge side of the valve for each burner stage. A manifold pressure adjustment is located on each valve.

The manifold pressure is preset at the factory and adjustment is not usually required. If the manifold pressure is to be adjusted the burner stage must be firing while the manifold pressure is set.

ELECTRICAL REQUIREMENTS (USA)

This appliance is wired for 120 volt service. The heater, 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 1and/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 (except when unit is provided with optional intermittent pump controller).
4. To avoid serious damage, **DO NOT** energize the unit until the system is full of water.

AMP DRAW DATA

INPUT	FAN(S)	CONTROLS	Approx. Total BTU AMPS @ 120 VAC
300,000	3.60	2.60	6.20
399,999	3.60	2.60	6.20
500,000	3.60	2.60	6.20
650,000	3.60	2.60	6.20
750,000	3.60	2.60	6.20
990,000	7.20	7.20	14.40
1,260,000	7.20	7.20	14.40
1,440,000	7.20	7.20	14.40
1,800,000	10.80	7.20	18.00
2,070,000	10.80	7.20	18.00

COMPONENT LOCATION DRAWING

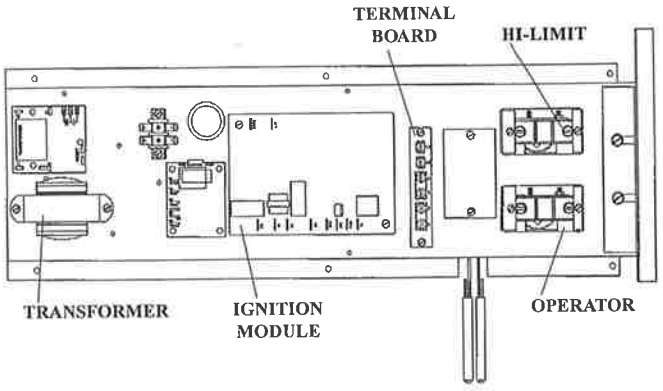


FIG. 12

TEMPERATURE ADJUSTMENT

300,000 thru 750,000 BTU Models:

Operating Temperature Control
An adjustable immersion operating control is located in the top control panel. The control uses a remote sensing bulb mounted in the front header. Turn the control setpoint dial to adjust the desired operating water temperature of the unit.

High Water Temperature Limit Control
An adjustable high limit control(s) is located behind the top control panel, beside the temperature control. The setting of this control(s) limits maximum discharge water temperature. An optional manual reset function is available. A small red reset button, located beside the knob, must be pushed whenever water temperature has exceeded the set point of the manual reset limit.

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

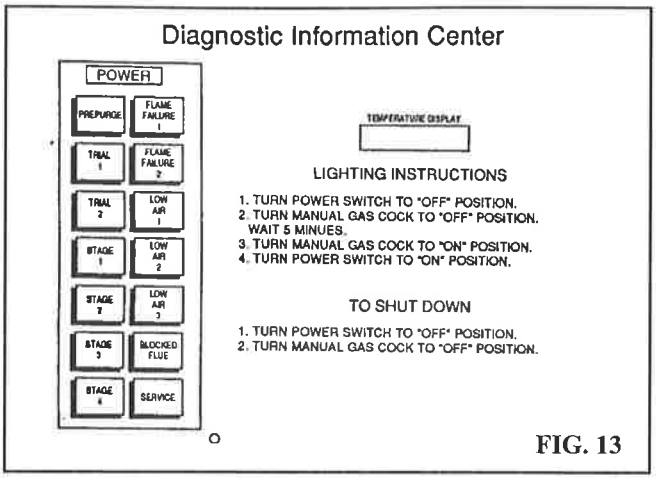


FIG. 13

TEMPERATURE ADJUSTMENT

990,000 thru 2,070,000 BTU Models:

These units use an adjustable electronic temperature control to provide staged ON/OFF control. Operation is based on temperature input from two immersion sensors. Each sensor is a positive coefficient platinum thermistor. Sensor A is placed in the inlet side of the front header and sensor B is placed in the outlet side of the front header. A liquid crystal display is provided to indicate sensed temperature and operating parameters. The temperature control for the 990,000 BTU unit operates with three (3) stages of control, 1,260,000 thru 2,070,000 BTU units operate with four (4) stages of control.

SPECIFICATIONS
Set Point Adjustment Range: Maximum setting 240° F.
Temperature Accuracy: +/- 1° F.
Display Resolution: 1° F via Liquid CrystaL Display (LCD).
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 (1,2,3,4). Once the last parameter value has been viewed, pressing the 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 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 programed the display will revert back to sensed temperature and load energized status.

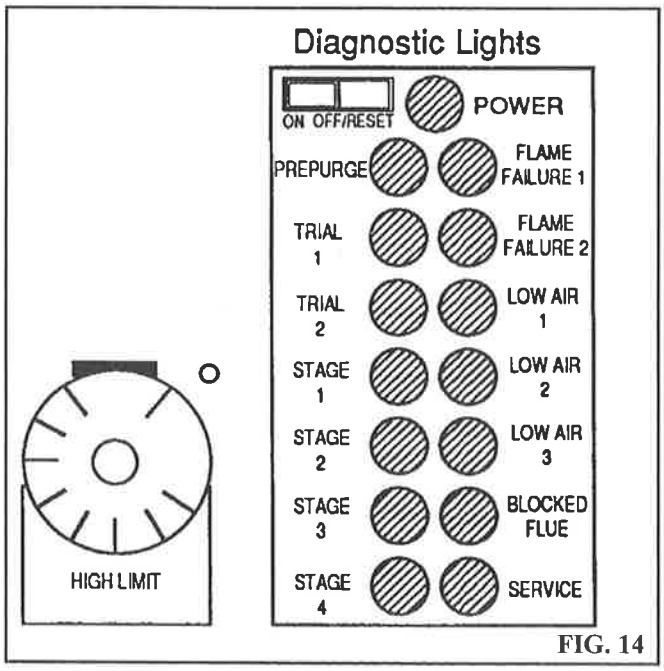


FIG. 14

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 hot water supply boiler or sensor B to operate a heating boiler. Adjustment of these settings 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 programing keys. Each stage of heating is de-energized as the sensed temperature reaches the programed 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 programed 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 programed with a set point and a differential. If two stages are programed 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 programed 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_____

Stage 4:
Set Point 4 _____ Off at _____
Differential 4_____ On at _____

These values will be programed into the temperature controller.

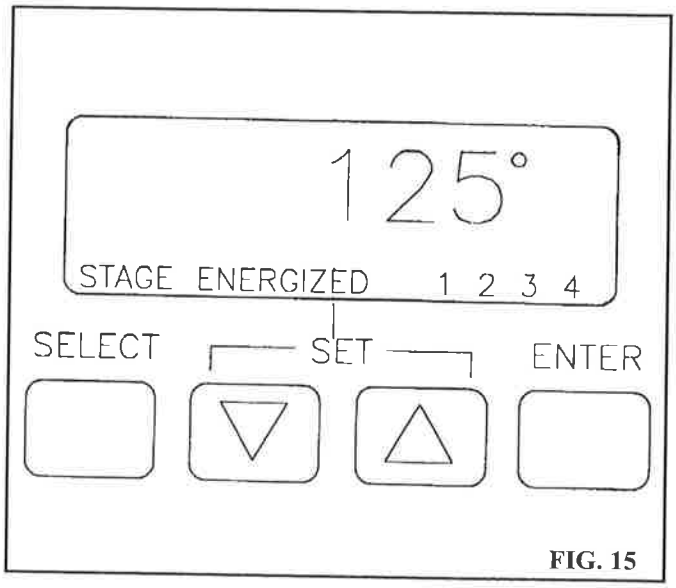


FIG. 15

PROGRAMMING

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

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

Re-program 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 unit is properly applied as either a heating boiler or hot water supply boiler, and the model number on the rating plate correctly identifies the unit.
2. Turn the power switch to the ON position. The control will begin counting down from 210. This countdown sequence will last for approximately 3-1/2 minutes.
3. To override this time delay, press **Select**
4. Press **Select** to display the current stage set point.
5. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired set point.
6. Press **Enter** to enter the displayed value into memory.
7. Press **Select** to display the current stage switching differential.
8. Press **Up Arrow** key to increase or **Down Arrow** key to decrease to the desired switching differential.
9. Press **Enter** to enter the displayed value into memory.
10. Repeat steps 4 thru 9 to program each additional stage.
11. Press **Select Select Select Select** (4 times) to return to stage 1 parameters. Scroll through the programming loop a second time to confirm that the appropriate values have been entered into memory by pressing **Select**.
12. Press **Select** after viewing the switching differential for the final stage to display sensor A temperature only (inlet water temperature).
13. Press **Select** again to display sensor B temperature only (outlet water temperature).
14. Press **Select** again to alternate the display between sensor A temperature and sensor B temperature at approximately 5 second intervals (to determine temperature rise).

The temperature control is now ready for operation.

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

HIGH WATER TEMPERATURE LIMIT CONTROL

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

NOTE: The control will not reset until the water temperature has droopped 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

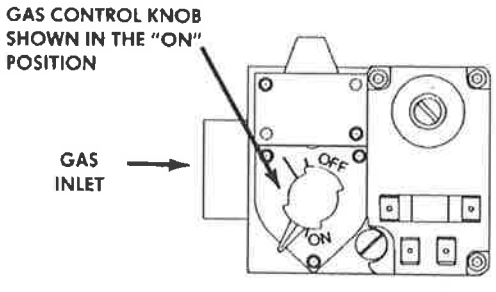
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbors phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to turn the gas control lever. Never use tools. If the lever will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

LIGHTING INSTRUCTIONS
300,000 BTU MODELS

1. STOP! Read the safety information.
2. Turn Off all electrical power to the appliance.
3. Open the left top jacket panel to access the controls.
4. Set the thermostat to the lowest setting.
5. This appliance is equipped with an ignition device which automatically lights the burners. DO NOT try to light the burners by hand.
6. Push in the gas control knob slightly and turn clockwise to the "OFF" position.



GAS VALVE
300,000 BTU Models

FIG. 16

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

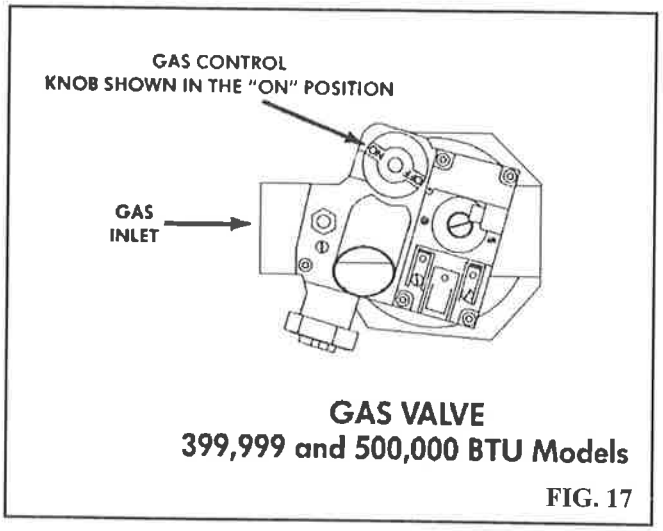
7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP! Follow "B" in the safety information. If you don't smell gas go on to the next step.
8. Turn the gas control knob counterclockwise to the "ON" position.
9. Set the thermostat to the desired setting.
10. Replace control access panel.
11. Turn on all electric power to the appliance.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Open the top left jacket panel to access controls.
3. Push in the gas control knob slightly and turn clockwise to the "OFF" position. Do not force.
4. Replace control access panel.

LIGHTING INSTRUCTIONS
399,999 AND 500,000 BTU MODELS

1. STOP! Read the safety information.
2. Turn Off all electrical power to the appliance.
3. Open the left top jacket panel to access the controls.
4. Set the thermostat to the lowest setting.
5. This appliance is equipped with an ignition device which automatically lights the burners. DO NOT try to light the burners by hand.
6. Turn the gas control knob clockwise to the "OFF" position.



GAS VALVE
399,999 and 500,000 BTU Models

FIG. 17

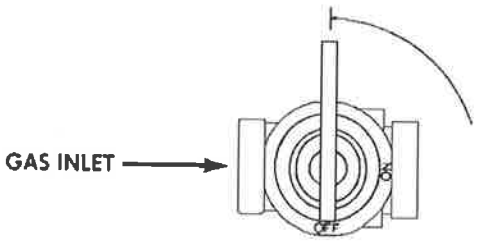
7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP! Follow "B" in the safety information. If you don't smell gas go on to the next step.
8. Turn the gas control knob counterclockwise to the "ON" position.
9. Set the thermostat to the desired setting.
10. Replace control access panel.
11. Turn on all electric power to the appliance.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Open the top left jacket panel to access controls.
3. Turn the gas control knob clockwise to the "OFF" position. Do not force.
4. Replace control access panel.

LIGHTING INSTRUCTIONS
650,000 AND 750,000 BTU MODELS

1. STOP! Read the safety information.
2. Turn Off all electrical power to the appliance.
3. Open the left top jacket panel to access the controls.
4. Set the thermostat to the lowest setting.
5. This appliance is equipped with an ignition device which automatically lights the burners. DO NOT try to light the burners by hand.
6. Turn the manual gas cock counterclockwise to the "OFF" position.



MANUAL GAS COCK
650,000 and 750,000 BTU Models

FIG. 18

7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP! Follow "B" in the safety information. If you don't smell gas go on to the next step.
8. Turn the manual gas cock clockwise to the "ON" position.
9. Set the thermostat to the desired setting.
10. Replace control access panel.
11. Turn on all electric power to the appliance.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Open the top left jacket panel to access controls.
3. Turn the manual gas cock counterclockwise to the "OFF" position.
4. Replace control access panel.

LIGHTING INSTRUCTIONS
990,000 THRU 2,070,000 BTU MODELS

1. STOP! Read the safety information.
2. Open the front access panel to program temperature control.
3. Set each stage of control to the lowest setting (See Temperature Adjustment).
4. Turn Off all electrical power to the appliance.
5. This appliance is equipped with an ignition device which automatically lights the burners. DO NOT try to light the burners by hand.

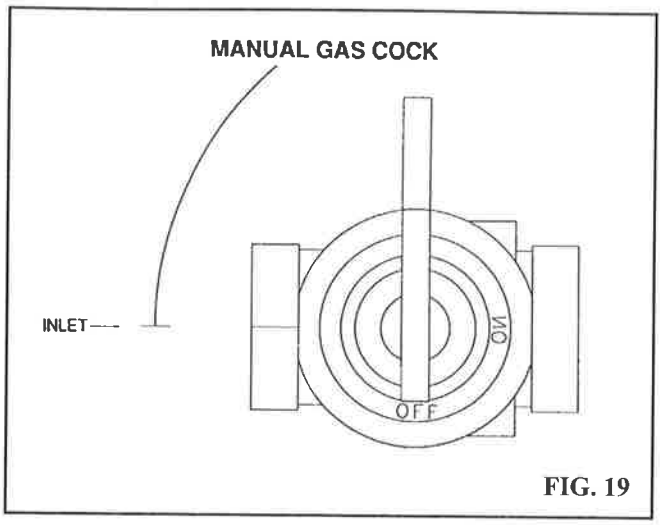


FIG. 19

6. Turn the manual gas cock clockwise to the "OFF" position.
7. Wait five (5) minutes to clear out any gas. If you smell gas, STOP! Follow "B" in the safety information. If you don't smell gas go on to the next step.
8. Turn the manual gas cock counterclockwise to the "ON" position.
9. Turn on all electric power to the appliance.
10. Program the temperature control to the desired settings.
11. Close the control access panel.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Turn the manual gas cock clockwise to the "OFF" position.

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

IGNITION SYSTEM CHECKOUT

300,000 Thru 650,000 BTU Models:

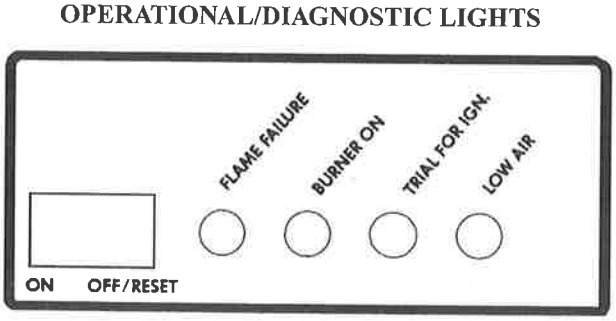
1. Turn off gas supply to unit.
2. Turn thermostat and high limit controls to highest setting.
3. Turn electric power on.
4. The ignition module will lock out.
5. Readjust thermostat and high limit to normal setting.
6. Turn on gas supply.
7. Turn power off then on to reset ignition module.
8. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

990,000 thru 2,070,000 BTU Models:

1. Turn off gas supply to unit.
2. Turn electric power on.
3. Program each stage of the temperature control to settings above water temperature or to highest safe setting.
4. Each ignitor will cycle on trial(s) for ignition.
5. Each ignition module will lock out and turn on the flame failure lights.
6. Program each stage of temperature control to desired temperature set points.
7. Turn on gas supply.
8. Turn power off then on to reset ignition modules.
9. If ignition system fails to operate properly, repair work must be performed by a qualified serviceman or installer.

HOT SURFACE IGNITION SYSTEM

The hot surface ignition module is not repairable. Any modification or repairs will invalidate the warranty and may create hazardous conditions that result in property damage, personal injury, fire, explosion and/or toxic gases. A faulty ignition module must be replaced with a new unit. 300,000 thru 750,000 BTU units have one ignition module and one hot surface ignitor. 990,000 thru 2,070,000 BTU units have two ignition modules and two hot surface ignitors.

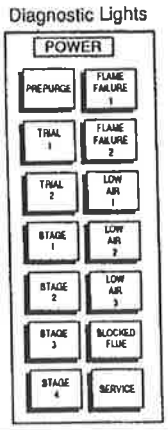


300,000 - 750,000 BTU Models

FIG. 20

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

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



990,000 - 2,070,000 BTU Models-FIG. 21

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

INDICATING LIGHT	FUNCTION
Power On	- Power switch in on position
Prepurge	- Operation of combustion air fan before ignition
Trial for Ignition 1	- Hot surface ignitor 1 prepared to light burners.
Trial for Ignition 2	- Hot surface ignitor 2 prepared to light burners.
Stage 1 On	- Burners for stage 1 operating.
Stage 2 On	- Burners for stage 2 operating.
Stage 3 On	- Burners for stage 3 operating.
Stage 4 On	- Burners for stage 4 operating (if equipped).
Flame Failure 1	- Ignition module 1 unable to properly prove ignition.
Flame Failure 2	- Ignition module 2 unable to properly prove ignition.
Low Air 1	- Improper level of combustion air provided by fan 1.
Low Air 2	- Improper level of combustion air provided by fan 2.
Low Air 3	- Improper level of combustion air provided by fan 3 (if equipped).
Blocked Flue	- Improper operation of flue (blockage).
Service	- Improper operation of optional device (if equipped).

FREEZE PROTECTION

Although these units are AGA design certified for outdoor installations - such installations are not recommended in areas where the danger of freezing exist. 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. If the system pump does not run continuously an additional pump must be installed to provide constanT circulation through the unit. This can help prevent freezing.
2. Freeze protection for a 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.
3. A snow screen should be installed to prevent snow and ice accumulation around the appliance or its venting system.
4. If for any reason the unit is to be shut off, you must:
   a. Shut off water supply.
   b. Drain unit completely.
   c. Drain pump and piping.

MAINTENANCE

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

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

1. Examine the venting system at least once a year. Check more often in first year to determine inspection interval. Check all joints and pipe connections for tightness, corrosion or deterioration. Clean screens in the venting air intake system as required. Have the entire system, including the venting system, periodically inspected by a qualified service agency.
2. Using the view port, located below the water connections, visually check main burner flames at each start up after long shutdown periods or at least every six months.

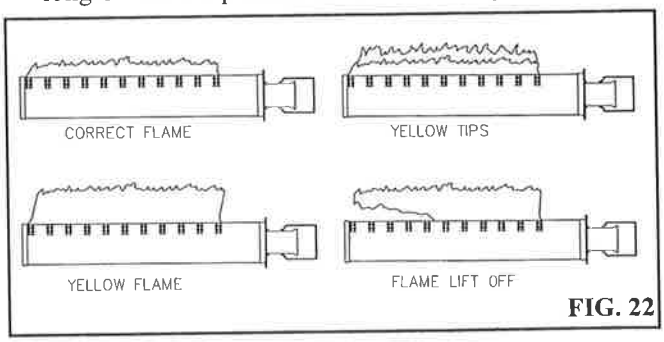


FIG. 22

a. **Normal Flame:** A normal flame is blue, without yellow tips, with a well defined inner cone and with 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), venturi tubes not properly in place or excessive gas input. This condition MUST be corrected immediately.
d. **Lifting Flames:** Lifting flames can be caused by overfiring the burner(s) or excessive primary air.

3. Flue Gas Passageways Cleaning Procedures: Any sign of soot at burners indicates a need for cleaning. The follow ing cleaning procedure must only be performed by a quali-

fied 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 on reassembly. Gasket kits are available from your distributor.

BURNER REMOVAL AND CLEANING

a. Turn off main power to unit.
b. Turn off gas supply.
c. Remove the front outer jacket panels.
d. Disconnect manifold from gas train using union(s) just below gas valve(s).
e. Remove screws from manifold mounting brackets. Pull manifold(s)/ orifice assembly away from burners.
f. Remove two mounting screws from each burner and slide burner out toward front of unit. Use caution to prevent damage to refractory or hot surface ignitors.
g. Remove soot from burners with a stiff bristle brush. Damaged burners must be replaced.

HEAT EXCHANGER CLEANING

h. Check the heat exchanger surface for sooting. If present, heat exchanger must be cleaned and problem corrected. Proceed as follows.
i. Remove manifold(s)/orifice assemblies and dividers for fan chambers.
j. Disconnect wiring from hot surface ignitors and hoses from burner taps.
k. Remove inner jacket mounting screws and slide door assembly out toward front of unit. Use caution to prevent damage to refractory.
l. Remove soot from heat exchanger with a stiff bristle brush. Use a vacuum to remove loose soot from surfaces and inner chamber.
m. Check "V" baffles on top of heat exchanger. Remove and clean if necessary.
n. Carefully reinstall inner jacket panels, dividers, burners, manifolds wires and hoses. Use new gasket material for proper air seal.
o. Reassemble and test for gas leaks.
p. Cycle unit and check for proper operation.

A heater installed in a dust or dirt contaminated atmosphere will require cleaning of the burners on a 3 to 6 month schedule or more often, based on severity of contamination. Contaminants can be drawn in with the combustion air. Non-combustible particulate matter such as dust, dirt, concrete dust or dry wall dust can block burner ports and cause non-warrantable failure.

4. Combustion Air Fan: Each combustion air fan should be checked and oiled every 6 months. Use non-detergent SAE 20 oil. Clean as required when installed in a dust or dirt contaminated location.
5. Water Circulating Pump: Inspect pump every 6 months and oil as necessary. Use SAE 30 oil or lubricant specified by pump manufacturer.
6. Keep appliance area clear and free from combustible materials, gasoline and other flammable vapors and liquids.
7. Check frequently to be sure the flow of combustion and ventilation air to the boiler is not obstructed.
8. This unit uses a transformer to supply a low voltage control circuit. The voltage on the secondary side should be 24 to 28 VAC when measured with a volt meter. 990,000 thru 2,070,000 BTU models have a 7 AMP circuit breaker provided on the secondary side of the transformer. A tripped circuit breaker indicates a short in the 24VAC controls that must be corrected.
9. Combustion Air Adjustment: This unit uses a fan assisted combustion process. 300,000 thru 750,000 BTU models have one combustion air fan, 990,000 thru 2,070,000 BTU models have multiple fans to supply combustion air to the burners. They are factory pre-set and should not need ad justment in most cases. 300,000 thru 750,000 BTU models have the fan located in the right top chamber, 990,000 thru 2,070,000 BTU models have fans located left, center and right in the top chamber. Units with three fans will not have a low air light on the "right" fan until the low air condition on the left and center fans have been cor rected. Follow the steps below to adjust fan if a continuous Low Air Light condition is observed,

a. Check for proper installation and draft in venting system. Correct as required.
b. Single fan units have one low air light. On units with multiple fans, determine which fan is to be adjusted by observing the low air lights. On two fan units, Low Air 1 indicates left fan and Low Air 2 indicates right fan. On three fan units, Low Air 2 indicates center fan and Low Air 3 indicates right fan.
c. Open the right top jacket panel to access the fan on single fan units. Remove the top front jacket panel(s) to access the combustion air fans on units with multiple fans.
d. Fan air shutter adjustment:

COMBUSTION AIR ADJUSTMENT
300,000 - 750,000

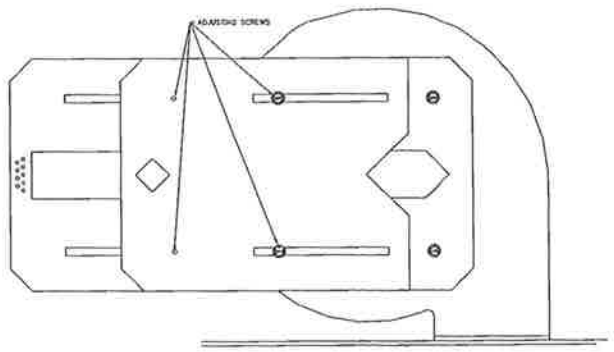


FIG. 23

300,000 thru 750,000 BTU Models:
Loosen the four (4) screws holding the air shutter in place. With the fan running, slowly close the air shutter until the low air light comes on. Slowly open the air shutter until the low air light goes off, plus an extra 1/8". Retighten the four (4) holding screws.

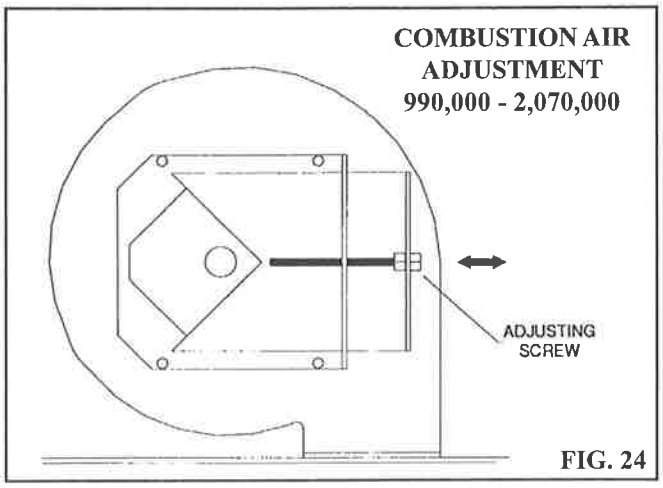


FIG. 24

990,000 thru 2,070,000 BTU Models:
With the fan running and the low air light on, slowly turn the air shutter adjustment screw clockwise until the low air light for that fan turns off. Turn the adjustment screw four additional turns after the low air light turns off. Repeat for each additional fan on low air.

e. Replace the top/front jacket panel(s).
f. Fire the unit, check operation and verify proper draft.

GAS TRAIN AND CONTROLS

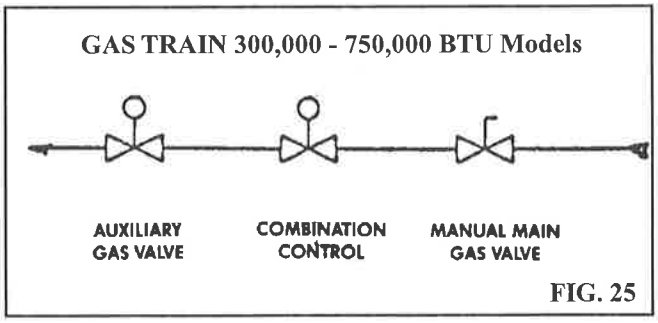


FIG. 25

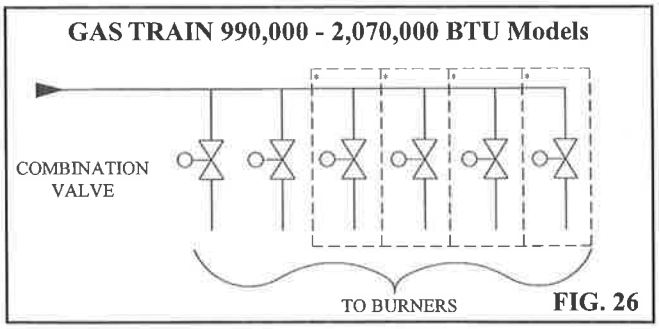


FIG. 26

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

LOW WATER CUT-OFF

If this hot water supply boiler is installed above radiation level, a low water cut-off device must be installed at the time of boiler installation (option, available from factory).

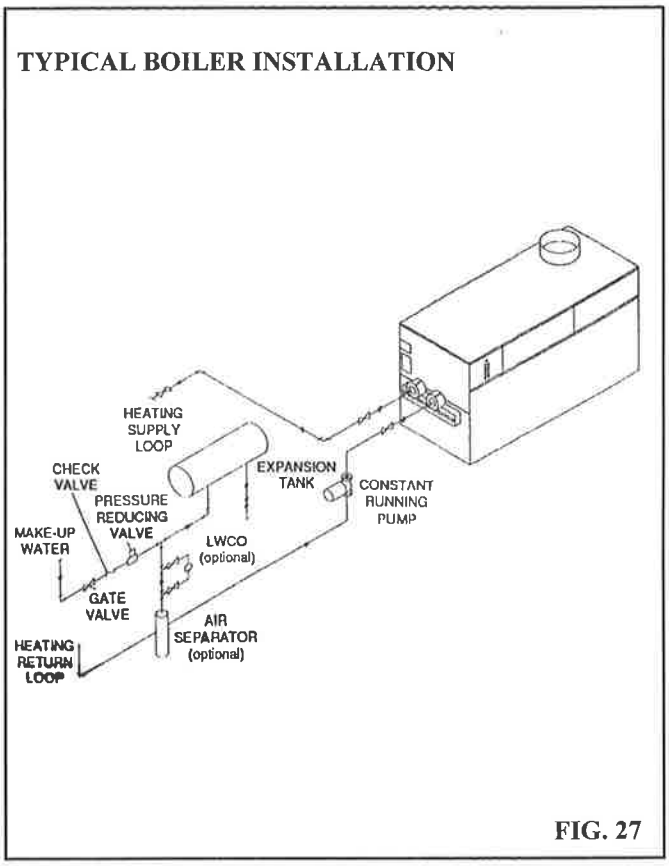


FIG. 27

FILLING THE BOILER

1. Fill the system with water. To be sure that the unit is not "air bound," open the relief valve. Leave the valve open until a steady flow of water is observed. Close valve and complete filling the system.
2. In hard water areas, water treatment should be used to reduce introduction of minerals into the system. Minerals in the water can collect in the tubes and cause noise on operation. Proper temperature rise must be maintained. Excessive buildup of minerals in the heat exchanger can cause a non-warrantable failure.
3. Make sure there are no system leaks. DO NOT use petroleum based stop leak products. All system leaks must be repaired. The constant addition of make-up water to a closed loop boiler system can cause minerals to collect in the heat exchanger and damage the boiler.
4. If freeze protection is required on a boiler with an indirect coil, DO NOT use undiluted or automotive type antifreeze. Use only hydronic system antifreeze following the manufacturers instructions.

SPECIAL DESIGN APPLICATIONS

The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.

The boiler piping system of the hot water boiler (when connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation) must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

LOW WATER TEMPERATURE SYSTEMS

A number of hydronic boiler applications call for system water temperature operation in the range of 60° to 100° F. Several of the more typical applications are: Water Source Heat Pump Systems; Greenhouse Soil Heating and Irrigation Systems; Process or Manufacturing Operations.

Installations such as these, while increasingly common, often present problems resulting from boiler condensation, thermal stresses and poor overall system efficiency. Copper-tube boilers are particularly adaptable to applications of this type for several reasons:

1. This is an instantaneous boiler, requiring virtually no heat - up time, and having no temperature "overshoot." Result? High system efficiency.
2. The boilers unique construction prevents the transfer of heat exchanger thermal stresses to the other boiler components-reducing wear and tear, while increasing equipment life expectancy.
3. Its compact, simple design and low boiler mass permits a simple by-pass arrangement which will allow the system to be operated at any temperature above 60° F.

The piping illustrations and instructions in Figure XX detail a simple by-pass arrangement which will allow the system to be operated at any temperature above 60° F, without condensation forming on the boiler.

Condensation is prevented by simply regulating the flow balancing valves. This diverts sufficient water flow through the boiler maintaining specified water temperatures while allowing the system to operate at design temperatures (as low as 60° F).

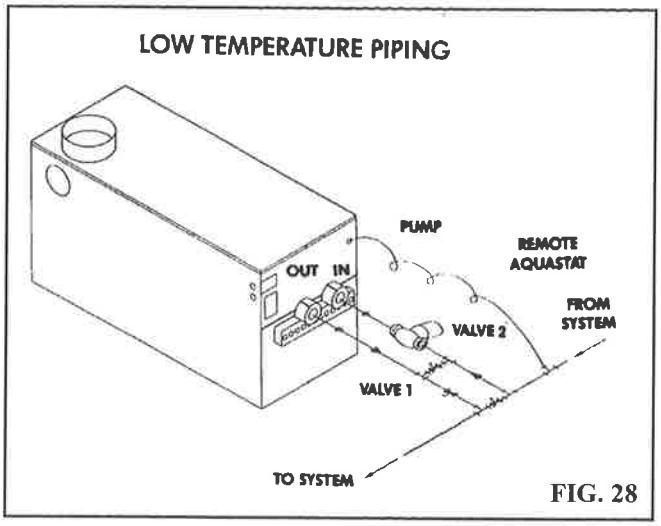


FIG. 28

LOW TEMPERATURE PIPING

Boilers in this input range should be operated with a 140° F inlet temperature to prevent condensation. Install the boiler with a secondary pump, valves and bypass as shown below.

NOTE: Closed Loop Systems may require an expansion tank, water feeder, air vents and/or other components not furnished with the boiler.

For Low Temperature Operation Proceed as Follows:

1. Select boiler type and size.
2. Set remote control aquastat at desired system temperature.
3. Start system and adjust balancing valve (1) slowly closing until inlet temperature to the boiler is 140° F minimum.
4. If temperature to boiler exceeds 140° F, slowly close valve (2) until 140° is maintained.
5. Operate boiler until desired system operating temperature is achieved. Check out all components for operation.
6. Carefully following these instructions will permit the system circulating loop to operate at the desired temperature

SYSTEM TEMPERATURE RISE CHART - TABLE L
Based on BTU Input

		ΔT 10°		ΔT 20°		ΔT 30°		ΔT 40°		ΔT 50°		ΔT 60°	
Input	Output	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD
300,000	252,000	51	5.2	26	1.3	17	0.6	13	0.6	10	0.6	9	0.5
399,999	336,000	68	7.4	34	2.4	23	1.1	17	0.6	14	0.6	11	0.6
500,000	420,000	85+	*	42	4.1	28	1.6	21	0.7	17	0.6	14	0.6
650,000	546,000	110+	*	55	5.2	37	3.0	28	1.6	22	0.8	18	0.6
750,000	630,000	127+	*	64+	*	42	4.1	32	2.3	25	1.2	21	0.7
990,000	831,600	166+	*	83	5.4	55	2.6	42	1.5	33	1.0	28	0.9
1,260,000	1,058,400	212+	*	106+	*	71	4.4	53	2.7	42	1.7	35	1.2
1,440,000	1,209,600	242+	*	121+	*	81	6.3	61	3.8	48	2.3	40	1.8
1,800,000	1,512,000	303+	*	151+	*	101+	*	76	6.6	61	4.4	50	3.0
2,070,000	1,738,800	348+	*	174+	*	116+	*	87	9.0	70	6.2	58	4.6

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

regardless of the higher boiler water temperature.

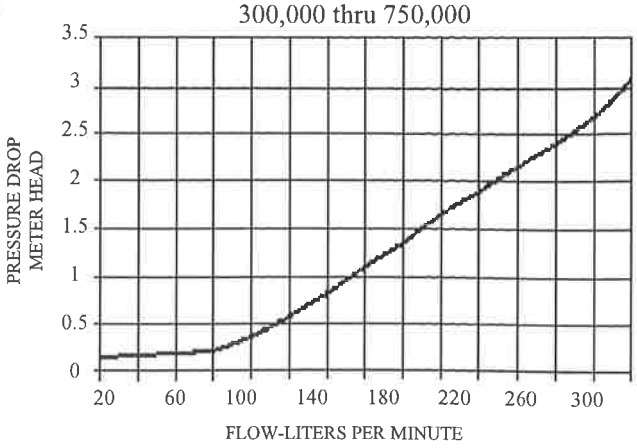
HEATING BOILER PERFORMANCE DATA

These boilers are generally capable of operating within the design flow rates for the building heating system. Should the flow rate of the system exceed the maximum flow rate through the boiler, an external boiler by-pass must be installed. This will prevent boiler damage.

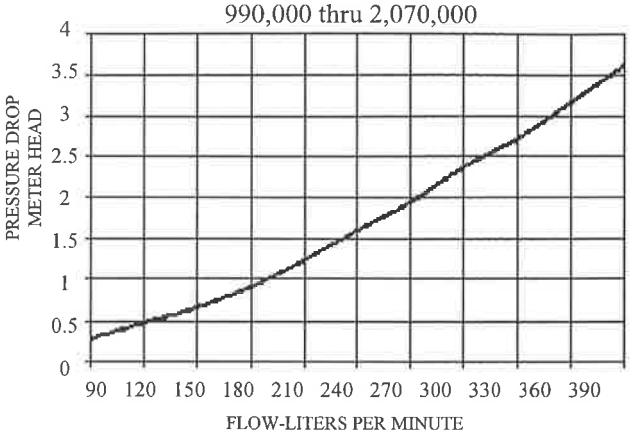
MAXIMUM BOILER FLOW RATES

INPUT	FLOW
300,000	75 GPM
399,999	75 GPM
500,000	75 GPM
650,000	75 GPM
750,000	75 GPM
990,000	90 GPM
1,260,000	90 GPM
1,440,000	90 GPM
1,800,000	90 GPM
2,070,000	90 GPM

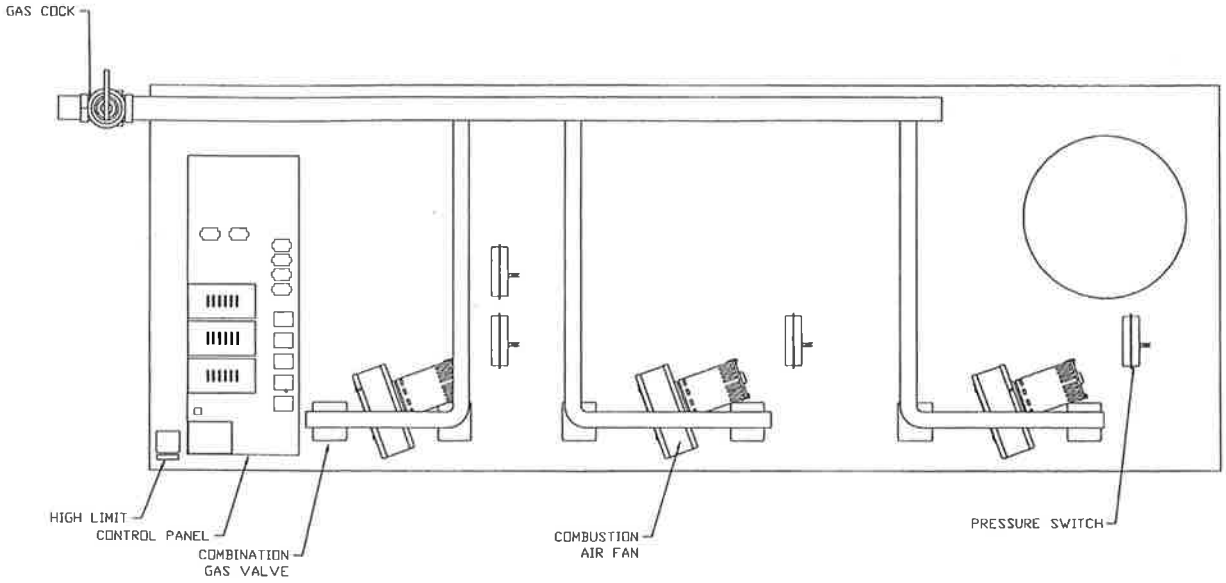
HEAT EXCHANGER HEAD-LOSS CHART
300,000 thru 750,000



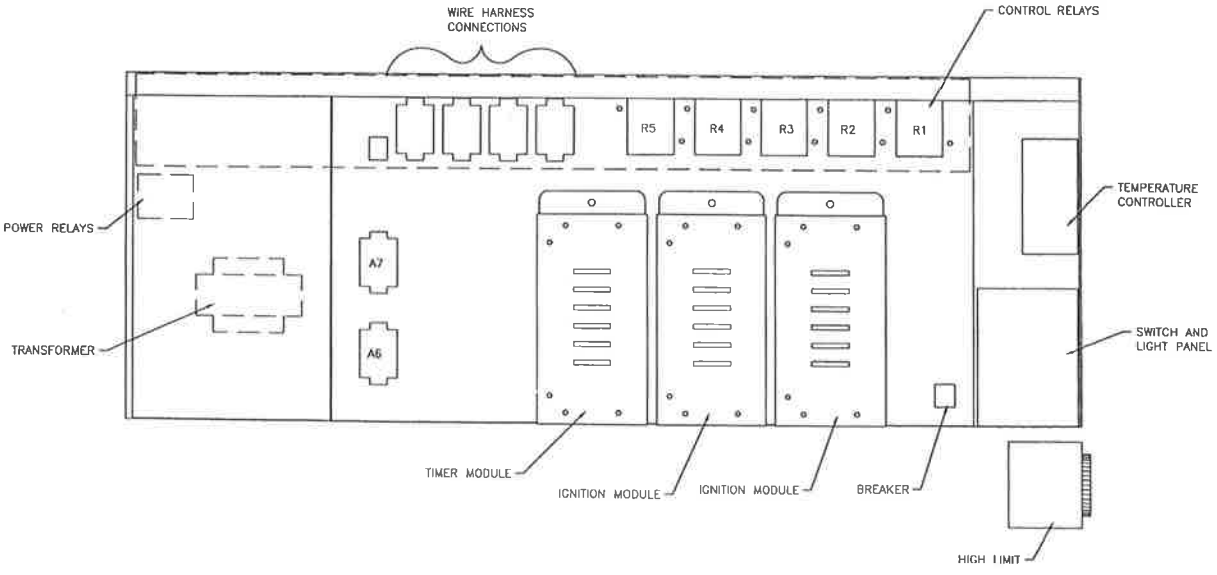
HEAT EXCHANGER HEAD-LOSS CHART
990,000 thru 2,070,000



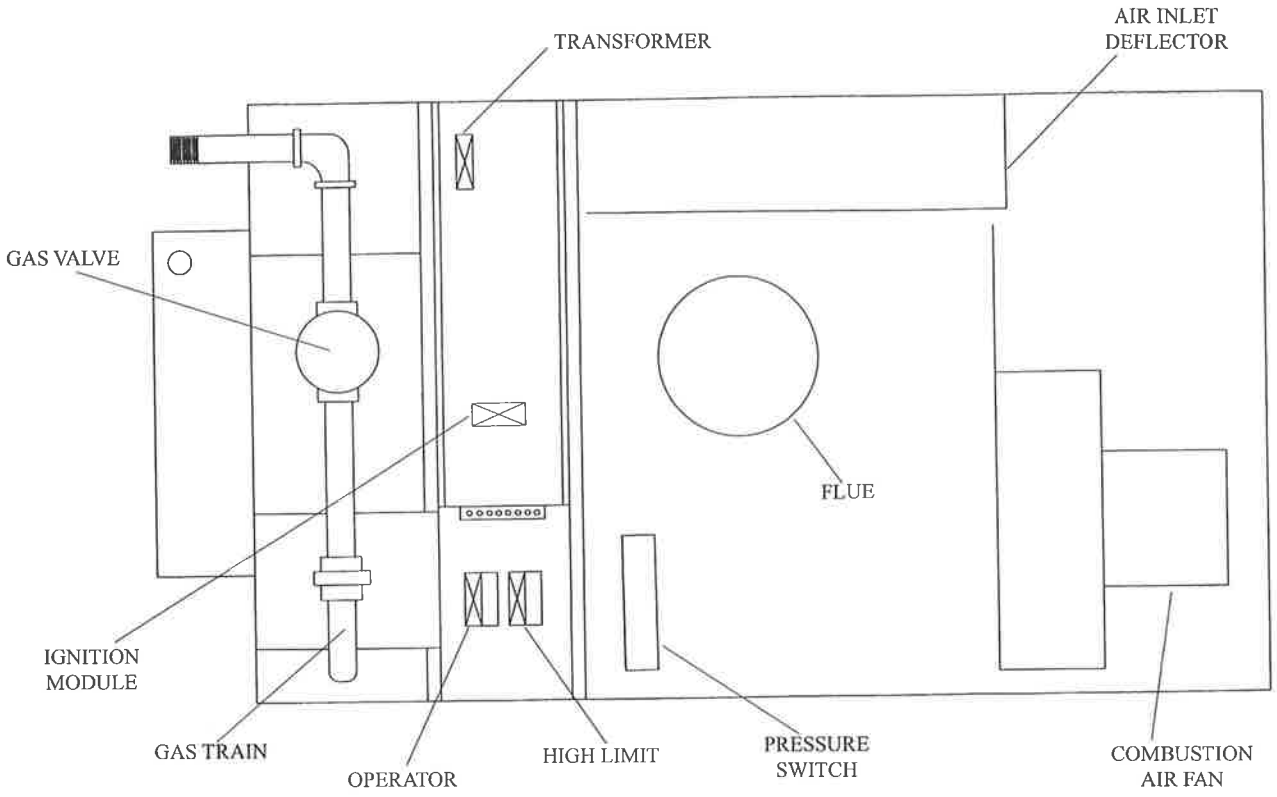
COMPONENT LOCATION
990,000 THRU 2,070,000 BTU MODELS



CONTROL PANEL LAYOUT
990,000 THRU 2,070,000 BTU MODELS



COMPONENT LOCATION
300,000 THRU 750,000 BTU MODELS



CONTROL PANEL LAYOUT
990,000 THRU 2,070,000 BTU MODELS