



Lochinvar®

High Efficiency Water Heaters And Boilers

PARTS DEPOT

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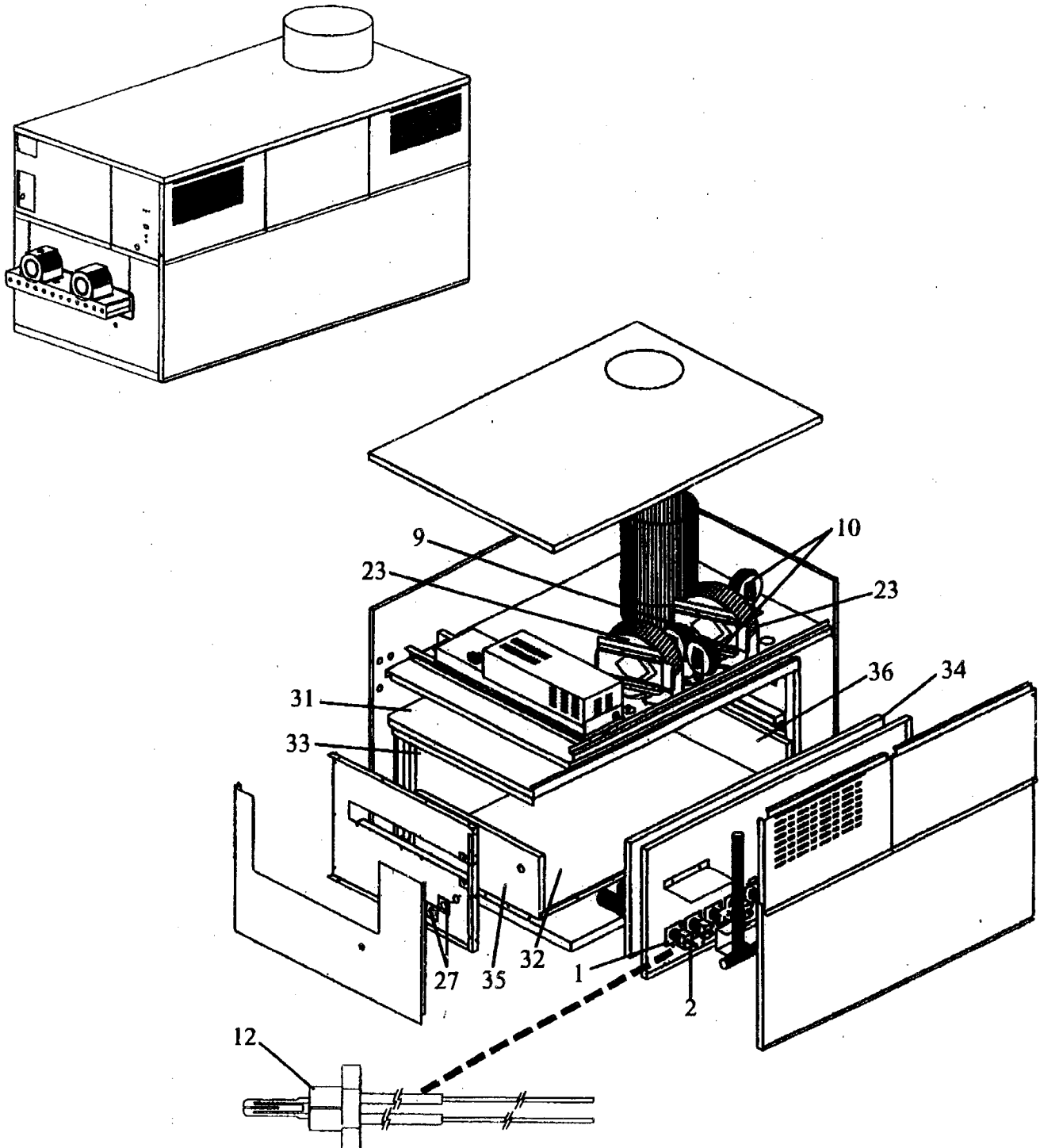
Replacement Parts List

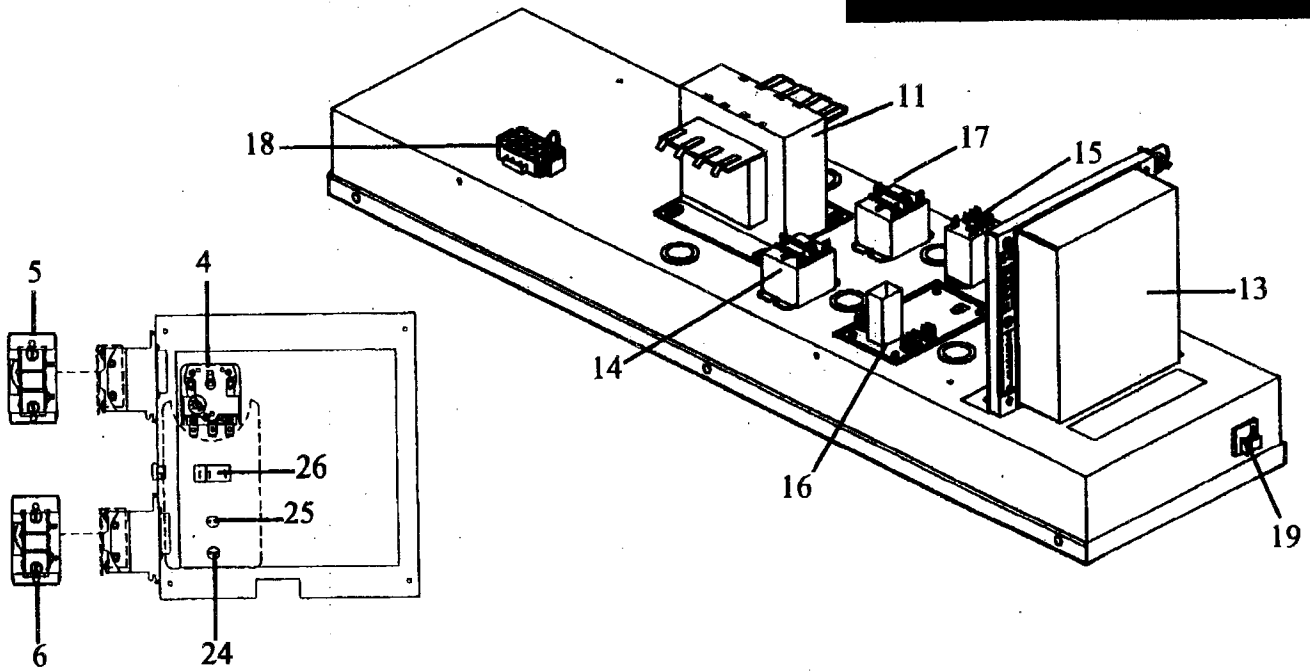
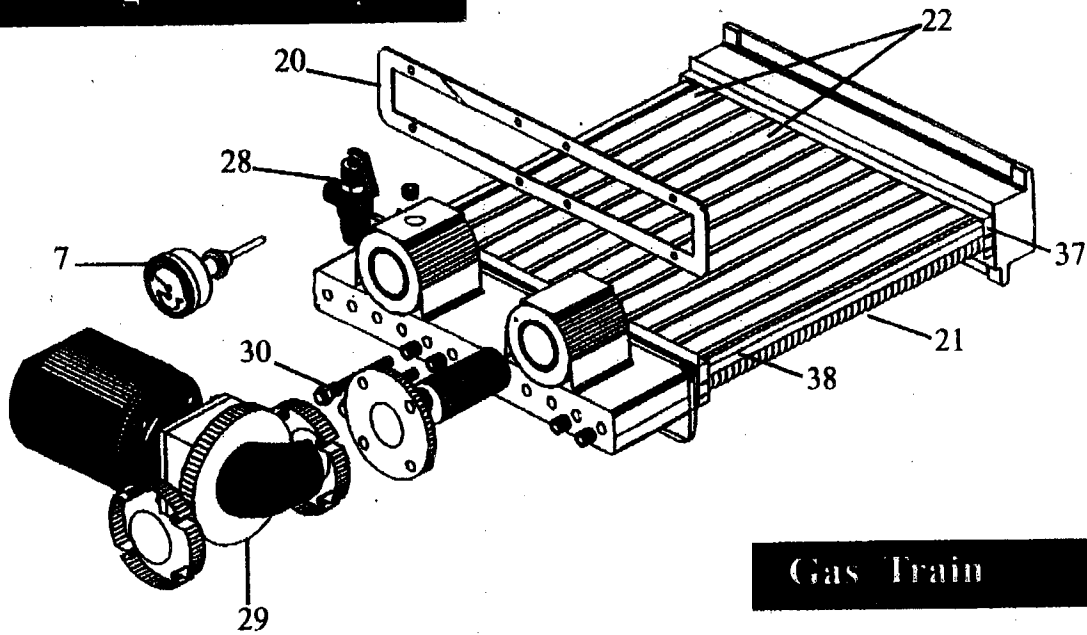
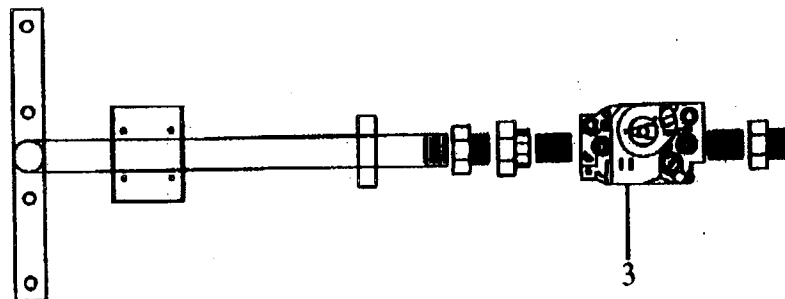
Copper-Fin®

Boilers — Water Heaters &
 Pool Heaters

CB—CW—CS — 985-2065

Beginning Serial Number: A950000



Control Panel**Heat Exchanger Assembly****Gas Train**

ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
GAS TRAIN ASSEMBLIES			
1	KIT #	BNR2404:	BNR3501: BNR3502:
BNR3410	985	9ea.	1ea. 1ea.
BNR3411	1255	12ea.	1ea. 1ea.
BNR3412	1435	14ea.	1ea. 1ea.
BNR3413	1795	17ea.	1ea. 2ea.
BNR3414	2065	20ea.	1ea. 2ea.
		(BNR2404) MAIN BURNER	
		(BNR3501) MAIN BURNER CONNECTED THERMOCOUPLE	
		(BNR3502) MAIN BURNERW/PRESSURE TAP	
2	ORF2404	ORIFICE, NAT.	ALL
2	ORF2405	ORIFICE, LPG.	ALL
3	VAL3403	VALVE, GAS NAT., W/NIPPLES	ALL
3	VAL3404	VALVE, GAS LPG., W/NIPPLES	ALL
CONTROLS AND GAUGES			
4	TST2701	THERMOSTAT, OPERATOR	ALL CB/CW/CS
5	TST2900	THERMOSTAT, HI LIMIT	ALL CB/CS
6	TST3910	THERMOSTAT, LIMIT	ALL CW
5	TST3911	THERMOSTAT, HI LIMIT	ALL CW
—	TST2025	THERMOSTAT, OPERATOR-HI LIMIT (BYPASS LOOP)PRIOR TO 4/98	ALL CS
7	GTP2900	TEMPERATURE & PRESSURE GAUGE	ALL CB
7	GTP2002	TEMPERATURE GAUGE 2	ALL CW/CS
—	MSC2016	TERMINAL STRIP, 8 POLE	ALL
9	PRS2416	PRESSURE SWITCH, BLOCKED FLUE	ALL
10	PRS2417	PRESSURE SWITCH, LOW AIR	ALL
11	TRF2701	TRANSFORMER 150V.A.	ALL
—	WTR2041	SWITCH, FLOW OUTDOOR	ALL CB/CW
—	WTR2040	SWITCH, FLOW INDOOR	ALL CB/CW
12	PLT3400	HOT SURFACE IGNITOR	ALL
13	RLY3428	IGNITION MODULE ASSEMBLY	ALL
14	RLY2706	RELAY, POWER 120V	ALL
15	RLY2903	RELAY 24V	ALL
16	RLY2714	TIME DELAY RELAY	ALL
17	RLY2030	RELAY, POST PURGE (BEFORE SERIAL # J991965)	ALL
18	MSC2407	JUMPER PLUG	ALL
19	MSC2447	CIRCUIT BREAKER 7 AMP	ALL
—	PRS2415	PRESSURE SWITCH, GAS	ALL
—	PRS2406	SWITCH, POOL HEATER PRESSURE	ALL
—	TST2403	THERMOSTAT BOARD	CS
—	TST2404	POTENTIOMETER	CS
—	TST2405	SENSOR	CS
—	HLC2702	MANUAL RESET HIGH LIMIT	ALL
—	HLC2501	200' FIXED HIGH LIMIT	CS
—	HLC2503	100' FIXED HIGH LIMIT	CS
HEAT EXCHANGERS			
20	GKT2418	GASKET, HEAT SHIELD	ALL
21	HEX3420	HEAT EXCHANGER	CB 985
21	HEX3421	HEAT EXCHANGER	CB 1255
21	HEX3422	HEAT EXCHANGER	CB 1435
21	HEX3423	HEAT EXCHANGER	CB 1795
21	HEX3424	HEAT EXCHANGER	CB 2065
21	HEX3000	HEAT EXCHANGER	CW/CS 985
21	HEX3001	HEAT EXCHANGER	CW/CS 1255
21	HEX3002	HEAT EXCHANGER	CW/CS 1435
21	HEX3003	HEAT EXCHANGER	CW/CS 1795
21	HEX3004	HEAT EXCHANGER	CW/CS 2065
22	JKE6078	V-BAFFLE 11 PER UNIT	985
22	JKE6079	V-BAFFLE 11 PER UNIT	1255
22	JKE6080	V-BAFFLE 11 PER UNIT	1435
22	JKE6081	V-BAFFLE 11 PER UNIT	1795
22	JKE6082	V-BAFFLE 11 PER UNIT	2065

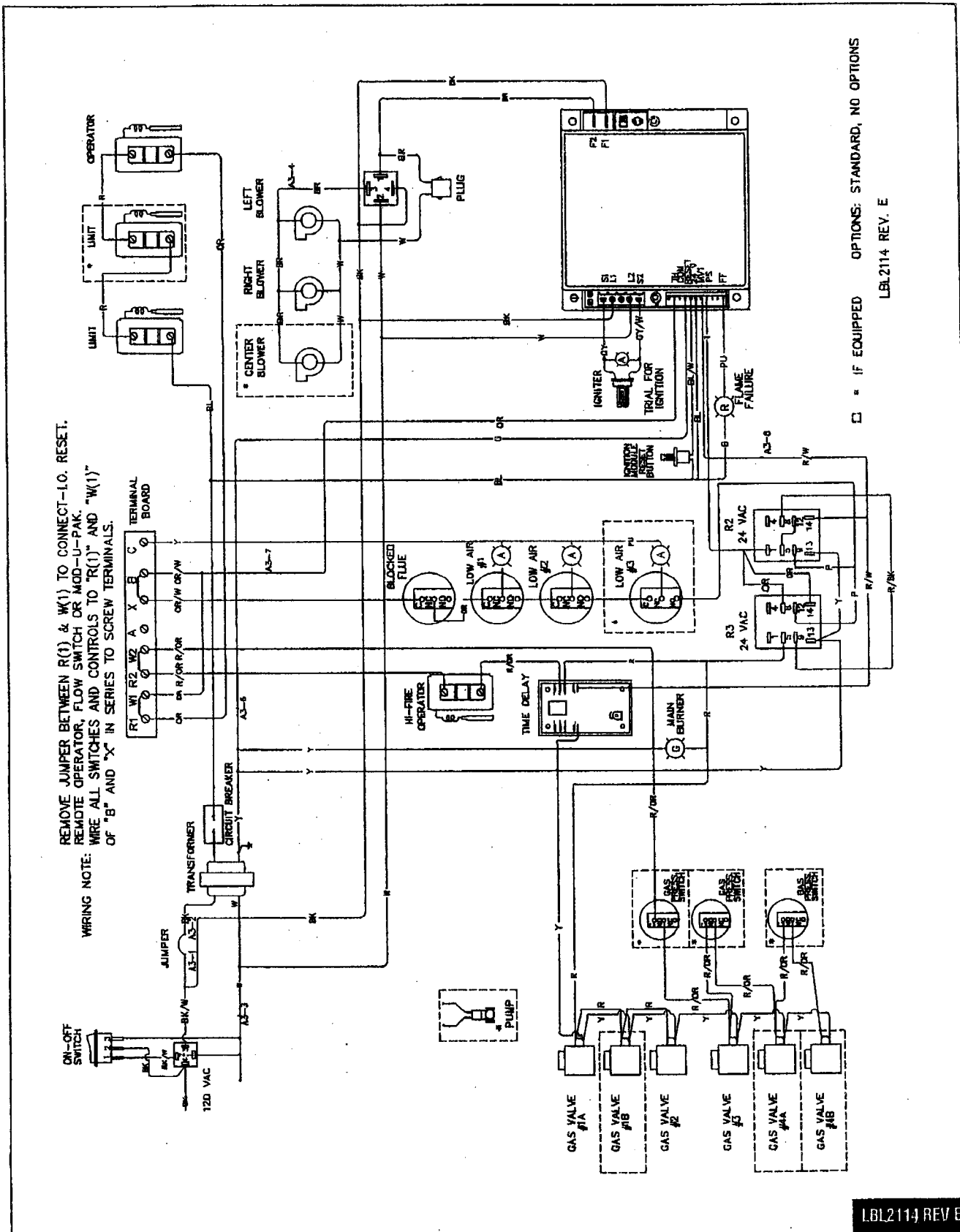
NOTE: CB BOILER, CW WATER HEATER & CS FOOD HEATER
PLEASE HAVE MODEL NUMBER AND SERIAL NUMBER WHEN ORDERING PARTS

ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
MISCELLANEOUS			
	JKE6083	FRAME RUNNER 2 PER UNIT	985
38	JKE6084	FRAME RUNNER 2 PER UNIT	1255
38	JKE6085	FRAME RUNNER 2 PER UNIT	1435
38	JKE6086	FRAME RUNNER 2 PER UNIT	1795
38	JKE6087	FRAME RUNNER 2 PER UNIT	2065
37	JKE6511	FRAME END 2 PER UNIT	ALL
23	FAN2712	FAN ASSEMBLY	ALL
—	MSC2424	LIGHT, AMBER 28V	ALL
—	MSC2023	LIGHT, AMBER 120V, TRIAL (BEGINNING SERIAL NUMBER G967041)	ALL
24	MSC2026	LIGHT, RED 24V	ALL
25	MSC2028	LIGHT, GREEN 24V	ALL
26	MSC2426	SWITCH, ROCKER	ALL
27	MSC3415	SIGHT GLASS & GASKET	ALL
28	RLV2001	RELIEF VALVE, PRESSURE ONLY	CB
28	RLV2017	RELIEF VALVE, TEMPERATURE & PRESSURE	ALL CW/CS
29	ARM3024PBF	PUMP	CW
29	ARM3024PABTE	PUMP	CS
30	TST2301	WELL, THERMOSTAT	ALL
LOCH-HEAT TILE			
31	FIB2441	LOCH-HEAT* TILE, TOP RIGHT SIDE	985
31	FIB2442	LOCH-HEAT* TILE, TOP LEFT SIDE	985
31	FIB2443	LOCH-HEAT* TILE, TOP RIGHT SIDE	1255-1435
31	FIB2444	LOCH-HEAT* TILE, TOP LEFT SIDE	1255
31	FIB2445	LOCH-HEAT* TILE, TOP LEFT SIDE	1435
31	FIB2446	LOCH-HEAT* TILE, TOP RIGHT SIDE	1795-2065
31	FIB2447	LOCH-HEAT* TILE, TOP MIDDLE	1795-2065
31	FIB2448	LOCH-HEAT* TILE, TOP LEFT SIDE	1795
—	FIB2449	LOCH-HEAT* TILE, TOP LEFT SIDE	2065
—	FIB2471	LOCH-HEAT* TILE, BOTTOM	985
—	FIB2450	LOCH-HEAT* TILE, BOTTOM RIGHT	1435-2065
32	FIB2451	LOCH-HEAT* TILE, BOTTOM	1255
32	FIB2452	LOCH-HEAT* TILE, BOTTOM LEFT	1435
32	FIB2453	LOCH-HEAT* TILE, BOTTOM LEFT	1795
32	FIB2454	LOCH-HEAT* TILE, BOTTOM LEFT	2065
33	FIB2472	LOCH-HEAT* TILE, BACK	985
33	FIB2455	LOCH-HEAT* TILE, BACK RIGHT	1435-2065
33	FIB2456	LOCH-HEAT* TILE, BACK	1255
33	FIB2457	LOCH-HEAT* TILE, BACK LEFT	1435
33	FIB2458	LOCH-HEAT* TILE, BACK LEFT	1795
33	FIB2459	LOCH-HEAT* TILE, BACK LEFT	2065
34	FIB2460	LOCH-HEAT* TILE, FRONT DOOR	985
34	FIB2461	LOCH-HEAT* TILE, FRONT DOOR	1255
34	FIB2462	LOCH-HEAT* TILE, FRONT DOOR RIGHT	1435
34	FIB2469	LOCH-HEAT* TILE, FRONT DOOR LEFT	1435
34	FIB2463	LOCH-HEAT* TILE, FRONT DOOR RIGHT	1795
34	FIB2470	LOCH-HEAT* TILE, FRONT DOOR LEFT	1795
34	FIB2464	LOCH-HEAT* TILE, FRONT DOOR RIGHT	2065
34	FIB2465	LOCH-HEAT* TILE, FRONT DOOR LEFT	2065
35	FIB2466	LOCH-HEAT* TILE, FRONT HEAD SIDE	ALL
36	FIB2467	LOCH-HEAT* TILE, REAR HEAD SIDE	ALL
—	FIB2468	LOCH-HEAT* TILE, REAR HEAD SPACER STRIP	ALL
OPTIONAL			
—	GAC2032	GAS COCK 2	ALL
—	PAN3201	OPTION BOX A: LOUVER RELAY w/PUMP DELAY (LVR w/P. DELAY)	ALL
—	PAN3202	OPTION BOX B: MR-LWCO, LVR w/P. DELAY	ALL
—	PAN3203	OPTION BOX C: MR-LWCO, LVR w/P. DELAY, ALARM ANY FAILURE	ALL
—	HLC2702	MANUAL RESET HIGH LIMIT	ALL

NOTE: CB BOILER, CW WATER HEATER & CS POOL HEATER
PLEASE HAVE MODEL NUMBER AND SERIAL NUMBER WHEN ORDERING PARTS

CONNECTION WIRING DIAGRAM-HOT SURFACE IGNITION-M9

MODELS CB985-2065



INSTALLATION AND SERVICE MANUAL

HOT WATER HEATING BOILER HOT WATER SUPPLY BOILER MODELS 495 thru 2065

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 Instructions for Operation).
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 Instructions for Operation for proper pump performance).

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 electrical 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.

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.

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.

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 UNDERWATER. 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 UNDERWATER.

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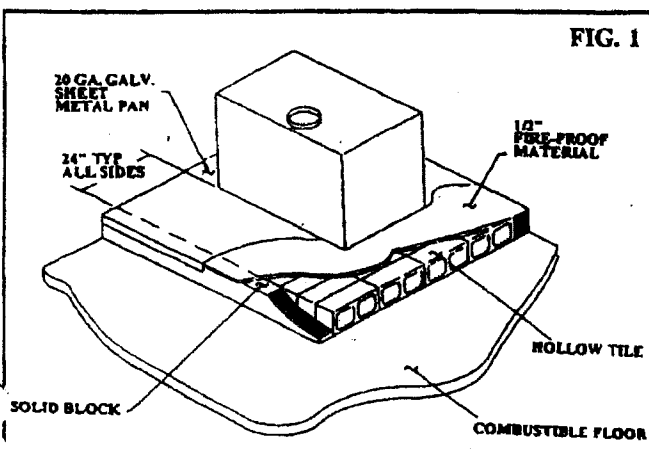
CODES

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-B149.2 and or local codes.

LOCATION

These units are suitable for indoor or outdoor installation. The optional outdoor venting configuration is 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:

495,000 thru 2,065,000 BTU input units installed over a combustible floor **MUST** be provided with a base of

hollow clay tile or concrete blocks from 8" to 12" thick and extending 24" beyond the sides of the unit. 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 and air inlet shield. Instructions for mounting the vent cap assembly 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.

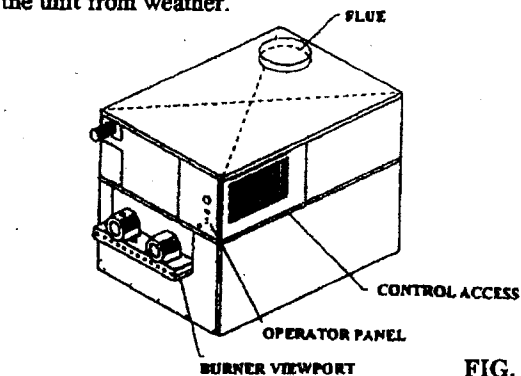


FIG. 2

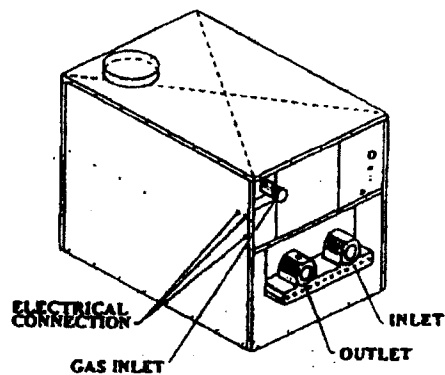


FIG. 3

CLEARANCES TABLE A

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.

COMBUSTION & 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 Installation Code 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 2,000 BTU input. This opening must be located near the floor.
 - b. Ventilation air opening, one square inch per 2,000 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 1,000 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 boiler stack. The result is improper combustion and premature boiler failures.

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 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 or barometric damper is required on

single unit installations when draft is within the specified range. Multiple unit installations with combined venting require barometric dampers to regulate draft at each unit.

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).

FLUE PIPE SIZES - TABLE B

The flue pipe sizes are:	
Input BTU/hr	Flue Size
495,000	6"
645,000	8"
745,000	8"
985,000	10"
1,255,000	12"
1,435,000	12"
1,795,000	14"
2,065,000	14"

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 manufacturers 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 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 systems properly vents when tested as above, return doors, windows, exhaust fans, fireplace dampers and other gas burning appliances to their previous conditions of use.
- (g). Any improper operation of the common venting system should be corrected so that the installation conforms to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.

This unit has two venting options. They are: (1) conventional negative draft venting and (2) outdoor installation.

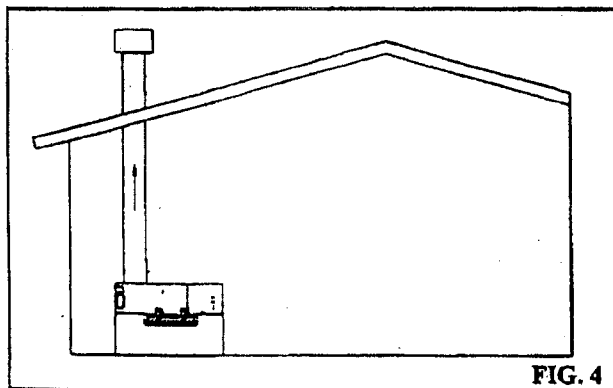


FIG. 4

CONVENTIONAL VENTING

The vent terminal should be vertical and exhaust outside the building at least 2 feet (0.6m) 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.

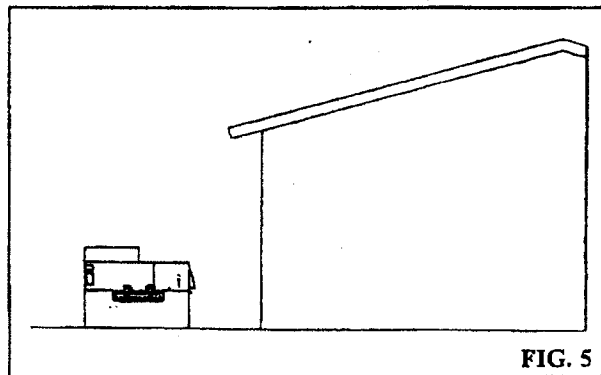


FIG. 5

OUTDOOR INSTALLATION

Units are self venting and can be used outdoors when installed with the optional Outdoor Cap and Air Inlet Shield. The flue cap mounts over the flue outlet on top of the unit and no additional vent piping is required. The air inlet shield mounts over air inlet grill on the front of the unit. Use pre-punched screw and mounting holes.

WARNING: Outdoor models **MUST** be installed outdoors and **MUST** use the vent cap and air inlet shield 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 (0.91m) from any wall or vertical surface to prevent adverse wind conditions from affecting performance.

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

**FITTINGS TO EQUIVALENT STRAIGHT PIPE
TABLE G**

iameter Pipe (inches)	1/4"	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'

**MULTIPLE UNIT INSTALLATIONS
GAS PIPING SIZE CHART
TABLE H**

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		
1/4"	369	256	205	174	155	141	128	121	113	106	95	86	79	74		
1/2"	697	477	384	325	292	267	246	235	210	200	179	164	149	138		
3/4"	1,400	974	789	677	595	543	502	472	441	410	369	333	308	287		
1"	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441		
1 1/4"	4,100	2,820	2,350	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820		
1 1/2"	6,460	4,460	3,610	3,100	2,720	2,440	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300		
2"	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,330	3,000	2,710	2,500	2,340		
2 1/2"	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720		

Maximum capacity of pipe in thousands of BTU's per hour for gas pressures of 14" inches Water Column (0.5 PSIG) or less and a pressure drop of 0.05 Inch Water Column (Based on NAT GAS, 1025 BTU's per Cubic Foot of Gas and 0.60 Specific Gravity).

WATER CONNECTIONS

Inlet and Outlet Water 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 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 coupling or other restriction 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.

WATER FLOW SWITCH (IF EQUIPPED)

A water flow switch is available as a factory installed option on all models. The flow switch will be installed in the boiler outlet piping. The flow switch on models 495,000 thru 745,000 BTU requires a minimum of 18 GPM to start the burners. The flow switch on models 985,000 thru 2,065,000 BTU requires a minimum of 26 GPM flow to start burner operation. A special sealed flow switch and conduit is available 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.

LOW WATER CUTOFF (IF EQUIPPED)

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

COMBINATION GAS VALVES

500,000 thru 990,000 BTU Input:

Each unit has multiple combination gas valves 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. A manifold pressure adjustment is located on each valve. The manifold gas pressure tap for each valve is located on the discharge side of the valve.

1,260,000 thru 2,070,000 BTU Input:

Each unit has multiple combination gas valves 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. A manifold pressure adjustment is located on each valve. The manifold gas pressure tap for each valve is located in the discharge side of the valve. A gas pressure switch(s) located in the valve discharge proves operation of adjacent valve(s) before the next valve will open to provide gas to the burners.

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)

The 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 Codes ANSI/NFPA No. 70. When the unit is installed in Canada, it must conform to the CAE C22.1, Canadian Electrical Code, Part I and/or local Electrical Codes.

1. All wiring between the unit and field installed devices shall be made of 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 - TABLE I

BTU INPUT	FAN(S)	CONTROLS	APPROXIMATE
			TOTAL AMPS @ 120 VAC
495,000	3.6	3.6	7.2
645,000	3.6	3.6	7.2
745,000	3.6	3.6	7.2
985,000	7.2	3.6	10.8
1,255,000	7.2	3.6	10.8
1,435,000	7.2	3.6	10.8
1,795,000	10.8	3.6	14.4
2,065,000	10.8	3.6	14.4

TEMPERATURE ADJUSTMENT

495,000 thru 2,065,000 BTU Models:

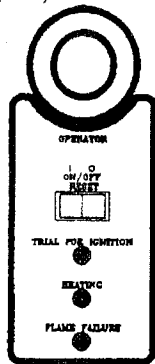


FIG. 7

Operating Temperature Control

An adjustable immersion operating control is located on the end of the jacket, above the ON/OFF switch. 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.

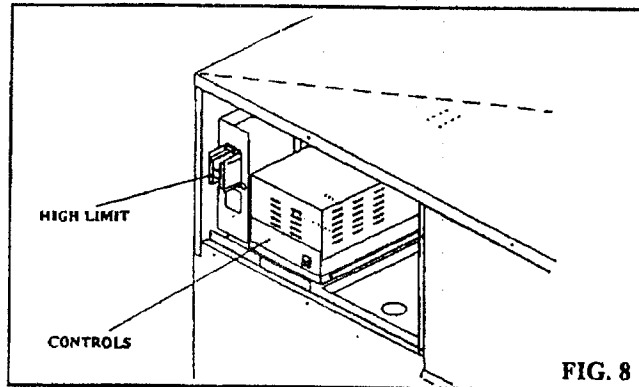


FIG. 8

HighWater Temperature Limit Control

An adjustable high limit control(s) is located on the internal control panel. 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.

OPTIONAL TWO STAGE BURNER CONTROL SYSTEM

495,000 Thru 2,065,000 BTU Models:

An optional two stage burner control system is available. This system is equipped with two operating temperature controls to fire each burner stage at a different temperature set point. Stage one (Low Fire) must fire before stage two (Hi-Fire) will function. Set Low Fire operator at the desired system set point, Set Hi-Fire operator at a lower setting, approximately 5-15 degrees lower, for staged operation.

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 electrical 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 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

495,000 THRU 2,065,000 BTU MODELS

1. Stop! Read the safety information.
2. Turn off all electrical power to the appliance.
3. Open the top front jacket panel(s) to access the gas valve controls.
4. Set the thermostat(s) to the lowest setting.
5. This appliance is equipped with an ignition device which automatically lights the burners. **DO NOT** attempt to light the burners by hand.
6. Turn the gas control knob on each gas valve clockwise to the "OFF" position.

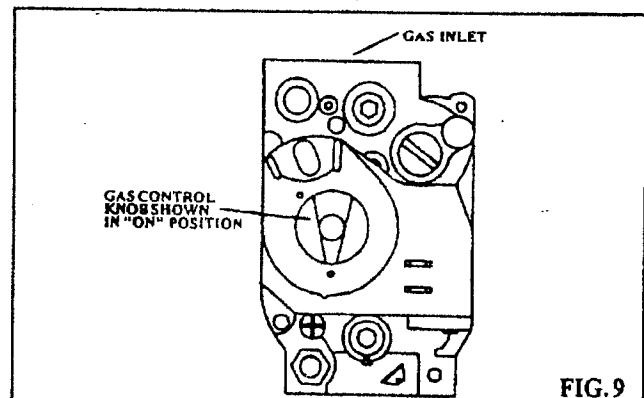


FIG. 9

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 next step.
8. Turn the gas control knob on each gas valve counter clockwise to the "ON" position.
9. Set the thermostat(s) to the desired setting.
10. Replace gas control access panel(s).
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 front jacket panel(s) to access gas valve controls.
3. Turn the gas control knob on each gas valve clockwise to the "OFF" position. Do not force.
4. Replace control access panel.

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

IGNITION SYSTEM CHECKOUT

495,000 thru 2,065,000 BTU Models:

1. Turn off gas supply to unit.
2. Turn thermostat(s) and high limit controls to highest setting.
3. Turn electric power on.
4. The ignition module will lock out.
5. Readjust thermostat(s) 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.

HOT SURFACE IGNITION SYSTEM

The hot surface igniton 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. 495,000 thru 2,065,000 BTU units have one ignition module and one hot surface ignitor. The hot surface ignitor is also the flame sensor.

OPERATION AND DIAGNOSTIC SYSTEM

495,000 thru 2,065,000 BTU Models:



FIG. 10

The external control panel has a lighted ON/OFF power switch and two indicating lights. Internal lights are provided to monitor fan operation.

EXTERNAL INDICATING LIGHTS	TABLE J FUNCTION
Power On	— Lighted power switch in on position.
Flame Failure Red	— Ignition module unable to properly prove ignition.
Heating-Green	— Burner On.

INTERNALLY MOUNTED LIGHT	TABLE K FUNCTION
Low Air- Amber	— Improper level of combustion air provided or a blockage in the flue. Located beside each combustion air fan.

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 can be provided by using hydronic system antifreeze. Follow the manufacturers instructions. **DO NOT** use undiluted or automotive type anti freeze.
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

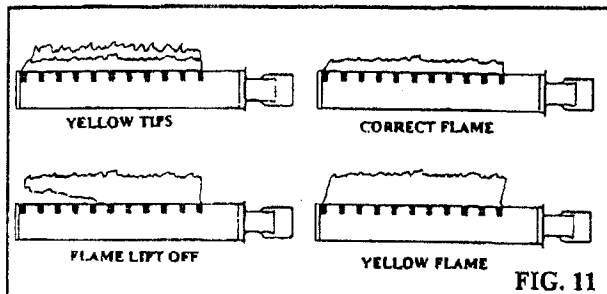
Listed below are items that should be checked to insure safe reliable operations. Verify proper operation after servicing.

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.



- 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 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 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 assemblies 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.

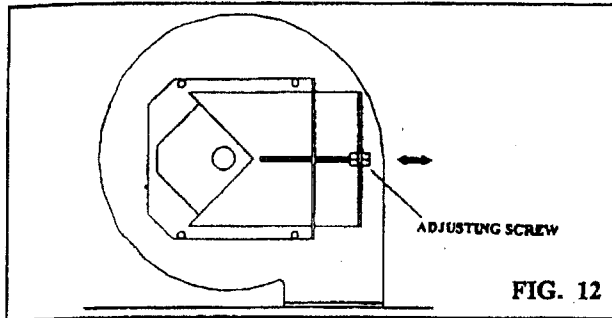
- i. Remove manifold(s)/orifice assemblies and dividers for fan chambers.
- j. Disconnect wiring from hot surface ignitor and hose from burner tap.
- k. Remove inner jacket mounting screws and slide door assembly out toward front of unit. Use caution to prevent damage to refractory.
- l. Remove soot 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 boiler 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 Circulation 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. 985,000 thru 2,065,000 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. 495,000 thru 745,000 BTU models have one combustion air fan, 985,000 thru 2,065,000 BTU models have multiple fans to supply combustion air to the burners. They are factory pre-set and should not need adjustment in most cases. 495,000 thru 745,000 BTU models have the fan located in the right top chamber; 985,000 thru 2,065,000 BTU models have fans located left, center and right in the top chamber. Follow the steps below to adjust fan if a continuous Low Air Light condition is observed.

- Check for proper installation and draft in venting system. Correct as required.
- 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 beside each fan.
- Open the front jacket panel to access the combustion air fan(s).
- Fan air shutter adjustment:

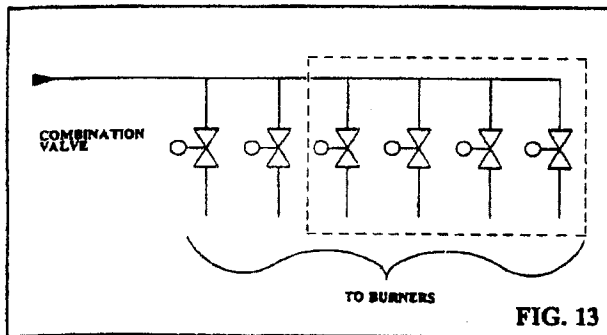
COMBUSTION AIR FAN



495,000 thru 2,065,000 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.

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

GAS TRAIN AND CONTROLS



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

HOT WATER HEATING BOILER 495,000 THRU 2,065,000 BTU MODELS

This section contains specific requirements for Hot Water Boilers. All warnings, cautions, notes and instructions from general section apply to these units in addition to the following instructions. These instructions must be followed closely to obtain maximum life and usage from your boiler.

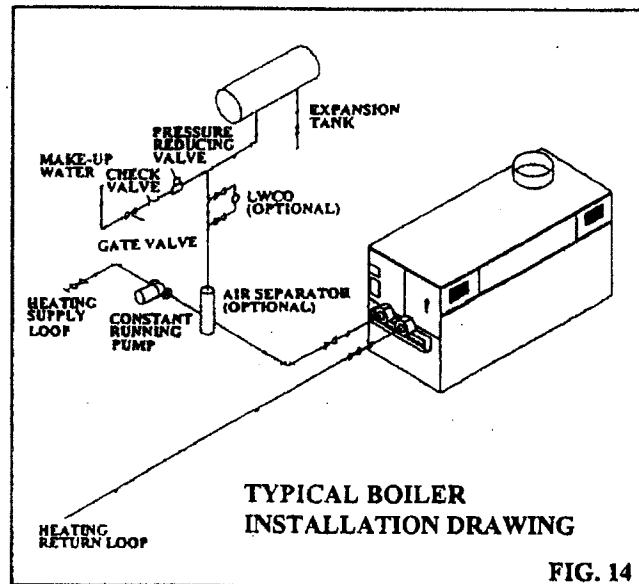
IMPORTANT: Operation of this boiler on low temperature systems requires special piping to insure correct operation. Consult low temperature system section for piping details.

LOW WATER CUT-OFF

If this 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).

FILLING THE BOILER

- Fill the system with water. To be sure that the boiler 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 boiler.
- 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. Excessive buildup of minerals in the heat exchanger can cause a non-warrantable failure.
- 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 can cause minerals to collect in the heat exchanger and damage the boiler.
- If freeze protection is required. **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 SYSTEM

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 boiler's 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 15 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).

LOW TEMPERATURE PIPING

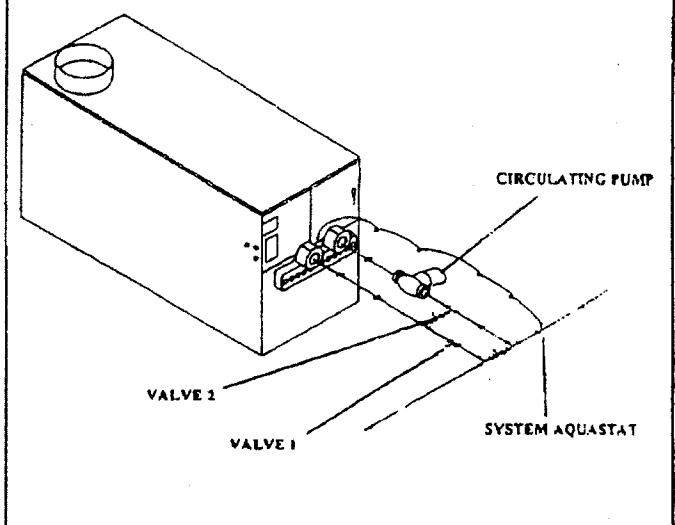
Boilers in this input range should be operated with a 140° F inlet temperature to prevent condensation. Install the boiler with a secondary pump, valves and bypass as shown below.

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 regardless of the higher boiler water temperature.

**LOW TEMPERATURE BOILER PIPING
FIGURE 15**



SYSTEM TEMPERATURE RISE CHART - TABLE L

Based on BTU Input

LOW TEMPERATURE PIPING

		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
495,000	400,950	82-		41	4.1	27	1.6	20	0.7	16	0.6	14	0.6
645,000	522,450	106+		53	5.1	35	3.0	27	1.6	21	0.8	18	0.6
745,000	603,450	123+		61+	*	41	4.1	31	2.3	25	1.2	20	0.7
985,000	797,850	162+		81	5.2	54	2.5	41	1.5	32	1.0	27	0.9
1,255,000	1,016,550	206+		103+	*	69	4.3	52	2.7	41	1.7	34	1.2
1,435,000	1,162,350	236+		118+	*	79	6.3	59	3.7	47	2.3	39	1.8
1,795,000	1,453,950	295+		147+	*	98+	*	74	6.5	59	4.4	49	2.9
2,065,000	1,672,650	339+		169+	*	113+	*	85	8.8	68	6.1	56	4.5

*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.

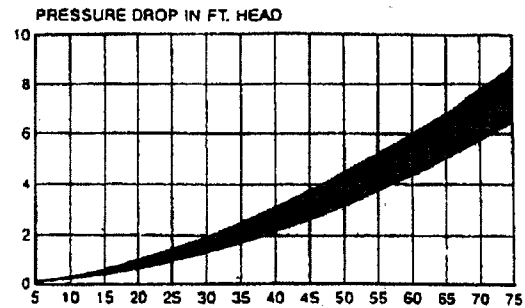
HEATING BOILER PERFORMANCE DATA

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.

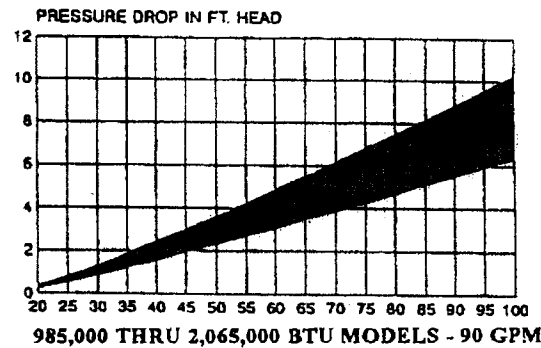
MAXIMUM BOILER FLOW RATES
TABLE M

<u>INPUT</u>	<u>FLOW</u>
495,000	75 GPM
645,000	75 GPM
745,000	75 GPM
985,000	90 GPM
1,255,000	90 GPM
1,435,000	90 GPM
1,795,000	90 GPM
2,065,000	90 GPM

HEAT EXCHANGER HEAD-LOSS CHART
FIG. 16

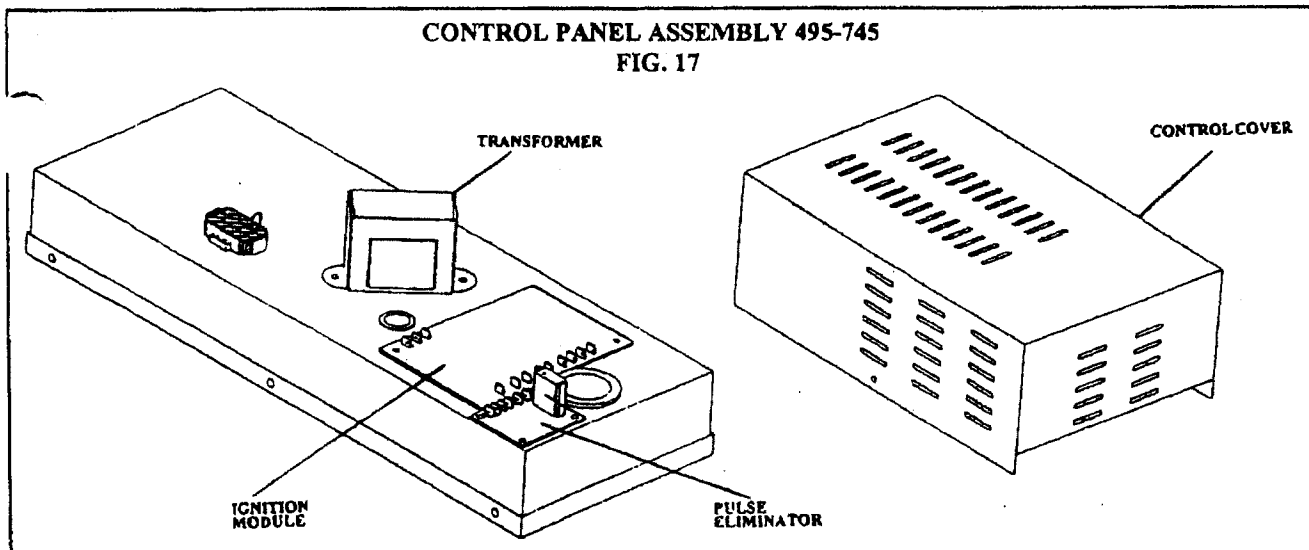


495,000 THRU 745,000 BTU MODELS - 75 GPM

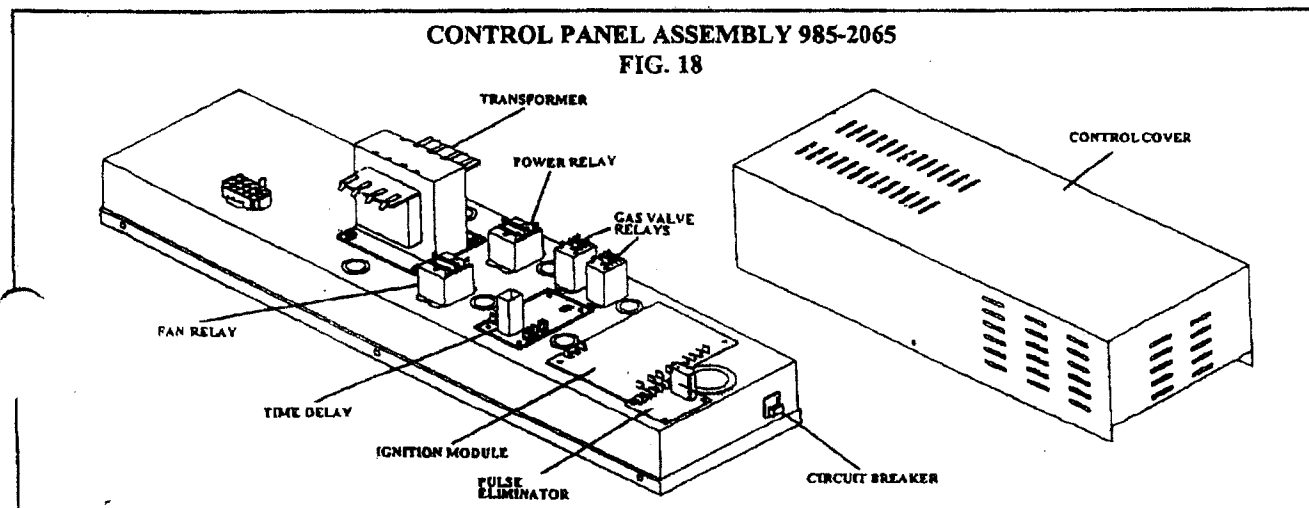


985,000 THRU 2,065,000 BTU MODELS - 90 GPM

CONTROL PANEL ASSEMBLY 495-745
FIG. 17



CONTROL PANEL ASSEMBLY 985-2065
FIG. 18



DOMESTIC HOT WATER SUPPLY BOILER

HOT WATER SUPPLY BOILER

495,000 - 2,065,000 BTU MODELS

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

WATER VELOCITY CONTROL

IMPORTANT - To insure proper velocity through the heat exchanger, it is necessary to regulate the temperature rise across the heat exchanger from inlet to outlet. This must be done on initial installation and periodically rechecked. With the correct temperature rise across the heat exchanger, you may be assured of the proper velocity in the tubes. This will yield long life and economical operation from your hot water supply boiler. Excessive lime build-up in the tubes is a result of too little velocity in the tubes. Excessive pitting or erosion in the tube is caused by too much velocity through the tubes. Care should be taken to measure temperature rise and maintain a velocity as follows:

1. The pump must run continuously.
2. With the pump running and the hot water supply boiler off, the inlet and outlet thermometers should read the same temperature. If they do not, an adjustment must be made to your final calculation.
3. Turn the hot water supply boiler on and allow time for the temperature to stabilize. Record the difference between the inlet and outlet temperatures. This difference will be the "temperature rise".
4. Compare the temperature rise on the heater with the required temperatures rise in Table N below. Should adjustment be needed, proceed as follows:

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

1. Check for restrictions in the outlet of the heater.
2. Be sure all valves are open between the heater and the tank.
3. Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.
4. Be sure that the circulation pipes between the heater and storage tank are no less than 2" diameter for 495,000 thru 745,000 BTU models and not less than 2 1/2" diameter for 985,000 thru 2,065,000 BTU models.

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

1. Slowly throttle the valve on the outlet side of the heater until the temperature rise is steady at the required temperature rise as noted in Table N.

REQUIRED TEMPERATURE RISE

TABLE N

BTUs	ΔT, °F	BTUs	ΔT, °F
495,000	15	1,255,000	23
645,000	19	1,435,000	26
745,000	22	1,795,000	32
985,000	18	2,065,000	37

COMMON WATER MANIFOLD SIZE FOR MULTIPLE HOT WATER SUPPLY BOILER INSTALLATION TABLE O

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

Number of Units	Common Manifold Size (Min.)
495,000-745,000	
1	2"
2	3"
3	3 1/2"
4	4"
5	5"
6	5"
985,000-2,065,000	
1	2 1/2"
2	4"
3	4"
4	5"
5	6"
6	6"

PUMP OPERATION

1. The hot water supply boiler must be connected to a properly sized, continuously running pump that circulates water between heater and storage tank.
 2. Pump is sized to heater input and water hardness. Care should be taken to size pump correctly.
 3. Lubricate pump to manufacturers recommendations. Pump damage due to inadequate lubrication is non-warrantable.
- The pump chart is based on the following fittings:

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

Not more than 45 feet of straight pipe

For every elbow and tee in excess of those shown above, DEDUCT 5 FEET from maximum allowable straight pipe in heater to tank circulating loop.

PUMP PERFORMANCE TABLE P

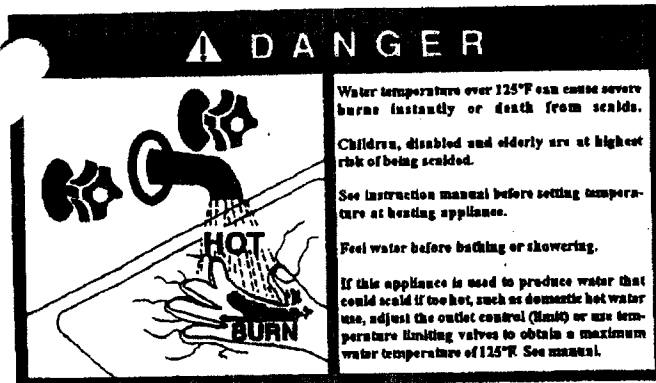
BTUs	Water Hardness of 25 grains	
	GPM	Ft. Hd.
495,000-745,000	55	10
985,000-2,065,000	90	15

HEAT EXCHANGER

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

THERMOSTAT SETTINGS

1. The thermostat is adjusted to a low test setting when shipped from the factory.
2. Set the thermostat or temperature control to the lowest settings which will satisfy hot water demands and prevent risk of scald injury.



WARNING: SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS CONTROL VALVE TO THE APPLIANCE.

TEMPERATURE ADJUSTMENT (Domestic Hot Water Use)

This unit has an adjustable thermostat to control water temperature. The thermostat is factory pre-set at approximately 125° F. Households with small children or invalids may require a 120° F or lower temperature setting to reduce risk of scald injury. Some states may require a lower temperature setting. Check with your gas supplier for local requirements governing the temperature setting. Remember, no water heating system will provide exact temperatures at all times. Allow a few days

of operation at this setting to determine the correct temperature setting consistent with your needs.

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

CAUTION: Hotter water increases the risk of scald injury. Incorrect piping of the cold water supply to the system may result in condensate formation on the heat exchanger and operational problems. See typical installation drawings provided with the unit for correct piping. Higher water temperatures reduce condensate formation.

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

RELIEF VALVE

This hot water supply boiler is supplied with temperature and 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.

THERMAL EXPANSION

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

CATHODIC PROTECTION

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

TEN YEAR LIMITED WARRANTY FOR COPPER TUBE BOILERS

WHAT DOES THIS LIMITED WARRANTY COVER? WHAT IS THE DURATION OF THE IMPLIED WARRANTY?

This limited warranty covers the Heat Exchanger for leakage, thermal shock or other malfunction caused by defects in materials and/or workmanship. It extends to the first buyer and to any subsequent owner(s) as long as the boiler remains installed at its original place of installation.

TEN YEARS OF COVERAGE!

This limited warranty is effective 60 days from the date of manufacture as determined by the serial number. Model number and serial number are found on the rating plate affixed to the boiler.

Copper tube heat exchangers are warranted against leakage and thermal shock for 10 years. Parts are warranted for one year. Any replacement copper tube heat exchanger under this warranty shall remain in warranty only for the unexpired portion of the original warranty.

SPECIAL NOTE: The warranty of any boiler found to be operating as a "water heater" shall revert back to Lochinvar's standard water heater warranty.

WHAT DOES THIS LIMITED WARRANTY NOT COVER?

1. This limited warranty does not cover leakage or other malfunction caused by:
 - a. Defective installation and specifically, any installation which is made:
 - I. in violation of applicable state or local plumbing, housing or building codes; or
 - II. without a certified American Gas Association, or ASME, Pressure Relief Valve, or
 - III. contrary to the written instructions furnished with the unit.
 - b. Adverse local conditions and specifically, sediment or lime precipitate in the tubes and/or headers or corrosive elements in the atmosphere.
 - c. Misuse and specifically, operation and maintenance contrary to the written instruction furnished with the unit; disconnection, alteration or addition of non-approved components or apparatus, operation with fuels or at settings other than those set forth on the rating plate, or accidental or other exterior damage.
2. This warranty also does not cover:
 - a. Production of noise, odors, discoloration or rusty water.
 - b. Damage to surrounding area or property caused by leakage or malfunction.
 - c. Cost associated with the replacement and/or repair of the unit, including: any freight, shipping or delivery charges; any removal, installation or reinstallation charges; any material, and/or permits required for installation, reinstallation or repair; charges to return the boiler and/or components to the manufacturer.

ANY IMPLIED WARRANTY, INCLUDING THE WARRANTY OF MERCHANTABILITY IMPOSED ON THE SALE OF THE BOILER UNDER THE LAWS OF THE STATE OF SALE ARE LIMITED IN DURATION TO ONE YEAR FROM DATE OF ORIGINAL INSTALLATION.

HOW DOES STATE LAW RELATE TO THE WARRANTY?

Some states do not allow:

1. Limitations on how long an implied warranty lasts.
 2. Limitations on incidental or consequential damages.
- The above limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WHAT WILL WE DO TO CORRECT PROBLEMS?

If a defect occurs within the warranty period we will:

- a. Provide a comparable manufactured replacement, or at our option, repair any unit which develops a leak in the copper tube heat exchanger within the warranty period.
- b. Provide a replacement part, or at our option, repair any part which fails to function within the part's warranty period. To obtain a replacement, you must return the defective part to one of our distribution centers. We do reserve the right to verify any claims of defect by inspection.

CONDITIONS

We will not:

- a. Repair or replace any boiler, or part, subject to conditions outlined in "What Does This Limited Warranty Not Cover?"
- b. Reimburse any costs associated with repair and/or replacement.
- c. Replace and/or repair any boiler without complete model/serial number.
- d. Replace any boiler without prior receipt of actual rating plate from the appliance.

HOW TO KEEP YOUR WARRANTY IN EFFECT?

To facilitate warranty service, you should:

- a. Follow all instructions enclosed with the product.
- b. Retain all bills of sale or receipts for proof of installation, etc.
- c. Contact your installer or dealer as soon as any problem or defect is noticed.
- d. When necessary, allow our representative to inspect the unit.
- e. For your reference, fill in the Model and Serial Number found on the unit's Rating Plate:

Model Number _____

Serial Number _____

Date of Installation _____

Lochinvar Lochinvar Corporation
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(615) 889-8900 • Fax No. 615-885-4403