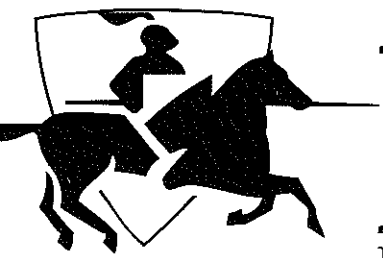

Lochinvar®

High Efficiency Water Heaters And Boilers

COPPER-FIN II®

SERVICE

CH/CF 300 THRU 2070

A DISTINGUISHED FAMILY OF
QUALITY STANDARD AND CUSTOM-BUILT
WATER HEATERS AND BOILERS

FACTS

WATER

One gallon of fresh water	8.333 lbs.
One cubic foot of water	7.48 gallons
One cubic foot of water (at 39.2° F maximum density)	62.428 lbs.
One cubic foot of water (at 212° F—boiling point)	59.83 lbs.
One U.S. Gallon	231 cubic inches

The capacity of a cylinder in gallons is equal to the length in inches multiplied by the square of the diameter in inches x .0034

A water column one foot high exerts a pressure of .4333 pounds per square inch

Doubling the diameter of a pipe increases its capacity four times.

pH: above 7.0 alkaline; 7.0 neutral; below 7.0 acid

1 Grain per gallon = 17.1 parts per million

Water expands 4.34% heated from 40° to 212°

ELECTRICITY

Amps (3 Phase)	$\frac{KW \times 1000}{Volts \times 1.732}$	1 KW Hour will evaporate 3.5 lbs. of water from and at 212° F
Amps (1 Phase)	$\frac{KW \times 1000}{Volts}$	1 KW Hour = 3412 BTU 1 BHP = 34.5 lbs. of steam at 212°
GPH =	$\frac{KW \times 3412}{8.33 \times Temp.\ Rise}$	1 BHP = 33,475 BTU 1 BHP = 9.8 KW

RECOVERY FORMULA

Formula for recovery in gallons per hour for any deg. F. rise.

$\frac{\text{Rated Rec. in Gals. Hr.} \times 100}{\text{Desired Deg. F. Rise}} = \text{Gals. Hr.}$

% Efficiency	$= \frac{GPH \times 8.33 \times Temp.\ Rise}{BTI/Hr.\ Input}$
BTI Input	$= \frac{GPH \times 8.33 \times Temp.\ Rise}{\%\ Efficiency}$
Rise (°F)	$= \frac{BTI/hr.\ Input \times \%\ Efficiency}{GPH \times 8.33}$

BTU CONTENT OF FUELS

	BTU'S
COAL	
1 lb.	10,000-15,000
1 Ton	25 Million (Approx.)
ELECTRICITY	
1 KW	3,412
GAS	
1 lb. of Butane	21,300
1 Gal. of Butane	102,600
1 Cu. Ft. of Butane	3,260
1 Cu. Ft. of Manufactured	530
1 Cu. Ft. of Mixed	850
*1 Cu. Ft. of Natural	1,075
1 lb. of Propane	21,600
1 Gal. of Propane	91,000
1 Cu. Ft. of Propane	2,570
OIL	
1 Gal. #1 Fuel	136,000
1 Gal. #2 Fuel	138,500
1 Gal. #3 Fuel	141,000
1 Gal. #5 Fuel	148,500
1 Gal. #6 Fuel	152,000

1 lb. of Gas = 28" Water Column

1 lb. of Gas = 16 Oz. *100 Cu. Ft. = 1 therm

METRIC CONVERSIONS

Multiply	By	To Obtain
Farenheit (F)	5/9 (after subtracting 32)	Celsius (Cel)
Celsius (Cel)	9/5 (then add 32)	Farenheit (F)
Ounce (oz.)	28	GRAM (g)
GRAM (g)	.035	Ounce (oz.)
Pound (lb.)	0.45	Kilogram (kgm)
Kilogram (kgm)	2.2	Pound (lb.)
Gallon (gal.)	3.8	LITER (l)
LITER (l)	0.26	Gallon (gal.)
Inch (in.)	2.5	Centimeter (cm)
Centimeter (cm)	.4	Inch (in.)

PIPE SIZES — Round Pipe

Diameter in Inches	Area in Square Inches	Diameter in Inches	Area in Square Inches
3	7.06	17	226.98
4	12.56	18	254.47
5	19.63	19	283.53
6	28.27	20	314.16
7	38.48	21	346.36
8	50.26	22	380.13
9	63.61	23	415.48
10	78.54	24	452.39
11	95.03	25	490.87
12	113.10	26	530.93
13	132.73	27	572.56
14	153.94	28	615.75
15	176.71	29	660.52
16	201.06	30	706.86

STORAGE TANK CAPACITIES IN GALLONS

LENGTH IN FEET	*TANK DIAMETER—INCHES														
	20	22	24	30	36	42	48	54	60	66	72	78	84	90	96
1	16	20	24	37	53	72	94	120	145	180	210	250	290	330	375
2	32	40	48	74	106	144	188	240	290	360	420	500	580	660	750
3	48	60	72	110	159	216	282	360	435	540	630	750	870	990	1125
4	66	80	96	147	212	288	376	480	580	720	840	1000	1160	1320	1500
5	82	100	120	184	265	360	470	600	725	900	1050	1250	1450	1650	1875
6	98	120	144	220	317	432	564	720	870	1080	1260	1500	1740	1980	2250
7	114	140	168	257	370	504	658	840	1015	1260	1470	1750	2030	2310	2625
8	131	160	192	294	423	576	752	960	1160	1440	1680	2000	2320	2640	3000
9	147	180	216	330	476	648	846	1080	1305	1620	1890	2250	2610	2970	3375
10	163	200	240	367	529	720	940	1200	1450	1800	2100	2500	2900	3300	3750
11	180	220	264	404	582	792	1034	1320	1595	1980	2310	2750	3190	3630	4125
12	196	240	288	440	634	864	1128	1440	1740	2160	2520	3000	3480	3960	4500
13	212	260	312	477	687	936	1222	1560	1885	2340	2730	3250	3770	4290	4875
14	228	280	336	514	740	1008	1316	1680	2030	2520	2940	3500	4060	4620	5250
15	244	300	360	550	793	1080	1410	1800	2175	2700	3150	3750	4350	4950	5625
16	260	320	384	587	846	1152	1504	1920	2320	2880	3360	4000	4640	5280	60

*To determine diameter when only the circumference is know... divide that figure by 3.1416 (π).

Lochinvar

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INTRODUCTION

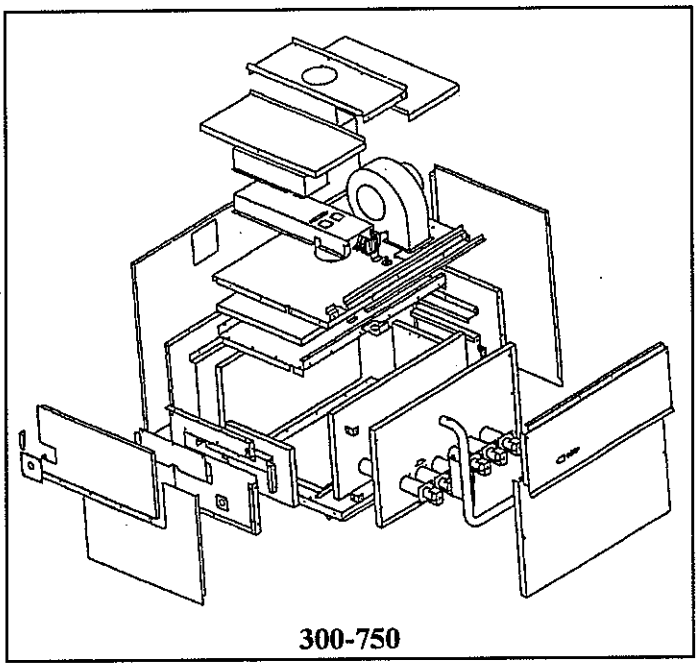
This manual supplies information for the installation, operation and servicing of the boiler. Experience has shown that improper installation or system design, rather than faulty equipment is the cause for most operating problems.

JACKET CONSTRUCTION

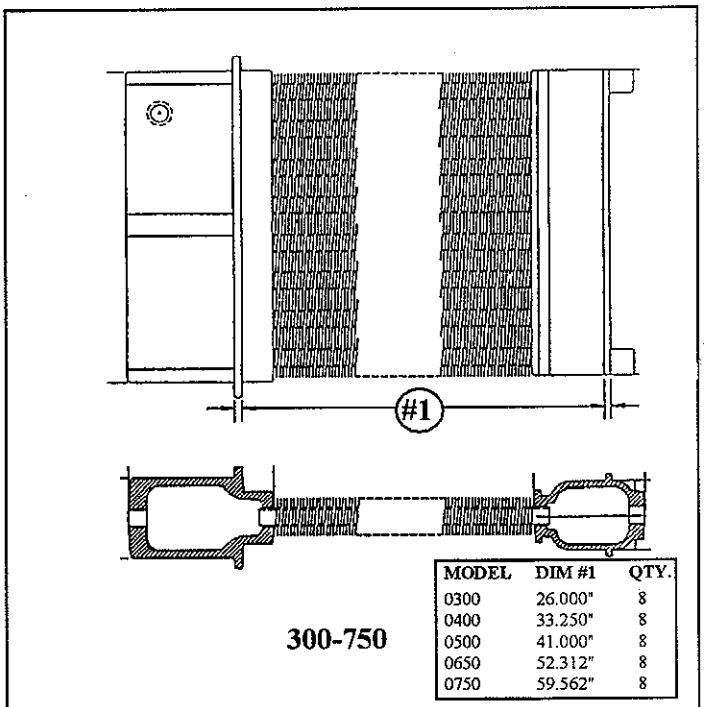
The jacket is constructed of sturdy 18 gauge galvannealed steel to prevent rusting. The self supporting design of the unit eliminates the need for an iron frame and dramatically reduces the over all size and weight of the unit. The unit also utilizes LOCH-HEAT™ Tile (a ceramic fiberboard) in the combustion chamber. The advantages of this material over standard refractory is the weight, longevity, and its reflection of heat as opposed to the absorption of heat as in "standard refractory". The jacket panels are easily removable for access to all the components inside the unit.

HEAT EXCHANGER

The heat exchanger is constructed of two glass lined cast iron headers with 8 (300 - 750) or 12 (990 - 2070) copper-finned tubes, rolled precisely into place. This rolling process eliminates the need for o-ring gaskets between the tubes and the headers creating a water tight seal. The headers are core constructed, meaning they are one piece headers without gaskets. The front header has plugs which are removable for field inspection of the copper tubes. The sophisticated design of the heat exchanger creates an interleaved fin design of the copper tubes. This coupled with the two pass water flow pattern allows maximum heat transfer into the water. All COPPER-FIN II heat exchangers are tested to 240psi and are approved for 160psi working pressure by ASME. All heat exchangers are registered with the National Board.

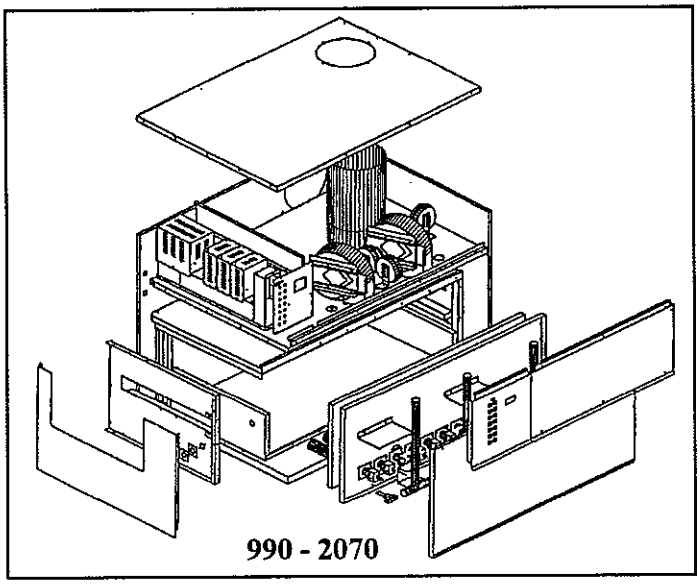


300-750

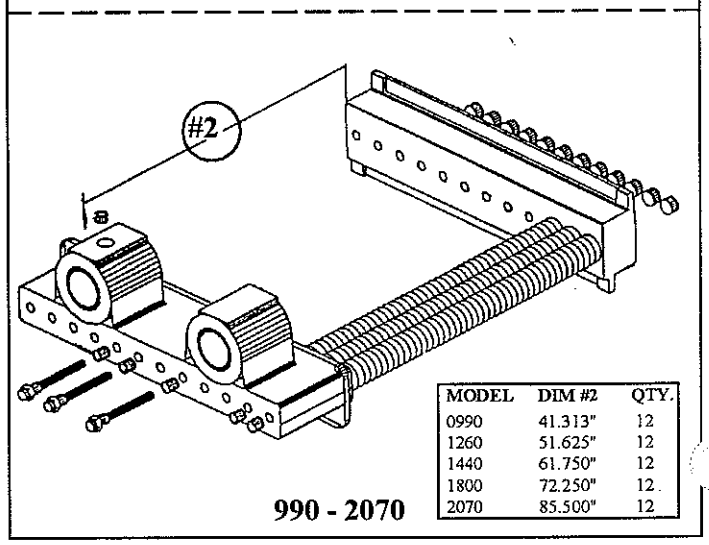


300-750

MODEL	DIM #1	QTY.
0300	26.000"	8
0400	33.250"	8
0500	41.000"	8
0650	52.312"	8
0750	59.562"	8



990 - 2070



990 - 2070

MODEL	DIM #2	QTY.
0990	41.313"	12
1260	51.625"	12
1440	61.750"	12
1800	72.250"	12
2070	85.500"	12

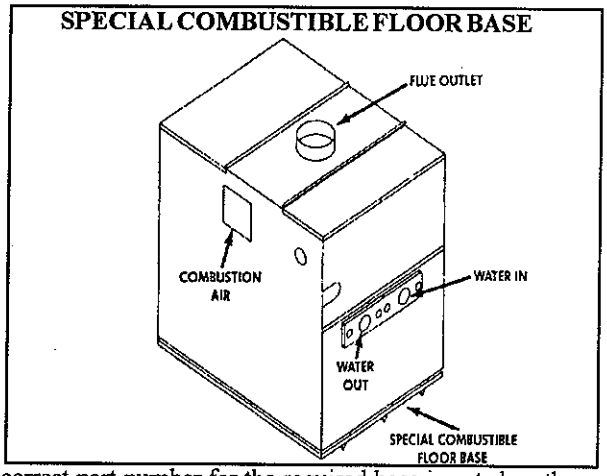
LOCATION

These unit 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 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, noncombustible floor. Concrete over wood is not considered noncombustible.
4. The appliance must not be installed on carpet.
5. Installation over a combustible floor:

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 the following illustration.

SPECIAL COMBUSTIBLE FLOOR BASE



The correct part number for the required base is noted on the rating plate of each unit and is 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 input units installed over a combustible floor **MUST** be provided with a base of hollow clay tile or concrete blocks from 8" to 12" thick and extending 24" beyond the sides. The blocks must be placed in line so that the holes line up horizontally to provide a clear passage through the blocks. A 1/2" fireproof millboard with a 20 gauge 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 the weather.

CLEARANCES

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 OPENING

For indoor installations with conventional negative draft stacks or the optional Sidewall venting system, the boiler room must be provided with two openings to assure adequate combustion air and proper ventilation.

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. are operating, they will rob air from the boiler. If negative air pressure exists, additional combustion air and ventilation must be provided.

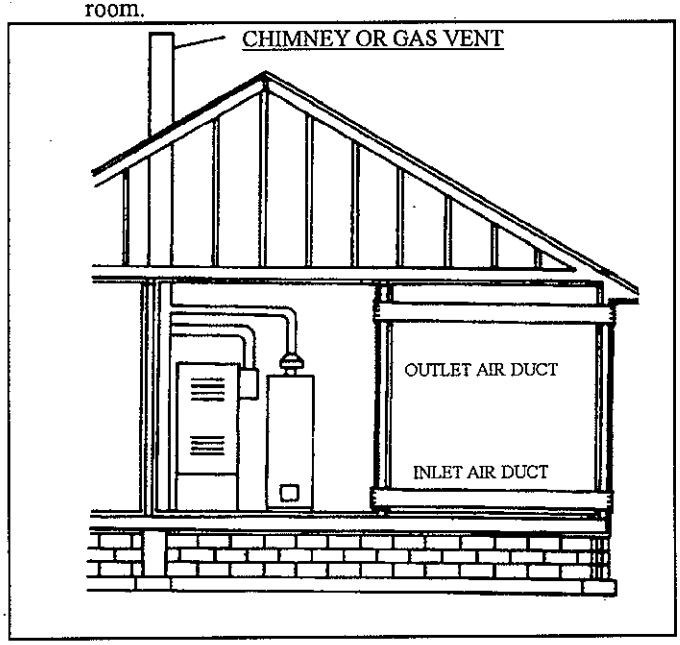
The combustion air supply must be completely free of any chemical fumes which may be corrosive to the boiler. Common chemicals which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as freon, trichloroethylene, perchloroethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the copper tubes, headers, tube sheets, flue collectors, and boiler stack. The result is improper combustion and premature boiler failures.

Provisions for combustion and ventilation air must be in accordance with Section 5.3, Air 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 local codes.

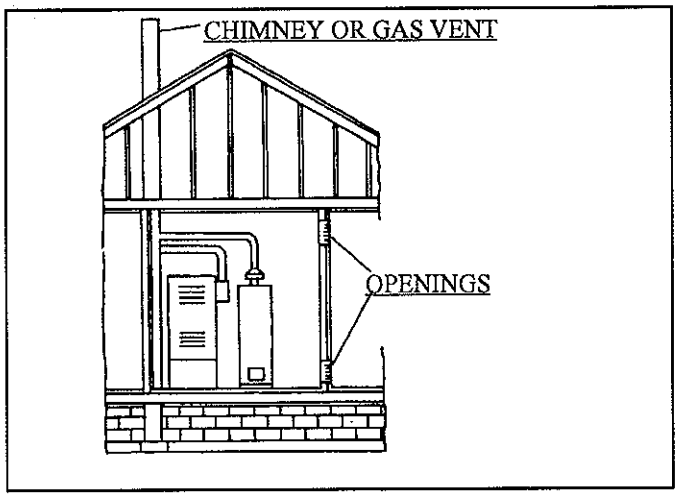
1. If air is taken directly from outside the building:
   a. Combustion air opening shall be a minimum free area of 1 square inch per 2,000 BTU total input rating of all the equipment in the room. This opening must be located 12" from the floor.

b. Ventilation air opening shall be a minimum free area of 1 square inch per 2,000 BTU per hour of total input rating of all equipment in the room. This opening must be located 12" from the ceiling.

c. If the room is located against an outside wall and the air openings communicate directly with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000BTU's of total input rating of all equipment in the room.



2. If air is taken from another interior space, each opening specified above should have a minimum free area of 1 square inch per each 1,000 BTU per hour of total input rating of all the equipment in the room.



CAUTION: In calculating free area, consideration shall be given to the blocking effect of louvers, grilles or screens protecting opening. Screens used shall not be smaller than ¼" mesh. If the free area through a design of louver or grille is known, it should be used in calculating the size opening required to provide the free area specified. If the design for free area is not known, it may be assumed that wood louvers will have 20 - 25% free area and metal louvers or grilles will have 60 - 75% free area. Louvers or grilles shall be fixed in the open position or interlocked with the equipment so that they are opened automatically during equipment operation.

GAS SUPPLY

1. Before making gas hookup, verify that the boiler is being supplied with same gas type as indicated on the data plate. Conversions are authorized by factory personnel only. The rating plate will be marked to indicate high altitude. Consult factory for installations at elevations 4,000' and above.
2. For the purpose of input adjustment, the inlet gas pressure, upsteam of the gas valve and pressure regulator should be as follows:

INLET GAS PRESSURE	Nat. Gas	LPG
Max. Allowable (Inches-water column)	10.5"	13"
Min. Allowable (Inches-water column)	5"	11"
MANIFOLD GAS PRESSURE		
300 - 750	4"	10"
990 - 2070	3.5"	10"

GAS CONNECTION

All gas connections must be made with a pipe joint compound resistant to action of liquefied petroleum and natural gases.

The following tables shall be used to size the gas lines for natural gas installations and L.P. installations. The total BTU requirement of all units on the gas supply line and total equivalent length of pipe are used to determine gas line pipe size.

GAS PIPE SIZING CHART

NOMINAL IRON PIPE SIZES INCHES:	LENGTH OF PIPE IN STRAIGHT FEET													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
¾	369	256	205	174	155	141	128	121	113	106	95	86	79	74
1	697	477	384	328	292	267	246	236	210	200	179	164	149	138
1¼	1400	974	789	677	595	543	502	472	441	410	369	333	308	287
1½	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
2½	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	3,330	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 hr for gas pressures of 14" water column (0.5 PSIG) or less and a pressure drop of 0.5 Inch Water Column (NAT GAS,1025 BTU's per cubic foot of gas, based on 0.60 specific gravity gas.)

FIRST STAGE PIPE SIZING

Maximum capacity of pipe or tubing, in thousands of BTU/hr of LP-Gas. (Based on 10 PSIG inlet pressure at a pressure drop of 1 PSIG).

Size of Pipe or Copper tubing Inches:		Length of pipe or tubing, feet*											
		10	20	30	40	50	60	70	80	90	100	125	150
copper	3/8	448	307	246	210	186	168	155	144	135	127	113	102
tubing	1/2	1156	786	628	535	472	427	392	364	341	321	284	256
(O.D.)	5/8	2274	1548	1236	1054	931	841	772	717	672	634	560	506
pipe	1/2	2442	1885	1580	1382	1240	1133	1048	979	921	872	775	703
size	3/4	4831	3812	3230	2842	2561	2346	2175	2035	1917	1816	1618	1470
(I.D.)	1	8531	6916	5939	5270	4776	4392	4083	3829	3614	3429	3063	2789
	1¼	16626	13771	11963	10691	9736	8987	8378	7872	7443	7074	6336	5779
	1½	23670	19957	17510	15749	14407	13341	12470	11740	11119	10581	9501	8682
	2	42521	36514	32398	29359	27001	25104	23538	22216	21082	20097	18104	16580

*Total length of piping from outlet of first stage regulator to inlet of second stage regulator (or to inlet of second stage regulator furthest away).

NOTES:

1. To allow 2 PSIG pressure drop, multiply total gas demand by .707, and use capacities from table.
2. For different first stage pressures, multiply total gas demand by the following factors, and use capacities from table.

First Stage Pressure PSIG	Multiply by
20	.844
15	.912
5	1.120

SINGLE OR SECOND STAGE PIPE SIZING

Maximum capacity of pipe or tubing, in thousands of BTU/hr of LP-Gas.
(Based on 11" water column inlet pressure at a pressure drop of 1/2 "water column).

Size of Pipe or Copper Tubing, Inches:		Length of pipe or tubing, feet*											
		10	20	30	40	50	60	70	80	90	100	125	150
Copper Tubing (O.D.)	3/8	39	26	21	19	--	--	--	--	--	--	--	--
	1/2	92	62	50	41	37	35	31	29	27	26	--	--
	5/8	199	131	107	90	79	72	67	62	59	55	--	--
	3/4	329	216	181	145	131	121	112	104	95	90	--	--
	7/8	501	346	277	233	198	187	164	155	146	138	--	--
Pipe Size (I.D.)	1/2	275	189	152	129	114	103	96	89	83	78	69	63
	3/4	567	393	315	267	237	217	196	185	173	162	146	132
	1	1071	732	590	504	448	409	378	346	322	307	275	252
	1-¼	2205	1496	1212	1039	913	834	771	724	677	630	567	511
	1-½	3307	2299	1858	1559	1417	1275	1181	1086	1023	976	866	787
	2	6621	4331	3465	2992	2646	2394	2205	2047	1921	1811	1606	1496

*Total length of piping from outlet of regulator to appliance furthest away.
Note:
Data from ANSI Z223.1, Latest edition, National Fuel Gas Code

This chart may be used to convert pipe fittings to equivalent lengths of straight pipe for total equivalent pipe length from the meter to the appliance.

FITTINGS TO EQUIVALENT STRAIGHT PIPE

Diameter Pipe	¾"	1"	1¼"	1½"	2"	3"	4"	5"
Equivalent Length:								
Straight Pipe	2'	2'	3'	4'	5'	10'	14'	20'

Based on 0.5 inches of water column pressure drop.

SPECIAL NOTE: Gas pipe size is *larger than heater connection.*
NOTE: A trap (drip leg) should be provided in the inlet gas connection to the boiler.

A manual main gas shutoff valve is provided outside the jacket, upstream of the main gas valve. This gas shutoff is required by code and must not be removed.

VENTING

GENERAL:
Venting 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 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 the 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 the 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 the units as closely as possible to the chimney or the 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 they must be as direct as possible with no reduction in its diameter.

Horizontal portions of the venting system shall be supported to prevent sagging. Horizontal runs must slope upwards not less than 1/4" per foot (21mm/m) from the boiler to the vent terminal. Follow the 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 the exterior walls and 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.

A. Seal any unused opening in the common venting system.

continued

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 it 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 any fire place dampers.

D. Place in operation, the appliance being inspected. Follow the lighting instructions. Adjust the thermostat so the 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 a pipe.

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

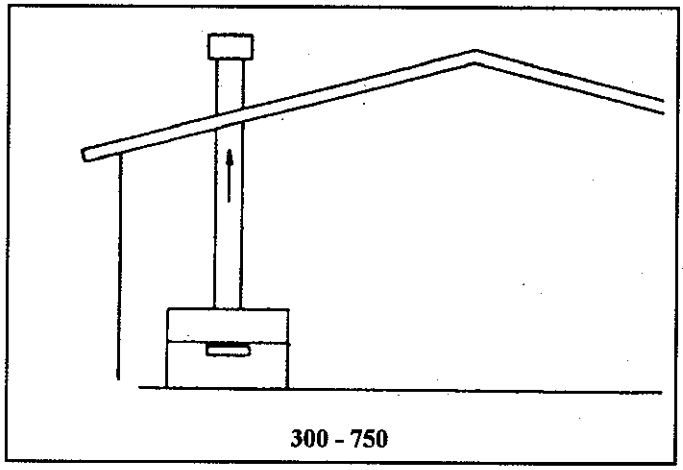
G. Any improper operation of the common venting system should be corrected so that the installation conforms to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. When resizing any 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.

VENTING OPTIONS

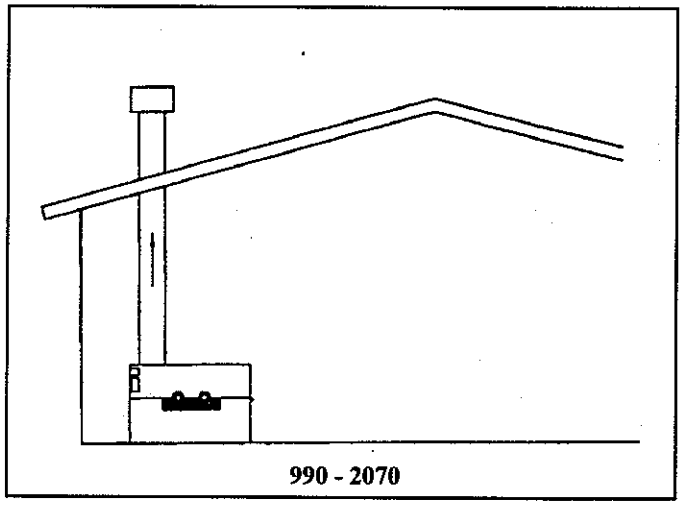
This unit has five venting options. They are: (1) conventional negative draft venting, (2) powered sidewall venting, (3) horizontal DirectAire venting, (4) vertical DirectAire venting and (5) outdoor installation.

THEY ARE AS FOLLOWS:

CONVENTIONAL VENTING



300 - 750



990 - 2070

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.

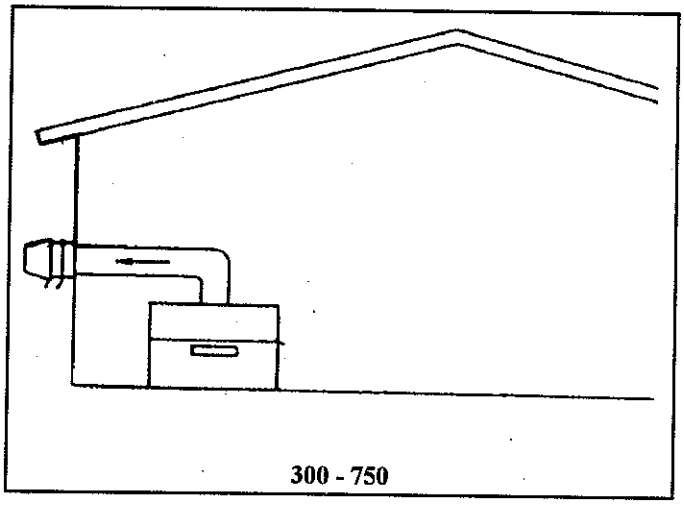
The vertical termination must be a minimum of 3 feet (0.91m) from a parapet wall and must be a minimum of 2 feet (0.61m) higher than the parapet wall.

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 following the general installation instructions.

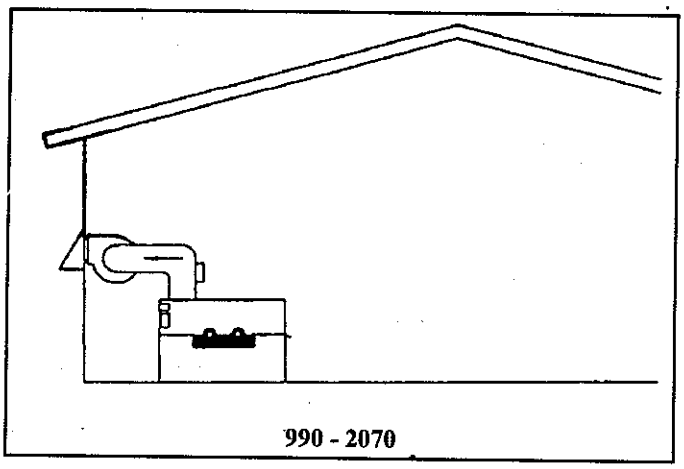
SIDEWALL VENTING

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.



300,000 BTU thru 750,000 BTU 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 heater control system. The internal damper on the sidewall fan must be adjusted to supply a draft within the range of 0.01 to 0.08 inches water negative while the 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.



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 the venting kit which must be furnished by the manufacture in accordance with the 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 the necessary relays to interlock with the heaters control system. The barometric damper must be installed on the flue and adjusted to supply a draft within the range of 0.04 to 0.08 inches water negative while the 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.

This applies to 300,000 thru 2,070,000:
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 before ignition will occur. See page 30 for wiring diagram.

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

The vent cap 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 and above normal snow levels. Also it shall terminate 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.

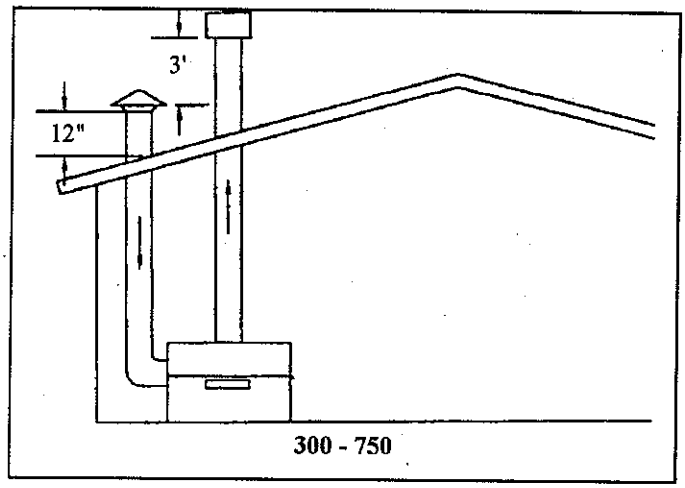
Flue gas condensate can freeze on the exterior walls and on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Some discoloration of exterior building or unit surfaces can be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet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

Input BTU/hr	Flue Size	Sidewall Vent Kit
300,000	5"	SVK3005
399,000	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"	SVK3010*
1,800,000	14"	SVK3012*
2,070,000	14"	SVK3012*

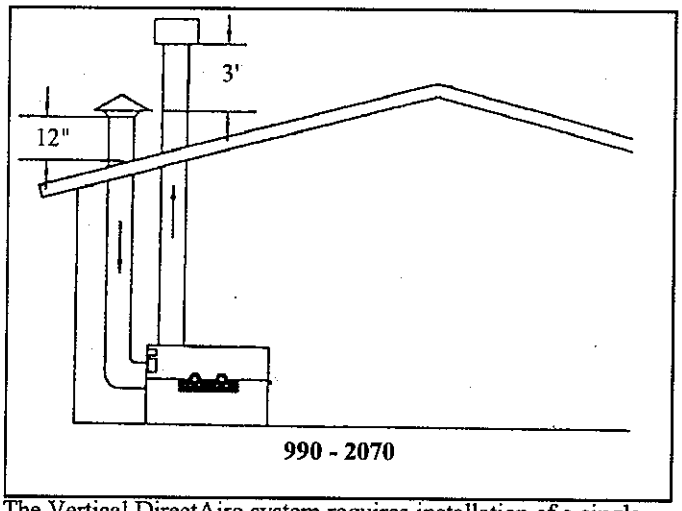
*(Includes barometric damper)

VERTICAL DIRECTAIRE

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



300 - 750



990 - 2070

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 (installer supplied) single wall combustion air pipe and it must terminate at least 3 feet (0.91m) lower than the flue gas outlet, if it is 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.

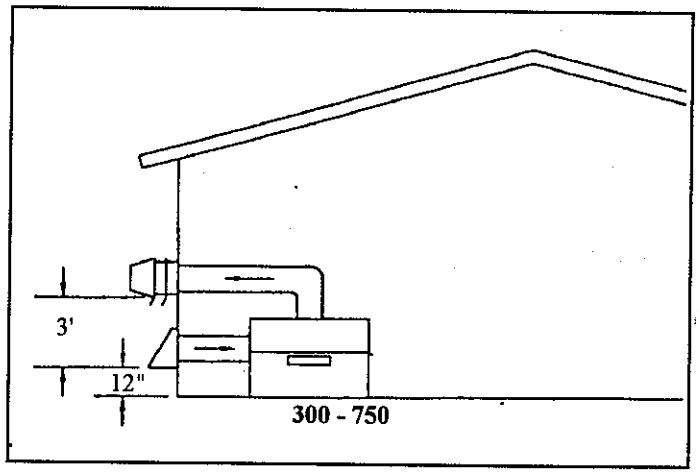
Combustion air supplied from outdoors must be free of contaminants (See Combustion and Ventilation Air). To prevent recirculation of flue products into the combustion air inlet, follow all instructions in this section. Combustion air supply **CAN NOT** be combined into a single pipe for multiple installations.

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

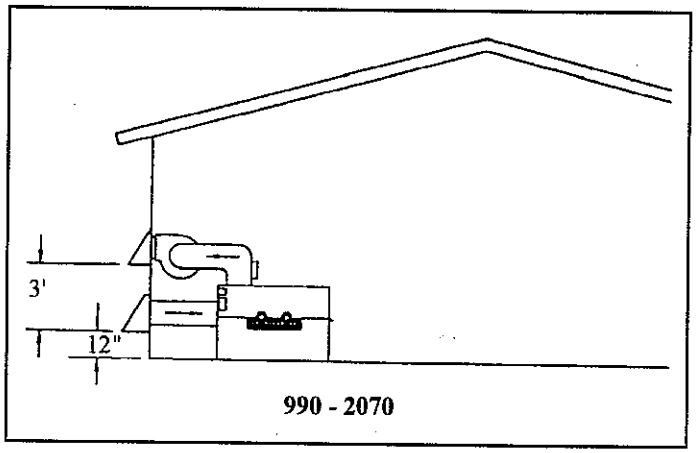
Input BTU/hr	Flue Size	Vertical Vent Kit
300,000	5"	VDK3005
399,000	6"	VDK3006
500,000	6"	VDK3006
650,000	8"	VDK3008
750,000	8"	VDK3008
990,000	10"	VDK3009
1,260,000	12"	VDK3010
1,440,000	12"	VDK3010
1,800,000	14"	VDK3010
2,070,000	14"	VDK3010

HORIZONTAL DIRECTAIRE

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



300 - 750



990 - 2070

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.

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 of the instructions in this section.

The combustion air inlet cap must be at least 3 feet (0.91m) below the powered vent cap, if it is located 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.

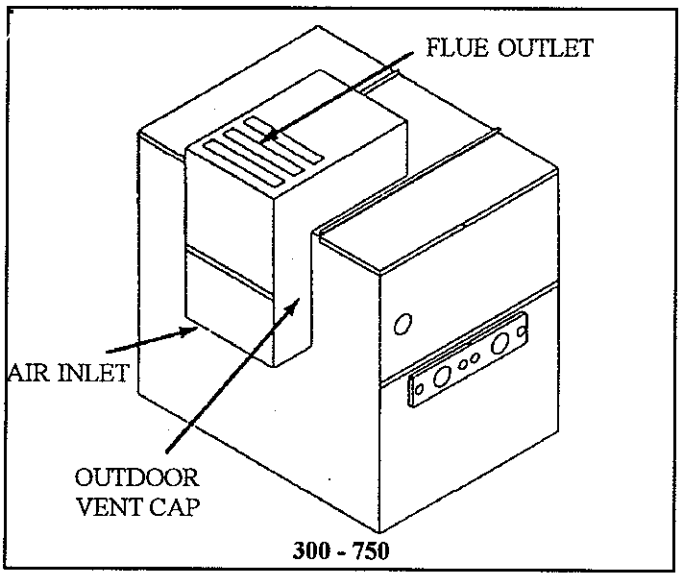
The required horizontal DirectAire kit part numbers are listed by the unit size. The venting kit must be furnished by the manufacturer in accordance with A.G.A./C.G.A. requirements. Each kit includes the special sidewall vent components for the flue, a combustion air intake cap for side wall mounting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

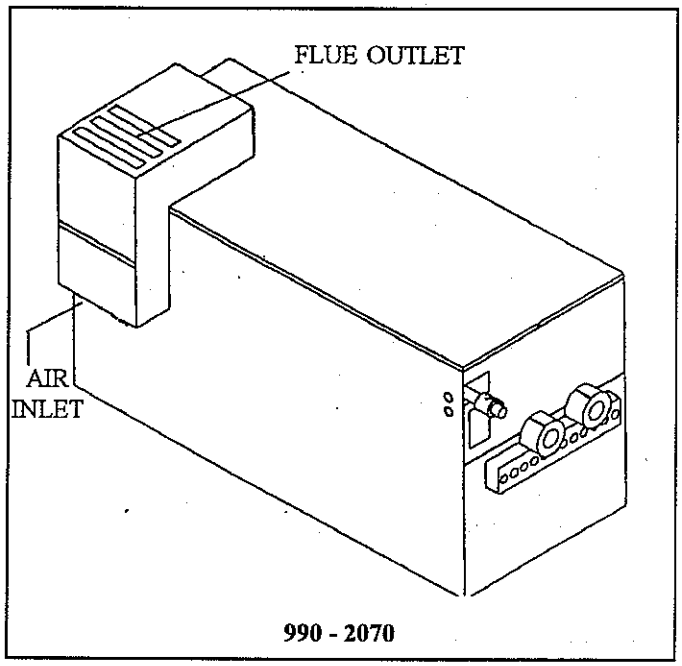
Input BTU/hr	Flue Size	Horizontal Vent Kit
300,000	5"	HDK3005
399,000	6"	HDK3006
500,000	6"	HDK3006
650,000	8"	HDK3008
750,000	8"	HDK3008
990,000	10"	HDK3009*
1,260,000	12"	HDK3010*
1,440,000	12"	HDK3010*
1,800,000	14"	HDK3012*
2,070,000	14"	HDK3012*

*(Includes barometric damper)

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 to prevent a hazardous condition.

Combustion air supply must be free of contaminates (See Combustion and Ventilation Air). To prevent recirculation of the flue products into the combustion air inlet, follow all the 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 inches to combustible surfaces and a minimum of 3 inches 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 inches (1.22m) clearance between the outdoor 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.

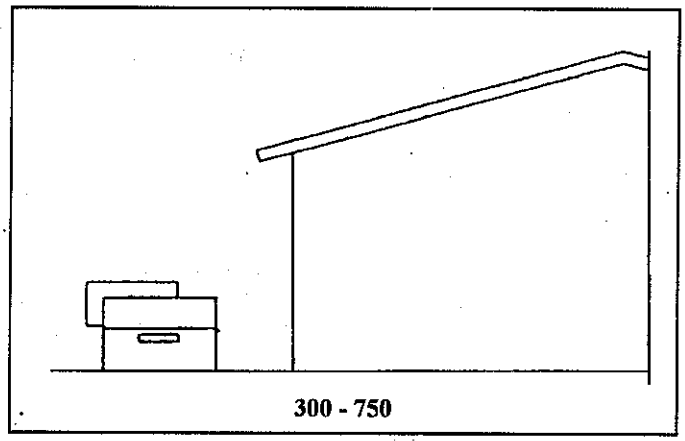
The unit must be at least 10 feet (3.05m) away from any forced air inlet.

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

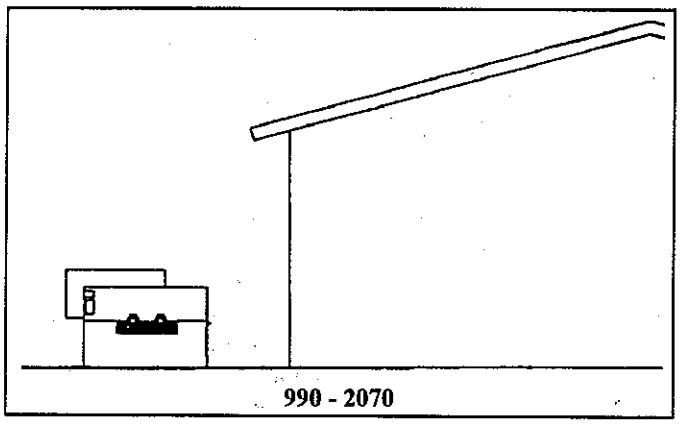
Clearances around outdoor installations can change with time. Do not allow the growth of trees, shrubs or other plants to obstruct the proper operation of the outdoor vent system.

Flue gas condensate can freeze on exterior wall or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Some discoloration to the exterior of the building or the 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.



300 - 750



990 - 2070

Input BTU/hr	Outdoor Cap Kit Number
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

VENTING EXPERTS
TJERNLUND 1-800-255-4208
FIELDS CONTROLS 1-800-742-8368
METAL BESTOS 1-800-635-6507
SIMPSON DURA-VENT 1-800-227-8446
HEAT FAB 1-800-772-0739

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

This section contain 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 always 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 the inlet to the 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 copper-finned tubes. This will yield long life and economical operation for your hot water supply boiler. Excessive lime buildup in the copper-finned tubes is a result of too little water velocity in the heat exchanger. Excessive pitting or erosion in the copper-finned tubes is caused by too much velocity through the heat exchanger. Care should be taken to measure the temperature rise and maintain the velocity as follows:

1. The pump must run continuously.
2. With the pump running and the hot water supply boiler turned off, the inlet and outlet thermometers should read the same temperatures. If they do not, an adjustment must be made to your final calculation.
3. Turn the hot water supply boiler on and allow time for the temperature to stabilize. Record the difference between the inlet and the outlet temperatures. This difference will be the temperature rise.
4. Compare the temperature rise on the heater with the required temperature rise in the table on page 13. Should any 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 any restrictions in the outlet of the heater.
2. Be sure all valves are open between the heater and the storage tank.
3. Check the pump to be sure it is running properly and that the pump motor is revolving in the proper direction.
4. Be sure the circulation pipes between the heater and the storage tank are not less than 2" diameter for 300,000 thru 750,000 BTU models and 2.5" diameter for 990,000 thru 2,070,000 BTU models.

If the temperature rise is to low, the water velocity is to 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 the following table.

REQUIRED TEMPERATURE RISE	
BTU INPUT	TEMPERATURE RISE °F
300,000	9°
399,000	12°
500,000	15°
650,000	20°
750,000	23°
990,000	19°
1,260,000	24°
1,440,000	27°
1,800,000	34°
2,070,000	39°

PUMP OPERATION

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

2. The pump is sized to the heater input and the water hardness. Care should be taken to size the pump correctly.

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

The pump chart is based on the following fittings:

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

Not more than 45 feet of straight pipe. **Note:** for every elbow and tee in excess of those shown above, DEDUCT 5 FEET from maximum allowable straight pipe in the heater to the tank circulating loop.

PUMP PERFORMANCE:

(WATER HARDNESS OF 25 GRAINS)

BTU INPUT	GPM	FT. HD.
300,000 - 750,000	55	10
990,000 - 2,070,000	90	15

COMMON WATER MANIFOLD SIZE FOR MULTIPLE HOT WATER SUPPLY BOILER INSTALLATIONS

This pipe sizing chart provides minimum pipe size(s) for common manifold piping to insure adequate flow.

300,000 - 750,000 BTU MODELS:

Number of Units	Common Manifold Size(Min)
1	2"
2	3"
3	3.5"
4	4"
5	5"
6	6"

990,000 thru 2,070,000 BTU Models

Number of Units	Common Manifold Size(Min)
1	2.5"
2	4"
3	4"
4	5"
5	6"
6	6"

RELIEF VALVE

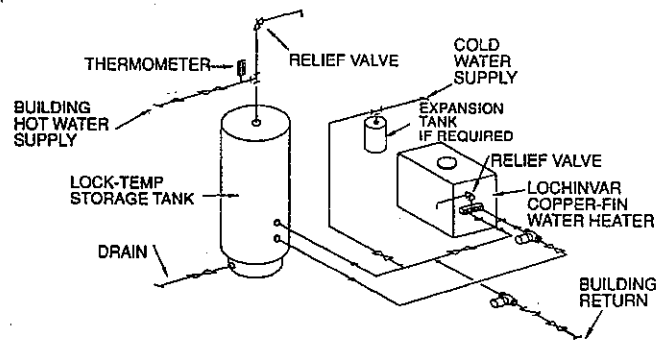
This hot water supply boiler is supplied with temperature and pressure relief valve(s) sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers"). The relief valve(s) is installed in the hot water outlet. No valve is to be placed between the relief valve and the hot 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 any other restrictions shall be installed in the discharge line. The discharge line shall allow complete drainage of the valve and the line. Relief valves should be manually operated at least once a year.

CAUTION: Avoid contact with hot discharge water.

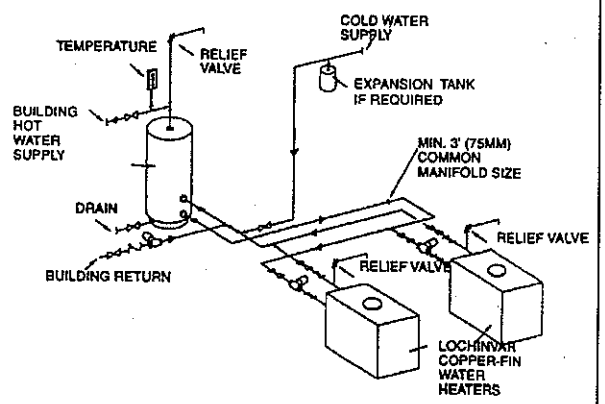
THERMAL EXPANSION

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 a check valve in the cold water supply, must be provided with a means to control expansion. Contact the water supplier or the local plumbing inspector on how to correct this situation. Do not plug the relief valve.

VERTICAL TANK INSTALLATION



SINGLE TANK - TWO HEATER INSTALLATION



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

This section contains specific requirements for Hot Water Boilers. All warnings, cautions, notes and instructions from the general service and installation sections 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 the low temperature system section for piping details.

FILLING THE BOILER

1. Fill the boiler 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. Then close the valve and complete filling the boiler.

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 during operation. 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 makeup water can cause minerals to collect in the heat exchanger and damage the boiler.

4. If freeze protection is required, DO NOT use undiluted or automotive type antifreeze. Use only hydronic system antifreeze following the manufactures instructions.

HEATING BOILER PERFORMANCE DATA

These boilers are generally capable of operating within 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 bypass must be installed. This will prevent boiler damage.

SYSTEM TEMPERATURE RISE CHART

Based on BTU Input

Input	Output	10°ΔT		20°ΔT		30°ΔT		40°ΔT		50°ΔT		60°ΔT	
		GPM	FtHd	GPM	FtHd	GPM	FtHd	GPM	FtHd	GPM	FtHd	GPM	FtHd
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	831,000	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	1,209600	242+	*	121+	*	81	6.3	61	3.8	48	2.3	40	1.8
1,800,000	1,515,000	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

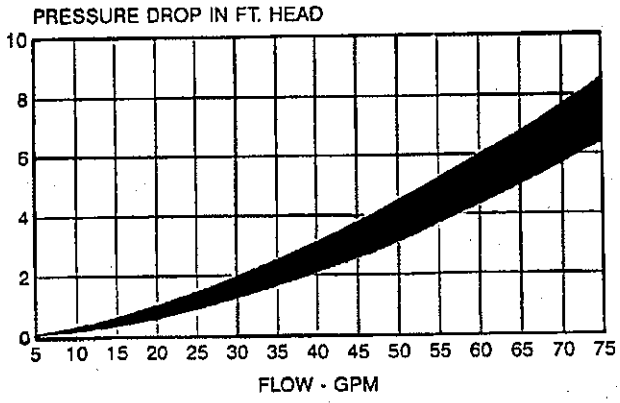
+ These flow rates exceed the recommended flow rates of the boiler. If these systems temperature rises are used, an external piping bypass must be installed.

* These foot head calculations exceed the maximum allowable flow rate of the boiler.

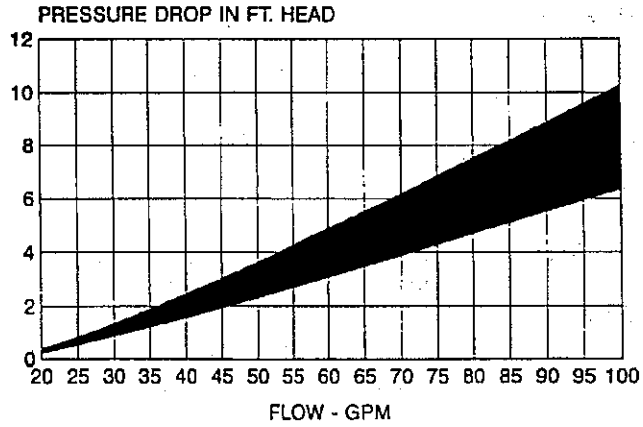
MAXIMUM BOILER FLOW RATES

INPUT	FLOW
300,000	75 GPM
399,000	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

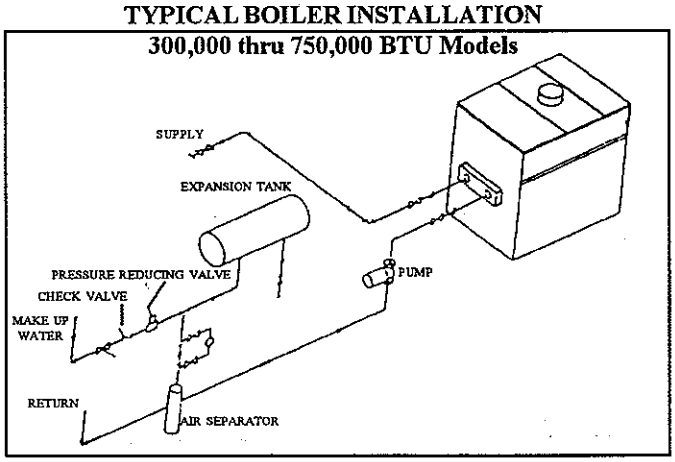
HEAT EXCHANGER HEAD LOSS
300,000 thru 750,000 BTU Models

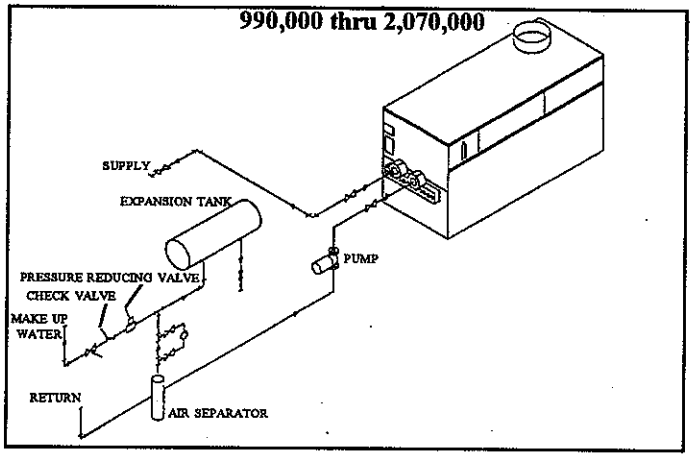


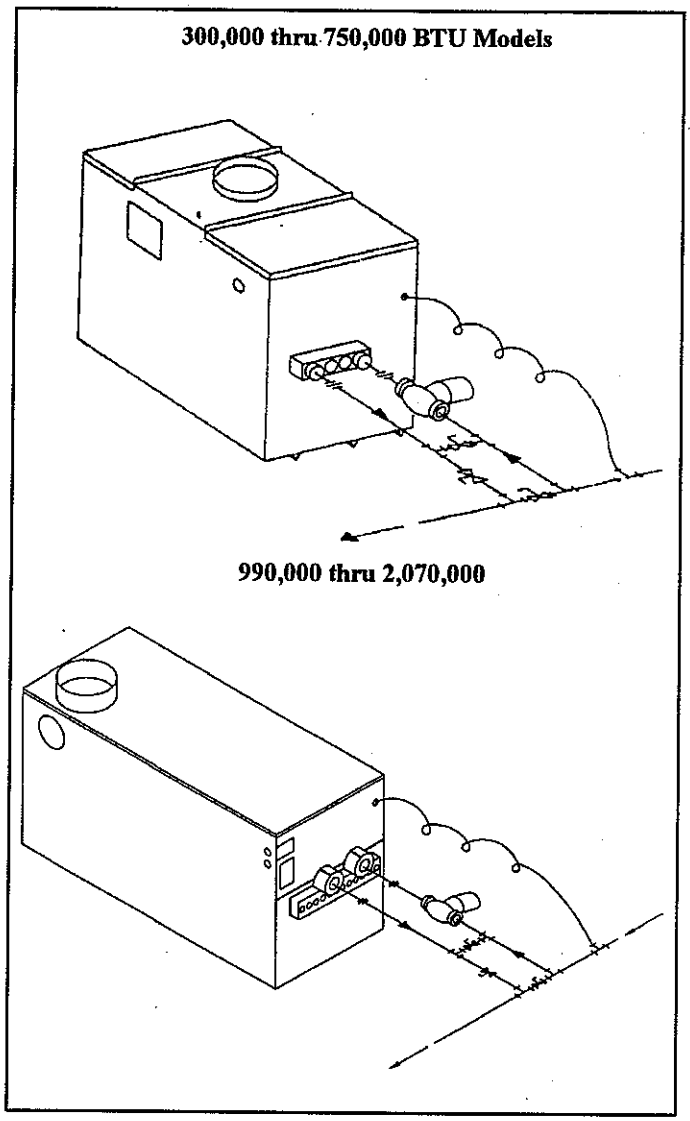
990,000 thru 2,070,000BTU Models



TYPICAL BOILER INSTALLATION
300,000 thru 750,000 BTU Models







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, and Process or Manufacturing Operations.

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 bypass arrangement which will allow the system to be operated at any temperature above 60° F.

The piping illustrations and instructions detail a simple bypass 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 in the following illustrations.

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 the balancing valve, slowly closing until the inlet temperature to the boiler is 140° F. minimum.
4. If the temperature to the boiler exceeds 140° F., slowly close the valve until 140° F is maintained.
5. Operate the boiler until the desired system operating temperature is achieved. Check out all the components for proper operation.
6. Carefully, following these instructions will permit the system circulating loop to operate at the desired temperature regardless of the higher boiler water temperatures.

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 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 the water supply
   (b) Drain the unit completely
   (c) Drain the pump and the piping.

ELECTRICAL REQUIREMENTS

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 CAF C22.1, Canadian Electrical Code, Part 1 and/or all local electrical codes.

1. All wiring between the unit and any 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 the unit is being fired. (Except when the unit is provided with an optional intermittent pump controller).
4. To avoid serious damage, DO NOT energize the unit until the system is full of water.

AMP DRAW DATA:

BTU INPUT	FAN(S)	CONTROLS	APPROXIMATE TOTAL AMPS @ 120 VOLTS AC
300,000	3.6	2.6	6.2
399,999	3.6	2.6	6.2
500,000	3.6	2.6	6.2
650,000	3.6	2.6	6.2
750,000	3.6	2.6	6.2
990,000	7.2	7.2	14.4
1,260,000	7.2	7.2	14.4
1,440,000	7.2	7.2	14.4
1,800,000	10.8	7.2	18.0
2,070,000	10.8	7.2	18.0

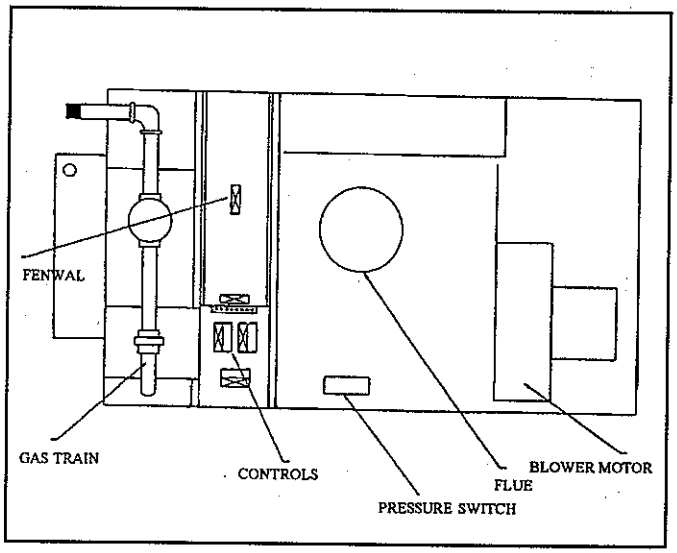
This chart may be used to determine the minimum wire size for 120 volt service, at the following lengths:

WIRE SIZE:	14ga.	12ga.	10ga.
BTU' S in 1,000s:			
300 -750	0 - 69'	70 - 109'	
990 -1440	0 - 46'	47 - 73'	
1800 - 2070		0 - 55'	56 - 87'

When connecting the unit to an energy management system, refer to this chart for minimum wire size at the following lengths:

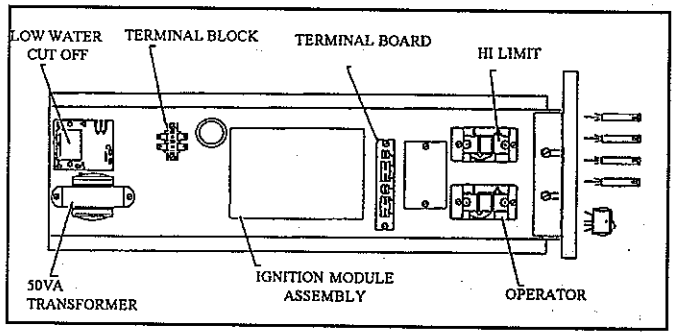
WIRE SIZE	12ga.	14ga.	16ga.	18ga.
Wire Length	100'	75'	50'	30'

STANDARD COMPONENTS: SEQUENCE OF OPERATION, WIRING DIAGRAMS, TROUBLE SHOOTING AND SPECIFIC INFORMATION FOR 300,000 thru 750,000 BTU MODELS:



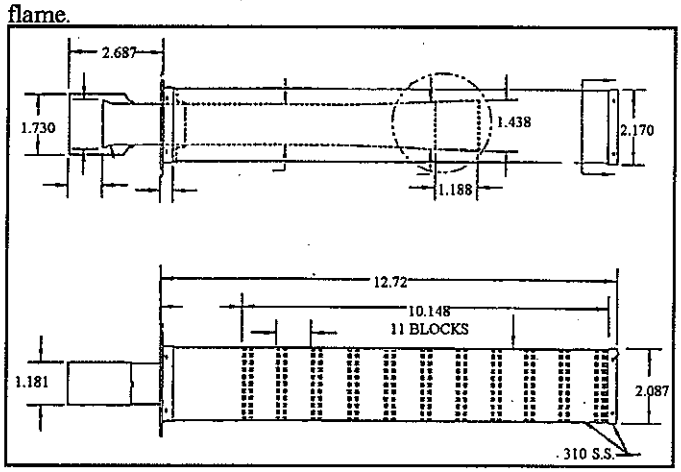
CONTROL PANEL

The control panel houses electrical components such as: thermostats, transformer, and ignition modules. The thermostats and terminal strip may be accessed by removing the top jacket panel. The other components may then be accessed by removing the inner sheet metal cover protecting them.



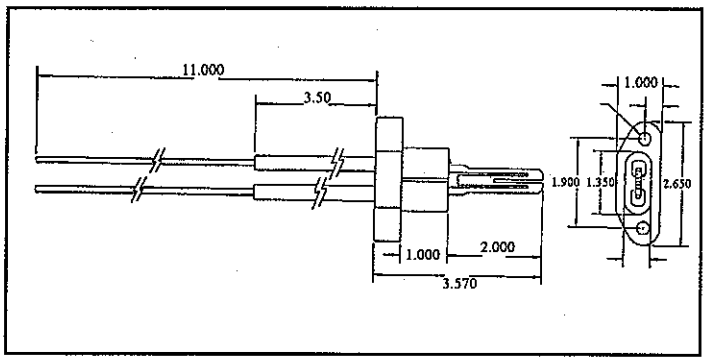
BURNER

The burner is a tubular design constructed of 310 stainless steel. It has eleven blocks of port area that define the flame pattern. The burner uses an inner venturi tube that balances the gas/air mixture over the surface of the burner, creating an even burner flame.



HOT SURFACE IGNITOR

The Hot Surface Ignitor is composed of a carbide silicon heating area with a ceramic mounting bracket. The hot surface ignitor must reach a minimum of 3.1 amps at 115 volts for proper operation. Production units following serial number F934953 the hot surface ignitor replaced the flame rod as the flame sensing device.



300 - 750

F-9 SEQUENCE OF OPERATION

1. When the **Power Switch** is placed in the **"ON"** position, 120 volt is supplied to the **Control Transformer** and to **L1** & **L2** on the **Ignition Module**. Any optional controls in the 120 volt supply must be made, i.e.: **Low Water Cut Off**.

2. The **Control Transformer** reduces the 120 volt supply to 24 volt to operate the control circuit. 24 volt is applied to **CN6** on the **Pulse Eliminator**, one side of the **Flame Failure Lamp**, and to **"R"** on the terminal board. **CN6** & **CN2** are internally jumpered, with **CN2** powering the **24VAC** terminal on the **Ignition Module**.

3. A jumper or remote control, between **R** & **W** on the **Terminal Board** supplies power to the **Operator**. With the **Operator** and the **High Limit** calling for heat, 24 volt is supplied to **B** on the **Terminal Board** and to **TH** on the **Ignition Module**. **TH** switches 120 volts on **L1** to **IND** of the **Ignition Module**. The **Combustion Air Blower** is now powered.

4. 24 volts is supplied to **X** on the **Terminal Board** by either a jumper between **B** & **X** or a remote safety switch, i.e.: **Flow Switch, Pressure Switch**, etc.. Terminal **X** feeds power to terminal **C** on the **Low Air Pressure Switch**.

5. Before the **COMBUSTION AIR BLOWER** reaches full speed, the **LOW AIR PRESSURE SWITCH** is in the normally closed position. 24 volts are supplied to *NC* on the **LOW AIR PRESSURE SWITCH**. The **LOW AIR** lamp is lit.

6. When the **COMBUSTION AIR BLOWER** reaches full speed, the **LOW AIR PRESSURE SWITCH** closes, sensing the differential pressure between the front chamber and burner venturi. Nominal differential pressure is .35" w.c. for natural gas and .32"w.c. for LP gas. Power is supplied to *NO* on the **LOW AIR PRESSURE SWITCH**.

7. Power is now supplied to *CN4* on the **PULSE ELIMINATOR** from *NO* on the **LOW AIR SWITCH**. *CN4* triggers the **PULSE ELIMINATOR** to latch closed. *CN1* is now powered.

8. *CN1* feeds *1* on the **TIME DELAY RELAY**. After approximately 15 seconds **TIME DELAY RELAY** contacts close *2* to *3* and *7* to *6*. *1* also feeds *PSW* on the **IGNITION MODULE**. Prepurge time starts, after 15 seconds the **HOT SURFACE IGNITER** is powered from terminals *S1* and *FS/S2* on the **IGNITION MODULE**.

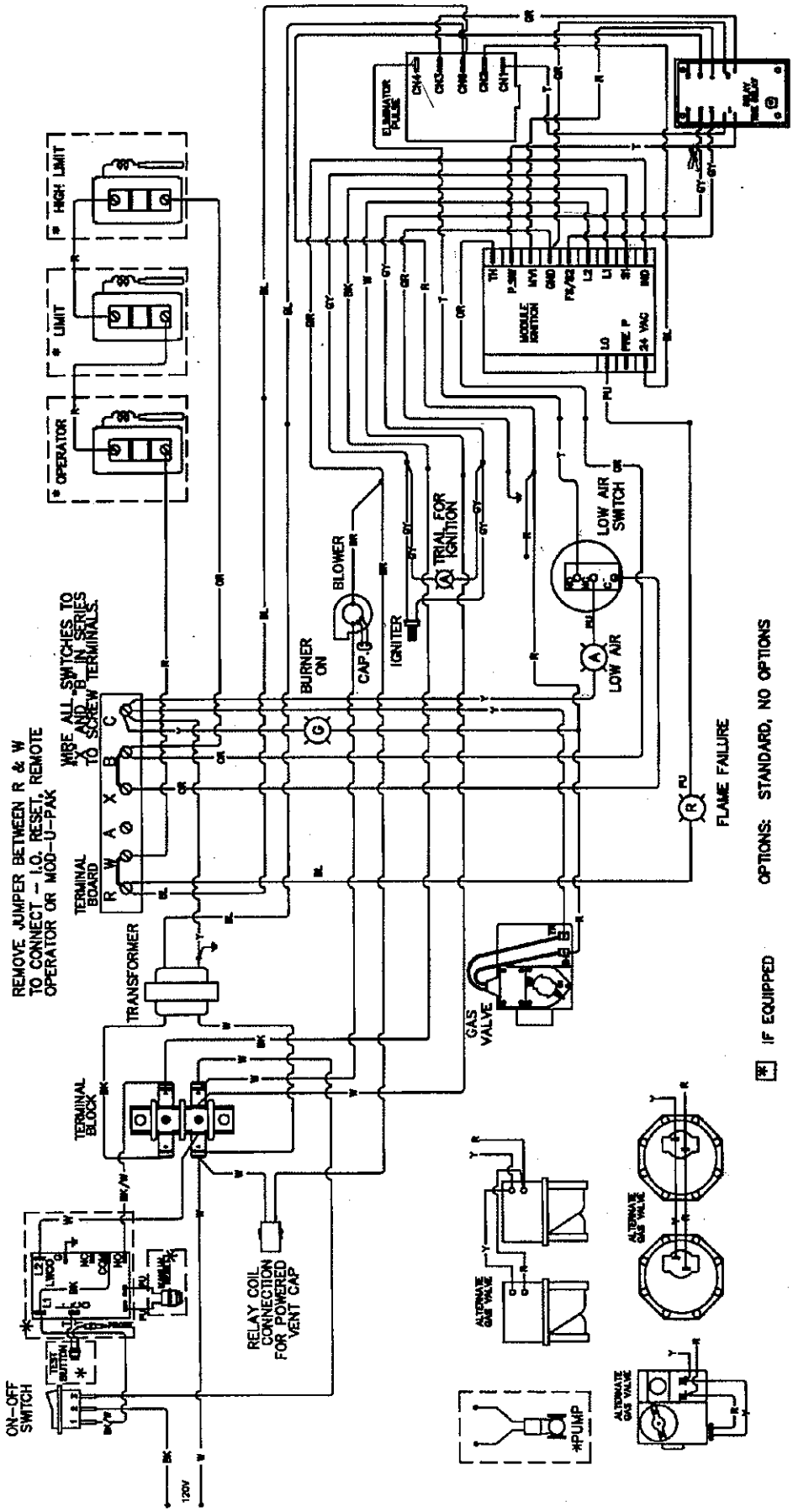
9. The **Ignition Module** monitors the amperage draw of the **Hot Surface Ignitor**. When the amperage draw reaches 3.1 amps., the **Ignition Module** powers the **Gas Valve** via terminal **MV1**. **MV1** also powers the **Burner On Lamp**.

10. The **Hot Surface Ignitor** is de-energized and now serves as a **Flame Sensor** to prove **Main Burner Flame**. If the Burner Flame has proven, the **MV1** terminal remains energized until the **Operator** is satisfied. With the **Operator** satisfied, the **Ignition Module** maintains power to terminal **IND** for a 30 second **Post Purge** period. At the end of the Post Purge, the blower stops and the unit is ready for the next demand for heat.

11. If the Burner flame isn't proven back to the **Ignition Module**, the **MV1** terminal is de-energized and the unit will **Shutdown**. The **LO** terminal on the **Ignition Module** will energize the common circuit to the **Flame Failure Lamp**. To reset the unit, it requires that you manually turn the power to the unit **Off**, wait 10 seconds and then turn the unit back **On**.

300 ~ 750

D955693 ~ after



WIRING FOR 300 - 750 AFTER SERIAL # D955693

REPLACEMENT INSTRUCTIONS FOR:
IGNITION MODULE SERVICE KIT RLY3428
FOR MODELS
CF/CH/CP 300-750

Instructions for CF/CH/CP 300 -750 models:

Serial Numbers J914346 to F934953
SEE SECTION 1.

Serial Numbers F934954 to B954568
SEE SECTION 2.

Serial Numbers B954569 to D955693
SEE SECTION 3.

Serial Numbers D955694 AND ABOVE HAVE THE IDENTICAL IGNITION MODULE INSTALLED. THEY ARE NOT INCLUDED IN THE RECALL. THIS PART IS A DIRECT REPLACEMENT, WIRE FOR WIRE FOR THESE UNITS.
SEE SECTION 4.

SECTION 1:
(Serial Numbers J914346 to F934953)

A. Turn off the power and the gas supply to the unit.

B. Remove the pink wire from FS/S2 on the original ignition module. Cut and cap this wire. (This wire is from the flame rod, leave the flame rod installed).

C. Locate the white wire from the 120 volt terminal strip to the hot surface ignitor. Disconnect this wire from the 120 volt terminal and connect it to one of the grey wires found on the wiring harness of the new ignition module in step I. [Hint: Three white wires leave the 120 volt terminal strip and go under the control panel. One goes to the on/off rocker switch, Two goes to the fan and Three goes to the hot surface ignitor. When disconnecting this is what will occur: Wire One (rocker switch) - no operation, Wire Two (fan) - the low air light will glow, but the fan will not operate, and Wire Three (HSI) - the unit will operate through to trial for ignition and will hang there, with no orange glow from the HSI].

D. Run a new white wire from the 120 volt terminal strip to the new ignition module wire harness plug - white wire, connecting it during step I.

E. The pulse eliminator next to the ignition module needs to be disconnected and discarded (See Figure 1). The Orange wires on CN2 & CN6 of the pulse eliminator are to be spliced together. The Tan wires on CN1 & CN4 are to be spliced together. The Yellow wire on CN3 is to be cut and capped.

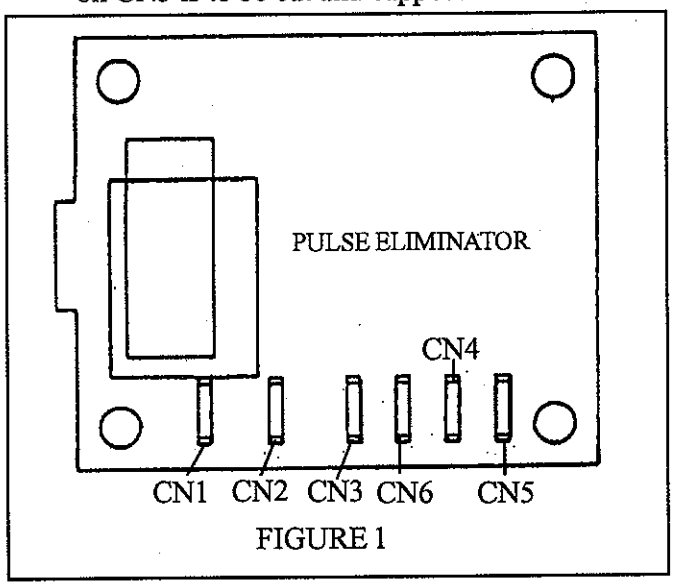


FIGURE 1

F. Disconnect the wires to the Fenwal ignition module and remove the module.

G. Install the Ignition Module Kit RLY3428 by positioning the ignition module in the same orientation as the original module and attach it by replacing the screws through ignition module and bracket assembly into the control panel (See Figure 2).
Note: If necessary, remove the four screws used to attach the top to provide access in mounting ignition module to the control panel.

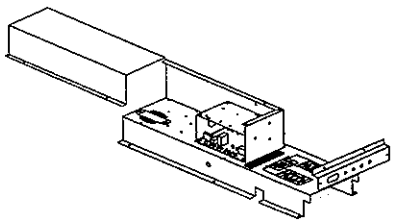


FIGURE 2 - CF/CH/CP 300-750 models

H. Position the wiring of the kit through the plastic bushing of the bracket assembly to agree with the existing wiring of the control panel.

I. Connect the wiring from the kit to the wiring from the original ignition module of the control panel. Match wire colors from the module kit to the wires from the control panel.

J. Replace the control panel assembly cover.

K. Replace the upper left access panel.

L. Turn on the power and the gas supply to the unit.

M. Test fire the unit to verify proper sequence of operation.

SECTION 2:
(Serial Numbers F934954 to B954568)

A. Turn off the power and the gas supply to the unit.

B. Disconnect the wires to the Fenwal ignition module and remove the module.

C. Install the Ignition Module Kit RLY3428 by positioning the ignition module in the same orientation as the original module and attach it by replacing the screws through ignition module and bracket assembly into the control panel (See Figure 2).
Note: If necessary, remove the four screws used to attach the top to provide access in mounting the ignition module to the control panel.

D. Position the wiring of the kit through the plastic bushing of the bracket assembly to agree with the existing wiring of the control panel.

E. Connect the wiring from the kit to the wiring from the original ignition module of the control panel. Match the wire colors from the module kit to the wires from the control panel.

F. Replace the control panel assembly cover.

G. Replace the upper left access panel.

H. Turn on the power and the gas supply to the unit.

I. Test fire the unit to verify proper sequence of operation.

SECTION 3:
(Serial Numbers B954569 to D955693)

A. Turn off the power and the gas supply to the unit.

B. The pulse eliminator next to the ignition module needs to be disconnected and discarded (See Figure 1). The Tan wires on CN1 & CN4 are to be spliced together. The Yellow wire on CN3 and the Orange wire on CN2 are to be cut and capped individually.

C. Disconnect the wires to the ignition module assembly and remove the module.

D. Install the Ignition Module Kit RLY3428 by positioning the ignition module in the same orientation as the original module and attach it by replacing the screws through ignition module and bracket assembly into the control panel (See figure 2).
Note: If necessary, remove the four screws used to attach the top to provide access in mounting the ignition module to the control panel.

E. Position the wiring of the kit through the plastic bushing of the bracket assembly to agree with the existing wiring of the control panel.

F. Connect the wiring from the kit to the wiring from the original ignition module of the control panel. Match the wire colors from the module kit to the wires from the control panel.

G. Replace the control panel assembly cover.

H. Replace the upper left access panel.

I. Turn on the power and the gas supply to the unit.

J. Test fire the unit to verify proper sequence of operation.

SECTION 4:
(Serial Numbers D955694 AND ABOVE)

A. Turn off the power and the gas supply to the unit.

B. Disconnect the wires to the ignition module assembly and remove the module assembly.

C. Connect the wiring from the replacement ignition module to the wiring from the original ignition module. (Match the wire colors, wire for wire, to the wires from the control panel).

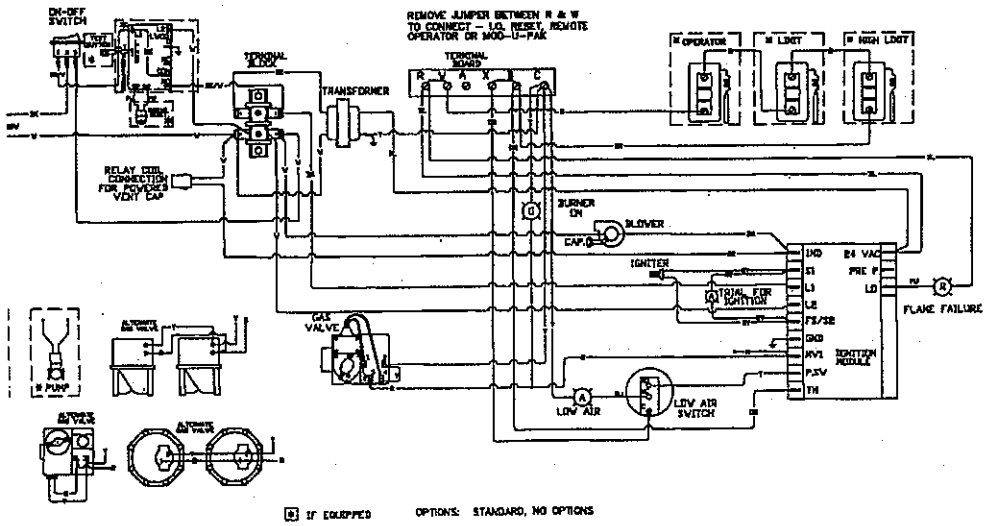
D. Replace the control panel assembly cover.

E. Replace the upper left access panel.

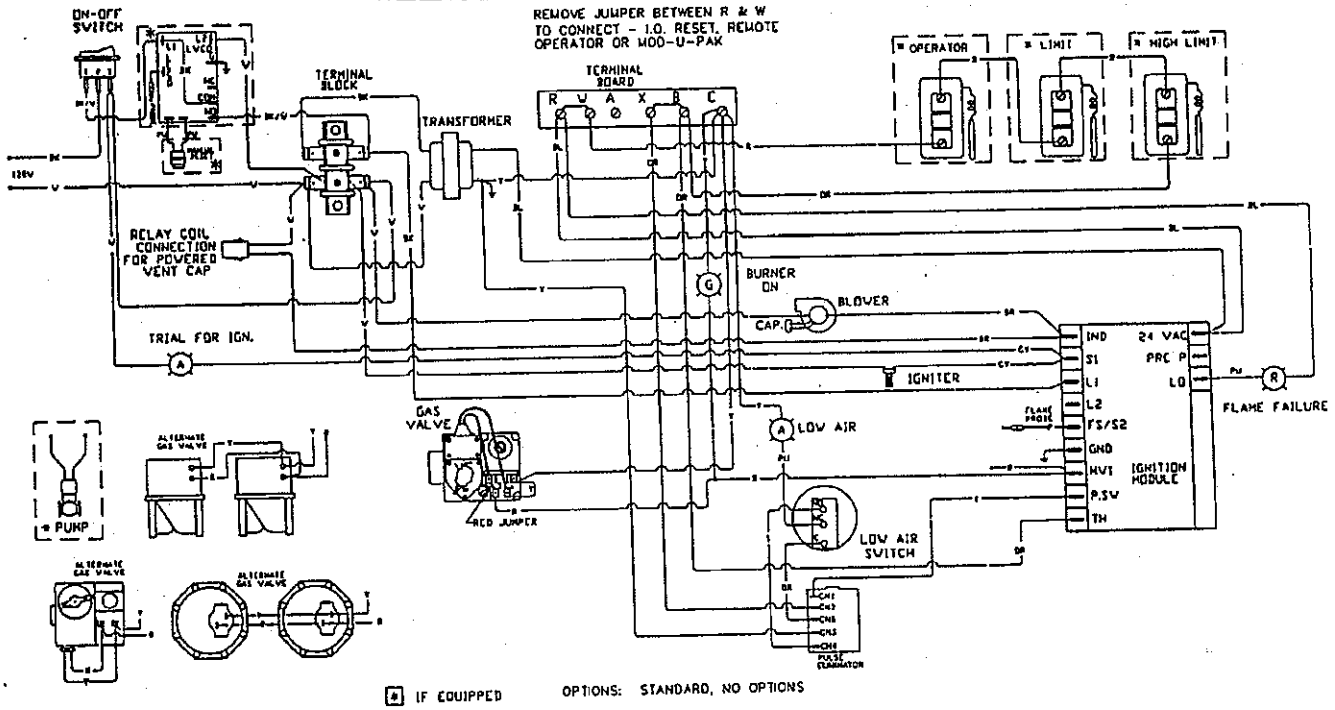
F. Turn on the power and the gas supply to the unit.

G. Test fire the unit to verify proper sequence of operation.

WIRING FOR 300 - 750 BETWEEN SERIAL #'S F934954 & B954568



WIRING FOR 300 - 750 PRIOR TO SERIAL # F934953



TROUBLE SHOOTING

FLAME FAILURE:

- Verify correct inlet and manifold gas pressures. See page 6 for specifics.
- Too much air pressure from combustion air blower. Pressure differential should be 0.35" W.C. for Natural Gas and 0.32" W.C. for Propane Gas. Look for flame lifting off the burner.
- High draft - Draft should be between -0.01 and -0.08" W.C.
- Flame rod - update ignition module, see page 19.
- Ground - Make sure the ground wire is connected to the ignition module and the burner mounting screw.

HANGING ON TRIAL FOR IGNITION:

- Broken H.S.I. - check to see if it glows orange.
- Ignition module - Check amp draw of ignitor. If ignitor is drawing a minimum of 3.1 amps the ignition module is bad.

RUMBLING ON IGNITION OR DURING OPERATION:

- Lean gas/air mixture - verify correct inlet and manifold gas pressure (See page 6). Verify correct air pressure and adjust the air as required on the combustion fan if necessary.
- High draft - Draft should be between -0.01 to -0.08" W.C..
- Burner Damage - Check burners for blockage of the burner ports and for damage to the burner ports.

SHORT CYCLING:

- Operator sensor bulb location - move sensing bulb to the inlet side of the unit.
- Temperature rise - Check flow through the unit. A low flow will create a high temperature rise triggering the high limit.
- High limit - setting to low, set appropriately.

LOW AIR:

- Check operation of the combustion air fan. Clean fan blades of any dirt and debris. Oil with 30 weight non-detergent oil.
- Check jacket for air leaks. Be sure bottom of the door panel is in place, all screws are installed and that the gasketing isn't disturbed.
- Check voltage to the fan - Voltage should be a minimum of 110 VAC.
- Check for flue blockage, sooted heat exchanger or down drafting conditions. These items will change the pressure in the combustion chamber and will effect the pressure differential.

START UP PROCEDURE AND FOLLOW UP MAINTENANCE:

I. START-UP

1. Review Installation and Operation Instruction manual before placing the unit into operation.
2. Review job site for:
   a. Properly sized gas supply
   b. Proper combustion and ventilation openings (conventional and sidewall venting only).
   c. Proper voltage supply.
   d. Proper venting of unit to the atmosphere.
   e. Assure that all gas supply lines are completely purged of air.
   f. Assure that the system is completely filled with water.
   g. Assure that all electrical connections are made and comply to all local codes. (Note: The unit is required to have it's own designated power source).
   h. Assure all circulating pumps are operating properly. Oil them if this has not already been done.
3. Review name plate information to assure that you have the proper unit.
4. Start-up:
   a. Begin with the operator and high limit set to their lowest setting and the on/off switch in the "off" position. The circulating pump and gas supply should be on.
   b. Turn the units power switch to the on position. It should illuminate red, if not check the power source to the unit.
   c. Turn the operator and high limits to their highest settings. This should energize the combustion air fan and the low air light. After the fan builds speed the low air light will turn off.
   d. Approximately 15 seconds later the "trial for ignition" light will be energized. This light will be energized for approximately 15 to 20 seconds. During this period the hot surface ignitor will be powered and begin to glow.
   e. The "main burner" light will now energize and open the gas valve so ignition can be achieved.
   f. Turn the unit off with the red on/off switch.
   g. Set the operator and high limit to the desired setting for normal operation.
5. Adjust the unit to meet factory specifications.
   a. Connect a slack tube manometer to the gas supply and record the gas pressure_____"w.c..
      1. Natural 5" minimum to 10.5" maximum w.c..
      2. L.P. gas minimum 11" to 13" maximum w.c..
   b. Connect the slack tube manometer to the manifold pressure tap and set the gas pressure while the unit is running.
      1. Natural - 4"w.c.
      2. L.P. - 10"w.c.
   c. The air shutter on the fan is factory preset. In most installations, further adjustment is not required. To adjust or check the combustion air setting connect the manometer to one of the hoses on the low air switch and record the measurement while the fan is running. Reconnect the hose and repeat the procedure with the second hose. Subtract the smaller measurement from the larger measurement and record the difference:
      1. Natural - 0.35"w.c..
      2. L.P. - 0.32"w.c..

      Note: The manometer used for air shutter adjustment should be able to read pressure to the nearest hundredth of an inch water column for an accurate setting. If this difference is not received, adjustment of the fan shutter will be necessary.
   e. Connect a volt meter to the supply voltage and record the voltage while the unit is operating. _____VAC (110v - 132v)
   f. To record the draft on the conventional vent, sidewall vent and the direct air vent units:
      1. Drill 1/4" hole in the stack

      Static: Unit Off_____

      Running:_____

      (Draft should be between 0.01 to 0.08" negative).
   g. Record the inlet and outlet water temperature. If it is a multiple unit installation do the same with all the units operating simultaneously.

      Temp in_____°F

      \- Temp out_____°F

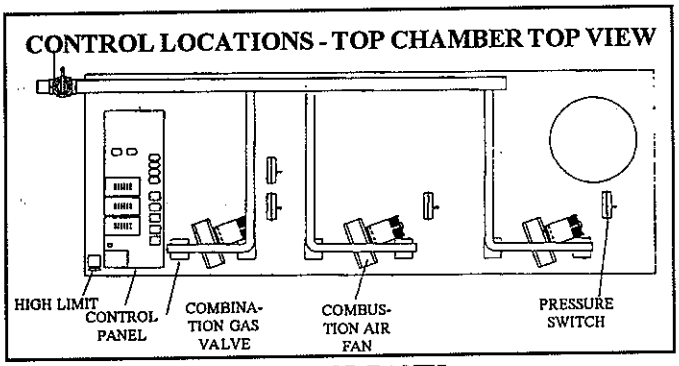
      = Delta T _____°F

The temperature rise on all water heaters is found on Page 13.

II. MAINTENANCE FOLLOW-UP:

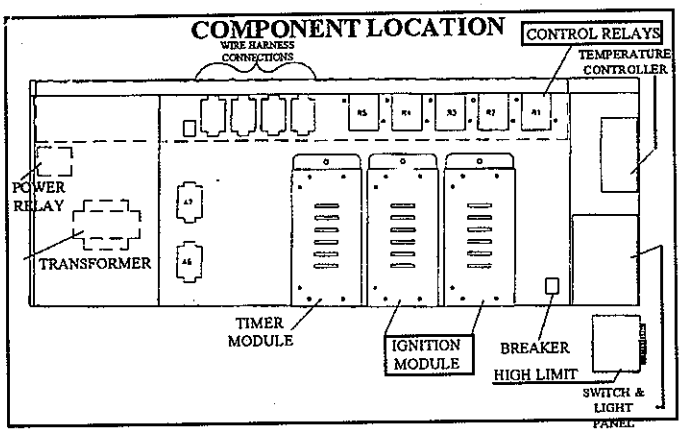
1. Biannual:
   a. Check the inlet and the manifold gas pressure.
   b. Check the air pressure differential.
   c. Oil the fan and pump motors.
   d. Review the temperature rise (Delta T) across the heat exchanger for proper flow rate (refer to page 13 for the correct temperature rise).
   e. Give the unit a complete visual inspection and note any problems. Check the surrounding area for dust, dirt or other airborne contaminates that may be drawn into the burner by the combustion air fan. A contaminate of enviroment may require that the burners be removed and cleaned.

STANDARD COMPONENTS: SEQUENCE OF OPERATION, WIRING DIAGRAMS, TROUBLE SHOOTING AND SPECIFIC INFORMATION FOR 990,000 thru 2,070,000 BTU MODELS:



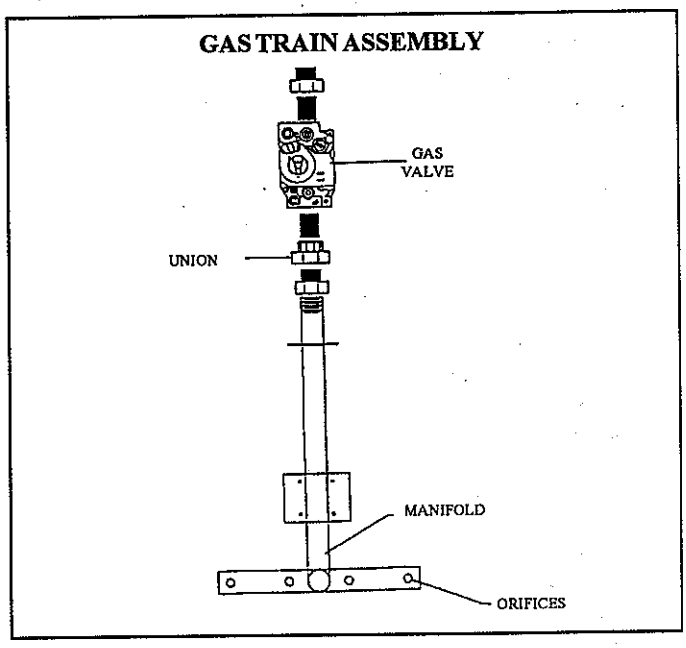
CONTROL PANEL

The control panel houses electrical components such as the digital temperature control, ignition modules and relays. All components may be accessed by sliding the control panel forward from the unit. All of these components may be removed by unplugging them from the base of the control panel assembly.



GAS TRAIN

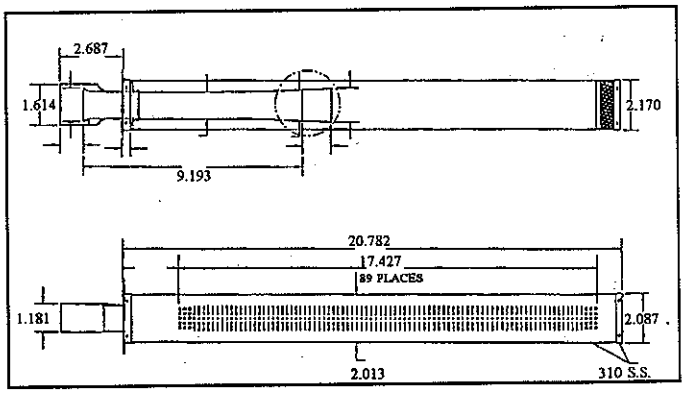
These units incorporate multiple gas valves for the staging. The number of valves is determined by the BTU input of the unit. The gas train assembly is composed of a dual seat combination gas valve, 2 unions - one above and one below the gas valve (for easy removal), the gas manifold and the main burner orifices.



MODEL:	NUMBER OF GAS VALVES
990	3
1260	4
1440	4
1800	5
2070	6

BURNER

The burner is a tubular design constructed of 310 stainless steel. It has 89 blocks of port area that define the flame pattern. The burner uses an inner venturi tube that balances the gas/air mixture over the surface of the burner, creating an even burner flame.



HOT SURFACE IGNITOR

The Hot Surface Ignitor is composed of a carbide silicon heating area with a ceramic mounting bracket. The hot surface ignitor must reach a minimum of 3.1 amps at 115 volts for proper operation. The hot surface ignitor is also used as the sensing device. There is no other flame rod used in this series. These units use two separate ignition systems for the staging. Ignition system one controls stages 1 & 2, while ignition system two controls stages 3 & 4.

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. 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 **Select** key will display the control values again from the beginning of the display loop.

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

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

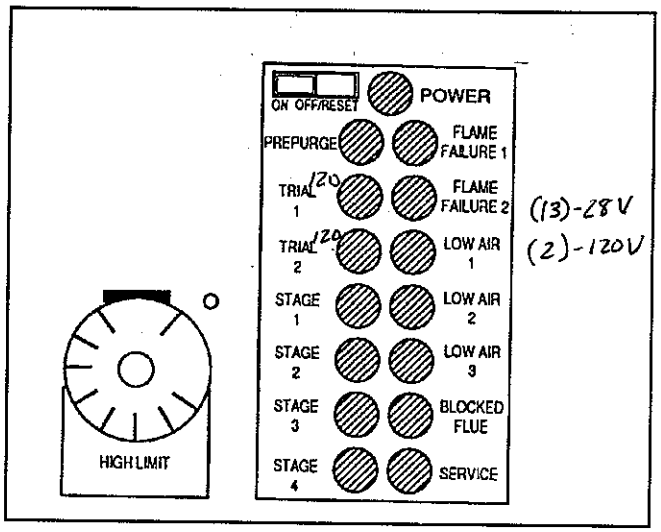
IMPORTANT

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

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

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

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



DISPLAY

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

The display can be configured with three options to show sensed temperature. The display can lock on Sensor A temperature, lock on Sensor B temperature, or be configured to alternatively indicate "sensor A" and "sensor B" sensed temperature at a 5 second rate. This allows comparison of 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 as the operating sensor. This sensor will be located in the front header on either the inlet side, when shipped as a hot water supply boiler, or on the outlet side, when used as a heating boiler.

Sensor B is used to monitor the water temperature opposite of Sensor A.

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 work sheet below.

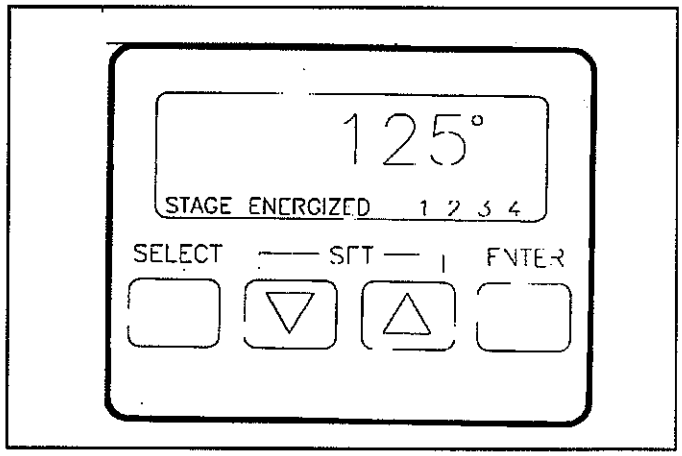
Programming Work sheet

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.



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

Reprogram set points and differentials to meet your system requirements.

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

1. Verify that the 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 dropped below the set point of the high limit.

DIGITAL CONTROLLER ERROR MESSAGES

There are seven error messages that can be displayed in response to software or hardware problems with the T775. The error codes that may be seen flashing on the display are listed below:

SF -- Sensor Failure
If the display shows a flashing **SF**, this indicates an out of range sensor. Determine if the sensor(s) are connected properly. For T775A, all loads will be de-energized when this error message is flashing.
For T775B, the loads controlled by the out of range sensor will be de-energized. The display will flash **"SF"** to indicate which sensor is defective, the remaining sensor and it's load(s) will operate normally. Only the loads controlled by the defective or unconnected sensor will be de-energized.

EF -- EEPROM Failure
The values read back from the **EEPROM** are not the same as what was written into the **EEPROM**. This error cannot be field repaired. Replace the device. The **EEPROM** is not intended to be field repaired.

CF -- Calibration Failure
A calibration resistor reading was not within the range of the Analog to Digital converter. This error cannot be field repaired. Replace the device. ELECTRONIC TEMP STAT

OF -- Stray Interrupt Failure
An unused interrupt occurred. This error cannot be field repaired. Replace the device.

CE -- Configuration Error
The device hardware has been configured to a nonexistent device. This error cannot be field repaired. Replace the device.

OE -- ROM Error
The internal ROM of the microprocessor is defective. This error cannot be field repaired. Replace the device.

AE -- RAM Error
The internal **RAM** of the microprocessor is defective. This error cannot be field repaired. Replace the device.

SEQUENCE OF OPERATION

990,000 - 2,070,000 BTU MODELS

1. Remove control panel over the diagnostic lights to access the **Power Switch** and **Digital Temperature Control** adjustments.

2. Place the **Power Switch** in the "ON" position. 120VAC is supplied to the coil of the **Power Relay** which switches 120VAC to the **Hot Surface Ignition Modules,** fan **Control Relay** switching terminals and the control circuit **Transformer.**

3. The control **Transformer** drops the 120VAC to 24VAC control circuit voltage. The **Green Power Light** will be turned on and 24VAC is supplied to operate the **Digital Temperature Control** sequencer.

4. 24VAC is supplied to terminals R and W on the **Terminal Board** for the connection of field installed temperature controls. The **Terminal Board** is located in the electrical junction box. A factory installed jumper is provided between R and W. If this jumper is removed a field installed temperature control, Mod-U-Pak or EMS must be wired to these terminals. The function of this field installed control will cycle the unit on and off. This field installed control must be on and calling for heat for the sequence of operation to continue.

5. 24VAC is supplied to the **High Limit Control.** Water temperature must be below the set point of the **High Limit Control** to allow 24VAC to be supplied to the switching contacts of the **Digital Temperature Control** sequencer. If

water temperature is above the set point of the **High Limit Control,** all operation will stop until water temperature drops below the **High Limit Control** set point.

6. 24VAC is supplied to terminals B and X on the **Terminal Board** for the connection of field installed safety controls. The terminal board is located in the electrical junction box. A factory installed jumper is provided between B and X. If this jumper is removed a field installed safety control must be wired to these terminals. Safety controls such as a flow switch, gas pressure switches or a proving switch for an ID Fan are wired to these terminals. The contacts of the field installed safety control must make to provide continuity between B and X for the sequence of operation to continue. 24VAC is also supplied to the **Blocked Flue Switch** circuit and **Hot Surface Ignition Modules 1 and 2.**

7. The **Digital Temperature Control** sequencer uses a thermistor to sense water temperature. When water temperature drops below the set point of stage 1, less the differential, the sequencer will begin the call for heat sequence. 24VAC is supplied to **EMS Terminal #1** and on to **Ignition Module 1.**

8. All of the **Combustion Air Fans** start and run for a 15 second pre-purge period. **Ignition Module 1** controls the timing of the left and center fans. The **Timer Module** controls the pre-purge operation of the right fan. The **Amber Pre-Purge Light** will be on for this 15 second period. During this pre-purge time the **Blocked Flue Pressure Switch** proves operation of the flue. A **Red Blocked Flue Light** will turn on with a flue blockage and the sequence of operation will stop until the condition is corrected.

9. At the end of the pre-purge time period, only the **Combustion Air Fan(s)** necessary to fire the first stage of burners will remain on. The operation of this fan is proven by a **Low Air Pressure Switch.** If the fan does not provide the proper volume of air, an **Amber Low Air 1 Light** will turn on and the operation of stage 1 will stop until the low air condition is corrected. The **Ignition Module** proceeds with burner ignition when the fan is proven.

10. **Ignition Module 1** supplies 120VAC to **Hot Surface Ignitor 1** and the **Amber Trial 1 Light** is turned on. The **Ignition Module** proves the ignition temperature of the **Hot Surface Ignitor** by monitoring the amp draw to the ignitor. The **Trial 1 Light** turns off when the **Hot Surface Ignitor** is proven and 24VAC is supplied to the **Gas Valve(s)** on stage 1.

11. 24VAC is supplied to the **Gas Valve(s)** on stage 1 and the **Green Stage 1 Light** is turned on. Gas is supplied to the burner, mixed with air and ignited. The **Hot Surface Ignitor** now functions to sense main burner flame and prove burner operation. If ignition of stage 1 burners is not proven, **Hot Surface Ignition Module 1** will lock out and a **Red Flame Failure 1 Light** will turn on. (If **Module 1** locks out on flame failure **Module 2** will try for ignition when stage 3 of the Sequencer calls for heat). The **Hot Surface Ignitor** senses main burner flame and the **Green Stage 1 Light** remains on while the stage 1 burners are firing. The **Green Stage 1 Light** and burners will turn off when the temperature set point of stage 1 is satisfied.

12. The **Combustion Air Fan** for stage 2 is proven by a **Low Air Pressure Switch.** If the fan does not provide the proper volume of air, an **Amber Low Air 2 Light** will turn on and the operation of stage 2 will stop until the low air condition is corrected.

13. Stage 2 is cycled on by a drop in water temperature below the set point, minus the differential. Stage 2 of the **Digital Temperature Control** sequencer calls for heat and 24VAC is applied to **EMS Terminals #2** and on to the **Gas Valve** on stage 2 and the **Green Stage 2 Light** is turned on. Gas is supplied to the burners, mixed with air and ignited by carry over from the burners on stage 1. The **Green Stage 2 Light** remains on while the stage 2 burners are firing. The **Green Stage 2 Light** and burners will turn off when the temperature set point of stage 2 is satisfied.

14. The right **Combustion Air Fan** for models 1260 and 1440 is energized when power is supplied to the **Gas Valve** on stage 2.

15. Stage 3 is cycled on by a drop in water temperature below the set point, minus the differential. Stage 3 of the **Digital Temperature Control** sequencer calls for heat and 24VAC is applied to **EMS Terminal #3** and on to **Ignition Module 2 (TH & PSW).** The right **Combustion Air Fan** for model 990 is energized. There is a 15 second delay before the start of the **Ignition Module 2** sequence and the operation of stage 3.

16. **Ignition Module 2** supplies 120VAC to **Hot Surface Ignitor 2** and the **Amber Trial 2 Light** is turned on. The **Ignition Module** proves the ignition temperature of the **Hot Surface Ignitor** by monitoring the amp draw to the ignitor. The **Amber Trial 2 Light** turns off when the **Hot Surface Ignitor** is proven and 24VAC is supplied to the **Gas Valve** on stage 3.

17. 24VAC is supplied to the **Gas Valve** on stage 3 and the **Green Stage 3 Light** is turned on. Gas is supplied to the burners, mixed with air and ignited. The **Hot Surface Ignitor** now functions to sense main burner flame and prove burner operation. If ignition of stage 3 burners is not proven, the **Hot Surface Ignition Module 2** will lock out and a **Red Flame Failure 2 Light** will turn on. Stage 3 and stage 4 will not operate when the **Red Flame Failure Light** is on. (If **Module 2** locks out on flame failure, **Module 1** will continue operation. If stages 1 and 2 satisfy the set point of stage 3 on the **Digital Temperature Control** sequencer, **Ignition Module 2** will reset and try for ignition on the next sequence of operation when stage 3 calls for heat). The **Hot Surface Ignitor** senses main burner flame and the **Green Stage 3 Light** remains on while the stage 3 burners are firing. The **Green Stage 3 Light** and burners will turn off when the temperature set point of stage 3 is satisfied.

18. Stage 4 is cycled on by a drop in water temperature below the set point, minus the differential. Stage 4 of the **Digital Temperature Control** sequencer calls for heat and 24VAC is supplied to **EMS Terminal #4** and on to start the right **Combustion Air Fan** (1800 and 2070 only). The **Combustion Air Fan** for stage 4 is proven by a **Low Air Pressure Switch** and 24VAC is applied to the stage 4 **Gas Valve(s).** If the fan does not provide the proper volume of air, an **Amber Low Air 3 Light** will turn on and the operation of stage 4 will stop until the low air condition is corrected.

19. 24VAC is applied to the **Gas Valve(s)** on stage 4 and the **Green Stage 4 Light** is turned on. Gas is supplied to the burners, mixed with air and ignited by carry over from the burners on stage 3. The **Green Stage 4 Light** remains on while the stage 4 burners are firing. The **Green Stage 4 Light** and burners will turn off when the temperature set point of stage 4 is satisfied.

20. When all stages of the **Digital Temperature Control** sequencer are satisfied, the **Combustion Air Blower(s)** will run for a 15 second post-purge period to clear the combustion chamber and flue of all flue products. At the end of the post-purge cycle the **Combustion Air Fan(s)** shut off and the unit is ready for the next call for heat.

21. The control panel has an optional **Red Service Light** which can be wired to indicate the operation on an optional safety control on the unit.

RECOMMENDED START UP PROCEDURE FOR MODELS 990,000 THRU 2,070,000 BTU INPUT

I. Start-Up Review
- A. Review Installation and Operating Instruction manual before placing unit into operation.
- B. Review job site for:
  1. Properly sized gas supply line.
  2. Properly sized combustion and ventilation openings (conventional and sidewall venting)
  3. Insure that all combustion and ventilation air is free of contaminates.
  4. Proper voltage supplied to unit.
  5. Proper venting of unit to atmosphere using a Type "B" vent material.
  6. Insure that factory supplied vent kits were used on any alternate venting systems (Sidewall, DirectAire or Outdoor).
  7. Check for proper installed equivalent length on specialized venting systems (Sidewall or DirectAire.) See pages 9 and 10 for maximum length.
  8. Assure that all gas supply lines are completely purged of air.
  9. Assure that the system is completely filled with water.
  10. Assure that all electrical connections are made and comply to all local codes. (Note: The unit is required to have it's own designated power source.)
  11. Assure that all circulating pumps are operating properly. Oil the pumps if this has not already been done.
  12. Review installation of any field installed controls. Insure that proper connection is made to the factory supplied terminal strip in the electrical junction box on the unit.

- C. Review the rating plate information to assure that you have the proper unit for the application.
- D. Ignition System Checkout
  1. Turn off gas supply to unit.
  2. Remove control panel over diagnostic lights to access power switch and temperature control adjustments.
  3. Set the High Limit Control to maximum desired water temperature.
  4. Turn the electric power switch to ON.
  5. Program each stage of the temperature control to settings above water temperature to allow unit to cycle on. Factory pre-programed control points may be used for system checkout.
  6. All fans will run on pre-purge for a 15 second period. If a blocked flue light is observed review the venting system.
  7. Each ignitor will cycle on trial(s) for ignition along with operation of the combustion air fan required for each stage of burner operation as digital control sequences on.
  8. Each ignition module will lock out and turn on the flame failure lights 1 and 2.
  9. Read the Temperature Adjustment procedure on pages 24 - 26. Be prepared to program each stage of the temperature control to the temperature set points and differentials to test fire each stage of burner operation.
  10. Turn power off. (When power is turned on again it will reset the ignition modules).

II. Start-Up.
- A. Connect a manometer to the gas supply cock and record the gas pressure when unit is firing. Inlet gas pressure should be:

  1. Natural Gas - 5" W.C. minimum with standard gas train or 6" W.C. with any optional gas train, 10.5" W.C. maximum.
  2. L.P. Gas - 11" W.C. minimum, 13" W.C. maximum.

NOTE: Higher minimum inlet pressures may be required on optional firing control gas trains (F-3, F-4, etc..) See Rating Plate.

Inlet gas pressure is_____" W.C.

- B. Connect a volt meter to supply voltage at the electrical junction box. Record voltage while unit is firing.

Voltage_____VAC

Voltage range: 110VAC to 132VAC

C. Check draft on all conventional vented, sidewall vented or DirectAire venting systems. Make draft readings while performing operational test.
   1. Drill a 1/4" hole in the stack between the top of the unit and the barometric damper (if used).
      Draft: Static - Unit Off_____" W.C.
      Running - Unit On_____" W.C.
   2. Draft for all venting except Sidewall should be between 0.01 to 0.08 inches W.C. negative. Sidewall venting systems should have a draft between 0.04 to 0.08 inches W.C. negative.
   3. Barometric dampers are required on Sidewall venting and Horizontal DirectAire venting. A barometric damper is required on combined venting of multiple units or other installations when draft exceeds the maximum of 0.08" W.C. negative.

D. Remove top front jacket panels to access the gas valves and combustion air fans. Connect a manometer to the gas valve(s) for the #1 stage of operation.

E. Measure fan #1 differential pressure, this should be 1.5" W.C.. The air shutter should be adjusted to meet this requirement.

F. Program the #1 stage for 180 degree operation. Program the #2, #3, and #4 stage for 50 degree operation, this will only allow the #1 stage to fire.

G. Allow the #1 stage to fire. Set the manifold pressure for stage #1. Natural 3.5" W.C., Propane 10.0" W.C.

H. Connect a manometer to the gas valve(s) for the #2 stage.

I. Program the #2 stage for 180 degree operation.

J. Measure the differential pressure on fan #2, this should be 1.5" W.C. . The air shutter should be adjusted to meet this requirement.

K. Allow the #2 stage to fire. Set the manifold pressure for stage #2. Natural 3.5" W.C., Propane 10.0" W.C.

L. Repeat these steps for the #3 and #4 stages.

M. After each stage is properly set and fired the temperature control can be programed for operation.

N. Program each stage of the temperature control to desired temperature set points and differentials. Use caution on potable water systems to insure that water temperature set points will not cause risk of scald injury.

O. Turn the power off. Remove all test equipment. Use a soap solution to leak test any plugs or fittings removed from gas train. Replace all jacket panels removed for inspection. When power is turned on again the unit will be ready for operation.

III. Notify the installing contractor and the owner of any installation problems or operational errors observed during start-up.

TROUBLE SHOOTING

FLAME FAILURE:
- Verify correct inlet and manifold gas pressures. See page 6 for specifics.
- Too much air pressure from combustion air blower. Pressure differential should be 1.5" W.C. for all fans. Look for flame lifting off the burner.
- High draft - Draft should be between -0.01 and -0.08" W.C. on conventional venting and vertical directaire units. For sidewall venting and horizontal directaire the draft should be between -0.04 and -0.08"W.C..
- Ground - Make sure the ground wire is connected to the ignition module and the burner mounting screw.

HANGING ON TRIAL FOR IGNITION:
- Broken H.S.I. - check to see if it glows orange.
- Ignition module - Check amp draw of ignitor. If ignitor is drawing a minimum of 3.1 amps the ignition module is bad.

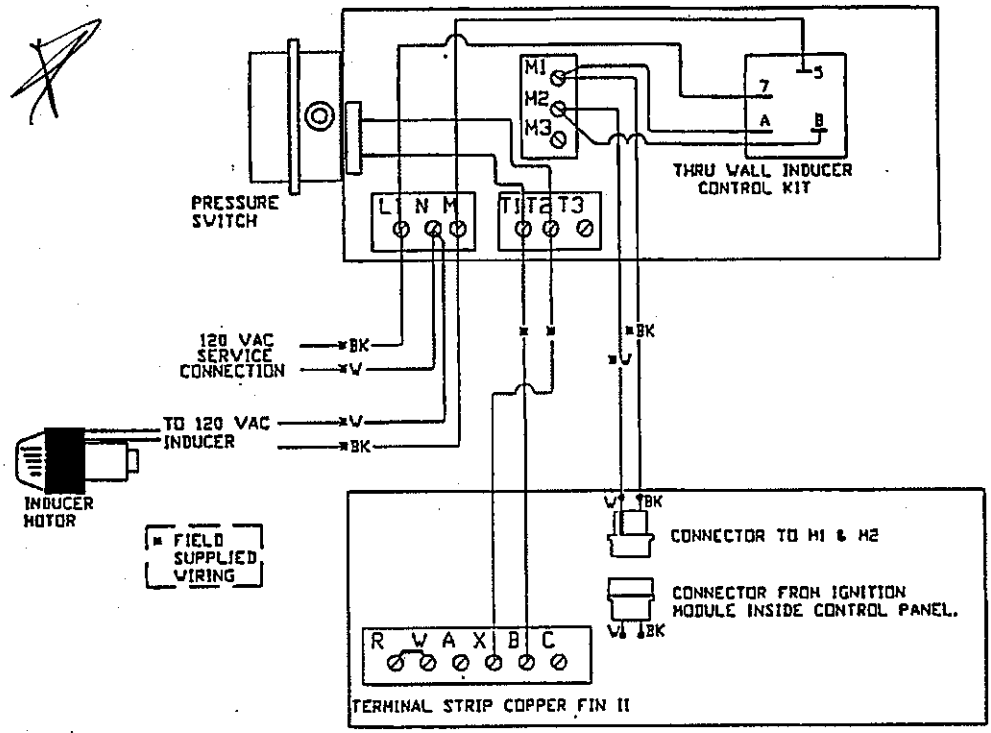
RUMBLING ON IGNITION OR DURING OPERATION:
- Lean gas/air mixture - verify correct inlet and manifold gas pressure (See page 6). Verify correct air pressure and adjust the air as required on the combustion fan if necessary.
- High draft - Draft should be as specified.
- Burner Damage - Check burners for blockage of the burner ports and for damage to the burner ports.

SHORT CYCLING:
- Operator sensor bulb location - move sensing bulb to the inlet side of the unit.
- Temperature rise - Check flow through the unit. A low flow will create a high temperature rise triggering the high limit.
- High limit - setting to low, set appropriately.

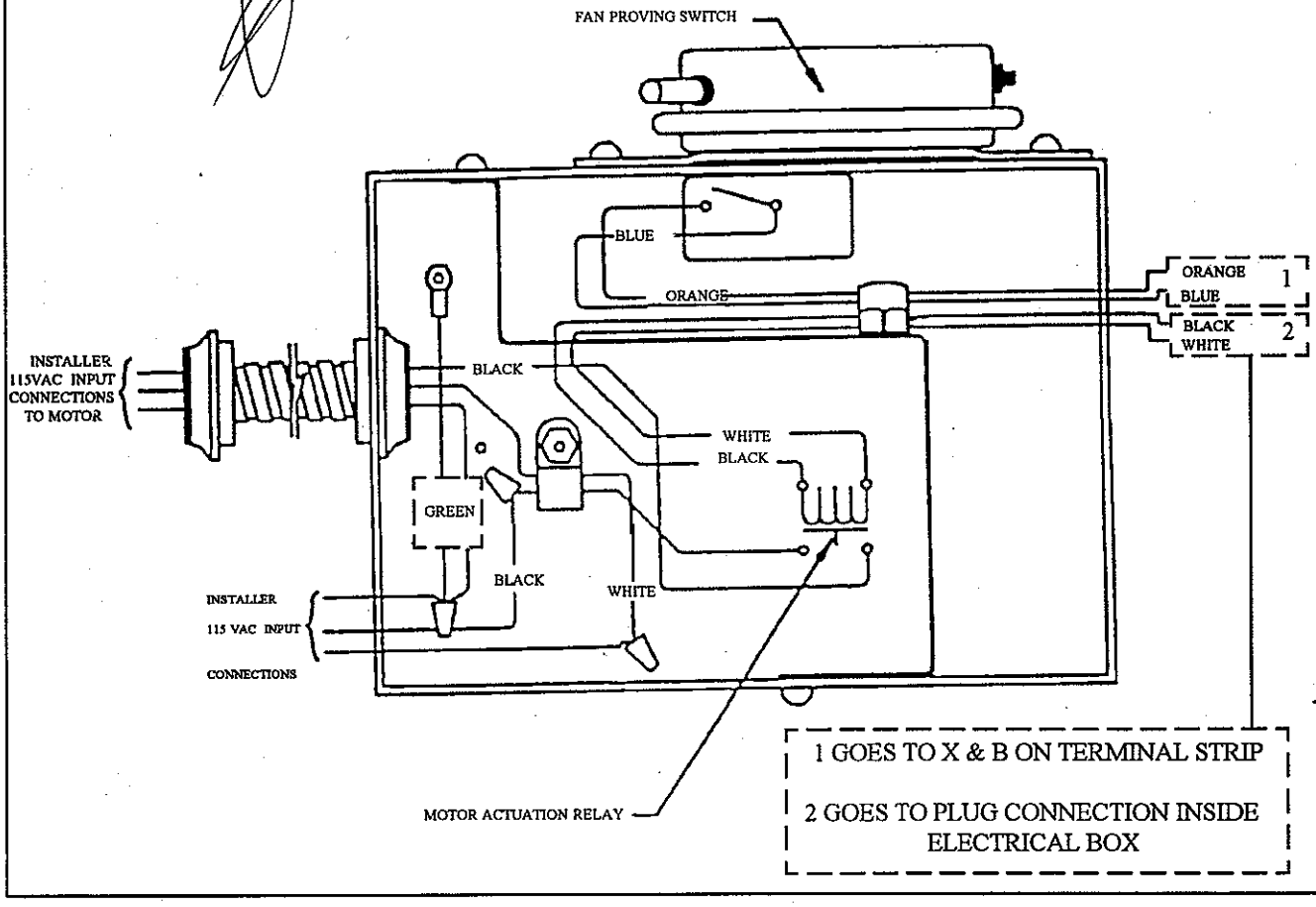
LOW AIR:
- Check operation of the combustion air fan. Clean fan blades of any dirt and debris. Oil with 30 weight non-detergent oil.
- Check jacket for air leaks. Be sure bottom of the door panel is in place, all screws are installed and that the gasketing isn't disturbed.
- Check voltage to the fan - Voltage should be a minimum of 110 VAC.
- Check for flue blockage, sooted heat exchanger or down drafting conditions. These items will change the pressure in the combustion chamber and will effect the pressure differential.

BLOCKED FLUE:
- Check vent cap for restrictions or obstructions. Verify that the vent cap is properly sized.
- Verify that the sensor tubing is connected at all points.
- Verify that the draft is in the proper range. Excessive draft or down drafts can cause this condition.

300,000 THRU 750,000 SIDE WALL FAN WIRING



990,000 THRU 2,070,000 SIDE WALL FAN WIRING



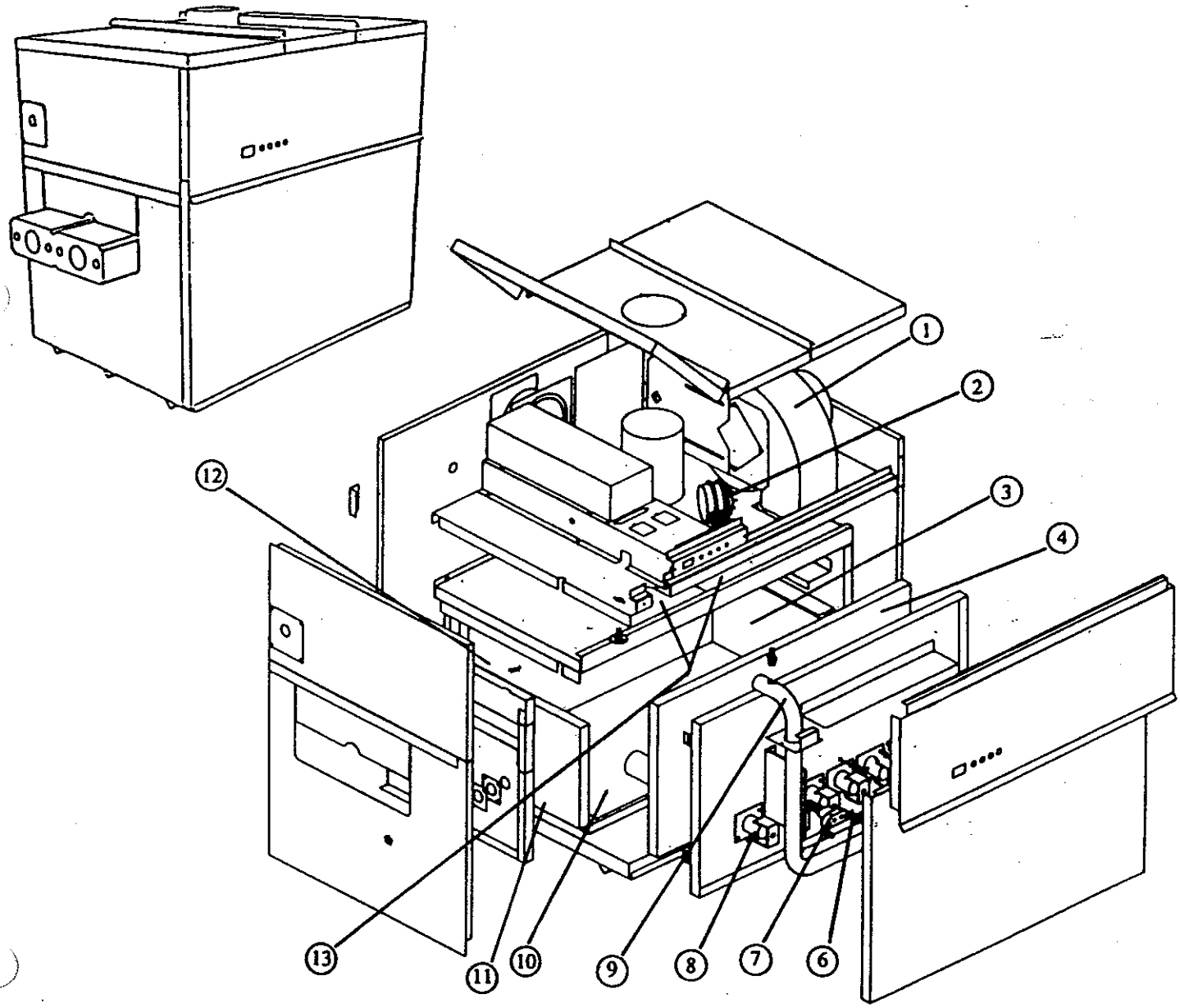
CFIIR-04

Lochinvar

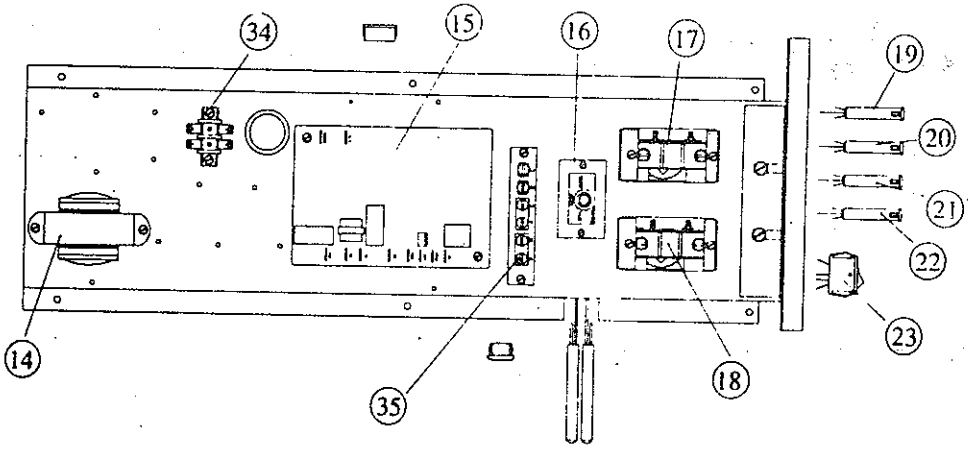
REPLACEMENT PARTS LIST

PARTS DEPOT
DETROIT, MICHIGAN 48170 (313) 454-4480
FAX: (313) 454-1790
NASHVILLE, TENNESSEE 37210 (615) 889-8900
FAX: (615) 885-4403
DALLAS, TEXAS 75234 (214) 484-8677
FAX: (214) 247-1411
TAMPA, FLORIDA (813) 248-2545
FAX: (813) 248-1254

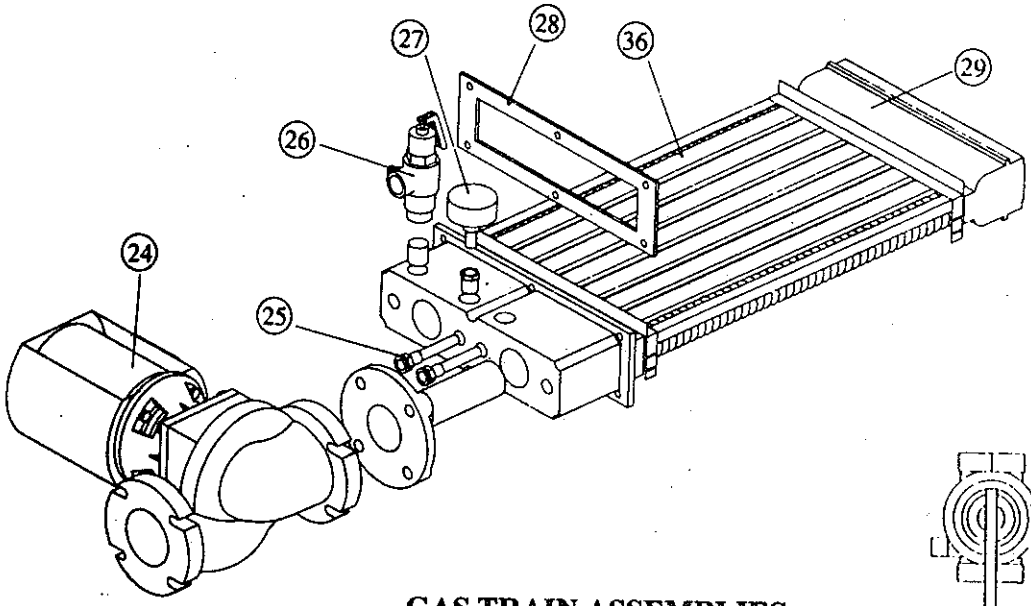
COPPER-FIN II®
BOILERS/WATER HEATERS/POOL HEATERS
CH/CF/CP 300-750



CONTROL PANEL

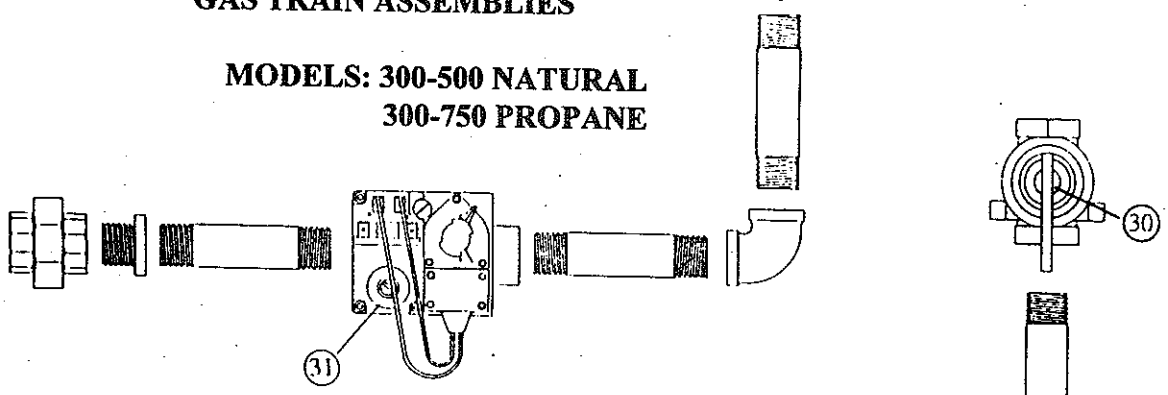


HEAT EXCHANGER ASSEMBLY

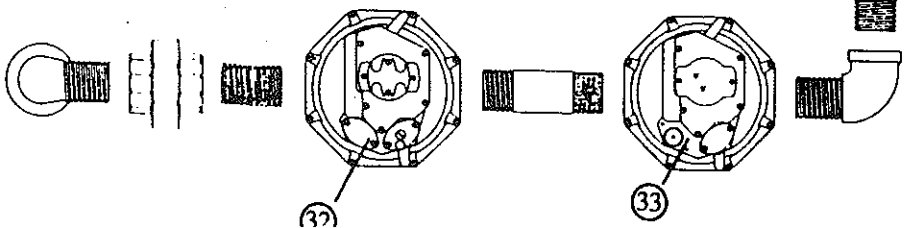


GAS TRAIN ASSEMBLIES

MODELS: 300-500 NATURAL
300-750 PROPANE



MODELS: 650 & 750 NATURAL



ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
GAS TRAIN ASSEMBLIES			
6	ORF2401	ORIFICE, NAT.	ALL
6	ORF2402	ORIFICE, LPG.	ALL

8

ALL:	BNR2400:	BNR3400:	BNR2401:
300NAT.	5ea.	1ea.	–
300LPG.	4ea	1ea.	1ea.
400NAT.	7ea.	1ea.	–
400LPG.	6ea.	1ea.	1ea.
500NAT.	9ea.	1ea.	–
500LPG.	8ea.	1ea.	1ea.
650NAT.	12ea.	1ea.	–
650LPG.	11ea.	1ea.	1ea.
750NAT.	14ea.	1ea.	–
750LPG.	13ea.	1ea.	1ea.

BNR2400 MAIN BURNER
BNR3400 MAIN BURNER W/PRESSURE TAP
BNR2401 MAIN BURNER LOCATED UNDER HOT SURFACE IGNITOR ON LPG. ONLY

9	MAN2400	BURNER MANIFOLD	300
9	MAN2401	BURNER MANIFOLD	400
9	MAN2402	BURNER MANIFOLD	500
9	MAN2403	BURNER MANIFOLD	650
9	MAN2404	BURNER MANIFOLD	750
30	GAC2028	GAS COCK ¾"	300
30	GAC2029	GAS COCK 1"	400 & 500
30	GAC2030	GAS COCK 1¼"	650 & 750
31	VAL2400	VALVE, GAS NAT.	300
31	VAL2915	VALVE, GAS NAT.	400 & 500
31	VAL2401	VALVE, GAS LPG.	300-500
31	VAL2916	VALVE, GAS LPG.	650 & 750
32	VAL2102	VALVE, GAS NAT.	650 & 750
33	VAL2108	VALVE, GAS NAT.	650 & 750

MSC-1095 - 5/8 BRUSH
MSC-1096 - 24" EXT. for BRUSH

CONTROLS & GAUGES			
2	PRS2401	SWITCH, LOW AIR PRESSURE	ALL
7	PLT3400	HOT SURFACE IGNITOR	ALL
14	TRF2004	TRANSFORMER 50VA	ALL
15	RLY3428	IGNITION MODULE	ALL
16	TST2407	THERMOSTAT, OPERATOR	ALL CF
16	TST2401	THERMOSTAT, OPERATOR	ALL CP
17	TST3911	THERMOSTAT, HI LIMIT	ALL CF & CH
17	TST3910	THERMOSTAT, HI LIMIT	ALL CP
18	TST2901	THERMOSTAT, OPERATOR	ALL CH
18	TST3910	THERMOSTAT, LIMIT	ALL CF
18	TST3921	THERMOSTAT, LIMIT	ALL CP
27	GTP2900	TEMPERATURE & PRESSURE GAUGE	ALL CH
27	GTP2002	TEMPERATURE GAUGE 2"	ALL CF & CP
34	MSC2910	TERMINAL STRIP, 2 POLE	ALL
35	MSC2420	TERMINAL STRIP, 6 POLE	ALL
--	PRS2406	SWITCH, POOL HEATER PRESSURE (NOT PICTURED)	ALL CP
HEAT EXCHANGERS			
29	HEX3400	HEAT EXCHANGER	300
29	HEX3401	HEAT EXCHANGER	400
29	HEX3402	HEAT EXCHANGER	500
29	HEX3403	HEAT EXCHANGER	650
29	HEX3404	HEAT EXCHANGER	750

NOTE: CH = BOILER, CF = WATER HEATER & CP = POOL HEATER

LWCO WTR2530 Manual, 2528 Auto Reset, WTR 2532 Probe only

ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
MISCELLANEOUS			
1	FAN2712	FAN	ALL
19	MSC2424	LIGHT, AMBER 28V	ALL
20	MSC2425	LIGHT, AMBER 125V	ALL
21	MSC2423	LIGHT, GREEN 28V	ALL
22	MSC2422	LIGHT, RED 28V	ALL
23	MSC2426	SWITCH, ROCKER	ALL
24	ARM3044PBF	PUMP	ALL CF
24	ARM3044PABTE	PUMP	ALL CP
25	TST2301	WELL, THERMOSTAT	ALL
26	RLV2006	RELIEF VALVE, TEMPERATURE & PRESSURE	CF/CP 300 & 400
26	RLV2007	RELIEF VALVE, TEMPERATURE & PRESSURE	CF/CP 500-750
26	RLV2001	RELIEF VALVE, PRESSURE ONLY	ALL CH
28	GKT2400	GASKET, HEAT SHIELD	ALL
36	JKD6083	V-BAFFLE	300
36	JKD6084	V-BAFFLE	400
36	JKD6085	V-BAFFLE	500
36	JKD6086	V-BAFFLE	650
36	JKD6087	V-BAFFLE	750
37	MSC3415	SIGHT GLASS, KIT	ALL
LOCH-HEAT® TILE			
3	FIB2421	LOCH-HEAT® TILE, REAR HEAD SIDE	ALL
4	FIB2405	LOCH-HEAT® TILE, FRONT DOOR	300
4	FIB2406	LOCH-HEAT® TILE, FRONT DOOR	400
4	FIB2407	LOCH-HEAT® TILE, FRONT DOOR	500
4	FIB2408	LOCH-HEAT® TILE, FRONT DOOR	650
4	FIB2409	LOCH-HEAT® TILE, FRONT DOOR	750
10	FIB2415	LOCH-HEAT® TILE, BOTTOM	300
10	FIB2416	LOCH-HEAT® TILE, BOTTOM	400
10	FIB2417	LOCH-HEAT® TILE, BOTTOM	500
10	FIB2418	LOCH-HEAT® TILE, BOTTOM	650
10	FIB2419	LOCH-HEAT® TILE, BOTTOM	750
11	FIB2420	LOCH-HEAT® TILE, FRONT HEAD SIDE	ALL
12	FIB2400	LOCH-HEAT® TILE, REAR	300
12	FIB2401	LOCH-HEAT® TILE, REAR	400
12	FIB2402	LOCH-HEAT® TILE, REAR	500
12	FIB2403	LOCH-HEAT® TILE, REAR	650
12	FIB2404	LOCH-HEAT® TILE, REAR	750
13	FIB2410	LOCH-HEAT® TILE, TOP	300
13	FIB2411	LOCH-HEAT® TILE, TOP	400
13	FIB2412	LOCH-HEAT® TILE, TOP	500
13	FIB2413	LOCH-HEAT® TILE, TOP	650
13	FIB2414	LOCH-HEAT® TILE, TOP	750
OPTIONAL			
–	TST2015	THERMOSTAT, HIGH LIMIT MANUAL RESET	–
–	PRS2402	CONTROL KIT (CK-50) [Horizontal Direct Air]	–
–	CFK3300	COMBUSTIBLE FLOOR KIT (NOT PICTURED)	300
–	CFK3301	COMBUSTIBLE FLOOR KIT (NOT PICTURED)	400
–	CFK3302	COMBUSTIBLE FLOOR KIT (NOT PICTURED)	500
–	CFK3303	COMBUSTIBLE FLOOR KIT (NOT PICTURED)	650
–	CFK3304	COMBUSTIBLE FLOOR KIT (NOT PICTURED)	750

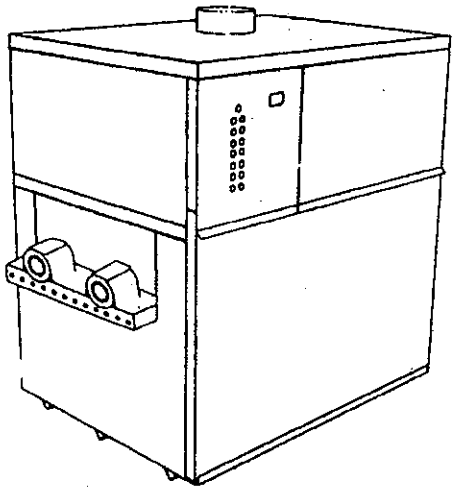
Lochinvar®
Nashville, Tennessee 37210
(615) 889-8900 ▼ FAX: (615) 885-4403

PARTS DEPOT

Detroit, Michigan 48170
(734) 454-4480 ▼ FAX: (734) 454-1790

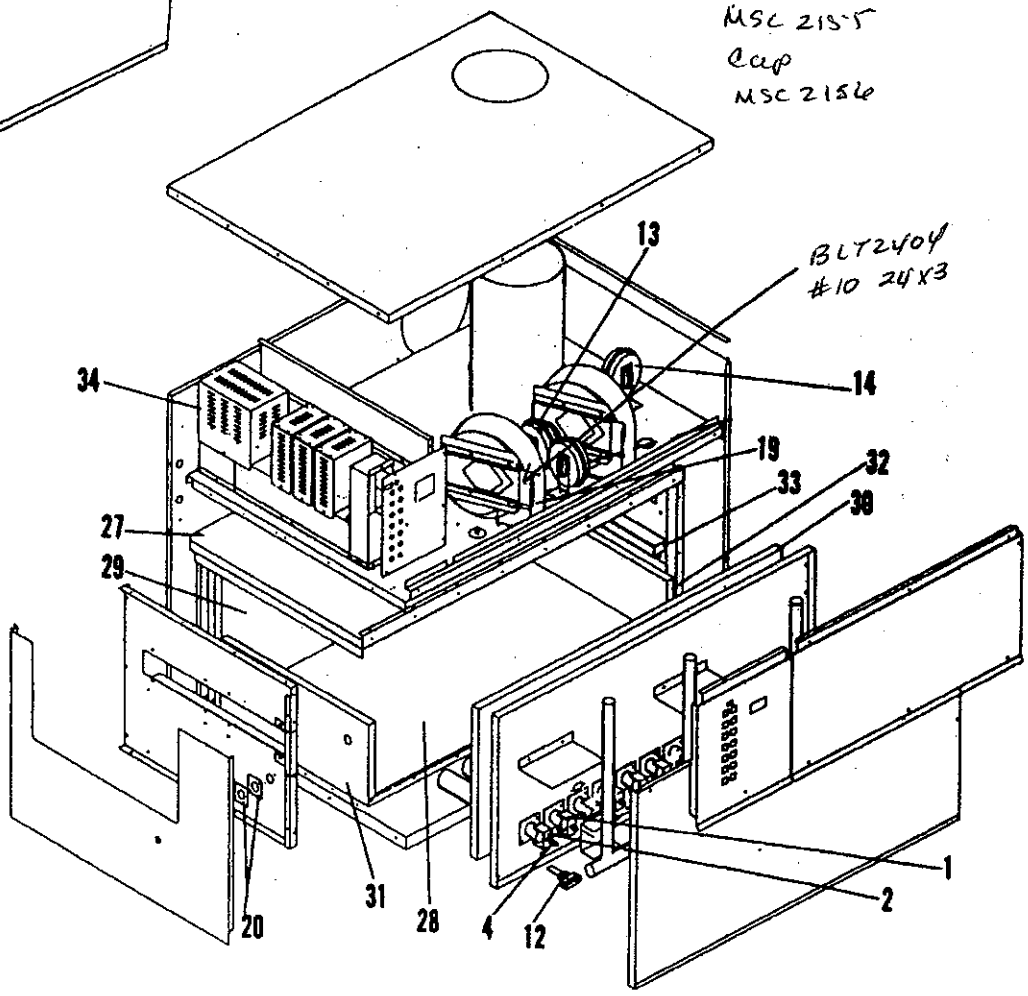
Replacement Parts List

Copper-Fin II®
Boilers — Water Heaters & Pool Heaters
CH—CF—CP — 990-2070
Beginning Serial Number: G936199 to Present



Air hose
3/4 MSC 2706
1/8 MSC 2406 Black
1/8 MSC 2461 clear

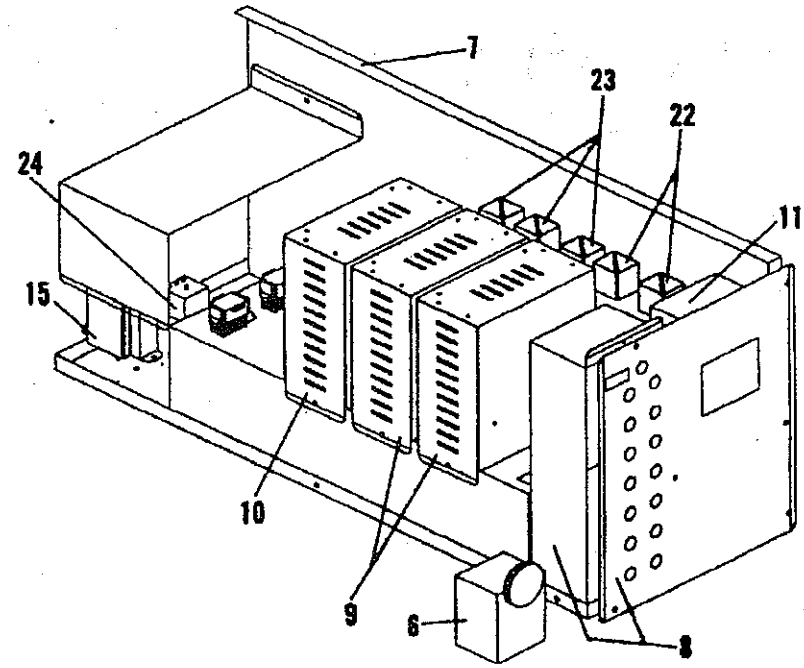
Black Tee
MSC 7700
white Tee
MSC 2155
cap
MSC 2156

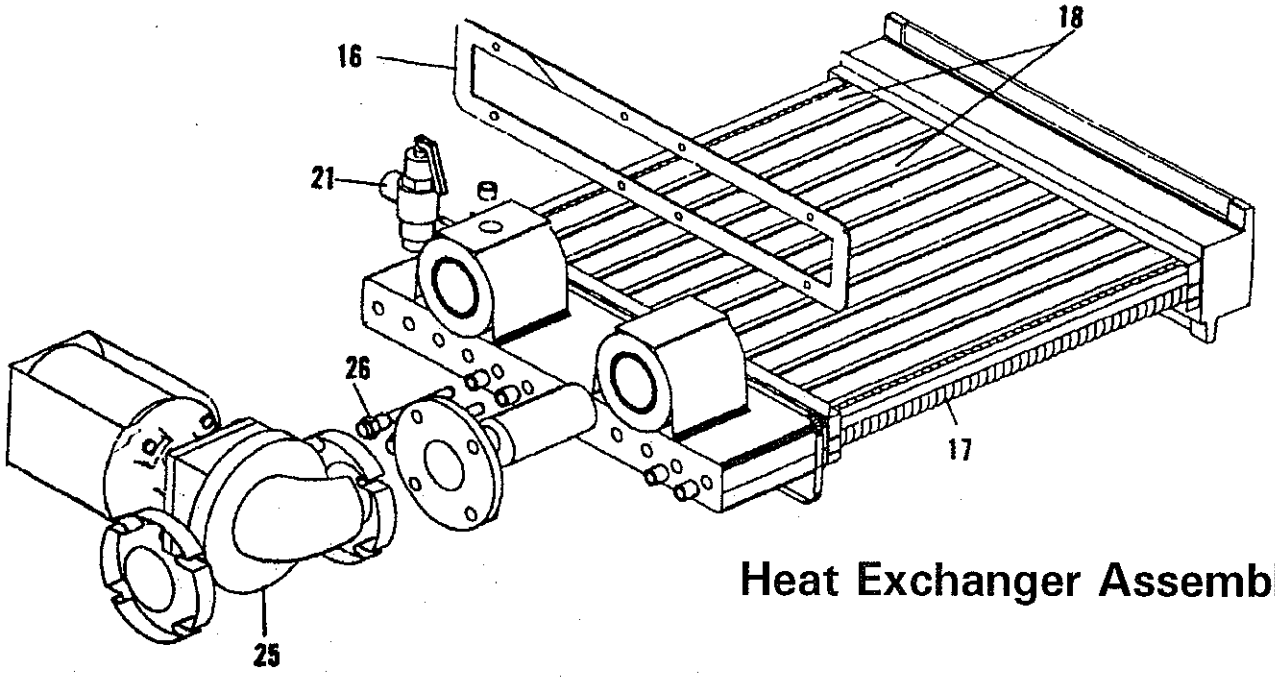


RPL7007 REV D.

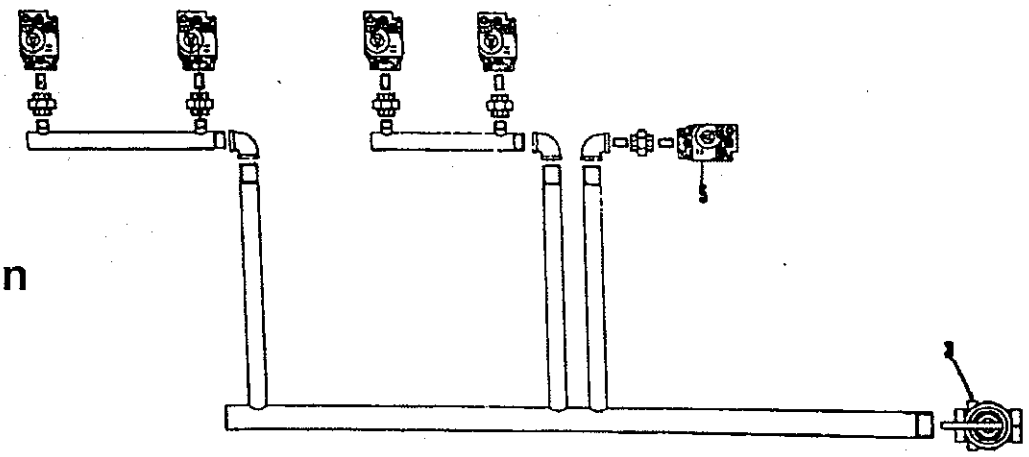
Control Panel

Grenor 2 Volt
2409





Heat Exchanger Assembly



Gas Train

ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
		Gas Train Assemblies	
1	BNR2404*	BURNER	ALL
2	BNR3501*	BURNER W/COMPRESSION FITTING	ALL
2	BNR3502*	BURNER W/ BARBED FITTING	ALL
4	ORF2404	ORIFICE, NAT.	ALL
4	ORF2405	ORIFICE, LPG.	ALL
5	VAL3403	VALVE, GAS NAT., W/nipples	ALL
5	VAL3404	VALVE, GAS LPG., W/nipples	ALL
		Controls & Gauges	
6	HLC2701	HIGH LIMIT	CF
6	HLC2702	HIGH LIMIT MANUAL RESET	CH
–	MSC2420	TERMINAL STRIP 6 POLE **(NOT PICTURED)**	ALL
–	MSC2447	CIRCUIT BREAKER 7 AMP. **(NOT PICTURED)**	ALL
7	PAN3000	CONTROL PANEL COMPLETE	ALL
8	PAN3001	LIGHT ASSEMBLY W/FRONT ESCUTCHEON	ALL
–	MSC2448	LIGHT, INDICATOR 120V.	ALL
–	MSC2449	LIGHT, INDICATOR 28V.	ALL
9	RLY3002	IGNITION MODULE	ALL
10	RLY3003	TIME DELAY MODULE	ALL
11	TST3004	ELECTRONIC THERMOSTAT CONTROL	ALL
11	TST3006	ELECTRONIC THERMOSTAT CONTROL, W/INDOOR/OUTDOOR SENSORS	OPTIONAL
–	WRE2416	SENSOR, TEMP w/brown wires	ALL
–	HLC2503	110° HI LIMIT (POOL PIPING)	CP
–	HLC2501	200° HI LIMIT (OUTLET SIDE) BEGINNING SERIAL # A980000	
12	PLT3400	HOT SURFACE IGNITOR	ALL
13	PRS2416	PRESSURE SWITCH, DUAL	ALL
14	PRS2417	PRESSURE SWITCH, LOW AIR .35 – 1.5	ALL
–	PRS2406	PRESSURE SWITCH, POOL HEATER **(NOT PICTURED)**	CP
15	TRF2701	TRANSFORMER 150V.A.	ALL
–	WTR2041	SWITCH, FLOW OUTDOOR **(NOT PICTURED)**	CF/CH
–	MSC2426	SWITCH, MAIN POWER	ALL
–	MSC2706	TUBING, EDPM 1/4" (ORDER BY THE FOOT)	ALL
–	MSC2461	TUBING, SILICONE (ORDER BY THE FOOT)	ALL
–	MSC2406	TUBING, EDPM 1/8" (ORDER BY THE FOOT)	ALL
		Heat Exchangers	
16	GKT2418	GASKET, HEAT SHIELD	ALL
17	HEX3420	HEAT EXCHANGER	990
17	HEX3421	HEAT EXCHANGER	1260
17	HEX3422	HEAT EXCHANGER	1440
17	HEX3423	HEAT EXCHANGER	1800
17	HEX3424	HEAT EXCHANGER	2070
18	JKE6078	V-BAFFLE	990
18	JKE6079	V-BAFFLE	1260
18	JKE6080	V-BAFFLE	1440
18	JKE6081	V-BAFFLE	1800
18	JKE6082	V-BAFFLE	2070
		Miscellaneous	
19	FAN2714	FAN ASSEMBLY	ALL
–	GTP2900	PRESSURE TEMPERATURE GAUGE	CH
20	MSC3415	SIGHT GLASS & GASKET	ALL
21	RLV2001	RELIEF VALVE, PRESSURE ONLY	CH
21	RLV2007	RELIEF VALVE, TEMPERATURE & PRESSURE	CF
22	RLY2425	RELAY 120 VOLT	ALL
23	RLY2424	RELAY 24 VOLT	ALL
24	RLY2706	RELAY, POWER	ALL
25	ARM3024PBF	PUMP	CF
25	ARM3024PABTE	PUMP	CP
26	TST2301	WELL, THERMOSTAT	ALL

"CONSULT FACTORY"

NOTE: *CH = BOILER, CF = WATER HEATER & CP = POOL HEATER*

ITEM NO.	PART NO.	DESCRIPTION	MODEL NO.
		Loch-Heat® Tile	
27	FIB2441	LOCH-HEAT® TILE, TOP RIGHT SIDE	990
27	FIB2442	LOCH-HEAT® TILE, TOP LEFT SIDE	990
27	FIB2443	LOCH-HEAT® TILE, TOP RIGHT SIDE	1260-1440
27	FIB2444	LOCH-HEAT® TILE, TOP LEFT SIDE	1260
27	FIB2445	LOCH-HEAT® TILE, TOP LEFT SIDE	1440
27	FIB2446	LOCH-HEAT® TILE, TOP RIGHT SIDE	1800-2070
27	FIB2447	LOCH-HEAT® TILE, TOP MIDDLE	1800-2070
27	FIB2448	LOCH-HEAT® TILE, TOP LEFT SIDE	1800
27	FIB2449	LOCH-HEAT® TILE, TOP LEFT SIDE	2070
28	FIB2471	LOCH-HEAT® TILE, BOTTOM	990
28	FIB2450	LOCH-HEAT® TILE, BOTTOM RIGHT	1440-2070
28	FIB2451	LOCH-HEAT® TILE, BOTTOM	1260
28	FIB2452	LOCH-HEAT® TILE, BOTTOM LEFT	1440
28	FIB2453	LOCH-HEAT® TILE, BOTTOM LEFT	1800
28	FIB2454	LOCH-HEAT® TILE, BOTTOM LEFT	2070
29	FIB2472	LOCH-HEAT® TILE, BACK	990
29	FIB2455	LOCH-HEAT® TILE, BACK RIGHT	1440-2070
29	FIB2456	LOCH-HEAT® TILE, BACK	1260
29	FIB2457	LOCH-HEAT® TILE, BACK LEFT	1440
29	FIB2458	LOCH-HEAT® TILE, BACK LEFT	1800
29	FIB2459	LOCH-HEAT® TILE, BACK LEFT	2070
30	FIB2460	LOCH-HEAT® TILE, FRONT DOOR	990
30	FIB2461	LOCH-HEAT® TILE, FRONT DOOR	1260
30	FIB2462	LOCH-HEAT® TILE, FRONT DOOR RIGHT	1440
30	FIB2469	LOCH-HEAT® TILE, FRONT DOOR LEFT	1440
30	FIB2463	LOCH-HEAT® TILE, FRONT DOOR RIGHT	1800
30	FIB2470	LOCH-HEAT® TILE, FRONT DOOR LEFT	1800
30	FIB2464	LOCH-HEAT® TILE, FRONT DOOR RIGHT	2070
30	FIB2465	LOCH-HEAT® TILE, FRONT DOOR LEFT	2070
31	FIB2466	LOCH-HEAT® TILE, FRONT HEAD SIDE	ALL
32	FIB2467	LOCH-HEAT® TILE, REAR HEAD SIDE	ALL
33	FIB2468	LOCH-HEAT® TILE, REAR HEAD SPACER STRIP	ALL
		Optional	
3	GAC2031	GAS COCK	990 & 1260
3	GAC2032	GAS COCK	1440-2070
34	PAN3401	OPTION BOX A: LOUVER RELAYW/PUMP DELAY (LVRW/P. DELAY)	ALL
34	PAN3402	OPTION BOX B: MR-LWCO, LVRW/P. DELAY	ALL
34	PAN3403	OPTION BOX C: MR-LWCO, LVRW/P. DELAY, ALM. ANY FAILURE	ALL
–	FAN2013	PROVING SWITCH FOR HS5	ALL

PLEASE: *Have model number and serial number when ordering parts*

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