



PRECISION BOILERS

**Installation and
Operating Instructions**

**FIRETUBE WATER
BOILERS AND HEATERS**

Models FPH&FPW

With

Power Burner

FOR YOUR SAFETY

This product must be installed and serviced by a professional service technician or gas/oil supplier, qualified in boiler/water heater installation. Improper installation and/or operation could cause serious injury or death. Improper installation and/or operation will void the warranty. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. **Read this manual thoroughly and follow the instructions herein.** For assistance or additional information, consult a qualified installer, service agency or the gas/oil supplier.



■ IMPORTANT ■

These instructions are intended as a guide for the installing contractor as a reference for the operator, owner and serviceman.

RETAIN THESE INSTRUCTIONS NEAR THE EQUIPMENT FOR READY REFERENCE

This unit must be installed in accordance with the installation regulations in force in the local area where the installation is to be made. Local regulations shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installation is made.

PRECISION has made a commitment to product improvement and follows a continuing quest for the highest standards of product performance. In pursuing this policy of continuous development of products, the manufacturer reserves the right to vary any details in this manual without notice.

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1.0 GENERAL INFORMATION

WARNING

Model FPH Boilers and FPW / FPWX Storage Water Heaters shall be installed according to the procedures detailed in this manual, or the PRECISION Limited Warranty may be voided. The installation must conform to the requirements of the local jurisdiction having authority, and to the latest edition of the National Fuel Gas Code, **ANSI Z223.1**. Any modifications to the boiler/heater or its gas/oil controls may void the warranty. If field installation requires modifications, consult the local PRECISION Representative or the Factory.

1.1 INTRODUCTION

This manual supplies information on the application, installation and operation of model FPH Boilers and FPW / FPWX Storage Water Heaters. Review all applications and installation procedures completely before proceeding with the installation. Consult the PRECISION Factory, or local Factory Representative with any problems or questions regarding this equipment. Experience has shown that improper installation causes most operation problems. The FPH, FPW and FPWX models are offered in the basic configuration shown in Figure 1 and Table 1.

1.2 WARRANTY

PRECISION Firetube Water Boilers and Heaters are covered by a limited warranty. **A copy of the warranty will be provided after all documents have been processed.** Make all warranty claims to an authorized PRECISION representative or directly to the Factory. Claims must include the unit serial number and model year (per the name plate), installation date, and the name of installer. **Shipping and labor costs are not included in the warranty coverage.**

1.3 RECEIVING SHIPMENT

Some accessory items may be shipped in separate packages. Verify the receipt of all packages listed on the packing slip. Inspect everything for damage immediately upon delivery, and advise the carrier of any shortages or damage. File any such claims with the carrier. The carrier, not the shipper, is responsible for shortages and damage to the shipment, whether visible or concealed.

1.4 ENGINEERING ASSISTANCE

Consult the Representative or Factory regarding any questions or problems which may come up involving the specification, installation or operation of PRECISION equipment. An experienced engineering staff is ready to assist in assuring their proper application and performance.

1.5 PHYSICAL DATA

FIGURE 1

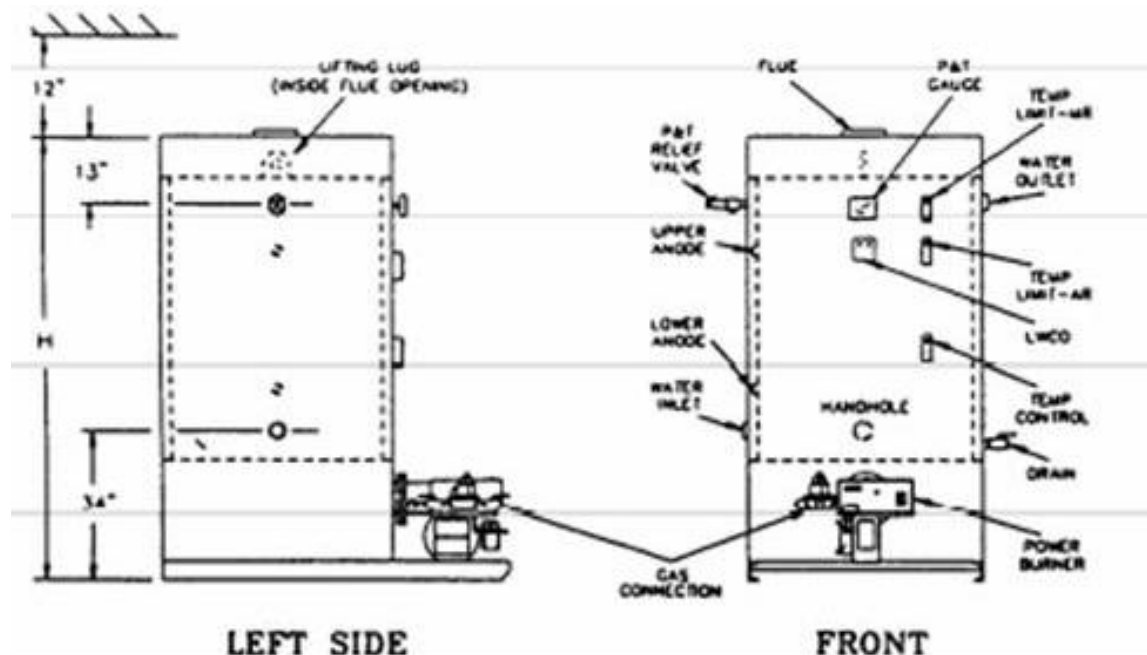


TABLE 1		PRECISION MODEL FPW & FPWX WATER HEATERS												
MODEL NUMBER	VESSEL DIMS		NOMINAL GALLONS	DIMENSIONS (IN)			CONNECTIONS (NPT)		MAX BURNER INPUT (MBTU)			WEIGHTS (LBS)		
	DIA	HEIGHT		W	L	H	IN/OUT	DRAIN	LOW*	MEDIU M*	HIGH*	SHIP	OPER	
FPW-24-0075	24	39	75	28	50	75	1-1/4"	1"	130	180	210	910	1430	
FPW-24-0100	24	51	100	28	50	87	1-1/4"	1"	150	230	280	1040	1740	
FPW-31-0120	31	36	120	35	57	72	1-1/4"	1"	200	250	340	1260	2100	
FPW-31-0160	31	48	160	35	57	84	1-1/4"	1"	240	310	450	1360	2480	
FPW-31-0200	31	60	200	35	57	96	1-1/4"	1"	290	380	560	1540	2930	
FPW-39-0210	39	42	210	43	65	78	1-1/2"	1"	510	700	780	1770	3230	
FPW-39-0240	39	60	300	43	65	84	1-1/2"	1"	570	790	900	1910	3580	
FPW-39-0300	39	60	300	43	65	96	1-1/2"	1"	690	970	1120	2190	4280	
FPW-39-0360	39	72	360	43	65	108	1-1/2"	1"	810	1140	1180	2470	4980	
FPW-46-0350	46	48	350	50	72	84	2"	1-1/2"	800	970	1380	2260	4700	
FPW-46-0425	46	60	425	50	72	96	2"	1-1/2"	970	1190	1540	2600	5560	
FPW-46-0500	46	72	500	50	72	108	2"	1-1/2"	1130	1400	1570	2940	6430	
FPW-58-0550	58	48	550	62	84	84	2"	1-1/2"	1200	1500	2280	2970	6800	
FPW-58-0675	58	60	675	62	84	96	2"	1-1/2"	1460	1830	2850	3430	8140	
FPW-58-0800	58	72	800	62	84	108	2"	1-1/2"	1710	2150	2910	3880	9460	
FPW-62-0750	62	60	760	66	88	96	3"	1-1/2"	1950	2360	3220	3880	9110	
FPW-62-0900	62	72	900	66	88	108	3"	1-1/2"	2290	2790	3470	4410	10680	
FPW-62-1000	62	78	1000	66	88	114	3"	1-1/2"	2520	3000	3400	4680	11850	
FPW-69-0950	69	60	950	73	95	96	3"	1-1/2"	2380	2930	3590	4460	11080	
FPW-69-1150	69	72	1150	73	95	108	3"	1-1/2"	2800	3460	4310	5080	13100	
FPW-69-1250	69	78	1250	73	95	114	3"	1-1/2"	3010	3730	4430	5400	14120	
FPW-76-1200	76	60	1200	81	103	96	3"	1-1/2"	2960	3600	4150	5090	13460	
FPW-76-1400	76	72	1400	81	103	108	3"	1-1/2"	3480	4260	4930	5810	15570	
FPW-76-1500	76	78	1500	81	103	114	3"	1-1/2"	3740	4580	4910	6170	16630	

FIGURE 1

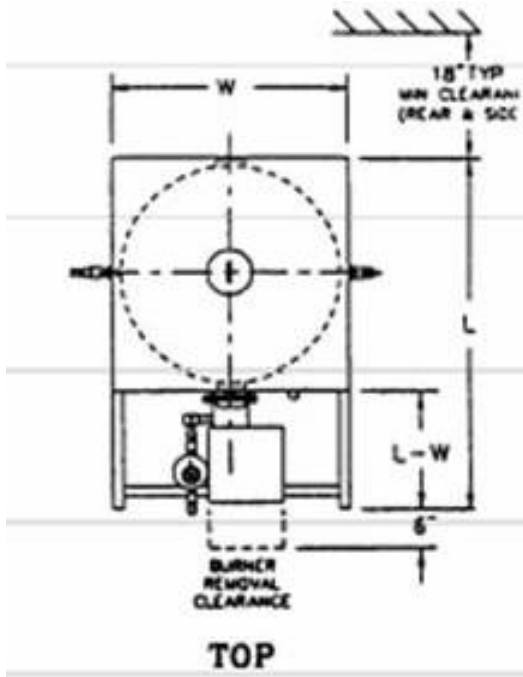


TABLE 2				PRECISION MODEL FPW HOT WATER BOILERS												
MODEL NUMBER	NOM BOILER	RATED INPUT	NOM OUTPUT	VESSEL DIMS		WATER	DIMENSIONS (IN)			CONNECTIONS (NPT)				BURNER BLOWER	WEIGHTS (LBS)	
	HP	MBTU	MBTU	DIA	HEIGHT	(GAL)	W	L	H	SUPPLY RETURN	DRAIN	GAS SUPPLY*	FLUE SIZE	HP (GAS)	SHIP	OPER
FPH-24-09	9.5	400	330	24	45	72	28	50	81	3"	1"	3/4"	6"	1/4	1950	2550
FPH-24-10	10	420	340	24	48	77	28	50	86	3"	1"	3/4"	6"	1/4	2030	2670
FPH-31-15	15	630	520	31	45	119	35	57	81	3"	1"	1"	6"	1/4	2550	3540
FPH-31-20	20	840	690	31	48	122	35	57	86	3"	1"	1"	8"	1/3	2820	3830
FPH-39-25	25	1050	860	39	45	185	43	65	81	3"	1"	1-1/4"	8"	1/3	3350	4880
FPH-39-30	30	1260	1030	39	48	192	43	65	84	3"	1"	1-1/4"	10"	1/3	3625	5220
FPH-39-35	35	1470	1210	39	54	217	43	65	92	3"	1"	1-1/2"	10"	1/3	3975	5780
FPH-46-40	40	1674	1370	46	48	283	50	76	84	3"	1-1/4"	1-1/2"	12"	1/3	4400	6750
FPH-46-45	45	1870	1530	46	54	320	50	76	92	3"	1-1/4"	1-1/2"	12"	1/3	4750	7400
FPH-58-50	50	2110	1730	58	48	383	62	88	84	4"	1-1/2"	1-1/2"	12"	1/3	5400	8580
FPH-58-60	60	2500	2050	58	54	421	62	98	92	4"	1-1/2"	2"	14"	1	6050	9550
FPH-58-72	72	3000	2460	58	60	454	62	98	98	4"	1-1/2"	2"	14"	1	6850	10420
FPH-62-84	84	3500	2870	62	60	512	66	106	98	4"	1-1/2"	2"	16"	1-1/2	7450	11700
FPH-62-100	100	4200	3440	62	60	464	66	106	116	4"	1-1/2"	2-1/2"	16"	1-1/2	8550	12400

2.0 INSTALLATION

2.1 RECEIVING

2.1.1 Storage

Electrical equipment can be damaged if exposed to adverse weather. **The unit should be stored inside.** The electrical panel and controls must be covered with plastic throughout all construction to avoid accumulation of dust and moisture on the controls and other components.

2.1.2 Uncrating

Care must be taken not to damage controls or to deform the unit's casing during removal of the crate. When using pry bars or fork lifts, be certain to support the unit on the shipping skids or the channel base.

2.2 PLACEMENT

2.2.1 Provide a **firm, level** foundation for the unit. Standard fired units are not suitable for placement on combustible flooring.

2.2.2 Leave a permanent space of 18 inches on the sides and rear, and 24 inches on the front for burner maintenance.

2.2.3 Be sure to keep the burner and controls covered at all times while work is in progress.

CAUTION: DO NOT USE THE UNIT'S HOUSING TOP FOR SCAFFOLDING!!!

2.3 PIPING CONNECTIONS

CAUTION: Pipe extensions outside the boiler are usually the extensions of pipes which are permanently welded into the boiler vessel. Normally the only removable (threaded) connection

is the boiler drain pipe. DO NOT ATTEMPT TO REMOVE ANY OTHER PIPING WITH A PIPE WRENCH.

NOTE: Refer to applicable Dimensional Drawing (**DD**) appended to this manual.

2.3.1 Boiler/heater piping connections and valves MUST comply with state and local codes, in addition to compliance with AMSE piping requirements.

2.3.2 Install the safety relief valve(s) on the connection(s) provided. Plumb the relief valve outlet(s) full size to the floor drain. When two or more valves are used, drain lines may be manifolded provided unions are included for valved removal and the common discharge pipe size must be greater or equal in area to the total of all relief valve outlets. Check local codes for proper safety relief valve discharge piping. Some jurisdictions may require cooling of relief valve discharge prior to its entering city sewer.

2.3.3 Connect return (makeup) and supply lines to the inlet and outlet tapplings, respectively, as shown on the DD. For water heaters, a check valve in the cold water inlet line may cause discharge of the relief valve due to thermal expansion of the water. This may be prevented by installing an expansion tank or by providing a relief valve on the makeup line set at a lower pressure than the heater relief valve.

2.3.4 Hot water boilers may be equipped with an air vent pipe on the top of the boiler. Plumb this connection to the expansion tank, or install an automatic air vent on this pipe.

2.3.5 Pipe the boiler/heater drain to a nearby open drain.

2.4 ELECTRICAL CONNECTIONS

CAUTION: The boiler/heater must be electrically grounded in accordance with the most recent edition of the National Electrical Code, ANSI/NFPA 70. Do not rely on the gas or water piping to ground the metal parts of the boiler. The use of plastic pipe or dielectric unions may isolate the boiler electrically. Service and maintenance personnel standing on wet floors could be severely shocked by an ungrounded boiler/heater.

2.4.1 Check the boiler Wiring Diagram (WD) for correct voltage, frequency, phase and amperage of the required branch circuit. The branch circuit must be protected by a properly sized circuit breaker or fused safety switch.

2.4.2 Electrically ground the unit per NEC and local code requirements using AWG #10 CU wire minimum.

2.4.3 All field installed electrical safety devices and controls (draft switches, relays, timers, outdoor temperature reset devices, etc.) must be connected as shown in the wiring diagram to the terminal block designated.

2.5 FUEL CONNECTIONS

NOTE: Also refer to the burner literature supplied as an appendix to this manual.

2.5.1 Gas

NOTE: Contact your local gas service company to assure the adequate gas service is available and to review applicable installation codes for your area. The gas line pressure should be in the range of 5-14 inches WC except when specified differently on burner documentation.

2.5.1.1 Size the main gas line in accordance with Table 2. The figures shown are for straight lengths of pipe at 0.2 inches WC pressure drop, which is considered normal for low pressure systems. Note that fittings such as elbows and tees will add to the pipe pressure drop.

2.5.1.2 Refer to Figure 2 for details of gas piping. Mount any items of the gas train shipped loose as shown. Install the main gas cock with drip leg upstream of the regulator and automatic valves. The pilot line should be piped into the upstream tapping on the main shut-off gas cock.

NOTE: For ease of servicing, we recommend the use of a union immediately upstream of the main gas pressure regulator or combination gas valve/pressure regulator.

2.5.1.3 Install separate vent line from main gas regulator (if used) and (if applicable) a diaphragm gas valve, normally open vent valve and diagram casings of controls. Vent lines should be run to the outside of the building, terminating clear of windows or fresh air intakes. Where more than one device is vented through a single vent pipe, the vent pipe cross sectional area must be greater than the sum of individual vent line cross sectional areas. The outside terminal of the vent should have a screen to prevent insects from building nests in the vent pipe. The vent should terminate in a manner which will preclude the possibility of water, dirt or other matter from entering the line.

2.5.1.4 Test all gas lines for leaks using soap solution. Your local gas service company may wish to carry out or witness this test.

CAUTION: Gas pressure above 14 inches. WC may damage the standard diaphragm gas shut-off valve. Do not exceed this value when pressure testing lines unless you cap off the line upstream of the main gas cock and pilot take-off.

2.5.2 Oil

CAUTION: Most oil burners supplied on model FPH, FPW and FPWX units are designed for use with light grade fuel oils – commercial standard grades #1 or #2.

2.5.2.1 Prior to installation, it is recommended that all national, local and other applicable codes be reviewed to ensure total compliance.

NOTE: A two pipe (separate suction and return line) system must always be used. The fuel pump is pre-set at the Factory for use only with a two pipe (separate suction and return line) system. The pump warranty will be voided if a one pipe system is used with this burner. Rigid pipe connected directly to the pump may cause excessive vibration. It is recommended that the connection to the pump be of copper tubing, complete with vibration dampening loop, on both suction and return lines. Do not use Teflon tape. The pump warranty will be voided if Teflon tape is used.

2.5.2 Size the oil supply and return lines in accordance with the guidelines provided in the fuel pump instructions appended to this manual. It is very important to properly size the oil suction line and oil filter, to provide fuel flow to the burner without exceeding 10" suction pressure (vacuum) at the oil pump suction port. Use copper tubing with flare fittings or iron pipe on all installations. Use 1/2" OD oil lines when ever possible. All units must utilize the proper size and type of suction line oil filters.

2.5.3 Refer to Figure 3 for details of oil piping. All field piped components must be mounted in the proper order as shown with the proper direction of oil flow.

CAUTION: Oil supply pressure to the burner oil pump must not exceed 3 psi per NFPA Codes.

NOTE: Do not install manual valves in the return line between the pump and the tank unless required by a specific code. If a manual valve is required, an automatic relief valve must be installed across the manual valve to ensure that oil will bypass directly back to ensure that oil will bypass directly back to the tank in the event that manual valve is inadvertently left in the closed position.

2.5.4 Before starting up the system, all appropriate air and oil leak tests should be performed. Make certain that the tank atmospheric vent line is unobstructed.

2.6 FLUE

CAUTION: Jurisdictional authorities relating to venting/flue requirements vary widely. In order to make certain of compliance, the controlling authorities should be consulted.

2.6.1 Breeching material should be designed and specified by a qualified professional familiar with such applications. The pressure at the flue outlet of the apparatus shall be neutral with a tolerance of +/- .05" WC.

2.6.2 A full size barometric damper should be installed in the breeching to regulate the drafts. After startup, check the damper and breeching by holding a match near the edge of the damper. A correct installation will pull the flame with the burner running.

2.7 COMBUSTION AIR

2.7.1 Provide fresh air to support combustion, and to supply the location with adequate ventilation.

NOTE: All fuel requires approximately 10 cubic feet of standard air (sea level at 60°F) per 1000 BTU's firing rate, for theoretically perfect combustion. In actual practice, a certain amount of excess air is required to ensure complete combustion, but this can vary substantially with the specific job conditions. Additional air is lost from the boiler room through barometric dampers, draft diverters and similar venting devices. It is generally accepted that 1/2 square inch of free air opening (for each gas or oil burner will be adequate.

2.7.2 After startup, test to assure a positive boiler room pressure with the boiler/heater operating at 100% input.

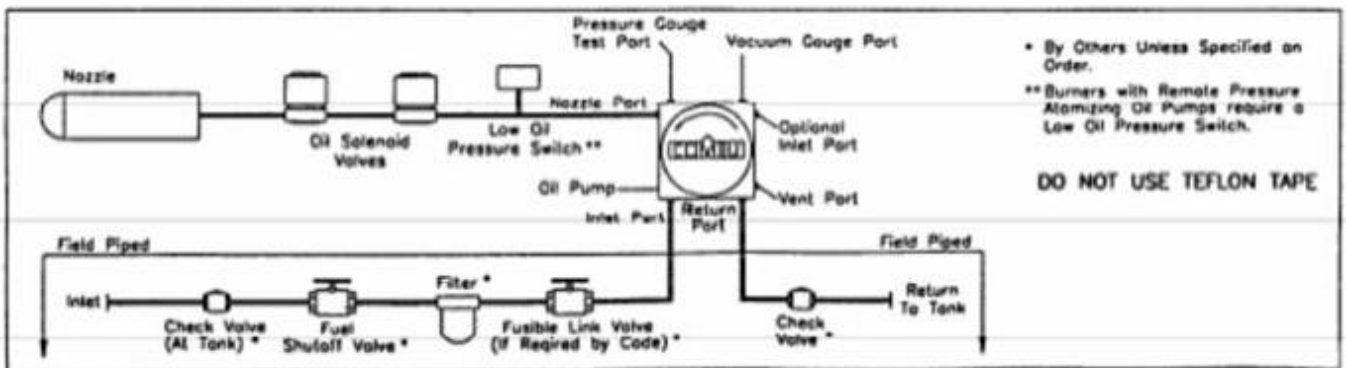
CAUTION: Under no circumstances should a boiler room be under negative pressure. If combustion air is ducted to the burner, make sure the duct size is adequate to assure proper burner operation.

2.8 Fuel Connection Reference

Table 3		Gas Piping Pressure Drop Data								
EQUIVALENT LENGTH OF STRAIGHT PIPE (In Feet)		20	30	40	50	60	80	100	150	200
Pipe Size in Inches		CFH GAS WITH A .2" PRESSURE DROP								
		300	250	210	190	180	150	135	110	75
1 1/4"		520	425	360	325	300	260	230	190	165
1 1/2"		800	690	560	500	480	410	370	300	260
2"		1700	1400	1200	1100	1000	850	750	600	540
2 1/2"		3000	2500	2100	1900	1800	1550	1375	1100	950
EQUIVALENT LENGTHS OF STANDARD PIPE IN FEET FOR LISTED FITTINGS										
Fitting Type		1	1 1/4	1 1/2	2	2 1/2	Nominal Pipe Size in Inches			
Std. Tee		5.5	7.5	9.0	12.0	13.5				
Std. Elbow		2.7	3.7	4.5	5.5	6.1				

FIGURE 3

Typical 2-Line Oil Supply Piping



3.0 STARTUP

3.1 PRE-STARTUP CHECKS

3.1.1 Plumbing Connections

- *Are they complete and correct?*

3.1.2 Pumps

- *Are the pumps functional?*
- *Is the direction of flow and motor rotation correct?*

3.1.3 Electrical

- *Is the branch circuit power supply as required per the burner name plate?*
- *Is the unit properly grounded?*

3.1.4 Combustion Air

- *Is fresh combustion air available?*
- *Is the breeching / stack open and unobstructed?*

3.1.5 Fuel

Gas

- *Is the gas supply available?*

Oil

- *Is there adequate amount of oil in the tank?*
- *Is the oil the proper grade?*

3.2 FILLING THE SYSTEM

3.2.1 The system and the boiler / heater should be thoroughly flushed before the final fill.

3.2.2 Before firing the unit, be sure the water system is full and the water is free to flow through the heater; relieve all air from the system before attempting to operate. If circulating pump is installed on the heater, the pump should be in operation before the heater is fired.

NOTE: For FPH (boiler) it is recommended that a flow switch, or pump interlock, be placed in the inlet piping of the unit and wired into the control wiring so the burner will be shut off if an adequate amount of water is not flowing through the heater.

3.3 CONTROL SETTINGS

3.3.1 Controller

This is the temperature sensing device which controls the operation of the burner. Set the controller for the desired outlet water temperature. FPW / FPWX Storage Water heaters are equipped with two controllers to allow temperature control under "hi demand" conditions.

NOTE: Water boilers should have no less than 135°F returning water temperature. Set controller high enough to accomplish this to prevent condensing.

3.3.2 High Limits

Set the high limit auto reset control 10°F above the setting of the controller. Manual reset limits should be set approximately 10°F above the auto reset limit, but should not be set higher than 180°F for heaters, 240°F for boilers.

3.3.3 Low Water Cut-off

This limit is always Factory set. If additional units are field installed, manual reset LWCO's should be positioned below the automatic reset limit.

3.4 BURNER

WARNING: Read the burner O & M manual (appended to this manual) thoroughly before attempting to start the burner. Failure to properly follow the detailed startup instructions may result in an explosion, which could cause property damage, injury, or loss of life.

3.4.1 Preparation of Start-Up – All Fuels

3.4.1.1 With power turned "OFF", inspect the tightness of all electrical connections and retighten as necessary. This tightness inspection is vital because vibration during shipment can often loosen electrical connections.

3.4.1.2 Set the burner control panel switch to the "OFF" position and turn power "ON" at the main disconnect.

3.4.1.3 Turn the operating control down to its lowest setting.

3.4.1.4 Check fuses and replace as necessary.

3.4.1.5 Depress the flame safeguard programming control reset button.

3.4.2. Start Up

3.4.2.1 Gas Burner

3.4.2.1.1 Manually open and close the main gas shut off cock, leak test cock, and pilot to determine that they operate freely. Open all three cocks, (Reset high and low gas pressure switches if supplied.)

CAUTION: Oil must circulate through the oil pump, even when firing gas. If oil is not available, remove oil pump coupling so that oil pump is not driven during gas firing operation.

3.4.2.1.2 When burning gas on a Combination Gas / Oil unit that has a blower motor driven oil pump, open all oil line valves.

3.4.2.1.3 Set the main power switch and burner panel control switch to the "ON" position. Wait 30 seconds and turn up the operating control to the desired setting.

3.4.2.1.4 The burner blower motor will start, and after a suitable prepurge period (this will vary with the type of flame safeguard control supplied, but will usually be a minimum of 30 seconds to a maximum of 90 seconds), the burner pilot will light, after which the main flame will be established.

3.4.2.2 Oil Burner

3.4.2.2.1 Open all valves in oil lines.

3.4.2.2.2 If pilot gas ignition system is supplied, open and close the pilot gas cock to determine that it is operating freely. Open the pilot gas cock.

3.4.2.2.3 Set the main power switch and burner panel control switch to the "ON" position. Wait 30 seconds, and turn up the operating control to the desired setting.

3.4.2.2.4 The burner blower motor will start. Depending upon the type of flame safeguard system supplied, the fuel ignition system may energize within 1 or 2 seconds after the blower motor starts, or it could be as long as 90 seconds.

NOTE: For more detailed burner startup information, refer to the burner literature supplied as an appendix to this manual.

4.0 OPERATION AND MAINTENANCE

4.1 OPERATION

4.1.1 When the operating controller calls for heat, the burner blower motor will start, and after a suitable prepurge period (30-90 seconds approximately), the burner pilot will light. (The unit performs its own safety check and opens the main valve only after the pilot is proven to be lighted.) The main flame is then established.

4.1.2 The Operating Controller will stop the burner when the desired service water temperature is reached. The temperature sensing bulb is located in the lower portion of the tank. This automatic reset temperature control is supplied standard on all units. The temperature sensing bulb for this control is located in the upper portion of the tank.

4.1.3 On the FPW Water Heaters, an additional automatic reset temperature control is provided in the lower portion of the tank to give more precise control under no-flow conditions.

4.1.4 A manual reset low water cutoff is also provided as standard equipment on all units. The low water cut off automatically shuts off the burner whenever the water level drops below the Factory set level in the upper part of the tank.

NOTE: Warranty does not cover any damage caused by lack of required maintenance or improper operating practices.

4.2 MAINTENANCE

4.2.1. At startup and at least every six months thereafter, the pilot and main burner flame should be observed for proper performance. (Refer to Burner literature supplied with this Manual for information.)

4.2.2. Inspect the venting system for obstruction, leakage and corrosion at least once per year.

4.2.3. Keep boiler / heater area clean and free from combustible material, gasoline and other flammable vapors and liquids.

4.2.4. Be certain all combustion air and ventilation openings are unobstructed.

4.2.5. The boiler / heater should be blown down monthly via the drain valves, to remove sediment.

4.2.6. The basic gas and electric controls installed on these boilers / heaters should be checked by a component service person every year and replaced as necessary. These basic controls are:

- a. Operating Control
- b. Pilot Safety System
- c. Automatic Electric Gas Valve(s)
- d. Limit Controls

4.2.7. Low water cutoffs should be inspected every six months, including cleaning probes and flushing floats.

4.2.8. Inspect tank interior annually. Check the condition of the lining and magnesium anodes. Replace anode(s) if necessary. Flush sediment on bottom tube sheet to drain.

CAUTION: Magnesium anodes provide corrosion protection for the tank in the event of lining perforation. Anodes must have adequate magnesium to last through the next inspection.

4.2.9. Firebox inspections can be made by removing the burner. If repairs are required, the entire firebox can be withdrawn from the beneath the storage vessel by the use of the (3) jacking eyes attached to the vessel lower flange.

4.2.10. Should sooting occur in the fire tubes, remove the collector at the top of the heater, remove turbulators and use a wire brush to clean each tube. Clean all soot from turbulators and re-install before placing the water heater back into service, the burner should be removed, internals of combustion head cleaned.

4.3 Boiler Maintenance Requirements

4.3.1 General Maintenance

A well-planned maintenance program avoids unnecessary down time or costly repairs. It is recommended that boiler room log or record be maintained, recording daily, weekly, monthly, and yearly maintenance activities.

Good housekeeping helps to maintain a professional boiler room appearance. Only trained and authorized personnel should be permitted to operate, adjust, or repair the boiler and its related equipment. The boiler room should be kept free of all material and equipment not necessary for operation for the boiler.

Alertness in recognizing unusual noises, improper gauge readings, leaks, signs of overheating, etc., can make the operator aware of developing malfunction and initiate prompt corrective action that may prevent excessive repairs or unexpected down time. All piping connections to the system and its accessories must be maintained leak-proof because even a minor leak, if neglected, may soon become serious. This applies especially to the water gauge glass, water level control, piping, valve packing, and manway gaskets. If serious leaks occur shut down the boiler immediately and gradually reduce steam pressure. Do not attempt to make repairs while the boiler is under pressure.

Daily Shift Maintenance

Shift maintenance should include checking the boiler water level in the gauge glass and the boiler steam pressure on the gauge. Operate the intermittent blowdown valve, with boiler at low pressure (20 – 50 psi) to remove any accumulated solids in the mud drum, 4 minute bottom blowdown before every shutdown and prior to the start of every 8 hour shift. The valves on the water column and gauge glass should be operated to make sure these connections are clear. Monitor water chemistry to adjust the chemical feed treatment and continuous blowdown as required, to remain within water treatment guidelines established by the Owner's water treatment consultant. Electrical cabinet external ambient temperatures not to exceed 110 deg F. Inspect electrical cabinet cooling fan filters and clean when dirty.

Monthly Maintenance

Check the condition of the refractory for significant damage or cracking. Patch and repair the refractory as required. Frequent wash coating of refractory surfaces is recommended. Use high temperature air-dry mortar diluted with water, per manufacturers instruction, for this purpose. This will seal small cracks and prolong the life of the refractory. Any large cracks should be cleaned out and filled with mortar.

Follow the recommendations of you authorized inspector pertaining to safety valve inspection and testing. The frequency of testing, either by the use of the lifting lever or by raising the steam pressure, should be based on the recommendation of your authorized inspector. Test the boiler safety valves in accordance with the valve manufacturer's instructions to be absolutely sure that the valves have not corroded shut.

WARNING: Failure of the relief valves in an overpressure situation is DISASTROUS!

Annual Maintenance

Have the boiler inspected and checked by a service representative from Precision Boilers. Clean both the heating and heated sides of the boiler. Remove all manway and handhole covers. Open all bottom blowdown and drain valves. Hose the inside of the boiler with clean water under high pressure. Use a hand scraper to remove accumulated sludge and scale. Start near the top and work toward the bottom. After cleaning tube exteriors, inspect the tube surfaces for signs of overheating, such as bulging, blackened surfaces in the tubes, etc. Specific local conditions determine the use of "wet" or "dry" storage during shutdown periods. If you are unsure of which procedure to follow, contact the Owner's water treatment consultant or your local insurance company.

Replacement of flange, manway, and handhole gaskets

1. Clean metal surfaces where cover plate bears against shell plate or ring.
2. Always use new gaskets. Apply graphite paste to gasket to prevent sticking and assure tightness.
3. Use care in centering cover plate and gasket in shell opening. Draw bolts up firmly. Yokes are designed for the positioning and holding of the covers only. Gasket sealing is accomplished by the application of internal pressure.
4. Spare gaskets should be maintained in your inventory to minimize your downtime.

Annual Inspection

Insurance regulations or local laws will require a periodic inspection of the pressure vessel by an Authorized Inspector. Sufficient notice is generally given to permit removal of the boiler from service and preparation for inspection. This major inspection can often be used to accomplish maintenance, replacements, or repairs that cannot easily be done at other times. This also serves as a good basis for establishing a schedule for annual, monthly, or periodic maintenance programs. Contact Precision Boilers to set up a pre-inspection service for your boiler.

While this inspection pertains primarily to the waterside and fireside surfaces of the pressure vessel, it provides the operator an excellent opportunity for detailed inspection and check of all

components of the boiler including piping, valves, pumps, gaskets , refractory, etc. Comprehensive cleaning, spot painting or re-painting and the replacement of expendable items should be planned for and taken care of during this time. Any major repairs or replacements that may be required should also, if possible, be coordinated with this period of boiler shutdown. Replacement spare parts, if not on hand, should be ordered sufficiently prior to this shutdown.

Have available information on the boiler design, dimensions, generating capacity, operating pressure, time in service, defects found previously, and any repairs or modifications. Also have available for reference records of previous inspections. Be prepared to perform any testing required by the inspector including hydrostatic testing of the equipment.