PRECISION BOILERS

INSTALLATION AND OPERATING

INSTRUCTIONS

FOR

Precision Flextube Boilers

FTH
HOT WATER BOILERS

INDEX

1.0 General Information

This manual supplies information on the application, installation and operation of Model FTH Boilers. Review all application and installation procedures completely before proceeding with the installation. Consult the Precision Local Factory Representative with any problems or questions regarding this equipment. Experience has shown that improper installation causes most operation problems.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. **Read this manual thoroughly and follow the instructions herein.** The FTH Series Boilers shall be installed according to the procedures detailed in this manual, or the Precision Boilers 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 or its gas/oil controls may void the warranty. If field installation requires modifications, consult either the local FTH Series Boilers' Representative or the Factory.

1.1 General Description

The Model FTH is a watertube boiler in which water is inside the tubes and combustion gases are outside the tubes; it consists of three major components, the support structure, the pressure vessel, and the casing. This particular boiler is designed to combine the higher efficiencies of some firetube designs with the rapid responses typical of watertube designs.

1.1.1 Support Structure

The boiler is built on a heavy duty fabricated steel structure. This steel structure is designed to support the movement and 'rigors' of shipping as well as the operating weight of the boiler. The support structure is not designed to withstand heat generated by the boiler, and is insulated from that heat. The support should be located above floor level on an elevated housekeeping pad.

1.1.2 Pressure Vessel

The pressure vessel is constructed of carbon steel designed and tested to ASME code requirements. The pressure vessel carries an ASME National Board number and is registered with the National Board, and includes the following major components:

1.1.2.1 Upper and Lower Headers

Process system return piping is connected to the lower header which distributes water to the heat exchanger section of the boiler; water then flows through the heat exchanger section into the upper header which collects the water and is

connected to the process system supply. The headers are drilled to exact dimensions for connection and support of the heat exchanger section. There is also a downcomer connected between the upper and lower headers; during high firing rates or extended periods of operation, there may be more heat generated than the process may need. The downcomer allows a natural circulation to recycle water flow from the upper header to the lower header.

1.1.2.2 Heat Exchanger

The heat exchanger section is constructed of heavy gage steel tubes connected between the top and bottom headers. These tubes are constructed in a 'serpentine' fashion and are designed to require the combustion gases to take a long route to the boiler exhaust. This additional time allows more heat exchange and effectively increases the heat exchanger capacity. The tubes form a tangent waterwall, which surrounds the combustion chamber on the top, bottom and side opposite the headers. Tubes are normally attached to the header with ferrules, which are driven into the headers and held in place by bolted 'keeper' plates. This arrangement allows for simple and easy tube replacement if the need occurs.

1.1.3 Casing

The boiler casing system consists of both an inner and outer casing, and contains all combustion gases in their route to the boiler exhaust. By containing all the gases, the inner casing keeps the boiler room free of exhaust gas. The boiler inner casing is constructed of heavy gage reinforced steel plate and is insulated with layers of mineral wool and ceramic fiber to protect the steel and retain the heat to effect higher boiler efficiency. The outer casing is separated from the inner casing with fiberglass insulation which protects personnel from high heat and allows a cooler boiler space. Access to the boiler combustion area is normally done by removing a boiler side wall. The wall on the header side of the boiler is designed to be easily removed.

1.2 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.

1.3 Engineering Assistance & Customer Service

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

1.4 Warranty

Precision Boilers Watertube Boilers are covered by a limited warranty. **A copy of the warranty is included with this manual.** Make all warranty claims to an authorized **Precision Boilers'** representative, or directly to the Factory. Claims must include the unit serial number and model (per the name plate), installation date, and name of the installer. **Shipping and labor costs are not included in the warranty coverage.**

2.0 Boiler Installation

2.1 Receiving

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.

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 Foundation

The boiler location should be prepared before uncrating the boiler. A concrete boiler foundation is recommended; the foundation should be level and designed to adequately and uniformly support the boiler operating weight. An existing concrete floor may be used only if it is determined that it will adequately and uniformly support the boiler operating weight.

CAUTION: *DO NOT INSTALL BOILER ON COMBUSTIBLE FLOORING.*

2.2.2 Clearance

See ***Table 1*** for minimum clearances to wall, ceilings or obstructions. The clearances in ***Table 1*** are intended as general recommendations

only. Local codes must be adhered to and minimum clearances established accordingly. Provisions must also be made for service, accessibility and clearance for piping and electrical connections. Do not obstruct combustion air and ventilation openings with piping, etc. All boilers must be installed in a large space compared to the boiler physical size.

NOTE: *Adhere to all applicable local codes regarding boiler installation and clearances.*

NOTE: *Be sure to keep burner and controls covered at all times while work is in progress.*

Table 1

BOILER CLEARANCES

Clearance From/To:	Model # FTH-1_ (9.5-60 bhp)	Model # FTH-2_ (60-110 bhp)	Model # FTH-3_ (120-200 bhp)
Above the Boiler	18 inches	18 inches	18 inches
Front of the Boiler	42 inches	42 inches	42 inches
Back of the Boiler	24 inches	24 inches	24 inches
Header Side of the Boiler	28 inches	40 inches	45 inches
Tube Side of the Boiler	18 inches	18 inches	18 inches

Note: Standard Boilers have headers on left side.

2.3 Piping Connections

2.3.1 General

Boiler service piping should not be routed along the header side of the boiler. Maintain clearances are shown on the dimensional drawing for servicing of the boiler tubes. See the boiler dimensional drawing provided for minimum clearance dimensions for the gas (fuel piping) train and burner. All piping should be designed, supported and installed to avoid any piping weight transmitted to the boiler/burner connections.

CAUTION: *THE BOILER IS NOT DESIGNED TO SUPPORT EXTERNAL PIPING LOADS.*

2.3.2 Process Flow Connections

The process system supply and return flow connections are shown on the boiler dimensional drawing. A valve and union (or flanges) is recommended at the boiler outlet and inlet lines to allow isolation of the boiler from the process system for draining and servicing. To allow for inspection and cleaning, the drain valve can be opened after the boiler is isolated.

2.3.3 Safety Relief Valve(s)

A connection is provided in the top of the boiler for the relief valve(s). The relief valve discharge piping must be, as a minimum, the same size as the relief valve discharge opening. All relief valve discharge piping must be independently supported with no weight carried by the valve. Over-tightening screwed joints can distort valve seats. Pipe the relief valve outlet(s) to the floor drain or as required per local codes.

2.3.4 Boiler Air Vent / Expansion Tank Connection

The boiler is provided with a 3/4" vent valve located on the top of the supply header. This connection is for venting air on boiler filling operations and for occasional venting as necessary. Additionally, this connection can be piped to a system expansion tank for continual venting and pressure balancing. If used as a vent, this connection should be routed to a suitable drain; the pipe end must be within 6" of the floor and in easy view of the vent valve.

2.3.5 Drain Connection

A drain valve is installed at the boiler drain connection. Piping, the same pipe size as this valve, should be routed to a suitable drain point. Drain piping should be terminated in proximity of the drain valve for easy viewing.

2.4 Fuel Supply Piping

2.4.1 General

The installation must conform completely to the requirements of the authority having jurisdiction, or in absence of such, requirements shall conform in the U.S. to the current National Fuel Gas Code, ANSI Z223.1, or in Canada to the current Installation Code for Gas Burning Appliances and Equipment (CAN/CGA B149.1-M91), or Oil Burning Equipment code (CSA B139-M91), and applicable regional regulations for the class; which should be followed carefully in all cases. Consult the local gas utility company for inspection and authorization of all gas supply piping and flue connections. The regulator vent line must be vented to outside of the building on any boiler equipment with electric gas pilot ignition.

2.4.2 Gas Supply Connections

Gas supply connections must comply with the National Fuel Gas Code (NFPA 54). Gas pressure must be regulated to the required pressure for the burner. (Standard *Power Flame* burners require a range of 5-12 inches of water pressure.) *Consult the local gas utility company for inspection and authorization of all gas supply piping and flue connections.* Gas connections should be made with unions or flanges so that the boiler gas train components and burner may be easily removed for service, if necessary. A drip leg or sediment trap must be installed in the gas supply line near the connection to the burner gas valve train.

2.4.3 Fuel Oil Supply Piping

Fuel oil supply piping must be sized by a qualified engineer or contractor; pipe size must be adequate to supply the required fuel flow. Oil supply connections must comply with NFPA 31. Any additional local or state codes must also be adhered to. Oil supply lines must be sized for the circulation rate of the burner pump. This is referred to as the suction gear capacity of the pump. If a transfer pump is used, it must have a pumping capacity no less that the total suction gear capacity of all burner pumps on the system. Refer to Burner Manual for the suction gear capacity of standard oil pumps. Two–pipe oil systems are recommended in all cases, although a one-pipe system might be acceptable on smaller boilers (under 6 gph). Two-pipe systems tend to have fewer problems with air entrainment in the oil. Air in the oil will cause nuisance problems and delayed ignition.

NOTE: *Use pipe compound, which is resistant to the action of liquid petroleum gas. Do not use Teflon tape.*

2.4.4 Gas Piping Leak Test

After completion of the gas piping, the installation must be checked for leaks, using a soap and water solution. Disconnect the boiler and gas train from the gas supply piping during any pressure testing of the gas supply system.

2.4.5 Venting of Gas Train Components

The gas pressure regulator, diaphragm gas valves, vent valves, and gas pressure switches must be vented outside the boiler room; minimum pipe or tubing size is ¼". All gas train components must be independently routed. Vents routed to a common pipe can experience pressure in the event of a leak. This pressure is a false backpressure to other components and can cause malfunctions. Vent piping should terminate in a downward direction and be free of restrictions.

2.5 Electrical Connections

IMPORTANT: *All electrical connections must conform to the National Electrical Code and to all other applicable State and Local Codes. Most forced draft boilers require a 3-phase power connection. See boiler wiring diagram and equipment list for details.*

<u>Equipment Grounding</u> – The boiler must be grounded in accordance with the American National Electrical Code, ANSI/NFPA #70-Latest Edition.

The boiler is supplied with burner from various burner manufacturers. The burner manufacturer's 'AS BUILT' wiring diagram is provided as part of the documentation package supplied with the boiler. Specific questions related to the burner controls and burner wiring are referenced to that drawing. Controls are added to the boiler to allow the boiler to perform its designed function. These controls are found on the Wiring Diagram provided; the drawing is WD-'Boiler Serial Number'.

Any questions not answered by the provided information may be answered by a call to the Factory.

2.6 Combustion Air Supply

2.6.1 Combustion Air – General

Complete combustion of natural or propane gas requires approximately ten cubic feet of air (at sea level and 70°F) for each 1000 Btu of boiler input. In reality, additional air is required to achieve complete combustion. Additional air is required for the proper operation of the appliance draft diverter or barometric damper.

WARNING: *Failure to provide an adequate air supply will result in boiler damage and hazardous conditions in the building (fire and asphyxiation hazard as well as equipment damage). Please note the following:*

a. Positive means for supplying an ample amount of outside air, allowing complete combustion of the gas, must be provided.

b. Movable combustion air dampers, automatic or manually adjustable, must be electrically interlocked with the boiler to prevent boiler operation if the dampers are closed.

c. Combustion air openings must never be blocked or obstructed in any manner.
   The boiler room must be at a positive or neutral pressure relative to the outdoors. Negative pressure, in the boiler room, will result in downdraft problems and incomplete combustion due to lack of air.

Ventilation Air

In addition to air needed for combustion, sufficient air must be supplied for ventilation, including air required for personnel comfort and proper working conditions in the boiler room. In colder climates, if needed for personnel comfort, provision should also be made to heat the boiler room.

CAUTION: *PROTECTION FROM COMBUSTION AIR CONTAMINATION : Where corrosive or flammable process fumes are present in the vicinity of the boiler room or the air stream for the combustion air supply, it is essential that suitable means be provided for their safe disposal. The boiler room and the combustion air supply must not be exposed to these fumes. Such fumes include, but are not limited to, carbon monoxide, hydrogen sulfide, ammonia, chlorine and halogenated hydrocarbons.*

NOTE: *Halogenated hydrocarbons are particularly injurious and corrosive after exposure to high temperatures.*

2.7 Combustion Gas Exhaust Connection

2.7.1 Code Compliance

The installation must conform to the requirements of NFPA 54, the National Gas Code (ANSI Z223.1), Part 7, "Venting of Equipment", or to the applicable requirements of all local building codes. For factory-built and listed chimney systems (such as type B vent), consult the system manufacturer's instructions for correct installation procedures. Gas vents may be of any of the construction types listed in this manual. No portion of a venting system may extend into or pass through any circulating air duct or plenum.

NOTE: *Additional state and local codes may apply and must be consulted.*

2.7.2 Flue Gas Economizers

When applying flue gas economizers, care must be taken to assure that:

a. Proper draft must be maintained. This requires that the gas side pressure drop be considered and that the economizer exchanger be designed so as to allow cleaning.
b. The vent system materials must be considered, regarding resistance from corrosion, which might result from the lower flue gas temperature.
c. In general, it is recommended that the boiler manufacturer be consulted when a flue gas economizer is to be added.

2.8 Before Placing the Boiler Into Operation:

2.8.1 Hydrostatic Test of Boiler and System

After completing the boiler and burner installation, the boiler connections, fittings, attachments and adjacent piping must be inspected for leaks by filling the unit with water. The pressure should be gradually increased to a pressure just below the setting of the boiler safety relief valve(s).

Remove the boiler header side panel (see dimensional drawing in this manual). Inspect the tube to header joints to be certain that all tube fittings are sealed.

Although the boiler is hydrostatically tested at the Factory, minor leaks in fittings and attachments can develop from shipping vibration or from installation procedures. It is often necessary to retighten such fittings after the installation and after the boiler has been operated for some time. Replace the tube access panel before proceeding to start boiler.

2.8.2 Test of Gas Piping

Reference gas system test under Section 2.4.4.

2.9 Firing Rate Adjustments – Forced Draft Boiler

Refer to the burner manufacturer's manual on the forced draft burner for start-up and adjustment procedures. Do not attempt to start burner before all safety systems are checked and fully operational. Insure the burner management system is properly installed and operational. Do not attempt to start or operate if an accumulation of fuel is observed.

2.9.1 On/Off Firing Systems

2.9.1.1 Combination Gas Valves (VR850 or VR852)

The minimum input on these gas valves is NOT adjustable. The maximum input must be properly set as outlined in the burner instructions. See the manufacturer's instructions on the VR850 or VR852 valves included in the Burner Manual for further information.

2.9.1.2 Dual Diaphragm Gas Valve High/Low By-Pass System

The minimum input on this control system is NOT adjustable. The maximum input must be properly set as outlined in the burner instructions. This system consists of two V48A (120 volt coil) or two V88A (24 volt coil) diaphragm gas valves which are piped in parallel. The minimum input is controlled by an orifice plug installed in a coupling in the by-pass piping (low fire valve piping) sized for approximately 1" WC manifold pressure at low fire for natural gas (2" WC if propane gas). When the high fire gas valve is not activated, gas flows only through the bypass piping. When the high fire gas valve is activated, gas will flow though both valves achieving full input.

2.9.2 Lo/Hi/Lo Firing Rate Control Systems

These system firing rates are usually controlled by a hydraulically actuated valve system. High firing rate is completely open and is not adjustable. Minimum firing rate is adjustable by controlling the valve in low fire position. Consult the manual provided by the valve manufacturer for instructions for this adjustment. Only highly qualified technicians will be able to make this adjustment.

2.9.3 Modulating Firing Rate Systems

With these systems, firing rates are controlled by a temperature controller sending a modulating signal to a modulating control motor; the motor, in turn, controls the position of both the fuel valve and the intake air damper. Qualified technicians using proper test equipment are required to make the required adjustments.

3.0 Safety and Control Devices

3.1 Flame Supervisory System

The boiler forced draft burner is supplied with a Burner Management System. This is a solid state device consisting of sensors, relays, timers and switches. Its function is to safely manage the firing system and to monitor all safety devices. The burner management system detects the main or pilot flame, depending on the type of device, and controls the gas valves accordingly. Its functions are strictly governed by Codes and are not accessible or adjustable. The flame supervisory system must be tested to assure that it will shut off the main gas valves in case of a boiler malfunction. Additional information including operating sequence and troubleshooting information may be found in the manufacturer's instructions in the Burner Manual.

3.2 Flame Detection System

Boiler burners are equipped with a flame detection system which, if a flame is not sensed or is not sensed at the proper time, will automatically shut the boiler down by closing all fuel valves.

3.2.1 Flame Detection System Type

The flame detection system is either the thermocouple type (such as a combination gas valve or a pilotstat), flamerod type, or electronic photocell type (such as the RA890 or RM7895). The purpose of this device is to detect the pilot and/or main flame, depending on the type of device. The device must be checked for proper operation. See the Burner Manual for the correct test procedure.

3.2.2 Automatic (Electric) Ignition Type

On burners equipped with automatic electrically-ignited pilots, follow the procedures described in the burner manual and test the controls for proper operation.

3.3 Low Water Cut-Off

If the boiler operates without sufficient water, it could overheat and burn out the heat transfer tubes. This very serious condition has been known to cause a boiler to explode. Boilers are supplied with at least one float or electric probe-type low water cut-off designed to sense the level of the water in the upper

drum. It operates to shut off the burner if the water level drops below its set level. The low water cut-off must be operationally tested by manually lowering the boiler water level (by opening the drain valve). The burner should cycle off when the water level drops below the actuation point of the low water cut-off. When the water level is restored, the burner should cycle back on. Depress the manual reset button of devices which require manual reset in order to restore the boiler to operation. Carefully read the enclosed manufacturer's literature on the installed low water cut-off device(s), particularly the sections on operation and maintenance.

3.4 Combination Low Water Cut-Off & Feeder

The low water cut-off/feeder supplied with some smaller boilers serves as a low water cut-off (see above) and also causes make-up water to be added to the boiler, before the level drops to the cutoff point. This type control is usually mounted above the boiler for system make-up and must be operationally tested to assure that both the make-up water is introduced as needed and that the cutoff actuates when the water level drops a preset distance below the make-up point. Carefully read the enclosed manufacturer's literature on the installed low water cut-off / feeder device(s), particularly the sections on operation and service.

3.5 Temperature Control

The temperature control is set at the desired water temperature. The boiler temperature control is not an actual safety device, but is the primary control element. This is true for all controls except those used for on/off firing, which also function as the auto-reset high temperature limit.

3.6 High Temperature Limit – Auto Reset

The high temperature limit is a safety device set for a temperature higher than the control temperature set point. In the event the temperature control fails, the boiler may continue to call for heat until stopped by the high temperature limit. This device is incorporated into the burner management system and causes the burner to shut off until the temperature lowers and the limit automatically resets. The high temperature limit automatically resets itself without the need for an operator. If the high temperature limit shuts down the boiler, the temperature control has failed and it should be replaced.

3.7 High Temperature Limit – Manual Reset

The manual reset high temperature limit is a safety device set for a temperature higher than the automatic high temperature limit. This high temperature limit is also incorporated into the burner management system to automatically shut down the burner in the event both the temperature control

and the automatic reset high temperature limit fail. This temperature limit requires an operator to manually reset the device and should not be reset until the reason for the shutdown is known. If both the temperature control and the automatic reset high temperature limit have failed, they should be replaced immediately.

3.8 Pressure Relief Valve(s)

If all control and electrical safety devices fail, the pressure relief valve(s) will open to prevent over-pressurizing the boiler. Proper operation of the Boiler Safety Relief Valve is critical to safe boiler operation. The best and recommended method for testing the safety relief valve is to have it pressure tested and certified by a testing agency licensed to perform this work. It is further recommended this be done on an annual basis as a minimum interval.

4.0 Boiler Start-Up

4.1 Limit Circuit Cut-Out Test

All boiler temperature limits, as well as the Low Water Cutoff, should be periodically tested. The temperature control set point can be raised to a higher setting to test the operation of a limit. Only qualified technicians should perform these tests. Insure the set points are returned to the desired setting after testing is complete.

4.2 Water Temperature Operating Control

The Boiler Temperature Controller regulates the burner to obtain the desired supply water temperature. This control senses the water temperature and turns the boiler burner On/OFF accordingly or regulates the firing rate. This control must be operationally tested. Turn the temperature setting on the control to a temperature less than the boiler temperature (as shown on the boiler temperature gauge). The control should turn the burner off. Restore the control setting to normal. The burner should cycle on.

4.3 Outdoor Reset Controls

Some boiler control systems also include an outdoor reset control. This control increases the boiler operating temperature with a decrease in outdoor temperature, and conversely decreases the boiler operating temperature with a rise in the outdoor temperature. For gas fired boilers, it is essential that the minimum operating temperature of the boiler never drops below 130°F, even at 70°F outdoor temperature. This is to prevent condensing in the flue gas. For further information refer to the manufacturer's literature for the outdoor reset control.

4.4 Additional Controls

Additional controls may be provided as specified by the purchase order. Please refer to the manufacturer's literature on these devices. All such devices must be operationally tested to assure reliable operation of the boiler and system.

4.5 Burner Start-Up

Please refer to the section provided by the burner manufacturer. The burner manufacturer's instructions are to be strictly followed.

4.6 Boil-Out

Before placing the boiler into service, the boiler waterside must be thoroughly cleaned of all possible manufacturing residue to eliminate fouling and foaming; both of which will reduce boiler efficiency and service and may cause system problems due to excessive carryover.

4.6.1 Procedure

Always follow the recommendations of a Water Treatment Professional. It is strongly recommended a Water Treatment Company be retained for water treatment and periodic testing and consulting.

4.6.2 Alternate Procedure

In the event a water treatment service is not available, the following procedure may be used.

4.6.2.1 Make a caustic solution using the following 'recipe'.

CAUTION: *This procedure requires the mixing of caustic compounds. Appropriate protective gear and procedures must be used when mixing these chemicals. Only qualified professionals should perform this procedure.*

For each 120 gallons of water, add:

1. One pound of caustic soda (50% pure sodium hydroxide)
2. One pound TSP (tri-sodium phosphate), commonly found in many building supply centers.
4. One pound powdered laundry detergent. (Example: Tide)

Mix the required amount of solution and pour into the boiler.

Note: *The removal of the safety relief valve may provide the best "point of pouring".*

Start-up the boiler – at low fire- and operate until the water temperature is 150^{o}F and 0 psig. **Do not allow the temperature to exceed 150^{o}F**.

4.6.2.2 Fire the boiler as necessary to maintain the temperature between 120 and 150^{o}F.

4.6.2.3 After four hours, drain the boiler. Fill and drain several times until a pH measurement indicates all caustic has been removed.

5.0 Boiler Operation

5.1 Curing

Before placing the boiler into operation, it is imperative to cure refractory. In the Precision Boilers FTH Series, it is only necessary that the boiler be placed into operation for approximately 45 minutes at low fire. This will ensure any collected moisture is slowly dispersed and will not harm the boiler.

5.2 Water Chemistry

A water chemistry program is strongly recommended. A water chemistry specialist should be retained to monitor and maintain water chemistry in the boiler and hot water system. Every effort should be made to minimize the formation of sludge and/or scale. This will increase boiler system efficiency and increase boiler component lifetime.

Note: *Heavy scale deposits have been known to cause tube failures.*

6.0 Operating Instructions

6.1 Temperature Controls

The temperature controller senses water temperature and automatically controls the boiler burner to maintain the water temperature at the desired set point.

6.1.1 On/Off Control

In this basic system, the temperature controller senses the water temperature and starts or stops the boiler burner to maintain the temperature set point. The controller has a temperature differential (factory set and not adjustable); the set point is the temperature at which the burner comes on and the differential is the temperature at which the burner turns off.

6.1.2 Lo/Hi/Lo Control

With this control system, the control is basically the same as the On-Off. The primary Controller senses the water temperature and operates the boiler burner to maintain temperature. If system demand is such that the temperature falls below the secondary controller set point, the burner will move to the High Fire position until the secondary controller is satisfied. The burner will move back to the Low Fire position and maintain water temperature until the primary controller is satisfied.

6.1.3 Modulating Control

Modulating temperature controllers sense the water temperature and send a variable signal to a firing-rate motor. The firing-rate motor operates the burner controls to vary the firing rate to maintain the water temperature set point and system demand. For modulating controllers, the differential is normally adjustable and sets the 'tightness' of control.

6.2 High Temperature Limit – Auto Reset

The On/Off, Lo/Hi/Lo, and Modulating control systems have a high water temperature limit. This limit will automatically shut down the burner if it's set point is exceeded. When the water temperature cools sufficiently, the burner will automatically restart. This limit should not operate and will only operate if the temperature controller fails. Care should be exercised to insure the control differential set points do not overlap.

6.3 High Temperature Limit – Manual Reset

All control systems have this safety feature. If the water temperature exceeds the set point of this control, the burner will automatically shut down. The burner will not start until manually reset by an operator. This limit will not operate unless the other control systems have failed. If those systems have failed, a qualified operator should first check the other controls before resetting the water temperature limit. As in Paragraph 6.2, care must be taken to insure the temperature differentials do not overlap.

6.4 Draft Adjustment

Draft adjustments are generally not necessary for daily operation of forced draft boilers. The air/fuel ratio and draft must be measured as part of the start-

up procedure and should be periodically checked by a boiler service professional.

7.0 MAINTENANCE

Procedures

This boiler is designed and will operate with minimal maintenance. The following procedures are recommended as a minimum.

7.1 Daily:

a. Check water chemistry daily and maintain a Water Chemistry Log.
b. Use the sight glasses to daily view the burner flame. Note any variations and notify a boiler service professional if necessary.
c. Use the sight glasses to daily view the boiler internal walls. Note the condition of all insulation and the condition of heat transfer surfaces.
d. Check and record the boiler flue gas temperature, note excessive variations.

Note: *A rising flue gas temperature usually indicates sealing of the tubes and a resulting decrease in boiler efficiency.*

7.2 Semi-Annual:

Obtain the services of a boiler service professional to check and adjust all burner and burner control systems as necessary.

7.3 Annual:

Open the boiler casing and inspect all internal insulation and tube surfaces. Repair as necessary.

8.0 Shutdown

To shut down the boiler, simply switch the main burner control to the 'Off' position. If the boiler is to remain off for a long period, turn off the main power supply as well. Maintain operation of the process circulating pump(s) until the boiler is cooled to 150ºF or less, as shown on the main temperature gauge. If possible, maintain an open vent to an expansion tank while the boiler is shut down. Proper water chemistry should also be maintained when the boiler is not in service.

9.0 Extended Shutdown

Follow the same procedure as above. Additionally, when the boiler is shut down for extended time periods, consult a Water Treatment Professional for a “Lay-Up” procedure. Proper water chemistry should be maintained when the boiler is not in service.