

VERTICAL CYCLONE BOILER

OPERATIONS MANUAL



TABLE OF CONTENTS

General Installation

Connections

- Safety Valve

- Vent Stack

- Fuel

- Supply, Steam or Hot Water

- Feedwater

- Bottom Blowdown

- Water Column Blowdown

- Surface Blowoff

- Electrical

Initial Inspection

Initial Cleaning

Pre-Start up

- Burner

- Water Column/Low Water Cutoff

- Secondary Low Water Cutoff

- High Water Alarm

- Pressure Gauge

- Pressure Controls

- Safety Valve

Unit Start Up and Operation

- Initial Heating

- Blowdown

Maintenance

- Combustion

- Follow Up Inspections

- Record Keeping

Burner Manual

Only qualified technicians should be allowed to start, maintain or service this equipment.

GENERAL:

Your boiler must be properly leveled and set on a solid foundation adequate to support the flooded weight of the unit. Controls may not function if the boiler has not been leveled.

Oxygen supports combustion of the fuel and must come from the fresh air supplied to the room. Allow 8 cu. ft. per minute (cfm) of air for each rated boiler horsepower up to 1000 feet of elevation. Add 3% additional volume for each 1000 feet above 1000 ft.

Adequate ventilation is necessary to maintain proper and efficient combustion. Ventilation of the boiler room should be provided through openings in the outer walls of the boiler room, preferably one on each side of the boiler near the ceiling.

The openings may be covered with wire mesh, but the mesh should have at least ½" openings. Keep all louvers clean, and maintain air velocity through the opening at 250 feet per minute or less.

Example: For a 50HP unit, the air requirement is $50 \times 8 = 400 \text{ cfm} / 250 \text{ ft./min.} = 1.6 \text{ square feet}$. Even with the smallest boiler, you should provide an opening of at least 1 sq. ft.

Adequate lighting in the area of the boiler is necessary to properly operate and maintain the equipment.

Check with your boiler and machinery insurance carrier and all local codes both of whom may have requirements for acceptable materials to be used for the floor, walls or roof of your boiler room as well as minimum clearance dimensions to combustible surfaces. This may be especially critical regarding the exhaust gas duct from the boiler to the outside of the room. This duct should be as short as possible and be directed through the roof of the building.

The boiler operates with a forced draft (pressurized furnace) which eliminates the need for tall stacks or draft inducing fans, but if there is more than one boiler connected to the stack, consult the factory for recommendations on stack size or damper requirements.

CONNECTIONS:

There are several connection points on the boiler that must be connected to other systems within the scope of the installation before operating the unit.

1. SAFETY VALVE: The safety valve will be located on or near the top of the boiler. The outlet of the safety valve must be piped to a point of safe discharge, and it must be the size of the valve outlet or larger. NEVER reduce the discharge line size.

2. VENT STACK: This is the stack through which the gases from the combustion process must be vented to the atmosphere. Local jurisdictional rules may address the routing of this duct, but it should always be terminated above the roof of the building.

3. FUEL: The fuel connection(s) will be for natural gas, manufactured gas, or light oil. The connection points are near the burner. The gas piping must be approved by the local gas company and will be inspected by their personnel. A vent may be required between 2 gas safety valves. This vent must be piped to a point outside the boiler room. Oil piping must be appropriate for the application.

4. SUPPLY: This is generally the largest opening on the boiler, and it will be on the top. This is the opening through which steam or hot water is allowed to exit the boiler to enter the external system. This must be piped as required by local jurisdictional requirements and as good construction requirements demand. In multiple boiler installations, some of this piping may need to be constructed and stamped according to the ASME Code.

5. FEEDWATER: This is the opening through which water enters to re-supply water lost through evaporation or leakage. This must be connected from the source of feed water to your system. The design requirements for pressure in this line must be greater than the MAWP of the boiler.

6. BOTTOM BLOWDOWN: This opening is in the lowest part of the boiler. There will be one bottom blowdown opening on a steam boiler and one drain on a water boiler.

7. WATER COLUMN BLOWDOWN: This refers to the piping directly below the water column / gauge glass if so fitted. This is the valve through which the unwanted contaminants will be expelled from the Low Water Cutoff / Pump Control device on a steam boiler.

8. SURFACE BLOWOFF: This opening is the opening through which surface contaminants will be expelled from a steam boiler. These are not common on water boilers.

9. ELECTRICAL: One or more connection points will require electrical power. Power requirements will vary with the size of the boiler and the accessory items included. These connection points will be terminal strips or breaker terminals inside the enclosure.

Since controls generally operate on 120 volt single phase while motors operate on 230 or 460 volts single or three phase, there may be a transformer supplied for the low voltage requirement.

Interconnections from the electrical enclosure to the external devices are completed at the factory.

INITIAL INSPECTION:

Most jurisdictions whether it is your State, your City or your Boiler and Machinery insurance carrier may have rules for documentation or inspection of the unit. This inspection will likely be made by a third party inspector licensed to perform boiler and pressure vessel inspections.

You should verify compliance with these entities before attempting startup of your unit.

Then, it is quite likely that your unit will be required to be inspected subsequently according to the jurisdictional schedule depending on the size of the unit, the design pressure, or other criteria they have established.

These formal inspections should not preclude periodic inspections made by the owner or his representative to verify the condition of the interior and the exterior of the unit.

INITIAL CLEANING:

After completing the installation of your boiler and after you have been given the go-ahead by the governing authorities, it is advisable to clean the water side surfaces of the boiler and the piping system to which the boiler is connected.

The piping system may contain oil, grease, welding slag, thread cuttings and other contaminants that should not be left in the system. These materials can block valves and control devices and damage gaskets.

Boiler chemical suppliers can supply the chemicals and the expertise to clean your boiler. In the absence of such consultation, a suggested procedure is outlined below.

1. Close all external valves, such as feedwater, steam supply, chemical feed, and blowdown to avoid loss of chemicals and to isolate the boiler internal parts.
2. Remove the safety valve.
3. Remove the top inspection cover from the uppermost part of the unit
4. Fill boiler with fresh water to a level about 12 inches below the top plate. Just basic tap water is acceptable for this filling.
5. Determine how many gallons of water the boiler will contain when completely filled.

USE CAUTION WHEN HANDLING CHEMICALS. WEAR PROTECTIVE CLOTHING AND A MASK. HAVE A NEUTRALIZING AGENT ON HAND WHILE MIXING OR APPLYING CORROSIVES.

6. Mix Tri-sodium phosphate and caustic soda (Sodium Hydroxide) in the amount of one (1) pound of each for each 100 gallons of water content in the boiler. Add the chemicals slowly into a bucket with water as necessary to dissolve them. Stir constantly to be sure that the chemicals are thoroughly dissolved.
7. Add the dissolved chemicals carefully through the largest opening available in the top of the boiler.
8. Complete filling of the boiler to near the top.
9. Begin firing the boiler at the lowest rate possible and intermittently, as necessary to get the water temperature just above 200 degrees F. During this early firing, the water volume will swell and tend to overflow the openings in the top, so operate the bottom blowdown as necessary to maintain flooded condition in the vessel while minimizing overflow.
10. Continue this low heat input for 4 hours and shut the burner off
11. Allow the boiler water to cool to a temperature of 120 degrees F or less, and drain to a point of safe discharge.
12. Remove all handhole plates or other inspection openings and wash the interior thoroughly with high pressure water.
13. If you determine the water side to be adequately clean, proceed to replace the safety valve, re-close the handhole plates with new gaskets, and refill the boiler with treated water from your feedwater system.
14. When filled to the normal level, the boiler should be checked for leaks and may be fired normally. Allow the trapped air to escape the boiler during this initial filling.

Since the cleaning procedure above only addresses the boiler, you should waste all your condensate for 4-6 hours of operation after start up to avoid contamination of your feedwater system and your newly cleaned boiler.

PRE-START UP:

The following steps in startup should be to identify and pre-check the several control and safety devices mounted on the unit;

BURNER: This should be a procedural check of the burner without actually allowing fuel to the burner. You will likely need your burner manual for proper steps to take. The rotation of the blower motor, the overload heater sizing, any automatic valve functions and flame safeguard function should all be verified before actually firing the unit.

WATER COLUMN / LOW WATER CUTOFF (LWCO): This device functions as both a pump control for starting and stopping a feedwater pump and as a low water cutoff to cut power to the burner in the event of a water level condition that is lower than acceptable. This unit may function with a float or electrodes. By being connected directly the water side of the

boiler it does not depend on other sensing devices. It responds to the actual water level in the unit. Therefore it is very important to maintain a high degree of cleanliness to the interior on the control.

There will also be a gauge glass mounted on the water column of a steam boiler to allow a visual indication of the water level in the boiler. At the bottom of the glass column is a valve for blowing down. The piping from the valve should be run to a point of safe discharge since a daily operation of the blowdown is mandatory.

SECONDARY LOW WATER CUTOFF: This auxiliary LWCO is to sense a water level condition that is lower than acceptable. This control may be a float operated device or it may be an electronic probe. It serves as a back-up to the primary LWCO with the same function of cutting off power to the burner in the event of a lower level of water. This control requires operator attention for re-setting when activated.

HIGH WATER ALARM: This device senses a water level in a steam boiler that is higher than normal, and it responds with an audible signal to alert the operator of an unusual condition.

PRESSURE GAUGE: A gauge that is piped directly to the vessel for reading the actual pressure inside the boiler.

PRESSURE CONTROLS:

1. The **Operating Pressure Control** senses the pressure inside the boiler and either switches the burner ON or OFF depending on the settings in the control device. The ON and OFF limits may be adjusted within the design of the switch. A hot water boiler utilizes an aquastat for the same function.
2. The **Modulating Pressure Control** senses the pressure inside the boiler in the same way as the Operating control, but instead of a simple ON / OFF function, it positions a rheostat to vary the burner firing rate within the chosen firing range. Unless your burner is so designed to allow variable firing, your unit will not have a modulating control.
3. The **High Limit Pressure Control** senses the pressure inside the boiler in the same way as the operating control and serves as a back-up to the operating control. In the event that the boiler pressure reaches a pressure exceeding the normal operating range this control will cut power to the burner at a preset pressure lower than the set pressure of the safety valve.

SAFETY VALVE: This valve is the most important safety device on the unit to protect against failure due to over-pressure. The discharge piping must never be reduced to any size smaller than the connection on the valve. Never place any valve in the discharge line ahead of or downstream of the valve. Pipe the discharge line to some point that will safe-guard personnel from a sudden burst of steam or hot water.

After becoming completely familiar with all of the controls and safety devices, you may start the unit.

When fuel is finally introduced to the burner, check all piping for leaks. Gas is a clean burning fuel, but you cannot see it. Piping leaks must be corrected and never be allowed to spill gas into any enclosed space – especially the boiler room.

Fuel oil is not as explosive as gas, but leaks must never be tolerated.

UNIT START UP AND OPERATION:

INITIAL HEATING: The final step to starting the unit is to actually start the burner supplying heat to the boiler and monitor the increase in pressure in the vessel. As the boiler pressure begins to rise above 0 psig, you should begin opening the main supply valve so the piping and heat consuming devices begin to heat up at the same rate.

As the pressure approaches set point on the operating pressure control, you should anticipate the burner shutting off. You can use this opportunity to do some final adjusting to the operating control if the burner shuts off too soon or perhaps does not shut off as soon as you wish.

Also during this initial heat up, if the system is receiving steam, the feed pump should have come on at least one time to replace water that has been evaporated. This is another good time to re-examine the feedwater piping for leaks between the pump and the boiler.

Although this is an automatic boiler, the starting and stopping of the burner and the feedwater pump will be controlled as described above. However, you should be sensitive to the sound of newly installed alarm devices that may alert you to conditions that are not in keeping with preferred operating conditions: High water level, Low water level, High gas pressure, Low gas pressure, High steam pressure and others.

BLOWDOWN: (Steam boilers) Blowing down is a very important step toward keeping sediment out of your boiler. Bottom blowdown helps remove settleable solids that have come into your boiler with the feedwater or with some chemical treatment programs. The bottom blowdown valves should be opened sometime in every 24 hours of operation. Your chemical supplier should prescribe the actual routine. Without that input, the blowing down should not be less than every 12 hours of operation.

Blowing down should proceed by opening of the quick opening valve followed by opening of the slow opening valve. As soon as the slow opening valve is fully open, close it again. Then, re-close the quick opening valve.

The surface blowoff is normally a continuous process, and it is to control solids that are dissolved or tend to float on the water surface. The amount of water removed is determined by

the total dissolved solids (tds) you choose to have remaining in the boiler water. Normally, 3000 – 3500 ppm is the upper limit for boilers operating at or below 300 psig.

Water column blowdown is the other significant blowdown you should perform. This procedure should be performed once every 8 hours of operation. This is accomplished with the boiler operating. The routine is to open the blowdown valve beneath the water column at least 2 or 3 turns. The water should immediately leave the sight glass, the burner should stop and the pump should start. Immediately, close the blowdown valve and note the water level returning to its normal level. At that point, the burner should start and the pump should stop.

If any of these functions do not follow the routing, move immediately to determine the problem and formulate a plan for correction.

The water and steam mixture from blowing down is very hot and under pressure. It should always be directed to a vessel that is substantial for receiving such discharge to protect anyone who might otherwise be impacted by it.

Surface blowoff and bottom blow down are not typical routines with hot water boilers. Once the boiler is filled with treated water, only leakage from the boiler or from the system to which it is connected will signal the need for water makeup.

MAINTENANCE:

COMBUSTION: In order for fuel to burn, it must be mixed with oxygen. Mixing of gas with oxygen is rather simple as the gas is delivered into the burning chamber along with air coming through the fan on the burner.

The mixing of air with a liquid fuel such as fuel oil takes a little more effort so the oil is broken into fine droplets. This is accomplished by the design of the oil nozzle on pressurized atomization systems and with compressed air on air atomization systems.

Maintaining the proper quality of oil and following good maintenance procedures as to keeping nozzles clean are the first steps to efficient operation. When the carbon in a fuel is only partially oxidized, carbon monoxide gas is formed. This is not only a dangerous, odorless, invisible gas, it will rob your boiler system of efficient output and cost you more to operate the system than is necessary.

Fuel filters should be checked routinely and cleaned or replaced as needed.

Burner fans will collect dirt and lint and should be checked and cleaned routinely.

Note any leak in piping or at handholes and plan for correction at the next opportunity when the boiler is shut down.

At six month intervals, clean the interconnecting piping and the float bowl on the water column. The need for this maintenance cannot be over-emphasized since the operation of this device is critical to maintaining a safe operation. If your unit has probes rather than a float, the same routine should be followed regarding cleanliness.

Annually, or as governed by your jurisdiction or insurance service, you must plan for and perform an internal inspection with their inspector(s). The date for this inspection should be scheduled long in advance so all parties can be in place without interference.

RECORD KEEPING: A log should be maintained regarding the operation of your boiler. This log should indicate fuel usage, any routing maintenance or repairs and unusual conditions that you observe. Jurisdictional or insurance inspections should always be documented.