Installation Operation And Maintenance Manual

Fulton Electric Boilers (Steam Models)

Serial # : _____

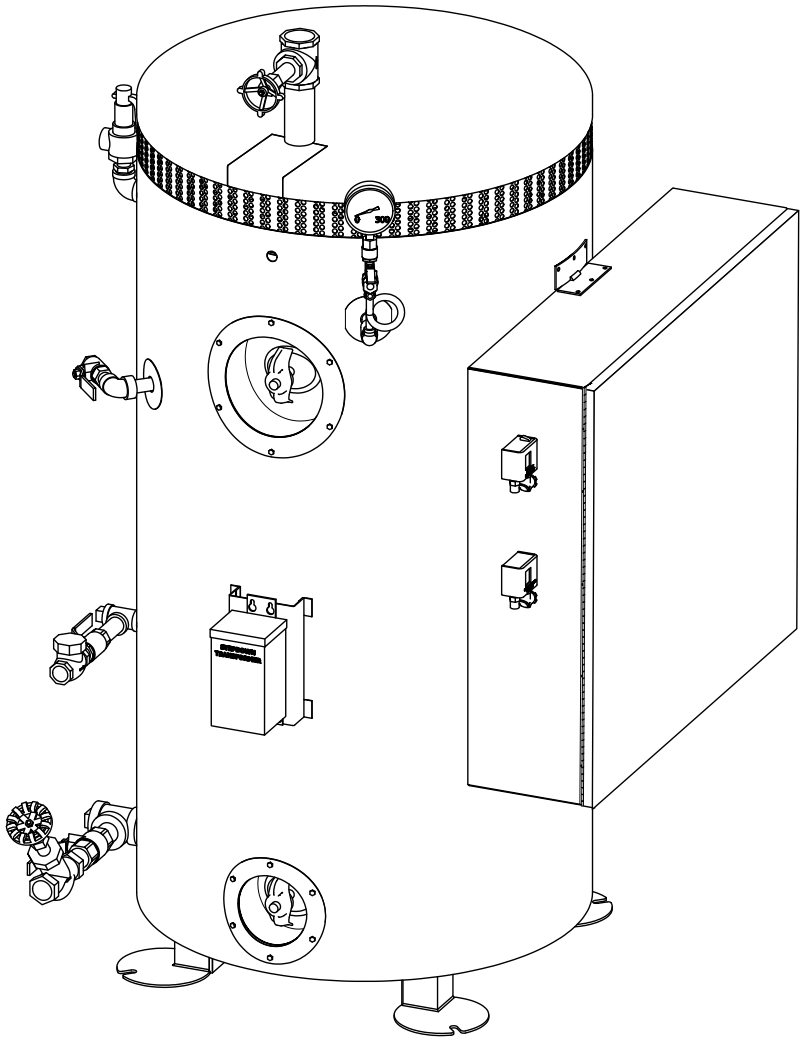
Model # : _____

Fulton Order # : _____

Sold To : _____

Job Name : _____

Date : _____



Product Bulletin

Date: January 22, 2010

Subject: Water Chemistry Requirements for Fulton Steam Products

Products: ICS/ICX, FB-A, FB-F, FB-S, VMP, PVLP, PHP, Electric Steam Boilers and Unfired Steam Generators

Please note that the water chemistry is different for carbon steel vs. stainless steel pressure vessels and vertical vs. horizontal orientation.

Effective immediately, please use the limits below. Should you have any questions, please do not hesitate to contact Fulton at 315-298-5121.

Water Chemistry Requirements for Fulton Steam Products (to 300 psig MAWP)

	Carbon Steel			Stainless Steel		
Parameter	Feedwater	Vertical Boiler/Steam Pac Water	Horizontal Boiler/Steam Pac Water	Feedwater	Vertical Boiler/Steam Pac Water	Horizontal Boiler/Steam Pac Water
pH	7.5-9.5	8.5-10.5	8.5-10.5	6.0-9.5	8.5-10.5	8.5-10.5
Feedwater Temperature	140F*	---	---	140F*	---	---
Hardness as $CaCO_3$	<2ppm	<10 ppm	<15 ppm	<2 ppm	<10 ppm	<15 ppm
Chlorides	---	---	---	---	50 ppm	50 ppm
Total Alkalinity	---	<300 ppm	<500 ppm	---	<300 ppm	<500 ppm
Total Dissolved Solids	---	<2000 ppm	<3000 ppm	---	<2000 ppm	<3000 ppm
Suspended Solids	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**
Total Organic Carbon	No sheen No foam+	No sheen No foam+	No sheen No foam+	No sheen No foam+	No sheen No foam+	No sheen No foam+
Iron	Colorless liquid++	Colorless liquid++	Colorless liquid++	Colorless liquid++	Colorless liquid++	Colorless liquid++
Dissolved Oxygen	<1ppm*	ND	ND	<5ppm	ND	ND
Visual Oil	ND	ND	ND	ND	ND	ND
Conducivity (uS/cm)	---	<2985	<4477	---	<2985	<4477

NOTES:

*This is a minimum temperature. Feedwater temperatures below 200F will require an oxygen scavenger.

** Suspended solids: Take a water sample. After the sample sits for 10 minutes, no solids should be visible.

+ Total Organic Carbon: Take a water sample. Shake vigorously for 30 seconds. No sheen or foam should be visible.

++ Iron: Take a water sample. Hold the sample against a white background. The water should have no visible yellow, red or orange tinge.

ND: None Detected.

Fulton®
The Fulton Companies
972 Centerville Road
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Contents

Section 1 Safety Warnings and Precautions

Safety Warnings and Precautions

This manual is provided as a guide to the correct operation and maintenance of your Fulton Electric Steam Boiler, and should be permanently available to the staff responsible for the operation of the electric boiler.

These instructions must not be considered as a complete code of practice, nor should they replace existing codes or standards which may be applicable.

The requirements and instructions contained in this section generally relate to the standard Fulton Electric Steam Boiler. When installing a packaged unit, this entire section should be read to ensure that the installation work is carried out correctly.
Prior to shipment the following tests were made to assure the customer the highest standards of manufacturing:

a) Material inspections.
b) Manufacturing process inspections.
c) ASME welding inspections.
d) ASME hydrostatic test inspection.
e) Electrical components inspection.
f) Operating test. (panel powered up)
g) Final Engineering Inspection
h) Crating inspection.

All units are crated for fork lift transport. Once uncrated, all units can be transported with a forklift. Under no circumstances should weight be allowed to bear on the jacket, control panel, or fan housing of any Fulton Boiler.

Rigging your boiler into position should be handled by a competent rigger experienced in handling heavy equipment.

NOTE

The installation of the Fulton Electric Steam Boiler should be carried out by competent personnel in accordance with all relevant safety regulations. A complete list of all safety precautions may be found in the safety summary at the conclusion of Section 1. It is the responsibility of the installer to ensure that the installation is in compliance with these regulations.

NOTE

If it is necessary to store the boiler for a prolonged period of time prior to installation, the boiler should be stored at a minimum 40 degree F in an atmosphere in which excessive moisture cannot damage the controls or the steel casing. If the storage is to be over sixty days, one element should be removed. Place several bags of dry dessicant inside the boiler. Bolt a blank flange over the element mounting plate to seal the boiler. If handholes are provided, these can be used to provide an opening versus an element to place the dessicant.

For Your Safety

The following WARNINGS, CAUTIONS, and NOTES appear in various sections of this manual. They are repeated on these safety summary pages as an example and for emphasis.

WARNINGS must be observed to prevent serious injury, or death to personnel.
CAUTIONS must be observed to prevent damage or destruction of equipment or loss of operating effectiveness.
NOTES must be observed for essential and effective operating procedures, conditions, and as a statement to be highlighted.

It is the responsibility and duty of all personnel involved in the operating and maintenance of this equipment to fully understand the **WARNINGS, CAUTIONS,** and **NOTES** by which hazards are to be eliminated or reduced. Personnel must become familiar with all aspects of safety and equipment prior to operation or maintenance of the equipment.

WARNING

Improper installation or maintenance of gauge glass and connections can cause immediate or delayed breakage resulting in bodily injury and/or property damage.

WARNING

When stopping the boiler for any extensive repairs, shut off main power switch and pull main disconnect switches on both the boiler side as well as the feed water side.

WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

WARNING

Prior to powering the boiler up, all electrical contacts shall be re-torqued to the individial components manufacturers recommendations.

CAUTION

Do not downsize piping below safety valve size.

CAUTION

Unless otherwise specified, the steam safety valve supplied with the boiler is pre-set. This valve is provided as a safety device for the boiler and should not be used as the sole protection for other equipment using steam from the boiler. Do not tamper with the setting (It could accidentally be set at a pressure higher than the design pressure of the boiler and, therefore ,create a hazardous condition.

CAUTION

Do not exceed pressure rating on boiler.

CAUTION

In general, ensure that the boiler area is in conformance with established boiler room requirements. Review national and local codes.

CAUTION

Do not tamper with the safety features of the low water safety cut out.

CAUTION

Keep boiler area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

CAUTION

Do not use harsh compounds that will injure the feed water pump or elements.

CAUTION

Do not clean the gauge or gauge glass while pressurized or in operation.

CAUTION

Prior to performing the "try lever" test, be certain to take precautions as a loud noise and high velocity steam will discharge freely from discharge port and through drain hole provided in the side of the valve body.

NOTE

Where a condensate return tank is to be fitted, this should:

a) Be vented and

b) Have a capacity sufficient to satisfy boiler consumption (normally 10 minutes worth of storage minumum) as well as maintain proper return tank temperature and

c) Vent pipe should not be down-sized (This may cause pressure build up in the condensate tank.)

NOTE

Care should be taken to ensure that the blow off receptacle used meets the regulations covering such items. If in doubt, consult a Fulton Representative for advice.

NOTE

Only properly trained personnel should install and maintain water gauge glass and connections. Wear safety glasses during installation. Before installing, make sure all parts of free of chips and debris.

NOTE

Keep gauge glass in original packaging until ready to install.

NOTE

After Installation is complete and prior to operation, the pressure vessel should be cleaned.

NOTE

Check with local authorities where approval for start-up is required. In some localities, final inspection of services may be required.

NOTE

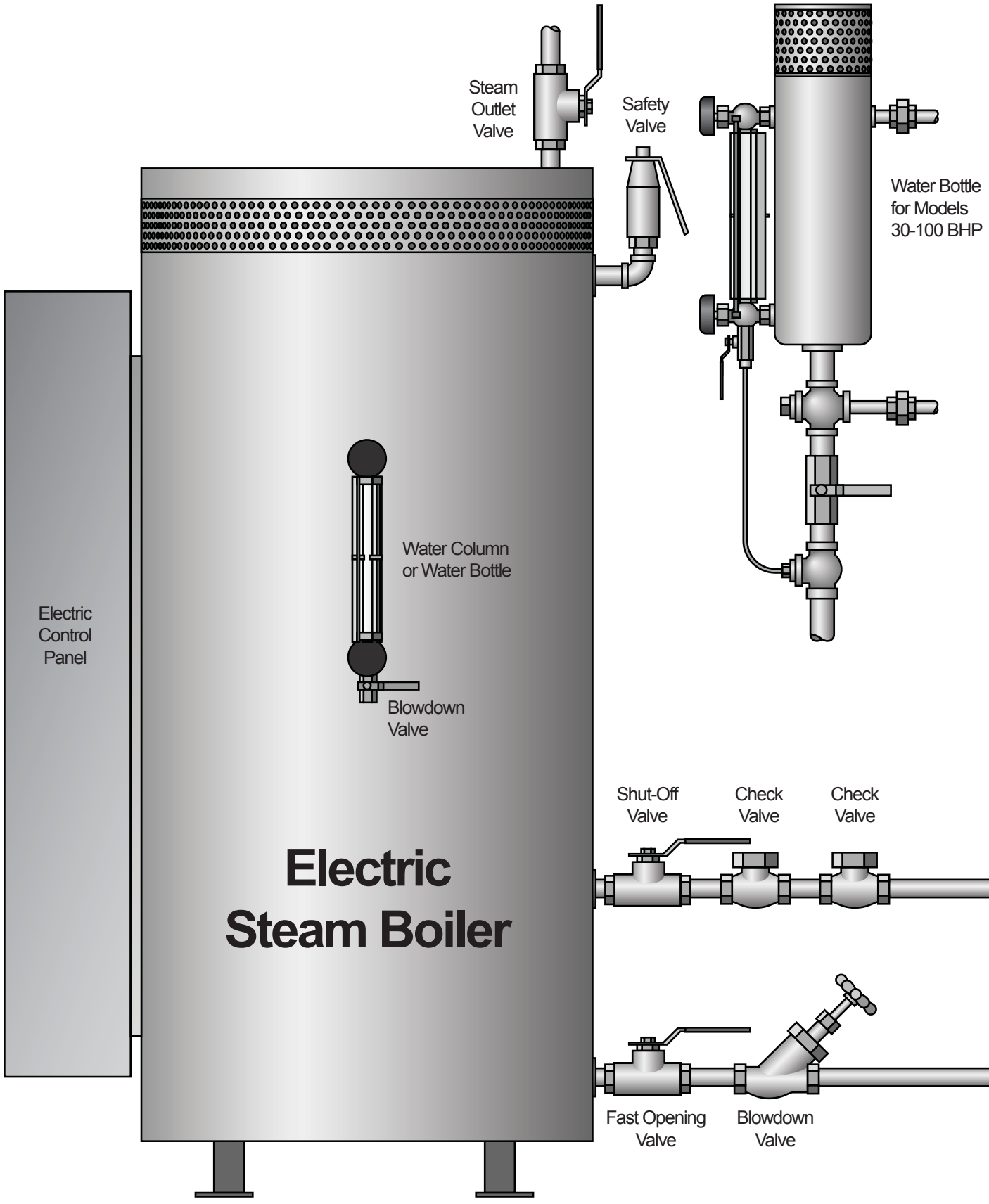
To ensure that your Fulton Steam Boiler is kept operating safely and efficiently follow the maintenance procedures set forth in this manual.

NOTE

The policy of Fulton Boiler Works, Inc. is one of continuous improvement, and therefore, we reserve the right to change prices, specifications, and equipment without notice.

Section 2 Installation

Basic Boiler, Condensate Tank, and Blow off Separator Piping Diagram



NOTE

Where a condensate return tank is to be fitted, this should:

1. Be vented and

2. Have a capacity sufficient to satisfy boiler consumption as well as maintain proper return tank temperature.

3. Vent pipe should not be down-sized (This may cause pressure build up in the condensate tank.

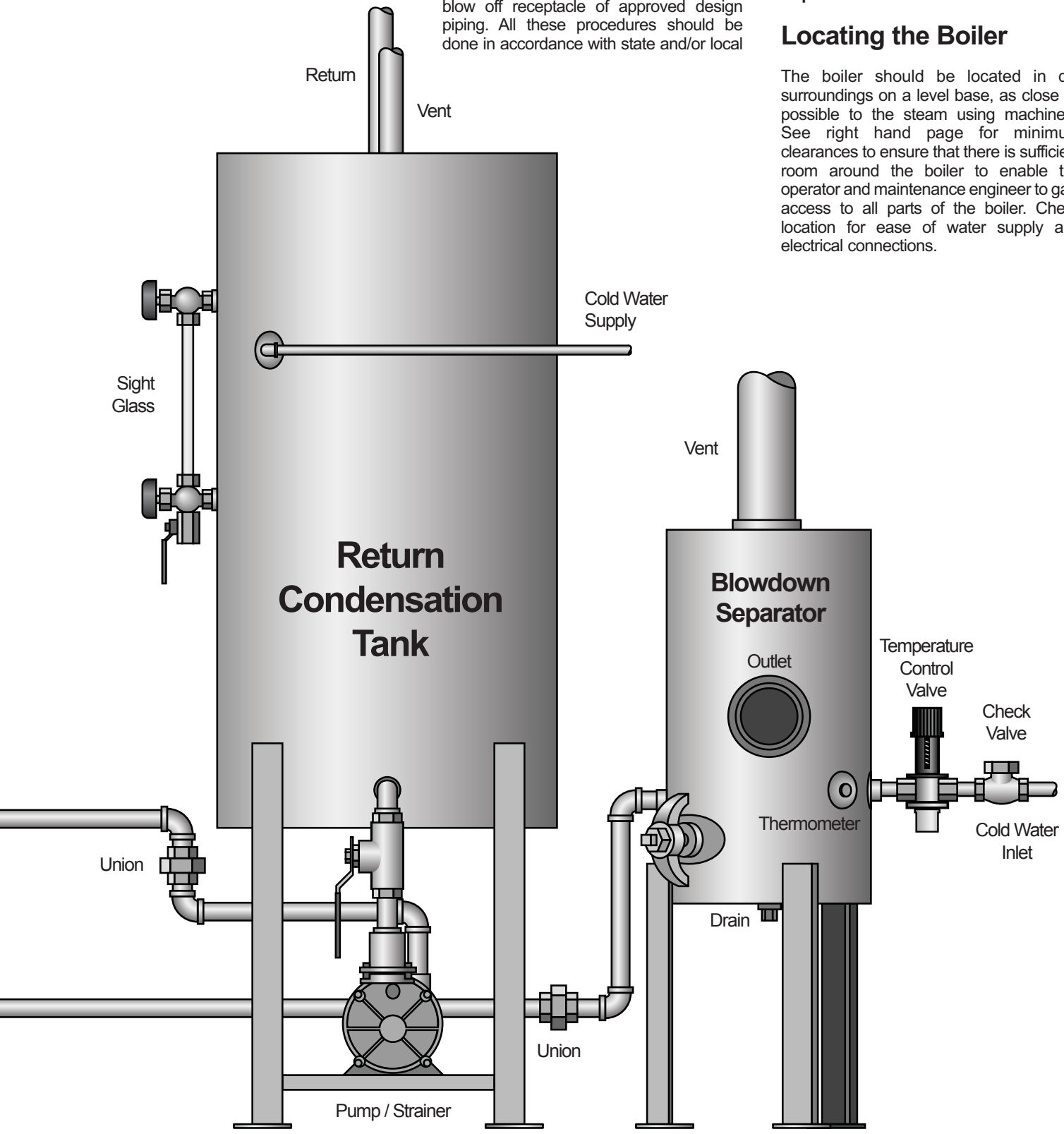
There are two blow off valves on the boiler; the main valve at the rear of the boiler and the water gauge glass blow off valve. The boiler blow off valve supplied with the boiler should be screwed to the blow off pipe at the rear of the boiler and connected to a blow off receptacle of approved design piping. All these procedures should be done in accordance with state and/or local codes. The water gauge blow off valve should be connected to the main blow off line.

NOTE

Care should be taken to ensure that the blow off receptacle used meets the regulations covering such vessels. If in doubt consult a Fulton Representative for advice.

Locating the Boiler

The boiler should be located in dry surroundings on a level base, as close as possible to the steam using machinery. See right hand page for minimum clearances to ensure that there is sufficient room around the boiler to enable the operator and maintenance engineer to gain access to all parts of the boiler. Check location for ease of water supply and electrical connections.

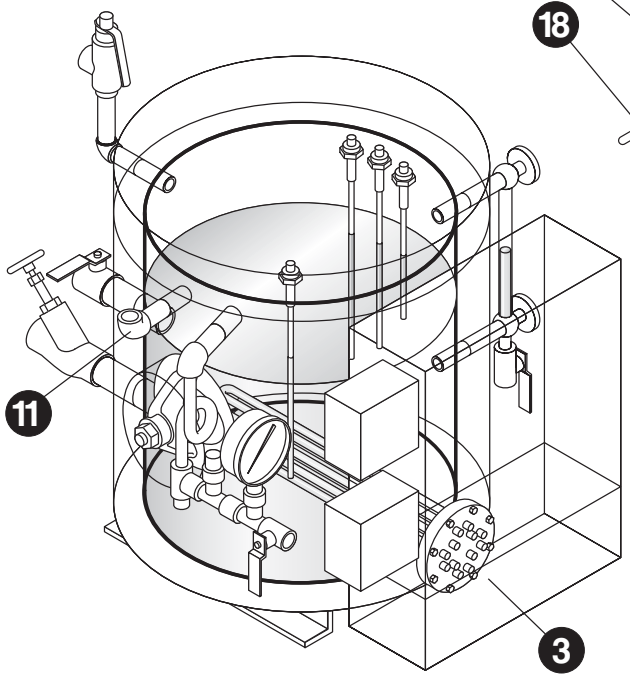


Component Locations of the Fulton 12 to 1000 kW (1.2 to 100BHP) Steam Boilers

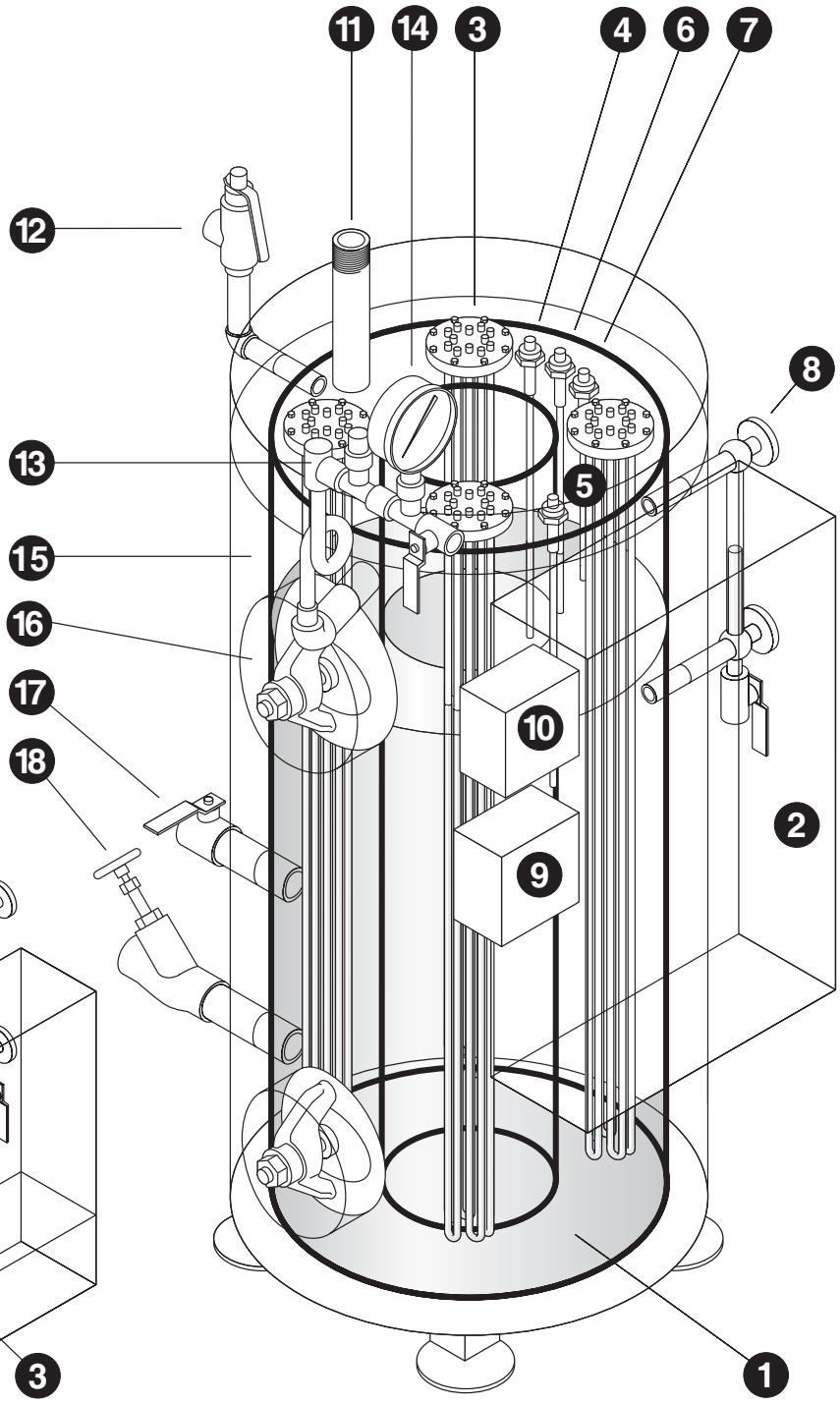
1. Pressure Vessel Is Built to ASME Code 5 Year Warranty
2. Electrical Control Panel Box
3. Electric Heating Elements
4. Low Water Cut Off Probe
5. Second (auxiliary) Low Water Cut Off Probe
6. Pump "On" Probe
7. Pump "Off" Probe
8. Sight Glass Assembly
9. Operating pressure control
10. High Limit Pressure Control w/ manual reset
11. Steam Outlet
12. Safety Valve
13. Steam Guage Assembly
14. Steam Pressure Guage
15. High Temperature Insulation Surrounds The Pressure Vessel
16. Large (3" x 4") Easy Access Handholes
17. Feedwater Shut Off Valve
18. Blowdown Valve
19. Water Bottle Assembly for 300 to 1000 kW Only

NOTE:
All Fulton Electric Steam Boilers have a second (auxiliary) low water cut-off probe

12 to 36 kW (1.2 to 3.6 BHP)
Element(s) are horizontally mounted at the bottom of the pressure vessel. All probes are located in the top of the boiler.

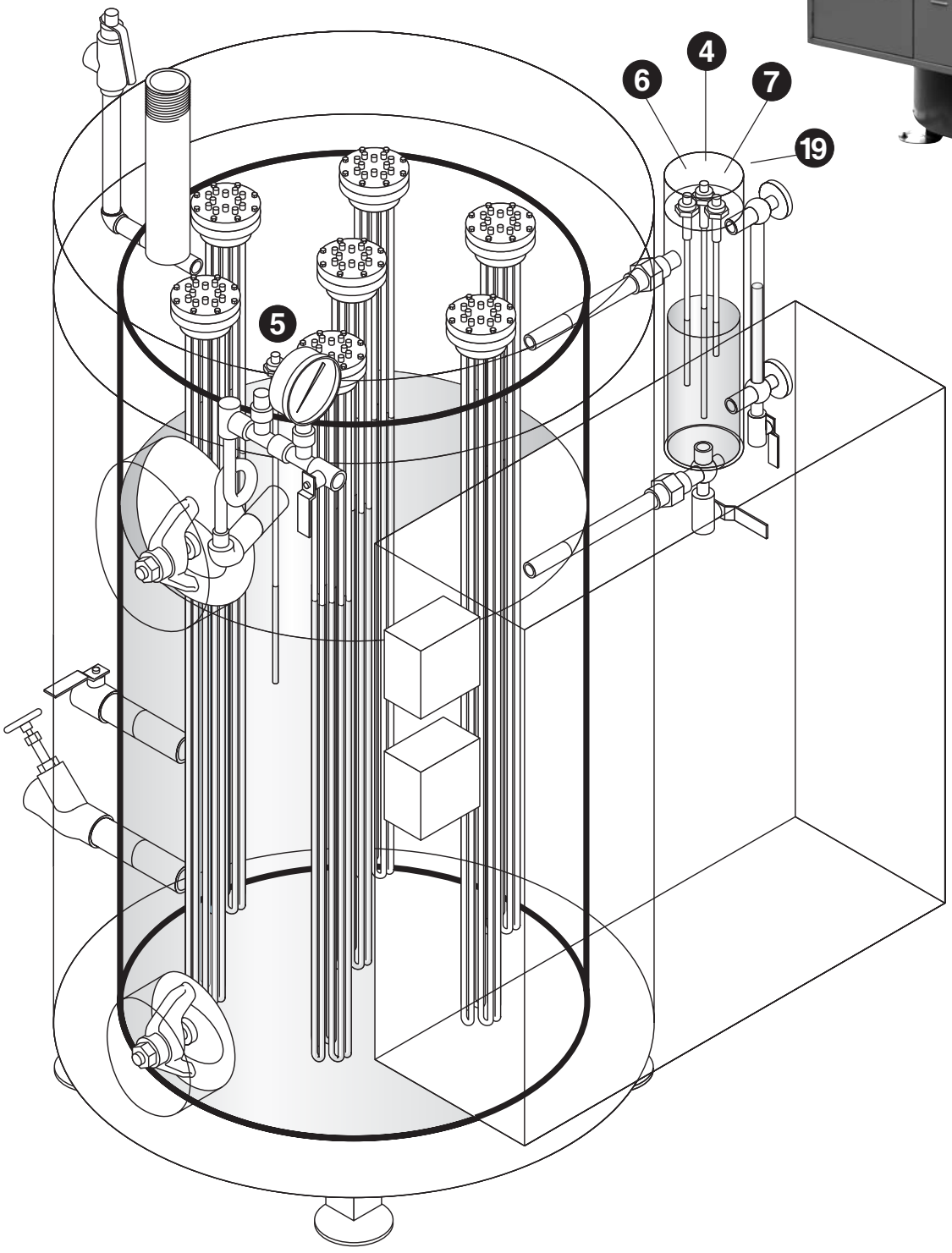


50 to 200 kW (5 to 20 BHP)
Elements are vertically mounted. All probes are located in the top of the boiler.

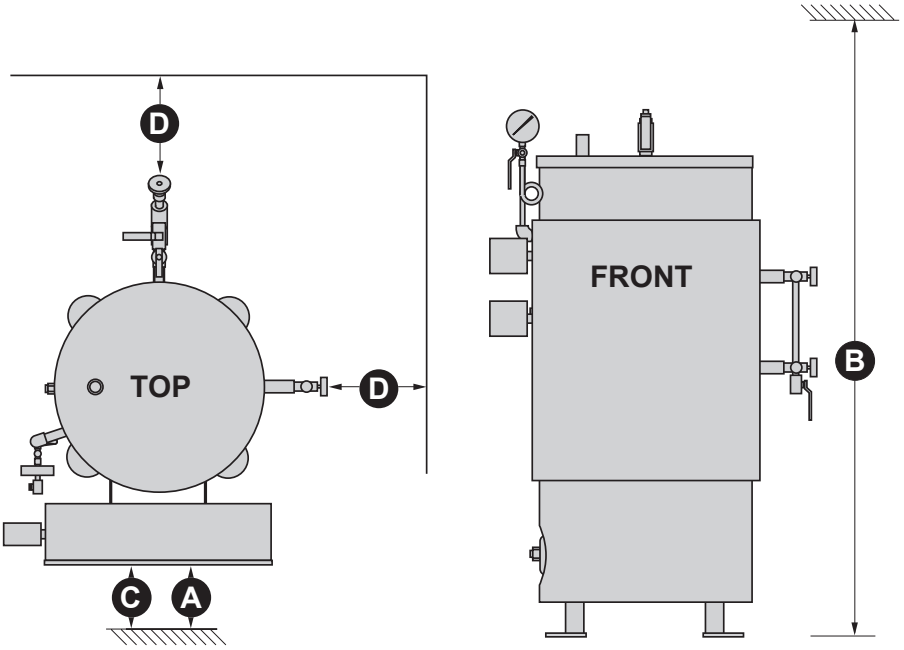


Component Locations of the Fulton 12 to 1000 kW (1.2 to 100BHP) Steam Boilers

300 to 1000 kW (30 to 100 BHP)
Elements are vertically mounted. There boilers have an externally mounted water bottle assembly housing the low water cut-off probe, pump on and pump off probe. The second (auxiliary) low water cut-off probe is mounted in the top of the boiler.



Electric Boiler Installation Guidelines



Model FB-L		012	015	018	024	030	036	050	075	100	150	200	300	500	750	1000
Unit Size:	kW	12	15	18	24	30	36	50	75	100	150	200	300	500	750	1000
	HP	1.2	1.5	1.8	2.4	3.0	3.5	5.0	7.5	10	15	20	30	50	75	100
(A) Horizontal	IN	14	14	14	14	14	14	--	--	--	--	--	--	--	--	--
to remove elements	MM	356	356	356	356	356	356	--	--	--	--	--	--	--	--	--
(B) Floor to Ceiling	IN	--	--	--	--	--	--	95	95	95	95	95	139	139	139	139
to remove elements	MM	--	--	--	--	--	--	2413	2413	2413	2413	2413	3531	3531	3531	3531
(C) Front of Boiler*	IN	24	24	24	24	24	24	24	32	32	32	34	34	36	36	36
	MM	610	610	610	610	610	610	610	813	813	813	864	864	914	914	914
(D) Sides & Rear of Boiler	IN	12	12	12	12	12	12	12	12	12	12	24	24	24	24	24
	MM	305	305	305	305	305	305	305	305	305	305	610	610	610	610	610

*This represents the door clearance. UL requires at least 36" clearance in front of any electrical control panel

Electrical Considerations

Typical 120 VAC controls allow for a +10% and -15% voltage fluctuation.

Motors are designed to operate within the following limits at the motor terminals:

AC Power supplied is within +/-10% of the motor rated voltage with the rated frequency applied; OR

AC power supplied is within +/-5% of the rated frequency and with the rated voltage; OR

A combined variation in voltage and frequency of +/-10% (sum of absolute values) of rated values provided the frequency variation does not exceed +/-5% of rated frequency.

For three-phase motors, the line to line full load voltage must be balanced within 1% of the rated motor voltage. If the motor is rated 208-230V, the voltage deviations must be calculated from 230V. Operation outside of these limits will degrade motor performance. 575V rated motors cannot be operated at voltages above 600V. Depending on the motor manufacturer, a 208V rated motor may not be able to run below the design voltage.

Electric elements will have an increase in watt density if the applied voltage is higher than the element design voltage. Therefore, electric elements have a 0% tolerance for operation over design voltage. Additionally, other components supplied may only be suitable for the design voltage. Electric elements can tolerate a lower than design voltage, but the kW must be derated accordingly.

Feed Water Blowoff Piping

Connect the feed water stop valve to the opening over the blow- off at the rear of the boiler and pipe it to the return system. If the city water pressure exceeds 40 lbs., a pressure reducing valve should be installed ahead of the return tank.

NOTE

Where a condensate return tank is to be fitted, this should:

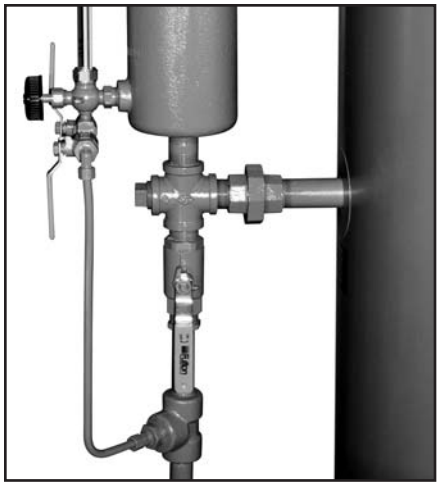
1. **Be vented and**

2. **Have a capacity sufficient to satisfy boiler consumption as well as maintain proper return tank temperature.**

3. **Vent pipe should not be down-sized (This may cause pressure build up in the condensate tank.**

Blow Off Valve

There are three blow off valves on the boiler; the 2 main valves at the rear of the boiler and the water gauge glass blow off valve. The 2 boiler blow off valves supplied with the boiler should be screwed to the blow off pipe at the rear of the boiler and connected to a blow off receptacle of approved design piping. **All these procedures should be done in accordance with state and/or local codes.**



The water gauge blow off valve should be connected to the main blow off line.

NOTE

Care should be taken to ensure that the blow off receptacle used meets the regulations covering such vessels. If in doubt consult a Fulton Representative for advice.

Main Steam Valve

Insert the main steam valve in the steam supply line as close as possible to the boiler and prior to any of the steam using equipment, ensuring correct steam traps are used.

Steam Safety Valve

1. Before installing, be sure that all steam pipes and connections have been blown clean; pipe compound or dope is used on external threads only; and inlet of valve is free of any foreign material.

2. When making installation, use proper type and size wrench .

3. The valve should be installed in a vertical upright position in the connection provided with no unnecessary intervening pipe or lining. Under no circumstances should there be a shut off valve or restriction of any kind between the safety valve and the boiler connection provided.

4. Do not cap or plug drain hole in the side of valve body.

5. Since the purpose of this safety valve is to protect against an overpressure situation, it will loudly discharge hot steam in doing so. Therefore, it is recommended that a discharge pipe be securely installed and run to a safe point of disposal.

6. When a discharge pipe is used, it must be of a pipe size equal to or greater than that of the valve outlet. Use schedule 40 discharge pipe only. Do not use schedule 80, extra strong or double extra strong discharge pipe or connections. It must be as short and straight as possible and so arranged as to avoid undue stress on the valve. It must have an ample provision for draining condensate at or near the valve outlet. It must terminate freely to atmosphere with no intervening valve of any description and it must be securely anchored and supported.

CAUTION

Do not downsize piping below safety valve size.

CAUTION

Unless otherwise specified, the steam safety valve supplied with the boiler is pre-set. This valve is provided as a safety device for the boiler and should not be used as the sole protection for other equipment using steam from the boiler. Do not tamper with the setting (It could accidentally be set at a pressure higher than the design pressure of the boiler, and therefore create a hazardous condition.

Electrical Power Requirements (In Amps)

Model FB-L	012	015	018	024	030	036	050	075	100	150	200	300	500	750	1000
208V 3 Phase	34	42	50	67	84	100	139	208	278	416	556	832	--	--	--
230V 1 Phase	52	65	78	--	--	--	--	--	--	--	--	--	--	--	--
230V 3 Phase	29	36	43	58	73	87	120	180	241	361	482	724	--	--	--
460V 3Phase	15	18	21	29	36	44	60	90	120	180	241	363	607	906	1204
575V 3 Phase	13	16	18	24	30	36	50	76	101	150	201	301	502	756	1004

Electrical Requirements

1. Connect wiring as shown in the specific wiring diagram which is furnished inside the cover of the electrical control box. Be sure to install a separate fused disconnect for the boiler. All wiring must conform to NEC Code.

WARNING

Prior to powering up the boiler, all electrical contacts require re-torquing to the individual compenents manufacturers recommendations.

2. A correctly sized fused disconnect switch should be fitted as close to the boiler as possible and connections made to the boiler control panel in compliance with NFPA (National Fire Protection Association), NEC Code, and local codes. The appropriate number of terminals are provided inside the control panel box to take these connections, but the panel box must be drilled to accept the type of conduit used. See additional notes on page 12.

Boiler Controls

Fulton packaged electric steam boilers are equipped with both a steam pressure control and a high limit pressure control mounted on the outside or inside of the electrical panel box.

1. The steam pressure control should be adjusted to suit the boiler application. The control has two scales (main and differential) which can be adjusted by means of screws on top of the control. The main scale setting should be adjusted to the desired operating steam pressure.

CAUTION

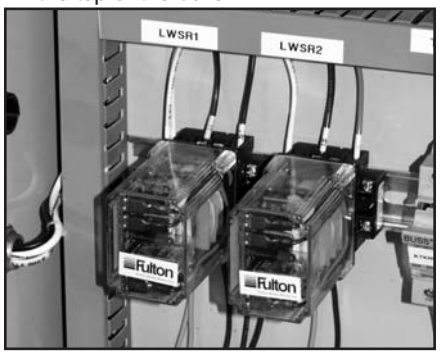
Do not adjust to exceed the pressure rating on the boiler.

2. A high limit pressure control is located next to the operating steam pressure control and should be set 5 to 10 pounds higher than the operating steam pressure control. This control serves as a secondary high pressure cut-off if for some reason the main operating steam pressure control should become inoperative.

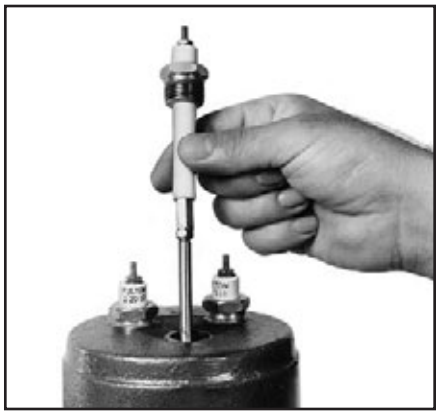
Low Water Control Relays

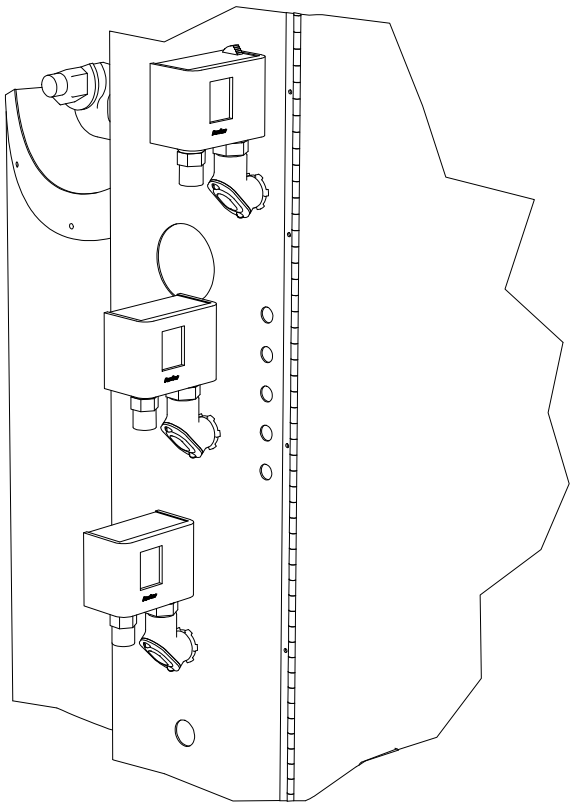
1. Boilers from 1.2 to 3.6 HP are equipped with one low water cut off relay in the panel box connected to two independent probes in the top of the boiler and one water level control relay in the panel box operating two probes in the top of the boiler.

2. Boilers from 5 - 20 HP contain two low water cut off relays in the panel box connected to two independent probes in the top of the boiler.



3. Boilers from 30 - 100 HP have an external water column on the right hand side of the boiler. There are two low water cut off control relays in the panel box. One connects to a probe in the top of the boiler and the other connects to a probe in the top of the water bottle.





Water Gauge & Gauge Glass Installation

NOTE

Only properly trained personnel should install and maintain water gauge glass and connections. Wear safety glasses during installation. Before installing, make sure all parts are free of chips and debris.

NOTE

Keep gauge glass in original packaging until ready to install.

1. Verify the proper gauge has been supplied.

2. Examine the gauge glass and packings carefully for damage before installation. Do not use the glass if it contains any scratches, chips, or any other visible signs of damage.

3. Do not subject the gauge glass to bending or torsional stresses.

4. Apply Teflon tape or pipe dope to pipe threads. Install top gauge fitting (fitting without a drain valve) into the uppermost tapping. Wrench tighten the fitting until it is snug and the glass outlet is pointing at five o'clock (about 1/8 turn from its final downward vertical position).

5. Install the bottom gauge fitting (the fitting with a drain valve) until it is snug and the glass outlet is pointing directly upward. Verify top and bottom fittings are threaded into the tappings the same number of turns (distance A=distance B).

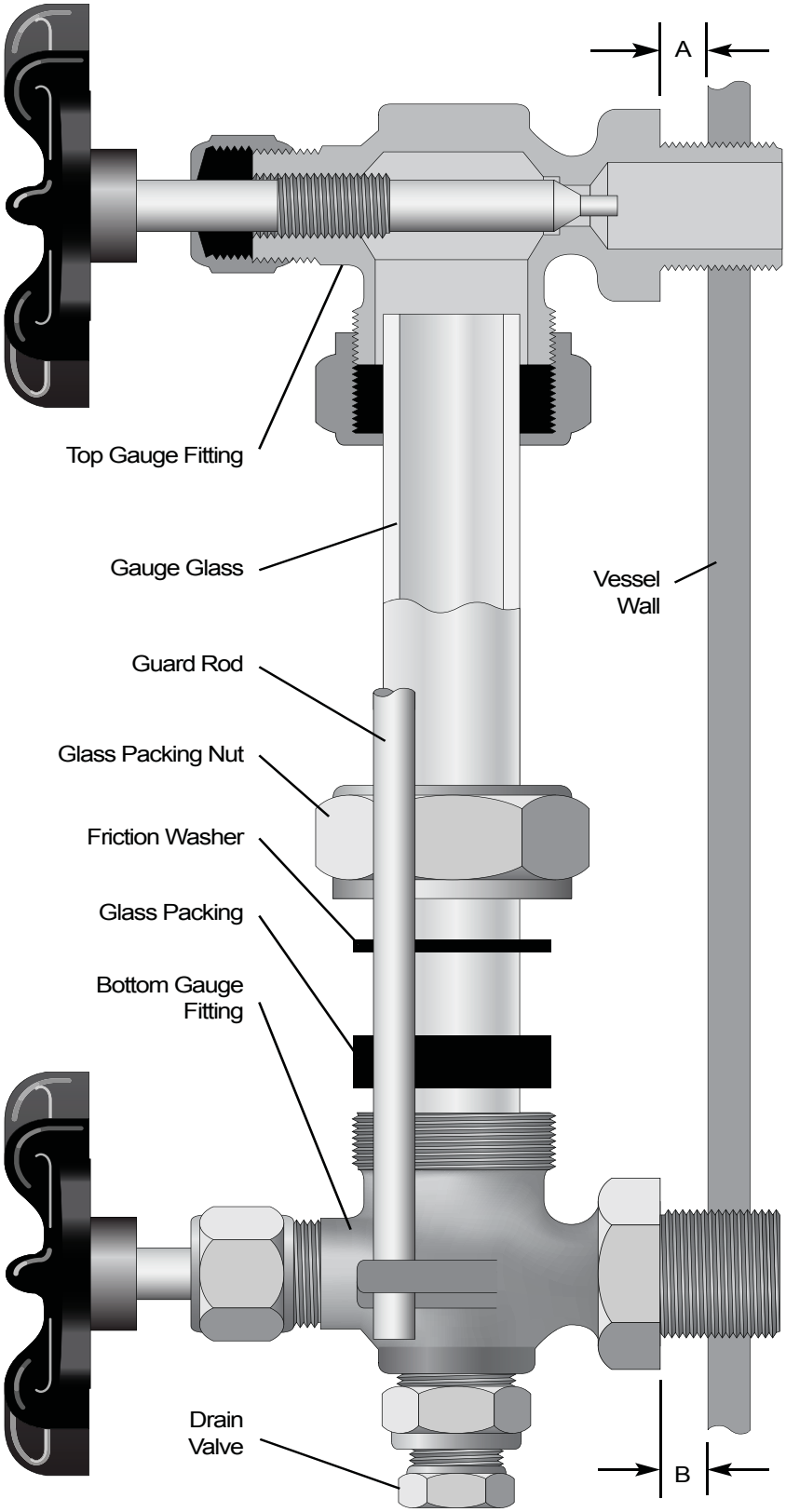
6. Remove glass packing nut, friction washer and glass packing from the fittings, and place them, in the same order, on to both ends of the gauge glass. Push both packings about an inch up the gauge glass.

7. Gently insert one end of the glass into the top gauge fitting. Keeping the glass inside the top fitting, gently rotate the top gauge fitting clockwise until vertically aligned with the bottom gauge fitting, then inset glass into bottom fitting until glass bottoms out on the shoulder inside the bottom fitting.

8. Carefully raise glass about 1/16" and slide lower glass packing down until the glass packing contacts the lower gauge fitting. DO NOT allow the glass to remain in contact with any metal!

9. Carefully slide upper glass packing up as far as possible.

10. Hand tighten both glass packing nuts, then tighten 1/2 turn more by wrench. Tighten only enough to prevent leakage. Do not over tighten! If any leakage should occur, tighten slightly, a quarter turn at a time, checking for leakage after each turn.



11. Install the protective guard, and utilize automatic ball checks where necessary to help prevent injury in case of glass breakage.

WARNING

Improper installation or maintenance of gauge glass and connections can cause immediate or delayed breakage resulting in bodily injury and/or property damage.

Water Supply

1. The quality of the water used in the boiler will affect the life of the elements and it is strongly recommended that a competent water treatment concern be consulted prior to the installation of the boiler. They should be advised that treatment will be used on an electric boiler. Certain chemicals may attack or attach to boiler heating elements and shorten their life span. Elements damaged due to adverse water conditions will not be replaced under warranty.

2. Natural feedwater supplies contain solids and dissolved gases. These may promote incrustation or scale, foaming, solids in steam, corrosion, and/or caustic embrittlement. To prevent this, feedwater must be studied individually and treated accordingly. The treatment should provide quality feedwater to the boiler such that corrosion and deposition in the boiler will be minimized. Dissolved oxygen, high chloride levels and low pH can all be major causes of corrosion. Untreated hardness is the major cause of deposits. Poor quality feedwater requires increased blowdown and increased chemical treatment costs to prevent boiler corrosion and scaling.

3. One way to lower the amount of dissolved oxygen in the boiler feed water is to preheat the feedwater. This option injects live steam into the feedwater to increase the water temperature to 180 degrees F or higher which removes oxygen from the water. Oxygen is a corrosive.

4. **RO/DIWater:** Reverse Osmosis / Deionized water is water that all dissolved solids have been removed. Osmosis is a process that uses a semi-permeable membrane, under pressure, to reject dissolved salts and allow water to pass through. When a solution of salt and water is separated by a membrane, the osmotic pressure forces the water through the membrane, diluting the salt solution. When pressure greater than osmotic pressure is applied to the salt solution, the membrane allows the water from the salt solution to pass into the water solution and rejects the dissolved salts. The osmotic process is reversed, hence, reverse osmosis. RO/DI water have no buffering capacity and a pH of <6.5. It is corrosive to carbon steel, however, not to stainless steel. Very high purity steam quality can be obtained with RO/DI water.

5. Electric boiler pressure vesselsmade from carbon steel that use RO/DI water for the supply water will require pH neutralization for vessel longevity. Electric boilers with stainless steel pressure vessels. ASME Code allows electric boilers to be manufactured with stainless steel pressure vessels provided RO/DI water only is used as the water supply. The use of RO/DI water must be listed on the nameplate of the boiler. The use of RO/DI water with stainless steel pressure vessels does not require pH neutralization.

6. The Fulton Warranty does not cover damage or failure that can be attributed to corrosion, scale or dirt accumulations. Oxygen is corrosive.

Recommended Water Treatment

1. Following are recommendations for feed water and boiler water. Contact your local water treatment professional for testing and treatment recommendations. It is very important that a strict water treatment program be followed.

Feedwater:

Dissolved Oxygen.....less than 0.03 ppm
pH Value.....9-11
*Hardness.....less than 70 ppm
in terms of calcium carbonate
Oil.....none
Suspended Solids.....none
Organic Matter.....less than 5.0 ppm
Chloride.....less than 50.0 ppmTotal
Dissolved Solids.....less than 300ppm
Temperature.....less than 120°F

Boiler Water:

Phosphate.....30 to 50 ppm
expressed as PO_4 (Phosphate)
Alkalinity.....less than 300 ppm
as CACO3 (Calcium Carbonate)
Chloride.....less than 500 ppm
pH Value.....9 to 11
(measured at room temperature)
Total Dissolved Solids....less than 2,000 ppm
Iron.....1 ppm maximum
Silica.....180 ppm max. as SIO_2
Hardness.....less than 50.0 ppm
Dissolved Oxygen.....none

ppm = parts per million
*1 Grain Hardness = 17.118 ppm
Therefore: 70 ppm = 4.10 grains hardness

2. It is critical that the boiler pH be alkaline (9-11) whenever water is in the boiler. This is traditionally maintained through a combination of sodium hydroxide, bicarbonate and phosphate. The phosphate has the additional benefit of removing any hardness that may leak past the softener. Solids that enter in with the feed water concentrate in the boiler. A regular schedule of boiler blowdown must be maintained to prevent high salt concentrations (chloride and sulfate) from corroding the boiler or forming deposits.

Glossary of Water Supply Corrosives and Inhibitors

Dissolved Oxygen: Oxygen that is dissolved in the feedwater will cause the steel in the boiler and the feedwater system to be attacked by the water in a manner described as “pitting”. The pits that are produced y can vary from tiny depressions to holes large enough to penetrate the boiler metal and are usually covered with tubercles of iron oxide. Once pitting starts, it may be extremely hard to arrest. Pitting can proceed at a surprisingly rapid rate and can occur not only in the boiler proper, but also in pre-boiler equipment such as ecomomizers, feedwater heaters, and feedwater lines.

Sodium Sulfite: Its purpose is to chemically remove the dissolved oxygen left in the feedwater after the feedwater has been mechanically deareated. Sodium Sulfite reacts chemically with dissolved oxygen, producing sodium sulfate. Since it is desirable to remove dissolved oxygen from the feedwater before it reaches a boiler. Sodium sulfite is best introduced continuously at some suitable point in the feedwater system (the storage section of the feedwater heater or deareator, six inches below the water line). Chemical residual control is based on the maintenance of a specific excess of sodium sulfite in the boiler water. The essential requirement being to maintain in the feedwater at all times slightly more than enough sodium sulfite to consume all of the dissolved oxygen that slips through the deareating equipment. When sodium sulfite is not fed continuously, protection of the boiler against oxygen attack must depend on the reserve of sodium sulfite that is present in the boiler water. In this case, it is important that the feedwater and the boiler water are mixed thoroughly and as quickly as possible so that boiler water sodium sulfite may consume feedwater oxygen before the latter can cause damage to the boiler. Sulfite as a treatment represents the second line of defense against oxygen corrosion. Primary protection against this type of attack requires adequate facilities for mechanical deareation of the feed-water plus a vigorous maintenance program to safe guard against oxygen leakage into the pre-boiler system.

Suspended Solids: Suspended solids are the undissolved matter in water, inc-luding dirt, silt, vegetation, iron oxides, and any other insoluble matter. Normally suspended solids are expressed in terms of turbidity. The presence of suspended solids in cooling water can increase impingement type corrosion. Suspended solids may also deposit in low velocity areas and create differential aeration cells. Pitting can result. The most common cause of high suspended solids is high hardness

feedwater or high corrosion rates.

In line filters, or various types of pretreatment can be used to lower the suspended solids level. Various polymers assist in holding solids in suspension. Periodic blowdowns will eliminate suspended solids.

Alkalinity: Alkalinity is the capacity of a water to neutralize acids. Common water alkalinities consist of bicarbonate, carbonates, hydroxide, phosphate, and silicate. These alkalinities, especially bicarbonates and carbonates, break down to form carbon dioxide in steam, which is a major factor in the corrosion on condensate lines. High alkalinity also causes foaming and carry over in boilers.
Both foaming and carry over cause erratic boiler operation. When foaming occurs an antifoam should be added or increased. The reason for the high alkalinity should be determined. It may result from lack of sufficient blow off. Pretreated makeup water and condensate should also be checked. Quite often the source of alkalinity is an overdose of alkaline internal water treatment chemical.

pH: pH is a measure of the degree of acid or base of solution. pH ranges of 7.5-8.0 will have little influence on the corrosion rate of cooling waters. If for some reason—pollution, etc.—the pH is lowered into the acid range, increased corrosion can be expected. The solution lies in determining the cause of the low pH and correcting that condition. A low pH can result in corrosion of metals, while a high pH can result in scale formation. In order to control boilers and equipment used for the external treatment of make up water, it is essential that reliable pH measurements be made. RO/DI water will have a pH of 6.0 - 6.5 and will require neutralization if used in a carbon steel vessel.

Phosphates: Ground or surface waters seldom contain large amounts of phosphates. If present, it generally indicates fertilizer runoff or pollution. Phosphate from raw water can be the cause of scale problems in open recirculating cooling water systems after the water is concentrated.

Chlorides: Chlorides are involved in most cooling water corrosion cells. Other factors being equal, it can be assumed the higher the chloride content, the more corrosive the water. When pits or cracks occur on stainless steel or other metals, chlorides are usually suspect. If chloride levels are high enough to cause severe corrosion, they can be controlled by limiting the cycles of concentration and increasing boiler blowdowns. Corrosion from chlorides can also be controlled by increasing the amount of corrosion inhibitor or changing to a more effective inhibitor. Reverse osmosis is another method of pretreatment to reduce chlorides.

Oil: Oil is not a natural constituent of boiler water; still it can frequently enter a system through leaks in a condenser or other heat exchanger. Oil can also enter a system through the lubrication of steam driven reciprocating equipment. Whatever the source, the presence of oil in boiler water is undesirable. Oil can act as a binder to form scale. In high heat-transfer areas oil can carbonize and further contribute to the formation of scale and low pH.
Foaming is one indication of oil in boiler water. Its presence can also be confirmed by first shaking a bottle containing boiler water. If oil is present foam will result. To ensure the foaming is being caused by oil, add a small amount of powdered activated carbon to the bottle containing the boiler water and shake. Little or no foam will appear if the foaming is caused by oil. Often oil in boiler water will originate in the condensate. This contaminated condensate should be directed to the sewer until the source of the oil is determined and corrective steps taken.

Silica: Silica in boiler deposits is usually combined with other constitutents. Silicates form a number of different scale complexes with calcium, magnesium, aluminum, sodium, and iron. Since there is at present no effective dispersant for silicate deposits, the scale problem can be alleviated by maintaining close control of calcium, aluminum, and iron as well as silica. The usual control procedure is to maintain the silica level in open recirculating water at 180 PPM max.

Iron (oxides): Iron in any of its oxide or complex forms is undesirable in boiler water. It is very difficult to disperse so that it can be removed the bottom blowoff lines. Iron in its various forms can originate in the raw water makeup, condensate return water, or form directly in the boiler as a result of corrosion. Most iron oxide originates outside the boiler. It does not concentrate in the boiler and it tends to collect in stagnant areas. If a boiler is using raw water makeup, iron is almost certain to be a major component of developing scale.

Water Hardness: Water hardness is the measure of calcium and magnesium content as calcium carbonate equivalents. Water hardness is a primary source of scale in boiler equipment.

Feedwater: Feedwater is the combination of fresh makeup and returning condensate that is pumped to the boiler.

Condensate: Condensate is condensed steam that is normally low in dissolved solids. Hence, it does not contribute to the dissolved solid content of the feedwater. In addition, condensate is very expensive to waste. It's been chemically treated, heated, pumped, converted to steam, and condensed. This costs money and when condensate is returned to the boiler, money is saved.

Installation Check Points

1. Make sure all piping connectors are complete and tight

2. Make sure the pressure controls are adjusted properly.

3. Make sure all electrical connections in the control panel box, the water column, and elsewhere are secure.

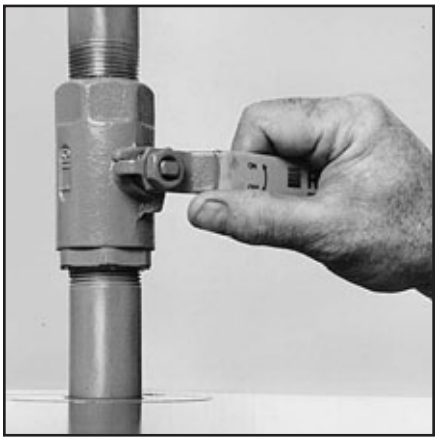
NOTE

After installation is complete and prior to operation, the pressure vessel should be cleaned.

Cleaning The Pressure Vessel

1. After the boiler has been installed and before it is placed in service, it is advisable to clean the pressure vessel to eliminate any oil film, dirt, or other impurities. Clean the pressure vessel as follows:

   a) Isolate the boiler from the system by shutting off the main steam valve.



   b) Remove the steam safety valve.

   c) Mix washing soda or other boilout chemical with water in a one-gallon container and pour it into the boiler through the steam safety valve opening.

The mixture of washing soda is as follows:

Boiler Size	Soda
12 Kw to 36 Kw	1/4 lb. (114g)
50 Kw to 75 Kw	1/2 lb. (227g)
100 Kw to 150 Kw	1 lbs. (454g)
200 Kw to 300 Kw	1.5 lbs. (681g)
500 Kw	3 lbs. (1362g)

   d) If Oxy-Clean is used, then use 1 lb. of Oxy-Clean per 50 BHP.

   e) Replace the steam safety valve.

   f) Fill the boiler with water. Water level is about center in the water gauge glass.

   g) Generate 15 PSI (1 Kg/cm2) of steam and shut off the boiler. Allow this hot solution to remain in the boiler for ten minutes.

   h) Drain and flush the boiler twice with fresh water.

   i) To remove all the oil and dirt from the main steam and condensate return lines, allow the returns to go into a floor drain or a safe discharge point for a few hours of operation.

Alternate method of boiler / feedwater system cleaning

1. Add Oxy-Clean chemical to feedwater return tank and allow feedwater pumps to pump feedwater/chemical into boiler. Allow boiler to discharge steam enough to pump 2 complete tankfuls of feedwater into the boiler.

2. Drain feedwater and boiler, refill, reheat to steaming and redrain.

3. Refill system and use as required.

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2
Section 3 Operation
4
5

Introduction

The following instructions are given for the guidance of the operator in the use of Fulton Electric Steam Boilers. Before operating your Fulton Electric Steam Boiler:

STOP!
Make sure you have read and followed all previous safety information.

NOTE
Check with local authorities where approval for start-up is required. In some localities, final inspection of services may be required.

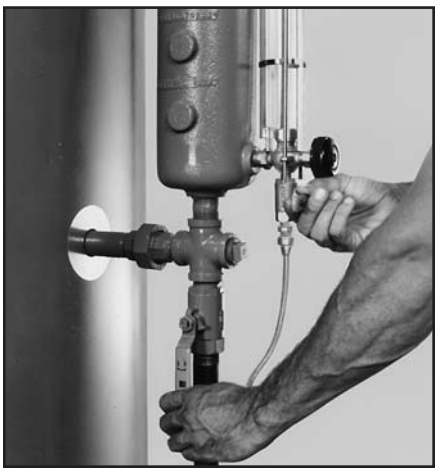
CAUTION
In general, ensure that the boiler area is in conformance with established boiler room requirements. Review national and local codes.

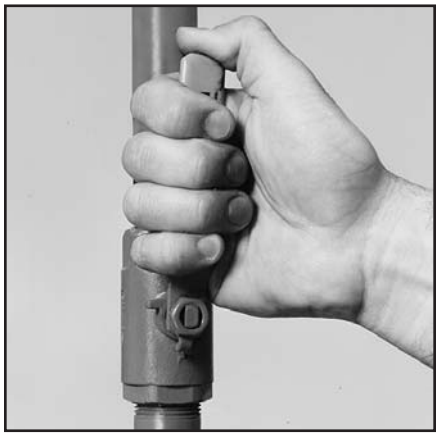
Starting the Boiler

Do not attempt to start the boiler until all of this section has been read. Carry out the following procedure on the initial start up of the boiler and on every subsequent occasion when restarting the boiler after a shut down.

1. Close blow-off valve.

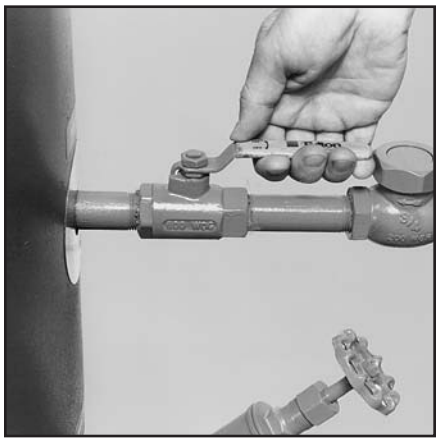
2. Close water gauge drain valve.





3. Open main steam stop valve at the top of the boiler.

4. Open water feed valve on boiler.



5. Open valves on makeup water line to return if return system is used.

6. Place feedwater pump fused switch in the “on” position. The water pump will continue to operate until the water has reached the proper level in the boiler. This level is at about the center of the water gauge glass.

7. To check proper boiler control operation and pressure control settings, you may choose to close the steam supply valve on initial start up. This will enable you to observe the complete boiler operation without heating the complete system. The fused switch that controls the feed water pump should be kept in the “on” position at all times during the boiler operation as well as during the non-operating period of the boiler. This should be turned off only when repairs or adjustments are to be accomplished.

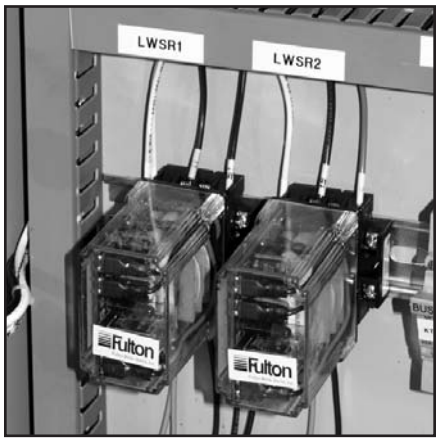
8. Turn the switch on the boiler to the “on” position. The white light will light indicating that the electrical circuit for the boiler has been energized and that all controls are working properly.

Boiler Controls

The boiler is now fully operational and will be automatically controlled as follows:

1. The steam operating pressure control will control the on/off cycle of the elements once the boiler is operating. The low water cut-off probes will signal the low water relays and shut off power to the elements should the water in the boiler drop to an unsafe level and will only re-energize the elements when the water in the boiler has regained a safe level. Proper water level control is maintained automatically by two water level probes located in the boiler shell (1.2-20 HP) or in the water column (30-100 HP). These two probes turn the feedwater pump on or off.

2. Fulton Boilers are equipped with solid state plug-in relays. Manual reset is



standard. It can easily be distinguished by the low water reset button located on the panel box. For Models FB-012-L through FB-036-L there is a pump control relay and one low water cut off control relay located in the panel box. For Models FB-050-L through FB-1000-L there is a pump control relay and two low water cut off control relays located in the panel box. The pump control relay is located on the left and the water level control relay(s) on the right.

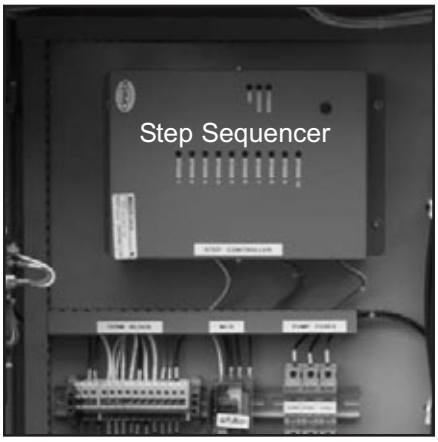
CAUTION

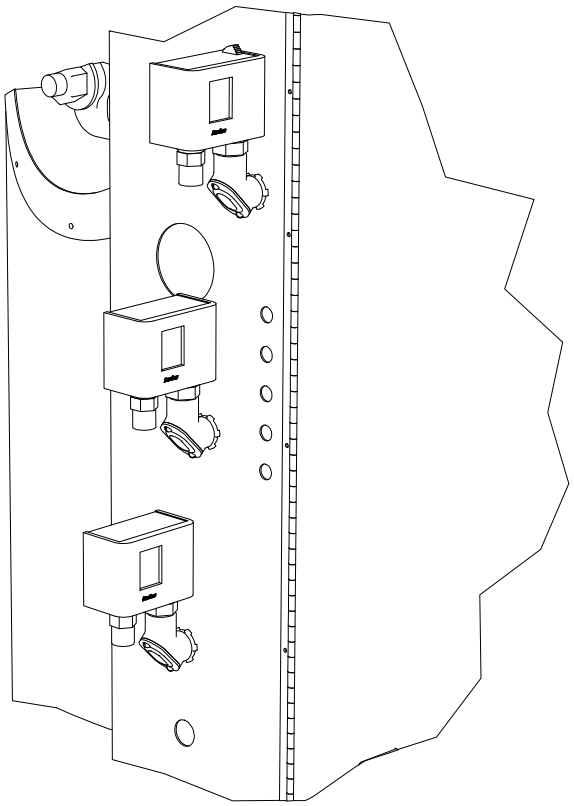
Do not tamper with the safety features of the low water safety cut off.

3. The boiler has a manual reset control should a low water condition arise. It will be necessary to reset the low water control after the water again reaches a safe level in the boiler. In the event of power failure this control must also be reset. Place the main switch to the “on” position and press the low water reset button and the contactor will start.

4. On Models FB-012-L through FB-075L after starting the boiler and the steam pressure reaches the set pressure on the operating pressure control, the heating element will then shut off automatically, and the green light will go out. After the steam pressure drops according to the differential setting on the operating pressure control, the heating element will then restart automatically and the green light will come back on. The differential can be changed on the steam operating pressure control by adjusting the screws found on the top of the control.

5. Models FB-100-L through FB-1000-L do not have a green light, but instead, are standardly supplied with a step sequencer which is located inside the panel box. The step sequencer indicates which element contactors are energized





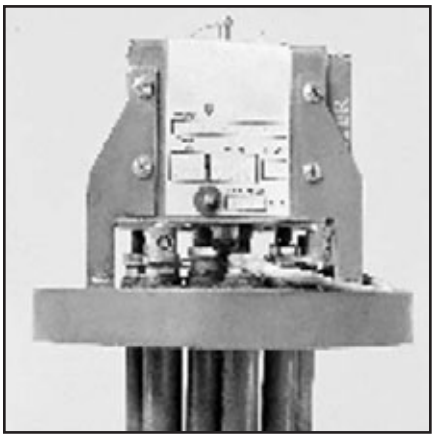
WARNING

When stopping the boiler for any extensive repairs, shut off main power switch and pull the main disconnect switches.

6. The high limit pressuretrol is located on the side of the control box and connected to a steam pressure fitting in the boiler by means of a copper tube. The high limit pressuretrol will shut the boiler off when the maximum pressure is reached. This pressure is usually set 10 to 15 PSI above the operating pressure -- but below--the maximum pressure of the relief valve.

Thermostat (Optional)

1. An optional thermostat may be supplied with your boiler. This thermostat is located on one of the heating elements and is factory preset at number 11. This should not be readjusted without consulting the factory or your local Fulton Representative. Thermostat serves to protect the element from overheating. Normally only the lead element will have a thermostat.



Blowdown Operation

1. Standard boiler configuration will have a manual bottom blowdown operation. Boiler blowdown should be frequent and short duration. Perform bottom blowdown by opening the slow opening y-valve 2 to 3 turns and opening the fast opening ball / knife valve for a few seconds. The strategy should discharge a small water volume quickly.

2. If an automatic blowdown system is supplied, please refer to specific cutsheets / procedures to understand it's operation.

3. Blowdown operation will help maintain boiler water solids at the proper level.

NOTE

Check maintenance section for more details.

Sight Glass Isolation Valves

1. The brass sight glass isolation valves are equipped with an internal ball check. In the event that a sight glass should break, the ball will seat, preventing the discharge of steam and water. The brass valve stem must be opened fully to arm this capability. If the valve is in any other position than full open, the ball will not seat. For added safety all Fulton boilers are equipped with gauge glass protectors.

NOTE

To ensure that your Fulton steam boiler is kept operating safely and efficiently, follow the maintenance procedures set forth in this manual.

Section 4 Maintenance

Maintenance

Introduction

Your Fulton Electric Steam Boiler has been designed for years of trouble-free performance. To ensure the continued safety and efficiency of the boiler, the schedule of maintenance outlined in this section should be adhered to. The boiler should be inspected annually. All service should be performed by a certified contractor.

WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to be boiler must be disconnected.

CAUTION

Keep boiler area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

CAUTION

Do not use harsh compounds which will injure the feed water pump or elements.

Recommended Daily Maintenance

1. The following procedures should be carried out daily. They are designed to prevent the build up of scale, silt, or sludge in the bottom of the boiler and in the pipes leading to the water gauge. In addition to these procedures the advice of a water treatment supplier should be sought and followed. An ASME Section VIII blow off receptacle must be provided for the appropriate pressure.

2. Make a daily inspection of the boiler and system for leaks or any unusual condition in the operation of the controls and feed pump.

3. Check water level in sight glass. (It should be halfway in the sight glass to prevent a dry fire condition which can permanently damage the elements and pressure vessel.)

4. Check all valves to see that they are opening and closing properly.

Daily Blow Off Sequence

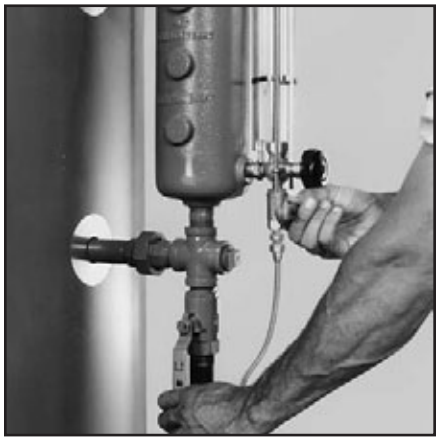
1. Close main steam supply valve.

2. Start the boiler.

Blow Down Boiler Daily. Shown is the blow down "Y" valve.

3. If the boiler is operating, stop the boiler and allow pressure to decrease.

4. When the steam pressure has reached 20 PSIG, turn on the tap water to the blow down separator, then open blow down valve(s) for approximately 10-20 seconds. Close the valve(s). (Automatic cooling kits do this automatically)



Blow down water column each morning by opening the water column and water gauge blow-off valves.

5. For 30 - 100 HP Electric Boilers you must also blow down water level control each morning by opening the water column and water gauge blow off valves for approximately 10 seconds. Close valves.

6. Allow the boiler feed water pump to restore the water level in the boiler.

7. Reopen main steam supply valve for plant operation. If surging occurs, closing the main steam valve partially will often stop this.

Water gauge glass

Inspect daily until the need for replacement becomes apparent. This will assist in establishing routine replacement schedules. Examine the surface of the glass for scratches, corrosion, chips, cracks, surface flaws, or nicks. To do this, shine a very bright concentrated light at an angle of about 45 degrees. A defective glass will glisten as the light strikes imperfections.

Recommended Monthly Maintenance

1. Feed water pump and motor should be lubricated according to the manufacturer's instructions.

2. **Heating Element** - Inspect heating element. To protect the element and prolong its life, it is essential that regular inspections are carried out. The most common causes of element failure are excessive build up of scale and corrosive attack. Both causes are due to adverse water treatment.

   a) The dangers of scale to the life of the element cannot be overstressed. Scale possesses excellent insulative qualities and its formation on the element prevents the heat generated by the element from being transferred to the water, causing the element to overheat and burn out.

   b) Loose powdery formations can be removed with a wire brush.

   c) Hard scale may be removed using a mild chemical cleaning agent followed by a neutralizing agent.

3. **Low water cut-off relay** - Check that the low water cut-off relay is operating correctly in the following manner:

   a) With the boiler operating, open the boiler blow down valve.

   b) When the water drops below the required level, the relay will shut off the contactor. This shows that the relay is working properly. Reset low water cut-off by pushing the reset button on the side of the panel (5 to 100 BHP only).

   c) Close blow-off valve lines and allow boiler to fill to proper level.

4. Blow down the boiler and sight glass completely as described under daily maintenance.

5. Clean the Water Gauge Glass

CAUTION

Do not clean the gauge or gauge glass while pressurized or in operation.

a) Clean the water gauge glass using a commercial non-abrasive glass cleaner. Use diluted acids such as hydrochloric (muriatic) acid when regular cleaners do not seem to work. Do not use wire brushes or any other abrasive materials which could scratch the glass. If any leakage is evident, replace the gaskets.

Clean Glass; Replace Gaskets If Leaking

b) Always replace the high impact plastic gauge glass protector which is standard on all Fulton Boilers.

6. Clean water pump strainers.

7. Check operation of all steam traps on condensate return system.

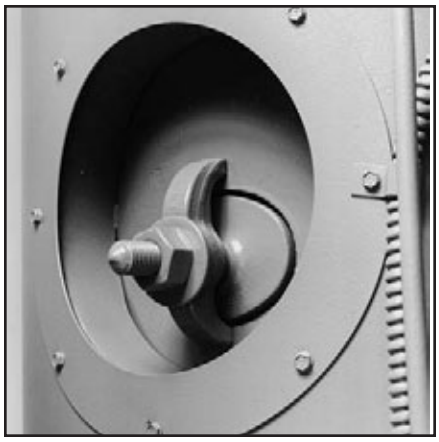
8. Remove pipe cap at the cross connection below water column and clean nipple into boiler. Boiler must be cold and water level below pipe, (30 - 100 BHP only).

Remove cap at cross section; clean nipple to boiler

Recommended Quarterly Maintenance

1. Shut off the boiler completely and drain.

2. Remove the handholes and inspect the interior of the vessel for scale or sludge deposits. The amount of deposits will indicate the efficiency of the water treatment being used. The frequency of this inspection will be dependent on the condition of the water side of the boiler.



Inspect handholes for scale or sludge buildup

3. Replace handhole gaskets using the following procedure.

a) Remove old gasket and thoroughly clean the surface on the boiler and the plate.

b) Place gasket on handhole plate. Be sure the gasket is pushed down tight on the plate. Do not use any grease, lubricant or adhesive.

c) After the plate is in the boiler and the gasket is in place, set yoke and tighten nut only enough to provide a snug fit. Make it hand tight and then snug with wrench about 1/4 turn. Do not compress excessively.

d) If the gasket leaks while pressure is being built up, tighten only enough to stop leakage. Never tighten more than necessary to prevent leakage. Excessive tightening may shorten life of the gasket.

4. Refill the boiler with fresh water.

Recommended Six Month Maintenance

1. **Steam Safety Valve** - Under normal operating conditions a “try lever” test should be performed approximately every six months. Testing should be performed more often under severe service conditions or if corrosion or deposits are noticed within the valve body. A “try lever” test should also be performed at the end of any extended non-service period. Check that the steam safety valve is operating properly by conducting a “try lever” test.

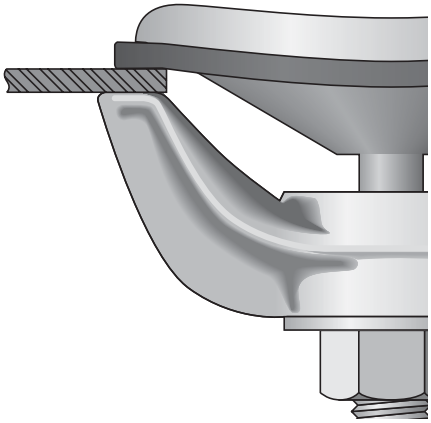


Illustration shows correct pressure on gasket

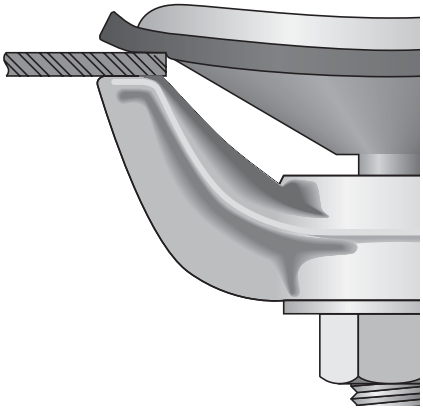


Illustration shows over compressed gasket

CAUTION

Prior to performing the “try lever” test, be certain to take precautions as a loud noise and high velocity steam will discharge freely from discharge port and through drain hole provided in the side of the valve body.

a) The test lever is designed to be activated only when 75% or more of the relief pressure is reached, otherwise distortion could result. The valve should be tested at or near maximum operating pressure by holding the test lever fully open for approximately 5 seconds to flush the valve seat free of any debris or sediment.

b) Permit the valve check to snap shut.

c) If lift lever does not activate and there is no evidence of valve discharge, shut down equipment immediately and replace valve.

2. **Cleaning Probes -** Clean probe on top of boiler shell and probes in water column (30 - 100 BHP). Make sure there is no pressure on boiler during the removal of the probes. Remove one probe, clean with very fine emery cloth and replace it before removing another to assure no probe mix ups that would change the control functions. For replacement purposes, installed probe lengths are indicated in the chart below. For a universally adaptable plug and probe which can be cut to length in the field to fit all boilers, order Part No. 2-20-017.

1.2 to 3.6 HP	5 - 20 HP	30 - 100 HP
A = 9-1/2”	A =11-1/2”	A = 7-1/4”
B = 10-1/2”	B = 13”	B = 9-1/4”
C = 11-1/2”	C = 15”	C = 11-1/4”
D = 11-1/2”	D = 15”	D = 16”

3. Drain the condensate tank and clean by flushing with hose. Check float valve operation.

4. Make sure pump is functioning.

5. Clean boiler out if necessary. See Installation Check Points: cleaning the pressure vessel.

Recommended Annual Maintenance

1. Repeat six month maintenance.

2. Check elements for correct amp draw.

3. Provide annual inspection by qualified ASME Boiler Inspector (if applicable in your state).

4. Re-torque all electrical connections in the control panel box to the manufactueres recommended specifications.

Troubleshooting

This troubleshooting guide will assist in the diagnosis and correction of minor field problems. It should be used in conjunction with the unit wiring diagram. In any case requiring additional assistance, contact your local authorized Fulton Representative.

Problem	Cause	Check
Control Circuit Failure	A. Fuse	If a break is detected, shut off power and remove fuse. Replace with a new fuse of same voltage and amps. Turn power on.
	B. Voltage	Trace wiring diagram through each component to verify power in each stage. If voltage is not detected at any point, replace component and continue test until circuits test clear.
	C. Control Switch	Check all wires from switch terminals for looseness or corrosion. Replace if either is evident. Next check for proper make and break of switch.
	D. Low Water Safety Relay	Verify that boiler has water. Check to verify power on terminal #1. If power is present, check to verify power on terminal #10. If power is not present, press the low water reset button to reset relay. If relay does not reset, inspect terminals for loose connections. Inspect probe connection.
	E. Corrosion of Probes	Check all wires to verify proper wiring to each probe. If a wire is suspected to be in the wrong place, shut off power and check wire with a continuity light. Check probes. If probes are dirty, clean with very fine emory paper and replace.
	F. Staging Controller	Verify timing and stage selection on DIP switches.
Pump Circuit Failure	A. Fuse	If a break is detected, shut off power and remove fuse. Replace with a new fuse of same voltage and amps. Turn power on.
	B. Corrosion of Probes	To verify proper wiring to each probe. If a wire is suspected to be in the wrong place, shut off power and check wire with a continuity light. Check probes. If probes are dirty,clean with veryfine emory paper and replace.
	C. Wiring Connections	With power off, check continuity of circuit through each point in the circuit. If a break in the circuit is found, repair. After repair, recheck with continuity light with power off. Turn power on and check with an amp meter.
	D. Motor Starter Relay	Check power supply to coil on motor starter.coil is being powered, check if contactors are being engaged completely. If coil and contactors are engaging, check power in and out on the control circuits. If contactor is chattering, clean contacts. If motor starter relay is weak or bad, replace.
Primary Voltage Circuit	A. Fuse	If a break is detected, shut off power and remove fuse. Replace with a new fuse of the same voltage and amps. Turn power on.
	B. Voltage	Trace wiring diagram through each component to verify power in each stage. If voltage is not detected at any point, replace component and continue test until circuits test clear.

Troubleshooting

Problem	Cause	Check
Primary Voltage Circuit	C. Wiring Connections	With power off, check continuity of circuit through each point in the circuit. If a break in the circuit is found, repair. After repair, recheck with continuity light with power off. Turn power on and check with an amp meter.
	D. Burned or Broken Wiring	With power off, check continuity of circuit through each point in the circuit. If a break in the circuit is found, repair. After repair, recheck with continuity light with power off. Turn power on and check with an amp meter. Verify wire size is sufficient for amp draw.
	E. Contactor Contact Points	If burned or dirty, clean with fine emory paper. If burned through, replace. If not engaging completely,coil may be weak. Replace.
	F. Elements Shorting or Open Circuit	With power using a continuity tester, check to see if an element is burned out between each point. If power is on, a volt meter may be used. If an element is bad, replace.
Low Water Condition	A. Circulating Pump	Clean or replace all filters or screens to assure proper water flow through them.
	B. Water Makeup Supply	Check to see that your supply water has not been shut off or that there are no restrictions in the line leading to the boiler.
	C. Leaks in the System	Check piping for any leaks.
Scale Formation Elements	A. Hardness, Salt, Precipitation B. High Dissolved Solids	Softener perfomance Blowdown Schedule
Poor Steam Quality	A. High Alkalinity in Boiler Water B. High Organics in Boiler Water C. High Total Dissolved Solids in Boiler Water	Adequate blowdown schedule or over feeding of water treatment chemicals

THE PROTECTION FROM CORROSION OF BOILERS IN STANDBY CONDITION

Prevention of corrosion in a boiler in standby condition is more difficult than in an operating boiler. This brief report has been prepared to summarize the methods that may be followed to prevent or minimize deterioration of the internal surfaces of boilers from corrosion during inoperative periods.

Two sets of conditions must be met:

1. The boiler must be held in readiness to operate at any time on short notice. This may be designated as intermittent standby.
2. The boiler will be continuously inoperative for an indefinite period of weeks or months. This is prolonged standby.

Intermittent Standby

In general, the water level maintained in the boiler under these circumstances corresponds closely to that of operation, or reduced firing, the temperature is held closely to that of steaming temperature. Circulation, however, is very slight if at all.

During operation the boiler water is maintained uniformly in an alkaline state, and by its rapid circulation, segregation of any water containing oxygen is prevented. During the standby period, however, some loss of water occurs…slight leakage through the blow down valve, slight leaking…which is replaced by feed water. IF the feed water is sufficiently oxygen free and of suitable alkalinity (pH value), conditions leading to corrosion will not be developed. However, if the conditions are anything but ideal, delayed intermingling of boiler water and feed water due to lack of circulation or low alkalinity, oxygen rich water may form at the boiler surfaces and initiate corrosion. In the case of considerable length of time and of appreciable make up of feed water to replace losses, the boiler water alkalinity may completely disappear, and general corrosion will result.

No single rule can be given to assure correct conditions in the boiler. The regular boiler water tests must be made as carefully on these boilers as on the operating boilers. This is due to the fact that these boilers while in standby can not be adjusted as easily as the operating boilers, and as such, they can be severely damaged by water problems more easily.

If the alkalinity falls to low, it can be boosted by putting a small amount of alkali solution (preferably a caustic solution) directly into the boiler at the point of feed water entry with a pump or any other convenient manner.

In the cases where quantities of oxygen are dissolved in the feed water, a solution of sodium sulfite (Na2SO3) can be fed to the boiler by means of a pump or either separately or in conjunction with the alkali solution. The minimum amount of residual sodium sulfite that should be maintained in the boiler is 30 – 50 ppm as a residual.

If oxygen pitting and localized corrosion in separate sections of the boiler, then this is a display of typical corrosion due to feed water segregation. Should this occur, then the segregation of the feed water must be stopped. This can be done by intermingling feed water (either by boiler circulation, a circulating pump, or through an injection method.) Additionally, the requirement for make up water can be brought under control by stoppage of system leaks. Finally, if several boilers are subjected to intermittent use, they should be alternated in turn in operating service. This will stop the irregularities that may come about to one boiler that experiences extended standby conditions. This type of rotation prevents nay one boiler from suffering from potential standby problems. On the other hand, do not alternate the boilers on a basis that is more frequent than every week, or you may experience problems from the heating and cooling of the boiler, which will result in leaks due to frequent expansion and contraction of the boiler pressure vessel.

The rules for treating a standby boiler are in large, the same as those for an operating boiler. The application of chemical treatment to a standby boiler must be as fully and more carefully performed.

Prolonged Standby

Two general procedures are available:

1. The boiler may be emptied and dried out, and kept dry.
2. The boiler may be filled completely with water. In this case the drums or the boiler body, whether a water tube or a fire tube boiler is being treated, are filled to the steam stop valve or water supply valve.

Draining and Drying

This method will allow excellent protection from corrosion to the metal surfaces so long as there is no moisture present in the boiler. One method is to let the boiler open for free circulation of air after drying. Another method is to place a desiccant as silica gel in the boiler and the boiler is then closed up for drying. In either case, water leakage over, or sweating of, the boiler metal surfaces must be protected against. Since this type of moisture is saturated with oxygen, its contact with metal surfaces will cause excellerated rates of corrosion. So long as the boiler metal surfaces remain free of moisture, no appreciable corrosion will occur.

If the boiler's past history indicates that external sweating of the boiler internals is a problem, then additional heater should be installed in the furnace at strategic locations in order to insure that the boiler pressure vessel is maintained above the dew point. This concept must also include the superheater section if the boiler has a superheater. If you allow dew to form, then the purpose of lay up is defeated, as the boiler tube metal will rapidly corrode both internally as well as externally.

For extended dry standby, blanketing with nitrogen should be considered. This method will dry out the metal and if maintained properly, it will help to maintain a moisture free atmosphere on the internal areas of the boiler.

Boiler Filled With Water

In this method, protection can be obtained for the boiler metal if:

1. Correct chemical conditions are maintained in the boiler water.
2. The boiler water is mixed adequately to maintain uniform conditions throughout the boiler.
3. The boilers are completely filled with **treated water** as not to allow any boiler metal surfaces to come in contact with the air.

Sufficient caustic soda (or equivalent alkalinity builder) should be added to the boiler water in order to produce a Hydroxyl (OH-) Alkalinity of 350 to 600 ppm. In addition, sufficient sodium sulfite must be added to the boiler water to establish a sodium sulfite residual of 30 – 50 ppm as a minimum.

The mixing of the water in the boiler must be thorough so that correct chemical conditions can exist in every section of the boiler. Mixing of the water can be accomplished by circulating water from one section of the boiler to another with the use of a pump, as in prolonged standby, the boiler is not fired off, and as such, can not mix the boiler water by means of circulation through heating up the boiler. If the pump method is practical, additional chemicals can be trickled into the boiler as they are needed during the circulation procedure.

Some boiler water sludge will form during standby conditions and this must be treated for. The cleaner the boiler surface metal, the lower the potential for corrosion. Either a Polymaleic, Sulfonated Copolymer,

Carboxylated Copolymer, Polyacrylate or a combination of these dispersing agents should be fed at a rate that would be considered the mid range for the sludge dispersant during normal operating conditions. The mixing of these dispersing agents into the boiler water in order to insure a clean boiler is as important as the required use of the previously discussed treatment chemicals.

If the circulating pump method is not practical, then if mixing is required, the boiler will have to be accomplished through light steaming. In this case, the proper levels of treatment chemicals will have to be built up during the week prior to the boiler going off the line. IF this is the method to be used, then increase the chemical treatment levels to; 500 – 800 ppm OH Alkalinity, 100 pm Residual Sodium Sulfite and Maximum Range Feed for the Sludge Disperant. This will supply the boiler water with sufficient treatment chemicals to maintain itself within the desired limits as the boiler sits and some water is slowly lost.

Deaerated water should be used to fill the boilers that are going to be in standby service, when even it is available.

A convenient method for keeping a boiler full of water is to connect a small expansion tank to some connection at the top of the boiler. This tank is to be located above the boiler and is to be kept filled with chemically treated water. If the tank remains full, then the boiler will remain full. If the tank over flows, then the boiler is taking on water from some form of system leakage. It is convenient for maintaining the proper level of chemical treatment protection as well as acting as a level control indicator.

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Section 5 Parts and Warranty

Spare Parts

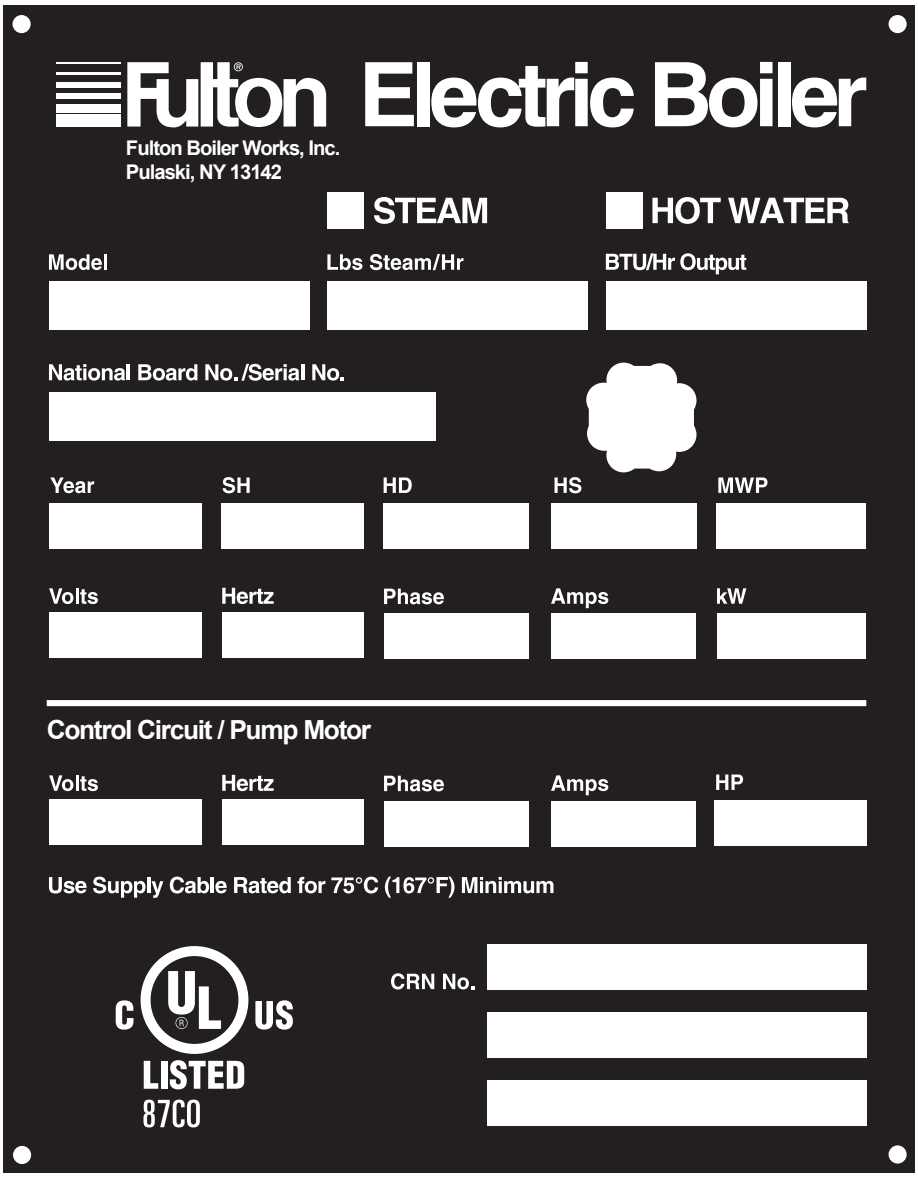
1. It is important that the correct replacement part is fitted to your Fulton Electric Steam Boiler.

2. When ordering replacement or spare parts, make sure that the full information given in the Parts List is supplied, together with the following details as shown on your boiler identification plate:
   a) Boiler Number
   b) Boiler Type
   c) Electrical Specifications

NOTE

The policy of Fulton Boiler Works, Inc. is one of continuous improve ment, and therefore, we reserve the right to change prices, specifications, and equipment without notice.

Fulton Boiler Identification Plate



Part No.	Description	Approx. Net Weight (lbs)	(kgs)
5-60-110	Instruction Manual - Electric		
5-10-800	Weld Patch 1.2-100 HP		
4-11-010	Handhole Assembly 1.2 - 5 HP (White)		
4-11-012	Handhole Assembly 7.5 -15 HP (Red)		
4-11-014	Handhole Assembly 20 HP (Green)		
4-11-016	Handhole Assembly 30 - 45 HP (Yellow)		
4-11-018	Handhole Assembly 50 -100 HP (Blue)		
2-11-100	Handhole Plate 1.2 - 5 HP (White)		
2-11-101	Handhole Plate 7.5 -15 HP (Red)		
2-11-102	Handhole Plate 20 HP (Green)		
2-11-103	Handhole Plate 30 - 45 HP (Yellow)		
2-11-104	Handhole Plate 50 -100 HP (Blue)		
2-11-105	Handhole Yoke		
2-12-004	Handhole Gasket		
2-23-237	Touch-Up Paint (Spray Can 16 oz.)		
4-23-010	Touch-Up Paint (Quart)		
4-23-040	Touch-Up Paint (Gallon)		
5-10-397	T-Handle Wrench		
2-20-017	Water Level Plug & Long Brass Rod Suitable for Cutting		
2-30-137	McDonnell Miller 53-2 Boiler Feeder		
2-30-149	Water Gauge Valves Only w/Ball Checks		
2-12-017	9-1/4“ Water Gauge Glass		
2-12-019	Rubber Water Gauge Glass Gasket		
2-12-020	Brass Water Gauge Glass Gasket		
2-35-514	Brass Packing Nut for Water Gauge Valve		
2-12-022	Lucite Gauge Glass Guard		
2-30-399	142S Watts Water Feeder		
2-40-403	IDIDO Relay 115 Volt		
2-40-402	IGIDO Relay 115 Volt		
2-40-401	ID2DO Relay 230 Volt		
4-45-050	Set of (3) Coils for IDIDO		
2-45-092	Manual Reset Switch		
2-40-420	Fulton Pump Relay - 120V		
2-40-421	Fulton Burner Relay-120V		
2-40-422	Base for Fulton Pump Relay		
2-40-423	Base for Fulton Burner Relay		
2-40-405	Fulton Pump Relay 220v		
2-40-406	Fulton Burner Relay 220v		
2-45-090	Night Switch for (2) Pressuretrols		
4-40-050	Night Heating Pressuretrol Set-Up		
2-45-107	White Panel Box Indicating Lights 120 V		
2-45-108	Amber Panel Box Indicating Lights 120 V		
2-45-110	Red Panel Box Indicating Lights 120 V		
2-45-115	White Panel Box Indicating Lights 240 V		
2-45-116	Amber Panel Box Indicating Lights 240 V		
2-45-114	Red Panel Box Indicating Lights 240 V		
2-40-901	1 20V 5 Step Solitech Sequencer		
2-40-902	240V 5 Step Solitech Sequencer		
2-40-903	120V 10 Step Solitech Sequencer		
2-40-904	240V 10 Step Solitech Sequencer		
2-40-910	Main Frame for Sequencer Athena		
2-40-911	Plug in Steps for Sequencer (White) Athena		
2-40-912	Plug in Step Delay (Yellow) Athena		
2-40-913	Plug in Signal Conditioner (Green) Athena		
2-40-914	Plug in Starter for Sequencer (Black) Athena		
2-21-085	Box for Sequencer		

Part No.	Description	Approx. Net Weight (lbs)	(kgs)
2-40-105	5 Step Sequencer (Honeywell)		
2-40-107	10 Step Sequencer (Honeywell)		
2-40-227	Pressuretrol L404A		
2-40-228	Pressuretrol L404A		
2-40-229	Pressuretrol L404A		
2-40-230	Pressuretrol L404A		
2-40-231	Pressuretrol L404C		
2-40-232	Pressuretrol L404C		
2-40-233	Pressuretrol L404C		
2-40-234	Pressuretrol L404C		
2-40-225	Pressuretrol L91B 0-15		
2-40-226	Pressuretrol L91A 5-150		
2-45-000	Terminal Block 1492-1 OOX A-B		
2-40-208	40 Amp Contactor 120 volt		
2-40-209	40 Amp Contactor 240 volt		
2-40-023	60 AmpContactor		
2-40-024	60 Amp Contactor with 300 Volt Fuse Clip		
2-40-025	60 Amp Contactor with 600 Volt Fuse Clip		
2-40-022	60 Amp Contactor with 600 Volt Fuse Clip - 220V		
2-40-027	240 Volt Coil for 60 Amp Contactor		
2-45-006	SC-40 Fuse		
2-45-007	SC-50 Fuse		
2-45-008	SC-60 Fuse		
2-45-010	JKS-35 Fuse		
2-45-011	JKS-40 Fuse		
2-45-012	JKS-50 Fuse		
2-45-013	JKS-60 Fuse		
2-30-100	Flange Gasket 12-35 KW Element		
2-30-101	Flange Gasket 50-75 KW Element		
2-45-015	Thermostatfor 12-35 KW Element		
2-45-016	Thermostat for 50-75 KW Element		
2-40-028	ABF 12-208 Volt 3 ph. Heating Element with Thermostat		
2-40-029	XBF 12-208 Volt 3 ph. Heating Element		
2-40-030	ABF 12-230 Volt 3 ph. Heating Element with Thermostat		
2-40-031	XBF 12-230 Volt 3 ph. Heating Element		
2-40-032	ABF 12-460 Volt 3 ph. Heating Element with Thermostat		
2-40-033	XBF 12-460 Volt 3 ph. Heating Element		
2-40-034	ABF 12-575 Volt 3 ph. Heating Element with Thermostat		
2-40-035	XBF 12-575 Volt 3 ph. Heating Element		
2-40-036	ABF 15-208 Volt 3 ph. Heating Element with Thermostat		
2-40-037	XBF 15-208 Volt 3 ph. Heating Element		
2-40-038	ABF 15-230 Volt 3 ph. Heating Element with Thermostat		
2-40-039	XBF 15-230 Volt 3 ph. Heating Element		
2-40-040	ABF 15-460 Volt 3 ph. Heating Element with Thermostat		
2-40-041	XBF 15-460 Volt 3 ph. Heating Element		
2-40-042	ABF 15-575 Volt 3 ph. Heating Element with Thermostat		
2-40-043	XBF 15-575 Volt 3 ph. Heating Element		
2-40-044	ABF 18-208 Volt 3 ph. Heating Element with Thermostat		
2-40-045	XBF 18-208 Volt 3 ph. Heating Element		
2-40-046	ABF 18-230 Volt 3 ph. Heating Element with Thermostat		
2-40-047	XBF 18-230 Volt 3 ph. Heating Element		
2-40-048	ABF 18-460 Volt 3 ph. Heating Element with Thermostat		
2-40-049	XBF 18-460 Volt 3 ph. Heating Element		
2-40-050	ABF 18-575 Volt 3 ph. Heating Element with Thermostat		
2-40-051	XBF 18-575 Volt 3 ph. Heating Element		
2-40-052	ABF 25-208 Volt 3 ph. Heating Element with Thermostat		
2-40-053	XBF 25-208 Volt 3 ph. Heating Element		
2-40-054	ABF 25-230 Volt 3 ph. Heating Element with Thermostat		

Part No.	Description	Approx. Net Weight (lbs)	(kgs)
2-40-055	XBF 25-230 Volt 3 ph. Heating Element		
2-40-056	ABF 25-380 Volt 3 ph. Heating Element with Thermostat		
2-40-057	XBF 25-380 3 ph. Heating Element		
2-40-058	ABF 25-415 Volt 3 ph. Heating Element with Thermostat		
2-40-059	XBF 25-415 3 ph. Heating Element		
2-40-060	ABF 25-460 Volt 3 ph. Heating Element with Thermostat		
2-40-061	XBF 25-460 3 ph. Heating Element		
2-40-062	ABF 25-575 Volt 3 ph. Heating Element with Thermostat		
2-40-063	XBF 25-575 3 ph. Heating Element		
2-40-064	BWF 50-230 Volt 3 ph. Heating Element with Thermostat		
2-40-065	XWF 50-230 Volt 3 ph. Heating Element		
2-40-066	BWF 50-460 Volt 3 ph. Heating Element with Thermostat		
2-40-067	XWF 50-460 Volt 3 ph. Heating Element		
2-40-068	BWF 75-230 Volt 3 ph. Heating Element with Thermostat		
2-40-069	XWF 75-230 Volt 3 ph. Heating Element		
2-40-070	BWF 75-460 Volt 3 ph. Heating Element with Thermostat		
2-40-071	XWF 75-460 Volt 3 ph. Heating Element		
2-45-115	White Panel Box Indicating Lights 240 V		
2-45-116	Amber Panel Box Indicating Lights 240 V		
2-45-114	Red Panel Box Indicating Lights 240 V		
2-40-904	240V 10 Step Solitech Sequencer		
2-40-227	Pressuretrol L404A 1354 2-15 PSI (Honeywell)		
2-40-228	Pressuretrol L404A 1370 5-50 PS (Honeywell)I		
2-40-229	Pressuretrol L404A 1396 10-150 PSI (Honeywell)		
2-40-230	Pressuretrol L404A 1404 20-300 PSI (Honeywell)		
2-40-231	Pressuretrol L404C 1147 2-15 PSI (Honeywell)		
2-40-232	Pressuretrol L404C 1150 5-50 PSI (Honeywell)		
2-40-233	Pressuretrol L404C 1162 10-150 PSI (Honeywell)		
2-40-234	Pressuretrol L404C 1139 20-300 PSI (Honeywell)		
2-40-225	Pressuretrol L91B 1035 0-15 PSI (Honeywell)		
2-40-226	Pressuretrol L91B 1050 5-150 PSI (Honeywell)		
2-40-3045	Pressuretrol KP34MR 2-15 PSI (Danfoss)		
2-40-3046	Pressuretrol KP35MR 6-50 PSI (Danfoss)		
2-40-3040	Pressuretrol KP36MR 15-150 PSI (Danfoss)		
2-40-3047	Pressuretrol KP37MR 58-300 PSI (Danfoss)		
2-40-3042	Pressuretrol KP34 2-15 PSI (Danfoss)		
2-40-3041	Pressuretrol KP35 6-50 PSI (Danfoss)		
2-40-3043	Pressuretrol KP36 15-150 PSI (Danfoss)		
2-40-3044	Pressuretrol KP37 58-300 PSI (Danfoss)		
2-40-023	60 Amp Contactor 120 volt		
2-40-295	60 Amp Contactor 240 volt		
2-40-296	60 AmpContactor 220 volt with type SC fuse clip		
2-40-024	60 Amp Contactor 120 volt with type SC Fuse Clip		
2-40-025	60 Amp Contactor 120 volt with type J Fuse Clip		
2-40-022	60 Amp Contactor 220V with type J Fuse Clip -		
2-40-027	240 Volt Coil for 60 Amp Contactor		
2-45-006	SC-40 Fuse		
2-45-007	SC-50 Fuse		
2-45-008	SC-60 Fuse		
2-45-010	JKS-35 Fuse		
2-45-011	JKS-40 Fuse		
2-45-012	JKS-50 Fuse		
2-45-013	JKS-60 Fuse		
2-30-100	Flange Gasket 12-35 KW Element		
2-30-101	Flange Gasket 50-75 KW Element		
2-45-015	Thermostatfor 12-35 KW Element		
2-45-016	Thermostat for 50-75 KW Element		

Part No.	Description	Approx. Net Weight (lbs) (kgs)
2-40-028	ABF 12-208 Volt 3 ph. Heating Element with Thermostat	
2-40-029	XBF 12-208 Volt 3 ph. Heating Element	
2-40-030	ABF 12-230 Volt 3 ph. Heating Element with Thermostat	
2-40-031	XBF 12-230 Volt 3 ph. Heating Element	
2-40-032	ABF 12-460 Volt 3 ph. Heating Element with Thermostat	
2-40-033	XBF 12-460 Volt 3 ph. Heating Element	
2-40-034	ABF 12-575 Volt 3 ph. Heating Element with Thermostat	
2-40-035	XBF 12-575 Volt 3 ph. Heating Element	
2-40-036	ABF 15-208 Volt 3 ph. Heating Element with Thermostat	
2-40-037	XBF 15-208 Volt 3 ph. Heating Element	
2-40-038	ABF 15-230 Volt 3 ph. Heating Element with Thermostat	
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2-40-069	XWF 75-230 Volt 3 ph. Heating Element	
2-40-070	BWF 75-460 Volt 3 ph. Heating Element with Thermostat	
2-40-071	XWF 75-460 Volt 3 ph. Heating Element	

Standard Warranty for Fulton Boilers

Warranty Valid for Models ICS, ICX, ICW, ICXW, VMP, VMPW, FB-A, FB-F, FB-L, FB-S, FB-W

Five (5) Year (60 Months) Material and Workmanship Warranty
The pressure vessel is covered against defective material or workmanship for a period of five (5) years from the date of shipment from the factory. Fulton will repair or replace F.O.B. factory any part of the equipment, as defined above, provided this equipment has been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by Fulton. The commissioning agency must also successfully complete and return the equipment Installation and Operation Checklists to Fulton's Quality Assurance department. This warranty covers any failure caused defective material or workmanship; however, waterside corrosion or scaling is not covered. Therefore, it is imperative that the boiler water management and chemistry be maintained as outlined in the Installation and Operation Manual.

Parts Warranty
Fulton will repair or replace F.O.B. factory any part of the equipment of our manufacture that is found to be defective in workmanship or material within one (1) year of shipment from the factory provided this equipment has been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by both Fulton and the component manufacturers and the commissioning agency has successfully completed and returned the equipment Installation and Operation Checklists to Fulton's Quality Assurance department.

General
Fulton shall be notified in writing as soon as any defect becomes apparent. This warranty does not include freight, handling or labor charges of any kind.

These warranties are contingent upon the proper sizing, installation, operation and maintenance of the boiler and peripheral components and equipment. Warranties valid only if installed, operated, and maintained as outlined in the Fulton Installation and Operation Manual.

No Sales Manager or other representative of Fulton other than the Quality Manager or an officer of the company has warranty authority. Fulton will not pay any charges unless they were pre-approved, in writing, by the Fulton Quality Manager.

This warranty is exclusive and in lieu of all other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Fulton shall in no event be liable for any consequential or incidental damages arising in any way, including but not limited to any loss of profits or business, even if the Fulton Companies has been advised of the possibility of such damages. Fulton's liability shall never exceed the amount paid for the original equipment found to be defective.

To activate the warranty for this product, the appropriate commissioning sheets must be completed and returned to the Fulton Quality Assurance department for review and approval.

Fulton

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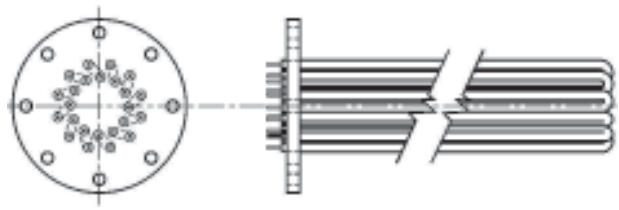
Fulton Heating Solutions, Inc.
972 Centerville Road
Pulaski, New York USA 13142
Call 315-298·5121
Fax 315-298·6390
www.fulton.com

Fulton Boiler Works, Inc. & Fulton Thermal Corporation are part of the Fulton Group of Companies, manufacturers of high grade industrial/commercial heat transfer products.

ELEC ST IOM
REV-2014-0306
Printed in USA

Installation, Operation, and Maintenance Instructions for Electric Immersion Heaters



Flanged Immersion Heater

IMPORTANT: Exposure of the boiler and/or heaters to weather conditions , while transporting or storing at a job site in an open or unprotected area, can cause water, excessive moisture, or condensation to collect in the terminal area of the heaters. This can cause moisture to be absorbed into the elements which may cause heater failure if energized.

No heater should be operated with a resistance to ground reading of less than 10 megohms. A qualified electrician must check the megohm reading before energizing.

PLEASE READ AND FOLLOW ALL INSTRUCTIONS BEFORE INSTALLING OR ENERGIZING

PRE-INSTALLATION

1. Unpack each heater upon delivery. Inspect each heater carefully for shipping damages. Report any claims to the carrier. Do not operate damaged equipment. Consult FULTON Steam Solutions, Inc. for instructions.

2. Compare the wattage, voltage rating, and phase listed on each nameplate or stamped on flange against your supply voltage, phase, and the requirements of your installation. Confirm that the sheath material and watt density of each heater is compatible with the material being heated. Check packing list.

WARNING

ALL ELECTRICAL WORK MUST BE DONE BY QUALIFIED PERSONNEL IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND APPLICABLE STATE AND LOCAL CODES.

BEFORE WIRING, SERVICING, OR CLEANING THE HEATER(S), TURN OFF POWER AND INSTALL A LOCKOUT ON THE HEATER CIRCUITS AT THE SERVICE PANEL. FAILURE TO DO SO COULD ALLOW OTHERS TO TURN ON POWER UNEXPECTEDLY, WHICH MAY CAUSE FATAL ELECTRICAL SHOCK.

FULTON FLANGE HEATER INSTALLATION INSTRUCTIONS

MOUNTING

Each heater shall be installed so that the heated section is totally immersed at all times. The liquid level must **always** be above the heated portion of the heater elements by at least several inches. **Failure of the heater could occur if this is not done as the heater may overheat and damage the heating element sheaths or resistance wire inside the sheaths.**

Do not bend the heating elements. .

INSTALLATION

INSPECTION: Thoroughly inspect each heater prior to installation by checking the elements, terminal box, thermostat, and thermocouple (if included). Immediately report any damage to the freight carrier who delivered the heater(s). Any sign of moisture or water stains on the packaging could be a sign of possible moisture damage. (See paragraph MOISTURE OR WETNESS before proceeding or wiring.)

MECHANICAL: Install each heater in the vessel with the gasket provided. Inspect the gasket and seating surfaces to ensure they are clean and undamaged. Observe "Top" stamp (if any) on the flange. Tighten all flange and electrical connections.

If the heater is installed horizontally, the fluid discharge must be at the top (12 o'clock) at either end, at or beyond the heated section. The fluid inlet should be at or beyond the heated section at the opposite end.

If the heater is installed vertically, the direction of flow shall be upward and no air pockets should exist above the discharge.

IMPORTANT: The heated portion of the heater elements must remain completely immersed and completely flooded whenever energized.

ELECTRICAL: The applied voltage should not exceed the highest heater nameplate voltage.

All wiring shall be done by qualified personnel in accordance with the National Electrical Code and applicable state and local codes.

Each heater shall be grounded in accordance with the National Electrical Code. (REF: NEC Articles 427, 250, etc.)

Refer to the wiring diagram supplied by Fulton or consult factory.

MOISTURE OR WETNESS:
Fulton heating elements are manufactured with high quality magnesium oxide. As added protection, each Fulton element terminal end has a high temperature silicone sealant moisture barrier just under the terminal insulator. All heaters manufactured and shipped by Fulton are electrically tested in accordance with UL specifications.

IMPORTANT: Exposure to weather conditions while transporting or storage at a job site in an open or unprotected area can cause water, excessive moisture or condensation to collect in the terminal area.

Drying a heater internally usually requires baking the entire unit at 250 - 300 degrees F for 24 hours. Do not attempt to dry the heater elements internally by applying voltage.

If baking is not practical, consult our factory.

No heater shall be operated with a resistance to ground reading of less than 10 megohms. A qualified electrician can check the megohm reading.

TERMINAL ENCLOSURES:
Heaters when equipped with a terminal enclosure may be of either a general purpose, weather resistant, or explosion resistant terminal type. The enclosure type must be selected based on the most extreme operating environment at the heater terminal area.

That is, a general purpose terminal enclosure can be used where there is no risk of water or other contamination, hazardous or explosive fumes, etc. It is dangerous to use a general purpose enclosure if the terminal area could be subjected to extreme conditions such as dripping liquid or an occasional washdown.

The terminal enclosure selection is the sole responsibility of the purchaser and installer. Weather or explosion-resistant terminal enclosures are available but must be specified at the time of the heater order.

Weather or explosion-resistant terminal enclosures must be tightly sealed at the cover, conduit openings, fasteners, and all other openings before electrically energizing or exposure to adverse conditions. Gasket(s) and weather resistant washers are provided with weather resistant covers. Some models have an alternate screw-on terminal cover and these should have a gasket (included) or a non-hardening compound shall be put on the cover threads and the cover must be tightened after wiring.

OPERATION AND MAINTENANCE

BEFORE WIRING, SERVICING, OR CLEANING THE HEATER(S), TURN OFF POWER AND INSTALL A LOCKOUT ON THE HEATER CIRCUITS AT THE SERVICE PANEL. FAILURE TO DO SO COULD ALLOW OTHERS TO TURN ON POWER UNEXPECTEDLY, WHICH MAY CAUSE FATAL ELECTRICAL SHOCK.

DO NOT OPERATE THE HEATER UNLESS THE HEATED SECTION OF THE ELEMENT BUNDLE IS COMPLETELY IMMERSED IN LIQUID AT ALL TIMES. DO NOT OPERATE HEATER IF DRY!

After some use, each heater should be periodically removed from the tank or vessel and the heater element bundle (the immersed portion of the heater) should be inspected and checked for coatings and corrosion. Remove deposits from each heater before returning heater to service.

The tank and vessel should also be checked and sludge deposits should be removed. The heaters must not be operated in sludge.

We suggest that periodic inspections be made to determine the appropriate frequency for cleaning and that a new heater flange gasket be installed whenever the heater flange is removed. The frequency of inspections will depend on use and fluid conditions.

ELECTRICAL: Electrical connections must also be checked periodically. All connections must be tight. All terminal ends and connections should be clean of all contaminants.

COMMON REASONS FOR HEATER FAILURE

To ensure long life of your electric heaters, we have listed below common reasons that heaters fail. Please consult factory for information if you are experiencing heater problems.

OVERHEATING OF HEATER ELEMENTS: Typically caused by one of the following: (a) Build up of foreign material on the element sheath such as lime scale, sludge, etc. (If this condition develops, element sheaths must have deposits removed); (b) Contactor welding shut; (c) Heater being allowed to operate dry; (Treated water sometimes produces “suds” which may cause a liquid level reading to indicate there is fluid when the heater is being operated in “air.” (d) Thermostat failing; (e) Localized boiling of fluid around sheath; (f) Watt density too high for the application.

CORROSION: As discussed under OPERATION and MAINTENANCE, if the medium being heated attacks the element sheath, after a certain amount of time the heated medium will cause pitting or otherwise degradate the element sheath. It may be necessary to treat the heated medium or change the element sheath material.

MOISTURE: As discussed under INSTALLATION, if a heater sits unenergized for a period of time, (“period of time” depends on the environment that the heater is in), the heater elements may absorb moisture into the MGO.

Therefore, before energizing the heaters, the heaters must be tested to verify that there is at least 10 megohms of resistance per circuit. If any circuit in the heater is less than 10 megohms **DO NOT** energize the heater. If the heater is energized, the heater could fail.

If the heater fails due to moisture, it will usually be one of two ways:
(a) The moisture inside the element turns to steam. As the steam is heated it causes pressure to build up inside the element sheath until the ultimate strength of the sheath material is exceeded causing it to rupture.
(b) Moisture weakens the dielectric strength of the MGO, therefore more current leaks to the sheath. This could cause either the fuse to blow or the circuit breaker to trip. If the fuse does not blow or the circuit breaker does not trip you could be gradually damaging the heater because you could be causing a carbon trail to form through the MGO to the element sheath causing eventual failure.

Once the heater is energized and running, it will normally stay dry. However, if a boiler is shut down for an extended period, the heaters need to be retested before reenergizing.

OTHER REASONS for heater failure include:

IMPROPER INSTALLATION

WRONG VOLTAGE and/or PHASE

VOLTAGE SURGE

1 Year (12 Month) Warranty

On Fulton Electric Heater(s)

WARRANTIES: There is no representation, warranty, or condition, of any kind, express or implied, unless otherwise expressly stipulated hereunder. Seller's sole representation as to equipment sold hereunder is that such equipment is under warranty, for a period of twelve (12) months from the date of shipment from factory, to be free from manufacturing defects if used in accordance with seller's recommendations, except that this warranty does not cover switches or elements damaged by short circuit wiring or unauthorized servicing beyond normal adjustment, and such switches or elements will not be replaced without charge. The obligation of the seller hereunder is limited to making the replacement or repair, whichever the seller may elect, of any equipment sold by the seller, or any part thereof, acknowledged by seller to be defective. This warranty does not include or cover reimbursement of expenses incurred by reason of normal use and service of the equipment, or the expenses incurred in connection with the inspection or transportation of equipment or any part thereof to be repaired or replaced pursuant to this warranty.

Also see Fulton's Standard Warranty for other terms and conditions.

Fulton®

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