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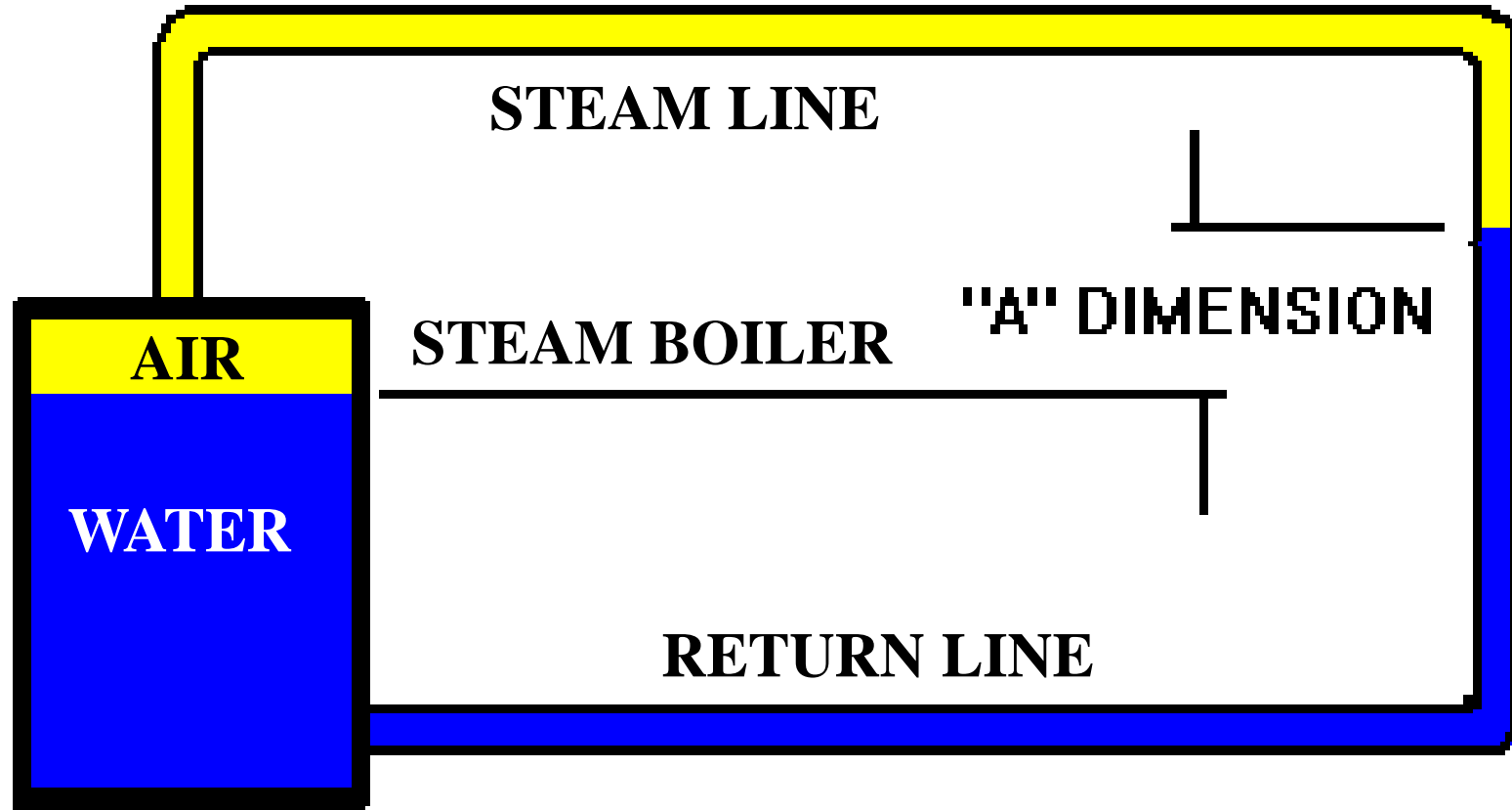
Steam and Boiler Controls

Jim Nolan – North Central
Market Development Manager

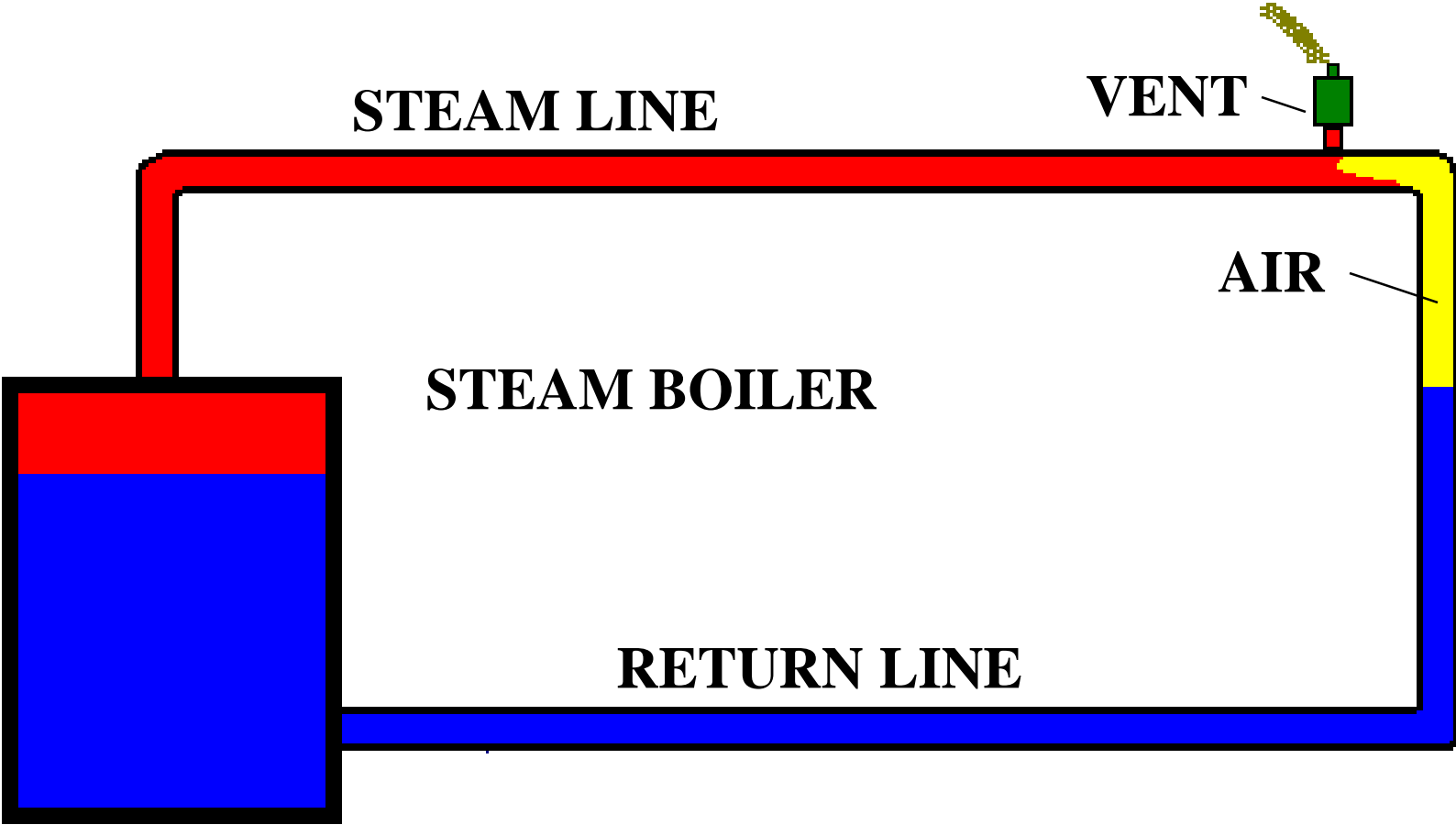
ONE PIPE STEAM SYSTEMS



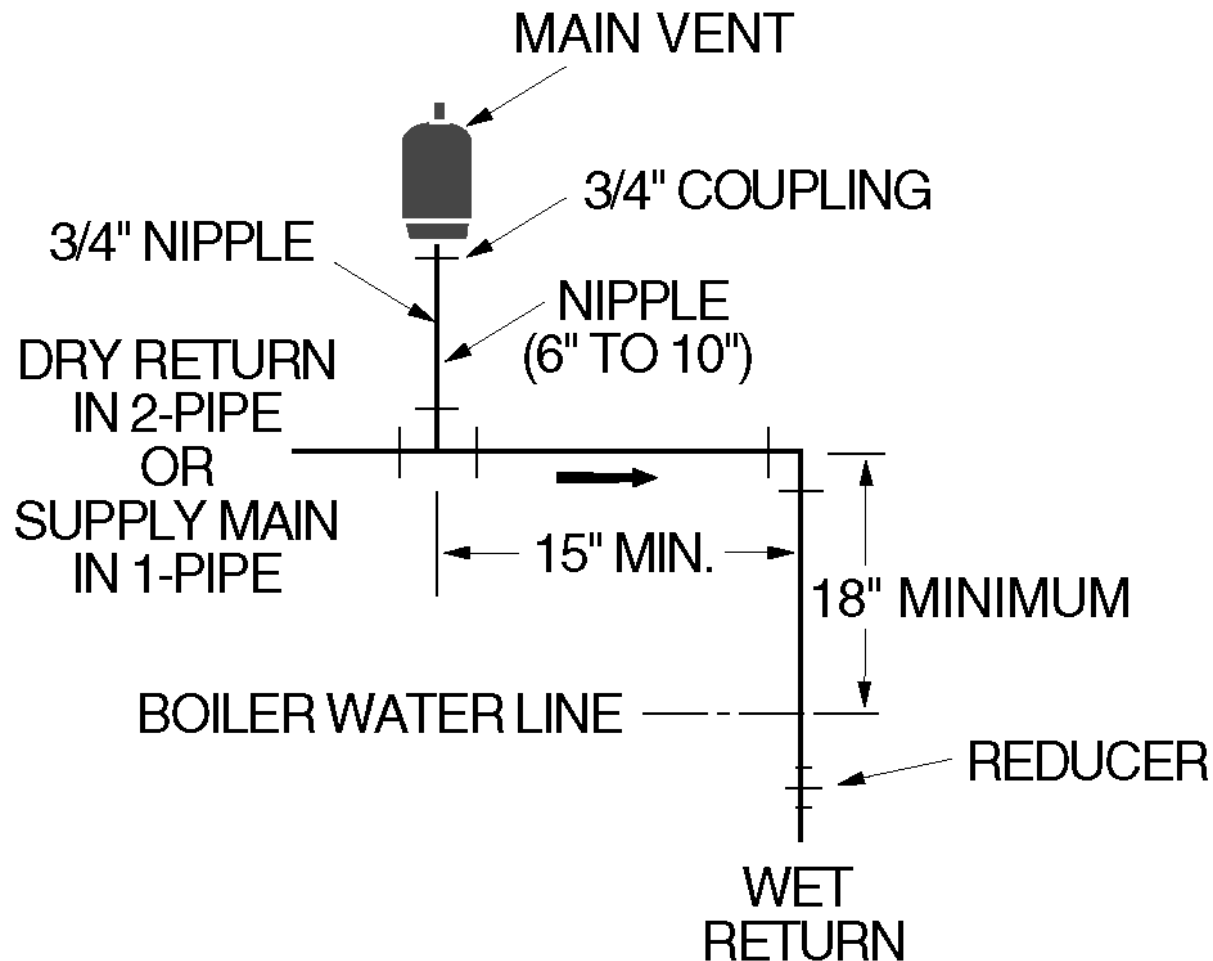
BASIC STEAM LOOP COLD BOILER



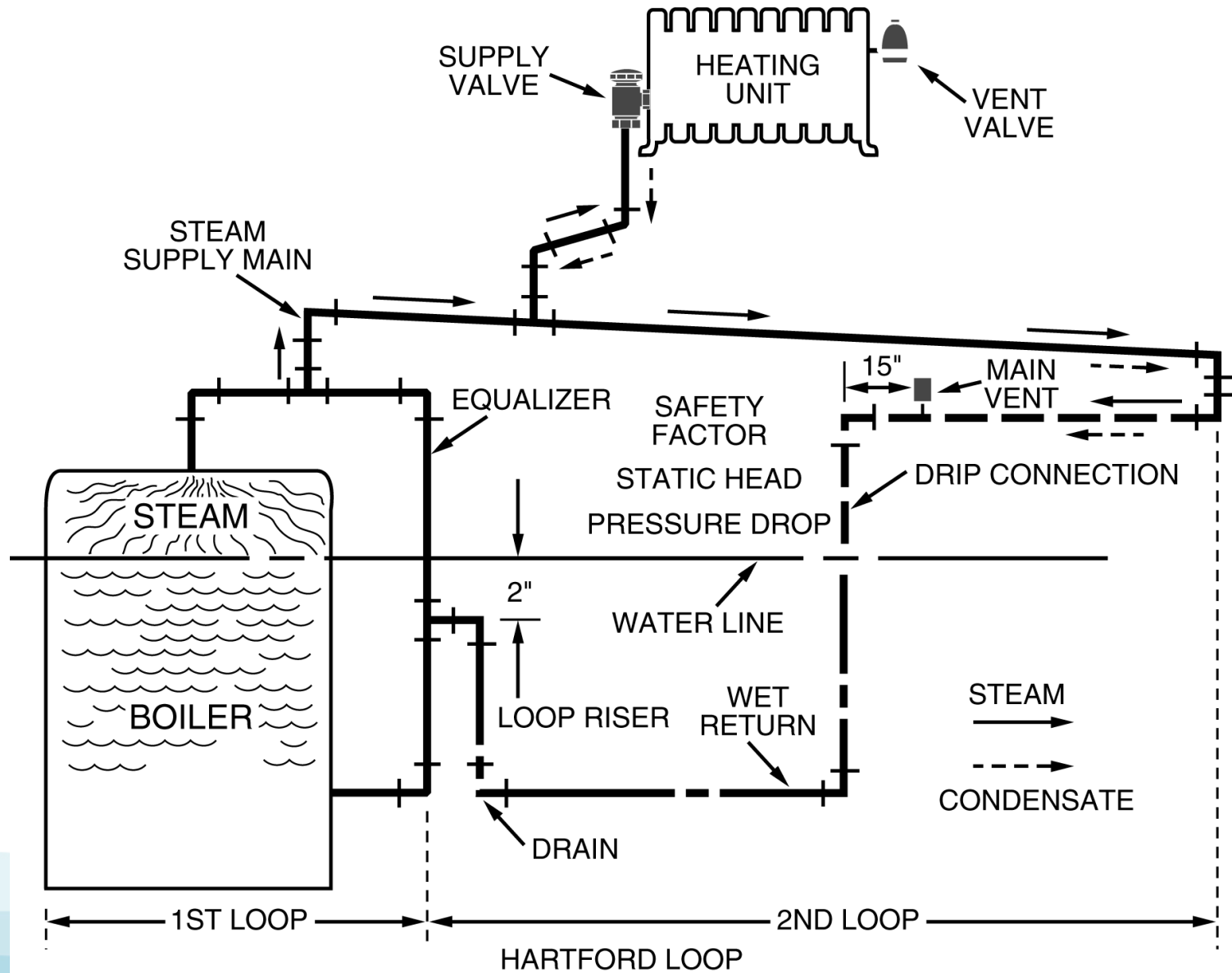
BASIC STEAM LOOP WITH AIR VENT



Proper Main Vent location



One Pipe Gravity Return

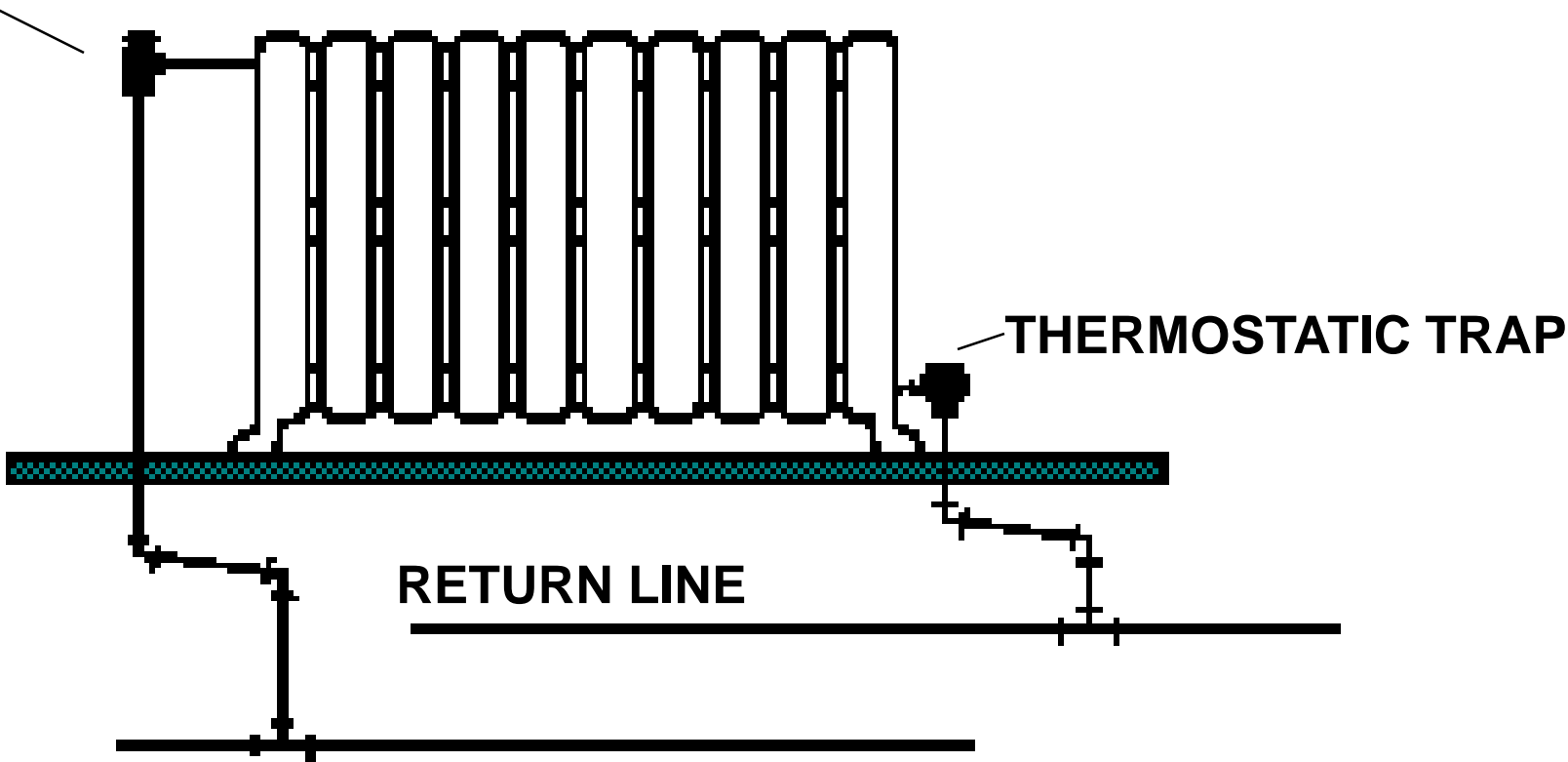


TWO PIPE SYSTEMS



TWO PIPE RADIATOR

SUPPLY VALVE



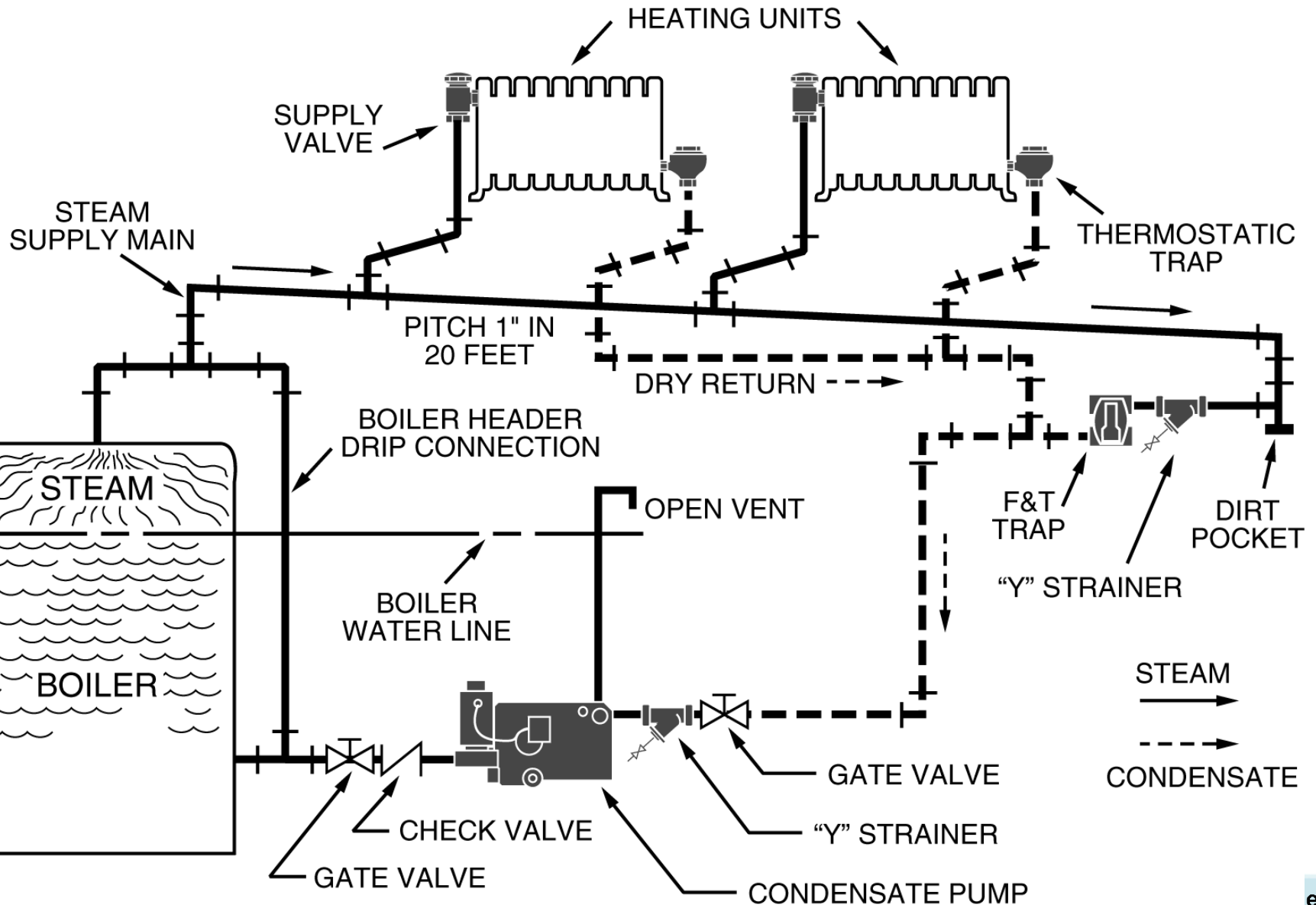
THERMOSTATIC TRAP

RETURN LINE

STEAM MAIN

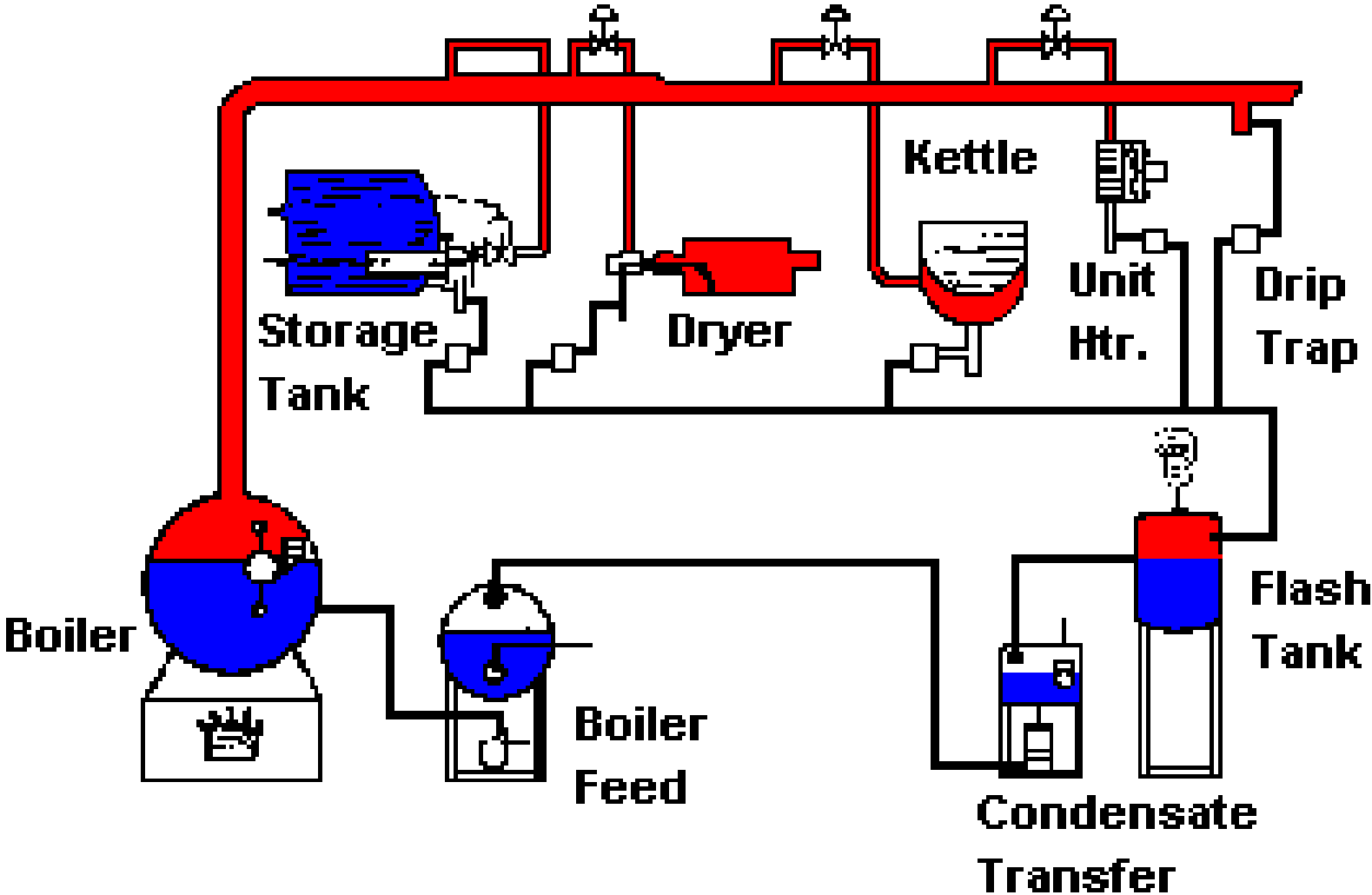


Two Pipe System



Typical Industrial Steam Loop

PRV's



Tips for Energy Savings

Use Thermostatic Traps where Possible to take advantage of Sub-cooling

Insulate Steam Lines



Tips for Energy Savings

Install Condensate Return Units

**Don't Insulate Return Line if it
results in Flash Loss or Pump
Cavitation**

Keep Traps in Good Condition

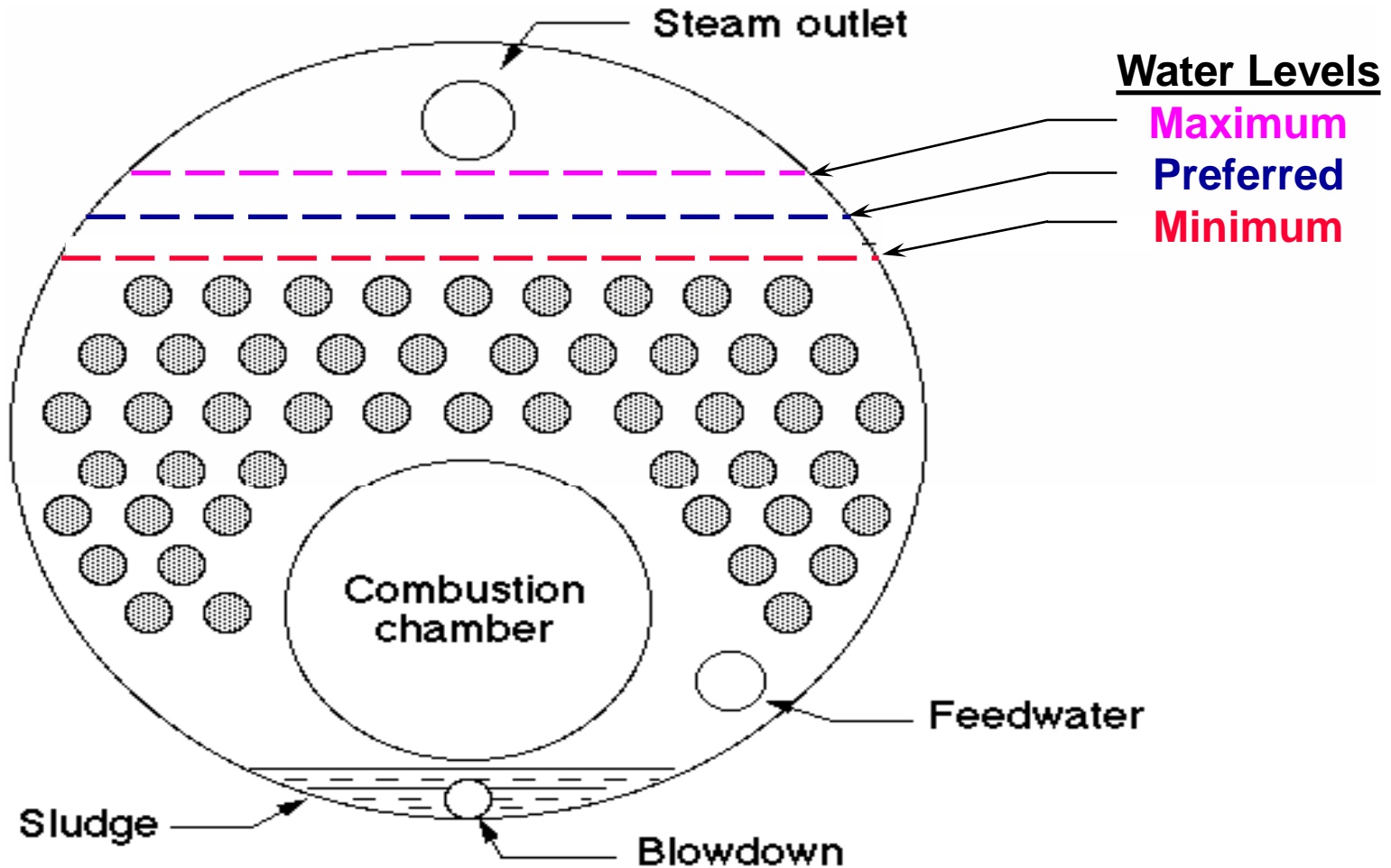


Low Water Cut-off Protection - WHY? Protect The Boiler From Operating If: There is a low water condition

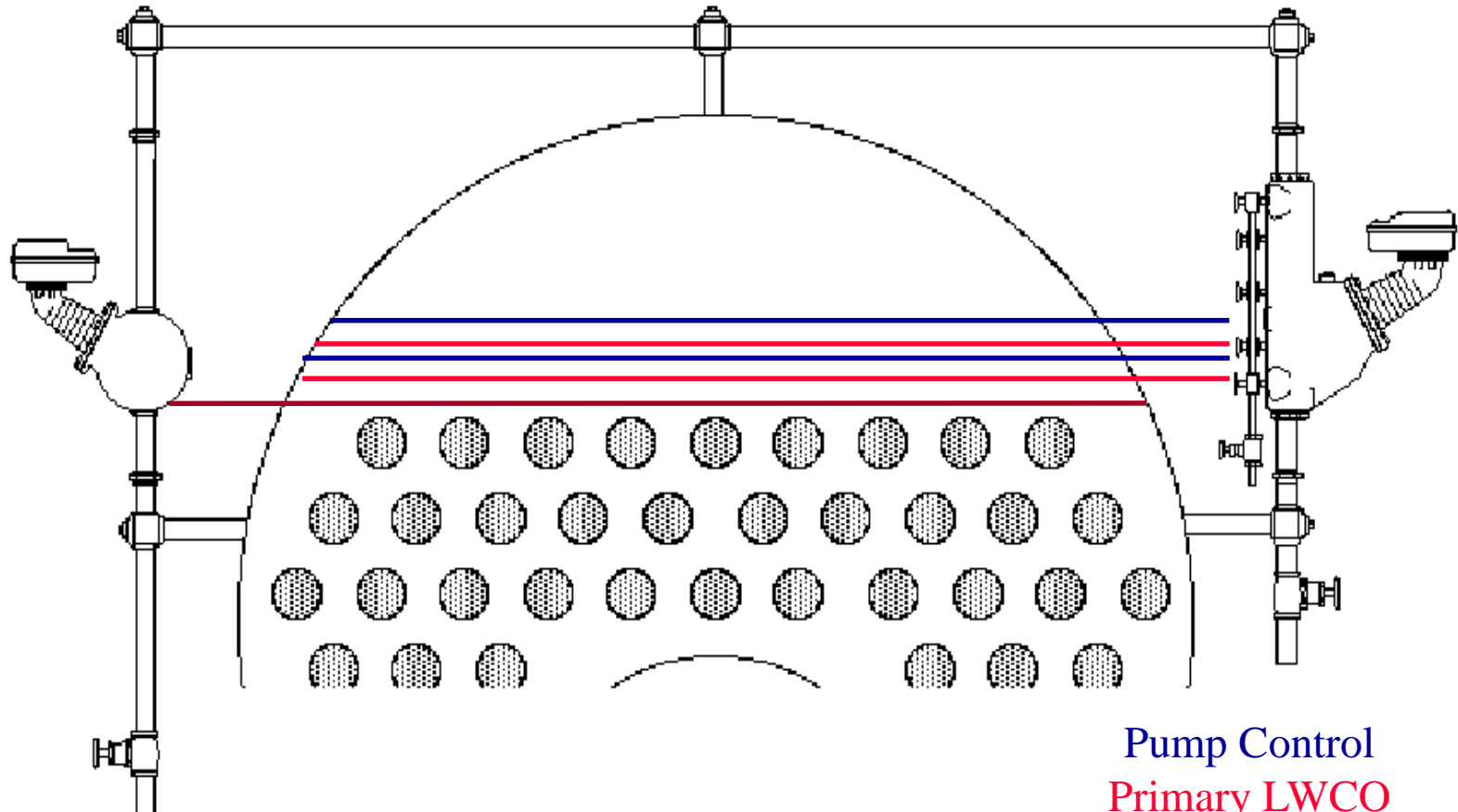
Leaking Boiler
System Leaks
Condensate Not Returning Fast Enough
Water Feeder Not Working

In 1888 246 boiler explosions killing 331 people, and injuring 505 others

Low Water Cut-off Protection



Low Water Cut-off Protection



Secondary LWCO
Manual Reset

Pump Control
Primary LWCO
Automatic Reset

NORMAL WATER LEVEL is only normal when the boiler is off and cold.

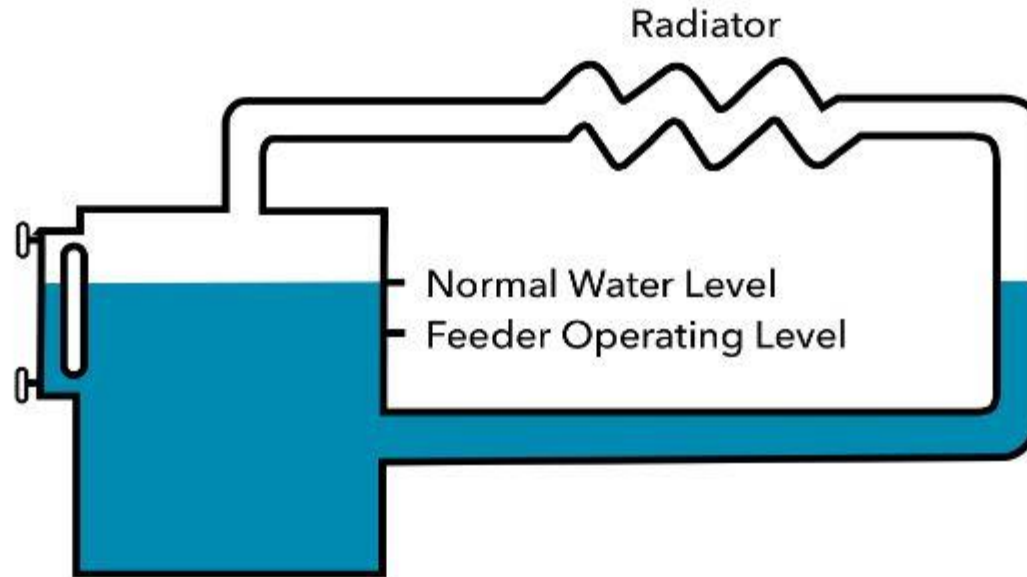


Figure 1

As soon as the boiler starts to make steam, the water line has to change because some of the water is changing state from a liquid to a gas. (Figure 2)
How fast the water changes into steam is a function of the boiler's BTU /H capacity

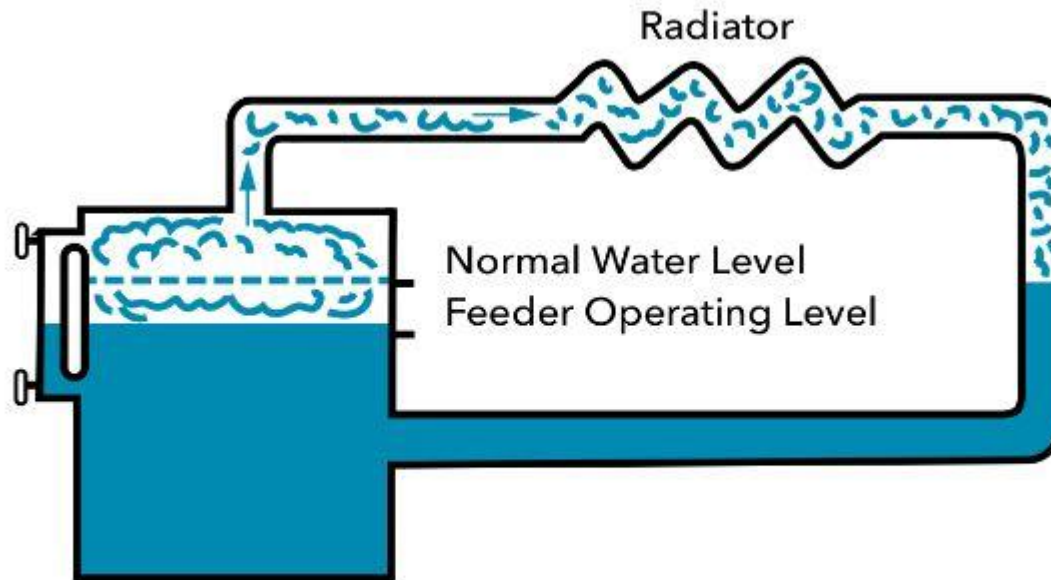


Figure 2

We know how the NWL is established, but how it is set in a boiler?

The only way to set the proper water level is by manually filling the boiler to the proper level. Some believe that an automatic water feeder is responsible for maintaining this water line, but a feeder's only function is to maintain a safe minimum water level, working in conjunction with the low water cut-off.

Series 51, 51S & 53 Feeder



- Mechanical water feeders.
- Available with #2 switch
- Typically installed on boilers
 - 51S For Larger Boilers
- Might be installed on deaerator, condensate receiver or boiler feed tank
- Float chamber for installation using equalizing lines

How To Select Water Feeder

Series	Characteristics	Maximum Boiler Pressure psi (kg/cm ²)	Boiler Size (Mfr. Gross Rating Sq. Ft. of EDR)						
			*Differential Pressure psi (kg/cm ²)						
			10 (.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.5)	60 (4.2)	70 (4.9)
Uni-Match®	For Automatic Fired Heating Boilers	15 (1.0)	All Boilers up to 5,000 sq. ft.						
101A	For Automatic Fired Heating Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
47	For Heating or Process Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
47-2	For Automatic Fired Heating Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
247	For Heating or Process Boilers	30 (2.1)	All Boilers up to 5,000 sq. ft.						
247-2	For Automatic Fired Heating Boilers	30 (2.1)	All Boilers up to 5,000 sq. ft.						
51	For Heating or Process Boilers	35 (2.5)	8,600	12,000	15,000	17,600	20,000	21,800	23,400
51-2	For Automatic Fired Heating Boilers	35 (2.5)	8,600	12,000	15,000	17,600	20,000	21,800	23,400
51S	For Heating or Process Boilers	35 (2.5)	10,500	17,500	22,400	26,500	30,000	32,600	35,000
51S-2	For Automatic Fired Heating Boilers	35 (2.5)	10,500	17,500	22,400	26,500	30,000	32,600	35,000
53	For Heating or Process Boilers	75 (5.3)	8,600	11,600	14,600	17,000	18,800	20,600	22,100
53-2	For Automatic Fired Heating Boilers	75 (5.3)	8,600	11,600	14,600	17,000	18,800	20,600	22,100

***Differential pressure should be based on water supply pressure at boiler, minus pressure setting of steam safety valve**

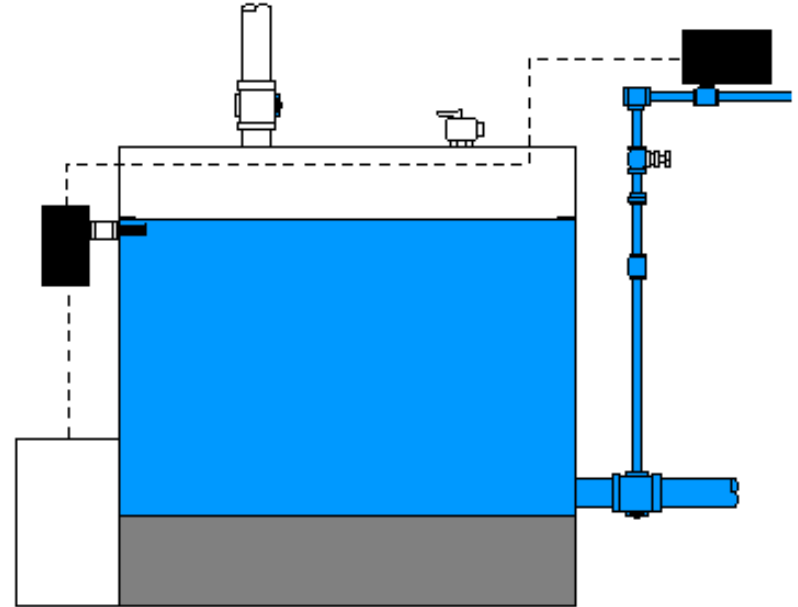
What Type of LWCO?



Probe Type



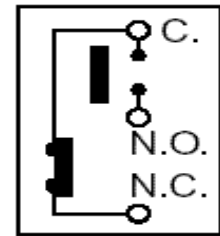
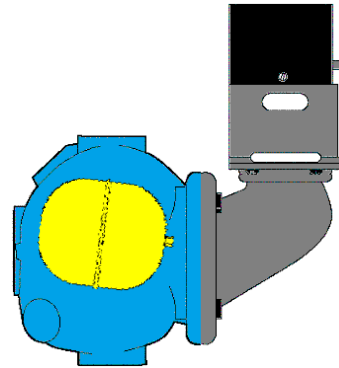
Float Type



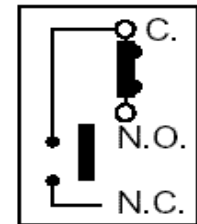
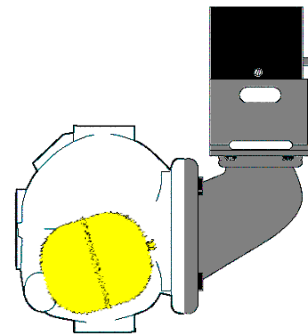
How Does It Work?

Float-Type LWCO

- Available 1920's
- Float reacts to the water line.
- As water level moves up/down, the float transfers that motion to a switch.



Normal Water
level



Low Water
Level

LWCO Comparison

	Float Control	Probe Control
Mounting Location	External	Internal
Control Logic	Burner on and feeder on	Burner or feeder on
Electrical	Passive	Requires power
Test Method	Blowdown – confirm burner off	Test button – confirm burner off
Foaming	Can't determine	Can sense foaming
Req'd Maintenance (Homeowner)	Weekly blowdown	None
Req'd Maintenance (Service Co.)	Annual – disassemble & clean – test functionality	5 years – remove probe & clean – test annually
Replacement Interval	Switch & float – 5 yrs. Control – 10 yrs.	Probe – 10 yrs. Control – 15 yrs.

Mechanical LWCO

Series 150S/157S Controls

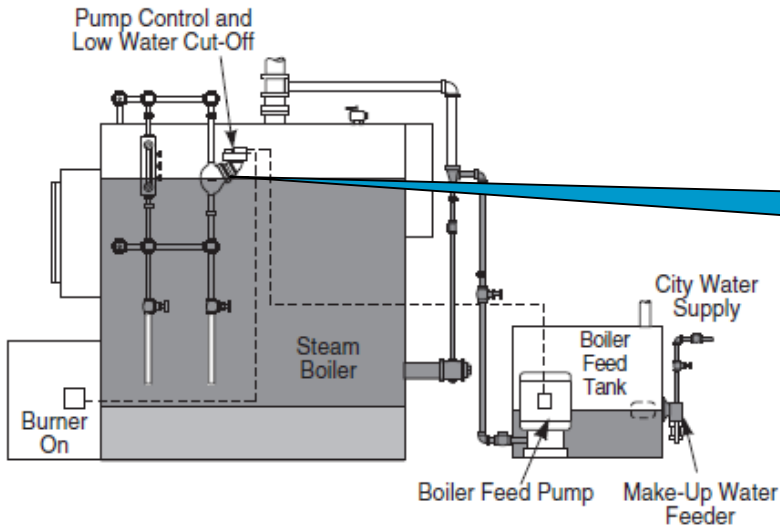
150S



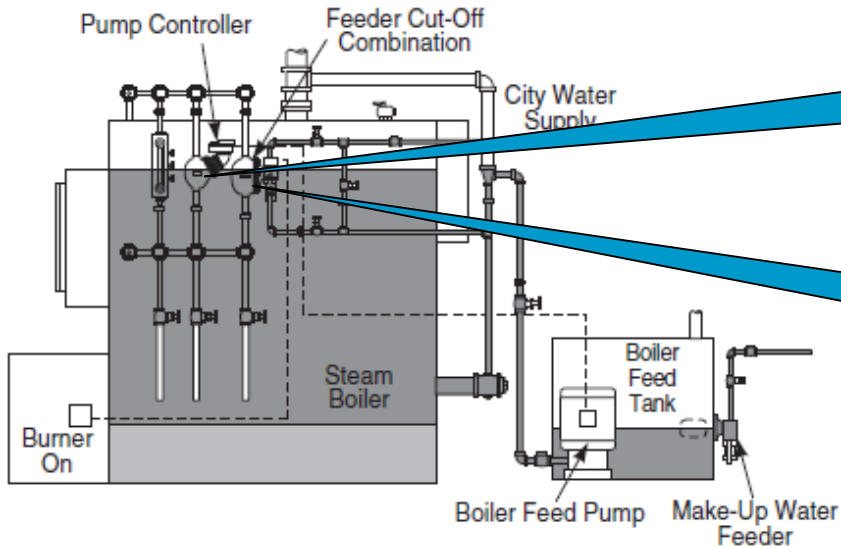
157S

- Typically installed on boilers used in commercial and industrial applications with operating pressures up to 150psi (10.34 bar)
- Used to operate a pump to maintain water level in boiler
- Low water cut-off switch to interrupt burner circuit
- NPT or BSPT threads
- 150S/157S - SPDT (pump), SPST (Burner)
- 158S- w/2 SPDT switches (Motorize valve)
- 159S – w/2 SPST switches (Two pumps)

Typical Application



Boiler with 150S controller

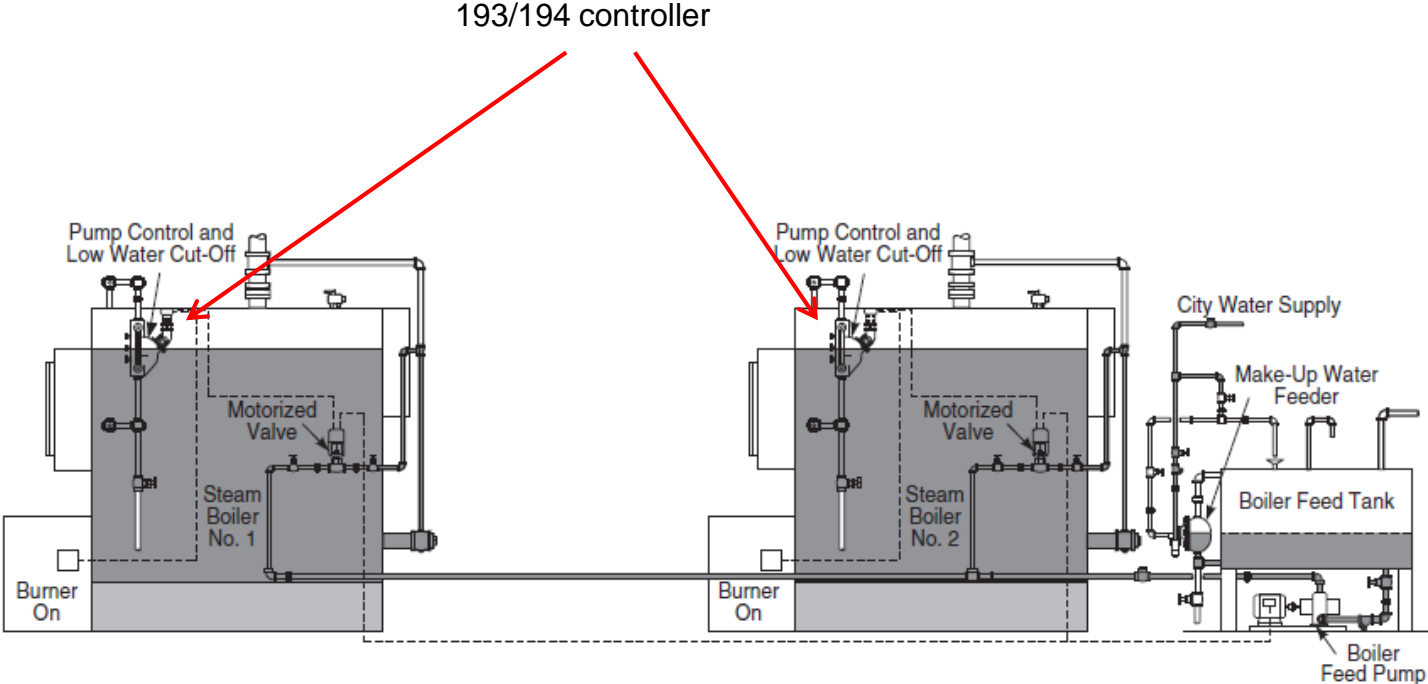


Boiler with 150S controller as primary control

Feeder/LWCO as secondary control

Single Boiler

Multiple Boilers



Multiple Boilers
Boiler Feed Pump and Motorized Valves

TC4 Valves for Hot Water Boilers



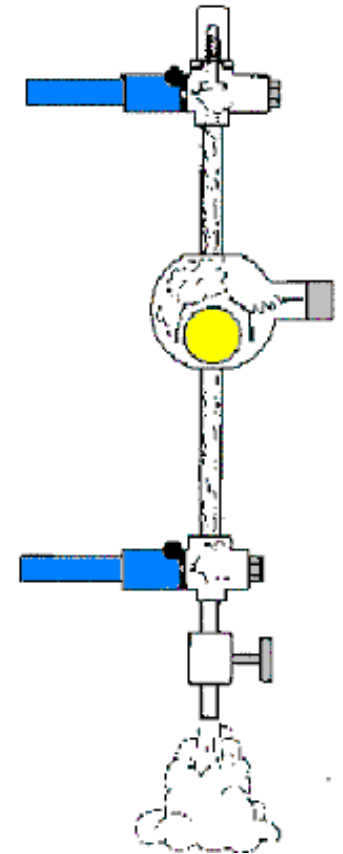
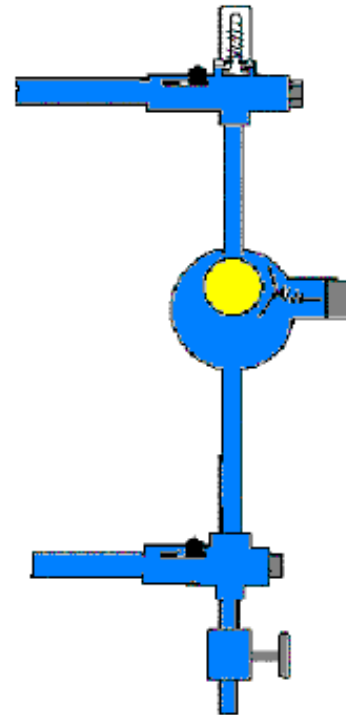
- Installed to test float type LWCO's on Hot Water Boilers
- Simplifies ASME CSD-1 code mandated testing of LWCO by eliminating need to drain the system
- Restricts water flow when blow down valve is opened
- Build in vacuum breaker
- 1"NPT
- Max. temperature 250F
- Max. pressure 160 psi

TC4 Valves for Hot Water Boilers

How it works

In normal operation, there is normal circulation of water through the equalizing piping and float chamber. Any sudden onrush of water, such as opening the blowdown valve, snaps shut a damper to restrict flow.

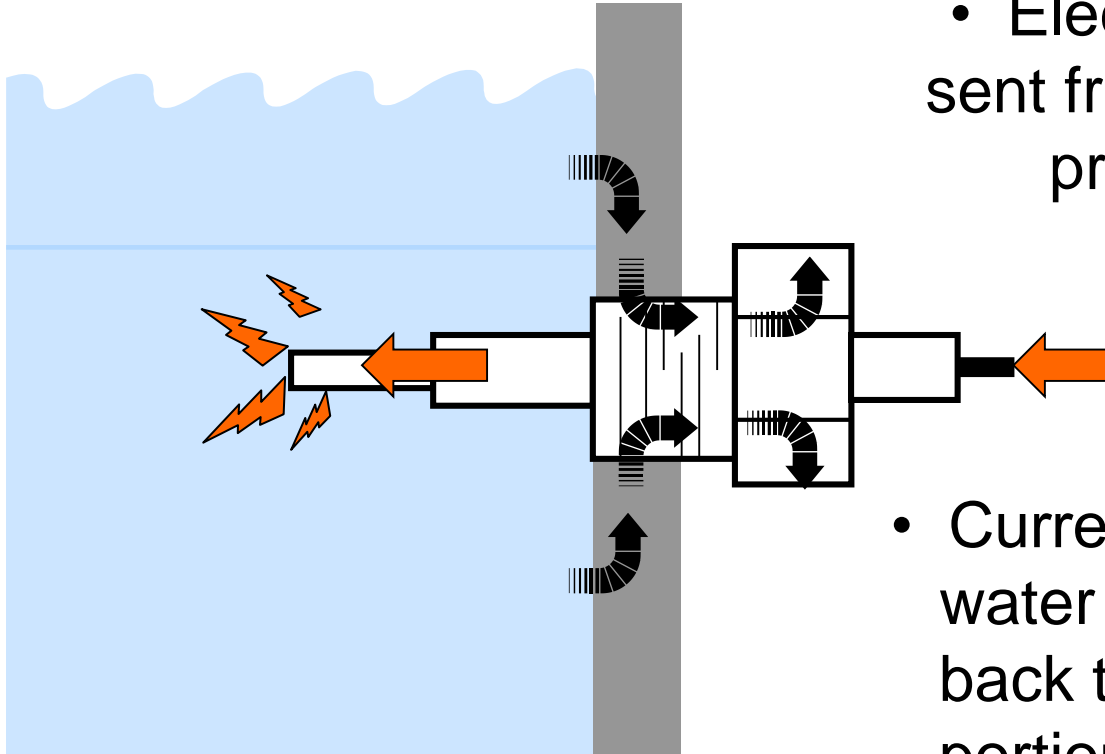
When blowdown valve is closed, dampers return to normally open position.



Electronic Controls

Residential, Light commercial Steam and Hot Water Boilers

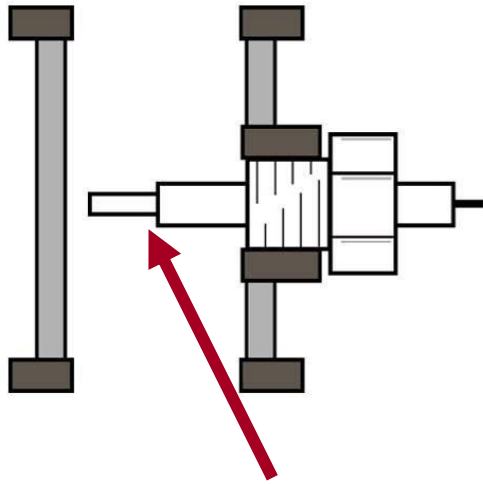
How Does It Work?



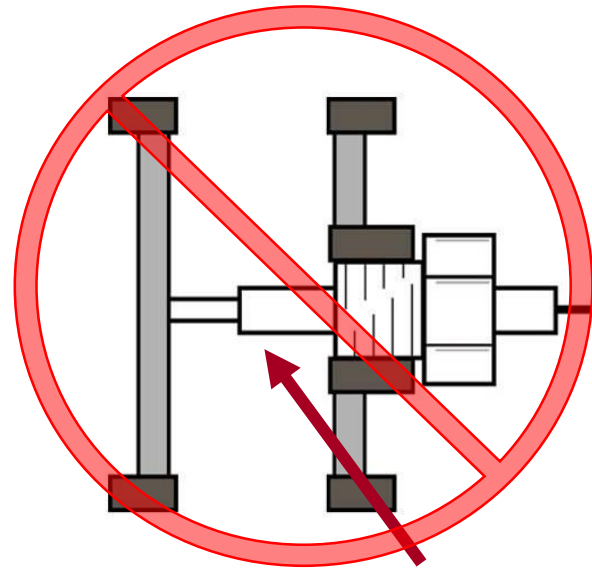
- Electrical current is sent from unit through probe and out tip.

- Current passes through water to boiler shell and back to unit via threaded portion of probe.

Installation tips

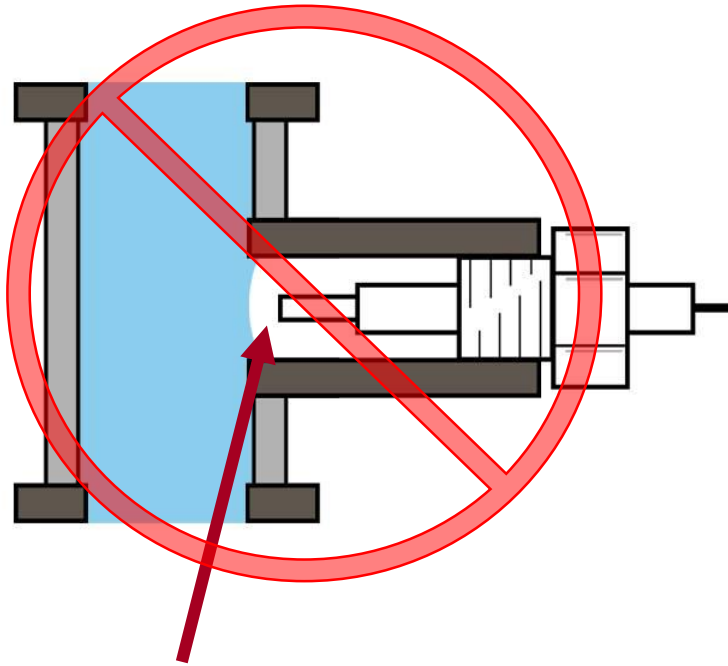


Make sure tip of probe is in pipe with **1/4"** clearance from wall of pipe.

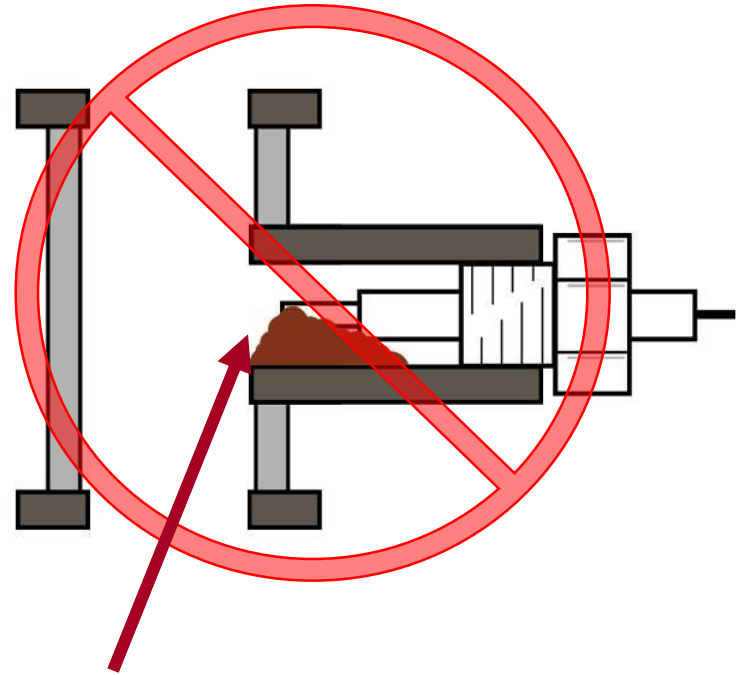


Metal-to-metal contact with the tip of the probe will ground the probe.

Installation tips



If probe is installed with extensions, an air pocket could develop, shutting down the boiler.



If probe is installed with extensions, a bridge of sediment, rust or scale could develop, preventing the boiler from shutting down if water falls below the level of the probe.

Maintenance and Troubleshooting

MAINTENANCE

SCHEDULE:

- **Blow down control as follows when boiler is in operation.**
 - Daily if operating pressure is above 15 psi.
 - Weekly if operating pressure is below 15 psi.

NOTE
More frequent blow-down may be necessary due to dirty boiler water and/or local codes.

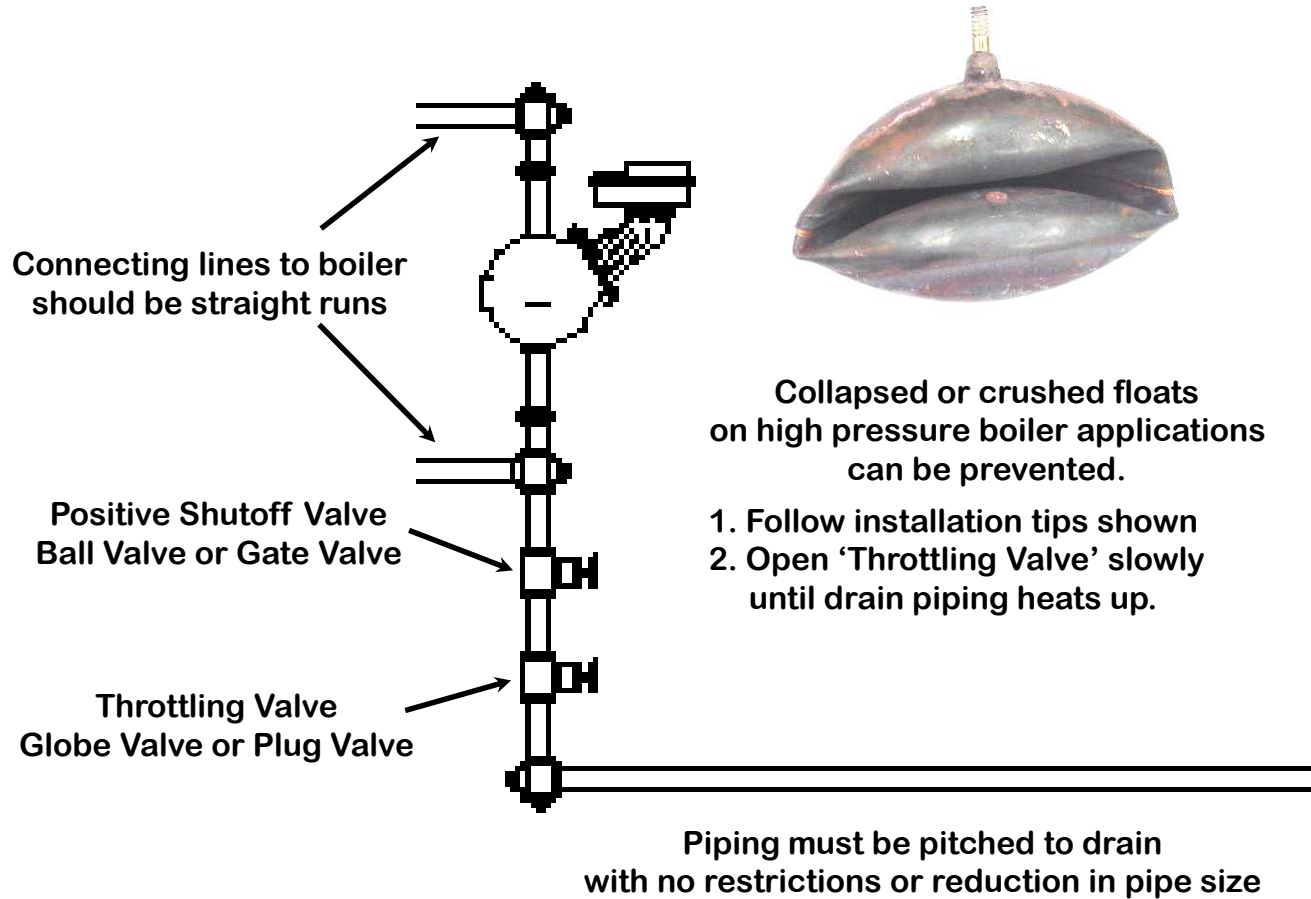
- **Disassemble and inspect annually. Replace the low water cut-off/pump controller if it is worn, corroded, or if components no longer operate properly.**
- **Inspect the float chamber and equalizing piping annually. Remove all sediment and debris.**
- **Replace head mechanism every 5 years.**
More frequent replacement may be required when severe conditions exist such as rapid switch cycling, surging water levels, and use of water treatment chemicals.
- **We recommend head mechanism replacement when the switch(es) no longer operate properly.**
If you choose to replace the switch(es), order the proper McDonnell & Miller replacement switch or switch assembly and follow the Repair Procedure provided.

Mechanical Controls Issues



Crushed Float

Blow Down



Maintenance Why?

People who change their smoke detector batteries every year and car oil every 3,000 miles let their boilers go year after year without even a thought of preventive maintenance. (Residential)

Then the boiler breaks down in the middle of winter!!

Regular maintenance saves end user money on fuel and replacement parts, and most importantly also prevent potential hazards.

Maintenance Why?





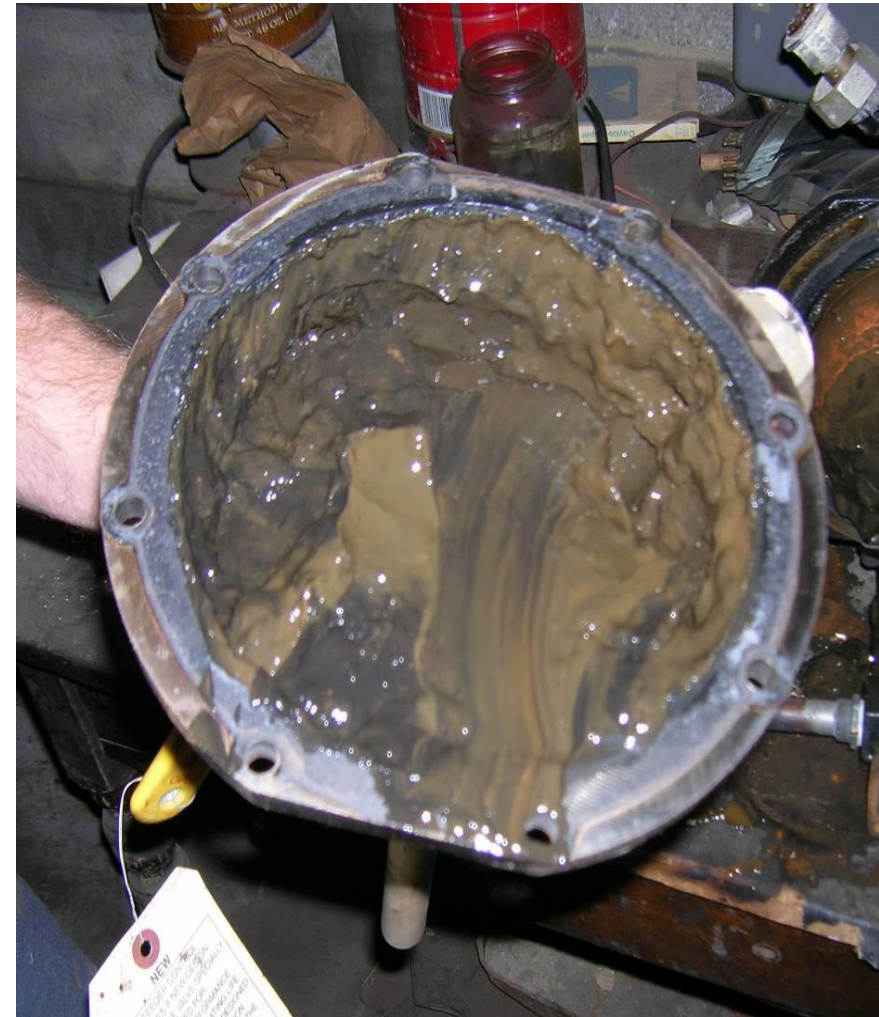
Corroded bellow



Sticking contacts



Maintenance Why?

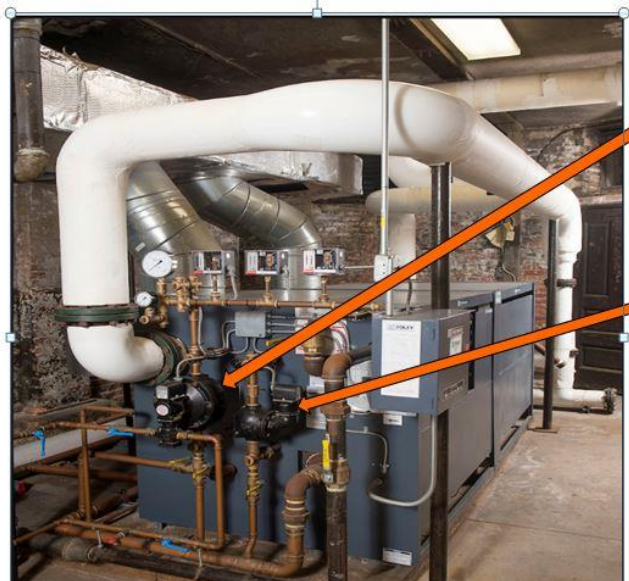




Maintenance Why?

Hot water, steam, gas-fired, and oil fired boilers each have special maintenance requirements. Oil-fired boilers in particular need more frequent inspection.

Also, any boiler used to heat domestic water is operating year-round and should be inspected at least twice a year



51-2 feeder/LWCO as a primary control

Model 63 as secondary LWCO

General Boiler Inspection / Maintenance

Manufacturers typically recommend specific procedures for inspecting their safety devices

- Fuel system - for proper operation, leaks and controls
- Combustion system - for boiler and exhaust leaks and signs of overheating
- Heating system - for leaks, uneven heating and zone balancing
- Circulator pump – for quiet operation
- Water – for cleanliness
- Gauges – for accuracy. Compare to a standard gauge.
- Expansion tanks – for proper pressure
- Controls - Follow the manufacturer's recommended procedures
- Safety devices – Inspect safety relief valves, temperature and pressure controls, low water and flow-sensing devices

General Boiler Inspection / Maintenance



Series RB-24E Low Water Cut-off for residential hot water boiler with self-cleaning probe



247-2 Mechanical Feeder/LWCO combination

McDonnell & Miller low water cut-offs with self-cleaning probe should be removed and inspected and the probes cleaned or replaced every five years. Controls without self-cleaning probes should be checked every year.

Mechanical Feeders – Remove and clean the strainer and cartridge. Replace if necessary

General Boiler Inspection / Maintenance



Series 150S LWCO-pump controller

Float-type controls - inspect the float mechanism and clean. Replace if necessary



Series FS4-3 general purpose flow switch

Forced circulation copper boilers have flow switches in lieu of low water cut-off. Remove for inspection and clean every year. Check for deterioration of paddle and replace if necessary.



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Type LWCO**



**RBT-3000 LWCO & Fuel
Economizer**



**Series FS6 High
Sensitivity Liquid Flow
Switches**



**Series 194 – Low Water
Cut-Off/Pump
Controllers**



QUESTIONS?