



Oilheating

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ANNUAL NEW ★ PRODUCT REVIEW!

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Also:

- ◆ Weather Derivatives
- ◆ A Canadian NORA?
- ◆ Low Water Cut-Off Switches
- ◆ Sustaining Growth in a Mature Market

NOTICE

PLACE BUCKET UNDER VALVE AND BLOW DOWN THIS CONTROL AT LEAST ONCE EACH WEEK DURING HEATING SEASON. FAILURE TO FOLLOW THE BLOW DOWN PROCEDURE ON BOILER CARD FURNISHED CAN CAUSE CONTROL TO MALFUNCTION RESULTING IN SERIOUS BOILER DAMAGE.

McDONNELL & MILLER ITT
FLUID HANDLING DIVISION

Residential steam boiler low water cut-off switch maintenance

By John P. Certuse P.E.

Of all of the different types of boiler failures, one of the most common types is a dry-fired boiler caused by a low water cut-off switch failure.

When a steam boiler loses its water level, the castings are subjected to the heat of the burner flame, which typically results in cracking of cast iron parts or melting of synthetic gaskets in boilers constructed in this manner.

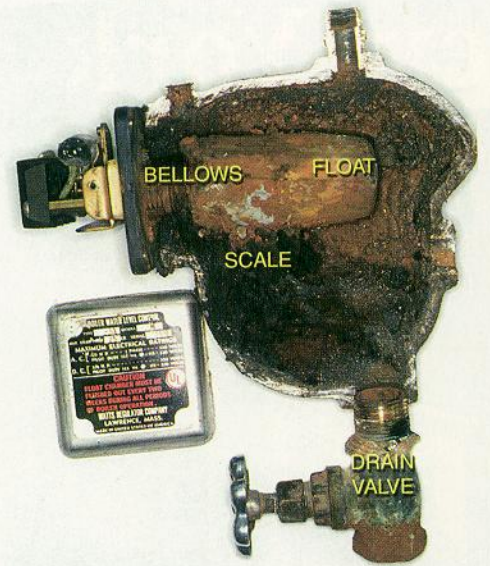
If this condition goes undiscovered and is prolonged enough, along with obvious damage to the boiler, other damages including fires could also result.

The low water cut-off switch is used to ensure that burner operation will occur only if there is water in an operating steam (and occasionally forced hot water) boiler.

There are two basic types of low water cut-off switches in use today, the **float type** and the **probe type**.

FLOAT TYPE LOW WATER CUT-OFF SWITCH

The float type of low water cut-off switch is used on steam boilers and is essentially a float connected to an electrical switch. The float is po-



Bisected low water cut-off switch showing scale accumulation areas.

sitioned at the normal boiler water level and changes in this water level are mirrored in the electrical switch operating the burner of the boiler.

This type of switch operates as a normally closed switch when the water level is in the normal operating range. It opens when the water level drops due to evaporation or leakage within the system.

PROBE TYPE OF LOW WATER CUT-OFF SWITCH (CONDUCTANCE ACTUATED)

The probe type of low water cutout switch is an electrical device that utilizes a two-conductor electrode inserted into the boiler water. The conductivity of the boiler water is used to complete the circuit to ground and allow firing to continue.

If the boiler water level drops below the designed level, the circuit opens and the addition of fuel, and therefore combustion, stops.

This type of switch is used in both steam and forced hot water boilers.

Discoloration of cast iron boiler sections indicates overheating did occur.



...switch maintenance *begins p. 12*

WHY THE STRICT REQUIREMENT FOR LOW WATER CUT-OFF SWITCH MAINTENANCE IN STEAM BOILERS? (SLUDGE & SCALE)

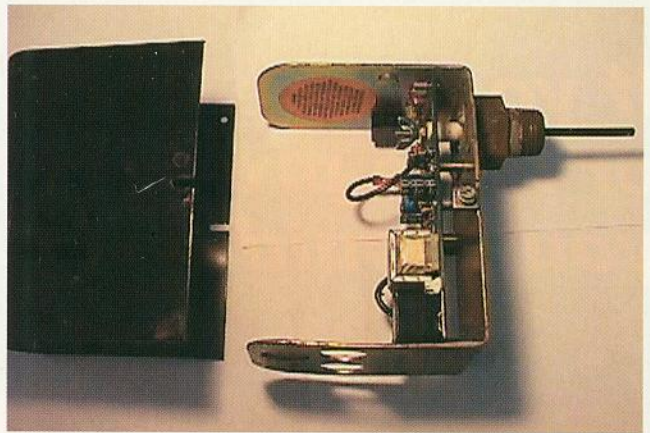
In a steam system, due to the continual evaporation of water, which also leaks from the system over time, contaminants such as corrosion byproducts and hard minerals such as calcium, silica and magnesium concentrate in the heating system water. These substances settle in the lower parts of the heating system, allowing them to accumulate in the boiler and its auxiliary connections including the boiler's low water cut out switch.

Unlike many commercial boilers that have water treatment chemicals and equipment to remove these substances, residential heating systems require that these substances be removed by periodic boiler and low water cut-off switch flushing and physical removal.

With a boiler continually exposed to these accumulations, their tendency to cause a low water cut-off switch malfunction is something that must be anticipated and prevented.

If these substances are allowed to accumulate in float type low water cut-off switches, the float may become stuck in the closed position, preventing the burner from stopping if the boiler water level falls below a safe level. Sludge and scale will also cause the water lines leading from a low water cut-off switch to become blocked, allowing a false water signal to be registered in the low water cut-off switch.

Likewise, just as sludge and scale will cause a malfunc-



Probe type of low water cutoff switch disassembled. Probe is to the right.

tion of the float type of low water cut-off switches, these same substances will also cause the probe type of low water cut-off switches to fail by causing a false water signal to be registered.

Initially, these solids form a liquid slurry substance called "sludge" and later will solidify to form "scale". The sludge can be removed by draining a low water cut-off switch while scale must be removed by more aggressive means, such as scraping and chipping.

LOW WATER CUT-OFF SWITCH MAINTENANCE

For all boiler controls, manufacturer's service requirements should be followed for specific maintenance along with

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recommended service life of the control. The ASME (The American Society of Mechanical Engineering) Chapter VI also provides service direction for many controls used in heating applications.

PROBE TYPE OF LOW WATER CUT-OFF SWITCH

Probe types of low water cut-off switches require that the probe be periodically removed by a service technician (usually annually) and cleaned of any accumulated sludge or scale.

If the probe is not inspected and cleaned on a regular basis, sludge or scale will complete the circuit across the switch, producing a false water level within the device and boiler damage in the event of a low water condition.

FLOAT TYPE LOW WATER CUT-OFF SWITCHES

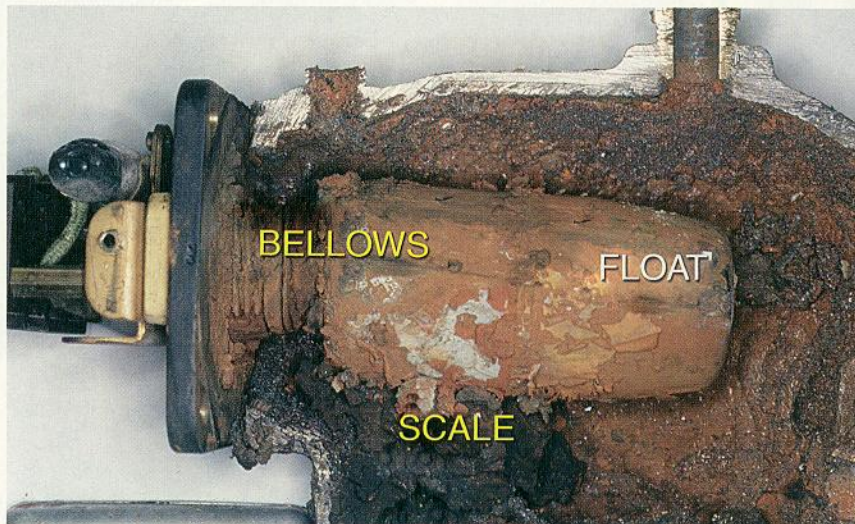
Float type of low water cut-off switches require maintenance by **BOTH** the homeowner and a service technician. On a weekly basis, accumulated sludge should be flushed from the device by the homeowners and on an annual basis, scale deposits should be removed from the device by qualified service technicians.

Flushing alone does not adequately remove these substances and it is a combination of these two parties performing maintenance actions that will insure safe operation of this type of safety control.

For a service technician to **properly** service a float type of low water cut-off switch, this requires **disassembly**, inspection and annual cleaning. OK, let me repeat this. I said, "DISASSEMBLY, inspection and cleaning is required". Not just "flushing", not just "checking" not just "testing"—we're talking about disassembling and cleaning all accumulated scale and sludge from the low water cut-off switch's interior surfaces!

The reasons for this are twofold.

First, a small amount of sludge can cause a float to be-



come restricted from travelling and mirroring boiler water level. If sludge and scale accumulates on the wall of a low water cut-off switch, the "stalagmite" of scale can grow in size to bridge the gap between the float and wall joining the two, seizing the float in place.

Annual cleaning reduces the build up of these substances.

Another reason for disassembly is to properly inspect the low water cut-off switch. Damage to low water cut-off switch components caused by gasket leaks, material fatigue or defects can only be discovered by thorough examination of the device's components.

As you can see, proper low water cut-off switch maintenance in a steam boiler requires a "team effort" between the homeowner and the service technician. As such, it may be a good idea to take the time to explain to a homeowner the necessity to perform weekly flushing.

Manufacturers provide instruction cards detailing this; however you may want to make your own and attach them to the boiler so that they are legible to a homeowner.

REQUIRED HOMEOWNER MAINTENANCE

ITT, McDonnell Miller Inc., a major manufacturer of low water cut-off switches, provides a "Notice" tag (See page 12) directing the weekly flushing of low water cut-off switches.

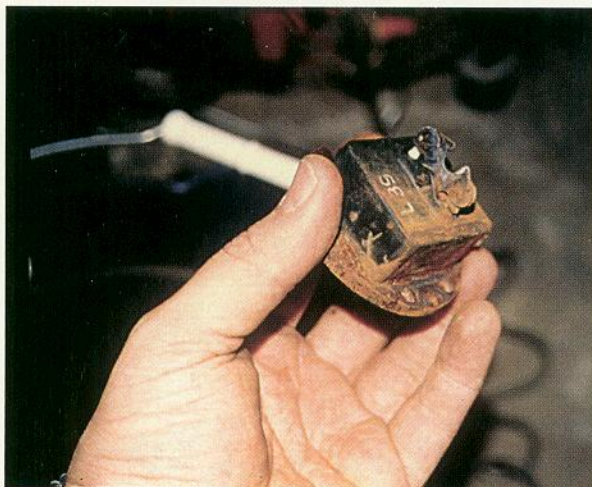
This reads: "**NOTICE:** Place bucket under valve and blow down this control at least once each week during the heating season. Failure to follow the blow down procedure on boiler card furnished can cause control to malfunction, resulting in serious boiler damage."

REQUIRED SERVICE ORGANIZATION MAINTENANCE:

According to ASME Boiler & Pressure Vessel Code-Section VI (Low Pressure Boilers for Heating Service) Paragraph 7.07 G, "Low water fuel cut-off and water feeders should be dismantled annually, by qualified personnel, to the extent necessary to insure freedom from obstructions and proper functioning of the working parts."

Disassembly and proper cleaning on an annual basis, as

continued p. 24



Low water cut-off switch damaged by unidentified leaking water.

directed by manufacturer and ASME Section IV, will remove the hard scale accumulations normal, weekly flushing of the device cannot remove.

CONCLUSION

Commercial boilers are usually maintained by facility engineers according to a strict, logbook driven maintenance regimen. In addition to this, typically commercial boilers are insured by companies that inspect the boiler's fire surfaces annually and require that low water cut-off switches be opened and made ready for inspection. As such, required low water cut-off switch maintenance is carried out.

Contrary to this, however, residential steam boilers are not typically subject to this system of inspection or service. Their safe operation relies on the diligence of the homeowner and thoroughness of the service technician in performing required maintenance actions.

The risk of boiler damage and homeowner safety in the event of a dry fired (a.k.a. "runaway", "low water fired") boiler is such that strict adherence to the required maintenance of these devices must be observed at all times. Unfortunately, dry fired boilers are so common as to indicate that proper maintenance is not being done.

Low water fired boilers can be greatly reduced by understanding that the cause of low water cut-off switch failure is usually a result of inadequate maintenance of these devices.



Bisected McDonnell Miller low water cut-off switch. Note scale formation.

Do what's right and take the time to explain to homeowners the importance of their role in maintaining their heating system and be sure to develop your own service plans to do your part in this vital maintenance action! ♦

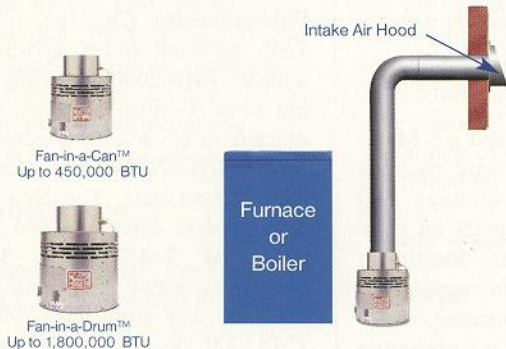
John Certuse is a Registered Professional Engineer and is the president and founder of Industrial Services & Engineering Inc. (ISE) in Attleboro, MA. ISE is a forensic Engineering firm specializing in the identification of equipment failures including heating system equipment. John also holds several licenses including licenses for boiler operation, oil burner repair and pipefitting.

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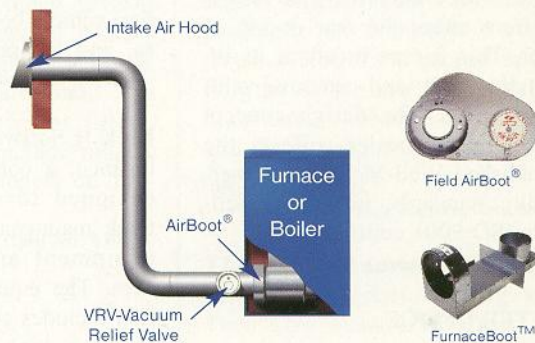
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