

# Probe LWCO & Conductivity of H<sub>2</sub>O



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**M**aintaining proper water levels in boilers is essential for both safety and operational efficiency. One of the key components to ensuring this is the low water cut-off (LWCO), a safety device that prevents the boiler from running dry. Among the various types of LWCOs, *probe-style low water cut-offs* have gained popularity due to their reliability and minimal maintenance requirements. However, their functionality is heavily dependent on one crucial factor: *water conductivity*.

Conductivity determines how well the water can complete an electrical circuit, which is the principle behind how a probe-style LWCO detects water presence. If the conductivity is too low, the probe may fail to function properly, leading to false readings or, in worst-case scenarios, the boiler failing to shut down during a low-water condition. This can result in catastrophic overheating, equipment failure or even dangerous explosions. Understanding the role of conductivity in these systems is essential for maintaining safe and efficient boiler operations.

## How Probe-Style Low Water Cut-Offs Work

A probe-style LWCO operates by using an electrode probe inserted into the boiler's water column. This probe is designed to detect water based upon its ability to conduct electricity. When water surrounds the probe, the electrical circuit is completed, indicating a safe water level. If the water level drops below the probe, the circuit is broken, signaling the boiler is in a low-water condition, which then shuts off the boiler.

This method of operation offers several advantages over traditional *float-style* LWCOs, which rely on mechanical movement and are prone to wear and failure over time. Since

probe-style LWCOs have no moving parts, they are generally more reliable and require less maintenance. However, their ability to function correctly hinges entirely on the *conductivity of the water in the boiler*. If the water lacks sufficient dissolved ions to carry an electrical current, the probe will not be able to detect the water level accurately, leading to potential safety risks.

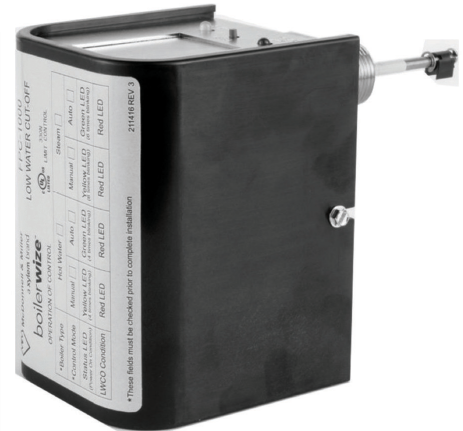
## The Role of Conductivity in Boiler Water

Conductivity is a measure of how well water can carry an electrical charge. It is influenced by the concentration of dissolved solids such as salts, minerals and other impurities. Boiler water typically contains a controlled level of dissolved solids to ensure that it conducts electricity efficiently. If the water conductivity falls outside the optimal range, the LWCO may either *misinterpret the water level or fail to respond appropriately to actual low-water conditions*.

When conductivity is too low, the probe may not register water presence, causing unnecessary boiler shutdowns. This can lead to operational inefficiencies, increased downtime and frustration for the homeowner and the service technicians. Conversely, if the conductivity is too high, it may cause excessive scaling or corrosion, impacting the probe and the overall boiler system. Some probes may even interpret this high conductivity level as a shorted probe, thinking the tip of the probe is touching metal, therefore keeping the burner circuit off. Striking the right balance is key to ensuring that probe-style LWCOs function as intended.

## Factors that Influence Conductivity

Several factors affect the conductivity of boiler water. One of the most



significant is the *quality of the water being used*. If a facility utilizes deionized or distilled water, conductivity can be extremely low because these processes remove most dissolved minerals. While such purified water may be beneficial for certain applications, it poses a problem for probe-style LWCOs, which rely on those minerals to function correctly. In cases where the water is too pure, it may be necessary to introduce conductive additives to ensure the probe-style LWCO operates as expected.

The chemical treatment of boiler water also plays a major role in maintaining proper conductivity (especially in commercial and manufacturing facilities, but not common in residential systems). Boiler operators in manufacturing facilities typically use carefully balanced chemical programs to prevent scaling, corrosion and excessive foaming while also ensuring that the water remains sufficiently conductive. Additives such as *sodium phosphate, sulfites and alkalinity boosters* are commonly used to maintain proper water chemistry and prevent operational issues.

Another critical aspect is the cycling of boiler water and the blow-down process. As water in the boiler evaporates, dissolved solids become more concentrated, which can lead to conductivity levels rising beyond ac-

ceptable limits. To manage this, operators perform periodic blowdowns-removing a portion of the high-mineral content water and replacing it with fresher feedwater. This process helps maintain conductivity within the optimal range while also preventing excessive scaling inside the boiler.

Contamination from sources such as rust, scale or oil in the system can alter conductivity levels. Corrosion products and foreign materials may interfere with electrical conductivity, leading to unreliable LWCO readings. Regular system maintenance will help mitigate these issues, ensuring the water remains in optimal condition for probe detection.

### **Best Practices for Maintaining Proper Conductivity**

To ensure that probe-style LWCOs function effectively, it is essential to monitor and manage boiler water conductivity consistently. In commercial applications, it is not unusual for the boiler operator to use a specialized

meter to test the water's conductivity. This type of maintenance will allow the operator to make the adjustments needed before operational problems arise.

Maintaining a well-balanced water treatment program is equally important. Working with a water treatment professional can help ensure that the correct chemicals are used in appropriate quantities to maintain conductivity within the recommended range.

Routine maintenance and cleaning of the LWCO probe is an important procedure that should be performed during an annual cleaning. Over time, probes can become coated with scale, sludge or corrosion, which can act as an insulator and prevent proper water detection. There are some probe-style LWCOs that promote a self-cleaning probe; they have a device mounted on the probe that continually rotates around it, helping to prevent scale from building up. Good maintenance practice is to pull

those probes annually for a visual inspection. Also, periodic cleaning using a mild abrasive or descaling solution can help maintain the probe's effectiveness.

Service technicians should also periodically test the LWCO system manually by simulating a low water condition. This allows them to verify that the cut-off mechanism is working correctly and responding as expected.

Conductivity plays a crucial role in the safe and efficient operation of probe-style low water cut-offs in steam and hot water boilers. Without sufficient conductivity, these devices may fail to detect water levels correctly, leading to false shutdowns or dangerous dry-firing conditions. Understanding boiler water conductivity is essential to ensure that LWCOs function properly and the boilers remain protected.

If you have any questions or comments, e-mail me at [gcarey@fiainc.com](mailto:gcarey@fiainc.com), call me at (800) 423-7187 or follow me on Twitter at @Ask\_Gcarey. **ICM**