Low Water and Your Boiler

Maintaining proper boiler water level is essential for the safe operation of your boiler. The water in a boiler absorbs heat from the combustion of fuel. When water levels are inadequate, rapid overheating can occur causing excessive temperatures that may result in rapid, catastrophic failure of boiler structures and components. Observations related to inadequate low water protection are among the most frequently issued violations and recommendations made by Travelers Risk Control Consultants.

Low water protection helps ensure a sufficient water level exists for safe operation. Boilers have built-in critical safeguard controls to prevent low water conditions from occurring. These protective devices are designed to shut off the heat source in the event of a low water or reduced-flow condition. Like other boiler controls and safety devices, low water cutoff devices require proper installation, maintenance and testing to help ensure they function properly.

Low Water Cutoff Devices

There are three main types of low water cutoff (LWCO) devices commonly found in use today:

- Float – These devices contain a float mounted on a linkage arm. When the water level in the boiler drops to a predetermined level, the float drops and activates a switch that causes the fuel valve to close or interrupts the electric supply to the boiler. The float is normally located in a small chamber attached by piping to the outside of the boiler.
- Probe – The probe is a metal rod that extends into the boiler and is insulated from the boiler shell. This probe is connected to an electrical circuit in the boiler control panel. During normal operation, water inside the boiler contacts the probe and completes an electrical circuit between the probe and boiler shell. If the water level drops below the probe, the electrical circuit is interrupted, and the control system shuts the fuel valves.
- Flow Switch – These devices are used with water heating and hot water supply boilers where the boiler is completely full of water during normal operation. Flow switches use a paddle or arm, usually installed in the piping or header, to measure water flowing through the boiler. If the flow of water through the boiler is inadequate, the flow-switch is designed to shut off the fuel supply.

Installation Considerations

Installation requirements can vary greatly depending on the boiler type, use and location. Contact your Travelers Risk Control Consultant or consult your local jurisdiction for details about specific requirements that apply to your installation.

The installation considerations listed below are just a few of those recommended by the National Board Inspection Code (NBIC) and American Society of Mechanical Engineers (ASME), which are applicable in many jurisdictions.

- Automatic low water protection should be installed on all boilers. Two devices should be installed on unattended steam boilers to ensure reliability if one should fail to operate.
- Low water cutoff devices connected to the boiler by piping should be installed without shutoff valves in the piping. This can prevent inadvertently disconnecting the low water cutoff device from the boiler, which would prevent it from operating.
- A cross or similar fitting, rather than elbows or tee fittings, should be used in the pipe connections at any right angle. These can be fitted with plugs or caps that can be removed to allow for cleaning and inspection without disassembling the piping.
- A mechanism for testing the low water cutoff device without draining the boiler or system should be provided. This may be as simple as a drain valve on steam boilers or a push-button test switch for probe-type cutoffs.
- On boilers that require two low water cutoff devices, the secondary low water cutoff device should trip a manual reset function. This manual reset helps alert the operator to a malfunction of the primary low water cutoff.

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Inspections, Testing and Maintenance

Adverse conditions such as leaks, scale accumulation in piping and float bowls, damaged wiring, inoperable electrical switches and stuck floats can develop over time or as a result of abnormal operation, but lack of maintenance is the leading cause of failure for low water protection devices. All low water cutoff devices require periodic inspection, testing and maintenance to help ensure that they will function properly.

Low water cutoff device testing and maintenance should be conducted only by those properly trained and familiar with the manufacturer's requirements. The internal and external mechanisms, including linkage, contacts, floats, switches, wiring, and connecting piping, should be tested and checked for defects.

Documenting the inspection, testing and maintenance can help ensure the safe and reliable operation of your equipment. Travelers can provide boiler inspection logs to assist with routine documentation of these tests and inspections.

Recommended Maintenance and Testing Frequencies for

Low Water Fuel Cutoff Devices

Boiler Type	Control or Safety Device	Frequency	Testing Mode or Action Required
Hot water heating boilers	LWCO Float or Probe type All Low Water Cutoffs	Monthly Annually	Rapid Drain Test** Open/Clean/Inspect/ Test
Hot water heating boilers that require forced circulation	Flow Switch	Monthly	Operational Test
Low pressure steam boilers	LWCO Float or Probe type	Daily Annually Annually	Rapid Drain Test** Slow Drain or Evaporation Test* Open/Clean/Inspect/ Test
High pressure steam boilers (automatically fired and unattended)	LWCO Float or Probe type	Daily Annually Annually	Rapid Drain Test** Slow Drain Test or Evaporation Test* Open/Clean/Inspect/ Test
High pressure steam boilers that require continuous operator attendant	LWCO Float or Probe type	Each shift Annually Annually	Rapid Drain Test** Slow Drain or Evaporation Test* Open/Clean/Inspect/ Test

*Slow drain or evaporation test should be performed by a qualified operator or technician.

** For probe-style low water cutoffs, follow manufacturers recommended test method if other than rapid drain test. Consult technician if the probe type LWCO is installed directly to the vessel.

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References

National Board Inspection Code, Part 1 and 2, The National Board of Boiler and Pressure Vessel Inspectors

Boiler and Pressure Vessel Code, Sections 1, 4 and B31.1, American Society of Mechanical Engineers