



## WHAT THE INSPECTOR LOOKS FOR WHEN INSPECTING A BOILER

Boiler safety is a serious issue and a matter of public safety, so all inspections are performed to help prevent catastrophic failures of boilers. This guidance document describes the items that boiler inspectors check during a boiler inspection. Click on the links below to go directly to information about the items listed.

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### **Nameplate**

The first thing the inspector looks for is the boiler nameplate. All boilers have a nameplate on the side of the boiler or on the heat exchanger that details when the boiler was made, the manufacturer that certified the boiler, the maximum allowable working pressure, maximum allowable temperature, input firing rate (in BTU/hr), output firing rate, minimum relief valve capacity (in BTU/hr or LBS/hr (steam)) and the boiler type.

Hot water heating boilers and hot water supply boilers both have the same ASME (American Society of Mechanical Engineers) stamp on the nameplate, which is the H stamp. This stamp tells the inspector which types of controls are needed for the boiler based on ASME manufacturing code and NBIC (National Board Inspection Code) requirements.

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### **Relief Valve or Safety Valve**

This is the most important device on a boiler or unfired pressure vessel. If a control fails, a properly installed and sized safety or relief valve will help prevent the boiler or pressure vessel from over-pressuring. An over-pressure condition can cause an explosion and lead to personal injury and/or significant property damage to the surrounding area.

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## Control Safety Devices

Boilers and pressure vessels utilize the following control safety devices; click on them below to learn more about them.

- [Low Water Cut Off Switch/Flow Sensing Device](#)
- [Operating Switch](#)
- [High Temperature Limit Switch](#)
- [Pressure Control Devices](#)
- [Fuel Train](#)
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All required controls and safety devices are listed in the ASME publication *CSD-1 Controls and Safety Devices for Automatically Fired Boilers*, commonly referred to by inspectors, manufacturers and contractors as CSD-1. This publication lists all of the controls and safety devices that the State of Colorado requires.

### Low Water Cut Off Switch/Flow Sensing Device

The first control safety device is the low water cut off switch, or, in some forced circulation boilers, it is the flow sensing device. These switches are extremely important because if the boiler water level drops below the lowest permissible water level, or if the flow through the boiler is insufficient for cooling in the case of forced circulation boilers, the boiler could overheat. If left unchecked, the overheating could result in a catastrophic failure of the boiler. This also poses the potential for serious personal injury and/or significant property damage.

### Operating Switch

For hot water heating or hot water supply boilers, the next item checked is the operating switch, which is sometimes referred to as the aquastat. This switch controls the firing rate of the boiler burners according to the heat of the water in the boiler. Basically, it turns the boiler on and off depending on demand. This switch works a lot like the thermostat in your living space where you enjoy the comforts of the heat produced by the boiler.

### High Temperature Limit Switch

The second switch checked is the high temperature limit switch with a manual reset. The Boiler Code requires a manual reset switch incorporated within the switch to be reset if there is an overheating problem with the boiler. When the overheating condition exists, the high limit will shut the boiler down, causing a **lock out** for the boiler burners. The manual reset button will need to be pressed to restart the boiler when the boiler is cool enough.

However, restarting the boiler does not solve your problem! There is a reason why the boiler went into lock out; most likely, the problem could be that the operating limit switch has failed to shut the boiler off on its own and should be replaced.

### Pressure Control Devices

Steam boilers use pressure control devices which ensure that the boiler does not build up too much pressure and make the operating conditions of the boiler unsafe. The first pressure control is the operator control, which controls the firing rate of the burners according to the pressure in the boiler. The second pressure control is the high limit device with manual reset that will cause a **lock out** condition to occur in order to protect the boiler in the event that the first pressure control fails to control the pressure properly.

Hot water heating and hot water supply boilers are inspected like steam boilers because they have the same control safety devices. The only difference between hot water heating and hot water supply boilers is that hot water supply boilers heat water for use other than space heating, such as domestic hot water for showers and car washes.

### Fuel Train

The fuel train supplies natural gas, fuel oil, propane or other fuel sources. Its controls consist of electric- or hydraulic-operated fuel stop valves and fuel pressure switches, a gas regulator, a combination gas and regulator valve, a thermocouple, a flame sensor and all flame failure equipment, manual gas stop valves and the burners. The condition of fuel train controls and the flame appearance may require the services of a trained technician for proper adjustments to assure a correct fuel-to-air ratio.

### Emergency Shut Off Switch

All boilers and forced flow water heaters must have an emergency shut off switch which will cause a **lock out** condition and will not allow the boilers to restart until the switch is brought back to the 'on' position. This switch must be installed either right outside or right inside the boiler room door if tampering could be a problem.

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## **Boiler Room Piping**

The inspector checks for proper piping materials used in feed water supply and return water pipes, gas lines and trains and blow-off piping on high pressure steam boilers and steam supply lines. Feed Water (make up water) for the boiler consists of a pressure reducing valve, feed stop valve and a check valve rated for 250°F or maximum temperature of the boiler. All of these high pressure piping connections are of ASME Code B31.1 specifications and require jurisdictional knowledge for limits on piping, such as the proper valves and proper pipe size/thickness because they are very important to the safety of the operation of the boiler and the people who are in close proximity to the boiler.

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## Combustion Air

Another item of inspection is the combustion air requirements of the boiler room, which is important to make sure the boiler has enough fresh air for the burners in the boiler which in turn assures that the boiler burners have the proper fuel-to-air ratio. Oftentimes, the inspector may go into boiler rooms that have the combustion air opening blocked off or there is just not enough fresh combustion air for the boiler by code standards.

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## Flue Pipe Connections

Proper flue pipe connections inside the boiler room are very important. Improper flue pipe connections inside a boiler room can cause **carbon monoxide leaks**. Carbon monoxide is a colorless, odorless gas, and if it is present in high concentrations, it can pose a serious threat to personal safety. If these connections are done improperly, the leakage of carbon monoxide can cause sickness or even death. That is why a qualified contractor, who must follow local jurisdiction code requirements and the international code, is required to perform the installation of flue pipe.

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## Expansion Tanks

One item of inspection that is commonly misunderstood by boiler owners, responsible parties and contractors that install the boiler is the expansion tank. The expansion tank of the boiler is installed in the piping of the boiler to allow for expansion and contraction of the water in the boiler or water heater as it heats and cools. Without this expansion tank, there is no place for the water to go as it expands, which results in the relief valve lifting to relieve the excess pressure. The expansion tank allows the water to expand without creating an over-pressure condition. If the relief valve on the boiler has a set pressure greater than 30 psi, the expansion tank must be constructed to ASME Section VIII DIV-1. Any Non-ASME expansion tank is not rated for the hydrostatic test pressure required above 30 psi. For further explanation, consult with your boiler inspector.

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## Boiler Room Condition

Excessive storage of materials makes inspections of boilers very hard, if not impossible, to perform. Boiler rooms are not for storage of any items, and flammable items are not allowed under any circumstances.

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## **Internal Inspections**

Internal inspections are required on steam boilers that have hand hole or manhole openings. A hand hole is a small oval port just large enough to get your hand, and in some cases your arm, inside the boiler to allow for a visual inspection of the water side of boiler and aid in the cleanout of mud and sludge from the waterside of the boiler. Manholes allow for the inspector to physically enter the boiler and are for the inspection of the steam drums and mud drums on large water tube boilers and some fire tube boilers. In order for an individual to gain access to a boiler through a manhole, there must be a confined space entry permit procedure in place for proper and safe entry. New gaskets should always be used after inspection so that boiler openings will seal properly when placing the boiler back into service. The internal inspection is required every time the boiler is due for a new certificate of inspection. Boiler water treatment is a very important part of the overall maintenance program of a boiler. Improper water treatment can lead to shortening the expected life of the boiler.

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