

Master Brewers Safety Toolbox Talk



Operational Boiler Safety

Overview

In the brewery, beer production is the order of the day. From a safety and risk standpoint, it should be considered that steam generation with a boiler poses the greatest risk to brewery operations than just about anything. In order of severity, those risks are explosion, significant steam leak or line rupture, combustion gases, chemical hazard, and hot surface burns. Let's talk about how you can minimize these risks in your brewery.

Checks to make at beginning of shift

Whether you have a licensed boiler operator or you are a brewer charged with the responsibility of utilities for brewhouse operations, the first thing to do when you begin your shift is to check the boiler water level using the direct-view water level gauge. ASME Section I boiler code (applies to 15 psig and above) is very specific that boilers, specifically boilers below 400 psig must have a gauge-glass that directly shows the water level in the boiler.

Level gauge:

Isolation valves between the boiler and the water column are optional, but if they exist, they must be open during operation. The water level should be in the middle of the gauge-glass as designed. If the water level is not visible in the glass, secure the boiler immediately. In order to maintain the tubular or armored glass for high visibility, it may be blown down in a sequence following the blowdown procedure for the water column. The sequence is to close the steam valve (upper), leave open the water valve (lower), open the drain valve on the bottom of the gauge for 20 seconds, close the water valve (lower), slowly open the steam valve (upper) for 20 seconds, close the drain valve, then open the water valve (lower).

Pressure controls:

On smaller boilers, "Pressure controls" are often used to establish a boiler operating pressure. The system

consists of one differential pressure (DP) switch to determine boiler operating pressure at the upper end and when to re-fire the boiler at the lower end. Another pressure switch is used as an electric high-limit switch to prevent overpressure in the control. These devices should be tested periodically.

Low Water cut-off:

The low water cut-off switch is typically a ball float activated switch located outside the boiler but at the determined lowest point for safe water level to operate. The low water cutoff switch has its own blowdown valve to keep the mechanism clean from scale. Conductance probes may also be used as a secondary device. This is a probe sensing contact conductivity occurring between the liquid (water) and the probe thus completing an electrical circuit in a relay. These devices should also be tested periodically. This can be done in low demand hours by forcing lower water level through blowdown with the feed pump secured in a supervised situation.

Safety valve:

The pressure safety valve (PSV) is a mechanical device that will prevent overpressure should the other pressure control devices fail and should be set at either MAWP (max allowable working pressure) of the boiler, if applicable, or at a pressure where the boiler operating pressure is no more than 80% of the nameplate stamped set pressure on the valve. That 20% is called the operating gap and represents the gap required to keep the valve from trying to open by leaking or "simmering". These have also been called "pop" valves since as the valve disc begins to open off of the seat, by overcoming the spring, the steam contacts the "disc holder", designed to provide a much larger face area for the steam and therefore a greater force to act against causing a "pop" and immediately going full open. The valve has to have a stamped nameplate with a National Board stamp an ASME Section I "V" stamp with the set pressure stamped on the nameplate as well. In this service, the PSV must have lifting lever for periodic test (6 months) and a lead seal must exist on a

wire that does not allow adjustment of stamped set pressure or removal of the test lever.

Fuel system:

If the boiler fuel is natural gas, this is now the second major risk for explosion within the brewery next to boiler overpressure. A scary fact is that there are many who perform piping repairs every day who don't understand that gas piping is quite different than air or water piping! Anyone contemplating or hiring someone to repair natural gas piping should have a copy of *NFPA 54: The National Fuel Gas Code* (www.nfpa.org). It is all about safe gas piping and repair practices. Questions to ask and answers to find include: where are the isolation points and how will isolation be achieved safely? Is there enough purge N2 and do all involved understand N2 hazards? Where will it purge to outside the building? Has a procedure been developed for re-introduction and start-up? One of the more dangerous parts is the re-introduction and start-up phase. When purging, there is limited hazardous material, limited by pipe volume only. When re-introducing, however, there will be unlimited gas that can easily create a maximum explosion!

Interlock testing:

The gas fuel train regulates volume and pressure of gas to the boiler burners. Further, it keeps gas from the combustion chamber while the boiler is secured. It sounds simple, but there is a train of regulators, flow control valves, FM safety shutoff valves, and sometimes vent valves. The fuel train also includes controls and sequences to ensure safe light-off and shutdown in response to operating anomalies, and combustion air control. The complete system is referred to as the burner management system. As if this were not complicated enough, manufacturers of some of the equipment in the gas train have different inspection intervals and local or state statutes require regular test intervals. This is an area where an outside professional should be consulted in line with local laws. It may cost a little more, but the operating performance (burner management) may

be optimized, or consider the alternative... Please be safe.

Water side care:

Chemical treatment is necessary to remove scale, prevent calcium buildup, and remove O₂. Without this operation, the boiler and piping system would have an unusually short service life due to O₂ oxidation and carbonic acid formation when allowed to cool and go back into solution in process piping & equipment, and in returning condensate feedwater. Mineral buildup can occur on boiler internals causing overheating and poor performance. Blowdown is the method used to remove minerals in suspension and sedimentary layers from the bottom of the boiler. Poorly maintained boilers require a lot of blowdown events while those optimally maintained require much less and therefore operate with much less energy loss.

Carry-Over:

Carry over is a condition where feedwater is drawn out of the boiler with the steam into the distribution system. This happens when the boiler level is too high for one reason or another. Other common reasons for carry-over are when the main steam stop valve is opened too quickly, or when there are large load swings, such as in the brewhouse in larger breweries, the boiler may be too marginally sized for max capacity, and when there are too many boiler chemicals in the feedwater such as in a high alkalinity condition. Another reason, if carry-over happens far too often, is that the near-boiler piping is not designed well to allow condensate to be "dripped out" of the boiler header before it enters the distribution piping. From a safety standpoint, this condition frequently causes damaging water hammer, the most dangerous known as differential shock. When an incompressible liquid is able to travel at the much higher steam velocity and hits downstream equipment, well...you wouldn't want to be standing on the tracks when the bullet train is coming!

Conclusion:

Creating and using steam is still the most efficient heat transfer media known to man. While we all want to enjoy pleasure, profits, and taste with which

this utility allows brewers to make, it is not without a host of hazards. Hopefully, these tech tips will help keep you safe as you operate your steam system.

Please note boiler requirements and operator certifications may vary from state to state.

If you have any questions regarding this Toolbox Talk, please see your supervisor / manager or a member of the Safety Committee.

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THE MBAA BREWERY SAFETY
WEBSITE AT:**

<http://www.mbaa.com/brewresources/brwsaef>