

The Locomotive

Improving Boiler Life and Reducing Cast Iron Boiler Accidents

By Brian W. Moore, P.E., The Hartford Steam Boiler Inspection and Insurance Company

[The original version of this article appeared in a 1975 issue of The Locomotive. But a key fact remains true today: overheating due to low water condition is still the major cause of boiler failures. Last updated some five years ago, our customers continue to request these guidelines.]

Introduction

Many years of experience have shown that cast iron boilers are well suited to low pressure heating applications. Fifty years of service, though not typical, is not unheard of for these boilers when given tender loving care. However, there is a tendency to forget about the heating plant when the weather becomes warm enough to shut down the boiler. With the advent of automatic controls, heating boilers are taken for granted even during the heating season. If so little attention is given to these workhorses, how then can the number of accidents be reduced?

The simple answer is to pay more attention to cast iron boilers by proper operation and maintenance. By this we mean that by following a few easy guidelines, the efficiency and operating life of a boiler can be improved. In this article are some guidelines for the "care and feeding" of a cast iron boiler.



Use A Boiler As It Was Intended To Be Used

A cast iron boiler is intended to be used as a heating plant either for hot water or steam supply. Use in other applications is asking for trouble. In one situation, for instance, the owner wanted to use a 15 psig cast iron steam heating boiler to supply steam for cleaning engine parts at a service station. Applications such as steam cleaners, steam baths, humidifying systems, or process supply are not appropriate for cast iron boilers.



Hartford Steam Boiler

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Heating systems should be closed; no condensate or water should be purposely voided from the piping or associated vessels. Applications such as those listed above require the addition of large volumes of make-up water which contain minerals, dissolved solids, and gases (oxygen and some carbon dioxide). These in turn cause the buildup of sludge, scale, or corrosion on the internal surfaces of the sections. The design of most sections makes it very difficult and usually not practical to attempt complete cleaning of the internal surfaces. Therefore, preventing such buildups is important to the life and performance of a boiler.

Water Chemistry

If a heating system is leak tight, water chemistry is usually not a major concern for cast iron boilers. Real world experience tells us, however, that leaks are all too frequent. If a sufficient volume of raw water is added to a system, careful attention to water chemistry will help reduce scale and sludge accumulation. Sections can overheat due to lack of adequate water flow and heat transfer through the metal. Less dramatic, but just as effective in preventing proper operation of a boiler, are cracks from overheating.

Excessive make-up using hard water (high mineral content) is a typical factor in scale and sludge build-up. Softening the water will reduce the mineral content, but can make it acidic leading to corrosion. It is important to have raw water tested to determine if water treatment is required. If rusty water or sludge is visible in the gage glass, you can bet that trouble is not far away.

If a boiler is an outside unit, has piping or vessels in unheated spaces, or is shut down in cold weather, freezing may be a concern. Antifreeze can be used to help prevent freezing. Most new boilers are being built with elastomer (hydronic) seals between sections. These seals are susceptible to possible deterioration due to attack by petroleum-based antifreeze and water treatment chemicals. Be sure to consult your heating professional for the correct products to add to boiler water.

Maintain Safety Devices

Safety devices on boilers include safety/relief valves and control devices. Safety/relief valves are intended to protect a boiler which is designed for low pressure applications; typically 15 psig steam and 30 psig water. If these devices are improperly installed or, worse yet, intentionally defeated, catastrophic accidents may occur.

A boiler can become overheated and over-pressurized by a combined failure of the burner controls and an inoperative safety/relief valve. Steam pressure in a cast iron boiler can have destructive, explosive power. But damage and possible personal injury or loss of life can be prevented. Be sure your qualified boiler service company or insurance inspector periodically checks your safety/relief valves.

Burner controls that do not shut off fuel flow can cause similar failures by overheating the boiler sections. The burner controls may use the following indications to stop fuel flow when:

1. Steam pressure or water temperature exceeds the set limits;
2. Water level drops below safe limits;
3. Ignition fails or main flame is interrupted;
4. Mechanical draft fails; or
5. A control circuit fails.

Low water cutouts and gage glasses should not be allowed to become fouled by sludge build-up, because they will not perform their function. As part of routine maintenance, these devices should be periodically inspected, cleaned, and flushed out.

Boiler Service Is Key

A recent incident illustrates the necessity for proper maintenance. The incident did not result in a catastrophic failure, but could have if not caught in time. The case involved a small boiler in a convent located in the Northeast. There was an obvious discoloration on the side of the unit.

The nuns reported that the boiler had been a problem and had been recently serviced. After the boiler was put back into service, the basement where the boiler is located became very hot, making it difficult to reach the emergency shutoff switch. When the boiler finally cooled down, investigation showed that the insulation had been improperly reinstalled after the recent service.

Because various combustible objects were in the basement, a fire could have resulted. Fortunately nothing more than the scorched paint resulted and no claim was filed.

Another situation that boiler inspectors see is overheating in replacement boilers. When replacing a boiler, the temptation is to replace like for like without considering the complete system.

New designs of cast iron boilers are using thinner metal and decreased internal water volumes. These boilers may need greater condensate storage capacity. If leaks are present and not repaired during the replacement, condensate may be inadequate (due to the leaks), resulting in overheating and cracked sections. It is important that boiler owners seek a qualified professional to consider their complete system, and not just the boiler itself.

Also, as part of building expansion, boilers often are replaced with larger capacity boilers without consideration to the expansion tank in hydronic systems or condensate storage in steam systems. Undersized expansion or condensate tanks also can cause water purge and addition. The effect in the boiler is the same as if there was a leak.

Checklist For Operation And Maintenance Of Cast Iron Heating Boilers

1. Have your boiler periodically checked out by a qualified service and repair company.

2. Keep boiler surfaces, firebox, ash pit, casing and ducts clean to prevent corrosion. Check for and flush out as needed to remove scale and sludge build-ups.

3. Keep the boiler room dry and reasonably clean. Do not let debris, ashes, etc. accumulate around the boiler or piping.

4. Examine the boiler for evidence of rust growth between sections. Check tie-rods of push-nipple type boilers to be sure the nuts have been backed off several turns, or that the rods are provided with split nuts or compression washers.

5. Maintain a closed, tight system. Leaks means excess make-up. Do not use sealants in the water. They may stop leaks but they also lead to plugging and eventual failure of sections.

6. Make sure all safety devices, controls and attachments are installed properly, clean and operational.

7. If make-up water is required, check raw water quality to reduce corrosion, scale and sludge. When needed, use only manufacture approved antifreeze and chemicals in the system.

Spring Shut Down

When the weather becomes warm enough to shut down the boiler in the spring, it is tempting to think there is no need to worry when the boiler is not being used. After all, there will be plenty of time during the summer to check over the heating plant and determine if it is in satisfactory condition for the next heating season. This belief could not be further from the truth! A properly shut down and laid up boiler will last longer and give you better service.

The check list indicates basic guidelines for proper spring shut down.

Spring Shut Down Check List

1. Drain boiler water only until it runs clear. Remember excessive make-up can contribute to scale build-up. Some operators fill steam systems to top of gage glass. Water systems should remain completely full. If the raw water quality requires treatment chemicals, they should be added. The circulation pumps should be operated on water systems to assure complete mixing of water treatment chemicals. If drained water is especially dirty, it may be necessary to remove blowdown valves and plugs and flush passages with a high pressure water lance. If hard scale is present, chemical cleaning may be necessary. If freezing is a concern during shut down, the boiler should be drained and thoroughly dried or an appropriate antifreeze solution should be added.
2. Clean all boiler surfaces. Using a wire brush and vacuum cleaner, remove all soot and ash from sections, smoke boxes, and flues. Remember soot and ash are corrosive when damp. Calcium chloride or unslaked lime placed in a tray in the fire box will help maintain dryness. Some operators even swab fire side heating surfaces with neutral mineral oil to protect against corrosion.
3. Inspect (disassemble if necessary) and clean all low water shut off, safety/relief valves, and other safety devices to assure proper operation.
4. Inspect and clean firing equipment. An efficient system will save money.
5. Complete any repairs needed

Fall Start Up

A properly done spring shut down makes the fall restart task easier. If any of the safety checks suggested above were not done in the spring, now is the time to do it.

Fall Start Up Checklist

1. Reassemble and install any safety devices and plugs taken out for the spring shut down.
2. For steam systems, if filled with water, drain excess water to normal operating level.
3. Remove any ash, soot, or drying agents from the boiler.
4. Check and verify proper operation of all safety devices and controls.
5. Restart boiler according to manufacturer's guidelines.
6. For best efficiency and safety, have a qualified professional tune burners and controls. Remember: an efficient boiler saves money.

Summary

This article is intended only to offer some basic guidelines for keeping your boiler operating safely and efficiently. It is not intended to be an extensive primer, but is appropriate to most cast iron boilers. Most accidents can be traced back to human error, so proper operation and maintenance is essential to reducing cast iron accidents.

About the Author

Brian W. Moore, P.E., is a Principal Engineer and boiler specialist for The Hartford Steam Boiler Inspection and Insurance Company. He earned B.S. and M.S. degrees in mechanical engineering from the Massachusetts Institute of Technology, and an M.B.A from the University of Connecticut. Moore has more than 20 years of experience in the boiler business.