



Property Risk Consulting Guidelines

XL Risk Consulting

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PRC.7.1.0.5

BOILER MAINTENANCE AND OPERATION

INTRODUCTION

This section identifies elements which should be included in a boiler maintenance program, and suggests minimum inspection and test intervals.

Boilers and fired pressure vessels are frequently subject to state or local legal requirements and, either by law or customary practice, to various codes and standards. Although most U.S. jurisdictions require construction in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code) and inspection in accordance with the National Board of Boiler and Pressure Vessel Inspectors Inspection Code (NBIC), many jurisdictions have additional rules for boiler and vessel design, construction, installation and repair. Many also require an operating certificate; some require a licensed operator in responsible charge of units in service. Because requirements vary among jurisdictions and because these requirements may change, AXA XL Risk Consulting procedures are based on accepted engineering principles. Some jurisdictions may have additional requirements which Property Risk Consulting Guidelines do not address. Consult the local rules to ensure compliance.

POSITION

Reliable boiler operation requires a maintenance program that includes inspection, test, preventive maintenance and repair procedures. For the program to succeed, it must be fully documented and have unequivocal management support. See *OVERVIEW* for information about management loss prevention programs.

Operating And Maintenance Procedures

Provide written procedures for all important activities, including:

- Operations, such as startup, shutdown, maintenance procedures and abnormal operations.
- Emergency response, including operator response to boiler problems, facility response to boiler problems, and operator and boiler response to facility problems and external challenges.
- Visual inspection and nondestructive testing and evaluation.
- Pressure equipment repair and hot work.

Ensure both facility employees and contracted personnel are properly trained in and comply with facility procedures. Conduct periodic refresher training and drills.

Maintenance Information

Include all boilers and fired vessels in a central maintenance management system. On each piece of equipment, maintain a file which includes:

- For standard boilers and vessels, an **ASME Manufacturers' Data Report**. For nonstandard boilers and vessels, a list of specifications, including design pressure and temperature, design calculations, materials used, thickness, construction methods, and tests and inspections performed during construction and prior to use. A form similar to the National Board NB-5, "Boiler or Pressure Vessel Data Report - First Internal Inspection, may be used. The following identification numbers should appear as applicable:
 - National Board Number
 - Jurisdiction Number
 - Manufacturer's Serial Number
 - Owner-User's Inventory or Identification Number.
- **Drawings or sketches** in sufficient detail to permit calculation of all components' service ratings.
- Complete pressure relieving device information, including setpoint and capacity.
- A **record of inspections**, including date of installation and date and nature of any repairs or alterations.

Maintain operating logs for all boilers. Boiler logs may be as sophisticated as automated digital event recording or as simple as a tag attached to the gauge glass where test activity can be entered. In all cases, provide a written system which is appropriate to the facility and properly maintained. The system should include, as applicable, records of all safety device tests and inspections, water chemistry activities and critical parameters subject to change.

Operation

Persons in responsible charge of a boiler should be trained and experienced in their tasks, and licensed if required. Training programs should provide operators with complete understanding of the required steps for normal operations. These operations include startup, shutdown, steady state and transient steaming, blowdown and chemical addition. Provide thorough training supplemented by periodic drills that cover emergency procedures, such as load rejection, loss of the normal electric power supply, loss of feed/low water, steam leak or rupture, and flameout.

Examine boilers at least daily. Examine steam boilers in closed heating systems and all hot water boilers larger than 400,000 Btu/h (115 kW) at least once each 8 hr shift. Examine any boiler larger than 12,500,000 Btu/h (3660 kW) at least hourly. Provide attention more often to any boiler with frequently changing operating conditions. Continuously man any boiler which does not have properly functioning automatic controls as recommended in Property Risk Consulting Guidelines. Log selected parameters each visit or at least hourly.

The items to be examined and logged will vary with the installation. Sample logs for use with small heating boilers are included in the *OVERVIEW* program forms packet. Additional suggestions for the content of a log program are available upon request.

During each tour, examine the water level gauge glass for cleanliness, leakage and appropriate level. If glass is dirty, drain and flush it as needed. Each time the LWFCO is slow drain tested, also drain the gauge glass to verify that it is not isolated or plugged. For boilers with remote operating stations, verify at least each shift that the remote level indication agrees with the actual level.

Boiler operators must always look for steam and condensate or feed water leaks, overflowing condensate tanks, and blowing or weeping safety or relief valves. This is because loss of system fluid wastes energy and causes additional (makeup) water feed to the system.

Adding makeup feedwater to a system intended to be closed will cause scale to accumulate in the boiler. Closed systems are those in which steam is used, condensed and returned, or hot water is

circulated. Systems designed to add makeup will have water treatment facilities. Makeup water is a problem in cast iron boilers regardless of the quality of the water treatment program, because cast iron boilers cannot be effectively cleaned internally.

During tours of inspection, examine the boiler for any leakage, bulging or distortion, loose or wet insulation, corrosion or support failure. If the boiler has firing doors or ports which can safely be opened, examine the visible fire surfaces for leakage, cracking, excessive soot or corrosion. If the boiler is firing, observe the flame pattern for excessive smoke. Evidence of combustion products blown back from burner openings may indicate that the flue or stack is clogged.

Recommendations concerning low water safety equipment are contained in PRC.7.1.0.6. Any boiler that does not have a sufficient number of operable safety valves installed must be shutdown immediately. Any boiler without functioning low water protection must be continuously manned until repairs are completed.

Regularly calibrate pressure gauges and other sensing and indicating instruments. An annual functional check is the minimum; instruments on power or process boilers should have a functional test at least quarterly and a formal calibration at least annually.

Water Chemistry Control

A water chemistry program is a set of procedures for controlling boiler water quality. Because boilers evaporate water, any impurities in the condensate and feedwater will concentrate in the boiler. Because some mineral salts ("hardness") come out of solution at higher temperatures, scale and sediment will result. In a closed system, water chemistry requirements are minimal because little or no water is added after the initial fill. For boilers which inject steam to a process or to systems whose condensate is dumped, the required treatment will depend upon the quality of the local water.

Chemical control of pH, with blowdowns (controlled drain and refill of the boiler during operation) to control solids content, may suffice for good ("soft") water, while more sophisticated chemical treatment and external water softeners (ion exchangers) may be required in more adverse conditions. For power or utility boilers, extreme purity involving distilled water as well as the other measures outlined may be required. In any case, either the owner or a contractor should analyze the water and document the results as well as recording any corrective action taken. The appropriate frequency varies from monthly, or even quarterly, for a heating boiler in a tight system with good water, to hourly, or even continuously, for a utility boiler.

Various operating conditions, for example, oil or chemical feedwater contamination, may cause excessive scaling of heat transfer surfaces that cannot be controlled or corrected by water treatment. Inadequate or out-of-control water treatment programs can also cause excessive scaling. Controlled chemical cleaning may be needed to remove excess deposits. Properly performed, this procedure involves filling the boiler with an inhibited acid solution and possibly heating it. Chemical cleaning should only be undertaken by experienced persons because of the potential for severe damage to the boiler and hazards to the surroundings.

A piece of equipment which is out of service for an extended period of time is said to be "laid up" or "in lay-up." For boilers, there are two methods. In wet lay-up, the boiler is filled completely with water. Water chemistry control must be maintained and freeze protection considered. In dry lay-up, the boiler is drained and dried. Means such as chemical desiccants or a dry nitrogen purge must be employed to insure dry conditions are maintained. For any boiler in lay-up, fire surface corrosion is of concern unless the fire surfaces are cleaned and kept dry.

Maintenance

Most boilers are subject to jurisdictional regulations that require annual or biannual shutdown for inspection. Arrange for complete water and fireside cleaning when these inspections are conducted. More frequent inspections may be required by operating conditions or the boiler manufacturer. See the National Board Inspection Code for more information. Ensure that any conditions found are corrected by properly qualified persons. Monitor all repair activities to ensure proper hot work procedures are employed and that proper safety precautions are taken.

See the referenced Property Risk Consulting Guidelines for information about maintenance for safety and relief valves and low water protection devices. See PRC.4 for information about fuel system tests and inspections. See PRC.7.1.5 for more information about organic fluid boilers.

Conduct any other maintenance as required by the manufacturer.