

BOILER MAINTENANCE and SERVICING

SEASONAL MAINTENANCE -

to be performed by trained boiler technician or boiler contractor only:

1. Disassemble **the low water cut-off** and **make-up water feeding devices**. All parts should be thoroughly cleaned and re-conditioned as required, then tested before the boiler is put into regular service. While in service the cut-off should be tested once a week.
2. **Burner equipment** should be cleaned and adjusted to give maximum efficiency. This can save fuel dollars.
3. The boiler **heating surfaces and ducts** should be cleaned of all deposits. Dirty internal surfaces not only waste fuel and dollars, but also can lead to the burning, bulging, cracking, corrosion and even explosion of the boiler.
4. The **safety/relief valve** should be tested for freedom of operation. This is of primary importance. The boiler must not be fired if the safety/relief valves are inoperative or otherwise defective. These valves should be tested once a month while in service.
5. All **pressure and temperature controls and gauges** should be checked for satisfactory operation and adjusted or replaced as necessary.
6. The water level **gauge glass** must be cleaned to indicate the proper water level at all times.
7. Any **leaking pipes or fittings** located on the boiler or anywhere throughout the heating system should be repaired or replaced to prevent a loss of water.
8. **Water lines exposed to freezing temperatures should be insulated to prevent freeze-up.** Steam and condensate return lines should be insulated to prevent unnecessary and costly heat loss.
9. All mechanical equipment, such as **fans and pumps**, should be checked for smooth operation and proper lubrication.
10. A **record of boiler operation** should be established and maintained throughout the season. Deficiencies should be documented in detail, priced, and brought to the attention of Director of Operations.

Understanding when to turn to qualified professionals for assistance is an operators' first responsibility.

The following maintenance should only be handled by qualified, licensed boiler technicians:

- Leaking pressure relief valves
- Substantial or continuous make up water to boiler
- Steam leaks or steam vented from condensate tank (steam systems)
- High stack temperatures (greater than 350 degrees)
- Insufficient heat to building
- Condensate dripping down stack or out the front of the boiler
- Constantly resetting controller, high pressure or temperature limits or low water cut-off switches

**WEEKLY INSPECTION and MAINTENANCE -
to be performed by trained maintenance technician:**

1. The boiler room should be maintained clean and dry. Combustibles and stored materials shall be removed.
2. Note all steam leaks, trap issues, or other “open system” issues affecting system function.
3. A **boiler blowdown** should be performed when the water shows sign of dirt or impurities.
4. Locate the valve that controls the release of water, known as the quick opening valve.
5. **Open the Quick Opening Valve.** The valve should operate with little resistance. Turn the valve until the flow line is running warm.
6. **Open the Valve at a Steady Rate.** Once the line begins running warm, open the valve at a steady rate until the water in the boiler site glass drops to half its level. When the water level is half the original level, quickly close the valve as well as any other open valves on the boiler. This will produce a churning effect that will help clean the system.
7. **Repeat the Process**, after you refill the boiler with water. This second blowdown should clean out the remaining impurities in the system and the water should return to a clear state. This process should be conducted on a periodic basis in order to make sure that your boiler is working properly. System impurities may affect efficiencies and boiler life.
8. The **safety/relief valve** should be tested for freedom of operation. This is of primary importance. The boiler must not be fired if the safety/relief valves are inoperative or otherwise defective. These valves should be tested once a month while in service.
9. **The low water cut-off and make-up water feeding devices** should be tested once a week

Noticeable changes in boiler performance precede most mechanical failures. If you notice a change in boiler performance such as new noises, smells, rising stack temperatures or continually resetting safety devices, **call a licensed boiler professional for inspection.** When unexpected mechanical failures do occur, it is likely that one of the boiler’s safety or operational devices is preventing the boiler from starting. Most safety devices have manual reset buttons that need to be reset before boiler operation can continue. **Continual resetting of safety devices is an indication of unsafe operating conditions. Prompt attention by a licensed boiler professional is required.**

Common boiler issues (to be brought to licensed service contractor) may be indicated by:



Water and scale buildup on floor indicates the relief valve has been leaking past seat for some time. This valve should be replaced as soon as possible as it could scale up and become inoperative.



Back flow preventer showing scale buildup on drain opening may indicate the back flow preventer needs to be tested for proper operation.



Manual test of relief valve. The manual test lever on the relief valve should be lifted on a regular basis to determine the valve is functioning properly. The pressure in the boiler should be at least 75% of the set pressure of the relief valve.



Pressure control showing mercury switch and manual reset on top. (Warning: Care should be taken with mercury switch as the mercury is highly toxic and any spills must be reported to the proper authority. Cleanup of a spill can be very costly.)



All boilers that are required to have **operating certificates** shall have a manufacturer's nameplate attached. The nameplate shall have the appropriate ASME Code symbol, the allowable working pressure, date of manufacture, and the minimum relief valve capacity.



A manually operated remote shutdown switch or circuit breaker shall be located just outside the boiler room door and marked for easy identification.

In the event of Boiler Servicing or Boiler Trouble, the following sequence **MUST** be followed to prevent loss of equipment, critical failure, and hazard to personnel:

1. **SHUT OFF POWER SUPPLY** at boiler disconnect panel or boiler switch.
2. **SHUT OFF GAS SUPPLY** at boiler gas supply line.
3. **SHUT OF WATER SUPPLY** at water supply line. In the case of leaking, system pressure can be relieved by opening the boiler valve (bottom of boiler casing) and diverting water to boiler drain. **WARNING: Scalding water/steam will likely be present.**

If a boiler or gas manifold has been flooded/submerged, contact a certified boiler technician before attempting to restart unit.

COMMON BOILER ROOM ACCIDENTS

- **Dry Fire Accidents:** Dry fire accidents or meltdowns accidents occur when the boiler is allowed to operate without adequate water in the boiler. Functioning low water cutoffs are essential to preventing dry fire accidents. Boiler damage can run from severe buckling and deforming of the boiler to complete meltdown or potential boiler explosion.

- **Excessive Pressure Accidents:** Excessive pressure is potentially the most lethal form of boiler accident. These accidents occur when the boiler can no longer contain the excessive pressure allowed to build in the boiler. The operator control, high pressure limit, and the pressure relief valve need to fail before these accidents can occur. Excessive pressure accidents, even in small boilers, can be catastrophic and have been known to completely destroy a building.
- **Fuel Related Accidents:** Fuel related accidents usually occur when an operator fails to purge combustible gases from the fire box before ignition is attempted.
- **Leaking fuel valves** can cause catastrophic accidents. If the service technician notices any gas odor the boiler should be shut down immediately.

UNDERSTANDING WATER TREATMENT BASICS

While many of our older boilers do not have treatment systems, some of the newer installs may. It is important to understand the concept of water treatment, but the maintenance and testing of these systems should not be attempted except by certified boiler professionals.

- Boilers are filled with water that contains naturally occurring impurities. Common impurities such as calcium, magnesium and oxygen can affect boiler performance and durability, if they are not managed.
- Allwater contains dissolved minerals such as calcium and magnesium. If these minerals are allowed to reach high enough levels in the boiler water they will come out of solution and form as a hard shell on the hot surfaces of the boiler. This hard shell is called scale. Scale insulates the heating surfaces reducing the ability of the heat exchanger to transfer heat from the hot combustion to the boiler water. High stack temperatures or premature failure of boiler sections are common problems related to scale build up.
- Boiler water also contains dissolved gases such as oxygen or carbon dioxide. These gases in the presence of water and metal will cause corrosion. Corrosion eats away the metal affecting the durability of the boiler. Leaks and “open systems” can have increasingly deleterious effects and greatly decrease the serviceable lifespan of boiler equipment.

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Boiler Checklist

| Description | Comments | Maintenance Frequency | | | | | | | | | | | | | | | |
|--|---|-----------------------|--------|---------|-------------|-----|----|----------------|-----|------|----------------|-----|------|--|---|--|--|
| | | Daily | Weekly | Monthly | Annually | | | | | | | | | | | | |
| Boiler use/sequencing | Turn off/sequence unnecessary boilers | X | | | | | | | | | | | | | | | |
| Overall visual inspection | Complete overall visual inspection to be sure all equipment is operating and safety systems are in place | X | | | | | | | | | | | | | | | |
| Follow manufacturer's recommended procedures in lubricating all components | Compare temperatures with tests performed after annual cleaning | X | | | | | | | | | | | | | | | |
| Check steam pressure | Is variation in steam pressure as expected under different loads? Wet steam may be produced if the pressure drops too fast | X | | | | | | | | | | | | | | | |
| Check unstable water level | Unstable levels can be a sign of contaminants in feedwater, overloading of boiler, equipment malfunction | X | | | | | | | | | | | | | | | |
| Check burner | Check for proper control and cleanliness | X | | | | | | | | | | | | | | | |
| Check motor condition | Check for proper function temperatures | X | | | | | | | | | | | | | | | |
| Check air temperatures in boiler room | Temperatures should not exceed or drop below design limits | X | | | | | | | | | | | | | | | |
| Boiler blowdown | Verify the bottom, surface and water column blow downs are occurring and are effective | X | | | | | | | | | | | | | | | |
| Boiler logs | Keep daily logs on: <ul style="list-style-type: none"> • Type and amount of fuel used • Flue gas temperature • Makeup water volume • Steam pressure, temperature, and amount generated Look for variations as a method of fault detection | X | | | | | | | | | | | | | | | |
| Check oil filter assemblies | Check and clean/replace oil filters and strainers | X | | | | | | | | | | | | | | | |
| Inspect oil heaters | Check to ensure that oil is at proper temperature prior to burning | X | | | | | | | | | | | | | | | |
| Check boiler water treatment | Confirm water treatment system is functioning properly | X | | | | | | | | | | | | | | | |
| Check flue gas temperatures and composition | Measure flue gas composition and temperatures at selected firing positions – recommended O2% and CO2% <table border="0" style="margin-left: 20px;"> <tr> <td>Fuel</td> <td>O2%</td> <td>CO2%</td> </tr> <tr> <td>Natural gas</td> <td>1.5</td> <td>10</td> </tr> <tr> <td>No. 2 fuel oil</td> <td>2.0</td> <td>11.5</td> </tr> <tr> <td>No. 6 fuel oil</td> <td>2.5</td> <td>12.5</td> </tr> </table> Note: percentages may vary due to fuel composition variations | Fuel | O2% | CO2% | Natural gas | 1.5 | 10 | No. 2 fuel oil | 2.0 | 11.5 | No. 6 fuel oil | 2.5 | 12.5 | | X | | |
| Fuel | O2% | CO2% | | | | | | | | | | | | | | | |
| Natural gas | 1.5 | 10 | | | | | | | | | | | | | | | |
| No. 2 fuel oil | 2.0 | 11.5 | | | | | | | | | | | | | | | |
| No. 6 fuel oil | 2.5 | 12.5 | | | | | | | | | | | | | | | |
| Check all relief valves | Check for leaks | | X | | | | | | | | | | | | | | |

| Description | Comments | Maintenance Frequency | | | |
|--|--|-----------------------|--------|---------|----------|
| | | Daily | Weekly | Monthly | Annually |
| Check water level control | Stop feedwater pump and allow control to stop fuel flow to burner. Do not allow water level to drop below recommended level. | | X | | |
| Check pilot and burner assemblies | Clean pilot and burner following manufacturer's guidelines. Examine for mineral or corrosion buildup. | | X | | |
| Check boiler operating characteristics | Stop fuel flow and observe flame failure. Start boiler and observe characteristics of flame. | | X | | |
| Inspect system for water/steam leaks and leakage opportunities | Look for: leaks, defective valves and traps, corroded piping, condition of insulation | | X | | |
| Inspect all linkages on combustion air dampers and fuel valves | Check for proper setting and tightness | | X | | |
| Inspect boiler for air leaks | Check damper seals | | X | | |
| Check blowdown and water treatment procedures | Determine if blowdown is adequate to prevent solids buildup | | | X | |
| Flue gases | Measure and compare last month's readings flue gas composition over entire firing range | | | X | |
| Combustion air supply | Check combustion air inlet to boiler room and boiler to make sure openings are adequate and clean | | | X | |
| Check fuel system | Check pressure gauge, pumps, filters and transfer lines. Clean filters as required. | | | X | |
| Check belts and packing glands | Check belts for proper tension. Check packing glands for compression leakage. | | | X | |
| Check for air leaks | Check for air leaks around access openings and flame scanner assembly. | | | X | |
| Check all blower belts | Check for tightness and minimum slippage. | | | X | |
| Check all gaskets | Check gaskets for tight sealing, replace if do not provide tight seal | | | X | |
| Inspect boiler insulation | Inspect all boiler insulation and casings for hot spots | | | X | |
| Steam control valves | Calibrate steam control valves as specified by manufacturer | | | X | |
| Pressure reducing/regulating | Check for proper operation valves | | | X | |
| Perform water quality test | Check water quality for proper chemical balance | | | X | |
| Clean water side surfaces | Follow manufacturer's recommendation on cleaning and preparing water side surfaces | | | | X |
| Clean fire side | Follow manufacturer's recommendation on cleaning and preparing fire side surfaces | | | | X |

| Description | Comments | Maintenance Frequency | | | |
|--|--|-----------------------|--------|---------|----------|
| | | Daily | Weekly | Monthly | Annually |
| Inspect and repair refractories on fire side | Use recommended material and procedures | | | | X |
| Relief valve | Remove and recondition or replace | | | | X |
| Feedwater system | Clean and recondition feedwater pumps. Clean condensate receivers and deaeration system | | | | X |
| Fuel system | Clean and recondition system pumps, filters, pilot, oil preheaters, oil storage tanks, etc. | | | | X |
| Electrical systems | Clean all electrical terminals. Check electronic controls and replace any defective parts. | | | | X |
| Hydraulic and pneumatic valves | Check operation and repair as necessary | | | | X |
| Flue gases | Make adjustments to give optimal flue gas composition. Record composition, firing position, and temperature. | | | | X |
| Eddy current test | As required, conduct eddy current test to assess tube wall thickness | | | | X |

Steam Traps Checklist

| Description | Comments | Maintenance Frequency | | | |
|----------------------------|---|-----------------------|--------|---------|----------|
| | | Daily | Weekly | Monthly | Annually |
| Test steam traps | Daily/weekly test recommended for high-pressure traps (250 psig or more) | X | | | |
| Test steam traps | Weekly/monthly test recommended for medium-pressure traps (30-250 psig) | | X | | |
| Test steam traps | Monthly/annually test recommended for low-pressure traps | | | X | |
| Repair/replace steam traps | When testing shows problems. Typically, traps should be replaced every 3-4 years. | | | X | |
| Replace steam traps | When replacing, take the time to make sure traps are sized properly. | | | | X |

COMMON PROBLEMS AND POSSIBLE SOLUTIONS

| COMMON SYMPTOMS | COMMON CAUSES | POSSIBLE CORRECTIONS |
|--|---|--|
| Rapid cycling—burners turn on and off frequently. | Unlevel thermostat. | Level thermostat. Refer to instructions with thermostat. |
| | Thermostat installed where drafts or heat affect reading. | Locate thermostat on inner wall away from heat sources or cool drafts. |
| | Heat anticipator in thermostat adjusted incorrectly. | Adjust heat anticipator to match current draw. Refer to boiler wiring diagram. |
| | Incorrect limit setting. | Set limit according to system design. Maximum setting is 220°F. Increase limit setting to decrease cycling. |
| Frequent release of water through the relief valve. | Insufficient expansion tank size. | Call installer to check expansion tank operation. |
| | Flooded expansion tank. | Call installer to check expansion tank operation. |
| Need to frequently add make-up water. | Leaks in boiler or piping. | Have installer repair leaks at once to avoid constant use of make-up water. Make-up water can cause mineral deposits which, in turn, can cause boiler section failure. Do not use petroleum based stop-leak chemicals. |
| Popping or percolating noise heard in boiler. | Mineral deposits in sections due to constant use of make-up water. | Call installer to delime boiler, if necessary. In some cases deposits will be too heavy to remove with deliming. |
| | | Have installer repair leaks to eliminate the need for constant make-up water. |
| | Incorrect pH of boiler water. | pH should be maintained at 7.0 to 8.5 |
| Metal flakes found in boiler base—flueway corrosion. | Halogenated hydrocarbons from environment contaminating the combustion air. | Locate and remove sources of hydrocarbons (i.e., bleaches, cleaners, chemicals, sprays, fabric softeners, paint remover, etc.). |
| | Condensation of combustion gases in cast iron sections of boiler. | Set high limit above 140°. If high limit is already above 140°, consult installer for by-pass piping recommendations. |
| Isolated radiation does not heat | Air in system. | Bleed air from system through vents in radiation. |
| | Low system pressure. | Fill to correct pressure. |
| | | Check for leaks in boiler or piping. Have installer repair at once. |
| High limit set too low. | Adjust high limit to a higher setting. | |
| Black Water Condition | Oxygen corrosion due to leaks in boiler and piping. | Have installer repair at once. Keep pH of water between 7.0 to 8.5. |