

Boiler Water Chemical Dosing And Alkalinity Testing

1.0 Maintenance Objective & Frequency

The objective of this procedure is to maintain proper boiler water chemistry by dosing chemical treatment (e.g., oxygen scavenger, phosphate, alkalinity builder) and verifying alkalinity levels through titration. Proper alkalinity control prevents scale deposition, caustic embrittlement, and carryover, ensuring efficient heat transfer and extending boiler life.

This PM shall be performed weekly for boilers operating continuously, or after every 100 hours of operation for cycling boilers. Additional testing is required after any significant feedwater composition change or chemical drum replacement.

2.0 Lockout/Tagout (LOTO) & Safety

- Chemical Hazard: Wear chemical-resistant gloves (nitrile or neoprene), safety goggles with splash shield, and a chemical apron when handling boiler treatment chemicals. Review Safety Data Sheets (SDS) for all chemicals in use.
- Electrical Isolation: Lock out the chemical dosing pump disconnect switch. Verify zero voltage using a calibrated voltmeter before servicing the pump or its controls.
- Pneumatic Isolation: If the dosing pump is air-driven, close the supply ball valve and bleed downstream pressure. Lock out the pneumatic supply valve.
- Hot Surface / Pressure Hazard: Allow boiler sample port and associated piping to cool below 50°C before drawing water samples. Use a sample cooler if available. Never open a hot sample valve without proper cooling.
- Spill Containment: Have a chemical spill kit and eyewash station accessible within 10 seconds of the dosing area.

3.0 Required Tools, Parts & Lubricants

- Boiler water treatment chemicals as specified by water treatment consultant (e.g., sodium sulfite, sodium phosphate, caustic soda)
- Chemical dosing pump (diaphragm or piston type, calibrated)
- Titration test kit for P-alkalinity and M-alkalinity (e.g., Taylor K-2006 or equivalent) including phenolphthalein indicator, bromocresol green-methyl red indicator, 0.02N sulfuric acid titrant, graduated cylinder (25 mL or 50 mL), and titration flask (125 mL Erlenmeyer)
- Digital pH meter (calibrated with pH 7.0 and pH 10.0 buffers) for verification
- Sample cooler (if boiler pressure > 50 psi) or stainless steel sample coil
- Graduated beaker (250 mL) for sample collection
- Chemical-resistant gloves, safety goggles, chemical apron
- Lockout/tagout kit (padlock, hasp, danger tag)
- Calibrated voltmeter (CAT III rated)
- Chemical spill kit (absorbent pads, neutralizer, disposal bags)
- ServiceGrid mobile device or paper work order form

4.0 Step-by-Step Maintenance Procedure

1. Perform Lockout/Tagout on the chemical dosing pump electrical disconnect and pneumatic supply (if applicable). Verify zero energy state with a calibrated voltmeter and by attempting a brief pump start.
2. Don all required PPE: chemical-resistant gloves, safety goggles with splash shield, and chemical apron. Ensure the eyewash station is functional and the spill kit is nearby.
3. Draw a representative boiler water sample from the sample port using the sample cooler. Allow the water to flow for 2-3 minutes to purge the line, then collect 250 mL in a clean beaker. Allow the sample to cool to $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
4. Measure and record the pH of the cooled sample using the calibrated pH meter. The acceptable range is typically 10.5–11.5 for most industrial boilers (refer to OEM or water treatment spec). If pH is outside range, adjust dosing accordingly after alkalinity test.
5. Perform P-alkalinity (phenolphthalein) titration: Pipette 50 mL of the cooled sample into a clean Erlenmeyer flask. Add 3-5 drops of phenolphthalein indicator. If the solution turns pink, titrate with 0.02N sulfuric acid until the pink color disappears. Record the volume of titrant used (mL). P-alkalinity (as CaCO_3) = mL titrant $\times$ 20.
6. Perform M-alkalinity (total) titration: To the same flask (after P-alkalinity), add 3-5 drops of bromocresol green-methyl red indicator. Titrate with 0.02N sulfuric acid until the color changes from green to a faint pink/red endpoint. Record the total volume of titrant used from the start of step 5 (mL). M-alkalinity (as CaCO_3) = total mL titrant $\times$ 20.
7. Calculate the hydroxide alkalinity: $\text{OH}^- \text{ alkalinity} = (2 \times \text{P-alkalinity}) - \text{M-alkalinity}$. If the result is negative, hydroxide alkalinity is zero. Compare all values to the boiler manufacturer's recommended range (typically P-alkalinity 100–300 ppm, M-alkalinity 200–500 ppm for low-pressure boilers).
8. If alkalinity is low, prepare the chemical dosing solution according to the water treatment consultant's instructions. Fill the chemical day tank or dosing pump reservoir. Prime the dosing pump suction line to remove air. Adjust the pump stroke length and speed to deliver the required dose (e.g., 10 mL/min of 5% sodium phosphate solution).
9. Remove LOTO from the dosing pump. Restore electrical and pneumatic supply. Start the dosing pump and verify that it is delivering chemical by observing the discharge sight glass or flow meter. Adjust the stroke or speed if necessary to achieve the target feed rate.
10. Allow the boiler to operate for at least one complete water turnover (typically 1-2 hours for a small boiler, up to 8 hours for a large system). Then draw a second sample and repeat steps 3 through 7 to confirm alkalinity is within the target range.
11. Record all test results (pH, P-alkalinity, M-alkalinity, OH^- alkalinity, chemical feed rate, and pump settings) in the ServiceGrid PM work order or the boiler logbook. Note any corrective actions taken.
12. Clean all titration glassware with distilled water and store properly. Dispose of chemical waste (used titrant, rinse water) according to local environmental regulations. Restock spill kit if used.

5.0 Verification & Return to Service

1. Confirm that the boiler water pH and alkalinity values are within the acceptable range specified by the boiler manufacturer and water treatment program. Typical targets: pH 10.5–11.5, P-alkalinity 100–300 ppm, M-alkalinity 200–500 ppm.
2. Verify that the chemical dosing pump is operating smoothly, with no leaks at the pump head, fittings, or discharge line. Check that the pump's flow rate matches the setpoint within $\pm 5\%$.
3. Inspect the boiler sight glass and water level controls to ensure no foaming or carryover is occurring. If foaming is observed, reduce chemical feed and consult the water treatment specialist.
4. Run the boiler through one normal operating cycle (including blowdown if scheduled) and confirm that all alarms and interlocks are functional. Monitor steam quality for any signs of contamination.
5. Sign off on the PM work order in ServiceGrid, including the date, time, test results, and any adjustments made. Attach a photo of the completed titration if required by company policy.

6. Return the boiler to normal service. Notify the shift supervisor and operations team that chemical dosing and alkalinity testing are complete.

Regulatory Disclaimer: This document is a generic maintenance template provided for educational and informational purposes only. It does not constitute professional engineering or reliability advice. The end-user assumes all liability for validating all step sequences, torque specs, and LOTO protocols against specific machinery OEM manuals before deployment to a live production floor.