

Boiler Inspections

By James McDonald, PE, CWT

Originally Published: CSTR – October 2005

“Boiler inspections are dirty, usually hot and wet, confining and always a humbling experience, but they are absolutely essential.” (James N. Tanis,

Procedures of Industrial Water Treatment, Ltan Inc., 1987)

With the heating season starting, it is only appropriate to discuss boiler inspections. The only way to truly know the overall performance of a chemical- and/or equipment-based program is to conduct an internal inspection. Simply sticking one’s head in the manhole will not cut it.

Typically, boilers are opened for routine maintenance and inspection annually. Not only will the regulatory/insurance inspectors be looking at the boilers on a routine

basis, but plant operators and the water management consultant should inspect the boiler every chance they get.

The water management consultant will be inspecting both the water and firesides to evaluate the overall effectiveness of the water program.

This article is written from the water management consultant’s point of view.



Figure 1: Boiler Inspections

Prior to Boiler Shutdown

Three to seven days before boiler shutdown and inspection, the manual bottom blowdown should be increased and continuous blowdown possibly decreased to maintain a boiler conductivity at the lower limit of the control range. Where manual blowdown is normally specified at a once per shift basis, increase to three or four times per shift. Remember that the feed rate of internal treatment chemicals must be increased to maintain the specified

residuals within the normal control range. Additional dispersant may be required to help remove suspended solids in the boiler prior to shutdown.

Follow the boiler manufacture's cool down procedure and be sure to rinse out the boiler as soon as the boiler is cool to avoid dried and baked on sludge deposits later on.

If the cooled boiler is to be left filled with water for an extended period of time, take the proper wet lay-up precautions to protect the boiler from corrosion. Studies have shown that the majority of boiler corrosion happens when the units are taken off-line.

Equipment Required

Be very careful when bringing anything into a boiler small enough to fall down a tube. Remove watches, rings, ear rings, etc. that may fall into the boiler. Ensure the battery compartment on your camera closes securely. The last thing you want to do is spend the rest of your day with a high pressure hose flushing tubes in a water tube boiler until your dropped item is found.

Recommended inspection equipment include coveralls, safety hat, safety glasses, gloves, safety shoes, flashlight, camera, inspection mirror, magnet, deposit containers, scraping device (knife or screwdriver), and any required atmospheric testing equipment.

More advanced inspection equipment such as fiber optics, Eddy Current, and Turner Gauge may also be used.

Safety

The most important part of any boiler inspection is your personal safety and the safety of those around you. Be sure to follow ALL plant safety procedures, confined space protocol, and common sense. If you do not feel safe inspecting a boiler, then by all means DO NOT inspect it. Some general safety tips include:

- Have an inspection buddy or attendant.
- Inform boiler operators of your inspection and request that other boilers not be blown down during your inspection.
- Make sure all fuel, steam, blowdown, feedwater, and chemical feed valves are turned off and locked out.
- Never use a 110 V light bulb and lead in the boiler to avoid electric shock.
- Touch the bare metal before entry to ensure the boiler is not too hot for inspection.
- Use atmospheric monitoring equipment to ensure nonhazardous conditions.

Scope of Inspection

The inspection should include a thorough examination of all waterside and fireside surfaces. Prior to the inspection, past inspection reports and boiler design documents should be examined so one knows what to expect before boiler entry. The deaerators, economizers, attemperators, feedwater heaters, and all other associated water equipment may also be inspected.

The inspector should look for evidence of waterside deposits, plugging, pitting, corrosion, leaks, cracks, bulges, blisters, overheating, surging, carryover, staining, and damage. Any such abnormalities should be recorded via pictures and a written report. In addition to this, the boiler operator and insurance inspector will be verifying the functionality of safety and operational controls.

Watertube Boilers – Waterside

Steam Drum: This is the area of the boiler where all the action occurs. Items to be inspected include:

- Water level
- Coloration above and below water level
- Check for secure internals
- Feedwater line
- Chemical feed line
- Continuous blowdown line
- Location of feedwater, chemical, and blowdown lines
- Downcomer tubes
- Riser or generating tubes
- Steam separation equipment
- Evidence of corrosion
- Manhole seal
- Deposition
- Rolled edges of tube
- Cracks in drums

Mud Drum: Mud drums are usually easier to inspect since baffling and steam separation equipment are not present. Key inspection recommendations include:

- Look straight up into tubes
- Deposition
- Drains
- Bottom blowdown
- Angle iron

Headers: Intermediate and bottom headers should be inspected via handholes with an inspection mirror, flashlight, etc. Any deposits should be noted and evaluated.

Economizers: Economizers by design are usually difficult to inspect internally. Since economizers are particularly vulnerable to oxygen pitting, signs of leaking should be noted.

Watertube Boilers – Fireside

A good water management consultant never forgets to inspect the fireside of a boiler too because problems seen on the waterside are often caused by improper fireside conditions. Cracked insulating materials, flame impingement, and blisters can either lead to or are signs of tube overheating. Common inspection points include:

- Wall tubes
- Floor
- Burner
- Furnace roof
- Baffles
- Convection section
- Superheaters

Firetube Boilers - Waterside

Inspecting a firetube boiler involves entering the boiler from the top manhole and looking at tubes from the bottom handholes. All the same precautionary measures should be taken as with watertube boilers, and the same basic problems (corrosion, deposits, internals, etc.) may exist. Inspection points include:

- Tube surfaces
- Water level and colorations
- Security of internals
- Feedwater line
- Continuous blowdown line
- Bottom blowdown line
- Location of feedwater, chemical and blowdown lines
- Steam separation equipment (if present)
- Evidence of corrosion
- Manhole and handhole seals
- Deposition
- Boiler shell and tubesheet

Firetube Boilers – Fireside

As with watertube boilers, the fireside of a firetube boiler should be inspected for signs of waterside issues. General items to be inspected include:

- Tubes
- Burner
- Refractory integrity
- Signs of flame impingement
- Tube sheets
- Rolled and welded edges of tubes
- Economizers

Report

A formal written report is always a vital part of the inspection. Written reports serve as a invaluable reference to conditions on a year-by-year basis and can be a great help in tracking improvements or system changes.

In each report the waterside conditions, fireside conditions, test analysis, conclusions and recommendations should be covered with pictures and drawings. Both the plant and water management consultant should keep copies of the report.

Conclusions

A good, well maintained water management program should ensure a trouble free boiler. The ultimate report card for the program is the boiler inspection. Is the boiler protected from scale and corrosion or isn't it? Plant operators and water management consultants use their knowledge of the steam system and water analysis to look into the "crystal ball" throughout the previous year to know what to expect at inspection time. Truly attentive plant operators and water management consultants usually have few surprises during inspections.

References:

- Tanis, James N., *Procedures of Industrial Water Treatment*, Ltan, Inc., 1987
- Frayne, Colin, *Boiler Water Treatment: Principles and Practice*, Chemical Publishing, Co., Inc., 2002
- Crown Solutions internal documentation, *Removing Boilers from Service*

Treatment Tips: Boiler Feed Points

By James McDonald

Originally Published: CSTN – September 2002

Treatment chemicals can be fed into a boiler system in a number of locations. Some locations are better than others depending upon the chemical being fed. The summary below lists the preferred boiler chemical feedpoints in order of preference.

Orthophosphate

- Boiler steam drum (this is the best place in case of any hardness upsets)
- Feedwater line
- Deaerator storage tank

Polyphosphate

- Storage tank, feedwater line, or boiler steam drum
Note: Polyphosphate should be fed to boiler steam drum if feedwater calcium is greater than 4 ppm.

Polymer

- Storage tank (best because polymers work better at the lower pH's)
- Feedwater line (good because polymers work better at the lower pH's)
- Boiler steam drum

Sulfite

- Deaerator storage tank

Neutralizing Amines

- Steam header (best)
- Steam drum
- Feedwater line
- Deaerator storage tank (may lose some through venting)