Rest Easy by *Preventing* Boiler Nightmares

by John Warner

eglect. It's a boiler's worst nightmare. If neglect makes a boiler restless and uneasy, those troubles in the mechanical room will quickly find their way into other parts of the building. If you're the technician on call, it may affect your ability to sleep at night, too.

Some trade professionals are very attentive to HVAC maintenance, yet willing to "let the boiler slide" for months, or even years, without a proper checkup.

This may have happened with some

early generations of atmospheric gas boilers because they were designed to go a long time without maintenance.

However, the market has pushed the need for higher effi-

ciency equipment. Today's condensing, fully-modulating systems that can attain 98% combustion efficiency have a greater need for routine maintenance than earlier generations did.

Fixing a problem caused by lack of maintenance can cost 10 times what the routine maintenance would have cost. After all, "preventive maintenance" gets its name because it averts the sort of problems you and your customers most want to avoid.

It's important to perform preventive maintenance on an established schedule. What follows are some basic guidelines about what that schedule should include to ensure optimal boiler performance and safety.



A combustion analyzer is a key tool for proper boiler maintenance.

Check the Installation

Many boiler problems stem from mistakes made during installation. Therefore, the first order of business in establishing a preventive maintenance schedule is to assess the overall picture. Observe and record in the maintenance log what you see with regards to the system piping, venting, gas or oil supply, and all other key facets of the mechanical room.

Use a boiler check-sheet to evaluate system performance and to spot trends that affect the boiler's operating pressure (for a steam boiler), operating temperature (for hot water systems), stack temperature, and water-level controls.

Completion of a check-sheet not only records the basic situation as you see it

today, but it sets a baseline for later maintenance and service calls.

Keeping a detailed record of the "forensics" of a boiler makes sense. Yet, the trail of information is too often neglected, lengthening the time it takes you to do the diagnostics. Basic recordkeeping is essential.

The Key Categories

Key categories for routine maintenance include:

- Venting
- Combustion air
- Gas or oil supply piping and filtration
- Water quality and piping
- Electrical wiring, diagnostics, and controls

Let's take a quick look at each of these.

Venting. Check all venting under Category I venting (negative pressure) for a white, chalky substance on the outside of the vent. The appearance of this troublesome residue most likely indicates condensation in the flue. One common remedy is to increase the boiler's operating temperature. Keep boiler temperatures at the minimums required by the manufacturer.

Category II, III and IV are vented with stainless steel material and need to be checked to be sure that all seams are sealed to prevent any leakage of flue gases. Every six months would be a prudent check.

Combustion air. Check for any blockage of combustion air openings. I've seen it so many times: some unwitting janitor or uninformed maintenance person uses cardboard to prevent cold air from entering the boiler room. That gums up the works fast.

Check the free flow of air into atmospherically fired boiler rooms at least every six months. For ducted combustion units, check for blockages routinely. Clean and check filters every six months (best) to a year (often sufficient).

Gas or oil supply piping and filtration. Check gas pressures while at peak load, or on the coldest day of the year, to determine if there's a measurable reduction during peak operation. This will certainly help answer any questions about a boiler's ability to meet heat demand. If there's a problem, call the gas company to see if line pressure can be increased.

Clean or replace fuel-line filters on oil boilers at least once a year, or every six months if the tanks are older and likely to contain sediment or sludge that ultimately will drift into the line. If this is the case, be sure that a boiler is off-line for a few hours during and after fuel deliveries.

Water quality and piping. Any evi-

Additional BOILER MAINTENANCE TIPS from the 'Boiler Team' by Jim Hike

B oiler maintenance and repairs requires special training and tools. In my experience in the field, the sales staffs that sell boiler maintenance agreements often have very little knowledge of the procedures that are required, or what value they have for the customer. Consequently the market is driven by the competition for the work, which often leads to rushed maintenance times and poor maintenance work for the customer.

The customer often has no idea how dangerous a boiler can be. I believe **education of the sales staff** is a great place to start in this industry. The customer should also be educated as to what is required by code and what procedures are needed to keep the boiler safe and extend its longevity. An informed customer is more likely to contract for necessary maintenance knowing that money will be saved in the long run.

Standing back and visually inspecting the room is the first step a technician should take. This will enable the tech to spot the most common boiler performance problems (which are frequently due to improper installation), such as insufficient combustion air, improper venting, and an undersized gas meter or lines.

The visual inspection will also reveal things that the boiler is trying to tell you. You may see blistering on the pipes; bubbled paint around seams; water stains or rust down the sides of the cabinet, down the stack, or in the breech; wet insulation; or corrosion in the collector box. Learn what these signs mean. Don't assume the damage was caused by a past problem, or is "expected" because of the age of the equipment. **Clean the boiler thoroughly** at least once a year so that in future inspections you can see if the problem recurs.

If there's a water header and you can't see it, remove the skin at least once a year to get a good look at it. Look over the fireside closely. Cracks or loose refractory can cause big problems down the road. A small amount of soot or water scale can lead to a great loss in efficiency.

I believe in **testing the water** as well. I would suggest a class or two in water treatment and some investment in a test kit. These tests will tell you if there is high iron or corrosion in the system. Boiler tube failures are often caused by impurities in the water, water temperature changes, expansion and contraction, and vibration. In addition, too low or too high pH will cause corrosion

Look at feed water quality and condensate return. Know how to determine if the traps are working properly. Energy wasted by bad steam traps can easily cost much more than the repairs and preventative measures. **Check auto air bleeds** and make sure they are not leaking or closed off.

Check the building controls. In most cases the building controls start and stop the boiler. Make sure the programmer and controls technician didn't create a hazard when the controls were installed. Don't forget that pumps are often tied to the controls, too.

Finally, my favorite subject: **combustion analysis.** If you're not using a combustion analyzer, start. Take a class on combustion and get a good analyzer with a printer. The combustion analyzer will alert you to problems very quickly. It can alert you to a host of problems such as dirty burners, poor combustion air, bad drafting, fouling on the exchanger, impingements on the flame, and improper firing ratios.

Boiler maintenance contracts need to be a balance of required codes, boiler manufacturers' recommendations, experience of the technician, and common sense. They should offer value to the customer and give piece of mind that the equipment is in good working order and safe to operate.

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SI: Boilers

by John Warne

The business of

maintaining boilers, especially if a problem is identified, is like detective work. Every problem has a logical path toward finding and solving it. For example, let's take a look at a boiler ignition problem, and the steps a detective (you) would take to solve it.

If an igniter fails, the possible causes include condensation, venting, or lack of proper combustion air.

If condensation is dripping from the heat exchanger onto the igniter, it could be caused by too-low return water temperatures entering the boiler. This could be a piping issue, or a system issue where a bypass loop needs to be installed to mix supply and return water.

Let's just say, as we look closer, that this may be a strong possibility. Stating the obvious: one should always check the installation and operations manual to see what the manufacturer recommends. Typically, for cast iron boilers the recommended minimum return temperature is 140F; for copper atmospherics it's typically 110F. Sealed combustion copper boilers usually call for minimum return temperatures of 120 to 130F. Naturally, to eliminate premature igniter failures with this condition, one must bring the temperatures up or the problem will continue.

What if we rule-out the possibility of condensation interfering with ignition? Other contributors to premature igniter failure would be improper venting or poor combustion air. Either of these conditions could lead to fouling of the heat exchanger, which would over-heat the combustion chamber. This isn't often a challenge with sealed combustion units, but it's rather common with atmospheric units.

Finally, if these causes are ruled out, there's the possibility of low gas pressure.

Enjoy performing boiler maintenance and the opportunity it affords you to serve as a great boiler detective. dence of corrosive activity on piping should be addressed immediately and could be evidence of air infiltration. Check all visible piping for signs of deterioration during each scheduled maintenance visit. Check the boiler's relief valve to ensure that it's not leaking or weeping. Be sure to maintain proper pressure in the system.

Electrical wiring, diagnostics, and controls. Check all wiring in the system for overheating. Hardening or melting of insulation will certainly cause problems. Among other things, this can incapacitate or otherwise influence diagnostic systems, disabling safety (boiler-off) checks that would turn off the boiler in the event of problems.

Check to be sure that the boiler shuts down on high limit and at low water cutoff. Check operation of the aquastat to be sure that the boiler shuts down at the set-point temperature. Check the flow switch to ensure that the boiler shuts off under no-flow conditions. Also test the igniter for Ohm resistance or micro amp signal (depending on type) to ensure that readings are within acceptable guidelines.

Use the Right Tools

Another key facet to identifying and solving problems in the field is having the right tools on hand. A combustion analyzer, gas manometer and volt meter are essential.

A combustion analyzer gets to the skinny quickly, telling you if a boiler has a combustion problem. It can then lead you to check the venting or combustion air, and then, as you move progressively through the diagnostics, may lead you to use a gas manometer to check the gas pressure.

- First step : gas pressure
- Second step: combustion test

• Third step : visual check of heat exchange surface.

After moving through steps one and two in logical fashion, you can (if need be) then check venting, combustion air, or gas pressure.

The key to preventing maintenance nightmares starts with a careful and

deliberate start-up of the equipment, and routine monitoring. Monitor more frequently initially, and then, after the foundation for reliable boiler service and operation is set and stable, at least every six-months. If check-ups and maintenance are performed routinely, and problems addressed promptly and skillfully, the boiler's life will be long and your uninterrupted sleep will be sweet.



Keep a close eye on electrical wiring for signs of overheating.

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For a sample boiler maintenance checklist, visit www.contractingbusiness.com/ boilerchecklist.html