WEBINAR
How to Prevent and Control The Big 5 Boiler and Pressure Vessel Recommendations

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September 29, 2016

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Why are we here?

1. Better understand the basics of boiler maintenance
2. Understand jurisdictional requirements
3. Operate boilers reliably, and efficiently
The top five recommendations our inspector are finding during their inspections are:

1. Log sheets
2. Leaks
3. Faulty controls/Gauges
4. Scale/Corrosion
5. Insulation
Components

1. Log Sheets
2. Steam Traps
3. Safety valves/Safety Relief Valves
4. Low Water Cutoffs
5. Controls
Boiler Logs

- Why use them
- What to include
- How to use them
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<tr>
<th>Day</th>
<th>Time</th>
<th>Outside Temperature</th>
<th>Outside Condition</th>
<th>Pressure</th>
<th>Temperature</th>
<th>Water</th>
<th>Safety Relief Valve Tested</th>
<th>Burner Operation</th>
<th>Operator on duty</th>
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**NOTE:** Should any checks or tests indicate that the device being tested or observed is not in good operating condition, it should be repaired immediately. Record repairs under the comment section so that a complete record will be available for review at any time.
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<th>Procedure Date</th>
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<td><strong>Safety Relief Valve:</strong> Pull try-lever to full open position with the normal operating pressure on the boiler. Release try-lever to allow the valve to snap closed. Caution - All discharges must be piped to a safe area. SRV need to be tested four times per year and recorded on the Boiler Operating Log.</td>
<td><strong>Pump and System:</strong> At least once a week check pump for proper operation and leaking packing. Examine check valves, makeup float valves, expansion tanks and other parts of the system. The results of the visual inspection should be recorded on the Boiler Operating Log.</td>
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<td><strong>Low Water Fuel Cutoff:</strong> Probe type low water cutoffs are tested quarterly with the burner in-operation. Hold down the test button (approximately 45 seconds) until the burner starts shutting down and then release. The burner will continue to shutdown the boiler and remain shut down until the reset button is pressed. Boiler will re-start in about 45 seconds. The results of the test should be recorded on the Boiler Operating Log.</td>
<td><strong>Burner Operation:</strong> All flame failure and fuel supply devices should be properly tested in accordance with the manufacturer's instructions. Always have a factory trained service mechanic check, adjust and repair gas and oil burners and their controls prior to the start of the heating season. Make daily checks on flame condition, fuel leaks and operating condition of the burner. Any problems noted, call your service personnel at once.</td>
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<td><strong>Emergency Cutoff switch:</strong> With the boilers firing, shutdown the boilers using the manually operated remote shutdown switch at the boiler room door. If more than one entrance to the boiler room, this test should be completed for each remote shutdown switch. The testing of the remote shutdown switch should be performed at the beginning of each heating season.</td>
<td><strong>Repairs:</strong> Mark any joint or fittings which have shown signs of leakage. Make a record of any repairs needed to the boiler, to the system or to attachments. Have proper repairs made as promptly as possible after the end of the heating season so that the heating plant will be ready for service when needed. Never make repairs while the boiler is in operation.</td>
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Leaks
STEAM TRAPS

1. Steam traps hold back steam and allow condensate to pass.
2. Steam traps remove condensate that causes “water hammer” which damages valves, piping & equipment.
3. Types:

   - Inverted bucket
   - Float thermostatic
   - Thermostatic
Signs of Steam Trap Failures

1. Warm boiler room
2. Condensate receiver venting steam
3. Condensate pump water seal failing regularly
4. Overheating/Underheating in different rooms
5. Boiler operating pressure difficult to maintain
6. Water hammer
7. Steam in condensate return lines
8. High Energy Bills
Sources of Boiler Contamination

Solids in boiler water come from:

- System makeup water (well or city water).
- Water treatment chemicals which are added to remove scale producing elements from the boiler water.
- System return water that contains system deterioration and/or processing contaminates.
- Air (oxygen and carbon dioxide) that enters the system via:
  - Pump seals
  - Valve packing
  - Air bleeders & vents
Fireside Soot
Scale/Sediment

1. Most common cause of overheating
2. Interferes with heat transfer
3. Dissolved minerals in boiler water
Corrosion
1. Prevent contaminates from forming scale on the internal water surfaces of the boiler.

2. Neutralize oxygen that causes corrosion in the boiler as well as the system.
The Cost of Scale in Boilers

- Increase Fuel Consumption
- Scale Thickness

- Scale Thickness:
  - 1/32
  - 1/25
  - 1/20
  - 1/16
  - 1/8
  - 1/4
  - 3/8
  - 1/2

Graph showing the increase in fuel consumption with different scale thicknesses.
Testing of Safety and Safety Relief Valves

Safety Valve

Safety Relief Valve
Safety and Relief Valves

ACCEPTABLE INLET PIPING

UNACCEPTABLE INLET PIPING
Safety and Relief Valves

ACCEPTABLE DISCHARGE PIPING

UNACCEPTABLE DISCHARGE PIPING
Vertical vs. Horizontal Installation

Mud and sediment settle out against disc and seat. PRONE TO LEAKAGE

Mud and sediment settle out away from disc and seat.
1. Installed with stem vertically
2. Nameplate
3. Pipe to a safe area
4. Discharge pipe is properly secured
5. Discharge is visible to Operator
6. Pulleys and Chains
7. No shut off valves between boiler and safety valve.
8. No painting
9. Quarterly testing
10. Document results
Low Water Cutoffs

Probe type low water cutoff

Float type low water cutoff
Steam Boilers

1. Need 2 LWCOs
2. Common connection on steam side
3. Separate connections on water side
4. Secondary LWCO needs to be a manual reset
5. Drains need to be piped to a safe area
   - Drain pipe minimum $\frac{3}{4}$”
6. No shut off valves between LWCO and boiler
1. Blow down daily during heating season – Steam
2. Pipe discharge to a safe area
3. Visible to the operator.

**DO NOT REDUCE SIZE OF DISCHARGE PIPE**

Minimum = \(\frac{3}{4}\)"

1. Open annually for inspection.
   - Remove plugs in cross tees
   - Remove float
   - Check mercury switches
   - Check electric wiring
Hot Water Heating Boilers

- Need 1 LWCO
- Installed above the lowest safe permissible water level established by the boiler manufacturer
- LWCO tested without draining the entire system
Monitoring Temperature

Thermometer installed at or near the boiler outlet and easily readable
EMERGENCY CUTOFF SWITCH

- Location
  - Every entrance
- Tested
  - Annually
General

- **Housekeeping**
  - Storage, Lighting, clearances
- **Fire prevention**
  - Emergency Egress
- **Combustibles**
  - Oil, and cleaners products
- **Flammables**
  - wood, paper and cardboard
  - keep at least 8 to 10 feet from the boiler
- **Paint and Gas**
- **Ventilation**
- **Leaks**
INVESTIGATION INTO THE CAUSALITY OF HOT WATER BOILER FAILURES
Background

Claims

- 2009-2013
  - NYSIR receives 40 Cast Iron Boiler claims
- January – June 2014
  - 10 Cast Iron boilers
  - 2 Cast Aluminum boilers
# Boiler Claims

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Claims</th>
<th>Developed AGL¹</th>
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<tbody>
<tr>
<td>Hot Water Boilers</td>
<td>20</td>
<td>110,140</td>
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<tr>
<td>Steam Boilers</td>
<td>20</td>
<td>375,125</td>
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<td><strong>TOTAL</strong></td>
<td><strong>40</strong></td>
<td><strong>485,265</strong></td>
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AGL = Adjusted Gross Loss
Potential Opportunity

- 2,555 Cast Iron boilers owned by NYSIR Subscribers

Monetary Savings
- Reducing cast iron boiler losses

Non-monetary Savings
- Downtime 1 to 4 weeks
- Extra expense for rental equipment
- Shutdown of schools for extended periods
- Relocate students
2015 Efforts to Address Losses

- Completed 40 Focus Loss Prevention inspections
  - January – April 2015
- Focused questions NYSIR Subscribers
  - Care and maintenance of boilers
  - Energy Management Control System (EMCS)
  - Thermal Cracking
  - Short Cycling
1. What can be done to reduce the boiler claims?

2. Does one brand or model of boiler account for more losses than others?

3. With respect to the boilers, is NYSIR better or worse than their peers or HSB experience as a whole?
Results and Analysis

- According to HSB data, country-wide there is no difference in claim rates between HB Smith and non-HB Smith boilers.
- NYSIR has an overall average boiler claim experience (all occupancies).
- Schools tend to have better boiler experience than non-schools.
- NYSIR boiler experience is worse than average for schools.
- NYSIR has worse claim experience with HB Smith boilers than non-HB Smith boilers.
The return water to the boiler should not be lower than 140°F.

The return water to the boiler should not be more than 40°F below the boiler temperature or supply water temperature.

Rapid drops in return water temperature are known to produce thermally induced shock. There are no known guidelines around this measure.

Firing rate
Findings

1. Thirty (30) Locations had boilers operating below 140° F
2. Eleven (11) had a temperature difference of more than 40° F between the supply water and return water temperature
3. Twenty (20) of the boilers were short cycling (i.e., seven or more firings in an hour)
4. Four (4) locations were operating within general manufacturers recommendations for all three parameters.
5. None of the boilers reached or exceeded the American Society of Mechanical Engineers (ASME) high temperature limit of 250° F
Conclusions

1. Reduce fuel costs;
2. Boiler technician vs. EMCS technician;
3. Too many heating zones actuating at same time;
4. Improper mixing valve operation
1. The boiler should be tuned up and inspected by a qualified mechanic to the manufacturer’s specifications. For boilers that are running at 140° F or less, the sections should be examined for fireside corrosion. If corrosion is noted, the return temperature set points should be adjusted.
1. Once the boiler has been tuned up, the system that controls the boiler needs to be set to the boiler manufacturers specifications. If there is a separate boiler technician and a separate control (energy management control system) technician, they need to work together to meet the boiler manufacturers specifications. This may result in adjustments to one or more of the following.

- Number of zones that are actuated at one time
- The sequence of zones that are actuated
- The temperature set points of the system
- The turn down rate of the boiler
- The use and maintenance of temperature mixing valves
1. Inspections

- External and Internal
  - Every 24 months for low pressure boilers
2. Installation requirements
3. Rules for repairs
4. Rules for alterations
5. Inspector’s role
QUESTIONS
THANK YOU VERY MUCH FOR YOUR ATTENTION