

# TECHNICAL BULLETIN

## Improving Boiler Efficiencies Through Effective Maintenance:

### *A Summer School Course for Your Boilers*

June is the month where the kids get out of school and many boilers go on a summer vacation...and stay that way until the first cold snap in the fall.

Instead of starting your boiler's vacation now, why not plan ahead with a short summer school maintenance course for them that will save you time, hassle and money when the kids and those cold days come back next fall.

Regular effective maintenance is the best way to obtain the most efficient operation and insure lasting boiler service. Often, efficient operation is a matter of keeping the boiler clean and the firing equipment properly regulated. Since the life and efficiency of the boiler is dependent upon the care it receives, this short course in recommended summer maintenance has been prepared to help you inspect and prepare your boilers for the efficient heating duty that will be expected of them next fall. With regular care, a quality boiler will last indefinitely.

### **Preparing a Packaged Boiler for Inspection**

- Prior to shutting down, the boiler should be blown down frequently to reduce waterside concentrations. The water treatment consultant should be contacted for other specific recommendations.
- After the boiler is shut down, it should be cooled slowly to allow even contraction of all metal components. The boiler should be cool enough that the boiler operator can touch the manhole hatch or bare shell. This ensures that the boiler is cool enough so that any sludge in the boiler will not become baked on the metal when the unit is drained.
- The air cock should be open when the boiler is drained to allow air to flow into the boiler and break the vacuum. Close the feed water nearest to the boiler and lock out the feedwater pumps. Drain the boiler completely.
- Lock out the bottom and continuous blowdown lines, chemical injection lines, non-return valve, main steam stop valve and control power to the burner. Lock out the manual fuel valves and blower motor.
- Remove the manhole hatch and all the handhole covers. Open the fire doors on the ends of the boiler and/or furnace access doors. If there are scale or sludge deposits in the boiler water side, collect representative samples for analysis by the water treatment company. Be careful not to contaminate the samples with dirty tools or foreign matter. Wash the interior of the boiler thoroughly with high-pressure water sprays to remove sludge before it dries and hardens.
- An insurance inspector and a water treatment company representative should be notified before the inspection because they may have to perform their own inspections while the unit is down.
- It is recommended that the unit inspection should be performed in conjunction with your local service representative.

## Checking the Water Side

- Specific notation should be recorded and saved for comparisons from year to year concerning locations and magnitude of scale or sludge deposits, corrosion or pitting locations, evidence of overheating and tube leak locations.
- It is a good idea to take photographs of the interior each time the boiler is inspected. These photographs may be compared over a long period of time.
- Inspect the internal piping (feedwater, chemical injection, etc.) for encrustation and debris.
- Remove the inspection plugs from the cross fittings in the water column piping and determine that the piping is clear.
- Open and clean all float chambers on level controls.
- Clean boiler as required.

## Checking the Fire Side

- Inspect refractory carefully, looking for cracks in refractory brick, missing brick or damaged cast refractory.
- Check for areas of flame impingement, spalling and loss of refractory thickness. (Spalling is breaking up by chipping.) Ash and slag accumulations should be cleaned from the tubes, waterwalls, baffles and brick so that any flaws will be revealed during the inspection.
- In solid fuel fired units the refractory thickness may be reduced because of slag deposits that break off, which in turn crack off layers of the brick. The burner throats and furnace wall opposite the burner are especially susceptible to damage especially with "dry back" boiler types.
- Inspect for tube warpage and any evidence of tube leakage due to erosion. Check for bags, blisters and evidence of overheating on the boiler heating surfaces. (A bag is a protruding bubble or bulge in the steel plate of a boiler. Bags prevent proper heat transfer from the steel to the water. Bags are commonly 3" to 4" in diameter and caused by scale deposits.) (A blister is a delamination of steel plate or tube surfaces. A lamination is a layer. Blisters are caused by impurities in the steel during manufacture, These impurities cause layers to peel and flake off when the steel is overheated.)
- Manually rotate the stoker grates if firing solid fuels and inspect each grate bar for damage. In boilers that fire oil or gas, inspect the burner throats for refractory integrity. Check burner tips and diffusers for overheating.
- On firetube boilers, check for evidence of overheating or leakage at tube ends. Stains on the tube sheets below a tube indicate that water may have been leaking from the tube. Have these tubes rerolled or retubed if needed.
- Inspect interior of breaching ductwork, economizer, air preheater, induced draft fan and stack for acid dew point corrosion.

## Checking the Firing Equipment

- Check condition of the oil tank. Clean and remove sludge if necessary.
- Drain and clean sediment and accumulated carbon from electric oil heater and boiler mounted oil heater.
- If the burner is to be out of service for the summer, be sure to close all valves and break all power connections to the burner and auxiliaries.
- CAUTION: Humidity Effect - to protect against high resistance leakage in the electronic circuit resulting from high humidity, it is recommended that the primary controls be left powered continually even when not in operation. If it is necessary to shut down completely for an extended period, the control should be thoroughly cleaned and power should be turned on for 48 hours before putting the control back in operation.
- Clean and inspect all burner components. Perform tune up and record readings as a comparison base. Replace defective components.
- Check and clean all external systems including steam traps, combustion air inlets, etc.
- Test safety valves under actual pressure.
- It is recommended that you do all these inspections under the supervision of qualified personnel.

## The Importance of a Clean Boiler

Cleaning vastly improves any system. Cleaning is one important phase of boiler care, which is too often neglected. Sometimes a boiler is drained for changes and adjustments but never actually cleaned. The architects, engineers or contractors who selected the boiler for your individual performance needs selected the equipment based on its best performance levels. These levels can be sadly missed when the internals of your equipment are coated with even a small amount of residue.

**Remember, an egg shell's thickness of scale on the internals of your boiler equals a 10% loss in its effective heat transfer...and will be reflected in at least a 10% increase in your fuel bills.**

Proper use and application of boiler room accessory equipment can vastly reduce the time needed for manual cleaning of boiler systems.

## Completing the Inspection

- After the cleaning and repairs have been completed, close the unit using new gasket materials.
- If repairs to the pressure vessel are performed during shutdown, perform a hydrostatic test before firing again. Document this test to the insurance company.
- If the boiler will be idle while other plant repairs are made, lay it up properly.

## Care of Idle Boilers

Boilers that are used on a seasonal basis that will be idle for a long period of time (in excess of 30 days) should be laid up either under a dry or wet method during periods of inactivity.

When cleaning a boiler in preparation to laying up the boiler, the water side of the unit should be cleaned and then the unit fired to drive off gases.

The fireside should then be cleaned. An oil coating of fire side metal surfaces is beneficial when the boiler is not used for extended periods of time. This will prevent oxidation of the metal. Fuel oil lines should be drained and flushed of residual oil and refilled with distillate fuel. If all boilers are to be laid up, care of oil tanks, lines, pumps and heaters is similarly required.

WET LAY UP - in order to protect the boiler during a short period of idleness, the boiler should be laid up wet in the following manner:

1. Fill the boiler to overflowing with hot water. The water should be approx. 120° F to help drive out the free oxygen.
2. Add enough caustic soda to the hot water to maintain approx. 350 PPM of alkalinity and also add enough sodium sulphite to produce a residue of 50-60 PPM.
3. Check all boiler connections for leaks and take a weekly water sample to make sure that the alkalinity and sulphite are stable.

DRY LAY UP - In the event that the boiler is to be idle for an excessive period of time, the following preparations should be made and carried out so that the boiler is not damaged over its period of inactivity:

1. Drain and clean the boiler thoroughly (both fire and water side) and dry the boiler out.
2. Place lime or another water absorbing substance in open trays inside the boiler shell and close the unit up tight to exclude all moisture and air.
3. All allied equipment such as condensate tanks, pumps, etc. should also be thoroughly drained.

## Boiler Restart-up

Upon restarting a boiler that has been laid up dry, laid up wet or been cooled down for inspection or repairs, be sure to follow the start up procedures recommended as for a new boiler per your manufacturer's instruction manual.

## Spare Parts

Before you begin any inspection and cleaning procedure, it is recommended that you have spare parts for your equipment readily available. Above are illustrations and applicable renewal parts information for the components required for the procedures described above for Kewanee brand scotch and firebox boilers. Many of these components will be similar and interchangeable for other boiler brands as well. Consult your local service company for further information concerning recommendation for your individual installation.

In addition to the required renewal components listed above, it is recommended that the following also be available:

- ◆ Motor starters
- ◆ Gauges
- ◆ Lights
- ◆ Flame Detectors
- ◆ Fuses
- ◆ Ignition Transformer
- ◆ Modutrol Motor
- ◆ Oil Metering Valve
- ◆ Electrode Assembly
- ◆ Nozzle Assembly
- ◆ Pressuretrol
- ◆ Potentiometer
- ◆ Tri Cock
- ◆ Low Water Cut Off
- ◆ Ignition Cable Assembly

Operator's manuals supplied with your packaged boiler are an excellent guide to the care of your boiler. These manuals should be kept in a place where they are readily available. Know your instruction manual and use it.

## Regular Maintenance Recommendations

The annual inspection and cleaning described above will add greatly to the lasting service and efficient operation of your boilers. To add substantial to the value of this procedure, the following daily, weekly and monthly maintenance procedures are also highly recommended (as applicable):

### Daily Recommended Maintenance

Observe general conditions. Determine cause of any unusual noises or conditions and make necessary corrections.

Record parameters on logs at prescribed intervals.

Check water level.

Blow down low water cutoff and gauge glass.

Blow down boiler.

Check and record chemistry of boiler water.

Inspect burner linkages.

Inspect pumps (belts, couplings, seals, etc.).

Inspect compressors (oil level, belts couplings, etc.).

Check temperatures and record - fuel - feedwater -economizer - air heater

Check pressures and record - boiler - fuel - feedwater

Inspect burner flame and record any unusual sightings.

### Recommended Weekly Maintenance

Observe condition of flame. Check fuel supply (oil only). Observe operation of circulating pumps.

Check all burner linkages to be sure that there has been no change from its original marked position. Tighten if necessary. Check to ensure linkage not binding. Lubricate if necessary.

On low-pressure steam boilers, open the blowdown valve of the low water cutoff while the burner is running. The burner should shut down when the water level drops in the glass, showing that the low water cutoff is operating properly and that the float bowl is clean.

On steam heating boilers, the gauge cocks and blowdown valves on the water column and water glass should be operated to make sure connections are open.

Note condition of belts and flexible couplings on oil pumps and air compressors. Have spare belts available (if used) and replace any cracked belts. Excessive side wear indicates need for realigning sheaves or correcting belt tension.

Check compressor oil pressure and maintain at prescribed pressure. Check oil level and maintain between high and low level marks. Do not overfill. Use oil approved by compressor manufacturer.

Check flame safeguard. Ensure proper shutdown and relight sequence by simulating a Flame failure and supervising a re-light.

Measure and record flame signal strength.

## Recommended Monthly Maintenance

Test limit controls.

Test operating controls.

Check boiler room floor drains for proper functioning.

Inspect fuel supply systems in boiler room area.

Check condition of heating surfaces

Check ignition assembly and electrode. Clean if necessary.

Clean oil nozzle (if necessary). Never use a sharp instrument on the nozzle. If nozzle becomes damaged, replace it. On burners firing # 5 of #6 oil, more frequent nozzle cleaning may be necessary.

Clean flame detector lens with a soft, clean, lint-free cloth. Check scanner cell.

Check air dampers and blower wheel. Remove any accumulation of lint or dirt.

Inspect condition of refractory.

Clean intake filter element on the air compressor in nonflammable solvent. The frequency of cleaning will depend on air supply conditions. The standard air filter is of sufficient size and design to meet normal conditions.

Inspect the oil strainer and clean if necessary, The frequency of cleaning will depend upon the frequency of the burner operation, and the quality of oil in use. Be sure that cap gasket is in good order and mating surfaces are clean. A light coat of clean oil will help secure a vacuum-tight joint. NOTE: Close the gate valve ahead of the strainer before removing the cap to prevent loss of oil prime.

Lubricate motors in accordance with motor manufacturer's instructions. (May be annual requirement)

Check safety valve by manually lifting with handle provided. Ensure they reseal.

Check and record flue gas analysis. Compare with previous readings to detect any trends. Make appropriate adjustments if required.

Lubricate all damper and drive arm bearing surfaces with a dry lubricant.

## Safety Considerations

Wear eye protection, safety shoes and hard hats in all designated areas.

Assume that all piping is hot. Wear protective gloves to prevent burns.

Always use appropriate lockout procedures when removing equipment from service for cleaning or repairs.

Relay information about unusual conditions to relief operator and to the supervisor.

Follow confined space entry procedures before entering confined spaces.

Eliminate clutter from boiler room. Clean up spills immediately. Survey the room regularly for hazards.

Establish and follow a procedure for regular inspection of all safety equipment.

Double check equipment for hazards such as loose flange bolts, uncovered shafts and open drain valves before starting operation.



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