

Boiler Boil-Out Procedure, Courtesy of [Rentech Boiler Systems](http://www.rentech.com)

### Boil-Out Procedure

The internal surfaces of a new boiler contain deposits of residual oil, grease and protective coating inherent in manufacturing procedures. It is important that these deposits be removed from the heating surfaces since this contamination will lower the heat transfer rate and possibly cause overheating of pressure vessel metal. These deposits can generally be removed by an alkaline boil-out using readily available chemicals. If during operation internal surfaces become contaminated by these deposits. Before boil-out procedures can begin, the boiler should be ready for firing and the operator must be familiar with the operation of the burner and follow instructions contained in the manual. The operating conditions of all auxiliary equipment and instrumentation should be formally checked out. Be sure that auxiliary equipment not supplied by RENTECH Boiler Systems, Inc. is of adequate size and pressure to ensure proper operation.

<u>Mixture</u>	<u>Chemicals</u>	<u>Lb chemical per 1000 lb water</u>
1	Caustic Soda (NaOH)	3
	Soda Ash (Na <sub>2</sub> CO <sub>3</sub> )	3
2	Trisodium Phosphate (Na <sub>3</sub> PO <sub>4</sub> .12H <sub>2</sub> O)	2.5
	Caustic Soda (NaOH)	2.5
3	Trisodium Phosphate (Na <sub>3</sub> PO <sub>4</sub> .12H <sub>2</sub> O)	1.5
	Caustic Soda (NaOH)	1.5
4	Soda Ash (Na <sub>2</sub> CO <sub>3</sub> )	1.5
	Caustic Soda (NaOH)	3

*Boil-out chemicals are highly caustic. Caustic Soda Ash will produce a violent flash if introduced to water too rapidly. Employees handling the chemicals must wear protective equipment, I.E. Goggles, gloves, aprons, etc.. and an emergency shower should be nearby. Use vinegar as an antidote.*

Check for proper voltages, fuses, and overloads. Check rotation of all motors by momentarily closing the motor starter or relay. Check the reset of all starters and controls having the manual reset feature. To the extent possible all operating mechanisms, valves, and dampers should be checked for evidence of operation and freedom from binding. Check the settings of all controls.

Before operating a boiler feed pump or an oil supply pump, be sure that all valves in the line are open or properly positioned and that all strainers are clean. Be certain that pump rotation is correct. If in doubt, remove the coupling and check motor rotation. Some pumps can be severely damaged by even a momentarily reversed rotation. Also recheck the coupling alignment.

For safety's sake, make a final and complete pre-startup inspection especially checking for any loose or uncompleted piping or wiring or any other situation that might present a hazard.

The boil-out chemicals shown in figure 1 are intended to serve as only a general guide. It is strongly recommended that the Client retain a water treatment consultant with expertise in the field of industrial boiler water chemistry to select the boil out chemicals and be available to provide consulting direction as required. There are specially prepared trademarked chemicals available. Some firms that manufacture and provide these are:

- [Betz Laboratories](#)
- [Dow Chemical Company](#)
- [Halliburton](#)
- [Nalco Chemical Company](#)

The instructions and advice provided by the manufacturer of the chemical should be followed. In the event the boil-out is not handled by a water consultant company the following is a recommended boil-out procedure that may be followed:

1. If the unit is furnished with prismatic type gage glass, replace it with the temporary boil-out glass to prevent chemical attack on the operational gage glass.
2. Remove all manway and/or handhole covers to verify that tubes and nozzles are not plugged with foreign materials.
3. Unbolt steam drum girth baffle sections and stack them within the drum to permit exposure of the tube ends to boil-out solution.
4. Wire brush any heavy scale on drum surfaces and vacuum out.
5. Close all inspection openings such as manways, handholes, etc.
6. Select the chemical mixture to be used:

A. If using a commercially prepared product, follow the manufacture's directions for concentrations and mixing. The chemicals are normally available from water treatment consulting companies in quickly soluble briquettes or liquid.

B. It is preferred to mix a solution at the job site, any one of the four combinations of chemicals shown in Figure 1 have proven satisfactory. The mix concentrations are for typical guidance only, actual chemical concentration and combinations should be established by a water treatment consultant. A good quality household or commercial detergent may be added to the boil-out mixture selected. Add the detergent at a rate of ¼ pound of detergent to 1000 pounds of water. The chemicals should be dissolved prior to placing them in the unit. To make the solution, place warm water into a suitable container. Slowly introduce the dry chemical into the water, stirring at all times, until the chemical is completely dissolved.

*Note: Do not introduce chemicals directly into the boiler. Mix the chemicals with feedwater prior to injecting the mixture into the boiler.*

7. Fill the boiler to the lower visibility level of the water gauge glass.
8. Blow-off valves, drain valves, and gauge cocks should be examined and closed.

Be sure that vent lines are piped to outdoor locations for indoor units.

9. Add the chemical and water mixture to the unit slowly and in small amounts to prevent excessive heat and turbulence. Admit the mixture through the chemical feed or feedwater connections to a level just above the bottom of the gauge glass.

*Note: The normal operating water level is 2" below the geometrical centerline of the steam drum. The low-low water level is 4" below the centerline, and the high water level is 4" above the centerline. Operation of the boiler with high water level will affect the steam purity and with low-low water level may result in overheating of the tubes. It is recommended that the unit be tripped when the drum water exceeds either the low-low or high water levels.*

10. Verify proper operation of the gauge glass by opening the gauge glass drain. If no liquid runs out, the obstruction blocking the flow must be removed. If liquid drains out, close drain valve. This is a caustic solution, avoid contact with it!

11. Purge the flue gas passages, with air, in accordance with the burner manufacturer's recommendations or at least for five minutes.
12. While purging, verify that the valves are positioned in accordance with the [Summary of Valve Positions](#).
13. Fire the boiler at a very low firing rate to limit the flue gases entering the boiler to a maximum of 800°F. Alternately, introduce 5 psig steam from an outside source through the blowdown nozzles.
14. When the boiler begins to produce steam (as seen through the open vents), allow the unit to steam freely for at least four hours. Watch the level in the gage glass and always maintain normal water level (midpoint of the gage glass). It will be necessary to add more boil-out solution when the water level falls.
15. Close all vents.
16. Hold drum steam pressure at 5 to 10 psig while maintaining water level near the midpoint of the gauge glass. Adjust heat input as required to maintain this pressure.
17. After eight hours, increase drum pressure to 20% of anticipated operating pressure by increasing the firing rate.
18. Continue boil-out for at least forty-eight hours. During this period, open the intermittent blowdown valve and drain an amount of solution equal to one-half of the gauge glass every eight hours. Then refill the unit to the midpoint of the gauge glass with the boil-out solution.  
  
*Note: add chemical solution when boiler water alkalinity and phosphate level drops to half the original values. Do not over-add chemicals. Maintenance of chemical concentration must be carefully controlled. Excessive caustic can cause embrittlement of the metal. Seek the guidance of a water treatment consultant to determine proper chemical concentrations.*
19. If at the end of forty-eight hours the blowdown is not clean continue the boil-out for an additional eight-hour cycle, continue this cycle until the blowdown is clean.  
  
*Note: blowdown is considered clean if it is free of oil.*
20. When blowdown is clean, remove the heat source, and allow the unit to cool gradually.
21. Drain the boiler when water temperature drops below 200°F. The water and chemicals must be disposed of in accordance with local, state, and EPA guidelines. Draining the fluid into storm sewer may not be acceptable.
22. Remove the inspection covers, flush the system with treated water at least three to four times.
23. Inspect pressure parts internally. If any remnant oil is found, repeat the boil-out procedure.  
  
*Note: Owner should utilize the services of his water treatment consultant to assure that boil-out procedures are acceptable.*
24. Remove the temporary gauge glasses, and replace with the normal service gauge glass. Replace manway covers and install new gaskets.
25. Take the necessary precautions to protect boiler internal surfaces from corrosion by utilizing the appropriate lay up procedure in section entitled "[Standby Protection](#)".

## System Contamination

Steam and water piping systems connected to the unit may contain oil, grease, or foreign matter. In new systems, the piping usually has an accumulation of oil, grease, and dirt. Old systems have an additional hazard in that the piping and receivers may be heavily limed and full of scale as a result of improper water treatment. These impurities must be prevented from entering the unit. On a steam system the condensate should be wasted until tests show the elimination of

undesirable impurities. During the period that condensate is wasted, attention must be given to the treatment of the water used as make up so that an accumulation of unwanted materials or corrosion of materials does not occur.

If oil, dirt, and scale accumulations are permitted to get into the boiler system, it may be necessary to repeat the boil-out procedure. The waterside of the pressure vessel must be kept clean from grease, sludge, and foreign material. Such deposits, if present, will not only shorten the life of the pressure vessel and interfere with efficient operation and functioning of control or safety devices, but might possibly cause an unnecessary and expensive re-work, repairs and down time. The waterside should be inspected on a periodic basis, which will serve as a check against conditions indicated by chemical analysis of the boiler water. Inspection should be made three months after initial starting and at regular 6, 9, or 12 month intervals thereafter.

The frequency of further periodic inspections will depend on the internal conditions found.

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