BOILER & WATER TREATMENT REVIEW

NOTE: This article is provided as a Guide Only. S.P. Thermal Systems Inc. is not responsible for training of Boiler Safety and does act as an agent in training personnel on boiler safety. This is done in Ontario by TSSA and all companies having boilers should consider getting this training.

CUSTOMER: ____________________________ Date: ________________

Many boiler plants today, are operated by maintenance and production staff who have been assigned boiler care responsibility as part of their duties. This is due to the introduction of Coil Tube and Low Volume Boilers, which by code in Ontario, have relaxed restrictions, if these boilers meet certain guidelines.

It should be noted that TSSA has provided rules, that must be followed for the operation of these boilers. These rules are specified in the attached, and include daily monitoring and recording using a Log Book # 471.

**BOILERS:** Boilers are classified as Low Pressure Steam (< 15 psig), High Pressure Steam (> 15 psig) or Hot Water Design Boilers.

**CAUTION:** Any type of Boiler, is a pressure vessel and should be handled with caution, and care should be exercised at all times, when operating these units.

**TYPICAL BOILER PROCEDURES TO FOLLOW:**

1. When starting a boiler of any classification, it is important that the boiler must be started on **Low Fire First** for a short period, to allow the boiler to warm up. Only after the boiler has reached a recommended temperature or pressure should the boiler be put on to **High fire** or on to **automatic modulation firing.** This will reduce Thermal Shock and help protect the refractory.

2. Should a Boiler not start in the normal manner, care should be taken to determine what safety devices have locked out. Resetting safety devices **more than twice**, is not a desirable practice, without further investigating what is causing the lock out.

**TYPICAL RESET SWITCHES:** Low Gas Pressure - High Gas Pressure - Flame Safe Guard.
**OTHER TYPICAL RESET SWITCHES:** High Water - Low water - High Steam Pressure

Never try to bypass safety devices, on Boiler electrical system devices.

3. Boilers in Ontario, Canada, by code have Secondary Low water cut offs, with resets, High water cut offs with resets and High Steam Pressure with resets. In addition, there are indicating lights, of which failure and an alarm bell. For the boiler to re start after a trip, these manual resets have to be activated. When doing the manual resets, always consider why this has occurred and rectify the problem.

4. Gas Pressure switches might also require resetting before the boiler will start. If the boiler went out on high gas pressure or low gas pressure. The reason for the failure should be investigated and the reset button on top of the gas switch, can be activated to re start the boiler.

5. Flame failure issues, can also result in the Burner Control having to be reset, for the boiler to restart. If this reset occurs more than twice, please contact your service company to determine the reason for failure.

6. All steam boilers, should have a **minimum of one manual blowdown daily**. This might be required more frequent, depending on the water quality. When carrying out this procedure, care should always be taken not to open valves too fast, as this could possibly cause the steam pipe or fittings to break. (Remember you are dealing with pressure and temperature)

7. In most applications, Steam boilers have a manual fast acting blowdown valve and a slow acting valve. The **Slow acting valve is first opened.** The Fast acting valve is then slowly opened and counting to three before closing. The Fast acting valve is then closed slowly again and this procedure is normally repeated up to three times. After this is completed the Slow acting valve is shut off. The fast acting valve is there, to close quickly, in an emergency. Always prepare yourself with an exit point for rapid exit, in case an emergency was to occur.

8. All steam boilers have a Low water control. This control should be tested **daily**, to ensure if the boiler shuts down in Low water conditions. This test must be done only when the boiler is firing and care should be taken to determine if the boiler cuts out, when a low water condition occurs. To implement this, the water columns which contain the water controls and...
pump controls, must be blown down by opening the valve. If the boiler does not shut off, the problem should be reported and rectified immediately. When a low water condition occurs, in many applications, the boiler low water relay will require resetting to start the boiler again. This is explained above. These resets can be found on the burner panel or some where on the boiler.

9. Some Boilers also have a High Water probe, that shuts down the boiler, should a high water condition occur. High Water conditions, can be caused from a malfunctioning water controller or if the boiler is shutdown for some period, a vacuum occurs, pulling water in through the pump. In any case, high water is a dangerous condition and should be prevented / rectified if observed. This condition causes water hammer in pipes. To start up a boiler that has a high water relay, the boiler will have to be drained to the normal water level and the high water relay reset, before the boiler can start. (See Item 3)

10. Carry over or priming of boilers, can occur, resulting in boiler water going over with the steam. This problem causes many system problems, such as water hammer which can break the pipe fittings and valves. This condition will result in the following occurring.

11. (A) Lower temperatures at the process.
(B) Increase boiler blowdown results in high energy loss.
(C) Potential boiler failure, should the boiler carry over be the result of excess load, exceeding the boiler capacity. When this condition occurs, the boiler pressure starts to drop and water is sucked out of the boiler. Sometimes the feed water pump does not react fast enough and over heating of the boiler tubes occurs, resulting in a melt down of the boiler. To prevent this problem from occurring, the correct boiler size to match the load should be installed. To overcome this problem a Back Pressure Control Valve should be installed, which will function to help prevent this failure,

12. All boilers should have a complete Combustion Test carried out at least Once / year. Twice / year is preferred.

13. The air intake duct to the Burner fan blower and blower wheel should always be kept clean.

14. The Boiler room must have sufficient air in and out as required by Fuel code regulations.

15. Any gas leaks should be reported to the correct authorities and rectified immediately, by licenced personnel.

16. The gauge glass on steam boilers, should have the appropriate glass protective shield installed.

17. The safety valves on the boilers should be checked as required by the appropriate authorities. These valves are required by your insurance policy to be activated and checked on a scheduled basics. In addition these valves have to be sent out on a scheduled basics, for re-testing.

18. The boiler should be internally inspected yearly, by your Insurance Company and by your Water Treatment Specialist.

19. All Steam Leaks should be repaired immediately, to reduce Energy Loss and to provide safety.

20. Only use qualified Boiler Technicians, having the appropriate licence to work on your boilers.

21. Record all repairs done on the boiler in a dated journal. (Log book # 471) as per TSSA

22. Record all Water Treatment Tests daily.

23. Water Tests should be performed daily on all boilers, to help prevent failures from corrosion or scale. Failure to do this can result in very high maintenance costs and loss of production. Follow the recommended Water Treatment control values and correct any deviations from the program.
**WATER TREATMENT**

To maintain your Boiler in good condition, a Good Water Treatment program is essential.

Your Water Treatment program should be considered just as critical, as operating your car without the necessary oil changes.

For a good Water Treatment Program to be effective, the following **Standard equipment** should be part of your system.

**EQUIPMENT REQUIRED FOR GOOD CONTROL OF WATER TREATMENT:**
- Duplex Softeners for a 24 hour Operation. Single Softener for 8 hour operation is adequate
- Softener Polisher on all Low Volume or Coil Tube Boilers
- Where very poor water quality only is available, a Reverse Osmosis unit is recommended
- A Dealkalizer or Reverse Osmosis is recommended where the use of neutralizing amines is prohibited.
- Contact Water Meter to control a Chemical Timer and Chemical Pump.
- Chemical timers with accumulators.
- Feed Water Tanks should having a Steam heater. A Deaerator is recommended where very high water make up occurs.
- An Automatic Surface Blowdown Controller with needle valve and solenoid or motorized valve

**WATER TREATMENT TESTING**
The following water test should be carried out a minimum of once / day / shift.

**SOFTENER TEST:**
This is one of the most essential tests and should be done at least once per day on the preboiler system.

Water samples should be taken from the **softener** and the **polisher**. A sample should also be taken from the **Feed Water tank** or **deaerator**. A minimum of three (3) Test areas for Hardness should be monitored.

A. Flush sample lines and rinse the sample jar properly before taking a sample.
B. Collect the correct sample amount, based on the test procedure used. Sample amount ---- mls
C. Add Hardness Indicator to the sample ----- grams
D. Add Hardness Buffer to the sample ----- mls
E. Sample should turn **SEA BLUE**, if water is **SOFT**. If hardness is present, sample will turn **RED**
F. If RED, titrate with appropriate solution, until sample turns **BLUE**. Record hardness value.
G. If Hardness is present, always determine the reason and rectify the problem.

**TROUBLE SHOOTING FOR HARDNESS**

1. Check if salt level in Brine Tank is **LOW**. Level should always be 3/4 of Brine Tank
2. Check to see if the salt has bridged in tank due to heat. Add water and break salt up
3. Check to see if Clock Time is correct, alter if not. Make sure Electric power is on softener.
4. Check if the Emergency bypass valve has been left opened. Always keep closed.
5. Check if the Emergency bypass valve, is leaking water.
6. Check if softener drain line is plugged or damaged. Repair if required.
7. Check if the Softener brine line has a kink, preventing brine from getting to the softener resin.
8. Check if the Resin has got fouled with iron. Add a resin cleaner to the brine tank periodically.
9. If hardness test was done on the Feed Tank and soft water was detected at the softener but not in the Feed Tank, then hardness can be coming back with the condensate. Check if cold hard water quenching is occurring. Stop this practice if this is happening. Check if a leaking hard water line is connected to the condensate and rectify immediately.
10. Softener needs a Service Technician if problem cannot be corrected. Call immediately for Service.
In the event of Hardness Leakage, call your Water Treatment Supplier, and at the same time implement the following procedure.
A. Increase Boiler Blowdown by **reducing** Boiler TDS to **1500 mmhos** from **standard**.
B. Increase Boiler Dispersant Feed Rate by **twice** if using.
C. The Boiler may require inspection to determine if any damage was caused. (Scale Build up)

**BOILER CONDUCTIVITY (TDS) TEST:**
Check conductivity value in the boiler by following this procedure.

I. Flush line and collect a sample of water from the boiler gauge glass or off the surface blowdown line.
II. Cool the sample to room temperature.
III. Add sample to hand held conductivity meter
IV. Control level to maintain is **3500 - 4000 mmhos** in boiler
V. If less than **3000 mmhos** you are blowing down too much
VI. If higher than **4000 mmhos** you need to increase blowdown.
VII. If an Automatic Blowdown Controller is in use, check unit to see if it needs calibrating. Hit reset button always before calibrating.
VIII. If values are consistently low, it is possible that you may have a leaking solenoid valve or valve on the boiler, leaking water out of the boiler. Check blowdown pipes for heat loss.
IX. If values are high and you do not have an Automatic Blowdown Controller, then consider investing in an Automatic Blowdown Unit.
X. If values are high and you have an Automatic Blowdown Controller, then check if the solenoid valve has failed or needle valve is plugged.
XI. The automatic blowdown probe should be flushed daily for (3) three seconds as shown on the picture.
XII. Set Automatic Control as shown. Calibrate control weekly.

**SULPHITE TEST: If using this product.**
To protect the boiler and feed water tank from oxygen corrosion, the use of sodium sulphite is a common treatment program.
A. Flush and collect a sample of water from the boiler gauge glass, or off the surface blowdown line.
B. Cool the sample enough for safe handling.
C. Measure appropriate sample, based on test procedure into a jar. Sample size ------ mls
D. Add ----- grams of Acid Powder Starch reagent to sample.
E. Titrate, using Potassium Iodide Iodate solution until sample turns dark BLUE.
F. The value to maintain is -- to -- ppm in the boiler. (---- to ---- drops depending on size of sample)
G. Less than --- ppm (--- drops), in boiler, increase feed rate of chemical pump or increase chemical timer setting.
H. Higher > --- ppm (--- drops) in the boiler, reduce feed rate of chemical pump or reduce timer
I. If Feed Water Tank is cold < 180°F the feed rate of the chemical will be higher. Increase Feed Water temperature of Feed Water Tank to 180°F to reduce chemical usage.

J. If pH of Feed Water is < 8.6, the consumption of sulphite will be increased. Adjust pH in feed water tank, to achieve a level higher than 8.6 to reduce chemical usage & protect the boiler.

K. If Boilers are not operating 24 hours / day, 7 days / week you may have to increase the feed rate of sulphite, to achieve protection of the boiler during idle periods, where the boiler loses heat. Sodium Sulphite consumption is temperature dependant and will be consumed, as the temperature in the water gets colder. If you are having problems maintaining control, discuss this with your Water Treatment Supplier for other options available.

TROUBLE SHOOTING CHEMICAL LEVELS - (Sulphite or Molybdate Treatment Program)

1. If chemical is low, check to see if drum is empty.
2. If chemical is low, check to see if chemical pump has lost prime. Prime pump, if required.
3. If pump continues to loose prime, check pump Check valves and replace if required.
4. If chemical is low, check if pump strainer is plugged. If required clean strainer.
5. If chemical is low, adjust chemical pump timer or chemical pump frequency by increasing.
6. If chemical value is high, reduce pump stroke or timer setting.
7. If chemical value is high, check boiler TDS. If higher than recommended, increase blowdown and leave chemical timer and chemical stroke the same. Monitor TDS and control to range.
8. If chemical level is low, check boiler TDS. If value is low, you are blowing down the boiler too much or have leaking valve/s etc. Fix leak and correct TDS to recommended range.
9. Leaks can be from the automatic blowdown solenoid, boiler blowdown valves, float in tank failed.
10. Check to see if any of the blowdown valves on boiler has not been properly closed.

MOLYBDATE TEST: If using this product
To protect the boiler and feed water tank from corrosion, the use of special blends of Molybdate are available which can overcome many of the problems associated with a sulphite treatment program.

1. Flush & collect a sample of water from the boiler gauge glass or off the surface blowdown line.
2. Add the sample to the test tube provided, and fill to the 5 ml mark.
3. Add 1 drop of Reagent # 1 to the sample. (Using Jacklyn Reagent)
4. Add 3 Drops of Reagent # 3 to the sample. (Using Jacklyn Reagent)
5. Place test tube in comparator and compare sample with slide.
6. Recommended values to maintain is 100 - 150 ppm
7. Less than 100 ppm, increase feed rate. Higher than 150 ppm, reduce feed of chemical.
TROUBLE SHOOTING: Follow same check procedure shown above, reference Chemical Levels.

pH TEST of Condensate
A. Flush and collect a sample of water from the condensate
B. Cool sample to room temperature
C. Using pH meter, check pH of sample
D. Control range to maintain is 7.6 - 8.6 pH
E. Less than 7.6 pH increase feed rate of amine
F. Higher than 8.6 pH reduce feed rate of amine

TROUBLE SHOOTING: Follow same procedure shown above Chemical Levels, Item # 1 - 6 only.

NOTE: If you are getting Boiler carryover, you will also get false high pH readings. Carryover of boiler water will damage a steam system. In addition, you lose energy and contaminate heat exchangers, and process. This condition is also dangerous and could cause water hammer and break steam lines.

Hardness Test of Condensate
Flush and collect sample of condensate
Follow same procedure for hardness test, as done on softeners
If hardness is detected, please enforce same strict procedure as discussed with softener test.

Conductivity Test of Condensate
Flush and collect sample of condensate
Check conductivity of condensate, to determine steam quality
1. Conductivity of condensate should be < 50 mmhos, if good steam quality is occurring.
2. Conductivity > 50 mmhos, please review with your Water Treatment Specialist why this is high.

COPPER PIPING IN CONDENSATE SYSTEMS IS DANGEROUS
Copper should not be used in condensate systems. Copper tracing piping, copper heat exchanger bundles, can result in possible galvanic corrosion, occurring in boiler systems.
Copper has the potential in steam systems, to corrode at high pH and at low pH. As both of these possibilities are common, it is strongly recommended that copper should not be used.
If galvanic corrosion occurs, the potential result is pitting on the boiler tubes, resulting in tube failure.
As normal Water Treatment programs do not address this problem, the risk of failure is high and copper should be avoided in all equipment in condensate systems.
Failure of boiler tubes can result in very expensive repairs and loss in boiler down time.
Monitoring copper levels in the feed water will provide indication of possible problems, ASME recommends that copper should be < 0.05 ppm in the Feed water

DISPERSANT FEED:
If chemical dispersant is being used separately, control dispersants based on the feed rate recommended.
Note: Feed rate will depend on make up, boiler cycles and feed water quality.
If feeding dispersants separately, by separate pump, follow same Trouble shooting procedure shown for chemicals.

DEAERATOR
If you have a deaerator to mechanically remove oxygen, you will still need to use an oxygen scavenger. The deaerator functions well, operating at a pressure of 5 psig. The storage tank temperature of a deaerator, should run about 228 F, if the deaerator pressure is 5 psig.
In addition, the deaerator must have a vented gas plume, to remove the gasses. This plume should be about 2 - 3 feet high. It can be observed from outside the building. If the gases are not being vented properly, corrosion may occur in the deaerator.

ENERGY SAVING TIPS
To maintain an efficient boiler system, the following should be addressed.
1. Insulate all hot exposed areas, such as Feed Tanks, feed water pipe lines, steam lines, hot exposed areas on the boiler and condensate lines.
2. Repair any pipe insulation that has been removed or damaged.
3. Have a good Planned Maintenance Program on traps. Trap leaks are one of the biggest steam energy losses. Repair failed traps immediately.
4. A good sign of trap leaks, can be determined if the Feed water tank is venting off high steam plumes. Also if the boiler feed tank temperature shows higher than 200 F
5. Maintain conductivity in boiler at the recommended control range. Low conductivity values means excessive blowdown and energy loss.
6. Reduce Wet Steam by controlling Boiler Blowdown effectively.
7. Recover Flash steam or blowdown water and use to pre heat make up feed water, through heat exchanger
8. Carry out Fuel Combustion Test every 6 months.
9. Make sure your Burner Technician, has set up your boiler to the maximum achievable air to fuel combustion ratio, for the best combustion efficiency.
10. Return all condensate that can be returned that is not contaminated.
11. Monitor water make up regularly, to make sure you are not losing return condensate water.
12. Maintain a scale free boiler, by keeping softeners producing soft water.
13. Do not run higher boiler pressures than required.
14. Run boilers sized to Load. Over sized boilers have higher radiation and Purge Losses
15. Shut off steam going to areas that are not requiring steam any longer.
16. Repair immediately all steam leaks.
17. Make sure that the boiler room has adequate air in / out and room temperatures are in a range not to effect electronic equipment.

BOILER BLOWDOWN TANK
Boilers of steam pressure >15 psig, require in Ontario to be blowndown into a blowdown tank, designed for this operation. In addition the water exiting the blowdown tank to sewer, needs to be controlled below a specified temperature, based on the local regulations. To do this, boiler blowdown tanks should be outfitted with a temperature thermostat, to control the exit water temperature to the sewer. Adjust thermostat to suit. This will inject cold city water into the tank. Furthermore, care should be taken to protect drain lines, by making drain lines of tile or steel construction and not PVC due to the temperatures. PVC drains will fail with high heat in a very short time.

BLOWDOWN CAUTION
When blowing down boilers under pressure, the valves must be opened slowly. Any quick action could result in the pipe breaking, resulting in injury or death. In addition, caution should be taken, to have a get away path, in the event that a pipe was to break. Make sure to have a good clear access path all round the boiler, at all times.

IMPORTANT TSSA RULES: Follow all TSSA rules and procedures, as they are responsible for the safe operation of boilers in Ontario.
LEAD LAG CONTROL
Lead Lag Control if supplied, need to have the Steam Pressure set point on Heat Timer 10% Lower than High Steam pressure Limit set point on the boiler. If this is not done the Lead lag controller will not work properly.

TSSA LOG BOOK AND OTHER REQUIREMENTS
- Operators of Boilers in Ontario must enter daily any work done on boilers in Log Book # 471. To Purchase call 416 766 2228
- Boiler Blowdown needs to be entered in log book
- Boiler safety checks including low water checks must be recorded
- Boiler maintenance checks should be recorded daily
- Water Test should be recorded daily
- Boiler resets should be recorded daily
- Log book is to be signed daily, dated and weekly, the log book must be signed by a supervisor in charge of boiler. This is a General description. Please review log book and follow as per TSSA.
- TSSA Boiler Certificate issued by TSSA, must be posted in boiler room, also insurance certificate.

IMPORTANT NOTE: Call TSSA to arrange a Full review of your Boiler Safety Procedure.

INSTALLATION OF EQUIPMENT
We recommend that your boiler installing contractor, provides the following services, to protect you the owner, of the equipment, against any legal or potential problems.

The installing contractor should provide the following services:
1 - In the event that the project system is not designed by an engineer, the contractor should prepare and size all connecting piping and valves to achieve system correct performance, including system outputs.
2 - The installing contractor, should apply to TSSA and pay for Department of Labor drawings, permits and inspection to carry out the installation to code.
3 - The installing contractor should carry out the installation to conform to ASME, CSA, CGA and all necessary codes that are required in the Province of Ontario for boiler installation.
4 - The installing contractor must carry out all testing and installation as per code, on Gas, Water, Electrical and stream.
5 - The installing contractor should provide the owner with proper work insurance and be responsible to provide the owner with a warranty, for materials and workmanship on the installation work done.

MINISTRY OF ENVIRONMENT APPROVALS
The owner of the equipment is responsible and should apply and pay for having the boilers approved in their plant, by the Ministry of Environment for air and noise approval. Please contact S.P. Thermal Systems Inc. if you wish us to provide you with a company, that can carry out this work for you.

NOTE: Boilers are a dangerous piece of Equipment and should be Operated only by personnel who have been trained in the Safe use of this equipment.

DISCLAIMER
S.P. Thermal Systems Inc. is not responsible for any action regarding Safety or Operation of your Boiler.

The information provided, is only a general guide to help the owner in the operation of the boiler. We accept no responsibility regarding Boiler Safety, or Boiler operation. All safety regulations on boilers come under the “Operating Engineers Regulations” It is available at www.tssa.org

The proper Safety of your boiler, falls under the responsibility of the Owner and Management of the Equipment, to take the necessary steps and training of personnel.
BOILER COMMISSIONING

REFERENCE:  Boiler Start up Check list, and suggestions.

Customer:  

These notes are based on personal experience and should be used as additional notes. The Boiler manual commissioning procedures must be fully followed at all times.

START UP / COMMISSIONING THE BOILERS

- The procedure for start up is shown in the manual. The commissioning engineer must follow the Refractory curing during start up as outlined in the manual.
- The Boiler Stack weight must be supported off the boiler.
- The Feed water Pumps supplied have a bleed line at the side of the pumps. All pumps must be bled prior to start up. Failure to do this will damage the seals.
- The Pump motor should be checked for proper motor rotation.
- The Blower Motor on the boiler should be checked for proper motor rotation.
- The Refractory door at the back of boiler should be opened and inspected prior to start up and after commissioning for cracks. This is done by carefully opening the door at the back of the boiler. The Refractory is to be replaced in the same manner after completing the inspection.
- The wires in the control panel should be checked to make sure they are secured and tight prior to start up. This will eliminate any wiring problems.
- In the period of curing a boil out, chemical cleaner should be added to the boiler. This is usually an alkaline product such as caustic. This can be added by taking off one of the safety valves and pouring it into the top of the boiler. This must only be done when water is in the boiler, prior to start up. The safety valve should then be replaced. Use protective equipment such as gloves etc.
- Another procedure that should be done is to install a temporary steam line off the outlet of the steam boiler, vented to the roof with a shut off valve. This is used incase there is insufficient load on high fire, to keep the boilers on, without shutting off on high fire, during commissioning.
- After the boilers have finished the curing of the refractory, the boilers should be cooled off slightly and the water drained from the boilers. The hand hole cover on the steam drum and one in the bottom of the drum should be opened for inspection. A water hose should be used to wash out the boiler. The front column valves, where the probes for controlling the Water levels should be opened and drained. After washing out the boiler the hand hole covers and gaskets should be replaced and fresh water added to the boilers. Care must be taken not to drop the hand hole covers into boiler.
- The boilers on start up from cold should always be put on manual firing and warmed up on low fire before going on to automatic firing. This procedure is normal on all boilers.
- Any condensate that is dirty should be diverted to drain until clear. If this is not done, you will run the risk of fouling the water probe controls. If this happens, the probes in the two columns on the front of the boiler and the probe at the back of the boiler will have to be cleaned. When taking out probes for cleaning, make sure you wire back the probes correctly, otherwise you will have electrical problems. Also make sure the probes are tight on the base.
- The Boiler must only be commissioned by a qualified person familiar with the burner supplied who must have all the necessary Gas tickets. The commissioning engineer should use a Gas analyser to set up the burner on high fire, medium fire and at low fire. The values expected to achieve is 3 - 6 % as O2.
- The boiler Fuel inputs should be checked to determine if you are achieving maximum inputs to boiler. Over-firing of boiler will void all manufacturers warranties.
- Boilers that are not sized correctly and operate under over - Firing conditions will have early failures.
On start up the commissioning engineer will need to set up the gas pressure correctly to prevent the gas pressure switches going off on low gas or high gas. The gas regulator provided must have the correct spring for the pressure of the boilers being installed.

The pressure switches on the boilers will require setting, based on the pressure the boilers are going to be operating at. There is an operating pressure switch, which controls the modulation of the boiler, a high shut off pressure switch which shuts off the boiler when this pressure is reached and a high water level switch which will shut off the boilers if high water occurs.

These switches require resetting to restart the boilers when the limits are made. These reset switches are shown in this report and should be brought to the attention of the boiler operator.

The Honeywell Relay that controls the boiler also has a reset button if one of the Flame Control limits are locked out. In the event of constant resets, the fault should be found and corrected.

The boiler should be manually blowdown frequently in the first week of operation, to remove any accumulated sludge in the new boilers.

The Automatic Blowdown Control if supplied should be set up based on the recommendations of your Water Treatment specialist.

The Chemical feed to the boilers should be maintained based on your Water Treatment specialist. Failure to maintain levels may result in Tube failure. Boiler Warranty does not cover lack of Water Treatment control.

We recommend daily water test to be done and the control limits provided by your Water Treatment specialist be followed. All daily test results should be recorded.

In all applications we recommend that the Feed water to the boilers be of “ZERO" hardness. This can be accomplished using a Duplex Softener and a Single unit Polisher before the Feed water Tank. Hardness tests should be done daily on Softener / Polisher / Feed water Tank.

All steam piping, condensate piping, boiler Riser tubes, steam drum and header to be insulated.

The feed water pump system discharge, to the boiler, should be designed to prevent water siphoning into the boiler, when the boiler shuts off and cools down. Raising the pump discharge pipe above the feed water tank level, will resolve this problem.

The air in and out of the boiler room must be sufficient to meet Fuel code requirements.

Check condensate system to make sure no copper piping is installed.

Start - Up Report must be filled in and Faxed backed to S.P. Thermal Systems 905 563 6234

**COMMON START UP PROBLEMS**

In the period just after commissioning the boiler, the boiler might require slight adjustments. One of the common problems is dirty water fouling the probes as discussed previously. Also, the pump strainers might be fouled, or the Feed water check valve might not be sealing properly due to dirt. These are the conditions that might cause Low water problems.

High water can result from water entering the boilers through the pumps, when the boiler shuts off for periods of time. This usually happens as the boiler cools off, creating a vacuum. This can be prevented by installing a vacuum a breaker at the highest point on the piping that holds the Honeywell pressure controls at the front of the boiler. Chemical pumps should also be adjusted if required.

**DAILY ROUTINE MAINTENANCE**

- Water testing must be done on the softener, Polisher and the Feed water Tank. “Zero” hardness is the target and anything outside of this target must be immediately corrected as otherwise you will have a scale build up in the boiler which could result in tube failure.

- The Oxygen scavenger should be maintained at the level set by your Water Treatment specialist. Values set in the control limits must be maintained to achieve the best protection for the boilers.

- The Automatic blowdown control should be set to activate blowdown based on the control limits recommended by your Water Treatment specialist. Normally the control limit is 4000 mmhos for most boilers. This could vary based on water quality in the area where the boilers are located. The timer to activate the automatic blowdown is normally set at 1 hour. The other timer is usually set at around 5 -10 seconds to allow sufficient time for the probe to check the water. The probe must be installed
on the boiler as shown in the manual for blowdown controller. Another common mistake is installing the probe in the wrong position. There is a mark on the base of the probe which should line up with the pipe. This probe needs to be flushed daily as shown in the manual.

- All daily tests and maintenance performed should be recorded as required by TSSA in Log Book.
- The boiler must always be started when cold, on Low Fire before going to automatic control firing.
- Manual bottom blowdown of the boiler, is normally 2 - 3 slow burst of 3 seconds each per day.
- The two Front columns should be blowdown daily while the boilers are running. This is to make sure that the Low water resets are functioning properly. Do one Column at a time.
- The Blowdown Water is sent to a Blowdown tank on high pressure boilers. These are boilers operating >15 psig. The Cold water for cooling the blowdown tank needs to be adjusted to maintain the temperature going to the sewer. This varies based on regulations, but is around 120 - 140 F.
- If the boiler cannot be blowndown manually over weekends then depending on regulations, the Automatic Blowdown controls might be sufficient. This will be determined by the TSSA inspector.
- The softeners and the polisher should be checked daily, for salt. The salt level should be maintained at a minimum of 3/4 full at all times. Hardness tests must also be done.
- The safety Valves should be tested based on the requirements of your Insurance company.
- All leaks should be repaired immediately.
- In the event the boiler is not operating for extended periods, please discuss with your Water Treatment specialist, the best manner to store each boiler off line.
- Feed Water tank temperature must be checked and controlled at 180 F to prevent Thermal Shock.

SIX MONTHS OPERATION

- Every 6 months the boiler combustion should be checked to make sure that you are achieving maximum combustion efficiency.
- The Inlet air damper and the burner should be cleaned.
- The burner should also be checked to see if all parts are functioning.
- The Probes in the boiler for controlling water level should be checked and cleaned. Note there are 3 sets of probes. Two are in the front columns on the boiler and one set at the back of the boiler.

TWELVE MONTHS OPERATION

- The boiler should be inspected every 12 months by your Insurance inspector. This is normal procedure. This inspection will require that the boiler should be drained, washed, and the hand hole covers left open.
- After inspection the gaskets on the hand hole covers should be replaced with new ones.
- The boiler combustion should be checked to make sure that you are achieving maximum efficiency.
- The burner should also be checked to ensure all parts are functioning.
- All Probes in the boiler, should be checked and cleaned. Note there are 3 sets of probes. Two are in the front columns on the boiler and one set at the back.
- Water Column gauge glass should be checked and replaced if required. Seals should also be checked and replaced if required. Protector shield must be replaced securely.
- Feed Water check valve should be checked and replaced if required.
- Safety Valves should be checked and replaced if leaking.
- Feed water pumps should be checked and seals replaced if required. Make sure to bleed Feed water pumps.
- The water level control in the Feed tank should be checked, cleaned and repaired if required.
- The solenoid valves on the automatic blowdown control and the steam temperature controller in the feed water tank should be checked and replaced if required.
RECOMMENDED SPARE PARTS FOR MOST BOILERS

- Burner ignition electrodes
- Gauge Glass and Gauge Glass valve set
- Honeywell Flame scanner (Mini-Peeper)
- High and Low gas pressure switch
- Fan Blower Wheel
- Blower Motor
- Hand Hole Gaskets
- Gauge Glass seal and washers - minimum 4
- Gas Pilot regulator
- Pilot Gas solenoid valve
- Burner Diffuser (Spinner)
- Honeywell Relay RM 7840 L 1018 or similar. Check unit on boiler.
- Automatic Blowdown Probe
- On Boilers with motorized Feed Water valves, we recommend keeping a spare valve and actuator.
- Feed Water Pump.

NOTE: All these parts are readily available. However, in critical production conditions where time is important, we recommend that the above items should be kept in stock.

DISCLAIMER
S.P. Thermal Systems Inc. is not responsible for any action regarding Safety or Operation of your Boiler.

The information provided, is only a general guide to help the owner in the operation of the boiler. We accept no responsibility regarding Boiler Safety, or Boiler operation. All safety regulations on boilers come under the “Operating Engineers Regulations” It is available at www.tssa.org

The proper Safety of your boiler, falls under the responsibility of the Owner and Management of the Equipment, to take the necessary steps and training.

Training on Boiler and Chemical Testing has been carried out at

Date: -------------------------
by Stephen Foster of S.P. Thermal Systems Inc.
People Trained:

Signed: ---------------------- Date:---------------- Signed:---------------------- Date:----------------------

Signed: ---------------------- Date:---------------- Signed:---------------------- Date:----------------------

PLEASE REVIEW ALL PROCEDURES AND DATA SUPPLIED. IF YOU HAVE QUESTIONS PLEASE CALL
Ph 905 563 8651   Cell 416 876 0684   Fax 905 563 6234
How Safe is Your Plant?

The safe Management, Operation and Maintenance of Ontario’s Registered Power Plants are the foundation of the Operating Engineers Regulation mandate.

The two most essential components of a plant’s ability to operate safely are reflected by the knowledge and competence of the operating personnel and the effective functional operation of the safety controls and devices.

The responsibility for a plant’s safe operation and compliance with the requirements of the Regulation always starts with people.

In guarded unattended plants the owner/user is responsible for ensuring the plant complies with the Regulation. In guarded attended and full attendance plants, the Chief Operating Engineer/Operator and their related certified staff are an extension of the Regulation and as such, under the law are responsible for it’s compliance.

An important additional member of the plant’s team safety effort is the TSSA Operating Engineer Inspector.

Beyond the responsibility of enforcing the Regulation, the Inspector is an important resource for the Owner and Chief Engineer/Operator in their efforts to provide a safe and effective plant operation. One of the Inspectors’ most important responsibilities is the Periodic Inspections of Registered plants. Clearly, no Owner or Chief Engineer/Operator wants to operate a plant which presents a risk. The Inspectors’ efforts are therefore an important extension of your plant’s operating team with the goal of providing you with the guidance which will reinforce your effort to reduce risk.

Because one may extend a full career without experiencing an incident or serious plant failure, it is all too easy to assume there are no risks and that modern equipment is fail proof.

A recent report released by the National Board of Boiler and Pressure Vessel Inspectors has revealed some statistics of concern:

- Inspectors found over 36,718 safety violations at North American power plants in a one year period.
- 1,663 incidents resulted in 22 injuries and 5 deaths.

Please see attached report overview
What You Can Do To Reduce Risk

The actions you take or do not take can either protect or endanger public safety, the safety of employees and your company's investment in the facility. Reducing risk takes knowledge, discipline and teamwork.

1. **Know the Regulation.** Make sure you and other responsible persons have full knowledge of the Operating Engineers Regulation. It is readily available at [www.tssa.org](http://www.tssa.org). Remember that in the event of an incident, you would be expected to answer questions and demonstrate proper knowledge, actions and procedures.

2. **Be Diligent.** If you have never experienced an incident or serious plant failure, it is all too easy to assume that modern equipment is fail proof. We all know it is not. Make sure everyone on your team is committed to following the prescribed procedures, testing and maintenance requirements to ensure the effective function of safety devices and control systems.

3. **Work in Partnership with the TSSA.** The TSSA is a valuable safety partner and resource. We can help you understand your responsibility for compliance, provide on-site consultations and share our wealth of knowledge and experience with the goal of safe and effective plant operation.

An Accident Waiting to Happen? Be Proactive.

Why wait for a mandatory inspection to identify a hazard at your plant? Call the TSSA for an on-site consultation. We can work with your safety team to help you identify and correct potential safety issues and liabilities before they become a problem.

For further information or assistance, please contact your Regional Operating Engineer Inspector,

Sincerely,

John W. B. Coulter, C.E.T. TECH C.E.I.
Chief Officer
GENERAL BOILER INSPECTION & PREVENTIVE MAINTENANCE PROGRAM

Each group of items represents 1 notification to be generated by the SAP system at a time appropriate for the work to be completed. As individual requirements demand, each order can be modified to meet the needs.

This program is intended to cover low and high pressure steam and water boilers of the typical fire tube and fire box constructions.

Where a work group is specified, the responsible Team Leader should verify that the individuals doing the work posses all valid licenses and certificates necessary to carry out the required tasks or will reassign accordingly.

All work performed on equipment shall be recorded in the appropriate log books.

The appropriate safety and lock out procedures shall be used at all times.

SECTION A
Work to be done as part of seasonal shut down / cleaning / servicing

FIRESIDE INSPECTION  ANNUALLY

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>If Oil Fired, change or clean oil filters, strainers, baskets, water separators as appropriate</td>
</tr>
<tr>
<td>2</td>
<td>Tag and lockout valves and controls (Lockout / Blankoff as per TDSB Standard Operating Instructions SOI-Q-5 and SOI-Q-1 and any other manufacturer requirements) before opening boiler for cleaning</td>
</tr>
<tr>
<td>3</td>
<td>Brush all tubes clean of scale</td>
</tr>
<tr>
<td>4</td>
<td>Brush / scrape plate surfaces clean, remove all scale &amp; residue</td>
</tr>
<tr>
<td>5</td>
<td>Inspect refractory and brick work, report required repairs (follow proper confined space procedures)</td>
</tr>
<tr>
<td>6</td>
<td>Check flue connections for proper fitting of joints, covers. Check that combustion chamber, flues, breaching and chimney are clear of obstructions</td>
</tr>
<tr>
<td>7</td>
<td>Inspect all insulation components, report required repairs</td>
</tr>
<tr>
<td>8</td>
<td>If a sectional boiler, determine there is ample provision for expansion between sections</td>
</tr>
<tr>
<td>9</td>
<td>If a cast iron sectional, check for excessive rust buildup between sections</td>
</tr>
<tr>
<td>10</td>
<td>Request any required repairs, and specify as immediately required, or to be scheduled for following seasonal teardown.</td>
</tr>
</tbody>
</table>

WATERSIDE INSPECTION  ANNUALLY OR BIANNUALLY AS REQUIRED

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>BA1</td>
<td>Drain Boiler, tag valves and controls (Lockout / Blankoff as per TDSB Standard Operating Instructions SOI-Q-5 and SOI-Q-1 and any other manufacturer requirements) and properly vent to atmosphere. Note: allow boiler to come to room temperature before draining. Remove all hand-hole and access covers.</td>
</tr>
<tr>
<td>BA2</td>
<td>Wash out / flush full waterside of boiler including mud legs</td>
</tr>
<tr>
<td>BA3</td>
<td>Inspect connecting lines between boilers for sludge / scale buildup, clean as required</td>
</tr>
<tr>
<td>BA4</td>
<td>Inspection of hand holes, stays, waterside of tubes and boiler</td>
</tr>
</tbody>
</table>
### Annually

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teardown, clean, reassemble low water cut offs</td>
</tr>
<tr>
<td>2</td>
<td>Examine all steam and water line controls and valves to determine they are clean of scale and set to ensure proper control operations</td>
</tr>
<tr>
<td>3</td>
<td>Inspect and service all operating and guarded controls</td>
</tr>
</tbody>
</table>

### SECTION B

Work to be done as commissioning after seasonal or service shutdown. (Preparation of boiler for return to normal service)

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verify that boiler has had all required Insurance inspections, seasonal maintenance, and any required follow on repairs before closing up and refilling. Verify that all lockouts and tagouts have been removed.</td>
</tr>
<tr>
<td>2</td>
<td>Check that the boiler operating and safety controls, relief valves, low water cut offs and feedwater controls are in place and that all valves are set in the proper operation positions.</td>
</tr>
<tr>
<td>3</td>
<td>Inspect the boiler, piping, and tubing for any damage that may affect the safety or operation of the plant.</td>
</tr>
<tr>
<td>4</td>
<td>When refilling boiler, apply new, approved style and material gaskets to inspection and access holes, verify that proper water treatments have been added or arrangements are in place for same.</td>
</tr>
<tr>
<td>5</td>
<td>Check flue connections for proper fitting of joints, covers. Check that combustion chamber, flues, breaching and chimney are clear of obstructions. Check that the breeching and boiler access covers are secured in place, that the smoke box and explosion doors are closed and secured and that all gasketing is properly fitted.</td>
</tr>
<tr>
<td>6</td>
<td>Check that the boiler is filled with water to the normal operating level and that the access hole covers are in place and secured and that correct gauge glass shields are in place.</td>
</tr>
<tr>
<td>7</td>
<td>Inspect burner for any damage.</td>
</tr>
<tr>
<td>8</td>
<td>Inspect the draft control linkage for damage.</td>
</tr>
<tr>
<td>9</td>
<td>Start the burner and check the general operation and check of unit for leakage, observe correct system venting procedures during fire up.</td>
</tr>
<tr>
<td>10</td>
<td>Test the low water cut-offs, operating control and feedwater controls.</td>
</tr>
<tr>
<td>11</td>
<td>Inspect and check the operation of the accessory components, such as the smoke indicator, draft controls and boiler alarm paging system.</td>
</tr>
<tr>
<td>12</td>
<td>Test burner and burner gas train for gas leakage.</td>
</tr>
<tr>
<td>13</td>
<td>Notify the Head Caretaker or Engineer that the boiler can be put back on line.</td>
</tr>
<tr>
<td>14</td>
<td>Test operate all guarding and limiting devices and alarms and ensure the alarms conform to OE Regulations</td>
</tr>
</tbody>
</table>
SECTION C  
Service and operational checks and reports carried out under normal operating conditions.

**Shift/Daily/Weekly/Monthly**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Test operation of safety alarms and paging system if equipped.</td>
</tr>
<tr>
<td>2</td>
<td>Check water treatments &amp; associated supply system</td>
</tr>
<tr>
<td>3</td>
<td>Inspect fuel supply system for leaks or damage</td>
</tr>
<tr>
<td>4</td>
<td>Check main flame failure protection, positive fuel shut off,</td>
</tr>
<tr>
<td>5</td>
<td>Inspect steam and water lines, connections for leaks</td>
</tr>
<tr>
<td>6</td>
<td>Check feedwater system and feedwater makeup control</td>
</tr>
<tr>
<td>7</td>
<td>Check operation of all indicator lamps and pressure gauges</td>
</tr>
<tr>
<td>8</td>
<td>Check boiler operation through full cycle</td>
</tr>
<tr>
<td>9</td>
<td>Check water column sight glass and water level system and ensure sight glass shields are in place</td>
</tr>
<tr>
<td>10</td>
<td>Inspect boiler room for proper housekeeping and correct as required</td>
</tr>
<tr>
<td>11</td>
<td>Check, clean and replace oil filters as required</td>
</tr>
<tr>
<td>12</td>
<td>Check combustion side for cleaning requirements (oil, Weekly)</td>
</tr>
</tbody>
</table>

**Annually**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Check stems and shafts of all valves, lubricate as required, tighten packings as required, and verify they are operating properly</td>
</tr>
<tr>
<td>2</td>
<td>Check condition and operation of make up and return water/steam/condensate systems and associated tanks</td>
</tr>
<tr>
<td>3</td>
<td>Check condition and operation of all water / steam pressure gauges</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check boiler room make up air system for proper operation</td>
</tr>
<tr>
<td>2</td>
<td>Check operation of gas controls and valves including manual shutoff, regulator, safety shutoff valve and solenoid, automatic gas valves and test for full shut off and leaks</td>
</tr>
<tr>
<td>3</td>
<td>Check air louver motor and linkages</td>
</tr>
<tr>
<td>4</td>
<td>Check operation of all indicator lamps</td>
</tr>
<tr>
<td>5</td>
<td>Check flue connections for proper fitting of joints, covers. Check that combustion chamber, flues, breaching and chimney are clear of obstructions</td>
</tr>
<tr>
<td>6</td>
<td>Check, clean, adjust ignition components as per manufactures specifications, replace components as specified by manufacturers instructions, or best practice. Check condition of wiring components and terminations are secure.</td>
</tr>
<tr>
<td>7</td>
<td>Check and verify operation of all controls and safety interlocks and cut offs</td>
</tr>
<tr>
<td>8</td>
<td>Check any motors pulleys and belts or driven components, linkages for proper adjustments, lubricate as required</td>
</tr>
<tr>
<td>9</td>
<td>Replace consumable items / parts as required</td>
</tr>
<tr>
<td>10</td>
<td>Perform flue gas analysis to verify equipment performance, make adjustments as required. Refer to manufacturers performance criteria</td>
</tr>
</tbody>
</table>

**Every 5 Years**

Inspect, service, calibrate, seal all safety Valves  
Test and calibrate all pressure guages