

Diesel / Gas Fuel Fired Steam Generator Operating, Maintenance and Instruction Manual



erensan^o

a company of Groupe
Atlantic



ENSURE THAT THE BOILER PERSONNEL READ THESE OPERATING-MAINTENANCE INSTRUCTIONS!

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FEATURES OF e r e n s a n ° BRAND STEAM GENERATORS

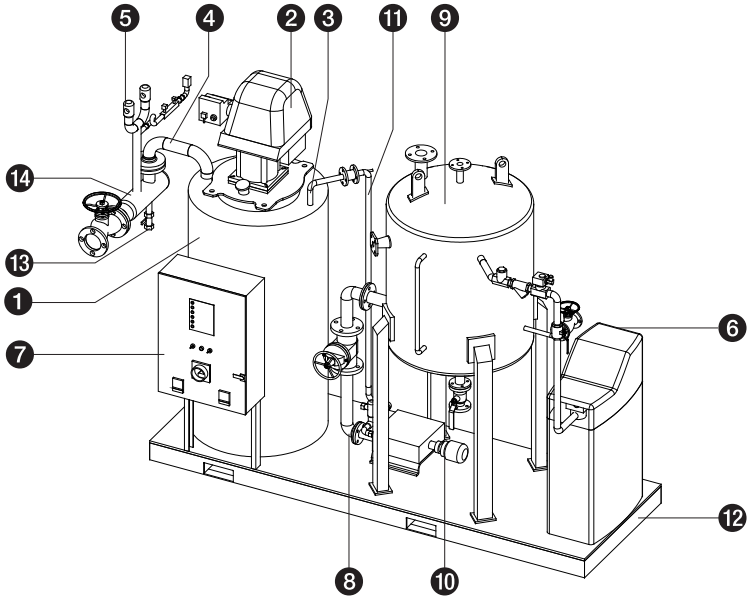
- ✓ Starts to generate steam in a short time.
- ✓ Occupies a small space. Comes as pre-assembled, easy to assemble in a short time.
- ✓ Consists of two serpentine one within the other. The water pass through serpentines is evaporated by the flame and flue gases pass out of the serpentine. Flame and flue gases make three passes through the generator.
- ✓ By force of low water volume, it is possible to use on residential building. It conforms to general conditions of The Ministry of Public Works and City Audit of Certificate Department.
- ✓ A separator that has to be put on steam generator provides fine and pure water by preventing water and foreign substance dragged into system.
- ✓ Instrument panel provides requested steam pressure and secure automatic working.

THE APPLIED DIRECTIVES AND STANDARDS

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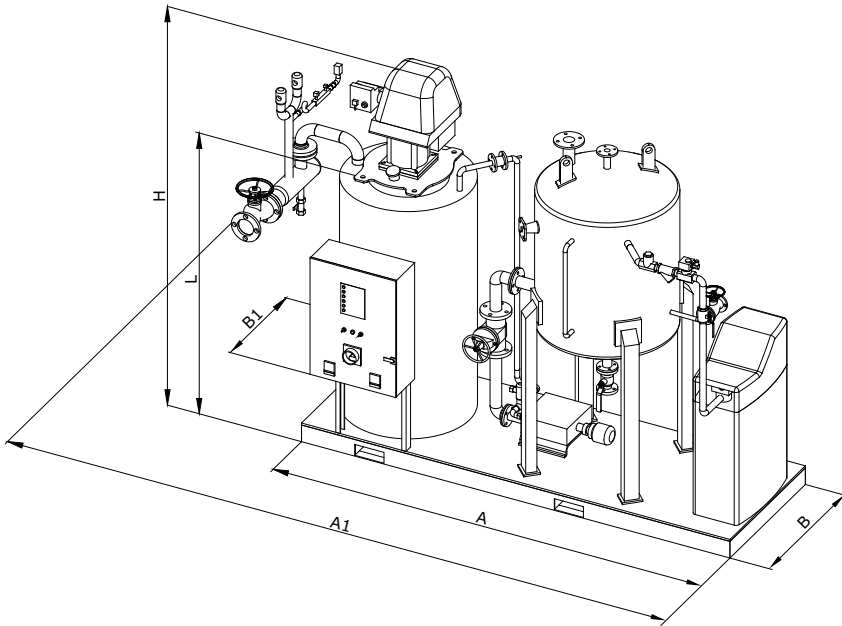
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INTRODUCTION:



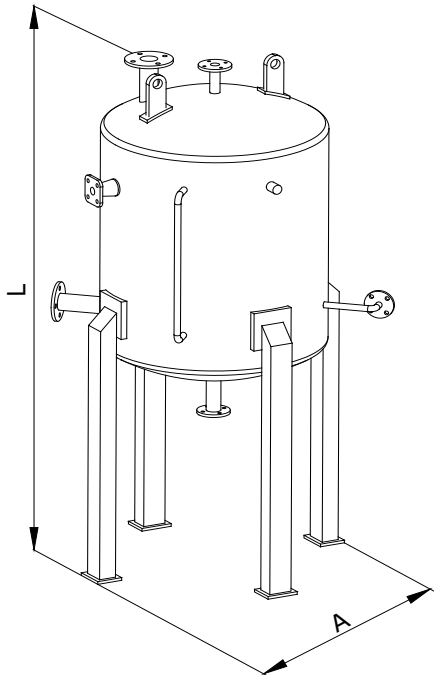
- 1 Sprint Steam Generator
- 2 Burner
- 3 Water Inlet
- 4 Steam Outlet
- 5 Safety Valve
- 6 Water Softening Device
- 7 Electrical Panelboard
- 8 Pump Suction
- 9 Condensate Tank
- 10 Feed Water Pump
- 11 Flexible Hose
- 12 Chassis
- 13 Start-up Blowdown Valve
- 14 Steam Collector

STEAM GENERATOR TYPES AND DIMENSIONS



TYPE		SSG 300	SSG 500	SSG 750	SSG 1000	SSG 1250	SSG 1500	SSG 2000
Steam Generating Capacity	kg/h	300	500	750	1000	1250	1500	2000
Calorific Capacity	kcal/h	180.000	300.000	450.000	600.000	750.000	900.000	1.200.000
Operating Pressure	bar	6-8-10	6-8-10	6-8-10	6-8-10	6-8-10	6-8-10	6-8-10
Chassis Width	A	2343	2500	2708	2906	3129	3200	3373
Chassis Depth	B	804	834	968	1046	1109	1109	1243
Width	A1	2677	2804	2960	3146	3348	3497	3621
Depth	B1	1004	1034	1168	1246	1289	1309	1443
Height	H	1983	2150	2768	3030	3262	3347	3525
Length	L	1400	1550	2018	2195	2447	2532	2710
Chimney Outlet	Ø	250	250	300	350	400	450	450
Water Volume	lt	27	39	90	127	171	194	296
Weight	kg ~	845	1.050	1.405	1.685	1.870	2.090	2.616

CONDENSATE TANK TYPES AND DIMENSIONS



SSG	Condensate Tank		
	[lt]	A [mm]	L [mm]
300	250	802	1773
500	400	902	1870
750	600	1002	1840
1000	800	1170	1841
1250	1000	1170	2388
1500	1200	1220	2416
2000	1600	1270	2392

STEAM GENERATOR OPERATING PERSONNEL

The personnel to be charged with steam generator operation are responsible for intervention in case of any emergency. For this purpose, they must be fully informed about the functions, operating characteristics, operating pressure and temperature and flow rates; they should know the functions and operation of all control circuits and measurement devices and electrical safety hardware well.



MAKE SURE THAT THE STEAM GENERATOR PERSONNEL TRAINED AND CERTIFICATED!

TRANSPORTATION AND TEMPORARY STORAGE

The boiler should be transported using the lifting and transportation points and utilizing appropriate equipment.

For horizontal movement, horizontal displacement is possible through controlled sliding on pipes when it is not possible to utilize a winch.

The boiler should be protected against mechanical blows and collisions during loading, transportation and unloading.

During temporary storage before transportation and installation, the boiler must be protected against damages that may result due to moisture and external mechanical agents.



USE THE STEAM GENERATOR IN COMPLIANCE WITH WARNINGS AND RECOMMENDATIONS IN THIS INSTRUCTION GUIDE!

INSTALLATION

Steam Generator installation site should comply with the related standards and procedures. Boiler room door should open outside and fresh air inlet at floor level and polluted air outlet at ceiling level should exist. More than one boiler should not be connected to the same chimney.

The steam generator should be installed on a foundation elevated from the floor at the installation site. The mechanical connections of the boiler should comply with Installation Circuit Diagram.

Condensed tank water level and feed water suction line is arranged in accordance with 70°C temperature.

Condensed tank water temperature should be maximum 85°C.

Below control devices must be on steam generator.

- Manometer (min. Ø100 mm),
- Safety Presostat,
- Thermometer (for feed water temperature)
- Pressure Prob,
- Temperature Prob,
- Instrument panel,
- Frequency inverter,
- Flow control switch,
- Blowdown control solenoid valve,
- Safety valve 2 pieces.

In order to prevent battery corrosion, the steam generator must be grounded with,

- a) 0,5m², 2mm thick copper sheet,
- b) 0,5m², 3mm thick hot dip galvanized sheet,
- c) Massive copper bar electrodes.

Automatic lockout and protection hardware

For their safe operation, boiler generator should be equipped with safety lockout systems and alarm circuits depending on their type, capacity and features. At least the following lockout elements are recommended to exist in a boiler:

- Constantly monitor initial ignition spark and stop the ignition circuit if the burning doesn't occur on time
- A photo-electric monitor that checks main burner flame and shuts off fuel and puts the flame out if the flame goes out or combustion is excessively smoky.
- An adjustable pressure safety switch (pressurestat) that stops the burner when steam pressure is too high.
- A level control device that stops the burner when water blowdown.
- In diesel fuel burning steam generators, adjustable pressures switch that cuts fuel if fuel pump outlet pressure drops.
- In fuel oil burning steam generators, an adjustable thermostat that cuts fuel if fuel temperature drops.
- A pressure switch that shuts the burner in case boiler combustion air pressure drops (air proestad).
- If atomization is being applied during liquid fuel burning, hardware to cut fuel if atomization (steam or pressurized air) environment pressure drops.
- In gas burning boilers, an adjustable pressure switch that cuts fuel if gas pressure drops (minimum pressure preostad).
- Discharge valves, control valves, pressure and temperature gages, safety valves, measuring and control devices, locking and protecting hardware, air heaters, boiler feed pumps, blower should be inspected and maintenance, control and adjustment operations should be done.
- Instrument panel, burner panel and fan, water feed pump propellers should be cleaned with dry pressurized air. They should be protected from dust and water.

Required protective elements, apart from these.

BURNER SELECTION AND INSTALLATION

To achieve efficient combustion, the burner to be attached to the steam generator should be selected in compliance with the combustion chamber dimensions defined in the steam generator technical specifications section.

During the installation of the burner, care should be shown to match burner nozzle axis with combustion chamber axis.

To prevent entry of excess air into the combustion chamber from outside, the burner installation should be performed carefully to prevent leakage.

The fuel used for operating should comply with burner manufacturer recommendations.

A suitable burner should be selected, which conforms to the nominal capacity, combustion chamber pressure and the counter pressure of the steam generator. When ordering a boiler, the related sales personnel should be informed about the burner selected to enable the design of connection flange to suit the burner.

FUEL SELECTION AND STORAGE

Fuel complying with the characteristics indicated in the burner user manual or burner vendor catalogues should be obtained.

Fuel transfer lines should comply with technical specifications, procedure guides and standards in effect. The fuel tank-burner axis levels should not exceed figures specified in the burner user manual.

Fuel tanks should conform to standards. A wall must exist between the fuel tank and the boiler.

If the fuel is oil, the necessary arrangements and heating system should be installed for fuel flow from tank to burner.



BEFORE OPENING BOILER GENERATOR'S DOOR, SHUT THE BURNER AND DISCONNECT BURNER POWER!

FUEL HARDWARE

In a boiler operation, fuel hardware is quite important. Different burner hardware exists for various fuels. Automatic systems are also used for fuel burning.

The fuel hardware should be controlled before firing whatever the fuel type it runs with.

When the steam generator is first fired or a burner, which was shut off for any reason, is restarted, the boiler should be ventilated for at least 2 minutes to enable purging of flammable gas mixtures that may have collected in the furnace and chimney gas channels.

Liquid fuel hardware

In liquid fuel burning steam generators, before first firing, all the tank, heater, pump, valve and pipe system related to the fuel circuit should be reviewed and ensured that they are in good status and function normally.

If the liquid fuel tank is at a lower level than the fuel pump, parts such as valves, flanges, filters should be inspected and full leakage prevention should be provided in suction pipe; the pump should thus be prevented from drawing air. When fuel-oil is used as liquid fuel, all heaters operating with electricity or steam should be checked to be in good working order. In steam heaters, fuel oil leakage to steam side should be checked. To understand this, the oil pump should be run and by using the pump safety valve or the first valve after the heater outlet on fuel oil pipe, the highest pressure in the system should be applied for five minutes while the steam is closed on the heater fuel oil side. After this, the steam inlet should be fully opened and the condenser water should be checked for fuel oil existence.

In liquid fuel burning steam generators, the most important reason for bad combustion is fuel not being fully atomized. To ensure full atomization, the type of atomization that will be recommended by the manufacturer should be applied.

The water collected at the bottom of the fuel tank should be discharged.

Fuel circulation should be provided running the pump after ensuring the fluidity of the fuel-oil in the pipes. All air in the fuel-oil hardware should have been bled.

Gas fuel hardware

Before firing, all jointed points such as valves, flanges in the gas pipe should be checked for gas leaks; all burning hardware, hardware such as burners, control valves should be controlled, the leaks found should be urgently removed.

The burners should be fired after adjusting the gas and air amount to first firing values.

In both the liquid and gas fuel burning hardware (dual fuel), the fuel valve or valves, coming after the last manometer in front of the burner or burner group, should always be kept fully open during combustion. Otherwise, the real conditions in the burner (such as the real value of the fuel feed pressure) cannot be monitored.

SAFETY RULES

- The steam generator should only be used for steam production purposes.
- The steam generator should be used complying with warnings and recommendations in this procedure.
- Steam installation should be commissioned to authorized personnel.
- Electrical connections of the steam generator should be commissioned to authorized personnel.
- The boiler should not be operated if boiler water level is below minimum.
- When opening the steam generator's door, the burner should be shut off and burner power should be disconnected.
- It should be ensured that the personnel to operate the steam generator have certification.
- The boiler chimney should be built in compliance with chimney building rules. brick and briquette should not be used in steam generator's chimney.
- 2 times a year, chimney cleaning should be procured. It should be ensured that the chimney has no any cracks, holes, the chimney cleaning door is closed and sealed properly.
- During first operation and subsequent firings, it should be checked that the boiler and condensate tank is filled with water and that the suction and discharge valves of the boiler feed pump, which is expected to run, are open, the pump air has been purged off and pump rotation direction is correct.

- If abnormal noises are heard in the steam generator or the installation when the steam generator is operated, the burner should be immediately shut off and pressure should be relieved by the discharge lines. Then, the fault should be determined and removed.
- In cold climate regions, required measures should be taken to prevent boiler and condenser tank water temperature dropping to freezing temperature.
- Except before firing, the boiler should not be fed cold water. Feed water temperature should be 70 °C for 10 bars. It is recommended not to drop below 60 °C in any case. To be used in processes where condenser return is low or nil and at times when condenser water temperature is low; heating of the condenser tank should be ensured by connecting the condenser tank to steam heater line.
- Measures should be taken to prevent use of hard water that causes deposits and for more regular utilization of the Water Softener Device.
- In abnormal situations, for example when steam pressure is rapidly rising, when redness/bending at some parts of the boiler is observed or any leakage or drain is seen, the burner should be stopped immediately. The steam should be let off from the discharge and the authorized services should be notified.
- If the burner does not run, do not press the computer's reset button more than twice and call authorized burner service.
- If leaks and drains are observed on burner fuel connections and transfer lines, the burner should be immediately stopped and line valves should be closed. In the case of natural gas or LPG usage, utilize a leakage detector device in the boiler room and an automatic fuel cut-off system on the main inlet.
- In the case of LPG usage, when you observe icing and dew on fuel pipes due to liquidizing of residual gas in fuel pipes, especially on cold days, do not absolutely operate the burner. The LPG should be safely discharged from the drain tap (Liquidizing may also form at normal times due to gasification level control or line regulator problem).
- Flow control switch on water feed pump outlet should be active all the time. Should absolutely not stop electrically and boiler generator is started.
- Water feed pump inverter settings are made in factory and absolutely should not be changed.



HAVE THE VAPOR SYSTEM INSTALLED BY AUTHORIZED PERSONNEL!

PREPARATION OF THE BOILER GENERATOR FOR OPERATION AND FIRST FIRING

Initial preparations

Before a steam generator that is to be newly put in operation or on which maintenance-repair work has been performed is fired, both the water side and the gas side (such as furnace inside, chamber, chimney gas channels, air channels, air heater, burner combustion chamber) should be inspected thoroughly; should be cleaned of tools sets, pieces of cloth, iron pieces, oakum etc. Residues such as dust, soot, slag should be removed.

It should be ensured that all hardware in the fuel equipment and chimney draught system function correctly. If automatic combustion controls or other automatic controls exist, all adjustments, tests and all calibrations related to these should have been made and faultless operation status of the system should have been provided.

Water softening device settings should be made and water inlet opened, condence tank should be filled and check that water comes to until pump suction.

After making sure all discharge and release valves, level indicator relief valves and control valves are in working condition and leak-proof, these should be closed.

With water feed pump actuating, water with required chemical specifications (see Steam generator feed water specifications, page 32) should be filled. During this operation, blowdown valve should be opened.

When water comes from initial start-up blowdown line, boiler should be operated. If vapour without water from blowdown line is observed, vapour outlet valve should be opened slowly to inlet vapour to system and initial start-up blowdown valve should be closed.

Operation and safety pressure set forth and vapour temperature parameters that should be reached for safety should be entered on instrument panel.

During the rising of vapour pressure, vapour pressure figures on instrument panel and the figures on manometer should be checked.

The figures are set on instrument panel, boiler burning form alteration, water feed pump frequency and cycle alteration should be followed.

Operating of boiler generator

- Check system and boiler connections.
- During the first run of the steam generator or during initial ignition of a cold boiler, the burner should be fired 30 minutes and at 1st level small flame for at least 1 hour to let pressure and temperature rise gradually and to prevent thermal stress forming on boiler.
- Steam outlet valve should be opened slowly to let steam into the system for gradual warm up. When steam pressure reaches the pressure set on instrument panel, the burner will come to 1. operating level. In the mean time water feed pump cycle will decrease to set frequency. When operating pressure is reached, burner will stop and water feed pump will continue to work at low frequency value. When the steam pressure reaches the adjusted pressurestat level, the burner will stop and further rising of pressure will be prevented.
- In case of steam pressure rising above operation pressure value, boiler may automatically stop by safety valve set on instrument panel and safety pressurestat.
- In case of steam temperature reaches foreseen safety pressure, burner will be stopped by instrument panel.
- In case of sufficient water flow is not provided to thread of boiler generator (suction line blockage, fitter impurity, edge narrowing of water side surface of threads, eg.) burner will be stopped by flow control switch and instrument panel will show malfunction message.
- Steam generator and feed water analyses should be repeated periodically. If any negative analysis results are obtained, improvement procedures should be performed under control of expert water chemists.
- At least 3 times in shift and daily working period, possible deposits should be discharged and conductivity values not let rise by boiler generator water side blowdown valve manually opened
- The operation of the steam generator gages and control devices should be checked continuously every day and in case a condition out of normal operational behavior is observed, the steam generator firing should be stopped under control and the necessary inspections and evaluations should be done. If needed, defective devices should be replaced.

- Condensate tank temperature should be continuously controlled and not let rise over 85°C. High water temperature may cause cavitation in boiler feed pumps, may result in pump failure in a short time and intermittent water pumping into boiler may disrupt normal operation. For this reason the condenser stops in condenser lines should be checked and cleaned one by one and should be replaced if steam leakage is still observed.
- During the firing of boiler and pressure build up, the steam generator armatures and connections should be controlled and any leakages should be removed. The leakages detected after steam generator operating-pressure is reached, should not be handled immediately, the required intervention should be performed after combustion is stopped, boiler depressurized and material temperature drops to enable handling.
- Steam valves should be opened and closed slowly. Otherwise, steam impacts may form.

ADJUSTMENTS AND CONTROLS TO BE PERFORMED

All steam generator armatures are on the market as a package with Water Softening Device and Condensing Tank. In our standart Steam Generator, condensing tank water high is for 70 °C Condensing Tank Water Temperature. If Condensing Tank Water Temperature is higher (maximum 85 °C), arrangement should be made for Condensing Tank Water High and Water Feed Pump Suction Diameter according to the related table.

Burner capacity adjustment should be made by the relevant burner company and not exceeded steam generator nominal value.

Initial configuration setup will be performed by ERENSAN Autorised Service technician on instrument panel. Thereafter, instrument panel pressure values can be changed without exceeding the steam generator operating pressure values (we recommend to perform this by ERENSAN Autorised Services).

Condensate Tank water level on gauge, manometer on steam generator and pressure value on instrument panel should be controlled.

Control of safety valves

The nominal values of safety valves should be recorded at start and these records should be kept. In steam generators that have more than one safety valve, the valve that opens at the greatest pressure should be controlled first. For this purpose valves that rate higher opening pressures should be locked with special mechanisms and the safety valve spring to be controlled should be released. When the boiler generator reaches operating pressure the safety valve should be opened and closed manually several times. This way the safety valve should be ensured to work properly and valve body should be allowed to warm up.

After this, the steam generator pressure should be raised to valve discharge value and it should be checked whether the safety valve opens automatically at required pressure. As soon as the safety valve opens, combustion should be stopped and the pressure should be dropped discharging steam to a level enabling safe operation on valve.

Safety valves not rating desired nominal value are adjusted as recommended by manufacturer.

Valve that calibrated by manufacturer should be controlled according to above instructions after installed to boiler generator.

Boiler feedwater control

Steam generator feedwater should be sent to the boiler after passing through a water softener device and undesired conditions should be removed making constant analyses of the boiler water.

Steam feedwater pumps and flow outlet switch should be kept under observation. In case of observation water leaking on water feed pump or oil decrease in crankcase, consult ERENSAN Autorised Service.

Condensing tank water temperature should be followed everytime, on standart package steam generator application 70 °C and on special application values in table should not be exceed (maximum 85 °C).

Water feed pump faults resultant from exceeding these values will not be covered by guarantee.

Blowdown

Maintaining the concentration of solids dispersed in the steam generator water (TDS- Total Dissolved Solids) at an acceptable level(values given in pages 28 and 29) can be provided by constantly analysing the steam generator feedwater and blowing down continuously from the blowdown pipe installed for this purpose.

Water side blowdown should be done at least 3 times in every shift and working day.

Blowdowns should be done when steam draught is low by completely opening and closing blowdown valve.

When globe shaped blowdown valve is opened, solenoid valve on the line should automatically stop burner.

if solenoid valve does not stop burner when globe shaped blowdown valve is opened, blow down valve must be closed immediatly.

Blowdown should not be done until system fault about automatic stop by solenoid valve is recovered.

Consult ERENSAN Autorised Service to provide functionality of automatic burner stopping in blowdown system.

THINGS TO BE DONE IN EMERGENCY CONDITIONS

During the working of steam generator, there is failure information system shows risky pressure and temperature increase and water flow speed decrease on panel and automatically stops the burner.

Failure signal of burner on steam generator also is shown on instrumetn panel. For failures on steam generator, first place to look is instrument panel. Depends on the failure on the instrument panel, necessary checks should be done according to Operation and Maintenance Instructions. If the failure still exist, consult ERENSAN Autorised Service by phone. Failure is not dissolved yet, ERENSAN Autorised Service should be called for check. Any procedure out of Operation and Maintenance Instructions should not be implemented. Steam generator should not be worked with by-pass of safety system.

In case of obsorvation about leaking on water and steam circuits or deformation, steam generator threads absolutely should not be continued working. ERENSAN Autorised Service should be called for check immediatly. After intervention, part replacement and check by authorised service, steam generator cab be activated.



PERFORM THE INSPECTION AND MAINTENANCE OF THE STEAM GENERATOR AND ACCESSORIES FULLY!

STEAM GENERATOR HARDWARE OPERATING, INSPECTION AND MAINTENANCE RULES

Inspection, maintenance and controls of boiler hardware should be done in compliance with hardware manufacturer’s instructions.

Safety valves

Generally there should be two safety valves on boiler generator.

Safety valves should always be in good working order.

Safety valves should be passed through hot test at least once a year and compliance of opening and closing values with nominal values should be checked.

For new safety valves, nominal values should absolutely be controlled regardless of their values set by the manufacturer.

If a leak is seen in the safety valve during operation, the safety valve is manually opened to remove this leak and steam is blown down for a short time to enable discharge extraneous substances that may exist on valve seat. If the leak is still not removed, the safety valve is removed and repaired after the boiler is cooled. Spring pressure **should not be increased** in leaking safety valves to remove the leak.

During safety valve opening control, the following formula should be taken into consideration:

$$P_{\text{opening}} = 1,05 \times P_{\text{operating}}$$

EXAMPLE: Safety valve adjustment pressure for **10 bar** operating pressure is found to be:

$$P_{\text{opening}} = 1,05 \times 10 = 10,5 \text{ bars}$$

Feedwater pumps

Before boiler feed pump is put in operation, the protective substances applied to shiny external surfaces by manufacturers for protection purposes should be cleaned off. Pump suction is checked and water feed provided.

Leaking check of water feed pump water pressurization unit should be done constantly. In case of increased leaking from piston seals and not reaching to operational pressure of steam generator, ERENSAN Autorised Service should be consulted to change water side seal kit.

The oil on the water feed pump sump should be checked on gauge. In case of decreased oil level, topping up should be done with the same brand and type oils specified in the user book. If oil decreasing is rising, oil seal kit or pump should be changed by ERENSAN autorised Service.

STEAM GENERATOR INSPECTION AND MAINTENANCE RULES

General

Steam generator maintenance should be done according to operation and fouling condition. In normal operation condition, smoke side maintenance; at least once in 2 weeks on liquid fuel, once in 2 months on gas fuel. If it gets foulance according to operation condition, maintenance period should be shorten.

If there is a blockage or compulsion of water flow due to using of hard water in steam generator's spir pipes surfaces, chemical washing should be done by a water chemical specialist company. During the chemical washing, check should be done by removing of water feed pump and its outlet flex pipe connection, connecting the chemical substance to spir inlet and outlet with proper setup, without being harmful to the environment.

Steam generator that should be washed with chemical substances or already chemically washed will not be covered by guarantee.

Additionally, to remove faults of boiler generator, it should be stopped once a year and generally checked and maintained.

Taking the boiler out of operation

When requested to stop steam generator, burner switch on electric panel should be brought to 0 (off) position.

Following the stop, initial activation valve should be slowly opened to decrease pressure.

Water should be observed coming from blowdown line and let water flow from blowdown until steam pressure comes to 0 bar and water temperature decreases under 100°C.

After coming under these values, water feed pump should be closed from electric panel.

Between condensing tank water feed pump suction valve and initial blowdown valve should be closed. System power should be cut by cut-off valve on burner inlet and main switch on electric panel.

Discharging

In cold climate or long stopping conditions, freezing risk of steam generator spir and pipe circuits, when plan to maintain dry of steam generator, water should be drained.

In these conditions, after controlled stopping, should be waited until water temperature decreases (under 50°C).

Water should be drained by removing of water feed pump and suction line water, strainer filter part's flange/plug or connection with flange on the same line, or fitting.

Steam outlet pipe and collector side water should be drained from blowdown valve.

As for that the water in spirs should be drained by giving pressured water through initial start-up blowdown valve line and at the same time opening the water side blowdown valve.

Water between the check valve on water feed outlet circuit and spir inlet should be drained by loosening check valve flange.

Inspection and maintenance preparation

- The steam generator is stopped, cooled and discharged for inspection and maintenance.
- In case of getting inside for steam generator spirs checks and cleaning, steam generator doors should be removed by cutting of fuel feed and power feed. In the same way, front door clamping component should be removed. Using proper device and wire brush, spir exterior surface should be cleaned. In case of necessary circumstances to get inside of boiler generator, proper ladder should be used.
- Before entering the steam generator, the combustion chamber and chimney channels are aired and gases inside are purged.
- When personnel enter the steam generator for inspection, etc. labels or warning plates are placed at visible places to indicate that people are working inside. Hinged doors are fully opened and tied back before entering.
- The mobile lamps and lining to be used for lighting in the boiler should not be over 24 volts and the extension cables should be faultless and thickly isolated. The cables should be protected from crushes, cuts from possible damaging locations (such as sharp edges, door openings), all electrical devices to be used should be properly grounded and devices that work with the lowest voltages should be preferred and electricity connection work should be done outside the boiler.

Inspection and maintenance of internal surfaces

- Steam generator, after spir pipes cleaned, pipe external surface should be checked by lighting between two spirs and external spir body.
- Pipes should not be damaged any way during spirs water side chemical washing.

Inspection of the outer surfaces and other parts

- The steam generator should be inspected from outside to ensure that there are no breaks, welding tears at any part due to heating.
- All detected leaks and drains should be removed. Excessive force should not be applied while tightening for this purpose and if the leak does stop in spite of tightening, the leaky places should be opened and new gaskets should be placed after cleaning. While removing gaskets on shiny parts, care should be shown not to scratch these surfaces.
- The valves, pipes, pipe connection fittings and outer pipes on the steam generator and steam generator hardware should be inspected for leakage.
- Precautions taken for corrosion might be arisen by rain water comes from chimney should be checked.
- The steel construction, the steel platforms and stairs, carrier supports, pipe suspension bars should be controlled to see if dislocations and bends exist.
- During maintenance and inspection, the steam generator and its surroundings, air channels, chimney bottom, burners, boiler front, fuel hardware and control devices should always be kept clean. The tools and kits to be used during maintenance should not be scattered around in a disorderly manner.

Cleaning of internal surfaces

- Before starting to operate a steam generator whose installation has been completed, rust, corrosive substances, grease leftovers, organic substance leftovers, protective paint, welding electrodes, and other extraneous materials leftover from installation should be cleaned as thoroughly as possible.
- Surfaces that are in contact with water and steam during steam generator operation should be cleaned of substances such as oil, grease, oil acids, rust, and paint.
- Help must be obtained from expert institutions for chemical cleaning of the steam generator.
- If the steam generator will be kept out of operation for a period of time, it should be fully cleaned as in weekly cleaning and the surfaces should be cleaned with soda solution to remove acidity. If deposits have formed a layer, soda solution cleaning should be repeated as many times as required. Sufficient cleaning of sulphur may be tested with pH paper (pH value should be 9,2 on 25°C). Acid removal operation should be performed when the boiler is at a temperature of 50-60°C. When this process is completed, surfaces are left to dry and then linseed oil, turpentine and graphite are sprayed to prevent oxidation of metallic surfaces. The steam generator doors should be closed to isolate it from air. In addition a container of half active lime is placed in the boiler to keep the air inside boiler dry.

Corrosion

Corrosion may happen when the steam generator is in operation or when it is taken out of operation. If crusty deposits do not exist in the boiler, the life of the metal parts and pipes of the boiler depends on local blowholes or erosion of pipes or body due to corrosion.

If red or black iron oxide stains exist in locations with blowholes, these have formed due to neutral or alkaline character of the boiler water.

If there is excessive heat in regions, the steam generator water is in contact with metal parts and water circulation is not sufficient, they develop blowholes or pitting. Corrosion may similarly form in water of neutral character, although more slowly. As a result of this type of corrosion, iron oxide and hydrogen gas formed.

Sometimes, due to high metal temperatures that arise because of bad heat transfer on surfaces covered with excessive deposits, the deposited materials enter reaction with the metal leading to corrosion.

Therefore, the necessary hardware should be used to purge boiler feedwater from all kinds of gases, especially from oxygen (For this purpose a gas remover called de-aerator should be utilized). Furthermore, various gas removing chemicals should be added to the boiler water.

The CO₂ concentration in the steam condenser should be kept at minimum value.

Prevention of smoke side corrosion

When liquid fuel and especially heavy fuel oil is used, sulphur content reaches approximately 3%. During combustion, sulphur collects on fire and smoke surfaces, especially in far corners. During start stop operations of the boiler generator, the water vapor in the chimney gas condenses and sulphur mixes with water to form sulphuric acid.

To prevent this:

- Liquid fuel with low sulphur content should be used.
- Soot and smut gathering on boiler generator heating surfaces (combustion chamber, smoke pipes, smoke chest) should not be allowed, cleaning process should be performed as frequently as possible.
- The burner should not be stopped very frequently.
- Burner combustion settings should be good. Burner adjustment should be performed by authorized burner services with Chimney Gas Analyzer.

Cracks and brittleness formed in steel parts

Cracks in the steam generator and spir pipes should be removed immediately, as they will lead to dangerous consequences.

CHEMICAL SPECIFICATIONS OF STEAM GENERATOR FEEDWATER

Water to be used in steam generators must be conditioned. The chemical specifications that the feedwater must meet are shown in the tables and graphics in pages 28 and 29. To operate the boiler efficiently and economically, the steam generator feedwater should be continuously checked to ensure provision of the necessary chemical conditions for the water.

The degree of pureness of the steam and the degree of being polluted should be determined with samples taken from the steam condenser

Deterioration of steam purity

All solid and liquid extraneous substances carried away with steam produced in the boiler are polluters that impair steam purity. Liquid substances consist of water droplets that are dragged along without evaporating and solids consist of suspended or dissolved solid substances that are dragged along together with these water droplets or steam.

Not to deteriorated of steam purity, we recommend to use seperator.

Effects of water dragging

- Dropping of steam generator operating efficiency
- Erosion of devices that work with steam
- Deposits forming in steam and condenser circuits

Measures to prevent water dragging

- Performing controlled blowdowns continuously to keep the condensation in the boiler generator water at values foreseen by the application,
- Ensuring lack of foaming substances in the boiler water,
- Preventing sudden changes in steam draught,
- Keeping water level at limits shown on page 22.
- Reducing chemical substances input to the boiler generator feedwater.
- Establishing the feedwater conditioning system so as to provide the conditions in table-1,
-
- Adding special foam removing substances to boiler water,
- Checking the suitability of the boiler capacity selection,
- Checking the conformance of the selected burner and burner nozzle with boiler capacity,
- During initial operation in the morning, giving way to steam after all pipe lines reach operating pressure,
- Designing steam pipelines so as to prevent steam cooling and condensing.

Sampling boiler feedwater, boiler water and steam

The sampling dates and sample quantity of the samples taken for use in experiments to be performed for checking desired water conditions should be identified.

In conditions where boiler water composition changes slowly or generally stays constant, it is sufficient to take samples once in each shift or once a day.

The container for taking sample should be clean and the container should be rinsed with the water to be sampled before the last sample is taken in the container. Sample containers should be closed and the contact with dust or carbon dioxide in the air should be prevented. The results of the experiments made should be recorded daily with a record and kept.

FEEDWATER FOR STEAM BOILERS (EXCEPT ATTEMPERATOR SPRAY WATER) AND HOT WATER BOILERS

Parameter	Unit	Feedwater for steam boilers	Make-up water for hot water boilers
Operation pressure	bar (= 0,1 MPa)	> 0,5 - 20	total range
Appearance	-	clear, free from suspended solids	
Direct conductivity 25 °C	µS/cm	not specified, only guide values relevant for boiler water see table 5-2	
pH value at 25 °C *	-	> 9,2 ^b	> 7
Total hardness (Ca + Mg)	mmol/l	< 0,01 ^c	< 0,05
Iron (Fe) concentration	mg/l	< 0,3	< 0,2
Copper (Cu) concentration	mg/l	< 0,05	< 0,1
Silica (SiO ₂) concentration	mg/l	not specified, only guide values for boiler water relevant, see table 5-2	-
Oxygen (O ₂) concentration	mg/l	< 0,05 ^d	-
Oil/grease concentration (see EN 12953-6)	mg/l	<1	<1
Organic substances (as TOC) concentration	-	see footnote ^e	

* With copper alloys in the system the pH value shall be maintained in the range 8,7 to 9,2.

^b With softened water pH value > 7,0 the pH value of boiler water according to table 5-2 should be considered.

^c At operating pressure < 1 bar total hardness max. 0,05 mmol/l shall be acceptable.

^d Instead of observing this value at intermittent operation or operation without deaerator if film forming agents and/or excess of oxygen scavenger shall be used.

^e Organic substances are generally a mixture of several different compounds. The composition of such mixtures and the behaviour of their individual components under the conditions of boiler operation are difficult to predict. Organic substances may be decomposed to form carbonic acid or other acidic decomposition products which increase the acid conductivity and cause corrosion or deposits. They also may lead to foaming and/or priming which shall be kept as low as possible.

Ref: EN 12953-10 : 2003 Table 5-1

BOILER WATER FOR STEAM BOILERS

Parameter	Unit	Boiler water for steam boilers using			Boiler water for hot water boilers
		Feedwater direct conductivity > 30 $\mu\text{S}/\text{cm}$	Feedwater direct conductivity ≤ 30		
Operation pressure	bar (= 0,1 MPa)	> 0,5 - 20	> 20	> 0,5	total range
Appearance	-	clear, no stable foam			
Direct conductivity 25 °C	$\mu\text{S}/\text{cm}$	< 6000 ^a	see Figure 5-1 ^a	< 1500	< 1500
pH value at 25 °C	-	10,5 - 12	10,5 - 11,8	10 - 11 ^{b,c}	9 - 11,5 ^d
Composite alkalinity	mmol/l	1 - 15 ^a	1 - 10 ^a	0,1 - 1 ^c	< 5
Silica (SiO ₂) concentration	mg/l	pressure dependent, according to figure 5-2			-
Phosphate (PO ₄) ^e	mg/l	10 - 30	10 - 30	6 - 15	-
Organic substances	-	see footnote ^f			-

^a With superheater consider 50 % of the indicated upper value as maximum value.

^b Basic pH adjustment by injecting Na₃PO₄, additional NaOH injection only if the pH value is < 10.

^c If the acid conductivity of the boiler feedwater is < 0,2 $\mu\text{S}/\text{cm}$, and Na + K concentration is < 0,010 mg/l, phosphate injection is not necessary.

Under the conditions AVT (all volatile treatment, feedwater pH $\geq 9,2$ and boiler water pH $\geq 8,0$) can be applied, in this case the acid conductivity of the boiler water is < 5 $\mu\text{S}/\text{cm}$.

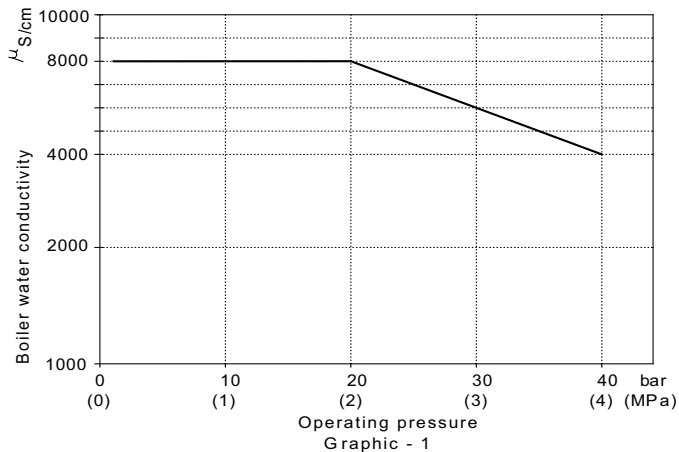
^d If non-ferrous materials are present in the system, e.g. aluminium, they may require lower pH value and direct conductivity, however, the protection of the boiler has priority.

^e If coordinated phosphate treatment is used; considering all other values higher PO₄ concentrations are acceptable (see also clause 4).

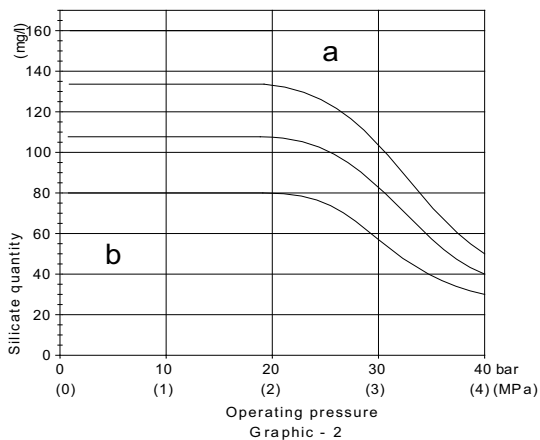
^f See^e in table 5-1.

Ref: EN 12953-10 : 2003 Table 5-2

Maximum acceptable steam generator water conductivity depending on the pressure



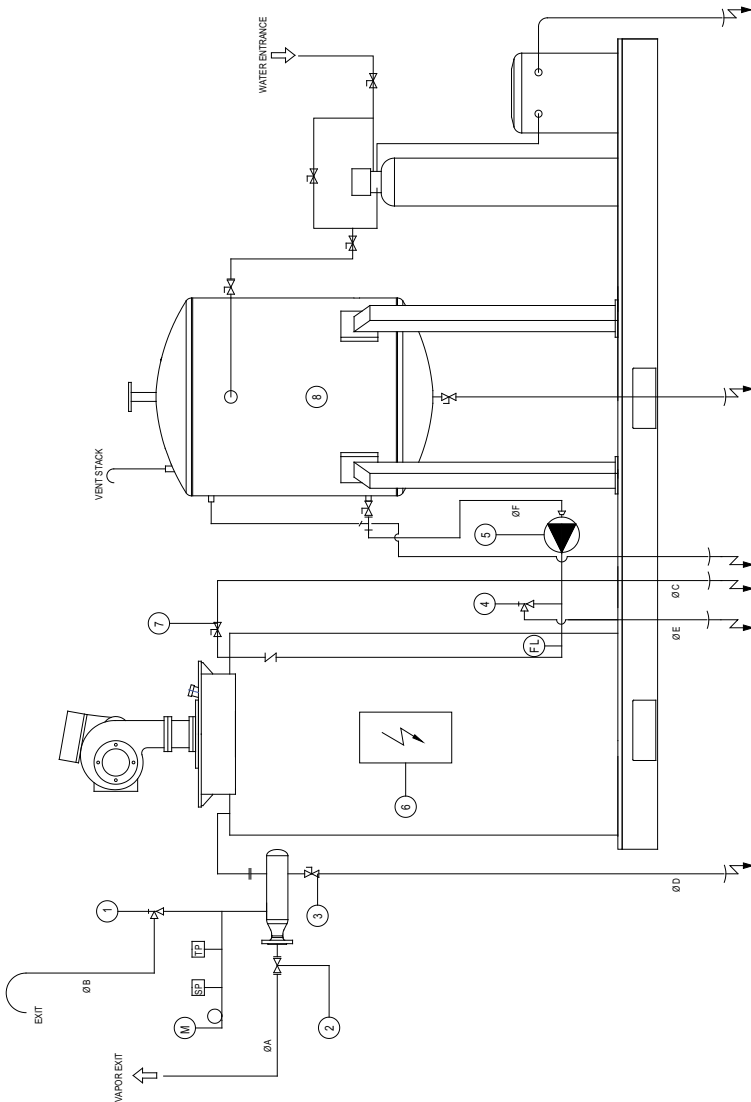
Boiler generator feedwater conductivity should be $>30 \mu\text{S}/\text{cm}$. Maximum silicate (SiO_2) quantity acceptable in boiler water depending on the pressure



- If operating pressure is >20 bars it is not appropriate to work in region (a).
- Max. acid quantity in (b) region should be $\text{pH}=8.2$

INSTALLATION CIRCUIT DIAGRAM

A boiler installation diagram is given as an example. An installation according to the needs of the operation and the characteristics of the process where the steam is utilized should be setup.



No	Description
1	Safety valve
2	Steam outlet valve
3	Activation Blowdown Switch
4	Pump Pressure Safety Valve
5	Feedwater Pump
6	Electric Control Panel
7	Water Blowdown Valve
8	Condensation Tank
9	Water Softening Device
M	Manometer
TP	Pressure Transmitter
SP	Safety Presostat
FL	Flow Control

SSG	Ø A	Ø B	Ø C	Ø D	Ø E	Ø F
300	1 1/4"	1 1/2"	1/2"	1/2"	1"	1 1/2"
500	1 1/2"	1 1/2"	1/2"	1/2"	1"	2"
750	2 1/2"	1 1/2"	1/2"	1/2"	1"	2"
1000	2 1/2"	2 1/4"	1/2"	1/2"	1"	2 1/2"
1250	2 1/2"	2 1/4"	1/2"	1/2"	1"	2 1/2"
1500	3"	2 1/2"	1/2"	1/2"	1"	3"
2000	3"	2 1/2"	1/2"	1/2"	1"	3"

6 bar

STEAM GENERATOR LIFE TIME

Steam generator's life span has been set by the Ministry of Industry to be 10 years. If erensan^o brand boiler generators are utilized in compliance with operating and maintenance instructions, it is possible to go well over the ministry stated life time. Therefore, make sure that this operating and maintenance procedure is read and fully applied by operating personnel.

When the boiler has reached unusable state, remove the junk from usage area in compliance with environmental procedures.

WISHING HAPPY USE OF YOUR BOILER...

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