



AKKAYA
B O I L E R S

USER MANUAL

**AKK-ECO (FG / S) MODEL
HOT WATER ECONOMIZERS
(Heat Recovery Boiler)**





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1. INTRODUCTION

Valuable Customer,

Akkaya hot/superheated water economizer you have purchased is produced according to EN & TURKISH norms.

This user guide is prepared for Akkaya AKK - ECO model economizers.

This user guide includes technical information about the economizer and operating and safety instructions as well.



Owner must employ a licensed or certificated operator for a safe and efficient use. Any accidents or breakdowns caused by operating conditions, other than described in this guide, shall be customer's responsibility. All local legal requirements must be fulfilled by the owner prior and during operation of the economizer.

There are some information and charts referred to standards and norms in this manual. Please refer to the latest versions of the standards and norms.



GENERAL DESIGN and CONSTRUCTION



2.GENERAL DESIGN AND CONSTRUCTION FEATURES

2.1 Design

- AKK-ECO model economizer is designed and manufactured according to the system which transfers the usable heat of gases to the water.

- The heat transfer area of the unit is selected properly to increase the efficiency and the lifetime of the economizer. The heat load per heat transfer surface area (W/m^2) of the boiler is selected properly because of this feature boiler has a safe and reliable operation.

- Isolation of the unit is specially made to minimize the thermal energy loss. Special covering materials are used on the surface, to protect the shell of the boiler from outdoor conditions and to prevent the tearing at maximum.

- The body is designed according to PED2014/68 directive and CE marked.

- EN12952, EN12953 , EN13445 & EN1090 norms are followed where applicable.

- Akkaya Boilers has ISO3834 & ISO9001 quality system certificates.

2.2 Working Principle

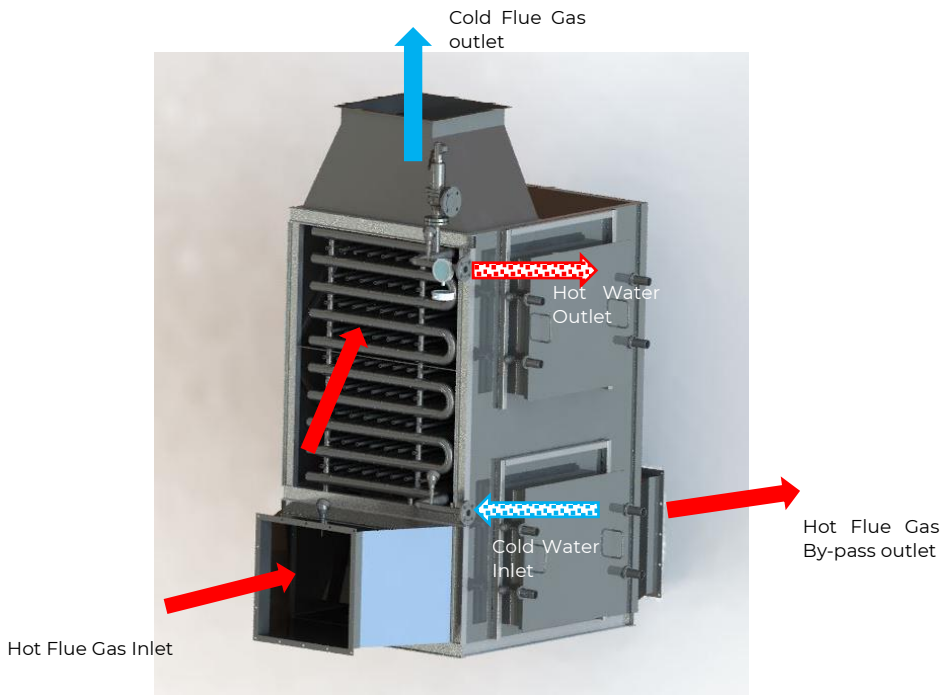


Figure 2.2.1 AKK-ECO S Economizer for Solid Fuel Fired Boilers Working Principle

(the by-pass system construction & layout may change according to the capacity)

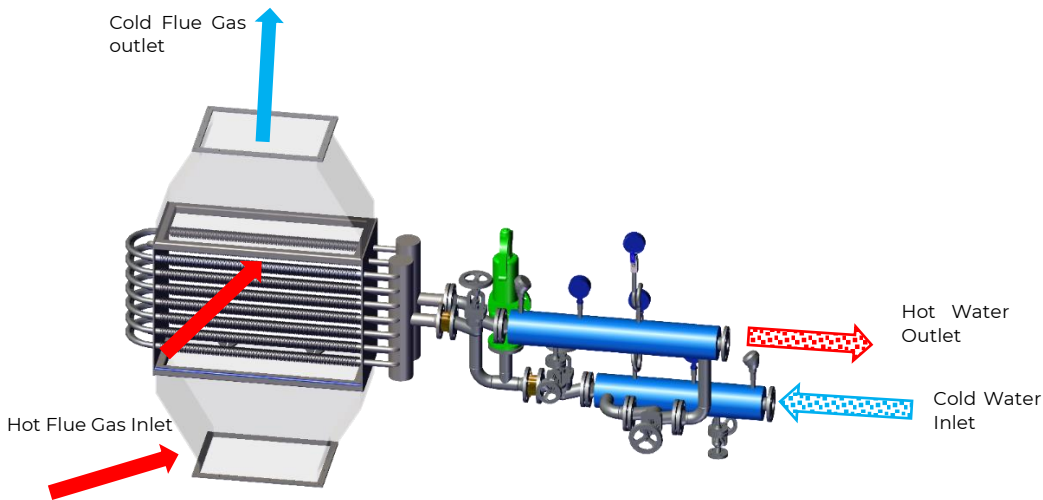


Figure 2.2.2 AKK-ECO FG Economizer for Oil / Gas Fired Boilers Working Principle

(the by-pass system construction & layout may change according to the capacity)

-  : HOT GAS PASS
-  : HOT WATER
-  : COLD WATER
-  : COLD GAS PASS

The hot gas reaches the gas entrance of the economizer and from here it goes towards the smoke exit. Water is fed from cold water inlet of the economizer and released to the boiler's water feed line from hot water outlet of the economizer. While the hot gas completes its pass around the economizer's water tubes the useful heat of the hot gas is transferred to the water that is travelling inside the water tubes. By this way the water fed to the boiler is preheated before it is converted into steam. This allows the fuel consumption to be decreased, and efficiency to be increased.

Finally colder exhaust gas is discharged from the chimney to the atmosphere.

2.3 Construction

AKK-ECO boiler body consists of; 1-pass water tubes, main body and mirror plates at proper thickness, according to the heater's operating pressure. EN12952 is taken as reference for design calculations where applicable.

2.4 Quality

2.4.1. Steel Materials

Steel materials are selected according to the requirements of EN12953-2. Generally, boilers are made of carbon steel of quality P265GH - P295GH -P355GH in accordance with EN10028-2 standard in the pressure-exposed parts and of S235JR - S355JR quality in non-pressure parts. The details of the materials used can be found in the "Technical File" of the boiler. For low temperature and condensing type economizers stainless steel can be used for construction.

2.4.2 Tubes

In accordance with the requirements of EN12953-2: EN10216-2 P235GH, 16Mo3, AISI304 or similar quality seamless steel tubes and EN10217-2 ERW (welded) tubes are used. To obtain increased heat transfer surface area, finned tubes are used in production of the economizers. The details of the materials used can be found in the "Technical File" of the boiler. (For the solid fuel or oil, fired applications bare tube construction can also be chosen to lower the soot accumulation in the economizer.)

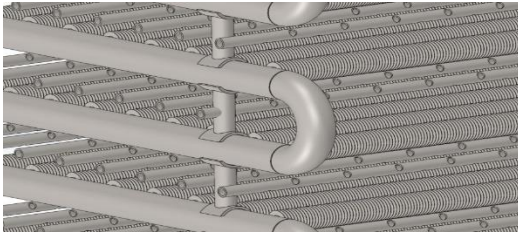


Figure 2.4.2 Finned Tubes

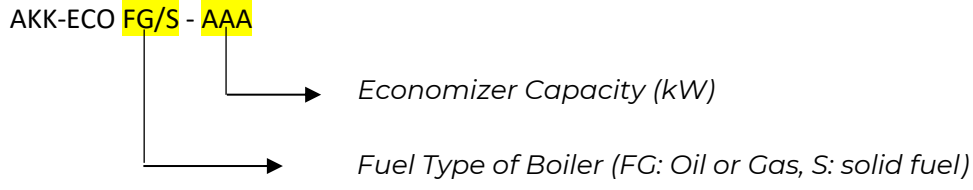
2.4.3 Welding

Welds were performed by certified welders according to EN9606, in accordance with EN15609, EN15614-1, EN15614-8 requirements of welding procedure specifications. According to EN12953-5, welds are subject to necessary non-destructive testing procedures (UT / RT, VT, MT / PT). The weld details including WPS, PQR, welding maps, NDT reports, welder certificates can be found in the "Technical File" of the boiler.


2.4.4 Isolation

On 50 mm thick glass wool, PVC and protective film coated galvanized steel, aluminum or stainless steel (which can be selected according to customer's request) is used for coating. Rear smoke box is isolated by ceramic-based insulation materials to decrease heat loss and to help safe operation.

2.5. Product Coding



2.6. Boiler Name Plate (Sample)

| |
|---|
|  <h1>AKKAYA</h1> <p>BOILERS</p> <p>AKKAYA ISI MAKİNALARI VE DOĞALGAZ SAN. VE TİC. A.Ş. AKKAYA HEATING INSTRUMENTS & NATURAL GAS INC.</p> |
| Tanım Description |
| Tipi Type |
| Seri No Serial Number |
| Standart Standard |
| Max. Isıl Kapasitesi Maximum Thermal Capacity |
| Akışkan Tipi Fluid Type |
| Isıtma Yüzeyi Heating Surface |
| Müsaade Edilen En Yüksek Basınç Max. Allowable Working Pressure |
| Müsaade Edilen En Yüksek Sıcaklık Max. Allowable Working Temperature |
| Hidrostatik Test Basıncı (bar) Hydrostatic Test Pressure (bar) |
| Hidrostatik Test Tarihi Hydrostatic Testing Date |
| İmalat Tarihi Manufacturing Date |
| CE |
| <p>📍 1.OSB.Yerli Su Sok. No:2 Selçuklu / KONYA - TÜRKİYE ☎ +90 332 248 92 21 +90 332 248 91 45 ✉ akkaya@akkaya.com.tr</p> <p>www.akkaya.com.tr</p> |



TRANSPORTATION INSTRUCTIONS



3. TRANSPORTATION INSTRUCTIONS

3.1. Placing the Economizer on Transport Vehicle

- 1- An open top vehicle must be selected for transportation of the economizer (either with truck or container)
- 2- While loading the equipment on a vehicle, a crane (with proper load capacity) must certainly be used. All the covers / doors of the vehicle must be opened before the boiler is lifted for placing.
- 3- Lifting eyebolts of the economizer must be used while lifting to place it on the vehicle.
- 4- Rope or chain must be selected carefully to carry the equipment safely. Connection and angle of the ropes/chains must be done according to the instructions & confirmations given by Akkaya.
- 5- Placing on the vehicle and positioning the economizer must be done carefully and instructions from the transport vehicle operator must be followed.
- 6- The lashing of the economizer on the vehicle or container must be carried out by professional and certificated companies.



When you lift the economizer from the ground level, there must be **NOBODY under or close to the it. Utmost care must be taken to avoid accidents.**

3.2. Transporting The Economizer

- 1- Before carrying the economizer on a vehicle, it must be fixed to the vehicle by being tied with barrier to prevent slipping. The lashing must be done by certificated companies.
- 2- Economizer mustn't be carried together with fragile equipment and/or living creatures.
- 3- The driver of the vehicle must avoid any sudden movements. The speed limits of the road must strictly be obeyed.

3.3. Placing The Economizer in The Boiler Room

- 1- Economizer must be placed in a boiler room, specially built for boiler and boiler auxiliaries.
- 2- Local legal regulations and rules must be followed for the boiler room placement and construction.
- 3- Economizer must be unloaded from the vehicle, using a crane. The eyebolts of the economizer must be used for crane operation.
- 4- Experienced staff must be in charge for unloading and placing the boiler in the boiler room. Safety tools like helmets, gloves, eye protectors... etc. must be provided.
- 5- The boiler room must be free from dust, flammable materials, dangerous or corrosive gases.
- 6- The fire protection & extinguishing system must be installed.



INSTALLATION OF BOILER AND AUXILIARIES



4. INSTALLATION OF BOILER AND AUXILIARIES

For the boiler room dimensions and construction rules please refer to the local regulations. Please consult Akkaya for the dimensions of the economizer and auxiliary equipment to be installed inside the boiler room.

- 1- All required legal permissions for boiler fuel supply and economizer hot gas supply, electrical power supply, piping & plumbing must be completed and provided by the owner.
- 2- The height of the boiler room must be built at least 2 m higher than boiler's height.
- 3- The boiler room must have at least two facing doors one of which must have ventilation openings to allow air circulation.
- 4- The doors must have at least 2 m height and 0,9 m width.
- 5- The boiler room floor must be a smooth concrete or a non-flammable basement.
- 6- The boiler room must be well ventilated but protected from outdoor conditions or wind.
- 7- Any flammable objects mustn't exist in the room.
- 8- The installation of the boiler and its auxiliary accessories must be carried out by an experienced and qualified staff.
- 9- If there is more than one boiler to be installed in the same boiler room, there must be minimum 1 m space between boilers.
- 10- Adequate space must be left to access the boiler for inspection or service purposes.
- 11- Easy access to the electrical control board and sufficient clearance must be provided.
- 12- Pressure drop in the boiler room can be maximum 0,5 mbar. It must be ensured that there is no negative pressure in the boiler room.
- 13- In case any kind of suction fan exists in the boiler room, it must be ensured that boiler flame draft is not affected. In case needed a draft inducer or engineered flue system must be provided.
- 14- The proper water and fuel line piping must be completed before the boiler start-up. P&ID (piping and instrumentation diagram) and item list of the equipment must be provided and must be kept for future records.

If the auxiliaries and accessories of the boiler is in the scope of contract, P&ID and item list are supplied by Akkaya. Please consult Akkaya for these documents.



The owner of the boiler must complete the following pre-works before start-up.

- 1- Proper water supply line and water drain must be built.
- 2- Water softening system must be connected to raw water inlet and to condensate tank inlet. For the specifications of the water to be connected to the feed water tank and to the boiler feed pump is described in the user manual and in EN 12952-12 or EN12953-10 standard.
- 3- Piping between condensate tank or deaerator to feed water pumps and from pumps to boiler must be done. For the dimensions of the pipes please refer to P&ID.
- 4- A proper electrical power supply cabling to the electrical control board must be done and its earthing (grounding) must be completed. Please refer to the electrical wiring diagram for selection of the power supply cables and protection switches (to be supplied by Akkaya if the control system supply is in the scope of the contract).
- 5- In case the boiler is not delivered as a packaged system with all accessories mounted on, Akkaya's authorized staff must be waited to connect all the accessories to the boiler. Also, the electrical control board connection of the boiler accessories shall be done by Akkaya's technicians, too if these works are in the Akkaya's scope of supply.
- 6- The safety valve outlets must be taken out of boiler room with proper separate piping for each of them. Do not connect the exits of the safety valves to a common pipe.
- 7- Boiler must be connected to a properly designed and certificated chimney. The calculations and the construction of the chimney and the smoke channels must be done according to EN norms.



Too long horizontal section or improper dimensioned smoke channels may cause poor draft. Chimney draft is very important for the heat transfer efficiency. Also, the diameter of the chimney is very important for draft and must be selected properly.

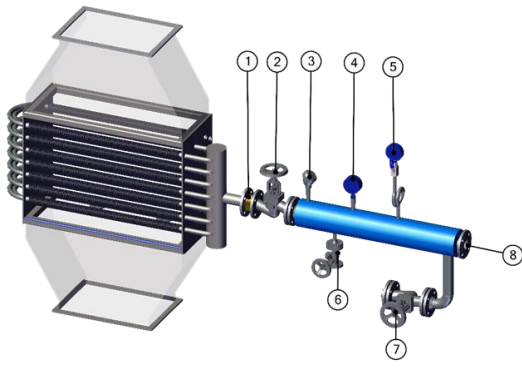


Figure 4.1 Economizer Outlet Line Components

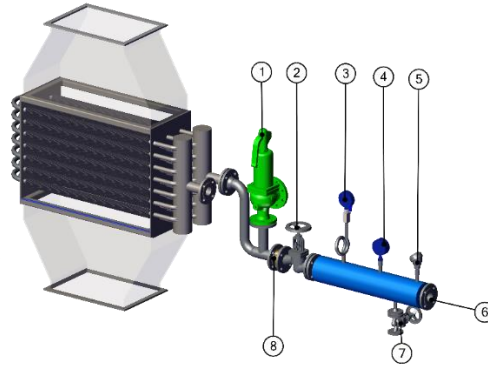


Figure 4.2 Economizer Inlet Line Components

| No | Outlet Line Components | No | Inlet Line Component |
|----|------------------------------|----|---|
| | Economizer Body | 1 | Safety Valve |
| 1 | Water Outlet Check Valve | 2 | Water Inlet Valve |
| 2 | Water Outlet Valve | 3 | Water Inlet Manometer |
| 3 | Outlet Thermocouple | 4 | Inlet Thermometer |
| 4 | Outlet Thermometer | 5 | Inlet Thermocouple |
| 5 | Outlet Manometer | 6 | Water Inlet Line |
| 6 | Drain Valve | 7 | Drain Valve |
| 7 | By-pass Valve | 8 | Water Inlet Check Valve |
| 8 | Water Outlet Line | | Gas Inlet Side Thermocouple |
| | Gas Outlet Side Thermocouple | | Electric or pneumatic actuated three-way modulating control valve group <i>(In case required and if this valve does not exist already on the boiler within a modulating water level control system)</i> |

The configuration and the equipment descriptions given in this manual are for a standard package AKK-ECO economizer system. The specifications and quantities of the accessories may vary due to customer's requests. For safety accessories EN12952-7 has been taken as reference where applicable. Please refer to the P&ID and Equipment list supplied by Akkaya for exact configuration.



START-UP, OPERATING, CLEANING AND MAINTANENCE INSTRUCTIONS

5. START-UP, OPERATING, CLEANING AND MAINTANENCE

5.1 Start-Up and Operating the Boiler with Economizer



Both the boiler and the economizer's first start-up & commissioning must be done by Akkaya's Technical Service. The guarantee of the equipment will be invalid unless the commissioning is done or approved by Akkaya.

When the boiler and the economizer are turned off manually and needs to be started up again the following steps must be completed to operate the system safely.

Boiler operators must have a valid license, or a certificate taken from official authorities (In Türkiye MYK certification is required). The operators must be responsible for interfering in any urgent situation. So, it is very important that they know the functional properties and operating principles of all equipment used in boiler systems.

The operators must have a control form and must fill it in daily.

(For sample daily control chart see Appendix 1)

- 1- All combustion, hot gas supply and chimney system must be checked for a safe operation. This check is done to be sure:
 - a) There is no unfired fuel / oil / flammable object deposit near or inside the boiler and the economizer.
 - b) There is no exhaust gas deposition inside the boiler and economizer.
 - c) There is no leakage at the hot gas line and the boiler and economizer peripheral is clean and free from fuel / oil / flammable object.
 - d) The chimney and smoke channels are open and clean. Proper suction exists in the gas side of the boiler and economizer. There are no hurdles in the smoke way. All the auxiliaries' (like economizer, recuperator, etc.) dampers are fully open, and smoke can pass through easily.
- 2- If there is any automatic combustion and/or hot gas supply control equipment in the system; electrical protection and functional controls and locking system controls must be done. All this equipment must be in operation.
- 3- All valves must be checked for no leakage.
- 4- Automatic water level control system of the boiler must be checked strictly, for correct operation. The correct operation of this system must be ensured before the boiler is started-up. These controllers can be checked during manual filling of the boiler.
- 5- The water flow control of the economizer must be checked strictly, for correct operation. The correct operation of this system must be ensured before the boiler is started-up.
- 6- If the boiler has stayed non-operating for more than 2 weeks, all valves, fittings and control equipment must be checked for any kind of faults before restarting.
- 7- Water with appropriate chemical composition complying with EN12953-10 or EN12952-12 must be filled in the boiler. Akkaya control systems has a manual filling option on the control board.

For boiler water chemical composition information see Appendix 2



Akkaya's manufacturer guarantee shall not be valid unless above mentioned chemical composition of boiler water is provided.

- 8- The boiler combustion system can be ignited, and hot gas is supplied to the economizer after making all the checks described above.



Before the first ignition of the burner and gas pass to the economizer, make sure that there is nobody in front of the boiler doors or in front of the explosion door. At this stage boiler operator(s) must stay at the side of the boiler. There may be a gas explosion and the boiler doors, or the burner can blow away by this explosion. This may cause deadly injuries.

- 9- Boiler and economizer inlet & exit valves must be controlled manually by opening and closing them. These valves must not be tightened too much during operation regarding expansion or squeezing.
- 10- The control values like pressure, steam temperature and stack temperature must be observed. Steam pressure manometer and the pressure value on the control screen obtained by the pressure transmitter must be observed and controlled. There may be slight difference between mechanical manometer and digital value on the screen. If the difference is higher than 0,2 bar Akkaya Technical service must be informed. The temperature of the steam can be controlled after letting some amount of steam flow from the boiler. The stationary steam or water temperature can be different than the actual value. The temperature of the steam must be close to the saturation temperature of the steam at that pressure. If the temperature value is not compatible with the saturation temperature Akkaya Technical Service must be informed.
- 11- The temperature of the economizer can be controlled during water circulation continues.
- 12- Combustion Air to Fuel ratio adjustment must be done by an expert with an exhaust gas analyzer.
- 13- During first ignition the burner must be operating less than its full capacity. The flame must be observed at minimum length at least one hour without increasing.
- 14- Water level rises because of temperature increase due to thermal expansion. Water level inside the boiler can be decreased to the normal level by making bottom blow down manually.
- 15- After obtaining homogenous heat inside the boiler, the burner flame and the boiler pressure can be increased gradually. (For example, 1 bar every 15 minutes). Sudden pressure increases must be avoided.
- 16- When the boiler pressure arrives at the set value the burner must stop automatically. There may be a hysteresis set value for restart of the burner. This value must be checked and if it is not well defined for the steam consuming process Akkaya Technical Service must be informed. The burner may be two stage or modulating type; in this case the set value of the 1st and 2nd stages and the modulating operation of the burner must be checked, if the operation of the burner is not stable the burner's technical service must be informed.
- 17- Safety valves operation must be checked. When the boiler pressure reaches to set value, the safety valves handles can be lifted to let some steam flow. Never try to increase the pressure of the boiler to the safety valves set value by firing the burner (by making shortcut in burner control line). The check of the safety valves at their set values can only be done by authorized Akkaya Technical Services.
- 18- The economizers safety valve can be checked during water supply to the boiler by lifting the handle manually. The operator must be very careful not to be harmed by the hot water coming out of safety valve during this test. It is recommended that the test of the safety valve is carried out by Akkaya technical service staff, during periodical maintenance works every 6 months.
- 19- Check all the flange or nozzle connections for water or steam leakages during the pressure rise of the boiler.
- 20- Check all the flange or nozzle connections for water leakages during the temperature rise of the boiler.



In case any water leakage is detected at a boiler under pressure and when the temperature is higher than 50°C do not attempt to solve the problem immediately. Wait for the boiler and the water to cool down. Be sure that there is no steam inside the boiler. Superheated water also can leak as steam for the high-pressure systems. Breathing steam can burn your trachea and cause suffocation. Steam and hot water can burn your skin. Pressurized water and steam can cause mechanical elements (like bolts, nuts, valves, handles, etc.) to rupture and hit your body. These incidents can cause fatal injuries. Utmost care must be taken during fixing any leakage.

- 21- After the boiler reaches set pressure value, bottom blow down must be done by opening the bottom blow down valve at the back side of the boiler. If the valve is manual, make the blowdown for 3 seconds in every 8 hours. If there is an automatic blowdown valve, check its working and waiting time set values. For the first start-up of the boiler, check the controller's operation manually to see if the automatic valve is open or shut off properly.
- 22- Surface blow down must be done from the surface blow down valve. If the surface blowdown system is manual, the operator must check the water quality / conductivity / foam formation. After observing the water quality of the boiler and compare it with the values listed in EN12952-12 the period and the **amount** of the blowdown must be determined. If the system is automatic, then the valve will automatically open and shut down according to the measured conductivity value.
- 23- During the boiler's operation, the flame must always be kept stable and smooth regardless the fuel type. The boiler operator must also check the fuel consumption and follow it to notice any kind of efficiency loss.
- 24- Water level must stay at normal level when boiler is operating. Even if the water level is controlled automatically, boiler operator must still observe the level as the automatic system may be out of order because of mechanical or electronic breakdowns.

- 25- Water level controllers and water level indicators must be cleaned monthly to obtain safe and efficient operation.
- 26- To let the steam flow through the pipeline, the main steam exit valve must be opened slowly. The steam exit valve of the boiler must be opened slowly with highest attention. Small amount of steam must be discharged until the pipeline's temperature and pressure reaches to the expected values. Sudden steam discharge to the pipeline can cause mechanical problems like steam or water hammering, rupture, or breakdowns due to thermal expansion ... etc.
- 27- Be sure to discharge all condensate in the pipeline before opening the boiler steam exit valve.
- 28- If any foam formation is detected, the boiler must be fed with water (as described in EN12952-12) and surface blow down must be done until the foam formation stops.



If foam formation cannot be eliminated, the boiler must be shut down, and possible reasons must be investigated. Please contact the authorized service for assistance.

- 29- Boiler feed water must be continuously analyzed chemically to prevent improper composition. Water sample must be taken in certain periods and be analyzed as described in Appendix 1 & Appendix 2 of this manual.
- 30- The temperature of feed water and the discharge pressure of the pumps must be kept stable at required normal level. NPSH (net pump suction head) is dependent on the temperature and pressure of water. The height difference between feed water tank and pump effect the pump's suction. Water below 80°C and around 2 m of water head is advised for standard operations. Please consult with Akkaya Technical Service for higher temperature and pressurized feeding systems.
- 31- The feed water pipes, economizer pipes and pumps must be controlled frequently (Ave. monthly). The calcination or scale formation inside the feed pipeline and especially at the boiler feed water inlet nozzle is a frequently faced issue. In case scaling or mud formation is seen they must be fully cleaned by mechanical or chemical means.
- 32- Blow down of level indicators and mechanical level controllers must be done at least daily. (see Appendix 1)
- 33- Boiler operator must record all the operations done on the boiler regularly.
- 34- The set values must not be changed by any unauthorized person.



IF WATER LEVEL DECREASES BELOW THE LOW-LOW LEVEL ALARM LEVEL AND THE BURNER KEEPS ON RUNNING THIS WILL CAUSE OVER HEATING OF THE BOILER PARTS. IN SUCH CASE BOILER&BURNER MUST BE STOPPED IMMEDIATELY. ALL ELECTRICAL POWER SWITCHES MUST BE TURNED OFF. ESPECIALLY FEED WATER PUMPS POWER CONNECTION MUST BE CUT IMMEDIATELY. NOBODY MUST BE ABLE TO RESTART THE PUMPS ACCIDENTALLY. FEED PUMP VALVES, BOILER FEED WATER INLET VALVE, STEAM DISCHARGING VALVE AND BURNER'S FUEL VALVES MUST BE CLOSED. BOILER MUST BE COOLED DOWN BY OPENING ITS SMOKE DOORS AND BY LETTING COLD AIR ENTER IN THE BOILER. NEVER TRY TO FEED WATER TO THE HOT BOILER. NEVER TRY TO COOL DOWN THE BOILER BY FEEDING WATER. AFTER THE REASON FOR LOW LEVEL IS INVESTIGATED AND ELIMINATED IT MUST BE CHECKED FOR ANY MECHANICAL DAMAGE. ESPECIALLY COMBUSTION CHAMBER TUBES OR FLAME RETURN LOCATION TUBES CAN GET HARMED BECAUSE OF LACK OF WATER. IN ORDER TO CHECK THE SITUATION, AKKAYA TECHNICAL SERVICE MUST BE CONSULTED. BOILER MAY EXPLODE IF YOU FEED THE HOT BOILER WITH WATER!



THE FLAME MUST BE OBSERVED DURING BOILER OPERATION. IF THE BURNER DOES NOT STOP AUTOMATICALLY AT THE SET PRESSURE VALUE, THE FUEL VALVE MUST BE CLOSED IMMEDIATELY AND AKKAYA TECHNICAL SERVICE MUST BE INFORMED.



IF THE FLAME CAN NOT BE FORMED IN A SHORT TIME AT THE FIRST IGNITION, THE FUEL VALVE MUST BE CLOSED. THE IGNITION MUST BE TRIED AGAIN AFTER BURNER & COMBUSTION CHAMBER IS FULLY VENTILATED AND CLEANED FROM FUEL RESIDUES. DEPOSITED FUEL RESIDUES OR COMBUSTIBLE GASES MAY CAUSE EXPLOSION!



IF THE BOILER OR ANY OTHER PERIPHERAL EQUIPMENT IS FROZEN DO NOT START THE BOILER BEFORE HAVING AKKAYA'S AUTHORIZED TECHNICAL SERVICE MAKE THE NECESSARY CONTROLS. NEVER TRY TO MELT THE FROZEN PARTS INSIDE THE BOILER BY FIRING THE BURNER. THE BOILER MAY EXPLODE IF YOU TRY TO RUN FROZEN BOILER!

5.2 Shutdown and Discharging The Boiler

- 1- Boiler is electrically shutdown from the control board by pressing stop button on HMI. (For different type of control board system please refer to electrical wiring diagram)
- 2- After shutdown be sure that the burner is fully stopped.
- 3- After the burner is fully stopped, fuel line shut off valve must be closed tightly.
- 4- If the water level is normal, the feed water pump can be turned off (if there is separate pump on/off button on the control board) and feed water inlet valve must be closed.
- 5- If the water level is higher than the normal level, the excess water can be discharged by making bottom blowdown.
- 6- Let the boiler cool down naturally. To prevent sudden temperature changes in the boiler, avoid sudden cooling.
- 7- The reduction of pressure must be observed while the boiler is cooling.
- 8- The boiler can be discharged from bottom blowdown valve after the water temperature is measured below 80 °C and 0 BarG pressure is observed at the boiler manometers.



It is dangerous to discharge the boiler when it is still hot.

- 9- Boiler blowdown and economizer drain valves must be closed tightly after the boiler is fully discharged and warning signs as "do not open" on the drain valves must be placed.

5.3 Shutdown Procedures at Emergency Situations

- 1- If there is an emergency case like low low water level, high temperature, high pressure, or low temperature, press the emergency stop button.
- 2- Be sure the burner and pumps are not working. Close the fuel inlet valve of burner and water inlet valve of the boiler.
- 3- If the system is solid fuel fired boiler. Take out the fire and unburned fuel from the combustion chamber.
- 4- For boilers which have been left without water and heated with lack of water, open the fire tube cleaning doors to let the boiler cool down naturally.
- 5- Never restart the boiler without inspection of an authorized body after an emergency stop.

5.4 Precautions

- 1- Do not fire the boiler if the water is below the normal water level.
- 2- Do not put your hands, your head or any of your body parts into the boiler gas side or water side during operation. Do not enter inside the boiler while the boiler is hot.
- 3- Do not close any of dampers on the smoke way fully. These dampers are boiler stack exit damper, economizer damper, recuperator damper or any damper that can stop the exhaust flow.
- 4- Insufficient chimney draft is harmful for human health and reduces boiler efficiency. So, the boiler draft must be kept adequate by means of cleaning and if needed by installation of a suction fan.
- 5- Chimney must be kept clean and in good condition for sufficient combustion. Before starting the boiler, the chimney draft must be controlled.
- 6- Be careful about the possible leakage at chimney and chimney connections.

- 7- Cleaning door on the chimney connection must be closed during operation.
- 8- The doors of fume box and chimney cleaning door must not be opened during operation.
- 9- Do not open the doors of the boiler during operation.
- 10- Before starting the burner, be sure that there are no flammable objects in the boiler and the furnace is clean.
- 11- You must keep the boiler under control during operation frequently.
- 12- Do not cook anything in the boiler.
- 13- Explosion door behind the boiler must be kept clear to be opened easily. Do not put anything in front of the door.
- 14- Do not use fuel with high sulfur content or materials that are harmful for human health.
- 15- Do not put explosive materials in the boiler.
- 16- There mustn't be any materials that can burn around the boiler (like woods, coal, oil, gas, textile materials, plastic materials ... etc.). Sparks or some heat can get out of the boiler, and this can cause fire. That's why the boiler room and the surrounding of the boiler must always be kept clean and free of materials that can burn.

5.5 Cleaning & Maintenance

The perfect reference for a boiler operator is a clean and well cared boiler room. Obtaining high efficiency and continuous operation depend on boiler's and boiler room's condition.

The cleaning and maintenance cost can be kept at a very low level by performing it correctly and frequently. If done so the boiler will have a very long operating life, high efficiency and return of the investment cost will take shorter time.

General cleaning Instructions:

- 1- All equipment that does not belong to the boiler room must be removed.
- 2- The clean water supply connection and drain connections must exist in the boiler room. The boiler shall be cleaned easily by water.
- 3- The boiler outer shell must be cleaned frequently to keep new and good appearance.
- 4- The control and safety equipment, bushings, flanges must be checked for leakage. If there is no water or steam leakage on any part of the boiler system, the boiler will be clean all the time as there will be no salt, dirt formation or calcification at any part.
- 5- The manholes and flanges must be tightened at least every two months to prevent leakages.
- 6- Front door, burner connection flange for boiler and gas connection flanges for economizer and rear explosion door can be used to clean the gas parts of the boiler. There are cleaning openings on the gas side of economizer. (please refer to the economizer's drawing)
- 7- If soot layer is less than 0,5 mm, you may leave it. Thicker soot / dirt must be cleaned with special boiler tube brush. The soot on the economizer tubes and fins decreases the efficiency too much.
- 8- Due to fuel and hot gas composition and operational conditions, hard layers of soot and sulfur formation may be observed. As these layers are dangerous for economizer & boiler materials, they must be cleaned as soon as possible. Cleaning with boiler tube brush shall not be enough for hard layers, a special electric cleaning equipment or movable head cleaning machines can be used.
- 9- Grease oil like molykote must be applied on bolts and nuts before closing the front doors, after cleaning.
- 10- There may be manholes on your boiler. These openings are also used to observe scale formation and sediments on the water part of the boiler. For interior inspection of the boiler Manholes are used. Manholes are heavy accessories. The operator must be very careful during handling these manhole covers. The manhole cover's weight is approximately 30-40 kg. The gasket of these manholes is special. Before attempting to open a manhole be sure to prepare at least 2 spare gaskets. Before opening the manholes, the steps described in "5.2 - Shutdown & Discharging" section must be completed. The doors/covers of manholes must be produced to face the sides of the manhole port with the letting no cavity. Before placing the gaskets, gasket's sockets must be cleaned up and the gaskets must be pulled in the sockets. The space between gaskets and their sockets must be equal in every side. Gaskets of the doors must be tightened equally and gradually. High quality gaskets with graphite or the gaskets advised by Akkaya Technical Service must be used.
- 11- Even just very thin layer like 1 mm of scale/lime on the water side of the economizer & boiler, not only drops the efficiency but also causes extra heating of the materials. It must be cleaned with pressurized water. If you fail to get rid of all the lime, chemicals can be used for cleaning.
- 12- If proper water is fed to the boiler, lime formation on the heating surfaces will not occur.
- 13- Feed water must always be checked for oil content. Oil content in feed water must strictly be avoided.

5.6 Protecting the Non-Operating Boiler



If the boiler is not going to be used longer than one week, the following process must be carried out to prevent rust and corrosion formation.

- 1- Smoke pipes and smoke side of mirror plates must be cleaned at a boiler temperature of approximately 40 ° C.
- 2- All smoke surfaces of the boiler must be cleaned with oil to prevent direct air contact.
- 3- The air at the smoke side of the boiler must be dry. This can be achieved by putting air drier chemicals inside the boiler.



When the boiler is out of service, corrosion formation can take place faster than an operating boiler. If there is water with a little alkali content in the boiler, rust and corrosion occurs quickly. If precautions are not taken, corrosion will keep on forming, even when the water is discharged completely. Corrosion can only be prevented if there is NO water in the boiler and the oxygen attack to the metal surfaces are prevented when it is NOT operating.

- 4- After the boiler cools down, water must be filled in with necessary chemical addition.
- 5- The phosphate content of the boiler water can be increased by mixing 600 g tri sodium phosphate per m³.
- 6- ~700 g hydrazine and ~150-250 g sodium sulfate can be added to the boiler water to prevent rust and corrosion.
- 7- Water must be fed to the boiler until water comes out from the valve at the highest point of the boiler (air vent valve or connection nozzle under the vacuum breaker). This is done to be sure there is no air left inside the boiler. Then all the valves on the boiler must be fully closed.
- 8- To prevent freezing, the boiler room temperature must be kept above +4 ° C.
- 9- Before re-operating the boiler, chemical added water must be gradually discharged by making blow down.
- 10- After the chemical added water is completely discharged, the boiler must be filled with normal boiler water until normal level is reached.



If the boiler will not be operated for a period more than 3 months, it must be kept free of water. The following steps must be followed.

- 1- Boiler water must be discharged through blowdown valve and economizer must be discharged from drain valve.
- 2- After the water is discharged, safety valve must be opened to discharge all the steam.
- 3- All inspection ports (manholes and handholes) must be opened and controlled whether inside of the boiler is dry or not. It must be dried if still wet.
- 4- The pots of diminished lime and calcium chloride must be put in the boiler. These pots must be discharged in every three months.
- 5- To eliminate the rest of oxygen in the boiler, a firing pot with oil-lamp and firewood must be placed in the boiler.
- 6- All inspection ports and valves must be closed.
- 7- Holes, flanges, and valves must be tightly closed and double checked to prevent leakage.

5.7 Feed Water and Boiler Water Quality

It is essential to eliminate risks at feed water, steam lines and boiler by continuous boiler feed water treatment. The possible risks and their results are:

- 1- Lime or scale formation on the boiler surface because of water hardness. This may cause safety failures, heat transfer difficulties, efficiency loss, heat deposition and non-operating boiler.
- 2- Thin layers of oil and organic material on the boiler's heating surface can cause excessive heat in the boiler.
- 3- Free oxygen and free carbon dioxide weaken the boiler material and cause corrosion.
- 4- High organic components quantity causes foam formation, and this foam carries organic substances. When evaporation starts particulate deposition and transfer will occur in the pipelines and equipment which will end up with blockings and breakdowns.



Proper water according to EN12953-10 or EN12952-12 must be used for generating steam.

Continuous control of Feed Water and analysis:

- 1- Date of taking sample of feed water must be recorded. It will be enough to take sample daily from where the water components amount and conditions are stable.
- 2- The sample must be taken just after blowdown, and it must be analyzed under pressure by cooling.
- 3- The sample pot must be clean. It must be shaken with the sample before filled in.
- 4- At least 2 liters of sample water must be filled in the pot.
- 5- Daily report of the analysis carried out must be written and archived.
- 6- Below specifications must be measured and recorded in the analysis report
 - Color
 - Smell
 - Nitrite ratio
 - Ammonia ratio
 - Hardness
 - pH value
 - Sediment
 - Conductivity
 - Organic Materials
 - Sulfur
 - P Alkaline
 - M Alkaline
 - Free Chlorine
 - Magnesium
 - Chlorine
 - Ferro
 - Silica
 - Calcium
- 7- Water must be clean and purified from mechanical dirt.
- 8- The specifications of the water softening system shall be determined according to the water properties. (EN 12952-12 must be studied for detailed information)



MANUFACTURER'S GUARANTEE SHALL BE VALID IF ONLY CUSTOMER CARRIES OUT THE RESPONSIBILITY TO PROVIDE PROPER FEED WATER CONDITIONS.

APPENDIXES



APPENDIX 1 -SAMPLE DAILY CONTROL CHART

| Observation and testing | Clauses Ref. EN 12953-6 | Daily * | 1 month | 3 months | 6 months | 12 months | Remarks |
|--|----------------------------|---------|---------|----------|----------|-----------|--|
| Safeguards against excessive pressure (safety valves) | 4.1 | O | | | T | | - |
| Water level indication | 5.1 | T | | | | | Compared with limiters and controls |
| Drain and blow-down devices | 4.6 | T | | | | | - |
| Valves | 5.3 | O | | | T | | As per manufacturer's operating instruction |
| Feed water control | 5.5 | O | | | T | | - |
| Low water protection | 5.6.1 | O | T | | | | Functional check by lowering the water level to the switching points |
| Boiler pressure and temperature indication | 5.2 | O | | | | | Compared with limiters and controls |
| Pressure limitation | 5.6.2 | O | T | | | | Functional check by increasing the pressure to the switching points |
| Temperature limitation | 5.6.3 | O | T | | | | |
| Devices for water quality protection | 4.8 | O | T (1) | | T(2) | | (1) Comparison of the measured values with the reliable samples (see 4.7.2 of EN12953-6) (2) Performed by a suitably qualified and competent person |
| Protective device | 4.3 | O | | | T(3) | | (3) Electrical and mechanical testing performed by a suitably qualified and competent person |
| Pressure parts (pipes, inspection openings, flanges, gaskets, joints...) | | | O | | | | |
| Pressure controller and temperature controller | 4.4.1 | O | | | T | | |
| Feed water supply | 5.4 | O | | T | | | |
| Water quality | 4.7 | T(4) | | | | | (4) see EN 12953-10:2003 |
| Energy Supply | 4.4 | O | | | | T(5) | Performed by a suitably qualified and competent person as per operating instruction but not less than once a year. |

(O) Observation of abnormal noises, smells or other noticeable factors.

(T) Checking and/or testing the functional behavior of equipment parts, including observation.

* In the standard it is written as 72 hours, Akkaya Boilers strictly recommends these controls to be done DAILY.

A daily control chart must be recorded and kept by the operator of the boiler. If the daily controls are not done and recorded properly manufacturer's guarantee will be invalid. A safe and efficient operation of the boiler can be sustained by making these controls.

APPENDIX 2 - WATER QUALITY REQUIREMENTS

ICS 13.060.25; 27.060.30;
27.100

TS 377 10
EN 12953-10 JANUARY 2006

| Table 5-1 — Feedwater for steam boilers (except attemperator spray water) and hot water boilers | | | | |
|---|--------------------|---|---------|-----------------------------------|
| Parameter | Unit | Feed water for steam boilers | | Feed water for warm water boilers |
| Working pressure | bar (= 0,1 MPa) | > 0,5 - 20 | > 20 | Total interval |
| 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** | > 9,2** | > 7,0 |
| Totalhardness (Ca + Mg) | mmol/L | < 0,01*** | < 0,01 | < 0,05 |
| Iron (Fe) concentration | mg/L | < 0,3 | < 0,1 | < 0,2 |
| Copper (Cu) concentration | mg/L | < 0,05 | < 0,03 | < 0,1 |
| Siliciumdioxide (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**** | < 0,02 | - |
| Oil/ grease concentration (see EN 12953-6) | mg/L | < 1 | < 1 | < 1 |
| Organic substances (as TOC) concentration | - | See Footnote ***** | | |

* pH must be in between 8,7 - 9,2 for copper alloys.

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

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

****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.

*****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.

ICS 13.060.25; 27.060.30;
27.100

TS 377-10
EN 12953-10 JANUARY 2006

| Table 5-2 — Boiler water for steam boilers and hot water boilers | | | | | |
|--|--------------------|---|---|---|------------------------------------|
| Parameter | Unit | Water for steam boilers | | | Boiler water for hot water boilers |
| | | Feed water direct conductivity > 30 µS/cm | Feed water direct conductivity > 30 µS/cm | Feed water direct conductivity > 30 µS/cm | |
| Working pressure | bar (= 0,1 MPa) | > 0,5 - 20 | > 20 | > 0,5 | total range |
| Appearance | - | clear, no stable foam | | | |
| Direct conductivity at 25 °C | µS/cm | < 6000 - (a) | Şekil 5.1-(a) | < 1500 | < 1500 |
| pH value at 25 °C | - | 10,5 to 12,0 | 10,5 to 11,8 | 10,0 to 11,0 (b,c) | 9,0 to 11,5 (d) |
| Composite alkalinity | mmol/L | 1-15 (a) | 1-10 (a) | 0,1 to 1,0 (c) | < 5 |
| Silica (SiO ₂) concentration | mg/l | pressure dependent, according to figure 5-2 | | | - |
| Phosphate - PO ₄ (e) | mg/l | 10 to 13 | 10 to 30 | 6 to 15 | - |
| Organic substances | - | see footnote (f) | | | - |

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

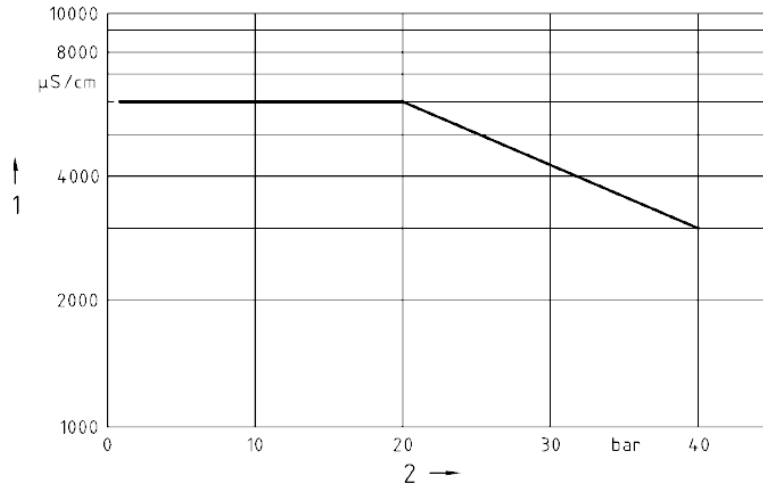
b- Basic pH adjustment by injecting Na₃PO₄, additional NaOH injection only if the pH value is < 10.

c- If the acid conductivity of the boiler feedwater is < 0,2 Na + K concentration is < 0,010 mg/l, phosphate injection is not necessary. Under the conditions AVT (all volatile treatment, feedwater pH 9,2 and boiler water pH 8,0) can be applied, in this case the acid conductivity of the boiler water is < 5

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).

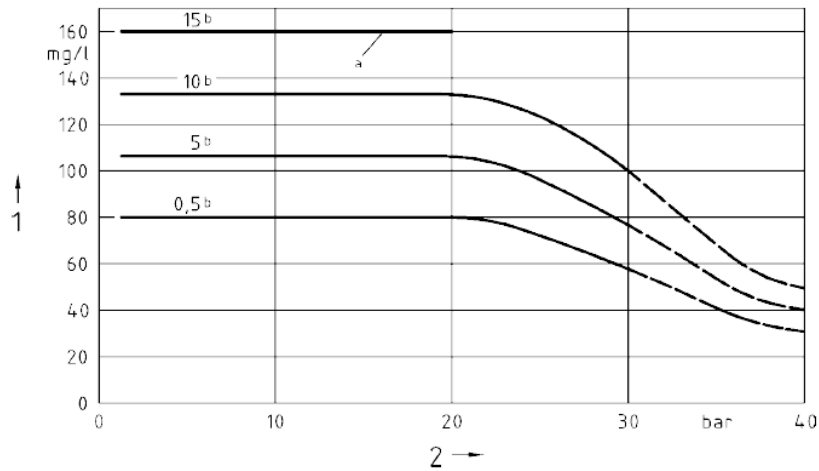
f- See e in table 5-1.



1: Direct Conductivity

2: Operating Pressure

Chart 1.1 Maximum acceptable direct conductivity of the boiler water dependent on the pressure; feedwater direct conductivity $\geq 30\mu\text{S} / \text{cm}$



1: Maximum silica content

2: Operating pressure

a) This level of alkalinity is not permissible ≥ 20 bar

a) Alkalinity in mmol / l

Chart 1.2 Maximum acceptable silica content (SiO₂) of the boiler water dependent on the pressure

APPENDIX 3 -BOILER CONTROL SYSTEM STANDARD ALARMS EXPLANATIONS

Boiler Water Low Level

This alarm turns on when the water inside the boiler is at a lower level than normal set level. When boiler gets into alarm position, burner stops. To operate the boiler again, MANUAL RESTART must be done. The causes of low water level must be investigated. (Faulty feed pump, lack of water in the feed water tank, blocked water feed line... etc.)

Boiler Water High Level

This alarm turns on when the water inside the boiler is at a higher level than normal set level. In this case the feed water pump does not operate, burner stops, and MANUAL RESTART is necessary. Water must be discharged through the blowdown line until the water level inside the boiler decreases to normal level. Increase in the water volume due to the initial heating up may cause this alarm to turn on. Another reason maybe, faulty operation of water level controllers.

Low Temperature Alarm

This alarm turns on when the water temperature inside the boiler comes close to the freezing point (+5°C). In this case pumps and burner do not operate. After the ambient temperature rises and the ice inside the boiler is checked and safely eliminated, boiler can be operated by MANUAL RESTART.

High Temperature Alarm

Boiler high temperature alarm turns on in cases where the saturated steam temperature inside the boiler exceeds the theoretical steam temperature at operating pressure (saturation temperature+10o C). In this case pumps and burner do not operate. Boiler can be operated again by MANUAL RESTART after the temperature is decreased. Lack of water in the boiler may cause this situation. It must strictly be investigated by the authorized personal / service.

High Pressure Alarm

This alarm triggered by the pressure switch or by the pressure transmitter installed on the boiler. It turns on when the system pressure is higher than the pre-set value. In this case burner stops automatically. To operate the boiler again, after the pressure decreases to normal value, MANUAL RESTART must be done.



In high pressure cases burner automatically stops. But if the pressure continues to increase, safety valves automatically open and steam is discharged until the pressure decreases to set value and alarm turns-off.

Burner Error/ Failure

Signal indicates that there is a fault in burner operation. Boiler must be re operated only after the fault is investigated and eliminated by an authorized service or staff.

Feed Water Pump & Solenoid Operation

-Boiler 1. Feed Water Pump On / Off must be "on" in normal operation.

-Boiler 2. Feed Water Pump On / Off must be "off" in normal operation as stand-by.

In cases where "pump error" signals are on, faulty pump must be stopped manually and other one must be operated. The pump error signal comes from the motor protection thermic switch. It must be reset from thermic relay.

-Feed Water Tank Solenoid Valve must be at "on" position in normal operation.

Hooter/ Siren Shutdown

It is for shutting down the voice of boiler controls. It only shuts down the voice alarms, signals continue to function.

Manual Restart Button

It is for deleting the alarm warning on the screen and to re-start the boiler. It aims to prevent the boiler's self, re-starting and forces the operator to go next to the boiler physically to see the alarm and take necessary actions.

Burner Alarm Reset

For some burner types, burner alarm reset button may be placed on the boiler control board instead of burner control board. This button is to reset the burner alarm from the boiler control board.



ATTENTION: Information in this section is to give general idea to the operator, about boiler control board and main controls on it. The number of equipment, switches and controllers may vary according to the purchased configuration. The main source for reference shall be the special "electrical control board diagram" that is provided to the customer during the system installation.



PLEASE KEEP THE FOLLOWING DOCUMENTS WHICH HAS BEEN SUPPLIED BY AKKAYA IN A SAFE LOCATION DURING THE ENTIRE LIFETIME OF THE BOILER

- a. USER MANUAL**
- b. P&ID (PIPING AND INSTRUMENTATION DIAGRAM)**
- c. ITEM LIST**
- d. TECHNICAL FILE, INCLUDING CERTIFICATES**
- e. ELECTRICAL WIRING DIAGRAM WITH CONTROL ALGORITHM**

A COPY OF THIS USER MANUAL WITH THE ABOVE DOCUMENTS HAS BEEN RECEIVED BY US AND THE EXPLANATION OF THIS USER MANUAL HAS BEEN DONE BY AKKAYA TECHNICAL SERVICE. WE AGREE TO OPERATE THE BOILER UNDER THE CONDITIONS EXPLAINED IN THIS USER MANUAL.

CUSTOMER NAME:

ADRESS:

DATE:

SIGNED BY (NAME-SURNAME-SIGNATURE):



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