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1 Scope of the Operating Instructions

These Operating Instructions contain basic information. They apply in combination with the following operating instructions:

- A002 Basic Safety Instructions

For the operation of the system as a whole, the operating instructions for the individual components are binding along with the relevant statutory provisions and official requirements.

2 Use in Accordance with Regulations

The specified limit values have been agreed with TÜV Süd and apply to hot water boilers and boilers made of non-alloy or low-alloy steel. They are based on long-term experience and the binding safety minimum requirements of EN 12953 Part 10 and VdTÜV/AGFW Information Sheet TCh 1466 / FW 510 Edition 03/2004, on the reduction of:

- Risk of corrosion
- Sludge waste and
- Formation of deposits.

In so far as parts of the hot water boiler or heat consumer system need additional requirements, then the manufacturer of the system shall specify this. During the planning of heating systems, the appropriate standards - in particular DIN 4751 and 4752, the boiler room guidelines and all the relevant regulations should be observed. If there is any doubt, we would ask you to contact us.

3 Safety

Please read the Operating Instructions:

- A002 Basic Safety Instructions

4 Operating and Maintenance Staff

Please read the Operating Instructions:

- A002 Basic Safety Instructions

5 General Risks and Accident Prevention

Please read the Operating Instructions:

- A002 Basic Safety Instructions

5.1 Dangerous situations

During the operation of the boiler plant dangerous situations may arise as a result of operation. Damage can only be avoided if these situations are recognised in good time and if the correct measures are taken immediately. The following list of dangerous situations makes no claim to be complete, but is based on values from experience that have been gathered through decades of observing our products. If other installations or system components are present, the measures that apply for these system components must be coordinated with the manufacturer of these installations or components.

- The operating staff must report any dangerous situations immediately to the supervisor responsible.
- According to the regional regulations, damage to pressure-bearing walls of the boilers and – if provided – the flue gas heat exchanger which, as a result of a danger to the operating staff or third parties, leads to a halt in operation must be reported to the competent supervisory authority and/or monitoring organisation which is responsible for safety tests on the boiler system.

5.2 Formation of deposits



Danger! There is a danger of deposits forming. The formation of deposits can destroy the boiler. There is an acute risk to life for everyone in the vicinity of the boiler from flying parts and from the hot medium (steam, hot water). Extremely serious damage can be caused to the boiler by insufficiently prepared water, unsuitable dosing agents or dirty condensate. Deposits should not be regarded as harmless. The thickness of the deposits is no indication of their effect in restricting heat.

If deposits are observed on the water side, further operation of the boiler system is not allowed.

The boiler may only be started up again once the deposits have been removed and if an expert allows the boiler to be fired up after a suitable test has been carried out. The manufacturer recommends that this inspection is carried out by a suitably trained service engineer on the manufacturer's staff, an expert or persons who have been expressly authorised by the manufacturer to carry out this work.

It is recommended that an experienced specialist company is employed to remove the coating and/or deposits. If chemical cleaning is required, this must be noted in the operating log.



Note: Boilers may only be cleaned with boiler scale solvents which are approved under regional regulations. The regulations on safety and environmental protection must be strictly complied with. These regulations and instructions are given on the cleaning product containers or in the corresponding safety data sheets. These data sheets are available from the supplier of the cleaning product.

5.3 Corrosion



Danger! Danger from corrosion. Corrosion can destroy the boiler. There is an acute risk to life for everyone in the vicinity of the boiler from flying parts and from the hot medium (steam, hot water). Extremely serious damage can be caused to the boiler by insufficiently prepared water, unsuitable dosing agents or dirty condensate.

If corrosion is observed on the water side, further operation of the boiler system is not allowed.

The boiler may only be started up again once the deposits have been removed and if an expert allows the boiler to be fired up after a suitable test has been carried out and measures have been taken to repair the corrosion, or at least to prevent the corrosion from spreading any further.

The manufacturer recommends that this inspection is carried out by a suitably trained service engineer on the manufacturer's staff, an expert or persons who have been expressly authorised by the manufacturer to carry out this work.

6 Requirements for filling and make-up water and circuit water quality

6.1 Filling and make-up water 2)

Table 1: Requirements for filling and make-up water

Boiler design	Flame tube-fire tube boiler		
	Salty ¹⁾	Low salt ¹⁾	
Water chemical operation	> 100-1500	> 30-100	≤ 30
Electrical conductivity in circuit water	[μS/cm]		
Column	1	2	3
General requirement	Colourless, clear, free of insoluable matter		
pH value at 25 °C	[-]	8.5-10.5	8-10.5
Earth alkalis (total hardness)	[mmol/l]	< 0.02	
	[° dH]	< 0.1	
Oxygen (O ₂) ³⁾	[mg/l]	< 0.1	
Iron	[mg/l]	< 0.2	
Copper	[mg/l]	< 0.1	
Oil/grease	[mg/l]	< 1	

6.2 Circulating water

Table 2: Circuit water requirements

Boiler design	Flame tube-fire tube boiler		
	Salty ¹⁾	Low salt ¹⁾	
Water chemical operation	> 100-1500	> 30-100	≤ 30
Electrical conductivity in circuit water	μS/cm		
Column	1	2	3
General requirement	Colourless, clear, free of insoluable matter		
pH value at 25 °C ⁴⁾	pH value	9.5-10.5	9-10.5
K _{SB,2} (p value)	mmol/l	< 0.5-5	0.1-0,5
Earth alkalis (total hardness)	mmol/l	< 0.02	
	° dH	< 0.1	
Oxygen (O ₂) ⁵⁾	mg/l	< 0.02	< 0.05
Phosphate (PO ₄) ^{4) 5)}	mg/l	5-15	5-10
When oxygen binders are used ⁵⁾			
Soldium sulphite (Na ₂ SO ₃)	mg/l	5-10	-

6.3 Notes on Tables 1 and 2

1) Low salt operation is advisable for:

- Large pipe networks with lots of branches, such as in industrial or remote heating systems;
- Longer periods of stagnation, also of parts of the heating network;
- Greatly varying pressures and temperatures;
- Systems with components made of various materials;
- Operation without chemical oxygen binders (if necessary, in conjunction with partial flow overpressure degassing).

Operation with frost protection agents in a hot water system requires a particular method. The electrical conductivity limit values do not usually need to be complied with. See Section 6.4.

2) Usually, the filling water is a mixture of prepared make-up water from the circuit. Well-prepared, low-salt make-up water, if necessary condensate, is required for low-salt operation.

3) The guide value for oxygen is adjusted to automatically on boiling in the top-up tank (boiling degasser) and under exclusion of air. The steam line for removing the vapour and toxic gases only needs to be open for make-up water refilling, approx. 30 - 60 min. afterwards.

4) Adjusting the alkalinity (pH value or $K_S 8.2$):

For salty operation, the alkalinity is usually set automatically by the filling water composition. If this is not the case, alkalify the water primarily using solid alkalis (trisodium phosphate or possibly addition of sodium hydroxide).

With low-salt operation, the pH value should be adjusted using trisodium phosphate or potassium phosphate.

Avoid ammonia.

If there are cupreous materials in the hot water network, the circuit water may not exceed pH 9.5.

5) In permanent heating mode, the limit values are maintained automatically - oxygen binders are then not essential. Otherwise, physical methods – see under ¹⁾ – and chemical agents are available.

A standard chemical agent is sodium sulphite. Film-forming amines are not an oxygen agent. The use and type of the oxygen agent must be specified for each system.

With sodium sulphite in salty heating water, there should be an excess of 5...10 mg/l. Sulphite may occur in heating networks, and has a corrosive effect on copper and copper alloys. The salt content of the water increases. There are no hygienic or toxicological restrictions on sodium sulphite.

In heating water with a low salt content, the limit values for phosphate must be maintained, to avoid tension crack corrosion – do not go below the lower limit value concentration.

The use of other dosing agents and protective chemicals/inhibitors other than those specified should be agreed with Loos.

Important: When using oxygen binders or other protective chemicals the application regulations of the appropriate manufacturer and supplier shall have sole validity. Damage to boiler systems caused by chemicals and insufficient protective measures shall be outside the sphere of liability of the boiler manufacturer.

6.4 Addition of frost protection agents to circuit water

In some cases, a frost protection agent, e.g. on a base of monoethylene glycol or propylene glycol, is added to the circuit water, in order to avoid freezing of the circuit water in the winter.

When using glycol-water mixtures, observe the following:

- In conjunction with frost protection agents, it is often not possible to comply with the limit values for electrical conductivity. Therefore use only completely desalinated water with a conductivity of $< 10 \mu\text{S/cm}$ as filling and make-up water.
- Due to their corrosion promotion properties, which are stronger than those of water, glycol-water mixtures may not be used without the addition of corrosion inhibitors. However, these corrosion inhibitors must be contained in the frost protection agent. Additional dosing agents may not be used!
- Comply with the minimum concentration specified by the manufacturer of the frost protection agent, as, if not met, there is the risk of insufficient inhibition. Also, always comply with the deadlines specified by the manufacturer for replacing the frost protection agent.



Important! *The mixing of frost protection agents changes the physical properties of the circuit water.*

The effects on the heating system and boiler selection should, if necessary, be checked by the manufacturer.

7 Initial filling

Hot water systems may only be freshly filled with treated, at least softened, water, to which at least 50 g of trisodium phosphate (20 % P₂O₅) should be added per 50 g. Low-salt water can, for example, be obtained from large power stations by tanker.

8 Down times

To avoid corrosion during down times (during longer operational interruptions or delayed commissioning), conserve hot water boilers, and if necessary the heating network, properly. For information on this, please refer to the operating manual of the appropriate components and the operating manual G012 Wet and Dry Conservation.

9 Water investigation

Check the characteristics of the filling and make-up water and circuit water once a week.



Important: *The water samples must only be taken from the system during normal operation, i.e. not when cold or in start-up operation.*

For the analysis, a representative sample is necessary which, via a suitable cooling device (e.g. water sample cooler from the manufacturer) allows the water to be tested to be cooled to 25 °C. For instructions on taking the water sample, see Operating Instructions E004 Water sample cooler module SCM.

Scope of the water investigations:

Filling and make-up water:

- pH value or $K_{\text{S } 8,2}$
- Earth alkalis (total hardness)
- Oxygen or oxygen binder

Guideline on Water Characteristics

Circuit water:

- pH value or $K_{S\ 8,2}$
- Earth alkalis (total hardness)
- Oxygen or oxygen binder
- Phosphate or alkalising agent
- Electrical conductivity
- Appearance

The results should be entered in the logbook L004 for hot water boilers or L005 boilers. The investigations of the other values and additional parameters, such as iron, copper or sulphides, should be carried out, as far as is relevant, on a monthly basis, and, if possible, the methods of analysis mentioned in EN 12953-10 applied.



Important! Should national requirements require more frequent or more comprehensive water investigations, these shall have priority over the manufacturer's requirements.







Note: Only experienced specialist companies should be asked to supply and install water treatment systems or water treatment devices. We have found that the support provided by the customer service units of these companies and/or departments specialising in water chemistry to be very useful.



Note: When using frost protection agents in the first year of operation, carry out a water-side investigation of the boiler every three months. If the result is positive, the investigation periods can be increased to the normal levels.

10 Measures in the event of unusual observations and operating faults




If anything unusual is observed and/or operating faults are displayed, the following table provides initial information on repair:

Observation/Fault: Turbid circuit water		
Cause	Elimination of the cause	By whom?
Hardness precipitation (earth alkali phosphates)	Adjust the water values according to the Circuit Water table	
	Determine the cause of the hardness	
	Partial water exchange (increase clarification rate)	
Entry of corrosion products	Testing of additional water treatment	
Use of unsuitable chemicals	Engage a specialist company	Operator

Guideline on Water Characteristics






Observation/Fault: Corrosion in the boiler, flue gas heat exchanger

Damage elimination: Repair of damaged heating surfaces, removal of coating by a specialist company







Cause	Elimination of the cause	By whom?
Improperly treated filling or make-up water	Testing of water treatment, for ion exchange plants, trigger regeneration as necessary	
	Adjust water treatment to different raw water values. (Check and correct the throughput between two regenerations)	
	Set a constant pressure in front of the water treatment plant	
	Use a higher quality treatment method (e.g. osmosis)	Operator
Outside substance ingress into circuit water (oils, greases, organic matter, acids, alkalis, hardness, etc.)	Plan for circuit water monitoring (conductivity, turbidity). Conductivity: Acids, alkalis, hardness, seawater Turbidity: Oils, greases, milk, paints	Operator
Use of film-forming aminos in conjunction with salt-free or low-salt methods	Precipitate film formation agent	Operator

Observation/Fault: Corrosion in the boiler, flue gas heat exchanger

Damage elimination: Build-up welding. Component replacement. This work may only be carried out by the manufacturer or by personnel authorised by the manufacturer.





Cause	Remedy	By whom?
Oxygen leaking in during down times	During down times proceed according to Operating Instructions G012 Wet and Dry Conservation. For shorter down times, keep system under pressure.	
Insufficient deaeration of the filling and make-up water	Check thermal deaeration (constant pressure or temperature, sufficient vapour steam volume)	
	Check excess O ₂ binder	
Insufficient chemical dosing	Check excess according to the circuit water table	
	Check chemical dosing	

Guideline on Water Characteristics

Cause	Remedy	By whom?
Overdose of dosing chemicals	Check excess according to the circuit water table	
	Check chemical dosing	
Use of unsuitable chemicals	Consult specialist firm	Operator
Acids / alkalis have leaked in via water treatment (with regeneration with acids/alkalis)	Check water treatment	
Foreign bodies entering the circuit water (oils, fats, organic matter, acids, alkalis, hardness, etc.)	Provide circuit water monitoring (conductivity, turbidity). Conductivity: acids, alkalis, hardness, sea water Turbidity: oils, fats, milk, dyes	Operator
	Higher Cu concentration in circuit water	Operator
Higher Cu concentration in circuit water	Remove components containing copper	Operator
	Keep pH value in circuit water between 9 and 10.5, see Table 2	
	Check ammonia dosage	
	Check sulphide concentration	

Observation/Fault: Corrosion in the hot water network

Damage elimination: Replacement of the corroded pipe sections

Cause	Elimination of the cause	By whom?
Oxygen ingress	Keep the system pressurised during down times.	
	Find the causes for the oxygen ingress into the system (e.g. gas-permeable plastics) and eliminate them	
	Make lines in a corrosion-resistant material	Operator
Insufficient degassing of the filling and make-up water	Testing of the thermal degassing (constant pressure and temperature, sufficient vapour volume)	
	Checking of the excess of O ₂ binder	
Outside substance ingress into circuit water (oils, greases, organic matter, acids, alkalis, hardness, etc.)	Plan monitoring of the circuit water (conductivity, turbidity).	Operator

Cause	Elimination of the cause	By whom?
	Conductivity: Acids, alkalis, hardness, seawater Turbidity: Oils, greases, milk, paints	

11 Guarantee notes

The guarantee becomes null and void:

- Use of film-forming aminos in conjunction with low-salt methods (osmosis, partial or complete desalination)
 - if dosing agents are used which are not listed in this guideline or not agreed with the manufacturer.
- if the limit values for water characteristics are not fulfilled.
- if the measured water values are not documented.

In the case of special operating requirements (e.g. reduced working pressure, high level of steam purity), the limit values must be agreed between the operator and the manufacturer.



Important! *If protective chemicals are used, the regulations laid down by the appropriate manufacturer and supplier apply exclusively. Damage to boilers caused by chemicals or faulty protective behaviour is basically not covered by the liability of the boiler construction company.*