STEAMTHERM
BOILERS PVT. LTD.
Engineering Steam Solutions for a Sustainable Future

BOILER WATER QUALITY LIMITS

Ensure Maximum Boiler Efficiency, Safety & Service Life

Maintaining proper boiler water quality is essential for efficient steam generation, preventing scale formation, minimizing corrosion, reducing fuel consumption, and extending boiler life. Poor water treatment can lead to overheating of tubes, tube failures, carryover, foaming, priming, and costly shutdowns.

The following table provides recommended water quality limits for industrial steam boilers. These are general engineering guidelines; the exact limits depend on boiler operating pressure, feedwater treatment system, and the applicable standards or manufacturer recommendations.

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1. Feed Water Quality Limits

Parameter	Recommended Value	Importance
pH	8.5 – 9.5	Prevents corrosion in feedwater system
Total Hardness (as $CaCO_3$)	0 ppm	Eliminates scale formation
TDS	<100 ppm	Minimizes concentration inside boiler
Conductivity	<150 µS/cm	Indicates dissolved salts
Dissolved Oxygen	<0.02 ppm	Prevents oxygen pitting corrosion
Iron	<0.3 ppm	Prevents deposits and tube fouling
Copper	<0.05 ppm	Reduces corrosion products
Silica	<1 ppm	Prevents turbine and steam deposits
Chloride	<30 ppm	Reduces corrosion risk
Oil & Grease	Nil	Prevents foaming and carryover

2. Boiler Water Quality Limits

Parameter	Recommended Value
pH	10.5 – 11.5
Total Hardness	Nil
TDS	2,000–3,500 ppm*
Conductivity	3,000–6,000 µS/cm*
Phosphate	20–50 ppm
Sulphite (Residual)	20–40 ppm
M-Alkalinity	300–700 ppm
P-Alkalinity	100–300 ppm
Silica	<150 ppm*
Chloride	<200 ppm
Iron	<0.3 ppm
Oil	Nil

*The allowable TDS, conductivity, and silica increase or decrease depending on boiler pressure and treatment program.

3. Condensate Water Quality

Parameter	Recommended Value
pH	8.5–9.2
Conductivity	<30 µS/cm
Iron	<0.1 ppm
Copper	<0.05 ppm
Oil	Nil
Hardness	Nil

4. Boiler Pressure vs Maximum Boiler Water TDS (General Guideline)

Boiler Pressure	Maximum TDS
Up to 10 bar	3,500 ppm
10–20 bar	3,000 ppm
20–30 bar	2,500 ppm
30–40 bar	2,000 ppm
Above 40 bar	As per treatment program and manufacturer recommendations

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5. Why Each Parameter Matters

pH

Maintains a protective alkaline environment that minimizes corrosion. Low pH causes acidic corrosion, while excessive pH can promote caustic attack.

Total Hardness

Calcium and magnesium salts create hard scale on heat-transfer surfaces. Even a thin scale layer significantly reduces heat transfer and increases fuel consumption.

Total Dissolved Solids (TDS)

High TDS increases the risk of foaming, priming, and carryover. Proper blowdown helps maintain TDS within acceptable limits.

Conductivity

Conductivity is an indirect measure of dissolved ionic impurities and is commonly used to control boiler blowdown.

Dissolved Oxygen

Oxygen is a primary cause of pitting corrosion. Mechanical deaeration combined with oxygen scavengers is commonly used to control it.

Silica

Silica can be carried with steam and form hard deposits on superheaters, turbines, valves, and process equipment, especially in higher-pressure systems.

Phosphate

Internal phosphate treatment helps keep hardness-forming salts in suspension so they can be removed by blowdown.

Sulphite

Residual sulphite reacts with dissolved oxygen, helping prevent oxygen corrosion in low- and medium-pressure boilers.

Chlorides

High chloride concentrations increase the risk of corrosion and indicate excessive concentration of dissolved salts.

Oil & Grease

Oil contamination reduces heat transfer, causes foaming, and can lead to tube overheating and failure.

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6. Common Problems Caused by Poor Water Quality

Water Quality Issue	Possible Effect
High Hardness	Scale formation
Low pH	Acid corrosion
High pH	Caustic corrosion
High TDS	Foaming and steam carryover
High Oxygen	Pitting corrosion
High Silica	Turbine and steam deposits
High Oil	Tube overheating
High Chlorides	Corrosion
Low Phosphate	Hard scale formation
Poor Blowdown	Reduced efficiency

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7. Best Practices

- Test feedwater and boiler water regularly.
- Maintain proper blowdown to control TDS.
- Use a correctly sized water softener or demineralization plant where required.

- Remove dissolved oxygen using a deaerator and suitable oxygen scavengers.
- Monitor chemical dosing continuously.
- Recover clean condensate wherever practical.
- Calibrate water quality instruments at recommended intervals.
- Keep detailed records of water test results and chemical treatment.

Engineering Note

The values above are intended as **general guidance for industrial steam boilers**. Final operating limits should be established based on the **boiler operating pressure, water chemistry, feedwater treatment system, applicable standards (such as ASME guidance), and the boiler manufacturer's recommendations**. For high-pressure boilers, more stringent water quality control is typically required.