

BS **DEAERATORS**



Spray-type Deaerators



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Spray-Type Feedwater Tanks – Best-in-Class Design, Proven Worldwide

The spray-type deaerator in its one-vessel configuration represents a uniquely established and highly efficient solution within the deaeration industry. Decades of reliable and adaptable operation have positioned this design as a benchmark across global power generation and industrial applications. Its widespread adoption reflects consistent satisfaction among plant operators and EPC contractors alike. Driven by continuous engineering refinement and a high degree of configurability, BS Deaerators

offers this advanced system across multiple delivery models. These include complete design and engineering packages with process guarantees and proprietary spray technology for pressure vessel manufacturers, full turnkey supply for EPC contractors - with or without auxiliary instrumentation - and comprehensive solutions for end users, ranging from complete vessel replacements to retrofits and spare parts for existing installations.

Operating principle

The spray-type deaerator operates based on fundamental physical principles of gas removal, executed in a highly efficient two-stage process:

1. Pre-Deaeration (Spray Zone)

Incoming water is finely atomized within the steam space using a high-performance spraying system. This process ensures rapid heating of the droplets to saturation temperature while simultaneously maximizing the interfacial area for mass transfer. Under these conditions, the solubility of oxygen in water approaches zero, enabling efficient release of dissolved gases into the surrounding steam phase.

As steam condenses onto the water droplets, localized oxygen concentration in the steam phase increases. This enables the controlled venting of a small steam flow with elevated oxygen content, ensuring effective removal of non-condensable gases.

2. Final Deaeration (Storage Tank)

In the second stage, residual gases are removed within the water storage section by introducing steam below the water level. Depending on plant conditions, superheated steam, saturated steam, pressurized hot water, or mixed-phase flows can be utilized.

A precisely engineered steam distribution system - comprising optimized injection pipes and flow-directing baffle arrangements - ensures ideal hydrodynamic conditions. This promotes intimate contact between steam and water, allowing remaining oxygen to transfer into the steam phase in accordance with Henry's law, thereby completing the deaeration process with high efficiency.

Design Flexibility and Operating Range

BS spray-type deaerators are designed for maximum operational flexibility, covering a wide range of process conditions:

- **Operating Pressure:** from 0.2 bar to 15 bar
- **Temperature Difference (ΔT) between condensate inlet and feedwater outlet:** typically 10°C to 30°C, depending on inlet condensate conditions
- **Steam Consumption:** scalable with ΔT , allowing optimization between energy input and performance

There is no strict upper limit for temperature difference; however, higher ΔT values will proportionally increase steam demand required to heat the incoming water to operating conditions.

Pressure Regimes

BS Deaerators are engineered to operate reliably across all relevant pressure regimes, including:

- **Positive pressure (overpressure) systems**
- **Atmospheric operation**
- **Vacuum conditions**
- **Sliding-pressure operation for dynamic load profiles**



Key Benefits

BS spray-type deaerators deliver industry-leading performance, setting new standards in efficiency and operational reliability. Compared to tray-type systems, steam losses are reduced by up to **90%**, significantly improving overall plant energy balance.

The system consistently achieves residual oxygen levels **well below 7 ppb**, ensuring optimal protection of downstream boiler systems and extending equipment lifetime.

Operational flexibility is a core strength of the design. The system maintains stable and efficient performance across wide load variations, with a **water-side turn-down ratio of up to 1:10** and a **steam-side turn-down ratio of up to 1:30**, enabling reliable operation even under highly dynamic process conditions.

Low Operating Costs

The BS spray-type deaerator is engineered for minimal operational expenditure without compromising performance. The highly efficient physical deaeration process eliminates the need for chemical oxygen scavengers, reducing both chemical costs and environmental impact.

Furthermore, the design does not require a vent condenser, simplifying system configuration and lowering both capital and maintenance costs. With a minimized number of critical components, spare parts requirements are kept to an absolute minimum, contributing to reduced inventory and maintenance effort.

Proven Simplicity and Long-Term Reliability

BS spray-type deaerator represents a mature and highly reliable technology. Its **single-vessel design** significantly reduces complexity and delivers tangible cost advantages throughout the project lifecycle.

This streamlined configuration results in savings across multiple areas, including:

- Transportation and logistics
- Structural steel and support requirements
- Installation and erection
- Insulation and instrumentation
- Maintenance and servicing

Designed for durability, BS deaerators offer an **operational lifetime exceeding 30 years**, ensuring long-term performance stability and an excellent return on investment. Technical comparison table between spray-type and conventional tray-type designs:



Design comparison	Tray-type 	Spray-type 
Layout	• Two vessels on top of each other, top-tank either horizontally or vertically aligned • Two vessels need to be constructed, isolated, transported, platformed, erected.	• Low build (single vessel) • Easy erection, easy platform design, minimal isolation material, minimal piping
Operation	• The operating range is 25%-100% • Pressure differences between top-tank and bottom-tank can arise	• Operating range is 10%-100% • No possibilities for pressure differences in one tank
Safety & Control	• Earthquake resistance not optimal with high build and two tanks sitting on top of each other	• Earthquake resistance optimal in one vessel, also suitable for on-ship installations • Control and safeguarding very simple. The amount of steam let in regulates pressure and temperature
Vibration	• Vibration problems often occur due to high steam velocities in the confined space of the top-tank.	• Steam velocities can be kept lower with the expansion in the full feedwater tank
Maintenance requirements	• Trays and small spray valves need to be inspected and regularly replaced	• No replacement parts besides gaskets for inspection openings for 30 years of lifetime. Inspections can be done easily by lifting the sprayer out of the vessel from the top.
Materials	• Stainless steel top tank, carbon steel bottom tank	• Only carbon steel tank needed
Venting	• High rate of steam loss, vent condenser required	• Minimal rate of steam loss, vent condenser not required (spray compartment functions as internal vent condenser)



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BS Deaerators offers a wide range of deaerator solutions that are carefully designed to meet the various needs of clients that include power stations, industrial facilities, and engineering firms. We can expertly lead you to the ideal deaerator system that helps ensure longevity and efficiency for your water-steam cycle because we have experience with the best designs in the world.

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