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**NATIONAL STANDARD OF THE
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GB/T 16507.3-2022

Replacing GB/T 16507.3-2013

Water-tube boilers - Part 3: Structure design

水管锅炉 第3部分：结构设计

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1 Scope

GB/T 16507.3-2022 is the Chinese national standard on water-tube boilers - part 3: structure design, in the field of energy and heat transfer engineering. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 9 March 2022 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 October 2022. Classification: ICS 27.060.30, CCS J98. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the requirements for the structure design of water-tube boiler drum, start-up (steam water) separator, water storage tank, header, desuperheater, piping, water-cooling wall, superheater, reheater, coal economizer, pipe joint, suspender, opening,

door hole, rigid beam, steel structures, escalator and platform. This document is applicable to the structural design of water-tube boilers defined in GB/T 16507.1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 985.1, Recommended joint preparation for gas welding, manual metal arc welding, gas-shield arc welding and beam welding

GB/T 985.2, Recommended joint preparation for submerged arc welding

GB/T 2900.48, Electrotechnical terminology of boilers

GB 4053 (all parts), Safety requirements for fixed steel ladders and platform

GB/T 16507.1, Water-tube boilers - Part 1: General requirements

GB/T 16507.2, Water-tube boilers - Part 2: Materials

GB/T 16507.4, Water-tube boilers - Part 4: Strength calculation of pressure parts

GB/T 22395, Specification for design of boiler steel structures

JB/T 6734, Calculation method of strength of boiler fillet welding seam

JB/T 6735, Calculation method of strength of boiler hanger rod

3 Terms and definitions

The following terms and definitions defined in GB/T 2900.48 and GB/T 16507.1 apply to this document.

4 Basic requirements

4.1 The basic principles of boiler design shall comply with the provisions of GB/T 16507.1.

4.2 During the design, the calculation loads to be considered and the load calculations to be performed shall be determined according to the provisions of this document and the special requirements of GB/T 16507.1 and GB/T 16507.4.

4.3 The design shall ensure that the wall temperature of the element does not exceed the allowable temperature of the material used. In addition, factors such as the temperature difference between the inner and outer walls of the tube on the heating surface and the inner wall's resistance to steam oxidation must also be considered. The selection of materials shall meet the requirements of GB/T 16507.2.

4.4 During the design, the minimum required thickness of the pressure elements shall be determined according to the relevant strength calculation formula or stress analysis calculation formula and regulations in GB/T 16507.4. For non-pressure element bearing loads, their calculation dimensions shall be determined in accordance with relevant regulations.

4.5 The design shall ensure that the evaporation heating surface, superheater, reheater and coal economizer system work reliably under the expected operating conditions. Ensure stable hydrodynamic properties. Prevent heat transfer from deteriorating.

4.6 The structure of the furnace, cladding wall and tail flue shall have sufficient bearing capacity. Prevent permanent deformation and furnace wall collapse. There shall be good sealing.

4.7 The expansion coefficient of the flat steel in the membrane wall structure shall be similar to that of the pipe. The determination of the width of the flat steel shall ensure that the allowable temperature of the material is not exceeded during the operation of the boiler. The weld structure shall ensure the effective cooling of the flat steel.

4.8 The load-bearing structure shall have sufficient strength, rigidity, stability and corrosion resistance when bearing the design load.

4.9 The furnace wall shall have good heat insulation and sealing.

4.10 The design of each component shall ensure that it can expand freely according to the design predetermined direction during operation. The expansion center determined in the design of the suspended boiler proper shall be fixed. An expansion guiding device shall be provided to ensure that the furnace body expands in a predetermined direction. For boilers with a rated pressure of not less than

9.8 MPa, when the equipment and fixed structure cannot withstand instantaneous loads such as safety valve discharge reaction force and earthquake force, damping devices shall be installed at appropriate under various startup modes.

4.20 When the DC power station boiler adopts an external start-up (steam-water) separator to start the system, the working pressure of the isolation valve shall be determined according to the design pressure under the maximum continuous load. The strength of the start-up (steam-water) separator is designed and calculated according to the design parameters of the boiler's minimum DC load. When the built-in start-up (steam-water) separator is used to start the system, the strength of each component shall be calculated according to the design parameters of the maximum continuous load of the boiler.

4.21 For control circulation boilers, low circulation ratio boilers and supercritical pressure composite circulation boilers, the layout of the boiler water circulation pump (starting circulation pump) and its inlet pipes shall prevent vaporization of the working medium in the pipe and at the pump inlet.

4.22 The pipe clamps, hangers, and clamping pipes on the heating surface shall be set reasonably and reliably. Prevent overheating, burning, straining and causing pipes to collide and rub against each other.

5 Solder connection requirements

5.1 The strength calculation of boiler fillet welds shall comply with the provisions of JB/T 6734.

5.2 The main welds of pressure elements and their adjacent areas shall avoid welding accessories as much as possible. If it is unavoidable, the weld of welding accessories may pass through the main weld but shall not terminate in the main weld and its adjacent area.

5.3 The distance (L) between the centerlines of the butt welds on the pipes on the heating surface of the boiler (except dissimilar steel joints) and the straight sections of the pipes shall meet the following requirements:

- a) The outer diameter is less than 159mm, $L \geq 2$ times the outer diameter;
- b) The outer diameter is not less than 159mm, $L \geq 300$ mm. When the boiler structure is difficult to meet the above requirements, the heat-affected zones of the butt welds shall not overlap, and $L \geq 50$ mm.

5.4 The butt welds of pipes on the heating surface (except for coiled pipes and formed pipe fittings) shall be located on the straight section of the pipe. The distance from the center line of the butt weld of the pipe on the heating surface to the outer wall of the drum and header, the starting point of the pipe bending, and the edge of the pipe support is at least 50mm. For boilers with a rated working pressure of not less than 3.8MPa, the distance shall be at least 70mm (except for dissimilar steel joints limited by the structure).

5.5 The longitudinal and circumferential butt welds of the drum, start-up (steam-water) separator, water storage tank, header, pipe and pipe, and the splicing weld of the head shall adopt a full penetration structure.

5.6 The longitudinal welds of two adjacent drum sections on the drum (except for those with unequal wall thickness), and the splicing welds of the head and the longitudinal welds of adjacent drum sections shall not be connected to each other. The distance between the centerlines of the welds (external arc length) shall be at least 3 times the thickness of the thicker steel plate, and not less than 100mm.

5.7 For a boiler drum formed by pressing and welding two steel plates with unequal wall thickness, the longitudinal joints of two adjacent drum sections are allowed to be connected. However, the intersection of welds shall be qualified by radiographic inspection.

5.8 Generally, the centerlines of the steel plates on both sides of the longitudinal and circumferential seams of the drum shall be aligned. When the thickness of the steel plates