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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 27698.3-2023

Replacing GB/T 27698.3-2011

**Test methods for the performance of heat exchangers and heat
exchange elements - Part 3: Heat exchanger elements**

热交换器及传热元件性能测试方法 第3部分：传热元件

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1 Scope

China's national standard for testing the performance of the elements from which heat exchangers are built. It is Part 3 of GB/T 27698 and describes the test methods, the test conditions, the measurement parameters, the test procedures, the processing of test data and the requirements for the test report, applying to heat transfer tubes and tube bundles and to heat transfer plate bundles. The distinction between this part and Part 2 is the distinction between a component and a product, and it exists because the two are bought

by different people for different reasons. A plant buys a heat exchanger and cares what it transfers as installed. An exchanger manufacturer buys tubes and plates, and needs to know what the surface itself does - because that is what it will build into a unit whose geometry, passes and baffling it is still designing. A finned or enhanced tube sold on a heat transfer enhancement factor is being sold on exactly this kind of measurement. The part also carries the vapour-gas condensation test in full, with its own test system, instrumentation, conditions, measurement parameters, procedure and data processing. Condensation in the presence of a non-condensable gas is a different problem from condensation of a pure vapour: the gas accumulates at the interface as the vapour condenses and forms a barrier that the vapour must diffuse through, and the heat transfer coefficient falls by an order of magnitude for a few per cent of air. Any surface intended for a condenser that may contain air has to be characterised under that condition rather than in clean steam. Issued and in force since 7 September 2023, it replaces GB/T 27698.3-2011 and GB/T 27698.5-2011.

This document describes the test methods, test conditions, measurement parameters, test procedures, test data processing and test report requirements for heat transfer elements used in heat exchangers. This document applies to the performance test of heat transfer tubes and tube bundles, and heat transfer plate bundles for heat exchangers.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1236, Industrial fan - Performance testing using standardized airways

GB/T 27698.1, Test methods for the performance of heat exchangers and heat exchange elements - Part 1: General requirements

GB/T 27698.2, Test methods for the performance of heat exchangers and heat exchange elements - Part 2: Heat exchangers
NB/T 47007, Air-cooled heat exchangers

3 Terms and definitions

For the purpose of this document, the following terms and definitions, as well as those given in GB/T 27698.1, GB/T 27698.2 and NB/T 47007 apply.

3.1 test sample Heat transfer elements for testing heat transfer performance and flow properties. 3.2

5.3 Heat transfer plate bundles When testing the heat transfer plate bundles, the product model and the following parameters shall be clearly stated:

- a) Plate corrugation form (corrugation angle, corrugation depth, corrugation spacing, mixing angle);
- b) Plate geometric dimensions (length, width, corner hole diameter, longitudinal and transverse center distance);
- c) Heat transfer area of a single plate;
- d) Spacing between plates;
- e) Flow channel cross-sectional area;
- f) Plate thickness;
- g) Plate material;
- h) Number of plates.

6 Vapor-liquid and liquid-liquid performance tests

When conducting vapor-liquid condensation performance test, vapor-liquid flow boiling and evaporation performance test, pool boiling heat transfer performance test and liquid-liquid no-phase-change performance test on heat transfer tubes and tube bundles, as well as heat transfer plate bundles, the heat exchange elements should be made into shell-and-tube, tubular or plate-and-shell heat exchanger test samples, and the tests and data processing should be carried out in accordance with the provisions of GB/T 27698.1 and GB/T 27698.2.

7 Vapor-gas condensation test method

7.1 Test system The test device consists of two parts: the air system and the stream system. The air system shall have a pretreatment section and a measuring section. The pretreatment section shall ensure that the air reaches a stable state suitable for testing. The wind speed measuring section of the air system shall ensure a certain length of straight tube section to meet the requirements for the use of the measuring instrument. To ensure stable air flow through the test sample, the length of the working section of the air duct shall not be less than

1.5 m. There is no uniform regulation for the cross-sectional width within the working section of the air duct, but the air mass flow rate at the effective venting area shall meet the test requirements. The test system is shown in Figure 1. 2 - exhaust valve; 3 - liquid level gauge; 4 - condensate tank; 5 - trap; 6 - subcooler; 7 - regulating valve; 8 - weighing device; a - temperature measuring point; b - pressure measuring point. Figure 2 - Schematic diagram of condensate flow measurement system

7.3.1.2 The air flow rate can be measured by an anemometer, whose installation and operation procedures shall be carried out according to the instruction manual; it can also be

measured by an orifice plate or a Pitot static pressure tube, where the measurement method shall comply with the provisions of GB/T 1236.

7.3.2 Temperature measurement

7.3.2.1 The working end of the temperature measuring element shall be located at the center of the pipeline or working section cross section, and its insertion depth shall not be less than the pipeline radius or the center of the working section cross section. When measuring in a narrow pipeline, a measuring section can be installed and the working end of the temperature measuring element shall be opposite to the flow direction.

7.3.2.2 The temperature measuring element shall be set at the specified position of the measuring section (see Figure 1), and the pipeline and air duct shall be well insulated. The upstream (inlet) and downstream (outlet) range of 600 mm of the temperature measuring point shall also be insulated.

7.3.2.3 The air inlet and outlet temperatures shall only be measured as dry bulb temperature. There should be no less than three temperature measurement points on each testing section, and the average value should be taken.

7.3.3 Pressure measurement

7.3.3.1 Steam pressure and air pressure shall be measured using a standard pressure gauge or a pressure transmitter. The installation and operation procedures shall be carried out in accordance with the instruction manual.

7.3.3.2 The ambient atmospheric pressure shall be measured using a mercury barometer. The installation and operation procedures shall be carried out in accordance with the instruction manual.

7.3.3.3 The air pressure measuring hole in the air duct shall be perpendicular and flush with the inner surface of the air duct; all internal protrusions shall be removed; the edge of the hole shall be rounded; the diameter of the hole shall not be less than

1.5 mm and not more than 5 mm.

7.3.3.4 The air pressure measuring holes in the air duct shall be set on the section about 0.5 m away from the test sample. Four pressure measuring holes should be set on each pressure measuring section of the rectangular channel, and the measuring holes should be distributed at the centers of the four sides of the section.

7.3.4 Humidity measurement

7.3.4.1 For laboratory humidity measurement, wet and dry bulb hygrometer, hair hygrometer, capacitance hygrometer or resistance hygrometer should be used.