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

GB/T 45027-2024

Valves for liquid hydrogen - General specification

液氢阀门 通用规范

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1 Scope

GB/T 45027-2024 is the Chinese general specification for liquid hydrogen valves. At minus 253 degrees Celsius almost nothing behaves as it does at room temperature: elastomers are useless, most steels are brittle, the metal contracts enough to change every clearance, and hydrogen itself is small enough to leak through what would stop any other gas. A liquid hydrogen valve is therefore a distinct engineering object, not a cryogenic valve with a different label. The standard sets the classification and designation, the requirements on the materials at cryogenic temperature, the design and structural requirements including the extended bonnet and the vacuum jacket, the requirements on the seat and stem sealing and on leak tightness in both directions, the pressure and temperature ratings, the flow characteristics, the cleanliness requirements for hydrogen service, the operating torque and endurance, the test methods including the cryogenic and helium leak tests, the inspection rules and the marking, packaging, transport and storage. For a valve maker, a hydrogen

plant builder or an operator in China, this is the acceptance text.

This document specifies the technical requirements, test methods, inspection rules, marking, packaging, storage and transportation requirements for valves for liquid hydrogen (hereinafter referred to as "valves"). This document is applicable to globe valves, check valves, ball valves, pneumatic control valves and fusible cut-off emergency shut-off valves for liquid hydrogen with nominal pressure not exceeding PN160, pressure grade not exceeding Class900, insulated by vacuum jacket and connected by welding.

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 version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 150.4, Pressure vessels - Part

3 Terms and definitions

Terms and definitions determined by GB/T 21465 and the following ones are applicable to this document.

3.1 maximum allowable working pressure The maximum pressure that the valve pressure-bearing parts are allowed to withstand when the medium temperature is $-20\text{ }^{\circ}\text{C}$ ~ $38\text{ }^{\circ}\text{C}$.

Note. The maximum allowable working pressure is the lowest value among the maximum allowable working pressures of all pressure-bearing parts of the valve.

3.2 rated minimum temperature The minimum operating temperature of the valve.

3.3 body extension The valve body structure that is appropriately lengthened between the connection end of the valve body and the valve cover.

4.1 Basic requirements

4.1.1 In addition to complying with the requirements of this document, valves shall also comply with the requirements of relevant product standards such as GB/T 4213, GB/T 12235, GB/T 12236, GB/T 12237 and GB/T 24918-2010.

4.1.4 For valves with vacuum jacket structure, the design pressure of the jacket shall not be less than the discharge pressure set by the vacuum jacket explosion-proof device of the pipeline system, and the design external pressure shall not be less than

0.1 MPa.

4.1.5 Double-seat valves shall be equipped with pressure relief holes or self-relieving valve seats. The pressure relief direction should be the upstream high-pressure side, and the pressure relief direction should be marked on the outside of the valve. Valves with self-relieving seat structures shall be subjected to pressure relief tests.

4.1.8 The valve structure shall not be a gate valve, but a globe valve or a ball valve may be used as the emergency shut-off valve.

4.1.9 Before assembly, all valve parts in contact with hydrogen media shall be degreased and dried. The degreasing and inspection shall comply with the requirements of HG 20202.

4.2 Materials

4.2.1 The selection of materials shall evaluate the influence of chemical properties, physical properties and process properties of the materials, as well as the compatibility with hydrogen medium, and shall comply with the provisions of GB/T 29729.

4.2.4 The material used to manufacture bellows should preferably be S31608 or S31603.

4.2.5 The metal material used for the pressure-bearing parts of the valve shall be austenitic stainless steel and shall be solution-treated. The metallographic structure of the material shall be stable, and the chemical composition analysis and room temperature mechanical properties of the material shall comply with the requirements of the corresponding material standards.

4.2.8 The parts of the valve that come into contact with the liquid hydrogen medium in the working state (such as the valve body, valve disc, ball, valve seat, valve stem, etc.) shall be subjected to cryogenic treatment for no less than 2 times before finishing.

4.2.11 When non-metallic materials are used as valve insulation materials, they shall be compatible with oxygen and shall comply with the requirements of GB/T 31481.

4.3 Structural design

4.3.1 Structural type The schematic diagrams of typical valve structures are shown in Figures 1 ~ 7.

4.4 Room temperature performance

4.4.1 Shell strength Shall comply with the requirements of

7.1 of GB/T 13927-2022.

4.4.2 Sealing performance at room temperature The sealing performance of the valve at room temperature shall comply with the provisions of Table 3, and the normal temperature valve seat sealing performance of the pneumatic control valve shall comply with the provisions of Table 4.

5 Test methods

Warning When conducting pressure tests, it is necessary to evaluate the safety of the test gas or liquid pressure and the emission of hydrogen; when conducting low-temperature performance tests, it is necessary to evaluate the safety of the test medium, test system, test environment, and the safety protection of the test operators.

5.1 Test conditions

5.1.1 Test environmental conditions Normal temperature performance test environmental conditions. temperature is $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$; relative humidity is 20% ~ 80%.

5.1.2 Test medium The test medium shall comply with the following requirements.

5.1.3 Instruments and apparatuses Measuring instruments, meters, gauges and other equipment shall be within the validity period of verification or calibration, and the measurement accuracy shall comply with the requirements of Table 6.

5.2 Materials

5.2.1 Chemical composition analysis The processed surface on the pressure-bearing material body or on the test bars of the same batch shall be analyzed by spectral analysis, or powder sampled for chemical analysis. Each batch of materials for main pressure-bearing parts (with the same furnace number, same manufacturing process, and same heat treatment conditions) shall be inspected at least once.

5.5.1.1 Perform shell test on the test valve in accordance with the method specified in

6.1 of GB/T 13927-2022.

6 Inspection rules

6.1 Factory inspection Valves shall be inspected one by one before leaving the factory and can only leave the factory after passing the inspection. Factory inspection items shall comply with the requirements of Table 11.

6.2 Type test

6.2.1 Type test shall be carried out in any of the following cases.

6.2.2 Type test items shall comply with the requirements of Table

11. Mass production can only be carried out after all type test items are qualified.