



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

GB/T 45161-2024

**Technical specification of safety valves for liquid hydrogen
vessels**

液氢容器用安全阀技术规范

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1 Scope

GB/T 45161-2024 is the Chinese specification for safety valves on liquid hydrogen vessels. Liquid hydrogen sits at about minus 253 degrees Celsius, and any heat that reaches it turns to gas: a liquid hydrogen vessel is therefore always venting, and the safety valve is not a last-resort device but a component in continuous duty at a temperature at which ordinary valve materials and seals do not work. The standard sets the classification and designation, the requirements on the materials at cryogenic temperature, the design and structural requirements, the set pressure, the discharge capacity and the reseating requirements, the leak tightness, the requirements on the seat and the seal, the low temperature performance and the cycling requirements, the test methods including the cryogenic tests, the inspection rules and the marking, packaging, transport and storage. As China builds out hydrogen infrastructure this becomes a gating component. For a valve maker, a vessel builder or a hydrogen operator in China, this is the text the valve is accepted against.

This document specifies the technical requirements, test methods, inspection rules, marking, painting, packaging, transportation and storage of safety valves for liquid hydrogen vessels. This document is applicable to safety valves (including spring-loaded safety valves and pilot operated safety valves) for liquid hydrogen vessels with a nominal size of not greater than DN200, a set pressure of not less than

0.1 MPa, a temperature of not less than -254 °C, and the medium being single-phase liquid hydrogen boil-off gas.

2 Normative references

The provisions of the following documents constitute the essential clauses of this document through normative references in this text. Among them, for referenced documents with dates, only the versions corresponding to the dates are applicable to this document; for referenced documents without dates, the latest versions (including all amendments) are

applicable to this document.

GB/T 229 Metallic materials - Charpy pendulum impact test method

GB/T 12224 General requirements for industrial steel valves

GB/T 12241 Safety valves - General requirements

GB/T 12242 Pressure relief devices - Performance test code

GB/T 12243 Spring loaded safety valves

GB/T 13305 Method for determining content of the alpha-phase in stainless steels

GB/T 22652 Overlaying-welding procedure qualification for valves sealing face

GB/T 24499 Technology glossary for gaseous hydrogen, hydrogen energy and hydrogen energy system

GB/T 24921.1 Sizing, selection and installation of pressure relieving valves for petrochemical industries - Part

1. Sizing and selection rating of the valve body material, the design pressure shall be determined based on the lower value.

4.1.3 The end connection of the safety valve shall comply with the provisions of

GB/T 12241. If the purchaser has special requirements, the safety valve can be designed and manufactured in accordance with the procurement technical agreement while ensuring the performance and safety of the safety valve.

4.1.4 Before assembly, all parts shall be cleaned, degreased and dried according to the methods specified in HG 20202, and the results shall comply with the inspection requirements of HG 20202.

4.2 Design requirements

4.2.1 Temperature adaptability Within the predetermined pressure range, the safety valve shall be able to operate normally within the range from the required minimum temperature to 65 °C.

4.2.2 Set pressure The set pressure of the safety valve shall be less than or equal to the difference between its design pressure and the overpressure (set pressure $\leq$ design pressure - overpressure), and should not exceed the specified values in Appendix B and Appendix C of GB/T 24920-2010.

4.2.3 Safety valve shell

4.2.3.1 Safety valves shall be designed to discharge liquid to avoid accumulation of liquid in the valve, unless otherwise specified in the procurement technical agreement.

4.2.3.2 The safety valve shell shall have sufficient strength to ensure that no harmful deformation occurs during strength tests and working conditions. It shall be able to withstand the total load of stress caused by medium pressure and temperature changes, additional stress caused by connecting pipes, and comprehensive stress caused by operating conditions for a long time.

4.2.3.3 When the safety valve is discharging, avoid the accumulation of solid matter in the valve body or at the outlet due to temperature drop, which may cause malfunction.

4.2.3.4 The shell thickness shall comply with the requirements of GB/T 26640.

4.2.4 Guide device

4.2.4.1 The design of the guide device shall ensure the normal operation of the safety valve and avoid the deposition and freezing of moisture in the atmosphere that may cause malfunction.

4.2.4.2 The structure of the guide device shall be strong enough to ensure its effectiveness during normal handling and operation.

4.2.5 Sealing of valve disc and valve seat

4.2.5.1 The sealing surface of the valve disc and the valve seat shall be designed to be metal-to-metal or metal-to-non-metal. When metal-to-non-metal sealing is used, a secondary metal sealing structure should be designed on the non-metallic sealing side; non-metallic sealing (such as pure PTFE and other materials) shall have sufficient support to prevent sealing failure caused by cold flow deformation of the material.

4.2.5.2 The connection between the non-metallic seal and the valve disc or valve seat shall be mechanically fixed and locked.

4.2.5.3 When the hard alloy is overlaid on the sealing surface of the valve disc and valve seat, the requirements of GB/T 22652 shall be met.

4.2.6 Anti-static The safety valve shall be designed with an anti-static structure to ensure that the shell, opening and closing parts, valve stem and other components are conductive, and the maximum resistance of the discharge path does not exceed 5 Ω .

4.2.7 Vibration and impact Safety valves used for mobile vessels shall, if necessary, be designed to be resistant to vibration and impact (drop) according to the requirements of the installed vessel, and their performance shall not change after vibration and impact (drop) tests.

4.3.1 Normal temperature performance requirements

4.3.1.1 Shell strength 4.3.1.1.1 The shell strength shall comply with the requirements of GB/T 12241 and