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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 24159-2022

Replacing GB 24159-2009

Welded insulated cylinders

焊接绝热气瓶

Issued on: July 11, 2022 **Implemented on: February 1, 2023**

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1 Scope

China's national standard for welded insulated cylinders - the vacuum-insulated vessels that hold cryogenic liquids. It specifies the classification, the materials, the design, the manufacture, the inspection and testing, the marking and the documentation for welded insulated gas cylinders. These are the portable dewars in which liquid oxygen, nitrogen, argon, carbon dioxide and liquefied natural gas are transported and used: an inner pressure vessel holding liquid at cryogenic temperature, an outer shell, and between them a vacuum with multilayer insulation. Two facts govern the design. The first is that the contents are hundreds of degrees below ambient and boil continuously - insulation slows the heat leak but never stops it, so the pressure rises whenever gas is not being drawn, and the cylinder must vent. A cryogenic cylinder is therefore a pressure vessel that is designed to leak, and the pressure relief arrangement is not a safety accessory but the normal operating mechanism, with a second independent device behind it. The second is the vacuum, which is the insulation: if it is lost, the heat leak rises by orders of magnitude, the contents boil violently and the relief has to handle a flow far beyond the normal case - which is the sizing condition for the relief system. Around those sit the material requirements, since only certain steels and aluminium alloys retain toughness at these temperatures and the inner vessel is austenitic for that reason; the welding and its examination; the vacuum performance and the static evaporation rate, which is the measure of insulation quality and the number a user is actually buying; the design pressure and the hydrostatic test; the valves and fittings; and the periodic inspection over the cylinder's life. Issued on 11 July 2022 and in force since 1 February 2023, it replaces GB 24159-2009.

This document specifies the symbols for welded insulated gas cylinders (hereinafter referred to as "cylinders"). It specifies cylinder model naming methods, basic parameters, materials, design, manufacturing, test methods, inspection rules, type test, marking, packaging, transportation, exit-factory data, data preservation and other requirements. This document is applicable to the refillable cylinders that are used under normal ambient temperature (-40°C~60°C), are used to store liquid oxygen, liquid nitrogen, liquid argon of which the nominal volume range is 10L~1000L, the nominal volume of LNG ranges from 150L to 1000L, that the design temperature is not higher than -196°C, and the nominal working pressure is 0.2MPa~3.5MPa. For cylinders storing liquid carbon dioxide and liquid nitrous oxide, the manufacture and inspection can be carried out with reference to this document. NOTE. All pressures not stated in this document refer to gauge pressure.

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 228.1, Metallic materials - Tensile testing - Part

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 12241, GB/T 13005, GB/T 16918, GB/T 18442.1, GB/T 18442.3, GB/T 18443.2, GB/T 18517, GB/T 26929, GB/T 33209 and GB/T 33215 as well as the followings apply.

3.1 lot/batch A quantity of product (or inner vessel) composed according to the same rules.

3.2 tare of cylinder The mass of the empty cylinder (for horizontal gas cylinder, it includes frame or support) that meets the basic functions of filling, storage, transportation, use and safety.

3.3 effective volume The maximum volume of liquid that the cylinder is allowed to fill.

3.4 heat transfer coefficient The amount of heat that can be transferred between hot and cold fluids in unit area, unit temperature difference, unit time, representing the strength of the heat transfer process.

3.5 free air Air at an absolute pressure of 1.01325x105 Pa and a temperature of 15.6°C.

4 Symbols

The following symbols apply to this document. Di. Inner diameter of head or cylinder body, mm. D

0.Outer diameter of head or cylinder body, mm. E

0.Elastic modulus of the material, MPa. g. Acceleration of gravity, g=9.81m/s2. Hi. Inner height of head, equal to the sum of the depth of the inner surface of the head and the height of the straight edge of the head, mm. hi. Depth of the inner surface of the head, mm. h

0.Total height of the outer surface of the head, h0=hi+Sn; mm. k

1.Coefficient determined by the ratio of the major and minor axes of the ellipse. L. Sum of the length of the cylinder, the height of the straight side of each head, and 1/3 of the depth of the inner surface, mm. P. Nominal working pressure, MPa. Pb. Design burst pressure of rupture disc, MPa. Sh. Minimum wall thickness of the head after forming, mm. Sn. Nominal wall thickness, mm. sigma. Wall stress, MPa. DeltaHi. Height tolerance inside the head, mm.

DeltapiDi. Tolerance of the inner circumference of the head, mm.

5 Model naming methods and basic parameters

5.1 Model naming methods Vertical type is represented by "DPL". Horizontal type is represented by "DPW". The rest are named according to the method specified in GB/T 15384.When the design is changed, Roman numerals I, II, III, etc. can be added at the end of the model as serial numbers.

5.2 Basic parameters

5.2.1 Nominal volume and inner diameter of inner vessel The nominal volume and inner diameter of the inner vessel shall be selected according to Table

1.The nominal volume shall be an integer multiple of 5.

5.2.2 Pressure

5.2.2.1 The pressure used in the calculation of the internal pressure of the wall thickness of the inner vessel is the design pressure. The design pressure is the pressure test pressure of the inner vessel. The pressure of withstand voltage test of the inner vessel shall not be less than 2 times the nominal working pressure (Pd=Pt>=2P).

6.1 General requirements

6.1.1 The material of the main body (cylinder and head) of the inner vessel shall be austenitic stainless steel that meets the requirements of GB/T 24511 and the requirements of the design documents.

6.1.2 The components welded on the inner vessel shall be austenitic stainless steel specified in the corresponding material standards and in accordance with the requirements of the design documents.

6.1.3 The chemical composition and tensile properties of welding materials and their deposited metals shall comply with the requirements of NB/T 47018.1 and NB/T 47018.3 as well as the requirements of design documents.

6.1.5 The outer shell shall be of austenitic stainless steel.

6.2 Chemical composition The chemical composition and allowable deviation of the main material of the inner vessel shall comply with the provisions of Table 2.

6.3 Mechanical properties The mechanical properties of the main material of the inner vessel shall comply with the provisions of Table 3 and design documents.

7.1.1 Composition