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Valves for Liquefied Dimethyl Ether Cylinders

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Valves for Liquefied Dimethyl Ether Cylinders

1 Scope

This Standard specifies the terms and definitions, model compilation, structural type and basic dimensions, technical requirements, detection and test methods, inspection rules, marking, packaging, storage and transportation of liquefied dimethyl ether cylinder valves (hereinafter referred to as valves).

This Standard applies to valves on liquefied dimethyl ether cylinders with an ambient temperature of $-40\text{ }^{\circ}\text{C} \sim +60\text{ }^{\circ}\text{C}$, a nominal working pressure of 1.6 MPa, a nominal volume of no more than 150 L, and a medium that complies with the provision of GB 25035.

This Standard does not apply to liquefied dimethyl ether cylinder valves for vehicles.

NOTE: The pressure in this Standard refers to the gauge pressure.

2 Normative Reference

The following documents are essential to the application of this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 197 General purpose metric screw threads - Tolerances

GB/T 228.1 Metallic materials - Tensile testing - Part 1: Method of test at room temperature

GB/T 1184 Geometrical tolerancing - Geometrical tolerance for features without individual tolerance indications

GB/T 1804 General Tolerances - Tolerances for Linear and Angular Dimensions without Individual Tolerance Indications

GB/T 3934 Specification of gauges for general purpose screw threads

GB/T 4423 Copper and copper alloy cold-drawn rod and bar

GB/T 5121.1 Methods for chemical analysis of copper - The electrolytic method for the determination of copper content

GB/T 5121.3 Methods for chemical analysis of copper and copper alloys - Part 3:

a) Aging resistance

Non-metallic seals shall be placed in air at a temperature of $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 72 h without cracks or obvious aging.

b) Low temperature resistance

Non-metallic seals shall be placed in air at a temperature of $-40\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ for 24 h without cracks or other damage.

c) Medium compatibility

After non-metallic seals are immersed in liquefied dimethyl ether solution at a temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 168 h, the volume expansion rate is no more than 15% or the shrinkage rate is no more than 1%, and the mass loss rate is no more than 10%.

6.2 Process requirements

6.2.1 The valve body shall be forged. The valve body surface shall be free of cracks, wrinkles, inclusions, incomplete filling and other defects that may damage the valve performance. The valve body surface shall be shot peened; and the size and depth of the surface pits shall be uniform.

6.2.2 Unspecified size tolerance specified shall be processed according to the Level-m precision in the GB/T 1804-2000 standard.

6.2.3 Unspecified geometric tolerance shall be processed according to the Level-k precision in the GB/T 1184-2000 standard.

6.2.4 The actual mass of valves of the same model, specification and trademark after assembly shall not deviate from the design mass of the valve by more than 5%.

6.3 Performance requirements

6.3.1 Opening and closing performance

Under the nominal working pressure, the opening and closing torque of the valve shall not exceed $5\text{ N} \cdot \text{m}$; and there shall be no jamming when the valve is opened or closed in the full stroke.

6.3.2 Air tightness

Under the following conditions and states, the valve leakage shall not exceed $15\text{ cm}^3/\text{h}$, or no bubbles shall be generated when immersed in water for 1 min if tested by immersion method.

a) Under nominal working pressure, closed and any open state;

b) Under 0.05 MPa pressure, any open state.

6.4 Minimum design service life

The valve shall ensure safe use of at least one cylinder inspection cycle.

7 Detection and Test Methods

7.1 General test principles

7.1.1 Test environment

Except for special requirements, the tests of this Standard are carried out at room temperature of 15 °C ~30 °C, and the test room is kept shockproof, moisture-proof, corrosion-proof and ventilated.

7.1.2 Test medium

Except for the pressure test medium which is clean tap water, other test media are pure dry air or nitrogen.

7.1.3 Test pressure gauge

The accuracy of the test pressure gauge shall be no lower than Class-1.6, and the range of the pressure gauge shall be 1.5 times to 2 times the test pressure.

7.2 Mechanical properties test and chemical composition analysis method of valve body metallic material

The tensile test specimen and test method of valve body metallic material shall be in accordance with GB/T 228.1; and the chemical composition analysis method shall be in accordance with GB/T 5121.1, GB/T5121.3 and GB/T5121.9.

NOTE: When not in arbitration, the chemical composition analysis method of metal can also be selected from electrolysis, atomic absorption, volumetric and spectroscopic methods.

7.3 Material performance test of non-metallic seals

7.3.1 Aging resistance test

Place three non-metallic seals in a test device at a temperature of 100 °C $\pm$ 2 °C for 72 h. Then take them out and visually observe their changes. The results shall comply with the provisions of 6.1.2.1.

7.3.2 Low temperature resistance test

Place three non-metallic seals in a test device at a temperature of -40 °C $\pm$ 1 °C for 24 h. Then take it out and visually inspect its changes (if the seal is an O-ring, it shall be placed on a steel mandrel with a diameter 1.2 times the inner diameter of the O-ring). The result shall comply

The inlet thread of the valve is inspected by a gauge that complies with GB/T 8336 and shall comply with the provisions of 5.3.

The outlet thread of the valve is inspected by a gauge that complies with GB/T 3934 and shall comply with the provisions of 5.4.

7.6 Mass inspection

Put the assembled valve on a balance with a sensitivity of no more than 1 g and an error of no more than one thousandth; and weigh it, which shall comply with the provisions of 6.2.4.

7.7 Opening and closing test

Install the valve on the test device; block the outlet; open the valve; fill the inlet of the valve with nitrogen or air to the nominal working pressure. Close the valve with a torque no greater than 5 N • m; and the valve shall not leak under this pressure. Then open the valve with a torque no greater than 5 N • m, and there shall be no jamming and no leakage during the full opening and closing stroke of the valve.

7.8 Air tightness test

7.8.1 Install the valve on the test device; close the valve; fill the inlet of the valve with nitrogen or air to the nominal working pressure. Immerse it in water for 1 min or place it in a leak detection device. The result shall comply with the provisions of 6.3.2a).

7.8.2 Install the valve on the test device; block the outlet; and put the valve in any open state. Fill the inlet of the valve with nitrogen or air to the nominal working pressure; immerse it in water for 1 min or place it in a leak detection device. The result shall comply with the provisions of 6.3.2a).

7.8.3 Install the valve on the test device; block the outlet; and put the valve in any open state. Fill the inlet of the valve with nitrogen or air to a pressure of 0.05 MPa; immerse it in water for 1 min or place it in a leak detection device. The result shall comply with the provisions of 6.3.2b).

7.9 Vibration resistance test

Install the valve on the test device; close the valve according to the torque specified in 6.3.1. fill the inlet of valve with nitrogen or air to the nominal working pressure; then install the test device on the vibration test bench; vibrate in any direction for 30 min at an amplitude of 2 mm and a frequency of 33.3 Hz; and then conduct an air tightness test according to the provisions of 7.8. The result shall comply with the provisions of 6.3.3.

7.10 Temperature resistance test

7.10.1 Install the valve on the test device; make the valve in any open state; block the outlet; fill the inlet of the valve with nitrogen or air to the nominal working pressure; and then place it

in a test box at $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 2 h. After taking it out, start full-stroke manual opening and closing of the valve within 30 s. After conducting for 25 times, place it in a test box at $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1 h. After taking it out, perform an air tightness test according to the provisions of 7.8 within 10 min. The result shall comply with the provisions of 6.3.4.

7.10.2 Install the valve on the test device; make the valve in any open state; block the air outlet. Fill the inlet of the valve with nitrogen or air to the nominal working pressure; then place it in a test box at $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 2 h; take it out and start full stroke manual opening and closing of the valve within 30 s. After conducting for 25 times, place it in a test box at $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1h. After taking it out, perform air tightness test according to the provisions of 7.8 within 5 min. The result shall comply with the provisions of 6.3.4.

7.11 Durability test

Install the valve on the test device; make the valve in the open state; block the outlet. Fill the inlet of the valve with nitrogen or air to the nominal working pressure; then install the test device on the durability test machine; and perform full stroke opening and closing at a rate of 8 times/min~15 times/min; and the opening and closing torque shall not exceed $5\text{ N} \cdot \text{m}$. After 30,000 full-stroke opening and closing, perform air tightness test according to 7.8. The result shall comply with the provisions of 6.3.5.

7.12 Valve body pressure resistance test

Block the valve body and the external vents (except the inlet of valve body); connect the inlet of valve body to the hydraulic pump; and fill the valve body with water to 5 times the nominal working pressure through the hydraulic pump; and maintain the pressure for 5 min. The result shall comply with the provisions of 6.3.6.

7.13 Valve body stress corrosion resistance test

The test method shall be in accordance with GB/T 10567.2; and the result shall comply with the provisions of 6.3.7.

7.14 Installation test

Fix the valve on the test device and tighten it with a torque wrench according to the installation torque specified in Table 3. The result shall comply with the provisions of 6.3.8.

7.15 Handwheel fire resistance test

The test method shall be in accordance with GB 15382; and the results shall comply with the provisions of 6.3.9.

8 Inspection Rules

8.1 Material inspection

8.1.1 Materials and parts entering the factory shall have a quality certificate.

8.1.2 The mechanical properties (R_m, A) and chemical composition (Cu, Pb, Fe) of copper materials and non-metallic seals shall be re-inspected according to the enter-factory batch number.

8.2 Exit-factory inspection

8.2.1 Piece-by-piece inspection

The piece-by-piece inspection items are as follows:

- a) Appearance inspection;
- b) Inlet and outlet thread inspection;
- c) Air tightness test.

8.2.2 Batch sampling inspection

The batch sampling inspection items are as follows:

- a) Basic dimension inspection;
- b) Quality inspection;
- c) Opening and closing test;
- d) Installation test.

8.2.3 Sampling inspection method and judgment

Valves shall be sampled from each batch (no more than 5,000 pieces) of continuously produced products that have passed the piece-by-piece inspection. When the continuous production is less than 5,000 pieces, they shall also be sampled as one batch; and 5 samples shall be taken from each batch of finished products. During the inspection process, if one valve does not meet the requirements of a certain item of this Standard, double sampling shall be conducted. If there are still unqualified items after re-testing, the batch of valves shall be unqualified or piece-by-piece inspection shall be carried out again.

8.3 Type test

8.3.1 The valve shall be subjected to type test when one of the following conditions is met:

9.2.2 The packaging box shall have the following marks:

- a) Name and address of the manufacturer;
- b) Name and model of the valve;
- c) Necessary operating requirement symbols;
- d) Quantity and gross weight;
- e) Volume (length $\times$ width $\times$ height);
- f) Production date or batch number;
- g) Standard code implemented by the product;
- h) Manufacturing license number and $\textcircled{\text{TS}}$ mark.

9.2.3 The product certificate shall indicate the following contents:

- a) Name and address of the manufacturer;
- b) Name and model of the valve;
- c) Applicable temperature and medium;
- d) Nominal working pressure and nominal diameter;
- e) Production batch number;
- f) Standard code implemented by the product;
- g) Inspection date;
- h) Design quality of the valve;
- i) Manufacturing license number;
- j) Seal of the quality department.

9.2.4 The packing list shall indicate the following contents:

- a) Name and address of the manufacturer;
- b) Name and model of the valve;
- c) Quantity, gross weight and net weight;
- d) Packer mark;

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