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Cryogenic emergency shutoff valve

低温介质用紧急切断阀

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Cryogenic emergency shutoff valve

1 Scope

This Standard specifies the terminology, technical requirements, test methods, inspection rules, appearance, marking and supply requirements of cryogenic emergency shutoff valve (hereinafter referred to as emergency shutoff valve).

This Standard applies to nominal dimensions DN 15 ~ DN 200, nominal pressure PN 16 ~ 63, operating temperature -196 ℃ ~ -29 ℃, emergency automatic cut-off temperature 70 ℃ ± 5 ℃, and using low-temperature media of oxygen, nitrogen, argon, natural gas, ethylene (O_2, N_2, Ar, CNG, C_2H_4) and other gases and liquids.

2 Normative references

The terms in the following documents become the terms of this Standard by reference to this Standard. For dated references, all subsequent amendments (not including errata content) or revisions do not apply to this standard. However, parties to agreements that are based on this Standard are encouraged to study whether the latest versions of these documents can be used. For undated references, the latest edition applies to this Standard.

GB/T 229, Metallic materials - Charpy pendulum impact test method (GB/T 229-2007, ISO 148-1:2006, MOD)

GB/T 1047, Pipework components - Definition and selection of nominal size (GB/T 1047-2005, ISO 6708:1995, MOD)

GB/T 1048 Pipework components - Definition and selection of nominal pressure (GB/T 1048-2005, ISO/CD 7268:1996, MOD)

GB/T 1220, Stainless steel bars

GB/T 1222, Spring steels

GB/T 4240, Stainless steel wires (GB/T 4240-1993, neq JIS G4309:1988)

GB/T 9113 (all parts), Integral steel pipe flanges

GB/T 12220, General purpose industrial valves - Marking (GB/T 12220-1989, idt ISO 5209:1977)

GB/T 12221, Metal calves - Face to face, end to end, center to face and center to end dimensions (GB/T 12221-2005, ISO 5752:1982, MOD)

GB/T 12224, General requirements for industrial steel valves (GB/T 12224-2005, AST MB 16.34a-1998, NEQ)

GB/T 12230, General purpose industrial valves - Specification of stainless steel castings

GB/T 12235, Steel globe valves and lift check valve for petroleum petrochemical and allied industries

GB/T 24925, Low temperature valve - Technical specifications

JB/T 106, Valves marking and paint

JB/T 6697, Tractors and machinery for agriculture and forestry - Electrical equipment - Basic specifications

JB/T 6902-2008, Methods for liquid penetrant examination of valves

JB/T 7248, Technical specification for low temperature service steel casting for valves

JB/T 7927, Valve cast steel visual quality requirements

JB/T 7928, Industrial valves - Delivery specification

JB/T 9218-2007, Non-destructive testing - Penetrant testing

3 Terms

The following terms and definitions are applicable to this Standard.

3.1

emergency shut-off valve

Value – installed on a tanker (tank truck), storage tank or pipeline – that can be quickly shut off manually or automatically in the event of an accident.

4 Technical requirements

4.1 General requirements

In addition to complying with the provisions of this Standard, emergency shut-off valves shall also comply with the provisions of GB/T 24925.

4.2 Parameters

4.4 Structural length

The structural length of the emergency shut-off valve shall be in accordance with the provisions of GB/T 12221, or in accordance with the requirements of the order contract.

4.5 Appearance

Except for austenitic stainless-steel valves, the non-machined outer surfaces of other metals shall be painted. The paint layer shall use coating of durability. The coating at the marking shall ensure that the marking is clear; the color of the paint shall be in accordance with JB/T 106. Special requirements are specified in the order contract.

4.6 Connection form

The connection forms of emergency shut-off valve shall be welded connection or flanged connection. The welded connection shall comply with the provisions of GB/T 12224, and the flanged connection shall comply with the provisions of GB/T 9113. Special requirements are specified in the order contract.

4.7 Cleaning requirements

All parts of the emergency shut-off valve shall be cleaned before assembly.

4.8 Performance requirements

4.8.1 Operating performance

Operate separately at normal and low temperatures. The emergency shut-off valve shall move flexibly without jamming or crawling.

4.8.2 Sealing performance

4.8.2.1 The sealing performance test shall be subjected separately to low-pressure and high-pressure sealing tests. After the low-pressure sealing test is qualified, perform the high-pressure sealing test.

4.8.2.2 Normal temperature sealing performance test

Test pressure: low pressure is 0.1MPa, high pressure is 1.1 times the nominal pressure of the valve, the test medium is nitrogen, the duration is 15 minutes, and there must be no leakage.

4.8.2.3 Low temperature sealing performance

Test pressure: low pressure is 0.1 MPa, high pressure is 1.1 times the nominal pressure of the valve, the test medium is helium, the duration is 15 minutes each, and the leakage is not allowed to be greater than 2×DN, in mL/min.

4.8.3 Shell strength

4.8.3.1 For emergency shut-off valves used in LNG tank containers, the strength test pressure of the shell (valve body, valve cover) shall be 4 times the tank design pressure; for emergency shut-off valves used in other situations, the strength test pressure of the shell (valve body, valve cover) is 1.5 times the nominal pressure.

4.8.3.2 After passing the shell strength test, the emergency shut-off valve shall have no structural damage, and there shall be no visible leakage on the pressure-bearing wall and the connection between the valve body and the valve cover.

4.8.4 Emergency shutoff time

The emergency shut-off valve shall close within 10 seconds from the time it starts to close.

4.8.5 Vibration resistance

The emergency shut-off valve for tankers and tank trucks shall be resistant to vibration and shall comply with the requirements of JB/T 6697.

4.8.6 Overtemperature shutdown

The fusible plug shall be able to melt when the ambient temperature reaches 70 ℃ ± 5 ℃, and the emergency shut-off valve shall automatically cut off.

4.8.7 Natural closure

For valves that rely on air pressure to open and close, when fully open, they shall be able to remain open for 48 hours and will not naturally close.

4.8.8 Anti-static

When the power supply voltage does not exceed 12 V, the resistance of the anti-static circuit of the valve disc, valve stem and valve body shall be less than 10 Ω.

4.8.9 No-load operating life

The emergency shut-off valve shall be able to meet the performance requirements after opening and closing 2 000 times under no load.

4.9 Parts

4.9.1 Main pressure parts shall be inspected for flaw detection. Casting defects shall not be lower than Level 2 (including Level 2) in JB/T 6902-2008, and forging defects shall not be lower than Level 2 (including Level 2) in JB/T 9218-2007.

4.9.2 The valve body, valve cover, valve disc, valve seat, valve stem and other parts shall be cryogenically treated. The valve body shall be cryogenically treated before assembly and grinding, and the rest shall be carried out before finishing.

For emergency shut-off valves used in LNG tank containers, the strength test pressure of the shell (valve body, valve cover) shall be 4 times the tank design pressure; for emergency shut-off valves used in other situations, the strength test pressure of the shell (valve body, valve cover) is 1.5 times the nominal pressure.

5.1.2 Test duration

The test duration is as specified in Table 3.

Table 3 – Test duration

Nominal size DN	≤50	65 ~ 200
Test duration/min	≥10	≥15

5.1.3 Test procedure

Fill the body cavity of each pressure test piece with the test medium (water); gradually pressurize to the test pressure; maintain for the specified duration; then, inspect the pressure test piece.

5.1.4 Test medium

The test medium is water. For stainless steel valves, the chloride ion content of the test medium shall not exceed 25×10^{-6}.

5.2 Sealing performance test

Conduct the sealing performance test at normal temperature and low temperature, respectively. Perform the low temperature test after passing the normal temperature test. The low temperature test temperature is -196 ℃.

5.2.1 External leakage test

5.2.1.1 The test pressure is 1.1 times the nominal pressure of the valve.

5.2.1.2 The test medium is nitrogen at normal temperature and helium at low temperature.

5.2.1.3 During the test, the valve is in an open state, the outlet end is closed, pressure is introduced from the inlet end, and there must be no leakage at the packing and the connection between the valve body and the valve cover.

5.2.2 Air tightness test

5.2.2.1 The air tightness test shall be subjected separately to low pressure and high pressure tests. After the low pressure air tightness test is qualified, perform the high pressure air tightness test.

5.2.2.2 The air tightness test pressure is the maximum working pressure (high pressure) and 0.1 MPa (low pressure) respectively, and the actuator test pressure is the maximum working air source pressure.

5.2.2.3 The test medium is nitrogen at normal temperature and helium at low temperature.

5.2.2.4 During the test, the valve is in a closed state, pressure is introduced from the inlet end, and the leakage amount is in accordance with the provisions of 4.8.2.

5.3 Action test

Use nitrogen or helium to apply the same test pressure as the maximum working pressure in the direction of medium flow. When the emergency shut-off valve starts to operate, it must be closed within 10 seconds.

5.4 Natural closure test

For emergency shut-off valves that rely on air pressure to open and close, open the valve, stop adding pressure to the system, and the valve shall meet the requirements of 4.8.7.

5.5 Vibration test

5.5.1 With the valve in a closed state, conduct a vibration test in accordance with the provisions of JB/T 6697.

5.5.2 After the valve undergoes the vibration test, first conduct an external inspection. The parts shall be free of damage and the fasteners shall not be loose. The subsequent test shall meet the requirements of 5.2 and 5.3.

5.6 Anti-static test

Select a valve for testing and use a digital multimeter or electric bridge to measure the resistance between the valve disc, valve stem and valve body. The test results shall meet the requirements of 4.8.8.

5.7 No-load operating life test

The valve shall be subjected to repeated operating life tests under no load, and sealing performance test shall be conducted after each opening and closing of 500, 1 000, 1 300, 1 600, 1 800 and 2 000 times. The test results shall meet the requirements of 4.8.2.

5.8 Fusible plug test

5.8.1 Fusible plug melting test

The test device is shown in Figure 3. Apply a pressure of 0.3 MPa to the fusible plug. When it reaches 70 ℃ ± 5 ℃, the fusible alloy in the fusible plug shall be able to melt.

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