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GB/T 15382—XXXX

Substitute for GB/T 15382-2009, GB/T 10879-2009

General specifications of gas cylinder valves

(IS0 10297:2014/Amd.1:2017(E),Gas cylinders—Cylinder valves—Specification and type testing, NEQ)

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Content

Foreword

This Standard is drafted in accordance with the rules given in the GB/T 1.1-2020《Directives for standardization—Part 1：Rules for the structure and drafting of standardizing documents》.

This document replaces GB/T 15382-2009《General specifications of gas cylinder valves》and GB/T 10879-2009 《Valves for dissolved acetylene cylinders》. This document focuses on GB/T 15382-2009 and integrates the contents of GB/T 10879-2009. Compared with GB/T 15382-2009, except for structural adjustment and editorial changes, the main technical changes are as follows:

The provisions on the scope of application of valves are changed (see Chapter 1, Chapter 1 of GB/T 15382-2009);

The definitions of operating mechanism, batch and minimum closing torque are changed (see 3.1, 3.3 and 3.6, and 3.1, 3.6 and 3.2 of GB/T 15382-2009);

The definitions of opening and closing device, test pressure, pressure test pressure, durability torque, excess torque, failure torque, pressure retaining valve and residual pressure retaining device are added (see 3.2, 3.4, 3.5, 3.7, 3.8, 3.9, 3.10 and 3.11);

The definitions of resistance moment, pressure relief device and shift are deleted (see 3.3, 3.4 and 3.5 of GB/T 15382-2009);

The basic type is changed and listed as a separate chapter (see Chapter 4, 4.2.2 and 4.2.3 of GB/T 15382-2009);

The general requirements for materials are changed (see 5.1.1, 4.1.1 and 5.6.13 of GB/T 15382-2009);

The technical requirements and test methods of valve body materials are changed (see 5.1.2 and 6.2, 4.1.2 and 5.6.12 of GB/T 15382-2009);

The technical requirements for operating mechanism materials are changed (see 5.1.3, 4.1.3 of GB/T 15382-2009);

The technical requirements and test methods of sealing materials are changed (see 5.1.4, 6.3 and 6.4, and 4.1.4, 5.6.14, 5.6.15 and 5.6.17 of GB/T 15382-2009);

The technical requirements for non-metallic materials in contact with oxygen or strong oxidizing gas are added (see 5.1.5);

The technical requirements for materials of safety relief devices are changed (see 5.1.6, 4.1.5 of GB/T 15382-2009);

The selection requirements of allowable stress safety factor are deleted (see 4.2.1 of GB/T 15382-2009);

The design service life, opening and closing direction and number of turns, handle length, non detachable structure, cleaning process, etc. of the valve are added (see 5.2.2, 5.2.4, 5.2.5, 5.2.8 and 5.2.7);

The design requirements, inspection methods and judgment basis of residual pressure retaining device and pressure retaining valve are added (see 5.2.9 and Appendix A);

The technical requirements and test methods of voltage withstand test are changed (see 5.3.1 and 6.6, and 4.3.6 and 5.6.7 of GB/T 15382-2009);

The technical requirements and test methods of fire resistance test are changed (see 5.3.2 and 6.7, 4.1.3.1 and 5.6.18 of GB/T 15382-2009);

The technical requirements and test methods of opening and closing test are changed (see 5.3.3 and 6.8, 4.3.1 and 5.6.2 of GB/T 15382-2009);

The technical requirements and test methods of air tightness test are changed (see 5.3.4 and 6.9, 4.3.2 and 5.6.3 of GB/T 15382-2009);

The technical requirements and test methods of durability test are changed (see 5.3.6 and 6.11, and 4.3.5 and 5.6.6 of GB/T 15382-2009);

Technical requirements and test methods for part integrity test are added (see 5.3.7 and 6.12);

The technical requirements and test methods of mechanical impact resistance test are changed (see 5.3.8 and 6.13, and 4.3.7 and 5.6.8 of GB/T 15382-2009);

The technical requirements and test methods of oxygen pressure ignition resistance test are changed (see 5.3.9 and 6.14, and 4.3.8 and 5.6.9 of GB/T 15382-2009);

Technical requirements and test methods for valve tightness test are added (see 5.3.10 and 6.15);

The technical requirements and test methods of hydrochloric acid corrosion resistance test are changed (see 5.3.11 and 6.16, 4.1.3.2 and 5.6.17 of GB/T 15382-2009);

The technical requirements and test methods for action test of safety pressure relief device are changed (see 5.3.12 and 6.17, 4.2.4.3, 4.3.10 and 5.6.11 of GB/T 15382-2009);

The technical requirements and test methods for temperature resistance test, cap loosening torque test and quality inspection are deleted (see 4.3.4, 5.6.5, 4.3.9, 5.6.10, 4.3.11 and 5.6.1.4 of GB/T 15382-2009);

The provisions on incoming inspection of raw materials are deleted (see 6.1 and 7.2.1 of GB / T 15382-2009);

The inspection items, sampling methods and conformity determination principles of individual inspection and batch inspection are changed (see 7.1.1 and 7.1.2, 6.2 and 7.2 of GB / T 15382-2009);

The type test coverage principle of valves with the same material and structure type is added (see 7.2.2); The coverage principle of type test when the local design of valve changes is added (see 7.2.3); Provisions on the submission of data by the manufacturer to the type test agency are added (see 7.2.4);

The test items of type test are changed (see Table 4, table 1 and table 2 of GB/T 15382-2009);

a) The regulations on valve mark and product certificate are changed (see 8.1 and 9.1, 8.1 and 9.1 of GB/T 15382-2009)。

This document is drafted with reference to ISO 10297:2014/AMD.1:2017(E)《Gas cylinders - Cylinder Valves - Specification and type testing》, and the degree of consistency is non equivalent.

Please note that some contents of this document may involve patents. The publisher of this document is not responsible for identifying these patents.

This document is proposed by and under the jurisdiction of the National Standardization Technical Committee of gas cylinders (SAC/TC 31).

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The previous versions of this document and its substitutes are as follows:

——GB 15382-1994 originally published in 1994;

——The first revision in 2009, intergrate with GB 10877-1989《Valves for oxygen cylinders》、GB 13438-1992《Valves for argon cylinders》、GB 13439-1992《Valves for liquid chlorine cylinders》、GB 17877-1999《Valves for li8quid ammonia cylinders》;

——The second revision in this time, intergrate with GB/T 10879-2009《Valves for dissolved acetylene cylinders》（The previous release of GB/T 10879-2009 was GB 10879-1989）.

General specifications of gas cylinder valves

1 Scope

This standard specifies requirements for terms, definitions and basic types, specifications, test methods, inspection rules, markings, packaging, transportation, storage, product certificate approval and batch inspection certificate, etc. of gas cylinder valves.

This standard is applicable to transportable, refillable valves for compressed, liquefied and dissolved gas cylinders (hereinafter referred to as valve) used at ambient temperature -40℃～＋60℃, and nominal working pressure less than to 35MPa.

This standard does not apply to valves which are used with welded insulated cylinders, fire extinguisher cylinders, vehicle cylinders, re breather cylinders, liquefied petroleum gas cylinders, liquefied dimethyl ether cylinders, and for Industrial use, non-refillable steel welded cylinders.

2 Normative references

The following referenced documents are indispensable 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 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 3863 Industrial oxygen

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

GB/T 7307 Pipe threads with 55 degree angle where pressure-tight joints are not made on the threads

GB/T 8335 Special threads for gas cylinders GB/T 8337 Fusible plug device for gas cylinders

GB/T 8337 Fusible plug device for gas cylinders

GB/T 13005 Terminology of gas cylinders

GB/T 15383 Connection types and dimensions for gas cylinder valve outlets GB/T 16163 Classification of gases filled in cylinder

GB/T 16918 Bursting disc safety devices for gas cylinders

GB/T 31481 Guidance for gas/materials compatibility of cryogenic vessels GB/T 33215 Pressure relief devices for gas cylinders

GB/T 33215 Pressure relief devices for gas cylinders

ISO 11114-1 Gas cylinders-Compatibility of cylinders and valve materials with gas contents Part1:Metallic materials

ISO 11114-2 Gas cylinders-Compatibility of cylinders and valve materials with gas contents Part2:Non-metallic materials

3 Terms and definitions

The following terms and definitions list in GB/T 13005、GB/T 33215 are applicable to this document.

3.1

Operating mechanism

Mechanism for opening or closing valve through-hole.

Note: the mechanism includes internal and external sealing system.

3.2

Operating device

Component which actuates the valve operating mechanism.

EXAMPLE Handwheel, key, handle, lever or actuator.

3.3

Batch

Quantity of valves made consecutively by the same construction, design, material lot and manufacturing techniques.

3.4

Test pressure

P_{vt}

Minimum pressure applied to a valve during testing.

Note: The test pressure is 1.2 times the nominal operating pressure.

3.5

Hydraulic test pressure

P_{vbt}

Minimum pressure applied to a valve during the hydraulic pressure test.

Note: The Hydraulic test pressure is 2.25 times the nominal operating pressure. The hydraulic test pressure of the dissolved acetylene cylinder valve in the opening state is 90.9MPa.

3.6

Minimum closing torque

T_C

The minimum torque applied to the opening and closing device of the new valve and meeting the internal air tightness at test pressure and room temperature.

3.7

Endurance torque

T_e

Closing torque applied during the endurance test.

3.7.1

Endurance test torque at start

$T_{e,start}$

Torque used at the beginning of the endurance test.

3.7.2

Endurance test torque at end

$T_{e,end}$

Torque used to maintain internal leak tightness at the end of endurance test.

3.8

Over torque

T_o

Opening or closing torque (whichever is the lower value)applied to the valve operating device to determine the level of torque which the valve operating mechanism can tolerate and remain operable.

3.9

Failure torque

T_f

Opening or closing torque (whichever is the lower value)applied to the valve operating device to obtain mechanical failure of the valve operating mechanism and/or valve operating device.

3.10

Residual pressure valve

RPV

The valve with a residual pressure device

3.11

Residual pressure device

RPD

Device that is designed to prevent ingress of contaminants to keep a positive pressure within the cylinder relative to atmosphere by closing off its internal gas passages in the discharging direction.The device is non-return to prevent gas flowing back from valve outlet to cylinder.

4 Basic type and construction

4.1 Basic type of the valve

According to the sealing type, this standard defines the following typical types:

a) Pressure seal valve – the valve with spring compression force and gas pressure through the valve stem to press the sealing ring for external sealing (Fig.1);

b)O-ring gland seal valve – the valve with O-ring at the rotating parts of stem and gland nut for external sealing (Fig.2);

c)Diaphragm gland seal valve – the valve with a diaphragm between the stem and the piston for external sealing (Fig.3);

d)Drum ring seal valve - the valve with moving the plug up and down through compresses the drum ring for external sealing (Fig.4);

e)Stuffing box seal valve - the valve between the valve body and the valve stem through compressing the sealing stuffing box for external sealing (Fig.5);

f)Piston seal valve - the valve between the valve body and piston through moving the O-ring for external sealing (Fig.6).

4.2 Valve description

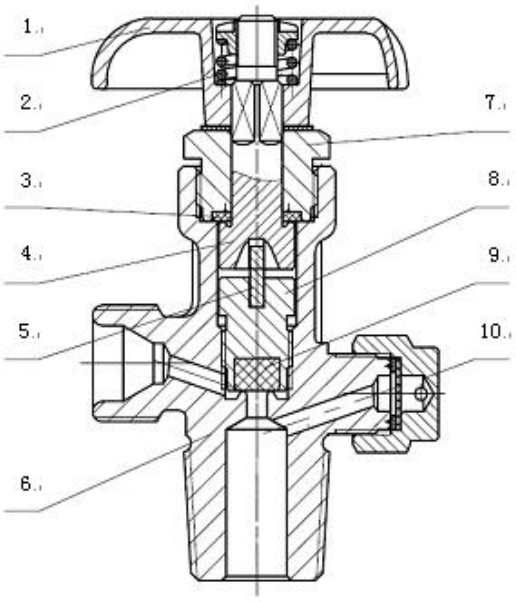
4.2.1 A valve typically comprises of:

a) valve body(Include outlet and inlet to connect cylinder);
b) valve operating mechanism;
c) valve operating device;
d) Seat and sealing components which ensure internal and external tightness.

4.2.2 Valves can also include:

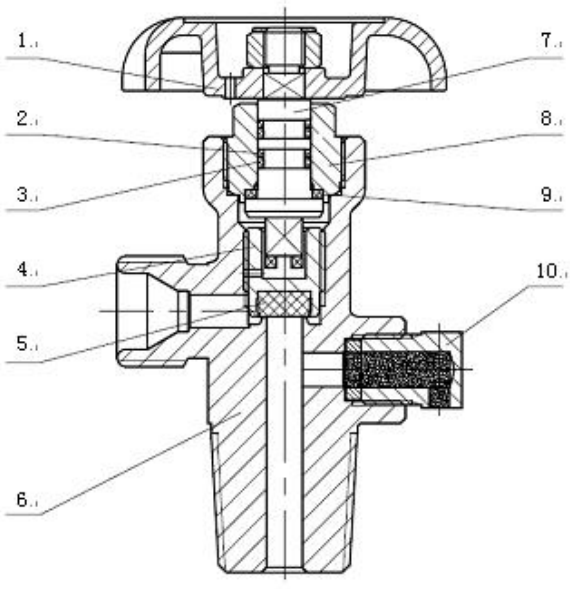
a) pressure-relief device
b) excess flow device;
c) non-return device;
d) pressure-reduction device;
e) dip tube;
f) outlet connection protective device;
g) residual pressure device (PRD)

4.2 Common valve designs



Note:

1——Handwheel
2——Spring
3——Sealing ring



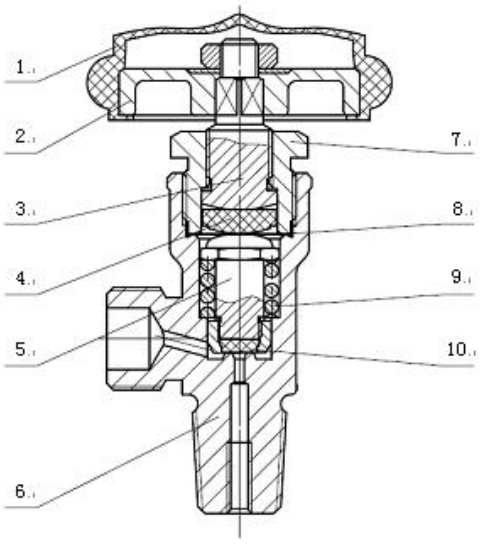
1——Handwheel
2——Seal retainer
3——O-ring

4——Valve stem
5——Connection pad
6——Valve body
7——Gland nut
8——Spindle
9——Seal gasket
10——Bursting disc device

Figure 1 Pressure seal valve

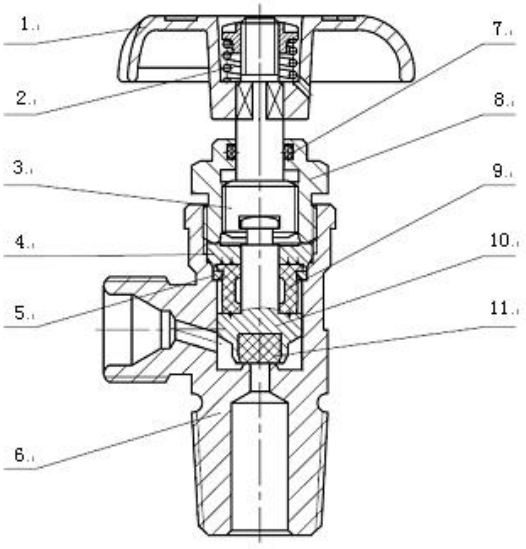
4——spindle
5——Seal gasket
6——Valve body
7——Valve stem
8——Gland nut
9——Anti-wear gasket
10——Composite device of bursting disc and fusible alloy plug

Figure 2 O-ring gland seal valve



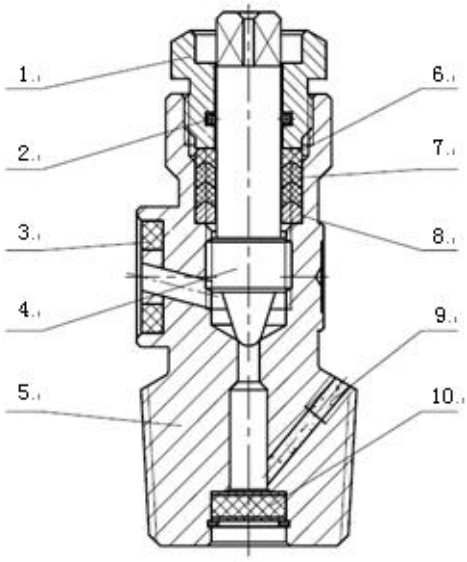
Note:
1——Handwheel shell
2——Handwheel
3——Valve stem
4——Gasket block
5——Plug
6——Valve body
7——Gland nut
8——diaphragm
9——Spring
10——Seal gasket

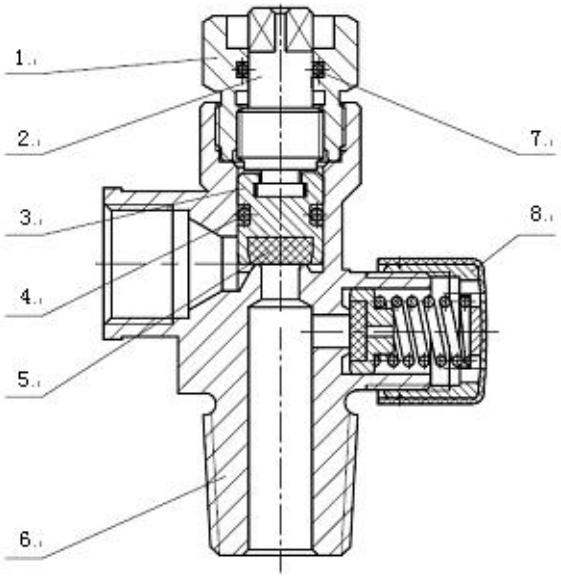
Figure 3 Diaphragm gland seal valve



1——Handwheel
2——Spring
3——Valve stem
4——Packing collar
5——Back up ring
6——Valve body
7——O-ring
8——Gland nut
9——Drum ring
10——Plug
11——Seal gasket

Figure 4 Drum ring seal valve





Note:

1——Gland nut
2——O-ring
3——Sealing ring
4——Valve stem
5——Valve body
6——Pressure ring
7——Seal stuffing box
8——Back up ring
9——Fusible plug device
10——Filter

Figure 5 Stuffing box seal valve

1——Gland nut
2——Valve stem
3——Plug
4——O-ring
5——Seal gasket
6——Valve body
7——O-ring
8——Spring pressure relief device

Figure 6 Piston seal valve

5 Technical requirements

5.1 Materials

5.1.1 General requirements

5.1.1.1 Metallic and non-metallic materials in contact with the gas shall be chemically and physically compatible with the gas, according to ISO 11114-1 and ISO 11114-2 under all intended operating conditions.

5.1.1.2 The mechanical properties of metal parts after forging and machining shall meet the design strength requirements of the valves.

5.1.1.3 Alloys containing in excess of 65% copper shall not be used with acetylene.

5.1.1.4 The valve for liquid ammonia shall not be made of copper alloy.

5.1.1.5 Hydrochloric acid corrosion resistant materials shall be used as the material of liquid chlorine cylinder valve.

5.1.2 Valve body material

5.1.2.1 It is recommend to use a material not showing a ductile to brittle transition (e.g copper alloys, austenitic stainless, steels aluminum alloys, nickel alloys), and it should meet the valve body's strength design requirements. the performance should meet the corresponding national standards.

5.1.2.2 A brass material having the copper (Cu) content in the range of 57.0%～65.0%, lead (Pb) content in the range of 0.8%～1.9%, and iron (Fe) content should be less than 0.5%. The mechanical properties shall not be lower than those specified in GB/T 4423.

5.1.3 Material for operating mechanism and operating device

5.1.3.1 Valve operating device shall have sufficient strength and ignition resistance, and it is recommend to use aluminum alloy.

5.1.3.2 The material of valve stem, seat and connecting plate shall have sufficient strength and corrosion resistance. The valve stem used in liquid chlorine medium shall be made of stainless steel with hydrochloric acid corrosion resistance or material with higher hydrochloric acid corrosion resistance.

5.1.3.3 it is recommend to use corrosion-resistant stainless steels if the spring inside the valve.

5.1.3.4 It is recommend to use elastic stainless steel material or combination using of medium corrosion resistant material and elastic stainless steel material for valve's diaphragm.

5.1.4 Materials of rubber seal

5.1.4.1 Resistance to oxygen aging

Visible crack and aging phenomenon shall not occur after the rubber seals are kept in oxygen with pressure of 2.3±0.2 MPa and temperature of 70±5 ℃ for 96 hours.

5.1.4.2 Resistance to low temperature

Crack or other damages shall not occur after the rubber seals are kept in the air with temperature of -40±2 ℃ for 24 hours.

5.1.5 Non-metallic materials contact with oxygen or other highly oxidizing gases

5.1.5.1 Materials of non-metallic seals, lubricant, sealant and other parts contact with oxygen and other highly oxidizing gases shall have resistance to fire.

5.1.5.2 Materials of non-metallic seals, lubricant, sealant and other parts contact with oxygen and other highly oxidizing gases shall have spontaneous combustion test according to GB/T 31481, and the spontaneous combustion temperature shall 100℃ higher than maximum operating temperature.

Note:maximum operating temperature is the highest temperature during valve using (e.g. as filling).

5.1.5.3 The test of materials of non-metallic seals, lubricant, sealant and other parts shall be in accordance with the rules given in GB/T 31481 under $P_{vt,}$ and will not react with oxygen.

5.1.6 Materials of pressure-relief device

The materials of pressure-relief device shall meet the requirements of GB/T 8337 or GB/T 16918.

5.2 Design and Process requirements

5.2.1 Valves shall operate normally in the range of -40 ℃～+60 ℃ environments, and the range can be extended for a short time(e.g. filling). Where higher or lower temperatures are required, agreement shall be signed between the manufacturer and purchaser, and specified in the manufacturer’s instructions.

5.2.2 The manufacturer shall specify the design service life of the valves. The design service life of valves is at least a periodic inspection cycle of the cylinder.

5.2.3 The connection type and size of inlet and outlet of valves shall in accordance with GB / T 8335 and GB / T 15383. The accuracy of connecting thread at inlet and outlet of valves shall meet the requirements of GB / T 8335, GB / T 197 and GB / T 7307. The accuracy of metric thread shall at least meet the level of 6g and 6H, and that of cylindrical pipe thread shall meet the level of grade B at least.

5.2.4 The closing direction of valves shall be designed to be clockwise, so that the valve can be opened or closed flexibly regardless of the pressure in the cylinder. For valves used for oxygen or other highly oxidizing gases, the valve shall be rotated more than one turn when fully opened.

5.2.5 If the valve with handle, the maximum length of the handle shall not damage the valve stem and the sealing surface during rotating. And the adjustable key shall not be used.

5.2.6 Valve body is recommend to use forging, its surface shall have the same color and there shall be no cracks, wrinkles, inclusions, porosity, shrinkage cavity, incomplete filling and other defects that may damage the performance of the valve.

5.2.7 The cleaning process of valves shall ensure that the filled mediums pureness will not be affected by the valves.

5.2.8 Valves can be designed as non-detachable construction according to relevant regulations and user that the filled

5.2.9 Combustible compressed gas, oxidizing compressed gas, nitrogen and argon shall be provided with RPD (except for the valves which are implementing the process of evacuation in advance of filling). RPDs and RPVs shall meet following requirements:

a) the type test, inspection method and judgment basis of RPD shall be in accordance with Appendix A;

b) the designed closing pressure of the RPD shall not be less than 0.15MPa;

c) c) the special connector should be used when the RPV valve is inflated, and the standard connector should be used when venting.

d) the RPV valve shall match the cap of the cylinder.
e) assembly line may be used for assembling and executing tightness test of RPV valve.

5.3 Performance requirements

5.3.1 Hydraulic pressure test

Hydraulic pressure test shall be carried out under the following conditions:

a) Valve seat in open position, the pressure shall be raised continuously and gradually to P_{vbt}, pressure holding time of 2 min, valve shall withstand the test, without leakage ,visible deformation or rupture.
b) T test pressure for dissolved gases such as acetylene of 90.9MPa in open position..

5.3.2 Flame impingement test

The valve operating device of the valve shall be exposed for 1 minute to a flame which reaches a typical temperature of between 800 ℃ and 1000 ℃ Although the valve operating device may be damaged during the test , it shall still be possible to close the valve manually or with simple tools after cooling

5.3.3 Operating performance test

5.3.3.1 The T_c of valve is given in Table 1.

5.3.3.2 At T_0 the valve shall be able to work without noticeable difficulties. It shall not show any damage or failure of any component of the valve operating mechanism and/or valve operating device.

5.3.3.3 At T_f (given in table 1), the valve operating mechanism may be severely damaged and not operable. Mechanical failure shall occur prior to the valve operating mechanism unscrewing itself from the valve body and shall be in a manner that will not result in ejection of valve component.

5.3.3.4 If a valve design is not covered by Table 1, the value manufacturer shall specify the torque values to be used for the tests and include them in the operating instructions.

Table1 Torques to be used for the valve tests

Valve seal/seat	Operating device	Minimum closing torque T_C N·m	Endurance torque[a] T_e N·m	Over torque T_o N·m	Failure torque T_f N·m
Non-metallic to metal	Handwheel diameter D=65 mm	≤7	$T_{e,start}$=7 $T_{e,end}$≤10.5	20	25
	Other handwheel diameters	≤D×7/65	$T_{e,start}$=D×7/65 $T_{e,end}$≤1.5×$T_{e,start}$≤16	D×20/65	1.25×T_o
	Key/toggle	≤11	$T_{e,start}$=T_C≥7 $T_{e,end}$≤1.5×$T_{e,start}$	T_f/1.25	T_f
Metal to metal	Handwheel diameter D=65 mm	≤7	$T_{e,start}$=1.5×T_C≥7 $T_{e,end}$≤1.5×$T_{e,start}$≤16	20	25
	Other handwheel diameters	≤D×7/65	$T_{e,start}$=1.5×T_C≥D×7/65 $T_{e,end}$≤1.5×$T_{e,start}$≥D×16/65	D×20/65	1.25×T_o
	Key/toggle	≤17	$T_{e,start}$=T_c≥7 $T_{e,end}$≤T_o	T_f/1.25	T_f

[a] The T_c to calculate $T_{e,start}$ is the actual value measured according to the 6.8.1, and the $T_{e,end}$ used in the test after durability test is the actual value obtained at the end with a relative tolerance of 0～+10%.

5.3.4 Leak tightness test

Bubbles shall not be observed when the valves are immersed in water for 1 minute during leak tightness test according to the test temperatures and sequences given in Table 4 and pressures given in Table 2. The leak tightness test of delivery inspection shall be carried out at room temperature with pressures of Pvt, 0.05 MPa and vaccum degree (if required).

The leakage shall not exceed 6 cm^3/h when leakage rate method is used. For high pure or toxic gases, lower permitted leakage rates shall be applied, and for electrinic applications, the permitted leakage rates shall not exceed $1*10^{-7}$ He atm cm^3/s.

Table 2 Test pressures for leak tightness tests

Test pressure sequence	Test pressures for leak tightness tests
1	0.05MPa
2	1MPa
3	P_{vt}
4	Vacuum degree (Valves with vacuum requirements)

5.3.5 Vibration test

Valves shall be free from looseness at the screw connections after the displacement amplitude of 2 mm (P-P), the frequency of 33.3 Hz, and the vibration for 30 minutes in each of the three vertical directions of X, Y and Z under P_{vt}, and shall meet the requirements for leakage.

5.3.6 Endurance test

The valve shall function satisfactorily after 2000 opening and closing cycles with T_e according to Table 1 at P_{vt} according to 6.11.After the test, the valve shall meet the requirements for leakage and .

5.3.7 Integrity of parts

After vibration tests, endurance tests, leak tightness tests at low,room and high temperatures all parts shall be free from displacement (out of assembly position), loss of function (fracture) or missing, and the joints shall not be loosen. The tests shall be carried out in accordance with the schedule given in Table 4,

5.3.8 Impact test

In circumstances where cylinder valves are used in cylinders of water capacity greater than 5l and where valve protection is not intended to be fitted during transkportation, the valve shall be struck impact with a minimum velocity of 3m/s. Valves with PZ27.8 inlet thread requires an impact test at 300 J, valves with other threads shall have an impact energy numerically equal to at least 3.6 times the total mass (cylinder plus content). Distortion after impact test is permissible, but cracks and leakage under P_{vt} is not permitted.

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5.3.9 Oxygen pressure surge test

Valves with oxygen and highly oxidizing gases shall be free of ignition and burning marks, and the parts of the RPV shall be free from displacement (out of assembly position), loss of function (fracture) or missing after oxygen pressure surge tests.

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5.3.10 Seat leak tightness

Valve of dissolved acetylene cylinder with nonmetal seal, it needs to assmble the seat into vlave without cleaning, which seat is after burning with flame. The leakage shall not exceed 50 cm^3/h, when apply a torque of maximum 12N.m under $P_{vt.}$

5.3.11 hydrochloric acid corrosion

The stem of liquid chlorine cylinder valve shall be tested for hydrochloric acid corrosion. When the test has been completed, the valve shall have no leakage under room temperature and P_{vt},the stem shall not be broken with the valve closed torque of T_0..

5.3.12 Pressure relief device action performance

5.3.12.1 The pressure relief device of the valves shall be designed in accordance with GB/T 33215. The bursting disc device, fusible plug device, bursting disc fusible alloy plug compound device or spring type pressure relief device can be set as required.

5.3.12.2 The operating pressure of bursting disc device or the set pressure and return pressure of pressure seal loading spring device shall be n accordance with GB/T 33215.

5.3.12.3 The operating temperature of fusible plug device shall be as follows:

a) 70^{+2}_{-4}℃, for valves with nominal operating pressure not exceed 3.45MPa;

b) （110±5）℃, for dissolving acetylene cylinder valve;

c) （110±5）℃, for valves with nominal operating pressure greater than 3.45MPa and not exceed 35MPa.

5.3.12.4 The operating pressure and temperature of the bursting disc-fusible plug device are given in 5.3.12.2 and 5.3.12.3.

6 Inspection and test method

6.1 General for test

6.1.1 Test environment

If there is no special definition, the test shall be carried out at room temperature of 15 ℃ - 30 ℃, and the laboratory shall be kept shockproof, moisture-proof, corrosion-resistant and ventilated.

6.1.2 Test medium

Except where otherwise stated or hydraulic pressure test with clean water, carry out tests with clean, oil-free dry air or nitrogen.

6.1.3 Pressure gauge

The accuracy of the pressure gauge used in the test shall not be lower than grade 1.6, within the range of 1.5 to 2 times of the test pressure.

6.2 Mechanical properties and chemical composition inspection

The mechanical properties of valve body materials shall be inspected in accordance with GB/T 228.1, and the chemical composition shall be tested by spectral method, and both of them are given in 5.1.2.1 and 5.1.2.2. In case of dispute arbitration, the inspection method specified in the corresponding material standard shall be adopted.

6.3 oxygen aging test

Place 5 rubber seals in the aging test device, exclude the air and then filling oxygen gas with purity ≥ 99.5% to reach the pressure (2.3 ± 0.2)MPa, raise the temperature to (70 ± 5) ℃, and maintain for 96 h, take out the rubber seals and inspect visually,the results are given in 5.1.4.1.

6.4 Resistance to low-temperature

Place 5 rubber seals in the test chamber at (- 40 ± 2) ℃ for 24 h, take them out and put them on the steel mandrel whose diameter is 1.2 times of the inner diameter of the rubber seals, and observe their changes visually, and the results are given in 5.1.4.2.

6.5 Connection dimensions inspection

6.5.1 The connection size of inlet and outlet of the valve shall be tested by measuring tools that meet the requirements of corresponding thread and dimensional accuracy, and the results shall meet the rules of 5.2.3.

6.5.2 The taper, profile half angle, profile height, pitch and other parameters of taper thread connecting with gas cylinder shall be detected by imager and other equipment, and the results shall meet the requirements of 5.2.3.

6.6 Hydraulic pressure test

Clean water shall be applied via valve inlet connection after connecting the inlet with the testing machine, blocking the outlet, opening the valve until the pressure in accordance with specified in 5.3.1, and keep it for 2 minutes. The valve shall be checked if deformation after disassembling ,and the test result is given in 5.3.1.

Note:For valves with pressure relief devices, the pressure relief devices shall be removed and the connections shall be sealed。

6.7 Resistance to flame impingement test

Install the valve on the testing device, open the valve, and expose the operating device (such as handwheel) in a 150 mm long LPG pipe blowing flame for 1 minute with the standard temperature between 800 ℃ and 1000 ℃. The operating device shall be completely surrounded by flame. After the test, the operating device damage is permissible, and the test result is given in 5.3.2.

6.8 Operating performance test

6.8.1 Minimum closing torque tests

Install the valve on the test device, the valve is in the open state, and a throttling device is connected to the valve outlet; immerse the valve in water, fill nitrogen or air from the valve inlet to the P_{vt} pressure, and adjust the throttle device to avoid a large amount of gas outflow; slowly close the valve until there

is no bubble at the valve outlet, and record the closing torque at this time, and the test result is given in 5.3.3.1.

6.8.2 Excessive torque tests

Install the valve on the testing device, close and open the valve according to T_0 torque in Table 1, and then disassemble the valve to check all parts , and the test result is given in 5.3.3.2.

6.8.3 Failure torque tests

6.8.3.1 Failure torque test of handknob valve

Install the valve on the testing device, slowly increase the closing torque until the valve has mechanical failure, then disassemble the valve to check all parts , and the test result is given in 5.3.3.3. Install the valve on the testing device, slowly increase the opening torque until the valve has mechanical failure, then disassemble the valve to check all parts , and the test result is given in 5.3.3.3.

6.8.3.2 Failure torque test of handle valve

Install the valve on the testing device, slowly increase the closing torque (and opening torque of another valve) until the valve has mechanical failure, record the torque. The smaller one shall be regarded as T_f to calculate T_o and T_e in Table1.

6.9 Leak tightness tests

6.9.1 Leak tightness tests of type test

6.9.1.1 General

The leak tightness tests of type test shall be conducted according to the following requirements:

a) The valve shall be subject to external leak tightness test, internal leak tightness test and vacuum leak tightness test (if required);

b) The valve shall be tested according to the temperatures (room temperature, - 40 ℃, - 20 ℃, + 65 ℃) and sequences (see Table 4) one by one, and pressures specified in Table 2;

c) The temperature of valves shall be kept at the corresponding temperature for at least 30 minutes in low and high temperature leak tightness tests.

d) The temperature of valves can be directly increased from - 40 ℃ to - 20 ℃ in the leak tightness test at - 20 ℃, and not need after rised to room temperature then decrease temperature.

e) The temperature of valves shall be raised to room temperature through natural conditions, and then to + 65 ℃ after the leak tightness test at - 20 ℃;

f) The valve shall be closed at room temperature and then cooled down in the internal leak tightness test at - 40 ℃,.

6.9.1.2 External leak tightness tests

Install a valve on the testing device, block the outlet, open the valve to any opening state with the torque of $T_{e,start}$ ($T_{e,end}$ after endurance test) in Table 1, and charge the pressure specified in Table 2 from the inlet, and maintain the pressure for at least 1 minute, which shall meet the requirements of 5.3.4.

Note:The leak tightness test of delivery inspection shall be carried out at room temperature with pressures of Pvt, 0.05MPa and vaccum degree (if required).

6.9.1.3 Internal leak tightness tests

Install a valve on the testing device, close the valve with the torque of $T_{e,start}$ ($T_{e,end}$ after endurance test) in Table 1, remove the plug, and charge the pressure specified in Table 2 from the inlet, and maintain the pressure for at least 1 minute, which shall meet the requirements of 5.3.4.

The leak tightness test of delivery inspection shall be carried out at room temperature with pressures of Pvt, 0.05MPa and vacuum degree (if required).

6.9.1.4 Vacuum leak tightness tests

Install the valve on the test device, connect the valve outlet with the vacuum pump, and connect the valve inlet with the vacuum gauge to make the valve open. Open the vacuum pump until the pressure in the valve reaches the set value. Close the valve with the torque of $T_{e,start}$ ($T_{e,end}$ after endurance test) in Table 1, maintain the pressure for 5 minutes

6.9.2 Leak tightness tests of delivery inspection

The leak tightness test of delivery inspection shall be conducted according to the methods in 6.9.1.2, 6.9.1.3 and 6.9.1.4 at room temperature.

6.10 Resistance to vibration test

Install a valve on the testing device, close the valve with the torque of Te,start, and charge Nitrogen or air to Pvt from the inlet. Valves shall be free from pressure drop and looseness at the screw connections, and meet the requirements of 5.3.5 after the displacement amplitude of 2 mm (P-P), the frequency of 33.3 Hz, and the vibration of 30 minutes with testing device is installed on the vibration test bench in three mutually perpendicular directions of X, Y and Z.

6.11 Endurance tests

Install a valve on the testing device as shown in Fig. 7, charge nitrogen or air into the inlet to P_{vt}, and carry out the following steps in the circulation mode shown in Fig. 8:

a) Close the valve with the torque of $T_{e,start}$ in Table 1 (the vent valve has been closed);

b) Hold for 6 s, and detect the pressure value at the outlet. If the pressure drop is greater than 1MPa, the valve has failed the test;

c) Open the vent valve, and then close it when the outlet end pressure is reduced to atmospheric pressure,;

d) Hold for 6 s, and detect the pressure sensor at the outlet. If the pressure rises more than 0.5MPa, the closing torque can be increased. If the torque exceeds $T_{e,end}$ in Table 1, stop the test, and the valve has failed the test;

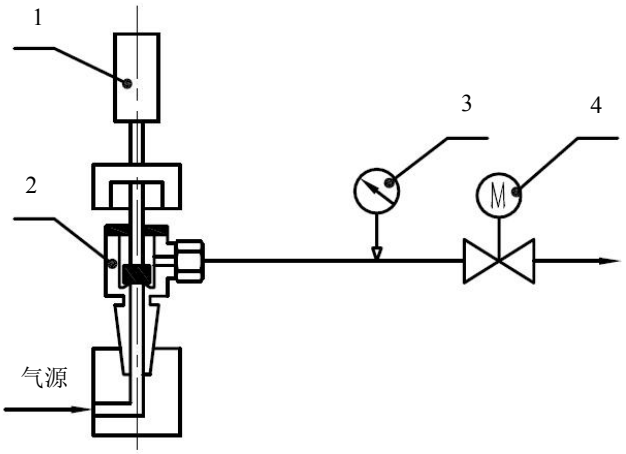
e) Open the valve;

f) Hold for 6 s until the gas is still and the temperature is balanced in the pipeline.

After 2000 cycles of the valve, check whether the results comply with the provisions of 5.3.6.

Note 1: in case of external leakage of stuffing box sealing valve, the pressure cap can be pulled to continue the test.

Note 2: the function of RPV device shall be removed before durability test of pressure retaining valve.



Note:

1——transmission with torque sensor

2——tested sample

3——pressure indicator

4——venting valve

Figure7 Diagram of endurance tests

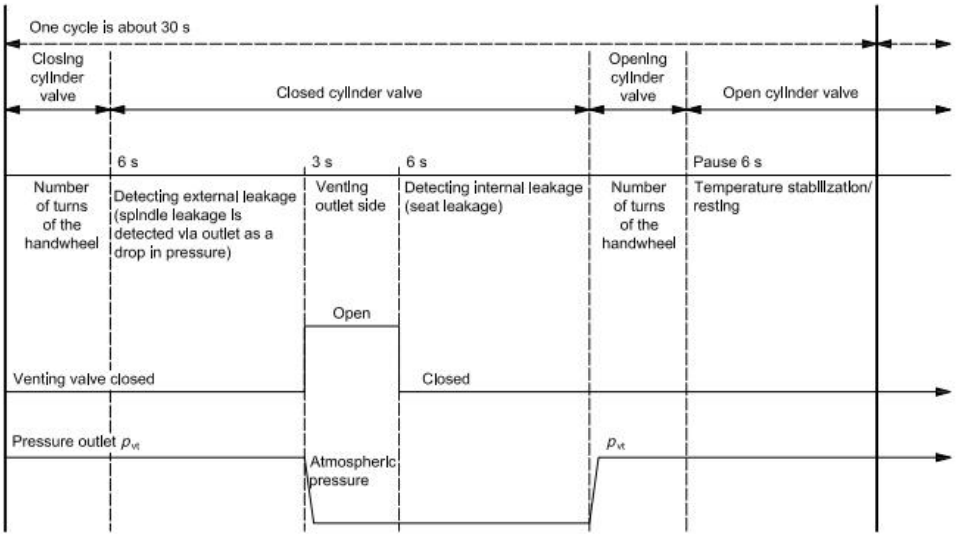


Figure 8 Diagram showing a typical cycle for the endurance test

6.12 Integrity examination of parts

to the test sequence in Table 4, after the vibration resistance, durability, low temperature air tightness, high temperature air tightness and room temperature air tightness tests, the valve parts shall be disassembled,and check whether all parts comply with the provisions of 5.3.7. If the medium is oxygen or highly oxidizing gas, it is necessary to check whether the valve is coated with grease to determine whether the durability test is conducted before the oxygen pressure ignition resistance test.

6.13 Resistance to mechanical impact tests

The steps of resistance to mechanical impact tests are as follows:

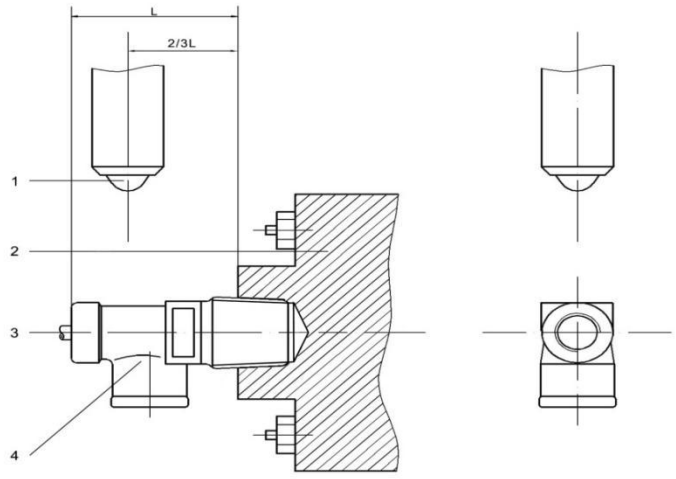
a) Install the valve on the test device as shown in Figure 9, close the valve, adjust the impact point to 2 / 3 of the farthest end (L) of the valve body and the plane where the inlet thread intersects with the top of the cylinder, and the impact direction is perpendicular to the longitudinal axis of the valve;

b) The weakest position of the valve body shall be selected as the impact point, and there shall be no obstacles, such as outlet thread, pressure relief device, handwheel, etc;

c) Strike the valve with an impact energy according to 5.3.8 and a minimum velocity of 3 m/s by a plummet weight, tipped a 13 mm diameter hardened steel ball

d) Distortion due to the impact is permissible. Determine whether the valve is broken by filling clean water into the valve through inlet to P_{vt}, after closing the valve with T_0 in Table 1.

e) The total leakage (comprising that from valve internal sealing system plus that from the threaded joint between the valve and test fixture)shall not exceed 100 cm^3/h by filling the valve with nitrogen or air through inlet if the valve is not broken. There shall no leakage in distortion area.



Note:

1 ——steel ball, diameter 13 mm

2 ——device or cylinder

3 ——longitudinal axis

4 ——test sample

Figure 9 Diagram of resistance to mechanical impact test

6.14 Resistance to oxygen pressure surge tests

6.14.1 Before the test preparation

6.14.1.1 Before the test, according to the inspection results in 6.12, if there is no grease or grease can bear P_{vt} pressure, the valve shall be directly tested for resistance to oxygen pressure surge; if the grease cannot bear P_{vt} pressure, the valve shall be tested for 2000 times of durability according to the test method of 6.11, and then the resistance to oxygen pressure surge test shall be conducted.

6.14.1.2 The testing medium is oxygen gas with purity ≥ 99.5%, and its hydrocarbon conforms to GB / T 3863. The testing pressure is P_{vt}, and the oxygen is heated to 60 ℃± 3 ℃.

6.14.1.3 Before the test, the pressure rise condition of the resistance to oxygen pressure surge test device shall be checked, and the pressure sensor shall be connected at the end of the copper pipe, and the temperature of the test device as shown in FIG.11 is 60 ℃± 3 The time difference between 10% of the first pressure peak and 90% of the first pressure peak (as shown in FIG. 10) is measured, and the first pressure peak shall not exceed 110% P_{vt}.

6.14.1.4 Due to different equipment in each laboratory, the actual pressure-time curves can be displayed in different waveforms, but it shall meet the requirements of Figure 10.

6.14.2 Test procedure

The steps of oxygen pressure surge tests are as follows:

a) Connect the valve inlet with the copper pipe as shown in Figure 11, and the close the valve;

b) Oxygen gas with the temperature of 60 ℃± 3 ℃ is used to start the quick on-off valve and pass through a copper pipe with an inner diameter of 5 mm and a length of 1000 mm, and the P_{vt} pressure is maintained for more than 3 s;

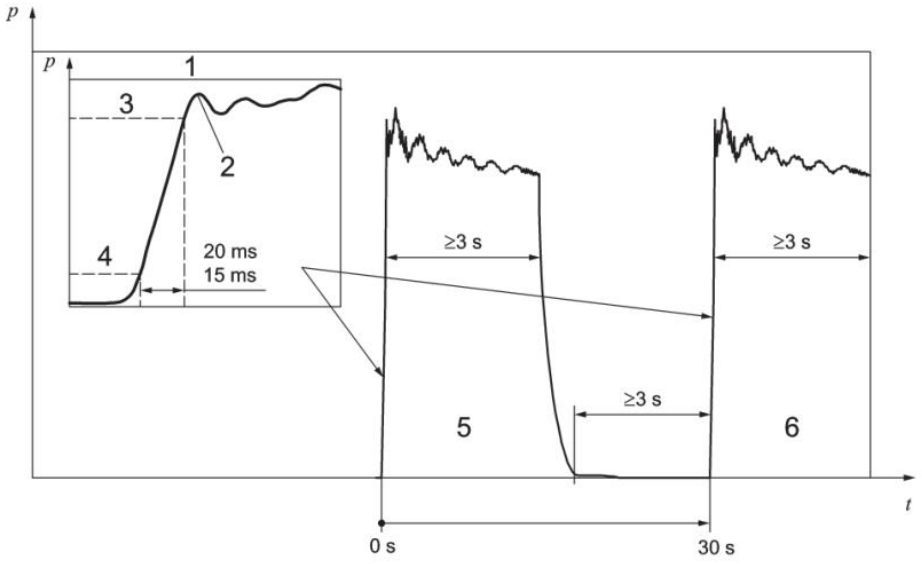
c) Close the shut off valve and reduce the pressure in the valve and the copper pipe to atmospheric pressure through vent valve for more than 3 s. The total time of a cycle shall be 30 s;

d) Repeat the above steps b) and c) for 20 times;

e) Cool the valve to room temperature;

f) Open the valve and repeat steps b), c) and d) above.

After the above tests, the valve shall be disassembled and in accordance with 5.3.9.



Note:

t——Time, s

p——Pressure, in MPa

1——pressure rise time measurement for each test cycle

2——first pressure peak measured at start of each cycle

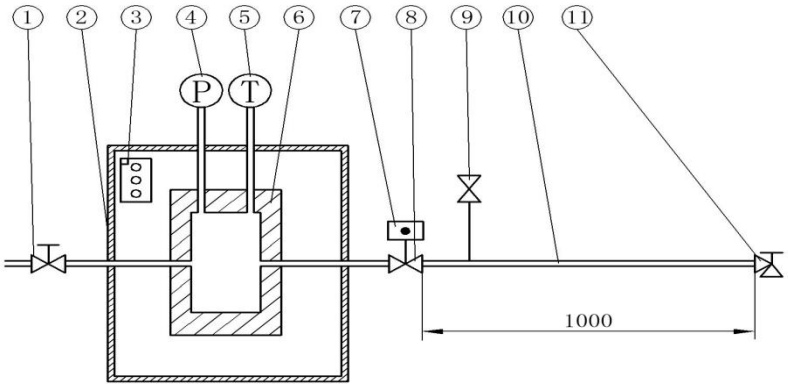
3——90% of 1st pressure peak

4——10% of 1st pressure peak

5——Cycle test 1

6——Cycle test 2

Figure10 Diagram of oxygen pressure cycle characteristic



Note:

1——Valve inlet;

2——Preheating device;

3——Temperature controller;

4——Pressure gauge;

5——Thermometer;

6——Oxygen container;

7——Acuator;

8——Quick shut off valve;

9——Vent valve

10——Copper pipe (inner diameter 5mm)

11——Valve under test

Figure11 Diagram of oxygen pressure surge tests

6.15 Seat leak tightness test

Take out the valve (including nonmetallic seal) of the valve, and burn the nonmetallic seal of the valve with alcohol lamp flame. After the nonmetallic seal is melted off or burned, the valve shall not be cleaned. The valve shall be reinstalled into the valve, and the valve shall be closed with a torque of no more than 12 N · M. nitrogen or air shall be filled into the valve inlet to P_{VT} pressure, which is given in 5.3.10.

6.16 Resistance to hydrochloric acid corrosion test

The steps of resistance to hydrochloric acid corrosion test are as follows:

a) Take out the valve stem of the valve;

b) Place the valve stem horizontally into the beaker A, add 1:1 hydrochloric acid until the sample is immersed about 2 / 3, the sample shall not touch the beaker wall, and it is placed at (20 ~ 28) ℃ for 12 h;

c) After taking out it, put it into another beaker B containing solid sodium chloride horizontally for 12 h;

d) Repeat steps a), b) and C) for 4 times;

e) Install the valve stem into the sample valve, close the valve with a torque of no more than T_o at room temperature and P_{VT} pressure, conduct internal

air tightness test according to the requirements of 6.9.1.3, and check whether the results comply with the provisions of 5.3.11.

6.17 Pressure relief device action tests

6.17.1 Bursting disc device action test

Install the valve to the testing device, keep the temperature of the valve at 60 ℃± 2 ℃, fill clean air or nitrogen to 90% of the minimum bursting pressure, the pressure rise rate shall be able to accurately read the minimum indication value of the pressure gauge, and the pressure holding time shall not be less than 5 S. Then pressurize steadily and continuously. The minimum indication value of the pressure gauge shall be accurately read during the pressure rise, and the rate of pressure rise per second shall not be less than 0.1% of the bursting pressure until the bursting disc bursts. This process shall not exceed 2 minutes, and the results are given in 5.3.12.2.

6.17.2 Fusible plug device action test

The acting temperature test, flow temperature test and anti extrusion test of fusible plug device shall be conducted according to the methods required in GB / T 8337, and the results are given in 5.3.12.3.

6.17.3 Bursting disc-fusible plug device action test

The flow temperature of fusible alloy shall be tested according to GB / T 8337, and the results are given in 5.3.12.4.

Install the valve to the special testing device, close the valve, keep the valve temperature at 11 ℃± 1 ℃ above the flow temperature of fusible alloy, then pressurize the valve until the bursting disc burst, and record the bursting pressure, which is given in 5.3.12.4.

6.17.4 Pressure seal loading spring device action test

Install the valve to the testing device, keep the valve in closed state, immerse in water, fill nitrogen or air from the valve inlet, and rise pressure slowly. When the first bubble starts formation at the outlet of pressure seal loading spring device, This pressure value is set pressure, and then continue to rise pressure to maximize the discharge, then slowly depressurize. When the bubble cannot be formed, This pressure value is the return sealing pressure. Repeat the test for three times, take the average value, and it is given in 5.3.12.2.

7 Inspection rules

7.1 Delivery inspection

7.1.1 Inspection of the valve one by one

Each valve shall be subjected to inspect one by one according to the items specified in Table 3; In the process of inspection, if one item is unqualified, the valve is unqualified.

7.1.2 Batch inspections

The manufacturer shall determine the batch number of the valves less than 5000. Three valves for batch inspection shall be random selected from each batch of all qualified products, and inspected according to the items in Table 3. In the process of inspection, if one valve does not meet the requirements of one item in this document, double sampling shall be conducted; When re-testing, if there are still unqualified items, the batch of valves will be determined as unqualified.

Table 3 Delivery inspection items

	Inspection items	Tests on every valve	Batch tests	Inspection methods	Judgment Basis	Numbers
1	Connection dimensions detection		√	6.5	5.2.3	V1～V3
2	Minimum closing torque test		√	6.8.1	5.3.3.1	V1～V3
3	Internal leak tightness test	√	√	6.9.2	5.3.4	V1～V3
4	External leak tightness test	√	√	6.9.2	5.3.4	V1～V3
5	Vacuum leak tightness test		√	6.9.2	5.3.4	V1～V3
6	Bursting disc device action test		√	6.17.1	5.3.12.2	V1
7	Fusible plug action test		√	6.17.2	5.3.12.3	V1
8	Bursting disc-fusible plug device action test		√	6.17.3	5.3.12.4	V1
9	Pressure seal loading spring device action test	√	√	6.17.4	5.3.12.2	V1
Note 1: Valves with vacuum requirement shall undergo test No.5 Note 2: Corresponding items of No. 6, 7, 8, 9 shall be carried out according to the valves with different pressure relief device types						

7.2 Type testing

7.2.1 The valve shall be type tested by the qualified inspection organization according to the requirements of relevant laws, regulations and safety technical specifications.

7.2.2 For valves with the same material and construction, type testing can be carried out according to the following coverage rules:

a) Valve with pressure relief device can cover those without pressure relief device;

b) The valve material shall meet the compatibility requirements of ISO 11114-1 and ISO 11114-2, and the outlet connection type shall meet GB / T 15383, which can cover the same medium;

c) Valves with high nominal operating pressure can cover those with low nominal operating pressure.

7.2.3 Some changes within the local valve design condition which have been type tested are given in 7.2.1 and 7.2.2, the supplementary coverage tests can be carried out according to the following rules:

a) Repetition of all tests except resistance to flame impingement test , excessive torque and failure torque if there is increase of valve test pressure;

b) The compatibility between each gas and the used material shall be verified according to ISO 11114-1 and ISO 11114-2 when there is a change of filled gas, and the corresponding test should be added if the gas is oxygen, acetylene and chlorine.

c) Repetition of any tests to be decided case by case depending on changes of chemical composition and mechanical properties if there is change in valve body material;

d) Repetition of endurance test with the parts integrity one test sample without subsequent leak tightness tests but with examination of the handwheel and handwheel to spindle interface, operating tests and flame impingement tests if there is change in handwheel material;

e) Additional endurance tests, internal leak tightness tests, part integrity examination and operating torque tests if there is a change in handwheel diameter;

f) Repetition of all tests to be decided case by case depending on the change if there is a change of the basic design dimensions of the valve components(valve stem diameter, spindle thread pitch, valve diameter, dimension of o-ring(s),diaphragm thickness);

g) ; Repetition of all tests to be decided case by case depending on the change if there is a change of metallic material of the valve operating mechanism components(e.g. gland nut,stem, diaphragm, springs);

h) Repetition of all tests to be decided case by case depending on the change if there is a change of gas passage geometry(e.g. diameter and flow impingement angles);

7.2.4 The manufacturer shall provide at least the following information to the type testing agency while providing samples:

a) Technical documents, including design drawings (The valve construction, grease usage, applicable gas medium, working pressure, design service life and whether it is used for gas cylinders with or without fixed protection devices shall be indicated), operate instruction (values of all the torques), list of parts , material specifications etc.

b) Information—of markings on valve

c) Declaration of medium compatibility in accordance with ISO 11114-1 and ISO 11114-2. manufacturer shall provide certificates of material compatibility, if selected materials are not covered by ISO 11114-1 and ISO 11114-2

d) The pressure range of opening and closing the RPD

7.2.5 The valves for type testing shall be selected from the products passing the delivery inspection. The sampling quantity, test items and test sequence are shown in Table 4. The sampling quantity of different types of valves shall be accumulated according to the corresponding test items.

For instance, for oxygen cylinder valve with safety relief device without fixed protection device, the sampling number should be 18pcs （V1～V11、V12、V13～V15、V16～V18）。.

Table 4 Test schedule for type testing

Test terms	Test items	Test methods	Judgment basis	Condition of test sample	Test temperature ℃	Test pressure MPa	Test sample number
Ⅰ	Mechanical property and chemical composition	6.2	5.1.2.1 5.1.2.2	New sample	Room temperature	——	J1～J3
Ⅱ	Oxygen aging test	6.3	5.1.4.1	As new sample	70±5	2.3±0.2	F1～F5
Ⅲ	Resistance to low temperature	6.4	5.1.4.2	As new sample	-40±2	——	F6～F10
1	Connection dimension inspection	6.5	5.2.3	As received	Room temperature	——	V1～V6
2	Hydraulic pressure test	6.6	5.3.1	As sequence1	Room temperature	P_{vbt}	V1
3	Resistance to flame impingement test	6.7	5.3.2	As sequence 1	Room temperature	——	V2
4	Operating performance test	6.8	5.3.3	As sequence 1	Room temperature	——	V3～V6
5	Leak tightness test	6.9.1	5.3.4	As new sample	Room temperature	See Table 2	V7～V11
6	Resistance to vibration test	6.10	5.3.5	As sequence 5	Room temperature	P_{vt}	V7～V11
7	Endurance test	6.11	5.3.6	As sequence 6	Room temperature	P_{vt}	V7～V11
8	Internal leak tightness	6.9.1.3	5.3.4	As sequence 7	-40^{0}_{-5}	P_{vt}	V7～V11
9	[a] Leak tightness tightness	6.9.1	5.3.4	As sequence 8	-20^{0}_{-5}	See Table 2	V7～V11
10	[a] Leak tightness tightness	6.9.1	5.3.4	As sequence 9	$65^{+2.5}_{-2.5}$	See Table 2	V7～V11
11	[a] Leak tightness tightness	6.9.1	5.3.4	As sequence 10	Room temperature	See Table 2	V7～V11

12	Integrity examination of parts	6.12	5.3.7	As sequence 11	Room temperature	——	V7～V11
13	[b] Resistance to mechanical impact test	6.13	5.3.8	As new sample	Room temperature	P_{vt}	V12
14	Resistance to oxygen pressure surge tests[c]	6.14	5.3.9	As new sample	60±3	P_{vt}	V13～V15
15	[d]Seat leak tightness test	6.15	5.3.10	As new sample	Room temperature	P_{vt}	V13～V15
16	[e]Resistance to hydrochloric acid corrosion	6.16	5.3.11	As new sample	20～28	P_{vt}	V13～V15
17	[f] Pressure relief device action tests	6.17	5.3.12	As new sample	6.17	6.17	V16～V18

Note:

[a] Only for valves with vacuum tightness requirement, vaccum tightness test is required;

[b] For valves without fixed protection devices, resistance to mechanical impact test is required;

[c] For valves with oxygen or other highly oxidizing gas, resistance to oxygen pressure surge test is required;

[d] For non-metallic seal acetylene cylinder valves, sealing test is required;

[e] For chlorine cylinder valves , resistance to hydrochloric acid corrosion test is required;

[f] For valves with PRD, hit test is required and according to corresponding PRD type..

7.2.6 All type testing items shall meet the requirements of this standard. If there is one valve fails to meet the requirements of one item in this standard , double sampling shall be conducted and all items shall be tested again. If there is still unqualified items, the valve type testing shall be determined as unqualified.

8 Marking, packing, transportation and storage

8.1 Marking

The following permanent and clear markings shall be provided on the valve:

a) Type of valve;
b) Nominal operating pressure;
c) Operating direction ;
d) Manufacturer’s name or trade-mark;
e) Manufacture batch and serial number;
f) Manufacture license number and TS mark(For valves with Regulatory requirements)
g) Mass marking of valves for liquid gas and acetylene;
h) Action pressure and /or action temperature of pressure relief device;
i) Design working life.

8.2 Packing, transportation and storage

8.2.1 Before packaging, the valves shall be kept dry. During packaging, the valve shall be clean, free of oil and corrosion, and the inlet and outlet threads shall not be damaged.

8.2.2 The product certificate and instruction manual shall be attached inside the packing box, and the product name, manufacturing license number, executive standard, production date, quantity, mass, manufacturer's name, contact address and telephone number shall be marked on the outside of the packing box.

8.2.3 The valves shall be stored in indoor of ventilated, dry, clean, and avoid of damp and chemical erosion. The valves shall be light loaded and unloaded. The valves shall be prevented heavy load, collision and falling during transportation, loading and unloading.

9 Product certificate and batch inspection certificate

9.1 Product certificate

The valve shall have product certificate. For residual pressure valves and valves used for supports combustion , flammable, toxic or very toxic media, electronic reading marks in the form of two-dimensional code shall be installed to publicize and information the electronic certificate of cylinder valve (for valves with electronic certificate, paper product certificate shall not be required). The product certificate shall at least include the following contents:

a) certificate number;
b) name and type of valve;
c) nominal operating pressure and nominal diameter;
d) suitable medium;
e) the standard number of products manufacturing;
f) manufacturing license number(valves with manufacturing license requirements);
g) delivery inspection date;
h) mass (valves with mass requirements);
i) manufacturer’s name;
j) official seal of manufacturer’s quality department.

9.2 Batch inspection certificate

9.2.1 Each batch number of valves delivered from the manufacturer shall be covered by batch testing certificate.

9.2.2 The contents recorded in the batch testing certificate shall contain delivery test items, product batch and product quantities this standard required.

9.2.3 The batch inspection certificate shall be signed and sealed by the product quality inspector or quality assurance engineer authorized by the top management of the manufacturer.

Annex A
(normative)
Residual pressure device

A.1 Type testing

Type testing of RPD shall be carried out in accordance with the schedule given in Table A.1.

Table A.1 Test items for type testing of RPD

Sequence	Test items	Test methods and judgment basis	Condition of test sample	Test temperature ℃	Test pressure MPa	Test sample number
1	Reverse direction Hydraulic pressure test tests	A.2.1	As new sample	Room temperature	$1.5\times P_{vt}$	D1
2	Opening pressure and closing-off pressure tests	A.2.2	As new sample	Room temperature	—	D2～D4
3	Endurance tests	A.2.3	From sequence 2	Room temperature	See A.2.3	D2～D4
4	Opening pressure and closing-off pressure tests	A.2.2	From sequence 3	-20^{0}_{-5}	—	D2～D4
5	Opening pressure and closing-off pressure tests	A.2.2	From sequence 4	Room temperature	—	D2～D4
6	Opening pressure and closing-off pressure tests	A.2.2	From sequence 5	$65^{+2.5}_{-2.5}$	—	D2～D4
7	Leak tightness tests in the reverse direction	A.2.4	From sequence 6	-20^{0}_{-5}	$0.05, P_{vt}$	D2～D4
8	Leak tightness tests in the reverse direction	A.2.4	From sequence 7	Room temperature	$0.05, P_{vt}$	D2～D4
9	Leak tightness tests in the reverse direction	A.2.4	From sequence 8	$65^{+2.5}_{-2.5}$	$0.05,\ P_{vt}$	D2～D4
10	Reverse direction hydraulic pressure test	A.2.1	From sequence 9	Room temperature	$1.5\times P_{vt}$	D2
11	Integrity examination of parts	A.2.5	From sequence 9	Room temperature	—	D3～D4
12	Resistance to [a]oxygen pressure surge tests	A.2.6	As new sample	60±3	P_{vt}	D5～D7

13	Resistance to [b] high flow impact tests	A.2.7	As new sample	Room temperature	See A.2.7	D8

[a] Resistance to oxygen pressure surge test is required, when the medium of RPV are oxygen or highly oxidizing;

[b] Two samples are required if the RPVs are used for both compressed and liquefied gases.

A.2 Test methods and judgment basis

A.2.1 Reverse direction hydraulic pressure test

The test must be carried out when the operating mechanism of the DPV is opened and the inlet is unblocked. Clean water shall be slowly injected from the outlet of RPV to 1.5 times of P_{vt}, and the test pressure shall be held for not less than 2 min without leakage.

After the test, disassemble the RPV and conduct visual inspection on parts. All parts shall be free from displacement (out of assembly position), loss of function (fracture) or missing, and the joints shall not be loosen.

A.2.2 Opening pressure and closing-pressure tests

Install the RPV to the test device as Figure A.1, and the following procedure shall be applied:

a) The RPD shall be activated three times by pressurizing the RPV in the opening condition via RPD inlet connection with twice the maximum opening pressure;

b) With the valve operating mechanism of shut off valve (V-1) and RPV open, gradually pressurize the RPV from the valve inlet connection, using a pressurization rate no more than 1 MPa/min. The opening pressure shall be recorded until visible bubbles are detected flowing from the RPV outlet connection;

c) Close the operating mechanism of RPV, and increase the pressure to a value of twice the maximum opening pressure;

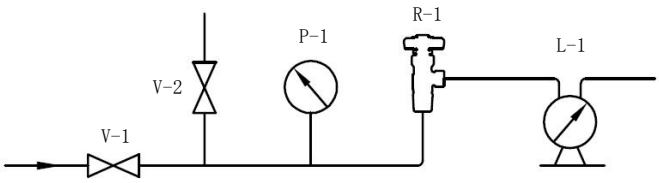
d) Close the shut off valve (V-1) , and stop pressurizing;

e) Open the valve operating mechanism fully and let the pressure decrease the RPV outlet. The RPD is considered activated when the flow rate decreases suddenly. The closing-off pressure shall be recorded if the leakage rate not exceeds 6 cm^3/h;

f) If the leakage rate exceeds 6 cm^3/h, to vent the gas opening of the vent valve (V-2) to decrease the pressure in every step of 0.02 MPa and measure the leakage rate at each step. If the leakage rate not exceeds 6 cm^3/h, the closing-off pressure has been reached and shall be recorded;

g) Action b) to f) shanll be repeated for 3 times.

The opening pressure and closing pressure at room temperature is decided by manufacturer. Whether the opening pressure and closing pressure test are conducted before or after the endurance test, they shall be verified against the manufacturer’s specification at room temperature. The RPD shall be able to open or close according to the above method in low or high temperatures.



Note:

V-1——Shut off valve

V-2——Vent valve

P-1——Pressure indicator

R-1——RPV

L-1——Flowmeter

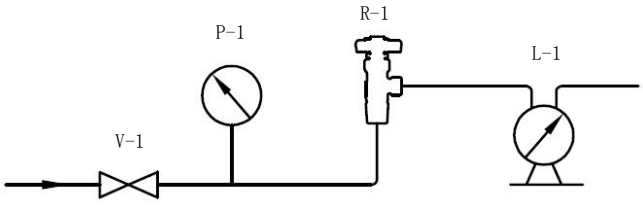
Figure A.1 Diagram of opening pressure and closing-pressure tests

A.2.3 Endurance tests

Install the RPV to the testing device, open Shut off valve(V-1) as Figure A.2, purge 2 times the maximum opening pressure or 1 MPa(whichever is greater) of filled air or nitrogen via RPV inlet, and open the RPD. Close the Shut off valve (V-1) as Figure A.2, and one cycle action completed when the pressure in RPV decreases to close the RPD. RPDs shall be tested for 100000 cycles.

The cycle time shall usually be set between 3s ～ 10s, and high pressure valves can appropriately extend the cycle time as the high frequency charging and discharging gas may cause the RPV temperature too high.

After the test, the RPV shall be able to work normally, and shall pass the opening pressure and closing-off pressure tests, reverse sealing tests, reverse direction hydraulic pressure test and integrity examinations of parts after endurance tests in Table A.1.



Note:

V-1——Shut off valve

P-1——Pressure indicator

R-1——RPV

L-1——Flowmeter

Figure A.2 Diagram of Endurance tests

A.2.4 Leak tightness tests in the reverse direction

Install the RPV to the testing device, open the operating mechanism of the RPV to open the main valve. When air or nitrogen is filled into the outlet of RPV to 0.05MPa and maintained for not less than 1 min, the leakage rate of RPD shall not be excess than 6 cm^3/h. Continue to pressurize gradually to P_{vt} and maintain for not less than 1 min, and the leakage rate of RPD shall not be greater than 6 cm^3/h.

A.2.5 Integrity examination of parts

When the endurance test, opening pressure and closing-off pressure, leak tightness tests in the reverse direction have been completed, parts (o-rings, gaskets, springs, diaphragms, plugs etc) shall be subjected to integrity examination according to the sequence in Table A.1.

During the visual examination, verification of the RPD and its components correspond to the submitted set of drawings shall be carried out.

A.2.6 Resistance to oxygen pressure surge tests

RPV with oxygen or other highly oxidizing gases shall be tested for resistance to Oxygen pressure surge. The Oxygen pressure surge tests shall be carried out according to the methods in 6.14 and the sequences in Table A.2.

After the test, the RPV shall be free from ignition and burning marks, and the parts of the RPV shall be free from displacement (out of assembly position), loss of function (fracture) or missing.

Note : All tests are conducted by filling oxygen from the outlet of RPV.

Table A.2 Sequence of resistance to oxygen pressure surge tests of RPV

Sequence	Operating mechanism	RPD	RPV inlet	connection device
1	Close	Function dismissed	No plugging	Special filling connector
2	Open	Function dismissed	Seal with metal threaded joint	Special filling connector
3	Open	Function not dismissed	Seal with metal threaded joint	Standard connector
4	Close	Function not dismissed	No plugging	Standard connector

A2.7 Resistance to high flow impact tests

A2.7.1 Preparation

According to the methods shown in Fig. A.3 and A.4, the RPD is tested for high flow test impact resistance in the direction of venting and filling. The test conditions shall meet the following requirements:

a) The RPV used for compressed gas shall be installed on a cylinder with water volume of 20 L and tested with air or nitrogen under P_w;

b) The RPV used for liquefied gas shall be installed on a cylinder with water volume of 10 L (filling capacity of 0.6 kg / L) and tested with gaseous carbon dioxide;

c) The minimum diameter of the testing device shall be larger than the maximum flow diameter of the RPV;

d) Before the test, the operating mechanism of the RPV shall be fully opened and the outlet shall be unblocked;

e) Take one test samples. If the valve is used for compressed gas and liquefied gas at the same time, two samples are required for high flow impact resistance tests of compressed gas and liquefied gas respectively;

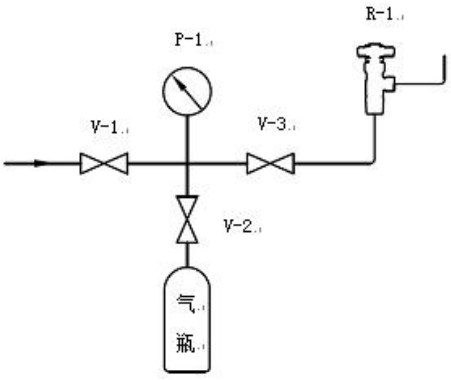
f) The special filled connector shall be used for the high flow impact resistance tests in the filled direction, and the RPD shall be opened.

A2.7.2 Test procedure

The resistance to high flow impact tests is carried out according to the following steps:

a) The RPD is impacted by high flow gas from the vent direction (see Figure A.3). The medium in the cylinder is completely discharged into the atmosphere through the RPV along the venting direction, and the tests shall be repeated for 10 times. After each impact and before the cylinder warms up, the closing-off pressure shall be at least 50% of that specified by the manufacturer;

b) The RPD is impacted by high flow gas from the inflation direction (see Figure A.4). The medium in the cylinder is completely discharged into the atmosphere through the RPV along the filling direction, and the tests shall be repeated for 10 times.



Note:

V-1——shut off valve

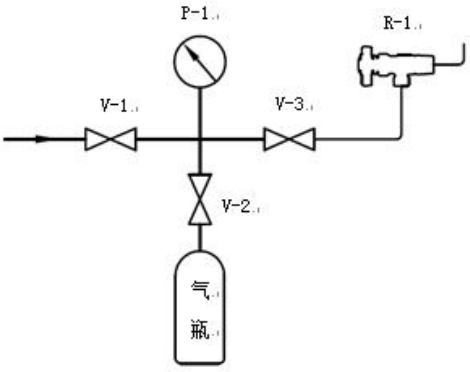
V-2——shut off valve

V-3——shut off valve

P-1——pressure indicator

R-1——RPV

FigureA.3 Diagram of resistance to high flow impact tests in outlet



V-1——shut off valve

V-2——shut off valve

V-3——shut off valve

P-1——pressure indicator

R-1——RPV

FigureA.4 Diagram of resistance to high flow impact tests in inlet

A2.7.3Judgment basis

After the test, the opening pressure and closing pressure tests shall be conducted at room temperature according to the procedure specified in A.2.2, and their ranges shall meet that of specified by the manufacturer.

Disassemble the RPV and conduct visual inspection on parts, and all parts shall be free from displacement (out of assembly position), loss of function (fracture) or missing, and the joints shall not be loosen.