
Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — Safety requirements in high-pressure devices

Matériel de soudage aux gaz — Centrales de détente pour la distribution d'acétylène pour le soudage, le coupage et les techniques connexes — Exigences de sécurité pour les dispositifs haute pression

STANDARDSISO.COM : Click to view the PDF file ISO 15615:2013



STANDARDSISO.COM : Click to view the full PDF of ISO 15615:2013



COPYRIGHT PROTECTED DOCUMENT

© ISO 2013

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Design	2
5 Requirements	2
5.1 General.....	2
5.2 General requirements.....	2
5.3 Additional requirements to be met by specific types of device.....	3
6 Type tests	4
6.1 General.....	4
6.2 Reference values and accuracy of instruments.....	4
6.3 Test gases.....	5
6.4 Acetylene decomposition test.....	5
6.5 Pressure resistance test.....	6
6.6 Non-return valve test.....	6
6.7 Endurance test.....	7
6.8 Trip pressure test for automatic pressure-actuated shut-off valves.....	8
6.9 Internal gas leakage test.....	9
7 Manufacturer's instructions	9
8 Marking	9
Annex A (normative) Summary of tests	10
Bibliography	16

STANDARDSISO.COM : Click to view the full PDF of ISO 15615:2013

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15615 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This second edition cancels and replaces the first edition (ISO 15615:2002), which has been technically revised.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 8 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

STANDARDSISO.COM : Click to view the full PDF of ISO 15615:2013

Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — Safety requirements in high-pressure devices

1 Scope

This International Standard establishes the general specifications, requirements and tests for devices located on the high-pressure side of acetylene manifold systems as defined in ISO 14114. It does not cover the high-pressure piping, flexible hoses and the regulator.

NOTE The terms “upstream” and “downstream” refer to the normal direction of gas flow in the device.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2503:2009, *Gas welding equipment — Pressure regulators and pressure regulators with flow-metering devices for gas cylinders used in welding, cutting and allied processes up to 300 bar (30 MPa)*

ISO 9090, *Gas tightness of equipment for gas welding and allied processes*

ISO 9539, *Gas welding equipment — Materials for equipment used in gas welding, cutting and allied processes*

ISO 10297, *Gas cylinders — Cylinder valves — Specification and type testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

non-return valve

device which prevents passage of gas in the direction opposite to flow

[ISO 15296:2004]

3.2

manual quick-acting shut-off valve

manually activated device to quickly stop the gas flow

[ISO 15296:2004]

3.3

automatic quick-acting shut-off device

self-acting device which closes quickly, e.g. when triggered by an acetylene explosion in the high-pressure manifold pipework

[ISO 15296:2004]

3.4

remotely actuated shut-off valve

quick-acting shut-off valve which quickly stops the gas flow when remotely triggered

3.5

automatic pressure-actuated shut-off valve

device which automatically stops the gas supply to the regulator when the downstream pressure rises above the maximum operating pressure

3.6

three-way valve

device which allows gas flow from one side of the high-pressure manifold to enter the regulator while isolating flow from the second side

Note 1 to entry: Its position can be reversed so that gas flows from the second side while the first side is isolated. It prevents simultaneous flow from both sides.

3.7

stop valve

device to prevent, when closed, the flow of gas

3.8

multifunctional safety device

device which incorporates two or more of the safety functions

[ISO 15296:2004]

3.9

pressure gauge

device which shows the actual pressure of the assembly (digital or analogue readouts) (e.g. used in the high-pressure line of manifold systems or in pressure regulators for manifold systems.)

4 Design

Components within the devices should be designed to remain at the same electrostatic potential as the body of the device during operation. All metal components in contact with gas should be electrically continuous to prevent static electricity discharges.

5 Requirements

5.1 General

The general requirements (see [5.2](#)) apply to all the devices defined in [Clause 3](#). The multifunctional safety devices shall meet the general and additional requirements corresponding to each function.

5.2 General requirements

5.2.1 Materials

Materials used for devices shall be in accordance with ISO 9539.

5.2.2 External gas tightness

The general requirements on external gas tightness shall be in accordance with ISO 9090 at all times, before and after the tests.

5.2.3 Internal gas tightness

Where internal gas tightness is required in this International Standard, the leakage rate shall not exceed 50 cm³/h for devices with a connection internal bore (diameter) less than 11 mm, or less than $0,41d^2$ for larger diameters. See 6.9 for test details.

NOTE The expression $0,41d^2$ gives the value of the flow in cm³/h when d is the internal bore (diameter), in mm, of the largest connection in the device.

5.2.4 Internal gas tightness after decomposition test

Where internal gas tightness is required after acetylene decomposition, the leakage rate shall not exceed 50 l/h. See 6.9 for test details.

5.2.5 Pressure resistance

The housings of the devices shall withstand a pressure of 31,5 MPa (315 bar) for 5 min without any observed leakage. After pressurization, there shall be no visible permanent deformation. See 6.5 for test details.

5.2.6 Acetylene decomposition

After the device has been tested with decomposition at 2,5 MPa initial pressure in accordance with 6.4, there shall be no visible permanent deformation of the device. No escape of gas shall occur during the test. Destruction of inner parts is permitted.

5.3 Additional requirements to be met by specific types of device

5.3.1 Non-return valve

Non-return valves shall not allow the reverse flow of gas greater than 150 cm³/h (0,15 l/h) when tested in accordance with 6.6.1 and 6.6.2, both before and after the 2 000-cycle fatigue test (see 6.6.3).

This requirement does not apply to the non-return valve after it has been subjected to the acetylene decomposition test.

5.3.2 Manual quick-acting shut-off valve

The decomposition test shall be carried out in the open position. Manual quick-acting shut-off valves shall meet the requirements of 5.2.3 before and after the endurance test (see 6.7). In the case of turn-acting valves, they shall not require more than half of a turn to close. See 6.7 for endurance test details. For valves with handwheels, the closing torque applied for the decomposition test shall be the endurance test torque as defined in the endurance test for cylinder valves in ISO 10297.

5.3.3 Automatic quick-acting shut-off device

Automatic quick-acting shut-off devices shall be triggered by an acetylene decomposition at 0,6 MPa (6 bar) and 2,5 MPa (25 bar). After tripping by acetylene decomposition, the internal gas leakage shall meet the requirements of 5.2.4.

5.3.4 Remotely actuated shut-off valve

Remotely actuated shut-off valves shall be triggered by an acetylene decomposition at 0,6 MPa (6 bar) and 2,5 MPa (25 bar). Remotely actuated shut-off valves shall meet the requirements of 5.2.3 before the decomposition test (see 6.4) and after the endurance test. See 6.7 for endurance test details.

5.3.5 Automatic pressure-actuated shut-off valve

Automatic pressure-actuated shut-off valves shall be triggered (stop gas flow on high-pressure side) at a pressure on the low-pressure signal port between 0,16 MPa and 0,20 MPa (1,6 bar and 2,0 bar) at both 0,1 MPa and 2,5 MPa (1 bar and 25 bar) on the high-pressure side. When triggered, the internal gas leakage shall meet the requirements of [5.2.3](#). See 6.8.2.1 (test 1) and 6.8.2.2 (test 2) for details.

The valve shall not be triggered when a pressure of 0,145 MPa to 0,150 MPa (1,45 bar to 1,50 bar) is held on the low-pressure signal port for 168 h. See 6.8.2.3 (test 3) for details.

Once actuated (closed), it shall not be possible for the valve to reset to an open condition without manual intervention.

In addition to the 31,5 MPa (315 bar) pressure resistance test on high-pressure chambers in [5.2.5](#), the internal chambers of the low-pressure signal port shall withstand a pressure of 6,0 MPa (60 bar) for 5 min. During pressurization, there shall be no visible permanent deformation or leakage to the atmosphere.

Automatic pressure shut-off valves shall meet the requirements of [5.2.3](#) before the decomposition test (see [6.4](#)) and after the endurance test (see [6.7](#)). During the decomposition test, the automatic pressure shut-off valve shall not burst. No parts shall be ejected.

5.3.6 Three-way valve

Three-way valves, when closed, shall meet the requirements of [5.2.3](#) before the decomposition test (see [6.4](#)) and after the endurance test (see [6.7](#)).

During the acetylene decomposition test, the three-way valve shall prevent the decomposition passing downstream of the valve.

For valves with handwheels, the closing torque applied for the decomposition test shall be the endurance test torque as defined in the endurance test for cylinder valves in ISO 10297.

5.3.7 Stop valve

The decomposition test shall be carried out with the valve in the closed position. In this position, stop valves shall meet the requirements of [5.2.3](#) before the decomposition test (see [6.4](#)) and after the endurance test (see [6.7](#)).

During the acetylene decomposition test, the stop valve shall prevent the decomposition passing downstream of the valve.

For valves with handwheels, the closing torque applied for the decomposition test shall be the endurance test torque as defined in the endurance test for cylinder valves in ISO 10297.

6 Type tests

6.1 General

The type test methods of [Clause 6](#) shall be applied to sample devices to be tested for compliance with this International Standard. Tests shall be carried out on new devices.

6.2 Reference values and accuracy of instruments

The pressure-measuring equipment used shall be accurate to within ± 1 % of the maximum reading

All pressures shall be given in megapascals (MPa) and in bars. If the temperature at the test assembly is outside the range of 20 ± 5 °C, the pressure shall be corrected in accordance with the ideal gas law. Consequently, the test shall be carried out at low temperatures with a lower initial pressure and at high temperatures with a higher initial pressure. The minimum temperature shall be 5 °C.

6.3 Test gases

The decomposition test shall be carried out with acetylene. All other tests shall be carried out with oil-free nitrogen or air.

6.4 Acetylene decomposition test

6.4.1 General

The test shall be carried out on three samples. The device shall be installed in the test equipment so the decomposition is initiated on the upstream side.

The device described in 3.1 shall be tested in the normal direction of gas flow. Devices described in 3.2, 3.3, 3.4 and 3.5 shall be tested in the open position. Devices described in 3.6 and 3.7 shall be tested in the closed position. The shut-off valves described in 3.2, 3.3, 3.4 and 3.5 are normally in the open position and intended to work in the event of an emergency.

The test conditions for all types of device and the number of samples to be tested are listed in [Annex A](#).

6.4.2 Test conditions

The devices shall be checked using a test set-up as shown in [Figure 1](#) and [Figure 2](#):

- ignition tube length (l_1): 5 m;
- tube length (l_2): 1 m;
- for samples with an outlet bore up to 10 mm: the internal diameters of the tubes, d_i , shall be 10 mm;
- for samples with an outlet bore larger than 10 mm: d_i shall be equal to the nominal outlet bore;
- industrial acetylene, static gas phase;
- ignition by fusible metal wire, ignition energy less than 100 J.

When testing pressure gauges (3.9), replace element 5 in [Figure 1](#) with a special T-fitting with an internal diameter of 10 mm and a branch line (internal diameter 5 mm and length 50 mm) and connect the device to the branch line. When testing pressure gauges, the internal diameters of the tubes of length l_1 and l_2 shall be 10 mm.

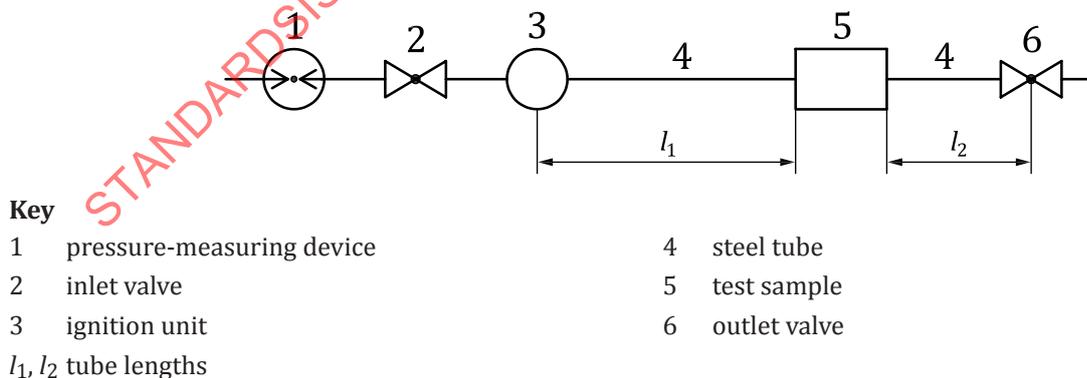
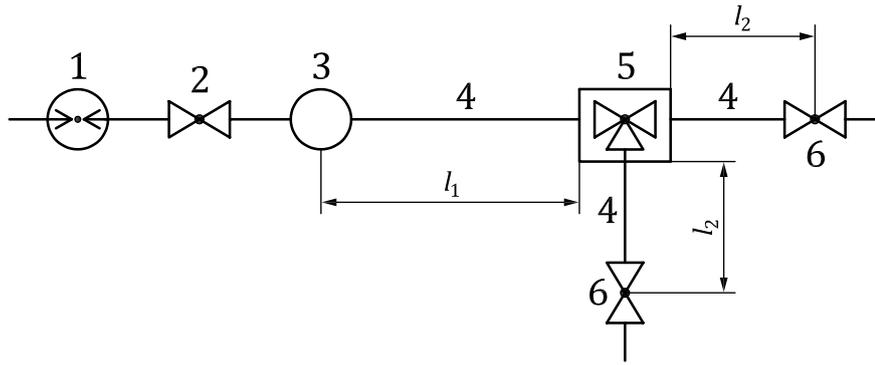


Figure 1 — Acetylene decomposition test set-up



Key

- | | | | |
|------------|---------------------------|---|-------------------------------|
| 1 | pressure-measuring device | 4 | steel tube |
| 2 | inlet valve | 5 | test sample (three-way valve) |
| 3 | ignition unit | 6 | outlet valve |
| l_1, l_2 | tube length | | |

Figure 2 — Test set-up for the acetylene decomposition test on three-way valves

6.4.3 Test procedure and test precautions

The test procedure is as follows:

- the whole test assembly shall be leak-tested with nitrogen at 2,5 MPa (25 bar);
- all residual gas shall be de-pressurized and evacuated (or purged with acetylene) from the system;
- the entire system shall be filled with acetylene to a pressure of 2,5 MPa (25 bar) or 0,6 MPa (6 bar), depending on the type of device being tested;
- the test assembly shall be isolated from the acetylene gas supply.
- it shall be ensured that all valves and controls are in the position required for the test;
- all personnel shall be evacuated from the area of the test to a suitable safe location;
- the ignition circuit shall be operated and it shall be checked whether a detonation has occurred;
- the device shall be examined using the pass/fail criteria as defined in [Clause 5](#).

All precautions shall be taken to protect personnel from the effect of fire and explosion.

6.5 Pressure resistance test

Conformity with the requirements of [5.2.5](#) shall be checked by means of a hydraulic-pressure test on one sample. No other tests shall be carried out on the sample either before or after this test, nor shall the sample tested be used for any other purpose.

6.6 Non-return valve test

6.6.1 General

For the tests, the samples shall be installed in the most disadvantageous position (gravity acting to open the valve).

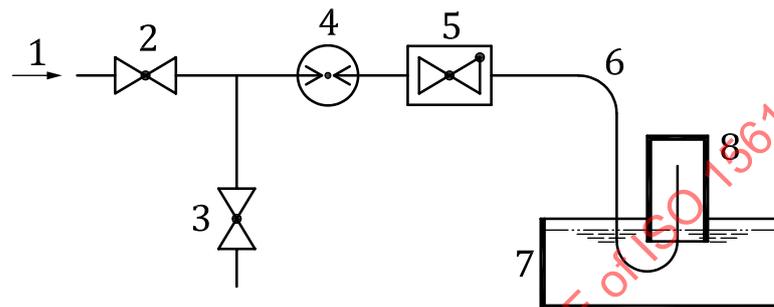
6.6.2 Reverse flow test

Three samples shall be subjected to this test. The test samples shall be checked against the requirements of 5.3.1.

A set-up of the equipment for the reverse flow gas test is given in Figure 3.

Before this test is performed, it shall be ensured that the non-return valve passes gas in the normal direction of flow.

The internal gas tightness of the non-return device shall be checked, with each device submitted, to a back pressure of 0,05 MPa (0,5 bar) and 2,5 MPa (25 bar) (see Figure 3).



Key

- | | | | |
|---|---------------------------|---|--|
| 1 | nitrogen or air | 5 | test sample (non-return acetylene valve) |
| 2 | shut-off valve | 6 | rubber hose |
| 3 | purge valve | 7 | water |
| 4 | pressure-measuring device | 8 | graduated cylinder |

Figure 3 — Set-up for reverse gas flow test

6.6.3 Fatigue test

The set-up of the equipment for the fatigue test is given in Figure 4.

Three samples shall be subjected to this test.

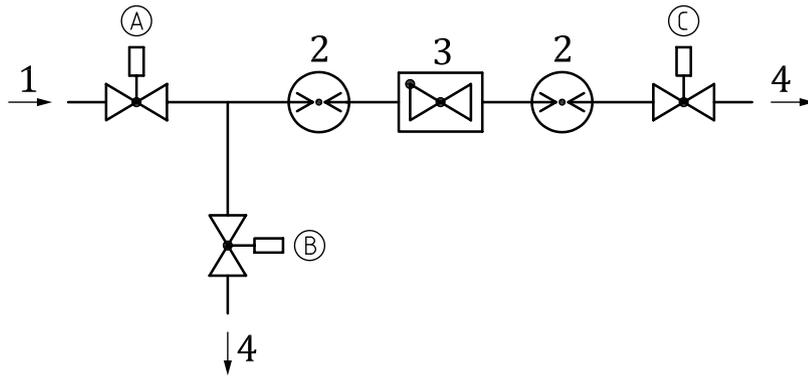
A sudden pressure (less than 100 ms) of 1,5 MPa (15 bar) is admitted through valve A in the normal direction of flow to the device being tested. Valve A is then closed and valve B is opened to vent the upstream side. Valve B is then closed, followed by valve C being opened briefly to vent the downstream side.

After a 2 000-cycle test, the non-return device shall again comply with the requirements of the reverse flow gas test (see 6.6.2).

6.7 Endurance test

The endurance test shall be in accordance with ISO 10297, with the following deviations. The number of cycles required is 500. The test shall be carried out at a test pressure of 2,5 MPa (25 bar).

The internal gas leakage of the valve in the closed position shall be checked against the requirements of 5.2.3 before and after the required number of cycles.



Key

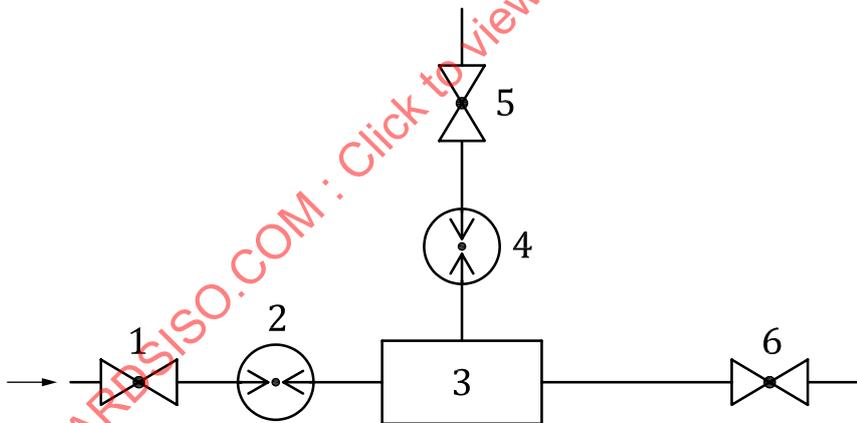
- | | | | |
|----------------|---------------------------|---|--------------------------------|
| 1 | nitrogen or air | 3 | test sample (non-return valve) |
| 2 | pressure-measuring device | 4 | purge |
| A, B, C valves | | | |

Figure 4 — Fatigue test set-up

6.8 Trip pressure test for automatic pressure-actuated shut-off valves

6.8.1 Equipment

The set up of the test equipment is given in [Figure 5](#).



Key

- | | | | |
|---|---------------------------|---|--------------------------------|
| 1 | inlet valve | 4 | signal port pressure indicator |
| 2 | pressure-measuring device | 5 | signal port valve |
| 3 | test sample | 6 | outlet valve |

Figure 5 — Test equipment for automatic pressure-actuated shut-off valves

6.8.2 Test procedure

6.8.2.1 Test 1

With the valve under test in the open condition and zero pressure on the signal port, set 0,1 MPa (1 bar) supply pressure and open control valve 6 to obtain a nominal flow of gas through the test valve. Increase the pressure on the signal port at a rate of approximately 0,2 MPa (2 bar) per minute until the valve under

test triggers and stops the gas flow. Record the signal pressure and repeat the test four times (giving a total of five tests). The signal pressure shall meet the requirements specified in 5.3.5 for all five tests.

6.8.2.2 Test 2

Repeat test 1 (see 6.8.2.1) with the supply pressure set at 2,5 MPa (25 bar).

6.8.2.3 Test 3

With the valve under test in the open condition, set 1 MPa (10 bar) supply pressure with control valve 6 closed (no flow). Set the pressure on the low-pressure signal port to between 0,145 MPa and 0,150 MPa (1,45 bar and 1,50 bar). Leave the equipment set in this condition for 168 h. After 168 h, open valve 6 to check that the valve under test has not closed.

6.9 Internal gas leakage test

With the device under test in the closed condition, connect the upstream side to a gas source at the maximum operating pressure, with the downstream side open to the atmosphere. Check that any internal gas leakage at the device outlet meets the requirements of 5.2.3 and, if necessary, 5.2.4.

7 Manufacturer's instructions

When distributed, the device shall be accompanied by the manufacturer's instructions, which shall contain, as a minimum, the following information:

- a) the function of the device;
- b) operational data and nameplate rating (e.g. maximum operating pressure, gas flow characteristics);
- c) type of gas: acetylene;
- d) instructions for installation of equipment;
- e) procedures to be carried out prior to operation;
- f) procedures for safe operation, in particular replacement of the device if some incident should be noticed;
- g) instructions in the event of malfunction;
- h) recommendations concerning inspection, testing, maintenance and lifetime (including the competence requested for the responsible personnel).

8 Marking

All marking shall be legible and durable as specified in ISO 2503:2009, Clause 7. The following information shall be included:

- a) the number of this International Standard;
- b) the name or trade mark of the manufacturer and/or distributor;
- c) the model or code number given in the manufacturer's instructions;
- d) the direction of normal gas flow (arrow);
- e) acetylene or its abbreviation, A;
- f) the maximum operating pressure, $p_{\max} = 2,5$ MPa (25 bar).

Annex A
(normative)

Summary of tests

See [Table A.1](#).

STANDARDSISO.COM : Click to view the full PDF of ISO 15615:2013

Table A.1 — Summary of tests with the corresponding requirements and number of test samples

Device	No. of test sample	External gas tightness	Internal gas tightness	Decomposition at 0,6 MPa	Decomposition at 2,5 MPa	Internal gas tightness after decomposition	Pressure resistance	Reverse flow	Fatigue	Reverse flow after fatigue test	Endurance	Internal gas tightness after endurance test	Trip test
		(as per ISO 9090)	(see 6.9)	(see 6.4)	(see 6.4)	(see 6.9)	(see 6.5)	(see 6.6.2)	(see 6.6.3)	(see 6.6.2)	(see 6.7)	(see 6.9)	(see 6.8)
Non-return-valve (see 3.1)	1	x	—	—	—	—	—	x	x	x	—	—	—
	2	x	—	—	—	—	—	x	x	x	—	—	—
	3	x	—	—	—	—	—	x	x	x	—	—	—
	4	x	—	—	x	—	—	—	—	—	—	—	—
	5	x	—	—	x	—	—	—	—	—	—	—	—
	6	x	—	—	x	—	—	—	—	—	—	—	—
	7	—	—	—	—	—	—	—	—	—	—	—	—
	Requirements	At 0,25 MPa and 2,5 MPa, leakage <8 cm ³ /h	—	—	Closed position, no permanent visible deformation, no gas escape during test	At 2,5 MPa, leakage <50 l/h	No permanent visible deformation or leakage to atmosphere after 5 min at 31,5 MPa	At 0,05 MPa and 2,5 MPa, reverse flow <150 cm ³ /h	2 000 cycles	At 0,05 MPa and 2,5 MPa, reverse flow <150 cm ³ /h	—	—	—
Manual quick-acting shut-off valve ^a (see 3.2)	1	x	x	—	x	x	—	—	—	—	—	—	—
	2	x	x	—	x	x	—	—	—	—	—	—	—
	3	x	x	—	x	x	—	—	—	—	—	—	—
	4	x	x	—	—	—	—	—	—	—	x	x	—
	5	—	—	—	—	—	x	—	—	—	—	—	—
	Requirements	At 0,25 MPa and 2,5 MPa, leakage <8 cm ³ /h	At 2,5 MPa, leakage <50 cm ³ /h or 0,41d ² (for units see 5.2.3)	—	Open position, no permanent visible deformation, no gas escape during test	At 2,5 MPa, leakage <50 l/h	No permanent visible deformation or leakage to atmosphere after 5 min at 31,5 MPa	—	—	—	500 cycles at 2,5 MPa	At 2,5 MPa, leakage <50 cm ³ /h or 0,41 d ² (for units see 5.2.3)	—

Table A.1 (continued)

Device	No. of test sample	External gas tightness	Internal gas tightness	Decomposition at 0,6 MPa	Decomposition at 2,5 MPa	Internal gas tightness after decomposition	Pressure resistance	Reverse flow	Fatigue	Reverse flow after fatigue test	Endurance	Internal gas tightness after endurance test	Trip test
		(as per ISO 9090)	(see 6.9)	(see 6.4)	(see 6.4)	(see 6.9)	(see 6.5)	(see 6.6.2)	(see 6.6.3)	(see 6.6.2)	(see 6.7)	(see 6.9)	(see 6.8)
Automatic quick-acting shut-off device (see 3.3)	1	x	—	x	—	x	—	—	—	—	—	—	—
	2	x	—	x	—	x	—	—	—	—	—	—	—
	3	x	—	x	—	x	—	—	—	—	—	—	—
	4 (may be 1/2/3)	x	—	—	x	x	—	—	—	—	—	—	—
	5 (may be 1/2/3)	x	—	—	x	x	—	—	—	—	—	—	—
	6 (may be 1/2/3)	x	—	—	x	x	—	—	—	—	—	—	—
	7	—	—	—	—	—	—	x	—	—	—	—	—
Requirements	At 0,25 MPa and 2,5 MPa, leakage <8 cm ³ /h	—	Open position, no permanent visible deformation, no gas escape during test	Open position, no permanent visible deformation, no gas escape during test	At 2,5 MPa, leakage <50 ml/h	No visible permanent deformation or leakage to atmosphere after 5 min at 31,5 MPa	—	—	—	—	—	—	—

STANDARDSISO.COM · Click to view the full PDF of ISO 15615:2013

Table A.1 (continued)

Device	No. of test sample	External gas tightness	Internal gas tightness	Decomposition at 0,6 MPa	Decomposition at 2,5 MPa	Internal gas tightness after decomposition	Pressure resistance	Reverse flow	Fatigue	Reverse flow after fatigue test	Endurance	Internal gas tightness after endurance test	Trip test
		(as per ISO 9090)	(see 6.9)	(see 6.4)	(see 6.4)	(see 6.9)	(see 6.5)	(see 6.6.2)	(see 6.6.3)	(see 6.6.2)	(see 6.7)	(see 6.9)	(see 6.8)
Remotely actuated shut-off valve (see 3.4)	1	x	x	x	—	x	—	—	—	—	—	—	—
	2	x	x	x	—	x	—	—	—	—	—	—	—
	3	x	x	x	—	x	—	—	—	—	—	—	—
	4 (may be 1/2/3)	x	x	—	—	x (open)	—	—	—	—	—	—	—
	5 (may be 1/2/3)	x	x	—	—	x (open)	—	—	—	—	—	—	—
	6 (may be 1/2/3)	x	x	—	—	x (open)	—	—	—	—	—	—	—
	7	x	x	—	—	x (closed)	—	—	—	—	—	—	—
	8	x	x	—	—	x (closed)	—	—	—	—	—	—	—
	9	x	x	—	—	x (closed)	—	—	—	—	—	—	—
	10	x	—	—	—	—	—	—	—	—	x	x	—
	11	—	—	—	—	—	—	x	—	—	—	—	—
Requirements	At 0,25 MPa and 2,5 MPa, leakage <8 cm ³ /h	At 2,5 MPa, leakage <50 cm ³ /h or 0.41d ² (for units see 5.2.3)	Open position, no permanent visible deformation, no gas escape during test	No visible permanent deformation, no gas escape during test	At 2,5 MPa, leakage <50 l/h	No permanent visible deformation or leakage to atmosphere after 5 min at 31,5 MPa	—	—	—	—	500 cycles	At 2,5 MPa, leakage <50 cm ³ /h or 0.41 d ² (for units see 5.2.3)	—