INTERNATIONAL STANDARD

ISO 15615

Third edition
2022-10

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

Reference number
ISO 15615:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 15615:2013), which has been technically revised.

The main changes are as follows:

— the manual quick-acting shut-off valve has been removed because it is no longer state of the art;

— the remotely actuated shut-off valve has been removed because it is no longer state of the art;

— in 3.8 the definition of change-over unit has been added;

— in 5.2.6 a requirement has been added;

— in 5.3.4 the additional requirements for three-way valves have been clarified;

— in 5.3.6 specific requirements for pressure gauges have been added;

— new subclause 6.4 on external gas leakage test has been added;

— in 6.7.2 tolerances have been added;

— in 6.7.3 a minimum value for vacuum has been added;

— in 6.7.4.4 the test conditions for three-way valves have been clarified;

— in 6.8.2 other comparable test methods for leakage have been permitted;

— in 6.8.3 a minimum settling time of pressure has been added;

— in Clause 8 the kind of device has been added to the marking.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

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

1 Scope

This document establishes the general specifications, requirements and tests for devices located on the high-pressure side of acetylene manifold systems up to 2,5 MPa (25 bar)[1)] as defined in ISO 14114. It does not apply to high-pressure piping, high-pressure flexible hoses or pressure regulators.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 5171, *Gas welding equipment — Pressure gauges used in welding, cutting and allied processes*

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*

ISO 15296:2017, *Gas welding equipment — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15296 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
non-return valve
device that prevents passage of gas in the direction opposite to the intended flow

[SOURCE: ISO 15296:2017, 3.4.2]

3.2
automatic quick-acting shut-off device
self-acting device that closes quickly, for example when triggered by an acetylene decomposition in the high-pressure manifold pipework

[SOURCE: ISO 15296:2017, 3.4.10, modified — Definition revised.]

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

3.3
automatic pressure-actuated shut-off valve
device that automatically stops the gas supply to the regulator when the downstream pressure rises above the maximum operating pressure

Note 1 to entry: The terms “upstream”, “upstream side”, “downstream” and “downstream side” in this document refer to the intended direction of gas flow in the device.

3.4
three-way valve
device that can be manually or automatically actuated and allows gas flow from one side or the other, but not both sides, of the high-pressure manifold to enter the regulator while isolating flow from the other side

3.5
stop valve
device that prevents the flow of gas when closed

3.6
multifunctional safety device
device that incorporates two or more of the safety functions

[SOURCE: ISO 15296:2017, 3.4.8]

3.7
pressure gauge
device that shows the actual pressure of the assembly (digital or analogue readouts), for example used in the high-pressure line of manifold systems

3.8
change-over unit
device in a two-sided system allowing switching the supply of gas to the system from either its bank of cylinders or bundles by means of a pressure-actuated switching mechanism without interrupting the supply

[SOURCE: ISO 14114:2017, 3.7, modified — Definition revised and note to entry deleted.]

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.

All flow and leakage rate figures in this document shall be specified and measured under normal conditions [0,101 3 MPa (1,013 bar), 23 °C].

5.2 General requirements

5.2.1 Materials

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

5.2.2 External gas leakage

The general requirements on external gas leakage shall be in accordance with ISO 9090 before and after the tests except for the pressure resistance test. See 6.4 for test details.

5.2.3 Internal gas leakage

Where internal gas leakage is named in this document, the leakage rate shall not exceed 50 cm^3/h for devices with a connection internal bore (diameter) less than 11 mm or less than $0{,}41d^2$ for larger diameters. See 6.5 for test details.

NOTE The expression $0{,}41d^2$ gives the value of the flow in cm^3/h, where d is the internal bore (diameter), in mm, of the largest connection in the device.

5.2.4 Internal gas leakage after decomposition test

Where internal gas leakage after acetylene decomposition is named, the leakage rate shall not exceed 50 l/h (see 6.5 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 6.6 for test details).

5.2.6 Acetylene decomposition

After the device has been tested with decomposition at 2,5 MPa (25 bar) initial pressure in accordance with 6.7, there shall be no visible permanent deformation of the device. No escape of gas shall occur during the test. No part shall be ejected. Destruction of inner parts is permitted.

5.3 Additional requirements to be met by specific types of devices

5.3.1 Non-return valve

Non-return valves shall not allow the reverse flow of gas greater than 150 cm^3/h (0,15 l/h) when tested with a back pressure of 0,05 MPa (0,5 bar) and 2,5 MPa (25 bar) in accordance with 6.8.2, before and after the 2 000-cycle fatigue test carried out in accordance with 6.8.3.

These requirements do not apply to the non-return valve after it has been subjected to the acetylene decomposition test.

5.3.2 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) and shall fulfil the requirements of 5.2.6. After tripping by acetylene decomposition, the internal gas leakage shall meet the requirements of 5.2.4.

5.3.3 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 6.10.3.1 (test 1) and 6.10.3.2 (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 6.10.3.3 (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 6.7) and after the endurance test (see 6.9).

5.3.4 Three-way valve

Three-way valves, when closed, shall meet the requirements of 5.2.3 before the decomposition test (see 6.7) and after the endurance test (see 6.9) and the requirements of 5.2.4 after the decomposition test.

Additional requirements for the decomposition test (see 6.7.4.4):

Sample 1: The three-way valve shall prevent the decomposition from passing through the isolated inlet of the valve.

Sample 2: The three-way valve shall prevent the decomposition from passing through the isolated part of the valve.

Sample 3: The three-way valve shall prevent the decomposition from passing through the isolated, intended upstream side of the valve.

5.3.5 Stop valve

In the closed position, stop valves shall meet the requirements of 5.2.3 before the decomposition test (see 6.7) and after the endurance test (see 6.9). After the decomposition test, the stop valves shall meet the requirements of 5.2.4.

During the acetylene decomposition test, the stop valve shall prevent the decomposition from 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.

5.3.6 Pressure gauge

If the pressure gauge is a Bourdon-tube pressure gauge, it shall fulfil the functions and safety requirements specified in ISO 5171 in addition to the requirements of this document.

6 Type testing

6.1 General

The type test methods of 6.2 to 6.10 shall be applied to sample devices to be tested for conformity with this document. Tests shall be carried out on new devices. The test order shall be carried out as specified in Annex A, Table A.1.

6.2 Reference values and accuracy of instruments

The accuracy of the pressure-measuring instrument shall be within ± 3 % of the measured value. For this purpose, the maximum measuring range (full scale) and class of the pressuremeasuring instrument to be used shall be selected appropriately.

All pressures shall be given in megapascals (MPa) and in bars (bar). 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 an acetylene supply source of purity of at least 99,5 %. All other tests shall be carried out with oil-free nitrogen or air.

6.4 External gas leakage

Conformity with the requirements of 5.2.2 shall be checked

6.5 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 5.2.4. The procedure of measurement of the leakage rate shall be carried out in the same manner as specified in ISO 9090.

6.6 Pressure resistance test

One sample shall be checked against the requirements of 5.2.5 by means of a hydraulic-pressure test. No other tests shall be carried out on the sample either before or after this test. The sample tested shall not be used for any other purpose.

6.7 Acetylene decomposition test

6.7.1 General

Three samples shall be checked against the requirements of 5.2.6. The device shall be installed in the test set-up given in Figure 1, so the decomposition is initiated on the upstream side (if a flow direction is given).

6.7.2 Test conditions

The devices shall be checked as follows using a test set-up as shown in Figure 1 or Figure 2:

— tube length between key 2 and key 3 (l_1) of Figure 1: 100 mm ± 3 %;

— ignition tube length (l_2): 5 m ± 3 %;

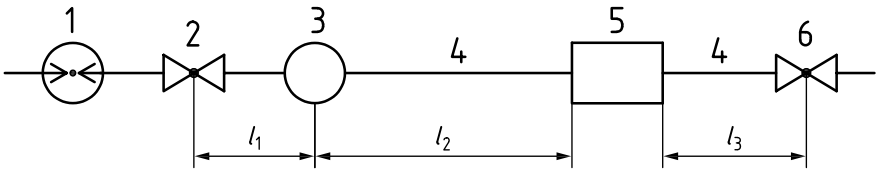
— tube length (l_3): 1 m ± 3 %;

— for samples with an inner diameter of connection up to 10 mm, the internal diameters of the tubes (key 4 of Figure 1 and Figure 2) shall be 10 mm ± 0,5 mm;

— for samples with an inner diameter of connection larger than 10 mm, the internal diameters of the tubes (key 4 of Figure 1 and Figure 2) shall be equal to or larger than the inner diameter of connection, but not larger than 1,2 times the inner diameter of connection;

— industrial acetylene, static gas phase;

— ignition by fusible metal wire, ignition energy less than 100 J.



Key

1	pressure-measuring device	4	steel tube
2	inlet valve	5	test sample
3	ignition unit	6	outlet valve
l_1, l_2, l_3	tube lengths		

Figure 1 — Acetylene decomposition test set-up

6.7.3 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 depressurized and evacuated down to at least 1 000 Pa (10 mbar) absolute from the system or the whole system shall be purged at least three times with acetylene (test gas);

— the entire system shall be filled with acetylene to a pressure of 2,5 MPa (25 bar) (for samples intended to be tested in the closed position also behind the closed sample), depending on the type of device being tested;

— the test assembly shall be isolated from the acetylene gas supply;

— it shall be ensured that the inlet valve (key 2) and outlet valve (key 6) are closed and controls are in the position required for the test;

— all personnel shall be evacuated from the area of the test to a suitably safe location;

— the ignition circuit shall be operated and a check carried out to determine whether a detonation has occurred;

— the device shall be examined using the pass or fail criteria as defined in Clause 5.

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

6.7.4 Additional test conditions for certain devices

6.7.4.1 Automatic quick-acting shut-off device

In addition to the acetylene decomposition test of three samples with 2,5 MPa (25 bar), another three samples shall be subjected to an acetylene decomposition test with 0,6 MPa (6 bar) in the same manner as 6.7.1 to 6.7.3. Automatic quick-acting shut-off devices shall be tested in the open position. The device is normally in the open position and intended to work in the event of an emergency.

6.7.4.2 Automatic pressure-actuated shut-off valve

Automatic pressure-actuated shut-off valves shall be tested in the open position. The device is normally in the open position and intended to work in the event of an emergency.

6.7.4.3 Pressure gauges

When testing pressure gauges (3.7), replace element 5 in Figure 1 with a special T-fitting with an internal diameter of 10 mm ± 0,5 mm and a branch line (internal diameter 4 mm ± 0,5 mm and total length of the branch line of 50 mm ± 3 %) 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 ± 0,5 mm.

6.7.4.4 Three-way valves

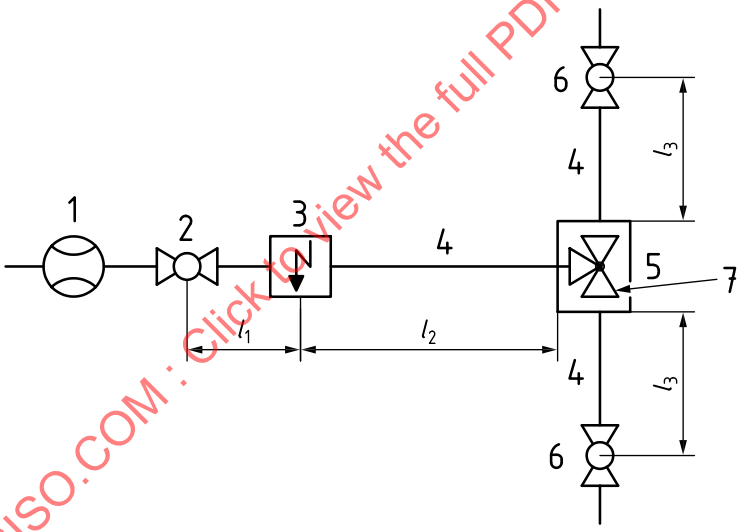
The required three samples of the three-way valve shall each be tested in a different manner (see Figure 2).

Sample 1: with l_2 on the intended downstream side and one intended upstream side isolated.

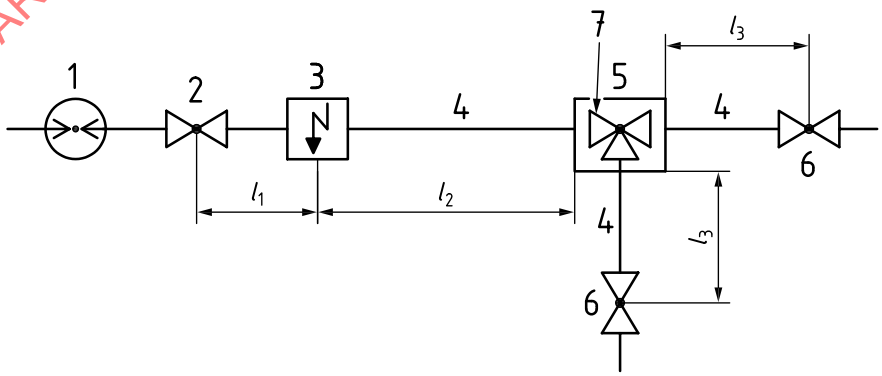
Sample 2: with l_2 on one intended upstream side (manifold side) while this upstream side is completely isolated from the other two connections of the valve.

Sample 3: with l_2 on one intended upstream side (manifold side) while this upstream side is open to the intended downstream side.

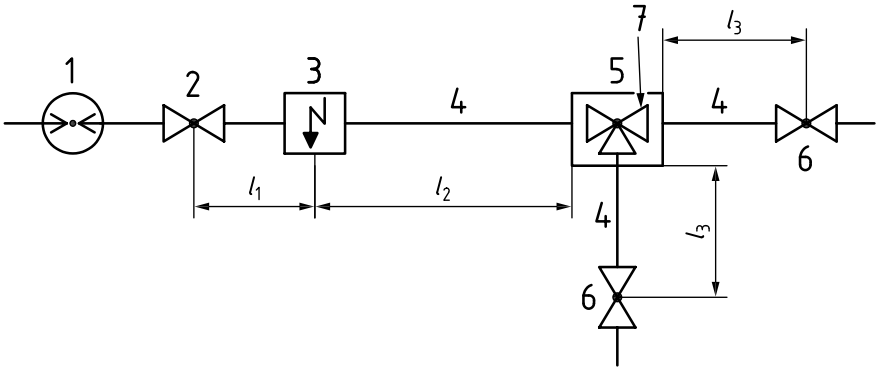
In the case of a three-way valve with a pressure-actuated switching mechanism (change-over unit), where the upstream side cannot be isolated, sample 2 shall be tested analogue to sample 1.



a) Test set-up for sample 1



b) Test set-up for sample 2



c) Test set-up for sample 3

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, l_3	tube lengths	7	side closed

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

6.7.4.5 Stop valves

Stop valves shall be tested in the closed position.

6.8 Non-return valve test

6.8.1 General

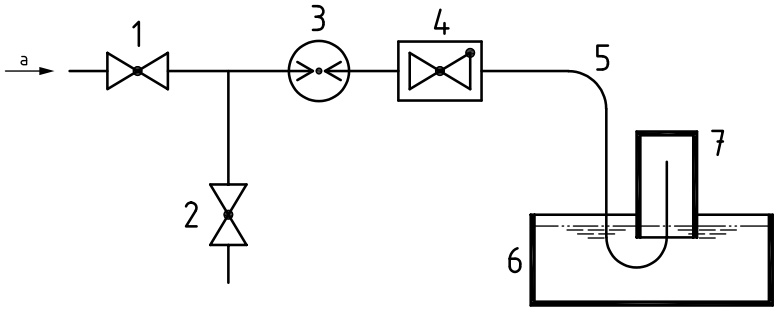
For the tests, the samples shall be installed in the most disadvantageous position (gravity acting to open the valve).

6.8.2 Reverse flow test for non-return valves

Three samples shall be checked against the requirements of 5.3.1.

An example of a set-up of the equipment for the reverse flow gas test is given in Figure 3. Other test methods for leakage are permitted, provided that it can be shown that these test methods give results as accurate as those available from the method given in ISO 9090.

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



Key

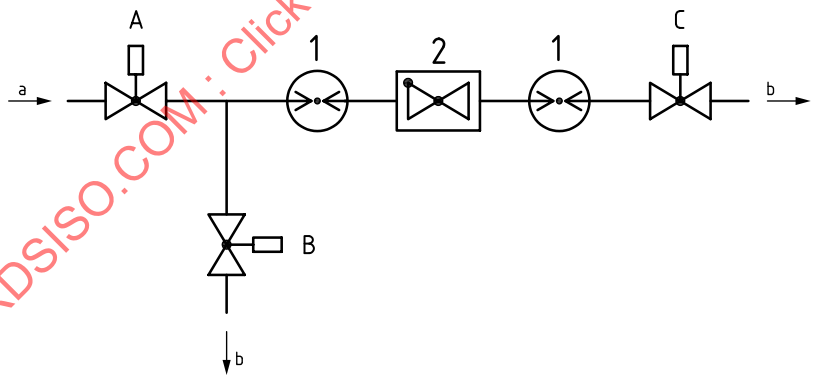
1	shut-off valve	5	rubber hose
2	purge valve	6	water
3	pressure-measuring device	7	graduated cylinder
4	test sample (non-return valve)	a	Nitrogen or air.

NOTE Intended flow direction of item 4 is reversed to the system flow direction.

Figure 3 — Set-up for reverse gas flow test

6.8.3 Fatigue test for non-return valves

Three samples shall be checked against the requirements of 5.3.1. The set-up of the equipment for the fatigue test is given in Figure 4. The following procedure describes the sequence of one cycle (of 2 000 cycles). 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 and maintained for at least 5 s. Valve A is then closed and valve B is opened to vent the upstream side for at least 5 s. Valve B is then closed, followed by valve C being opened for at least 5 s to vent the downstream side.



Key

1	pressure-measuring device	a	Nitrogen or air.
2	test sample (non-return valve)	b	Purge.
A, B, C	valves		

Figure 4 — Fatigue test set-up

6.9 Endurance test for three-way valves, automatic pressure-actuated shut-off valves and stop valves

One test sample shall be checked against the requirements of 5.3.3, 5.3.4 or 5.3.5. The endurance test shall be in accordance with ISO 10297, with the deviations of 500 cycles and a test pressure of 2,5 MPa (25 bar).

The internal gas leakage of the valve in the closed position shall fulfil the requirements of 5.2.3 before and after the endurance test.

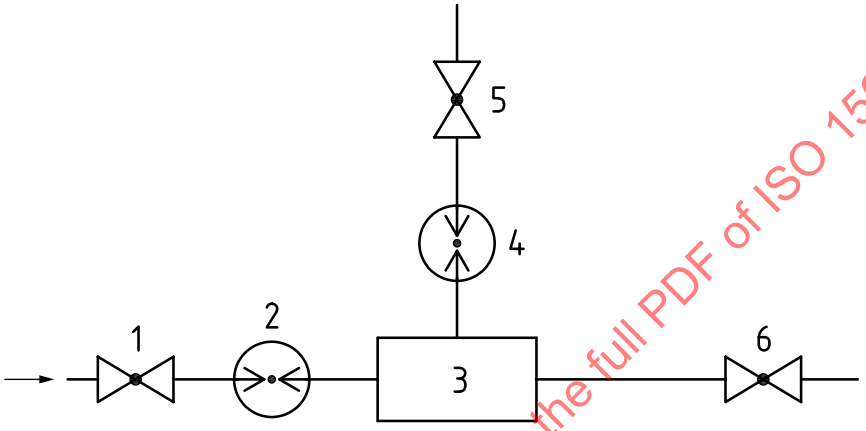
6.10 Trip pressure test for automatic pressure-actuated shut-off valves

6.10.1 General

Three test samples shall be checked against the requirements of 5.3.3.

6.10.2 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

6.10.3 Test procedure

6.10.3.1 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/min (2 bar/min) 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 5.3.3 for all five tests.

6.10.3.2 Test 2

Repeat test 1 (see 6.10.3.1) with the supply pressure set at 2,5 MPa (25 bar).

6.10.3.3 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.

7 Manufacturer's instructions

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

a) the function of the device;

b) operational data and nameplate rating (e.g. maximum operating pressure, gas flow characteristics);

c) the 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 an incident is noticed;

g) instructions in the event of malfunction;

h) recommendations concerning inspection, testing, maintenance and lifetime (including the competence requested for the responsible personnel);

i) maximum inner tube diameter (corresponding to the applied test tubes according to 6.7.2) to be connected.

8 Marking

All marking shall be legible and durable.

Markings shall be rubbed by hand, without undue pressure, first for 15 s with a cloth soaked with distilled water, then for 15 s with a cloth soaked with petroleum spirit.

The marking shall remain legible after this procedure.

The following information shall be included:

a) A reference to this document (i.e. ISO 15615:2022).

b) The kind of device (e.g. non-return valve) except for pressure gauges and stop valves. If the full name of the safety device cannot be marked, the following abbreviations shall be used:

   — non-return valve: HNV;

   — automatic quick-acting shut-off device: AQV;

   — automatic pressure-actuated shut-off valve: APV;

   — three-way valve: 3WV;

   — change-over unit: COU.

The appropriate letters shall be enclosed in a square as in the following example:

APV

c) The name or trademark of either the manufacturer or distributor, or both.

d) The model or code number given in the manufacturer's instructions.

e) The direction of normal gas flow (arrow).

f) Acetylene or its abbreviation, A.

g) The maximum operating pressure, p_{max} = 2,5 MPa (25 bar).

Annex A
(normative)

Summary of tests

See Table A.1.