INTERNATIONAL STANDARD

ISO 15615

First edition
2002-04-15

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 15615:2002(E)

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Printed in Switzerland

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

Annex A forms a normative part of this International Standard.

Contents

Foreword

This document (EN ISO 15615:2002) has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2002, and conflicting national standards shall be withdrawn at the latest by October 2002.

Annex A is normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard : Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard lays down the general specifications, requirements and tests of devices located on the high-pressure side of acetylene manifold systems as defined in EN ISO 14114. The standard 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

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 849, *Transportable gas cylinders — Cylinder valves — Specification and type testing.*

EN 13622:2001, *Gas welding equipment — Terminology — Terms used for gas welding equipment.*

EN 29090, *Gas tightness of equipment for gas welding and allied processes (ISO 9090:1989).*

EN 29539, *Materials for equipment used in gas welding, cutting and allied processes (ISO 9539:1988).*

EN ISO 2503:1998, *Gas welding equipment — Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar (ISO 2503:1998).*

EN ISO 7291, *Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 300 bar (ISO 7291:1999).*

EN ISO 14114, *Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — General requirements (ISO 14114:1999).*

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
non-return valve
device which prevents passage of gas in the direction opposite to flow
[EN 13622:2001]

3.2
manual quick acting shut-off valve
manually activated device to quickly stop the gas flow
[EN 13622:2001]

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
[EN 13622:2001]

3.4
remote 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. 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
[EN 13622:2001]

4 Design and materials

4.1 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.

4.2 Materials

Materials used for devices shall be in accordance with EN 29539.

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 External gas tightness

The general requirements on external gas tightness before acetylene decomposition shall be in accordance with EN 29090.

5.2.2 Internal gas tightness before decomposition test

Where internal gas tightness is required in this standard the leakage rate shall not exceed 50 cm^3/h for devices with a connection internal bore (diameter) less than 11 mm or 0,41 d^2 for larger diameters. See 6.9 for test details.

The value 0,41 d^2 shall be the flow in cm^3/h where d is the internal bore (diameter) in mm of the largest connection of the device.

5.2.3 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.

5.2.4 Pressure resistance

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

5.2.5 Acetylene decomposition

After the device has been tested in accordance with 6.4, there shall be no visible permanent deformation of the device. No escape of gas shall occur during the test.

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 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

Manual quick acting shut-off valves shall meet the requirements of 5.2.2 and 5.2.3 before and after a 500 cycle test. 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.

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 at 2,5 MPa (25 bar). After tripping the internal gas leakage shall meet the requirement of 5.2.3. See 6.10 for test details.

5.3.4 Remote actuated shut-off valve

The remote actuated shut-off valves, when in the closed condition, shall meet the internal gas leakage requirements of 5.2.2 and 5.2.3 before and after the acetylene decomposition test (see 6.4) as well as before and after a 500 cycle 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 to 0,20 MPa (1,6 bar to 2,0 bar) at both 0,1 MPa and 2,5 MPa (1 bar and 25 bar) inlet pressures. When triggered the internal gas leakage shall meet the requirement of 5.2.2. See 6.8.2.1 for test 1 and 6.8.2.2 for 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 for 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 test on high pressure chambers in 5.2.4 the internal chambers of the low pressure signal port shall withstand a pressure of 6,0 MPa (60 bar) for 5 min. During pressurisation, there shall be no permanent deformation or leakage to the atmosphere.

Automatic pressure actuated shut-off valves shall meet the requirements for internal gas tightness, external gas tightness and pressure actuation both before and after the acetylene decomposition test (see 6.4) as well as before and after a 500 cycle endurance test. See 6.7 for endurance test details.

5.3.6 Three way valve

Three way valves, when closed, shall meet requirements for internal gas tightness of 5.2.2 and 5.2.3 before and after the acetylene decomposition test (see 6.4) as well as before and after a 500 cycle endurance test. See 6.7 for endurance test details.

During the acetylene decomposition test the three way valve shall prevent the decomposition passing down stream of the valve.

5.3.7 Stop valve

Stop valves, when closed, shall meet the internal gas leakage requirement of 5.2.2 and 5.2.3 before and after the acetylene decomposition test (see 6.4) and after a 500 cycle endurance test. See 6.7 for endurance test details.

During the acetylene decomposition test the stop valve shall prevent the decomposition passing down stream of the valve.

6 Type tests

6.1 General

The type test methods of clause 6 are to be applied to sample devices to be tested for compliance with this standard. Tests shall be carried out on new devices.

6.2 Reference values and accuracy of instruments

Reference values and accuracy of instruments are as follows:

— flow-measuring equipment: ± 3 % of maximum reading;

— pressure-measuring equipment: ± 1 % of maximum reading.

All pressures are provided in megapascal (MPa) and in bar. Tests shall be carried out at a temperature of (20 ± 5) °C.

6.3 Test gases

The decomposition test shall be carried out with acetylene. All other tests shall be carried out either with industrial acetylene (with or without solvent) or nitrogen free from oil or grease.

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 into 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 test conditions for all types of devices and the number of samples are listed in Table 1.

Table 1 — Test conditions for acetylene decomposition test

Device	Test conditions	Test pressure	Acetylene decomposition test set-up
non-return valve (see 3.1)	Three samples shall be tested in the closed position at 2,5 MPa (25 bar).	2,5 MPa (25 bar)	Figure 1
manual quick acting shut-off valve (see 3.2)	Three samples shall be tested in the open position; after the test, the device shall be closed and checked that the internal gas leakage is below 50 l/h.	2,5 MPa (25 bar)	Figure 1
automatic quick acting shut-off device (see 3.3)	Three samples shall be tested in the open position at 0,6 MPa (6 bar), three samples [a] shall be tested in the open position at 2,5 MPa (25 bar).	0,6 MPa (6 bar) and 2,5 MPa (25 bar)	Figure 1
remote actuated shut-off valve (see 3.4)	Three samples shall be tested in the open position at 0,6 MPa (6 bar), three samples[a] shall be tested in the open position at 2,5 MPa (25 bar), and three more samples shall be tested in the closed position at 2,5 MPa (25 bar).	0,6 MPa (6 bar) and 2,5 MPa (25 bar)	Figure 1
automatic pressure actuated shut-off valve (see 3.5)	The test conditions shall conform to those specified for the manifold regulator according to EN ISO 7291.	—	—
three way valve (see 3.6)	Three samples shall be tested in the closed position.	2,5 MPa (25 bar)	Figure 2
stop valve [b] (see 3.7)	Three samples shall be tested in the closed position.	2,5 MPa (25 bar)	Figure 1

[a] These may be the same samples.

[b] Depending on the manufacturer's design, the stop valve can be a manual quick acting shut-off device. Therefore, it shall be tested under the stop valve conditions of use.

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;

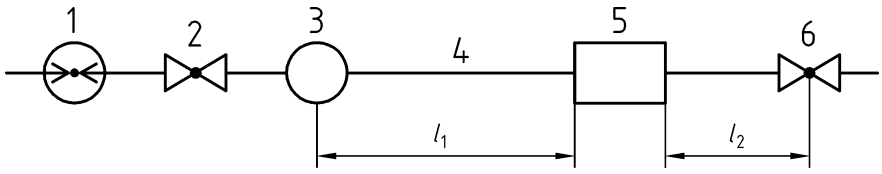
— for samples with outlet bore up to 10 mm: internal diameter of the tubes, d_i = 10 mm;

— for samples with outlet bore larger than 10 mm: d_i shall be equal the nominal outlet bore;

— industrial acetylene, static gas phase;

— the initial pressure of acetylene is as defined in Table 1 at a temperature of (20 ± 5) °C;

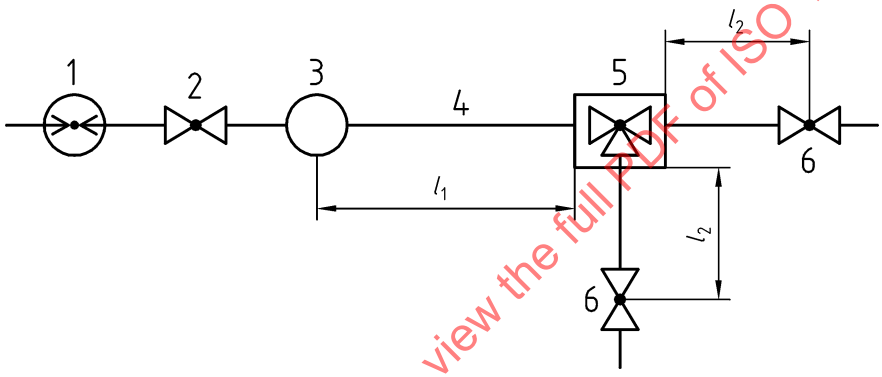
— ignition by fusible metal wire, ignition energy less than 100 J.



Key

1 Pressure measurement device
2 Inlet valve
3 Ignition unit
4 Steel tube
5 Test sample
6 Outlet valve
l_1, l_2: Tube length

Figure 1 — Acetylene decomposition test set-up



Key

1 Pressure measurement device
2 Inlet valve
3 Ignition unit
4 Steel tube
5 Test sample, three-way valve
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

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

— 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);

— the test assembly shall be isolated from the acetylene gas supply. The pressure shall be re-checked after ten minutes to check for losses;

— it shall be ensured that all valves and controls are in the required position 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 for pass/fail criteria as defined in clause 5.

6.5 Pressure resistance test

Conformity with the requirements of 5.2.4 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 purposes.

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).

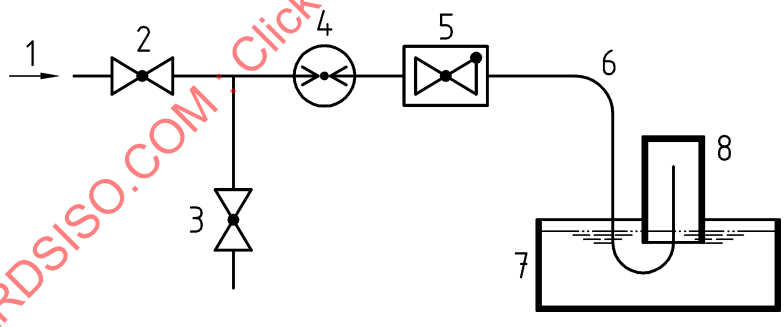
6.6.2 Reverse flow test

Three samples shall be subjected to this test.

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
2 Shut-off valve
3 Purge valve
4 p_1 = 0,05 MPa (0,5 bar) and 2,5 MPa (25 bar)
5 Test sample, non-return acetylene valve
6 Rubber hose
7 Water
8 Graduated cylinder

Figure 3 — Reverse flow of gas test set-up

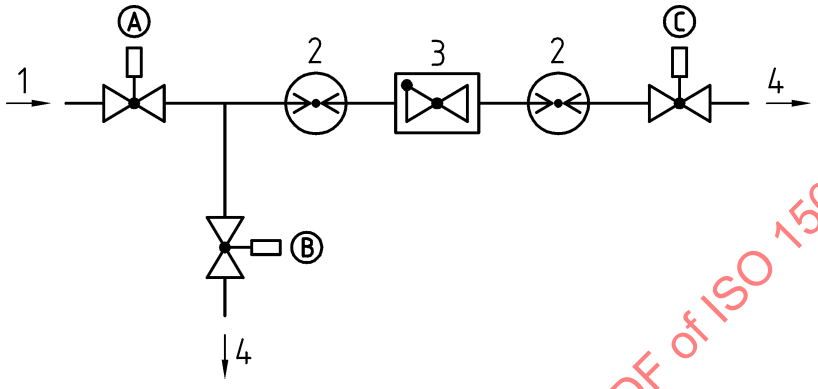
6.6.3 Fatigue test

A 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 reverse flow gas test (see 6.6.2).



Key

1 Nitrogen
2 Pressure measurement device
3 Test sample, non-return valve
4 Purge
A, B, C Valves

Figure 4 — Fatigue test set-up

6.7 Endurance test

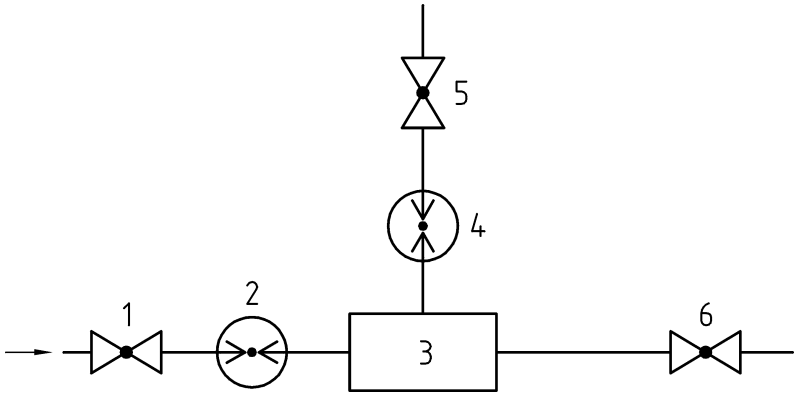
The pressure/venting cycle shall be as specified for cylinder valves in EN 849.

The internal gas leakage of the valve in the closed position shall be checked against the requirements of 5.2.2 before and after the required number of cycles.

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

6.8.1 Equipment

A set up of the test equipment is given in Figure 5.



Key

1 Inlet valve
2 Pressure measurement device
3 Test sample
4 Signal port pressure indicator
5 Signal port valve
6 Outlet valve

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

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 five times. 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 to 0,150 MPa (1,45 bar to 1,50 bar). Leave the equipment set in this condition for 168 h. After 168 h open valve 6 to check 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 atmosphere. Check that internal gas leakage at the device outlet meet the requirements of 5.2.2 and 5.2.3.

6.10 Trip test for automatic quick acting shut-off device

Three samples shall be tested in open position. Test condition and test procedure shall be the same as for the acetylene decomposition test (see 6.4.2 and 6.4.3). The test shall be carried out at both 6 bar and 25 bar.

After each test the internal gas tightness shall meet the requirements of 5.2.3.

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) types of gas: acetylene;

d) instruction 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 case of malfunction;

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

8 Marking

All marking shall be legible and durable in accordance with EN ISO 2503:1998, 11.6, the following information shall be included:

a) number of this standard;

b) name or trade mark of manufacturer and/or distributor;

c) model or code number relating to the manufacturer's instruction;

d) direction of normal gas flow (arrow);

e) acetylene or its abbreviation, A;

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

Annex A
(normative)

Summary of tests

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

Device	No. of test sample	External gas tightness (acc. to EN 29090)	Internal gas tightness (see 6.9)	Decomposition at 0,6 MPa (see 6.4)	Decomposition at 2,5 MPa (see 6.4)	Internal gas tightness after decomposition (see 6.9)	Pressure resistance (see 6.5)	Reverse flow (see 6.6.2)	Fatigue (see 6.6.3)	Reverse flow after fatigue test (see 6.6.2)	Endurance (see 6.7)	Internal gas tightness after endurance test (see 6.9)	Trip test (see 6.8, 6.10)
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	—	—	—	—	—	X	—	—	—	—	—	—
	Requirements	at 0,25 MPa and 2,5 MPa, leakage < 8 cm^3/h	—	—	closed position, no permanent deformation, no gas escape during test	—	no permanent 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	—	—	—

Table A.1 *(continued)*

Device	No. of test sample	External gas tightness (acc. to EN 29090)	Internal gas tightness (see 6.9)	Decomposition at 0,6 MPa (see 6.4)	Decomposition at 2,5 MPa (see 6.4)	Internal gas tightness after decomposition (see 6.9)	Pressure resistance (see 6.5)	Reverse flow (see 6.6.2)	Fatigue (see 6.6.3)	Reverse flow after fatigue test (see 6.6.2)	Endurance (see 6.7)	Internal gas tightness after endurance test (see 6.9)	Trip test (see 6.8, 6.10)
manual quick acting shut-off valve (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 resp. $0{,}41d^2$ (for units see 5.2.2)	—	open position, no permanent deformation, no gas escape during test	at 2,5 MPa, leakage < 50 l/h	no permanent deformation or leakage to atmosphere after 5 min at 31,5 MPa	—	—	—	500 cycles	at 2,5 MPa, leakage < 50 cm^3/h resp. $0{,}41d^2$ (for units see 5.2.2)	—

Table A.1 *(continued)*

Device	No. of test sample	External gas tightness (acc. to EN 29090)	Internal gas tightness (see 6.9)	Decomposition at 0,6 MPa (see 6.4)	Decomposition at 2,5 MPa (see 6.4)	Internal gas tightness after decomposition (see 6.9)	Pressure resistance (see 6.5)	Reverse flow (see 6.6.2)	Fatigue (see 6.6.3)	Reverse flow after fatigue test (see 6.6.2)	Endurance (see 6.7)	Internal gas tightness after endurance test (see 6.9)	Trip test (see 6.8, 6.10)
automatic quick acting shut-off device (see 3.3)	1	X	—	X	—	X	—	—	—	—	—	—	X
	2	X	—	X	—	X	—	—	—	—	—	—	X
	3	X	—	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	—	—	—	—	—	—	—	—	—	—	—	—
	Requirements	at 0,25 MPa and 2,5 MPa, leakage < 8 cm^3/h	—	open position, no permanent deformation, no gas escape during test	open position, no permanent deformation, no gas escape during test	at 2,5 MPa, leakage < 50 l/h	no permanent deformation or leakage to atmosphere after 5 min at 31,5 MPa	—	—	—	—	—	see 5.3.5