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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Equipment used in gas welding, cutting and allied processes — Safety devices for fuel gases and oxygen or compressed air — General specifications, requirements and tests

Équipements de soudage aux gaz, de coupage et procédés connexes — Dispositifs de sécurité pour les gaz combustibles et l'oxygène ou l'air comprimé — Spécifications et exigences générales et essais

Reference number
ISO 5175 : 1987 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5175 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes.*

This first edition cancels and replaces the first edition of ISO 5175-1 published in 1983; ISO 5175 combines general specifications and requirements laid down in ISO 5175-1 and information on tests and test requirements that should have been published in ISO 5175-2.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Equipment used in gas welding, cutting and allied processes — Safety devices for fuel gases and oxygen or compressed air — General specifications, requirements and tests

1 Scope and field of application

This International Standard lays down the general specifications, requirements and tests of safety devices for fuel gases and oxygen or compressed air used downstream of cylinder or pipeline outlet regulators and of pipeline outlet valves, and upstream of blowpipes for welding, cutting and allied processes.

It does not specify location and combination of these devices in the gas system.

2 References

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications.*

ISO 2503, *Pressure regulators for gas cylinders used in welding, cutting and allied processes.*

ISO 3253, *Hose connections for equipment for welding, cutting and related processes.*

ISO 9090, *Gas tightness of equipment for gas welding and allied processes.* [1)]

ISO 9539, *Materials for equipment used in gas welding, cutting and allied processes.* [1)]

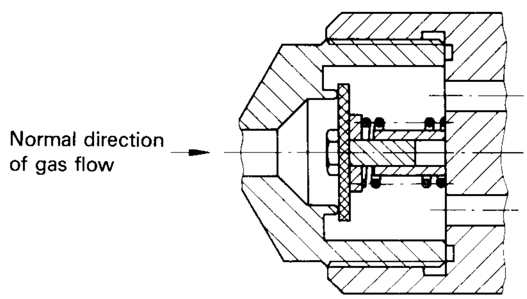
3 Definitions and functions

3.1 safety device: A device which, when correctly used and placed, prevents the damage resulting from misuse or malfunction of the blowpipe or associated equipment.

3.2 non-return valve: A device which prevents passage of gas in the direction opposite to normal flow.

Example:

Valve is held open by energy in gas stream and closes when downstream pressure is approximately equal to or greater than that in normal direction of flow.

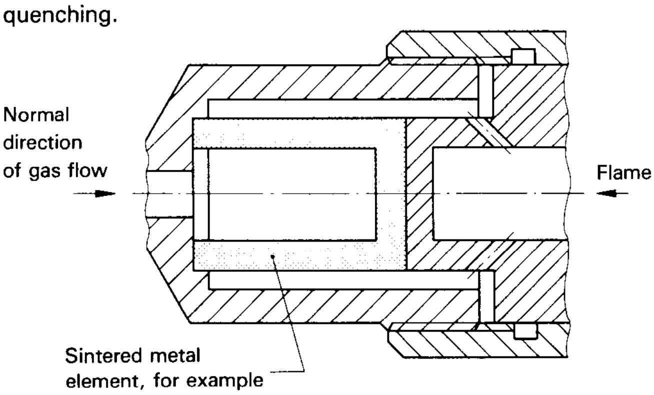


3.3 flame arrestor: A device which quenches a flame front (flashback or decomposition). Depending on design, devices are effective in one or both directions.

1) At present at the stage of draft.

Example:

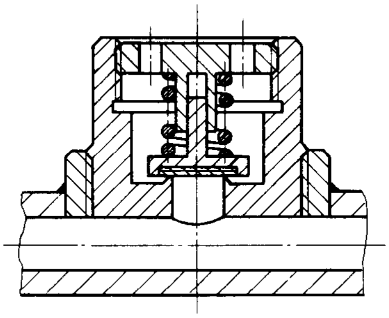
The good thermal conductivity, low porosity and small pore size (larger surface) of sintered metal elements lead to flame quenching.



3.4 pressure-relief valve: A device which automatically vents gas to the atmosphere when the pressure exceeds some predetermined value and seals again when the pressure returns to within specified limits of that value.

Example:

Valve is held closed by a spring; it opens when force caused by internal pressure rise exceeds the spring load.

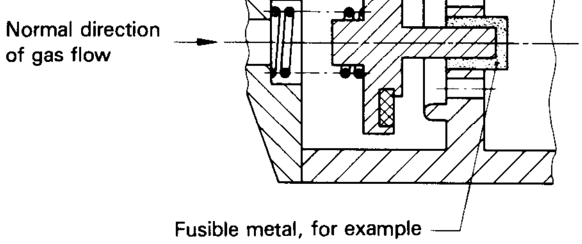


3.5 Cut-off valves

3.5.1 temperature-sensitive cut-off valve: A device which stops the gas supply when a predetermined temperature is reached.

Example:

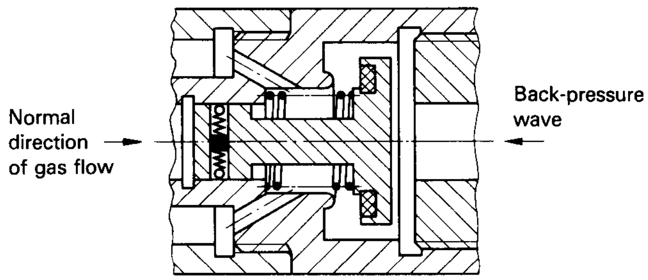
Valve is held open, e.g. by a fusible metal, and actuated by sustained temperature rise.



3.5.2 pressure-sensitive cut-off valve: A device which closes in the event of a back-pressure wave from the downstream side of the cut-off valve.

Example:

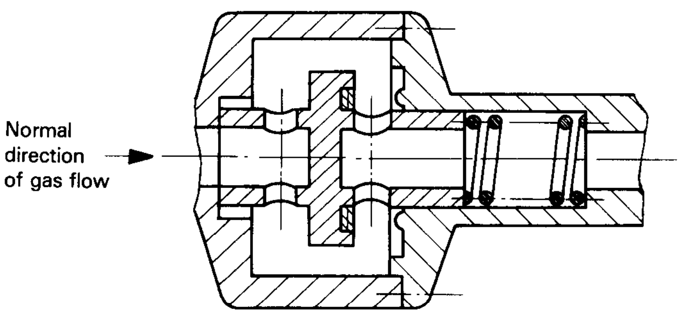
Valve is held open, e.g. by a spring; it is actuated by a pressure wave from downstream and is then automatically held closed by a special device.



3.5.3 excess flow cut-off valve: A device which closes in the event of flow exceeding a predetermined value.

Example:

Valve is held open by a spring; it closes when the force caused by the dynamic pressure becomes greater than the force of the spring. A resetting device is necessary.



4 Installation

The method of installing these devices (types selected, order of installation, etc.) varies with operating conditions. It is essential to follow the manufacturer's instructions regarding installation and operation and to ensure that the overall pressure drop due to the combination is as low as possible.

NOTE — It is possible to incorporate many of the functions described in clause 3 into one piece of equipment.

5 Design and materials

5.1 Design

The construction shall be suitable for the purpose intended and shall allow regular maintenance and routine inspection.

The design of connections shall prevent interchangeability between the fuel gas and oxygen or compressed air, in accordance with ISO 3253.

5.2 Materials

Materials used in the manufacture of these safety devices shall conform with the requirements laid down in ISO 9539.

6 Requirements

6.1 Requirements common to all devices

6.1.1 Gas tightness

The general requirements on gas tightness shall be in accordance with ISO 9090.

When the device is tested in accordance with 7.5.1, the leakage rate shall not exceed 8 cm^3/h.

6.1.2 Pressure resistance test

The housings of the safety devices shall resist a test pressure equal to five times the maximum operating pressure, with the test pressure in all cases not less than 60 bar[1)].

No permanent deformation shall occur after a test duration of at least 5 min.

6.2 Requirements applicable to each type of device

6.2.1 General

In the following sub-clauses, the terms "upstream" and "downstream" refer to the normal direction of gas flow in the device.

6.2.2 Non-return valves

Non-return valves shall prevent slow and sudden reverse flow of gases when tested in accordance with 7.6.1.

If non-return valves are not protected against flashback by design, i.e. by means of a flame arrestor downstream, they shall also prevent slow and sudden reverse flow of gases after having been submitted to a flashback test carried out in accordance with 7.6.2.

6.2.3 Flame arrestors

Flame arrestors shall quench five flashbacks when tested in accordance with 7.6.2.1 or 7.6.2.2. The requirement for the use of the units may be specified in the national regulations or standards.

NOTE — No country will be obliged to introduce a certain one or the other class of the flame arrestor in the national standard.

6.2.4 Pressure-relief valves

Pressure-relief valves incorporated in regulators shall be in accordance with ISO 2503.

The opening pressure of the pressure-relief valve shall be between 1,2 and 2 times the maximum operating pressure specified by the manufacturer and the valve shall close at a pressure between 1 and 2 times this pressure. They shall be leakproof at any pressure less than the maximum operating pressure.

The manufacturer shall state the flow capacity to atmosphere as measured at twice the maximum operating pressure.

6.2.5 Cut-off valves

6.2.5.1 Temperature-sensitive cut-off valves

Temperature-sensitive cut-off valves shall stop the gas supply when a predetermined temperature is reached (see 7.6.4.1).

6.2.5.2 Pressure-sensitive cut-off valves

Pressure-sensitive cut-off valves shall be leakproof in the normal direction of gas flow in the event of a back-pressure coming from the downstream side of the device. The differential operating pressure, i.e. the pressure difference between the upstream and downstream sides including cut-off, shall not exceed 700 mbar.

If pressure-sensitive cut-off valves are not protected against flashback by design, i.e. by means of a flame arrestor placed downstream, the requirements shall also be satisfied after the devices have been submitted to a flashback test carried out in accordance with 7.6.2.

6.2.5.3 Excess flow cut-off valves

Excess flow cut-off devices shall ensure that the gas flow cuts off when the gas flow reaches between 1,1 and 2 times the nominal flow specified by the manufacturer. The valve shall remain closed until it is manually reset.

NOTE — In addition to the requirements concerning marking (see clause 9), the manufacturer shall indicate the minimum working pressure, the hose bore diameter and the maximum length ensuring adequate protection.

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

7 Tests

7.1 General

The tests described in 7.5 and 7.6 are not intended as production inspection tests, but are to be applied to sample devices submitted for approval regarding compliance with this International Standard. Tests shall be carried out on new devices.

7.2 Reference values and accuracy of instruments

The accuracy of instrumentation for tests shall be as follows:

- flow-measuring equipment: ± 3 %
- pressure-measuring equipment: ± 1 %

All flows and pressures shall be expressed in standard atmospheric conditions in accordance with ISO 554. All pressure values are given as gauge pressure, expressed in bars.

7.3 Conformity testing

Fulfilment of the above-mentioned conditions can be certified on request by a conformity test carried out by an independent testing authority.

The following samples and documents are necessary for such tests:

a) five samples of the device to be tested (tests shall be carried out on new devices);

b) two copies of all detail drawings;

c) three copies of the general drawing with a list of spare parts;

d) a statement by the manufacturer indicating the nature of the materials and their stability with respect to the gases.

7.4 Test gases

Unless otherwise stated, tests shall be carried out in standard temperature and pressure conditions with air or nitrogen free from oil and grease.

Air is considered as oil-free if it comprises

- less than 5 ppm of oil vapour, and
- less than 1 mg/m^3 of suspended droplets.

In all cases, tests shall be carried out with dry gas with a maximum moisture content of 50 ppm corresponding to a dew point of −48 °C. Flow rates shall be corrected according to the gas type to standard conditions.

Safety devices for hydrogen shall be tested with hydrogen or helium for the gas tightness test only.

Gas flow of flame arrestors shall be measured with the actual gas.

7.5 Tests common to all devices

7.5.1 Gas tightness test

Conformity with the requirements of 6.1.1 shall be checked in accordance with ISO 9090.

If the device is not protected against flashback by design, i.e. by means of a flame arrestor placed downstream, the gas tightness test shall be repeated after the device has been submitted to five flashbacks in a flowing mixture in accordance with 7.6.2.

7.5.2 Pressure-resistance test

Conformity with the requirements of 6.1.2 shall be checked by means of a hydraulic pressure test.

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.

7.5.3 Gas flow measurement

7.5.3.1 General

The gas flow characteristics for each device or combination of devices, except for those valves defined in 3.4, shall be measured by means of a performance test using the circuit shown in figure 1. The results shall be reported graphically; a typical example is shown in figure 2.

7.5.3.2 Procedure

With the device discharging directly to the atmosphere, progressively increase the upstream pressure to the maximum permissible pressure, p_{max}, and measure the gas flow rate at different intermediate pressures.

Repeat the same test with upstream pressures equal to 0,25 p_{max}, 0,5 p_{max} and 0,75 p_{max}, and measure the gas flow rate for different pressure drops Δp[1)].

For class II fuel gas safety devices comprising a flame arrestor with or without a non-return valve, the pressure drop, Δp, shall not exceed 15 % of p_1.

The average of the results obtained from the five samples shall be considered to be the nominal value. The flow rates of the five samples shall not diverge by more than ± 10 %.

1) $\Delta p = p_1 - p_2$

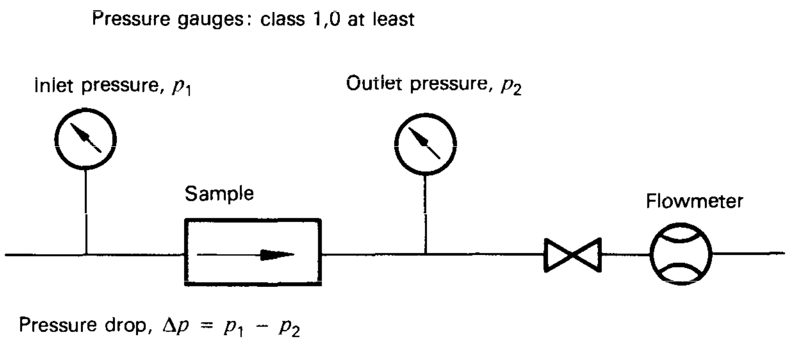


Figure 1 — Typical example of circuit for gas flow measurement

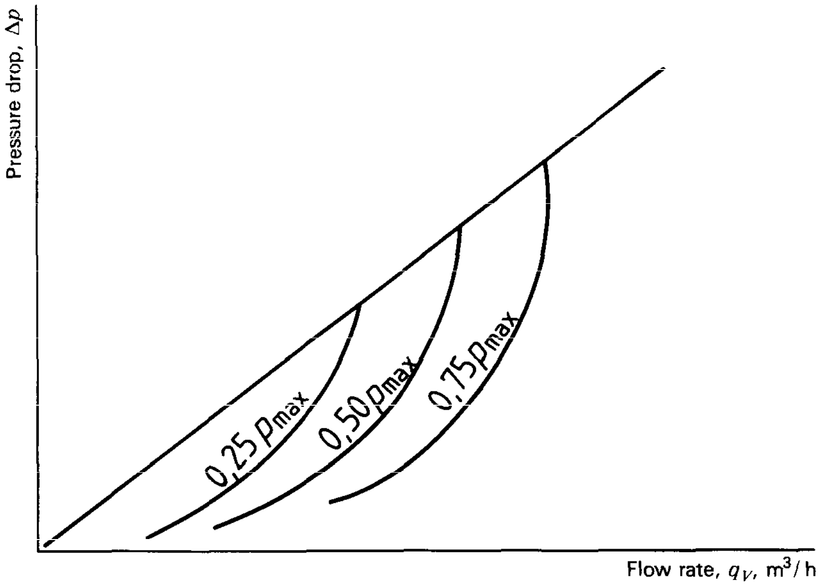


Figure 2 — Typical example of gas flow characteristics

7.6 Tests applicable to each specific type of device

7.6.1 Non-return valves

7.6.1.1 Determination of reference pressure

With a shut-off valve installed upstream, pass the test gas through the device to the atmosphere in the normal direction of flow. Progressively reduce the flow rate to zero by closing the shut-off valve. Measure the pressure upstream of the device after 1 min and use the corresponding value as a reference pressure, p_r, for subsequent tests.

For the tests, the samples shall be installed in the most disadvantageous position.

7.6.1.2 Tests with slow return of gas

After the reference pressure has been established, pass the test gas through the device in the reverse direction with the reference pressure, p_r, equal to the value determined in 7.6.1.1, and then proceed as follows:

a) increase the back-pressure at a rate of 6 mbar/min up to 1,5 p_r, at least to 30 mbar;

b) increase the back-pressure to the same value at a rate of 60 mbar/min.

7.6.1.3 Tests with sudden return of gas

Return the device to the same original conditions as maintained prior to the tests described in 7.6.1.2 and then proceed as follows:

a) increase the back-pressure within 1 s from 0 to 1 bar;

b) increase back-pressure within 1 s from 0 to 6 bar.

7.6.1.4 Expression of results

For each of the four tests described in 7.6.1.2 and 7.6.1.3, check that the non-return valve is leakproof, e.g. by verifying that the upstream pressure has not increased. If no pressure increase is noted, the non-return valve is acceptable.

If a small increase in pressure is noted, the flow tests described in a) and b) shall be carried out.

a) With pressure in the normal direction of flow at atmospheric and with a flowmeter fitted to the normal inlet connection, repeat the tests described in 7.6.1.2. Maximum permissible flow during the period of reverse pressure rise and for 1 min after 1,5 p_r has been reached shall not exceed 50 cm^3/h for hose connection diameters of less than 11 mm or 0,41 d^2 for larger diameters.

NOTE — The value 0,41 d^2 is given in cubic centimetres per hour when d is given in millimetres.

b) Repeat the tests described in 7.6.1.3. Maximum permissible flow should not be measured until final reverse pressure has been established for 5 s. Permissible flow shall be as specified in a).

7.6.1.5 Insensitiveness to flashbacks

If the device is not protected against flashback by design, i.e. by means of a flame arrestor placed downstream, the tests described in 7.6.1.2 and 7.6.1.3 shall be repeated after the device has been submitted to five flashbacks in a flowing mixture in accordance with 7.6.2.

7.6.2 Flame arrestors

7.6.2.1 Flame arrestors — Class I (Heavy class)

CAUTION — All precautions shall be taken for the safety of personnel in the case of the test apparatus fragmenting following an explosion.

The conditions for testing class I flame arrestors depend on the type of gas and the maximum operating pressure. Each class I flame arrestor should withstand five flashbacks with a static mixture and five flashbacks in a flowing mixture of fuel gas and oxygen. For the dynamic test, the time interval between ignitions is approximately 30 s.

The efficiency of class I flame arrestors shall be checked using the test circuit shown in figure 3.

The conditions for acetylene shall be as follows:

— composition of mixture: 32 % to 38 % (V/V) acetylene with oxygen making up the remainder

— upstream pressure of the mixture: 1,5 bar

— for dynamic testing, downstream pressure: 1,2 bar during the test

The conditions for propane shall be as follows:

— composition of mixture: 27 % to 31 % (V/V) propane with oxygen making up the remainder

— upstream pressure of the mixture: 2 bar

— for dynamic testing, downstream pressure: 1,7 bar during the test

The conditions for other fuel gases shall be as follows:

— composition of mixture: stoichiometric mixture

— upstream pressure of the mixture: maximum operating pressure of the fuel gas (as specified by manufacturer)

— for dynamic testing, the nominal flow rate and pressure drop shall correspond to the upstream pressure as determined in 7.5.3.

The conditions for oxygen shall be the same as for acetylene.

7.6.2.2 Flame arrestors — Class II (Light class)

The conditions for testing class II flame arrestors depend on the type of gas. Each class II flame arrestor should withstand five flashbacks with a static mixture of fuel gas and oxygen which corresponds approximately to those used industrially.

The test gas mixtures shall be used in the following volume proportions:

Oxygen	**Fuel gas**
1	Acetylene: 1
1	Propane: 0,263
1	Butane: 0,21
1	Hydrogen: 2,5

For the gas mixtures, a tolerance of ± 2 % is allowed.

The flashback test shall be carried out at the maximum inlet pressure, p_1, specified by the manufacturer.

The efficiency of class II flame arrestors shall be checked using the test circuit shown in figure 3.

7.6.3 Pressure-relief valves

The requirements specified in 6.2.4 shall be checked by progressively increasing and then decreasing pressure. Measure the valve flow when the pressure is equal to twice the maximum operating pressure.

7.6.4 Cut-off valves

7.6.4.1 Temperature-sensitive cut-off valves

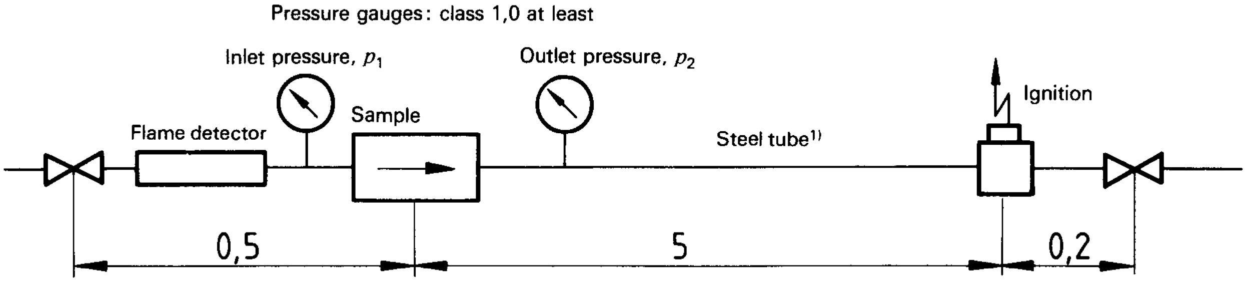
A diagram of the test circuit is shown in figure 4.

Adjust the fuel gas valve so that a flame at the outlet side of the steel tube is stable. Slowly open the oxygen valve until the flame retreats into the tube and device. The cut-off valve shall automatically cut off the gas flow before the upstream gas is ignited.

If used in conjunction with a flame arrestor, "upstream gas" implies gas on the upstream side of the flame arrestor.

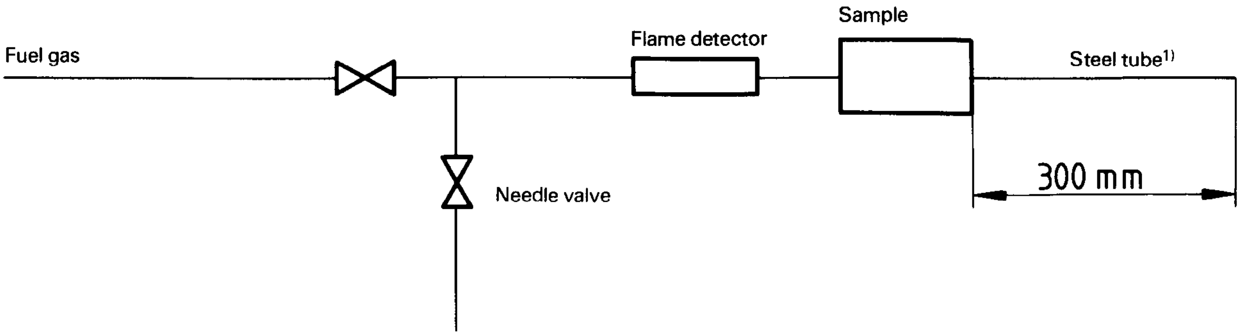
If any other device is used in conjunction with a temperature-sensitive cut-off valve, which is resettable, the functions shall be checked after the cut-off valve has been actuated.

Dimensions in metres



1) For connections up to G 3/8 LH (left-hand thread): internal diameter, d_i = 10 mm
For connections larger than G 3/8 LH (left-hand thread): d_i shall be equal to the nominal outlet bore

Figure 3 — Test circuit for testing efficiency of flame arrestors



1) Internal diameter of tube shall be equal to internal diameter of the outlet of the device.

Figure 4 — Test circuit for testing temperature-sensitive cut-off valves

7.6.4.2 Pressure-sensitive cut-off valves

Connect the device under test on the downstream side to a gas source, with the upstream side discharging to the atmosphere. Progressively increase the downstream pressure to check that the device is actuated by a pressure less than or equal to 700 mbar.

In addition, check by an appropriate method that the device is leakproof in the normal direction of flow.

If the device is not protected against flashback by design, i.e. by means of a flame arrestor placed downstream, the test shall be repeated after the device has been submitted to five flashbacks in a flowing mixture in accordance with 7.6.2.

7.6.4.3 Excess flow cut-off valve

Connect the device to a pipeline in the conditions specified by the manufacturer. Progressively increase the flow rate in the normal direction. Check that the device operates at a flow value between 1,1 and 2 times the nominal flow rate specified by the manufacturer. In addition, check that flow conditions cannot be re-established without outside manual intervention on the installation.

8 Manufacturer's instructions

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

a) the design and function of the safety device;

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

c) permissible types of gas;

d) procedures to be carried out prior to operation;

e) procedures for safe operation;

f) instructions in case of malfunction;

g) recommendations for inspection, testing and maintenance.

9 Marking

All marking shall be legible and durable; the followed information shall be included:

a) the name or trade mark of manufacturer or distributor;

b) the model or code number relating to the manufacturer's installation instructions;

c) the direction of normal gas flow (arrow);

d) the name of gas or type of gas code and colour code;

e) the maximum working pressure, p_{max}, expressed in bars;

f) the class of flame arrestor: class I or II;

g) the maximum flow rate, only for excess flow cut-off valve (see 6.2.5.3).

The abbreviations recommended for the gases in common use are as follows:

acetylene:	A
coal or town gas:	C
methane or natural gas:	M
propane or other LPG fuels:	P
hydrogen:	H
oxygen:	O
compressed air:	D

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Descriptors : gas welding, gas cutting, welding equipment, safety devices, definitions, specifications, tests, marking.

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