SRI LANKA STANDARD 1180:20××

SPECIFICATION FOR

PRESSURE REGULATORS FOR LIQUEFIED PETROLEUM GAS(LPG)

(First Revision)

SRI LANKA STANDARDS INSTITUTION

Draft Sri Lanka Standard
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SLS 1180:20××

Gr. 6

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SRI LANKA

Draft Sri Lanka Standard
SPECIFICATION FOR PRESSURE REGULATORS
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FORWORD

This standard was approved by the Sectoral Committee on LP Gas Industry and was authorized for adoption and publication as a Sri Lanka Standard by the Council, of the Sri Lanka Standards Institution on ……..

This standard is intended to establish minimum quality levels of material, construction and performance for low pressure regulators, high pressure regulators for use with liquefied petroleum gas which contains LPG in the vapour phase. It covers screwed, threaded and clip-on type connections.

This standard also includes requirements for limited capacity relief valves and under pressure shut-off devices (UPSO) and over pressure shut-off devices (OPSO) when they are an integral part of the regulator.

In this revision, standards specifications for automatic change over devices were not incorporated.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or an analysis, shall be rounded off in accordance with **SLS 102.** The number of significant. places retained in the rounded off value shall be the same as that of the specified value in this standard.

The pressure regulator is an integral part of a domestic LPG system and therefore the system safety is an important aspect.

The Sri Lanka Standards Institution gratefully acknowledges the assistance derived from the following publication of the European Union, in the preparation of this standard:

EN 16129:2013 - Specification for pressure regulators, automatic change-over devices, having a maximum regulated pressure of 4 bar, with a minimum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane, and their mixtures

1 SCOPE

This standard specifies requirements for materials, construction, performance and testing of low pressure and high pressure regulators with screwed, threaded and clip on connectors for use with liquefied petroleum gas which contain mixtures in the vapour phase, with maximum propane content of 30 percent by volume.

For installation rules of devices and their possible associated safety devices, reference should be made to national regulations in force.

2 REFERENCES

ISO 7-1 Pipe threads where pressure-tight joints are made on the threads

Part 1: Dimensions tolerances and designation

ISO 48 Rubber, vulcanised or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD)

ISO 188 Rubber vulcanised - Accelerated ageing or heat resistance tests

ISO 228-1 Pipe threads where pressure-tight joints are not made on the threads

Part 1: Dimensions, tolerances and designation

ISO 262 ISO general purpose metric screw threads - Selected sizes for screws, bolts and nuts

ISO 301 Zinc alloy ingots intended for casting

ANSI/ASME B 1 20.1 Pipe threads general purpose (inch series)

SLS 102 Presentation of numerical values

SLS 268 ISO metric screw threads

SLS 282 Pipe threads for tubes where pressure-tight joints are made on the threads

SLS 712 Liquefied petroleum gas (First Revision)

SLS 1171 Flexible rubber tubing, rubber hose and rubber hose assemblies for use in LPG vapour phase and LPG/Air installations

SLS EN 12420 Copper and copper alloys – Forgings

SLS EN 12164 Copper and copper alloys — Rod for free machining purposes

SLS EN 12165 Copper and copper alloys - Wrought and unwrought forging stock

3 DEFINITIONS

For the purpose of this standard the following definitions shall apply.

3.1 Clip-on system: A system that enables a non threaded union of regulator and cylinder valve to be easily connected without the use of tools, and ensuring a free flow of gas automatically in the normal 'in use' position.

3.2 high capacity relief valve: A device, actuated by excess outlet pressure of the regulator, designed to permit more than 5 per cent of the rated capacity of the regulator to be discharged to the atmosphere and to reset as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure.

3.3 high pressure regulator: A device, that maintains the outlet pressure constant at a nominal value in excess of 5 kPa, independent, within specified limits, of inlet pressure, temperature and/or flow rate.

3.4 limited capacity relief valve: A device, actuated by excess outlet pressure of the regulator, designed to permit a maximum of 5 per cent of the rated capacity of the regulator to be discharged to the atmosphere at an outlet pressure not exceeding the lower limit of the Over-Pressure Shut-Off(OPSO) and to reset as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure.

3.5 liquefied petroleum gas (LPG): Narrow boiling range mixture of hydrocarbons consisting of propane, propylene, butanes and butylenes, individually or in specified combinations, with limited amounts of other hydrocarbons (such as ethane) and naturally occurring, petroleum-derived non-hydrocarbons.

3.6 lock-up: The action of the regulator valve to seal and prevent an excessive rise in outlet pressure under conditions of zero flow.

3.7 low pressure regulator: A device that, maintain the outlet pressure constant at a nominal value up to and including 5 KPa, independent, within specified limits, of inlet pressure, temperature and/or flow rate (Figure 1).

3.8 nominal flow: A flow, rate declared by the manufacturer, at which the regulator or device is set.

3.9 over-pressure shut-off (OPSO) – A manually resettable device that closes to prevent the flow of gas when the pressure on the downstream side of the regulating member rises to a predetermined value. This device is an integral part of the regulator.

3.10 rated capacity: A flow rate declared by the manufacture, that can be achieved under all temperature and pressure conditions specified.

3.11 single-stage regulation: An arrangement whereby a reduction of the supply pressure is effected by one regulator in one stage.

3.12 set outlet pressure: The gas pressure measured at the outlet of the regulator at the flow and inlet pressure specified.

3.13 two stage regulation: An arrangement whereby the supply pressure is regulated in two stages. Two stages may be housed in one body.

3.14 under pressure shut-off (UPSO): A manually resettable device that closes to prevent the flow of gas when the pressure on the downstream side of the regulating member falls to a predetermined value. This device is an integral part of the regulator.

3.15 variable high pressure regulator: A high pressure regulator fitted with a means of outlet pressure adjustment intended to be operated by a competent user.

3.16 variable regulating device: regulating device whose regulated pressure may be modified by the user with simple manipulation between two fixed limits.

4 TYPES OF PRESSURE REGULATORS

4.1 General

Diagrammatic sectional illustrations of typical low and variable high pressure regulators are shown in Figures 1 and 2 respectively. A typical clip-on regulator is shown in Figure 3. Figure 4 shows a diagrammatic representation of a regulator with an integral limited pressure relief valve and over pressure shut-off (OPSO) and under pressure shut-off (UPSO) devices.

4.2 Pressure regulators shall be of the following two types:

a) Low pressure (single stage) regulator (Figure 1)

b) High pressure regulator (Figure 2)

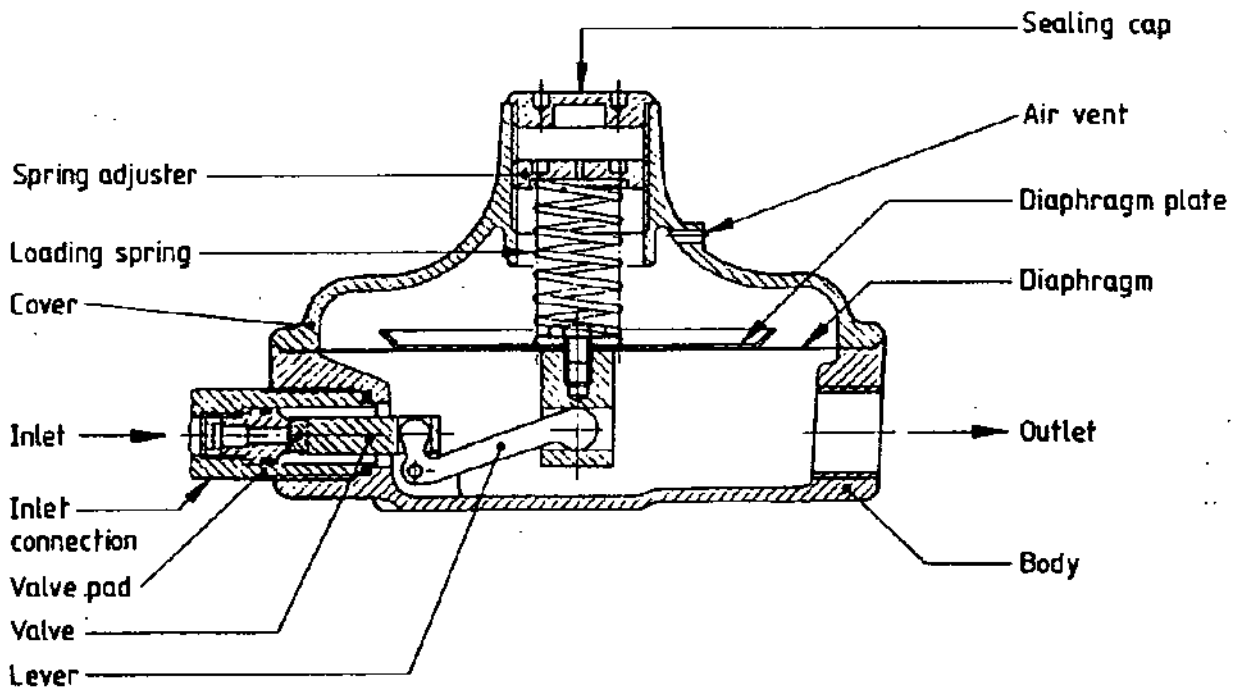


FIGURE 1- Diagrammatic sectional illustration of a low pressure regulator

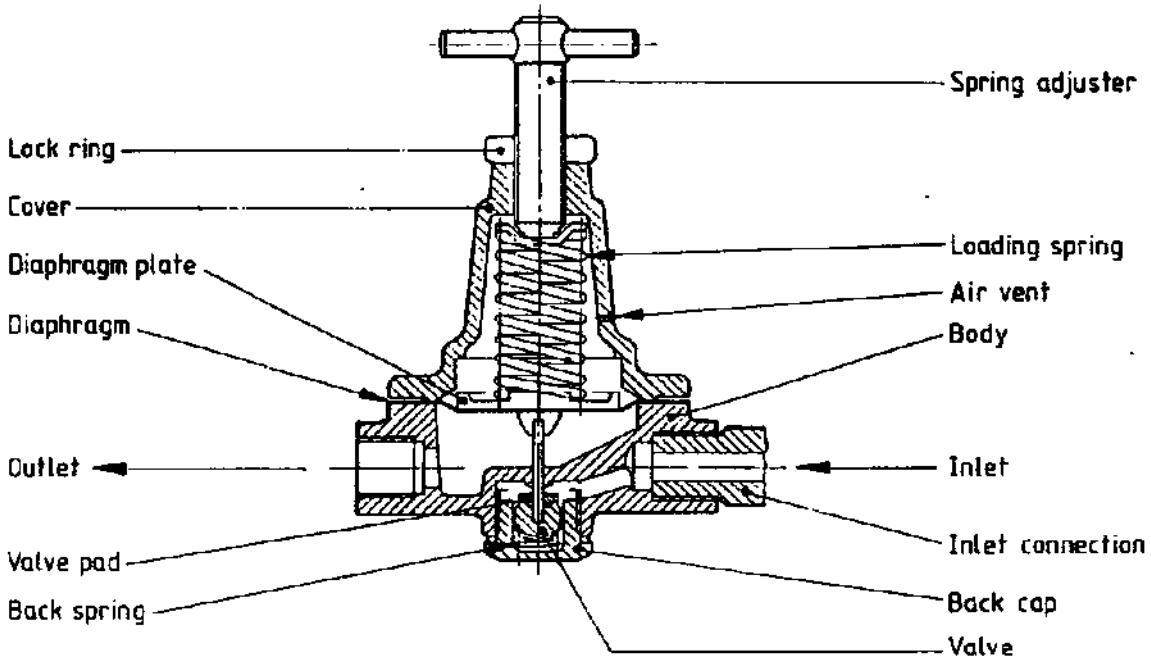


FIGURE 2 -Diagrammatic sectional illustration of a variable high pressure regulator

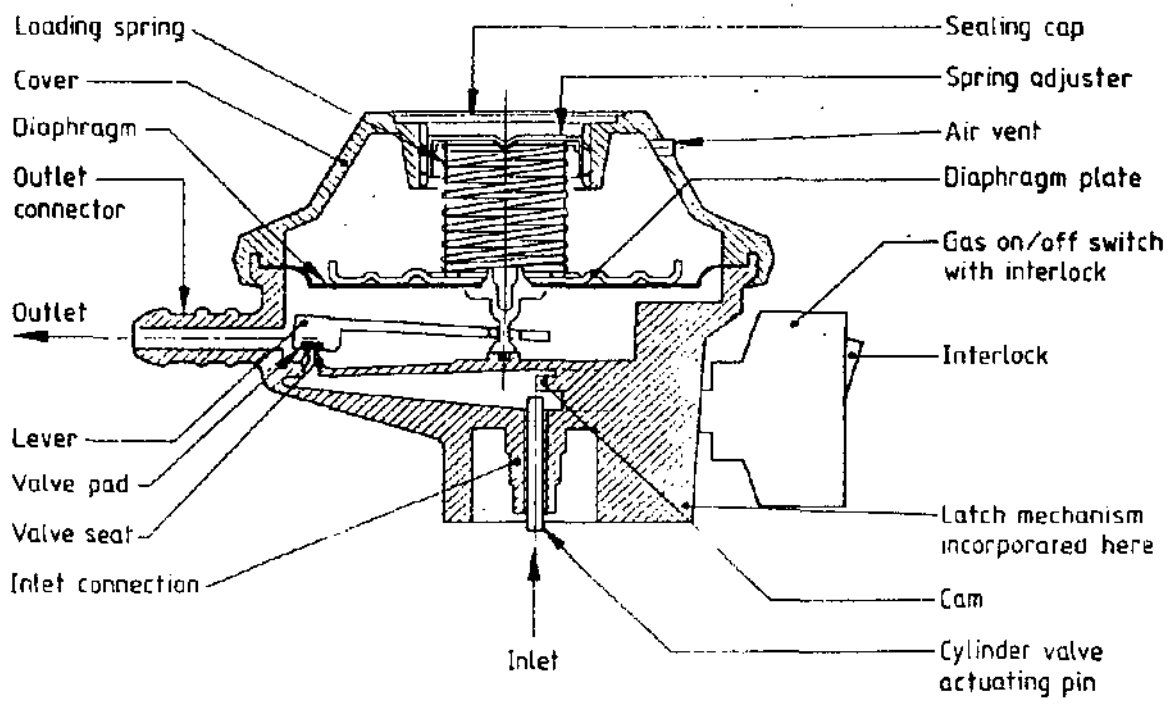


FIGURE 3- Diagrammatic sectional illustration of a clip-on regulator mainly used with domestic LPG cylinders

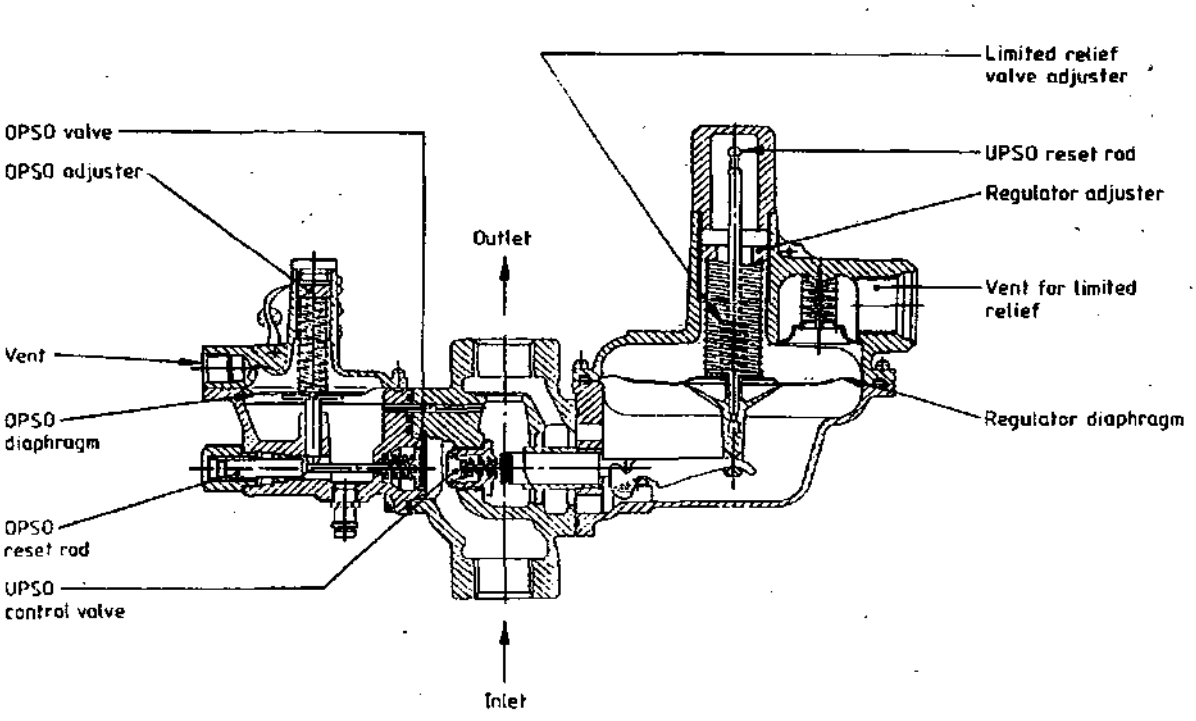


FIGURE 4 - Diagrammatic sectional illustration of regulator with integral limited pressure relief valve and OPSO and UPSO devices (only for out-door installation)

5 REQUIREMENTS

5.1. General

Pressure regulators shall be designed, manufactured and assembled in such a way that their operation is satisfactory under the installation and service conditions specified.

Safety devices, if incorporated into a device covered by this standard, shall be designed and constructed in accordance with the provisions of Appendices **A** and **B**.

Any safety device shall not be influenced by the operation of any other safety device.

All the parts of a device shall be free from sharp corners or edges capable of causing damage, deterioration, injury or faulty operation. Parts shall be clean internally and externally.

Holes for screws, pins etc. intended for the assembly of the device components and for their fixing, shall not open into the gas ways. The thickness of the material between these holes and the gas ways shall be at least 1 mm.

Holes necessary for machining which join gas ways to the atmosphere, but which have no influence on the operation of the device, shall be permanently closed metallically. Additional elastomeric seals complying with SLS EN 549 or additional sealant complying with SLS EN 751-1, SLS EN 751-2 or SLS EN 7521-3 may be used.

If the device incorporates a pressure test point or a pressure gauge, the diameter of the hole through the body of the device or the pressure test point shall not exceed 1.5 mm.

Where pressure tight joints are made on threads, they shall be in accordance with ISO 7-1, or with ANSI B1.20.1(NPT).

Components capable of modifying the operation of the regulating device shall not go out of adjustment and shall be sealed, except for adjustable and variable regulators parts used to adjust the regulated pressure. In particular, the regulating device body and cover shall be assembled in such a way that separation is not possible without permanent damage to these parts or the sealing.

The operation of mobile parts(moving parts), for example diaphragms or bellows, shall not be impaired by other parts. Any manual closing device shall close clockwise.

For variable regulating devices:

- The adjustment range shall be limited by two fixed stops; at zero flow (lock up) it shall not be possible to reduce the regulated pressure below 5 mbar or 1% of the maximum regulated pressure, whichever the greatest, for any supply pressure and in any orientation of the device.
- In order to reproduce the adjustment, a marking device using numbers may be used (the larger figures corresponding to the greater pressures) or a gauge may be installed to indicate the regulated pressure.
- It shall not be possible to remove the adjuster.
- When adjustment is carried out by rotation, the greater regulated pressures shall be obtained by rotation clockwise.

5.2 Materials

5.2.1 *General*

The quality of materials, the dimensions used and the means of assembling the various components shall be such that the construction and performance characteristics are ensured. Performance characteristics shall not

alter significantly during the life expectancy declared by the manufacturer when the device is installed and used in accordance with the instructions. Under these conditions, all components shall withstand the mechanical, chemical and thermal conditions to which they may be subjected during their use, when operating under normal conditions.

5.2.2 *Metal components*

5.2.2.1 Metallic parts

The body shall be made of metallic material. However, for regulators only, having a regulated pressure of up to 200 mbar and of a flow rate less than 4 kg/h, directly fitted onto the cylinder using a quick coupling with self closing valve and non-threaded outlet connection, non metallic (thermoplastic or thermo setting) materials may be used.

Internal parts and parts of the cover not retaining the pressure (except for connections) may be made of non-metallic (thermoplastic or thermo setting) materials.

The thermoplastic or thermosetting materials shall meet the requirements in Appendix C.

The whole device shall withstand the various tests specified in this standard and in Appendix E.

The rotating threaded parts of connections, whether they are male or female, shall be made of brass or steel. The materials and manufacturing processes used shall not cause subsequent risk of stress corrosion.

Internal parts made out of steel shall be protected against corrosion.

Fixed threaded parts of connections shall be made of metallic material. Non-threaded fixed parts of connections may be made of non-metallic (thermoplastic or thermo setting) material shall comply with the tests specified in Appendix **C**.

5.2.2.2 Brass parts

Leaded brass shall be CW611N, CW614N or CW617N in accordance with SLS EN 12420, SLS EN 12164 or SLS EN 12165.

Hot stamped brass shall be non-porous and suitable for machining or other processes. Components produced from stamping brass shall not exhibit cold shuts, also known as folds, or surface defects.

Sand-cast brass shall not be used.

Cold drawn brass rods shall only be used for machining after adequate testing for internal cracking, porosity or other inclusions and shall be heat-treated if required.

Brass parts shall not be susceptible to stress corrosion cracking. The susceptibility to stress corrosion cracking shall be determined by the method given in Appendix F.

5.2.2.3 Zinc alloys

Zinc alloys shall only be used if of quality $ZnAl_4$ or $ZnAL_4Cu$ in accordance with SLS EN 1774.

Zinc alloys casted parts shall only be used if they are ZP3 (Zn Al4) or ZP5 (Zn Al4 Cu1), in accordance with SLS EN 12844.

5.2.2.4 Stainless steel

Components made from stainless steel shall contain not less than 17 % chromium, and not less than 7 % nickel.

5.2.2.5 Cast iron

Spheroidal graphite cast iron shall comply with SLS EN 1563, with an elongation at fracture of more than 18 %. Other ductile irons or cast irons shall not be used. Castings shall be free from inclusions and surface defects, which could adversely affect the strength, leak tightness or performance of the device or fitting.

5.2.2.6 Solder

Solder which has a melting point below 450 ^{o}C after application shall not be used for gas carrying parts except for additional sealing.

5.2.3 ***Rubber type materials for diaphragms, valve pads and seals***

5.2.3.1 The material shall be of synthetic rubber or other material equally suitable for the application and shall satisfy the requirements given in 5.2.3.2 to 5.2.3.6.

5.2.3.2 The material shall be free from porosity, Pits and foreign particles and shall have a smooth non-tacky surface with minimum talc or bloom.

5.2.3.3 The material shall be impermeable to the test gas (see Appendix G) at a pressure of 2.5 times the maximum outlet pressure obtainable from the regulator when subjected to a suitable permeability and porosity test.

5.2.3.4 The material shall not change in hardness by more than 10 IRHD when subjected to the accelerated ageing test as specified in **ISO 188**. Test shall be aged at 70 ^{o}C (i.e. 20 ^{o}C above the maximum specified working temperature) a period of 168 h.

5.2.3.5 The material when tested by immersion in pentane for 72 h and in liquid test gas (see Appendix G) for a similar period of time shall not show a volume change or a weight loss greater the individual percentages shown in Table 1.

Elastomeric components shall comply with the requirements defined for material of class A2 as defined in EN 549, within the temperature range between -20 °C and +50 °C, including, for diaphragms, the requirements concerning resistance to ozone. In addition, reinforced materials shall comply with the additional requirements defined in Appendix **D**.

NOTE:
*The foregoing tests are work batch tests. On initial selection of a diaphragm material or a valve pad material, they shall also be tested.in the test gas in the vapour phase for 72 h and shall not show a weight or volume change greater than the individual percentages shown in Table **1**.*

TABLE 1 - Resistance to the action of liquid hydrocarbons

Component (1)	**Volume change percentage (2)**	**Weight loss percentage (3)**
Diaphragm	15	15
Valve pad	10	5

5.2.3.6 The material shall not change in hardness by more than 15 IRHD after being cooled and held at - 20 ± 2 ^{o}C for 30 min. The hardness meter and rubber shall be maintained in air or nitrogen at - 20 ± 2 ^{0}C whilst measurements are taken as described in ISO **48**.

5.2.4 *Valve pads and diaphragms*

5.2.4.1 The material shall be such that, when the assembled regulator device is subjected to the test described in **7.1** the diaphragm will not pull out or burst at a pressure lower than 0.3 MPa for low pressure regulators and

1.05 MPa for high pressure regulators or automatic changeover devices. After this test the regulator shall comply with the soundness requirements of this standard.

NOTE
No sample shall be taken in to use after test.

5.2.4.2 Reinforced diaphragms shall be used in high pressure regulators

5.2.4.3 The valve pad fitted in its housing shall show no evidence of being forced out of position due to swelling or other cause, when immersed for 72 h in test gas (see Appendix **G**) in the vapour phase.

5.2.5 ***Resistance to corrosion***

Any part in contact with the gas or the surrounding atmosphere, and also springs, shall be manufactured from corrosion resistant materials or shall be suitably protected. The corrosion protection for springs and other moving parts shall not be impaired by any movement.

The complete unconnected device (including any mounting components e.g. wall brackets) is subjected to the tests defined in **7.9**.

After this test, a visual examination shall reveal no corrosion of parts capable of impairing correct operation (salt deposit resulting from the test is not taken into account). Soundness and performance characteristics (when applicable) shall remain in accordance with the requirements **7.3**, **7.4** and **7.5** respectively.

5.3 Construction

5.3.1 *Screw threads*

5.3.1.1 Sealing threads

Where a pressure tight joint is made on the thread, the thread shall comply with either

a) ISO 7-1 or

b) other threads such as N.P.T. (specified in ANSI/ASME B1.20.1).

5.3.1.2 Fastening threads

Threads required for fastening or assembly shall comply with SLS 268, ISO 228-1. or ISO 262. Self-tapping screws that cut a thread and produce swarf shall not be used for connecting gas carrying parts or parts that may be removed in servicing.

5.3.2 *Connections*

5.3.2.1 General

5.3.2.1 a) Any screwed inlet unions designed for direct connection to gas cylinder shall use threads complying with ISO 7-1 or ISO 228-1.

5.3.2.1 b) Threaded connection shall comply with **5.4.2**.

5.3.2.1 c) Integral hose connectors shall be designed to accept flexible hose and tubing complying with **SLS 1171.**

5.3.2.1 d) Low pressure nozzles shall be as shown in Figure 6 and Table 2. High pressure nozzles shall be as shown in Figure 7 and Table 3.

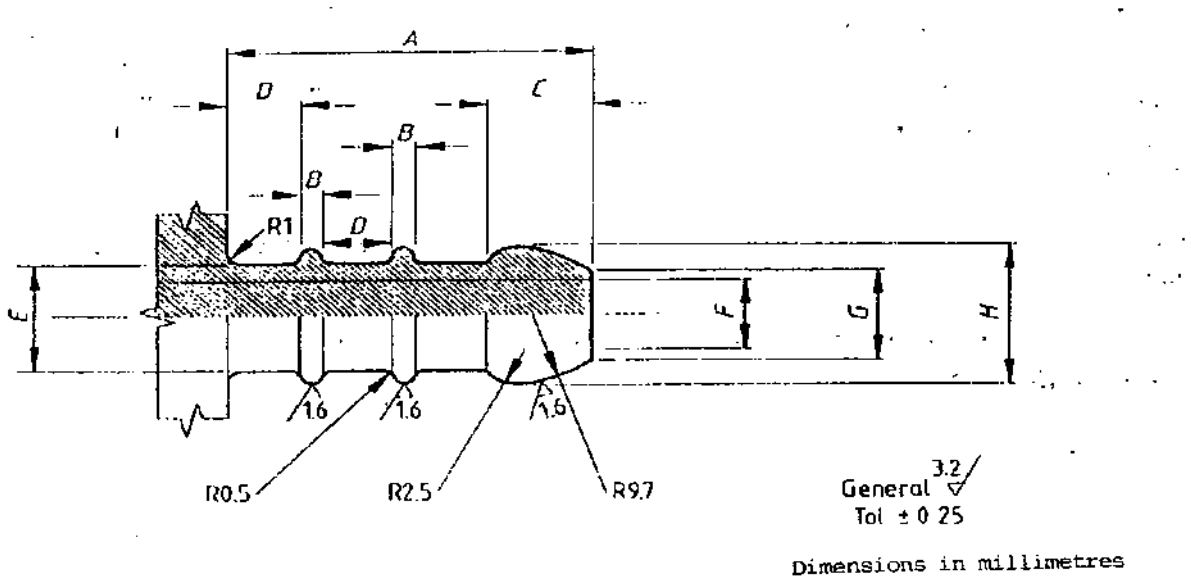


FIGURE 6 - Low pressure hose nozzle

TABLE 2 - Dimensions of low pressure hose nozzle

Dimensions in millimetres

Nominal hose bore (1)	A ± 0.25 (2)	B ± 0.25 (3)	C ± 0.25 (4)	D ± 0.25 (5)	ØE ± 0.13 (6)	ØF ± 0.13 (7)	ØG ± 0.13 (8)	ØH ± 0.13 (9)
8	23.8	1.52	7	4.58	7.9	5	6.35	10.3

NOTE

It is important that the hose nozzle profile has no sharp edges that could cut the hose whilst in use.

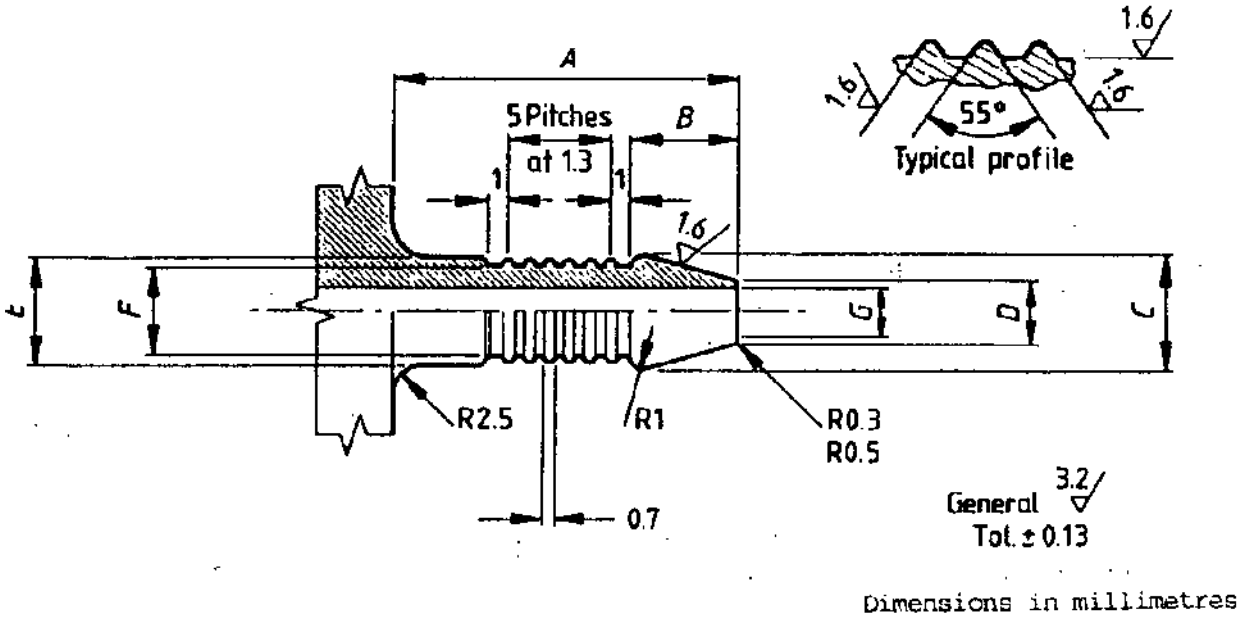


FIGURE 7 – High Pressure hose nozzle

TABLE 3 - Dimensions of high pressure hose nozzles

Dimensions in millimetres

Nominal hose bore (1)	A ± 0.25 (2)	B ± 0.25 (3)	ØC ± 0.25 -0 (4)	ØD ± 0.25 -0 (5)	ØE ± 0.13 -0 (6)	ØF ± 0.13 (7)	ØG ± 0.13 (8)
4.8	20.3	6.35	6.73	4.06	6.35	5.58	3
6.3	20.3	6.35	8.23	5.56	7.85	7.08	4.5
8	25.4	8.7	9.93	7.26	9.55	8.78	6.2

NOTE

It is important that the hose nozzle profiles has no sharp edges that could cut the hose whilst in use.

5.3.2.1 e) Second stage regulators shall not have inlet connections for direct connections to gas cylinders.

5.3.2.2 Clip-on connections

5.3.2.2 a) External soundness shall be maintained during complete operation of the system including connection and disconnection of the regulator to the cylinder valve. It is permissible for there to be a minimum momentary escape of gas during connection.

5.3.2.2. b) If the regulator is capable of pointing in different directions when attached to the cylinder valve. soundness of the connection shall be assured in all positions even during rotation.

5.3.2.2 c) The inlet of the regulator shall contain a manual means of opening and closing the flow of gas.

5.3.2.2 d) The direction of operation of rotary controls shall be clearly indicated on the regulator.

5.3.2.2 e) Means shall be provided to ensure that the regulator will itself meet the soundness requirements of this standard when it is in the 'gas off' position.

5.3.2.2 f) It shall not be possible to connect or disconnect connect the regulator from the cylinder valve with the gas supply in the 'on' position.

5.3.2.2 g) Where turning off the gas and disconnecting the regulator is combined in a single control, a single continuous movement of the control shall be prevented by a mechanism which shall be separately operated before the regulator can be disconnected.

5.3.2.2 h) The open and closed positions of flow shall be clearly marked and detectable by feel.

5.3.2.2 j) The gas supply valve shall be readily accessible and easily operable when in use.

5.3.3 ***Vents***

5.3.3.1 General

Breather holes and vents shall be protected against blockage or shall be located so that they do not easily get blocked. They shall be so arranged that the diaphragm cannot get damaged by a sharp device inserted through the breather hole or vent.

Protection against insects shall be provided where applicable, e.g. by vent screen.

5.3.4 *Valves*

5.3.4.1 Valve pad fixing

A valve pad shall be so retained that it cannot work out of position under service conditions.

5.3.4.2 Relief valves
Where a relief valve is incorporated it shall be of the spring-loaded type. The relief valve shall be set to discharge at a pressure of 4 to 6 times the outlet pressure.

5.4 Assembly and workmanship

5.4.1 *Workmanship*

Holes used in the assembly of the device, e.g. for fixing screws, shall not be closer than 1 mm ways. Holes communicating with gas ways used for manufacturing purposes shall be closed mechanically with a metallic seal so as to ensure a permanent gas tight seal and shall be treated in such a way that unauthorized interference can be detected.
Any jointing compound used shall withstand the effect of LPG without-deteriorating.

5.4.2 *Finish*

All Parts of a regulator shall be free from sharp edges, corners and any defect or design feature which might cause damage, injury or incorrect operation., The Parts not shall be clean internally and externally.

Parts not intended to be adjusted by the user shall not be accessible without the use of tools.

5.4.3 *Sealing*

After testing by the manufacturer, the body and cover of each regulator and device shall be sealed to discourage interference with the internal mechanism and the pressure setting. The manner of sealing shall be agreed between the purchaser and the manufacturer.

5.5 Properties and Performance

5.5.1 *Mechanical strength*

5.5.1.1. Resistance to impact

If the device is designed to be connected directly onto a cylinder valve, it shall be capable of resisting a fall on hard ground under the conditions defined in **5.5.5.7**. After this test, the device shall meet the requirements for soundness and performance as required by **5.5.2.1, 5.5.3.1** and **5.5.5.**

5.5.1.2 Torque and bending moment for connectors

The regulator or device shall be of sufficient mechanical strength to resist the stresses and conditions of normal use. A regulator or device that withstands the connection torque and bending moment tests described in **7.2** without showing any sign of cracking or any significant permanent distortion and remains functional and subsequently complies with the soundness requirements of this standard shall be deemed to have sufficient mechanical strength.

No sample shall be taken into use after any of the tests described in **7.2.**

5.5.2 *Low pressure, single stage regulators*

5.5.2.1 Soundness

A regulator shall be considered to be leak tight if the leakage rate does not exceed 4 mm ^{3}/s when tested as described in **7.4.**

NOTE
Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve these tests.

5.5.2.2 Outlet pressure setting

At the nominal flow at an inlet pressure of 140 kPa the set outlet pressure shall be as declared by the manufacturer ± 200 Pa.

5.5.2.3 Measurement of capacity

It shall be possible to vary the flow between 10 per cent and 100 per cent of the rated capacity under the conditions given in Table 4.

TABLE 4 - Low pressure, single stage regulators for LPG

Gas and Regulator temperature ^{0}C **(1)**	**Inlet pressure applied kPa** **(2)**	**Permissible deviation of set outlet pressure kPa** **(3)**	**Permissible deviation of set outlet pressure at lock-up kPa** **(4)**
0 ± 2	20 to 100	± 0.5	+1
20 ± 5	20 to 300	± 0.5	+1
50 ± 2	100 to 600	± 0.5	+1

5.5.3 *High pressure regulators*

5.5.3.1 Soundness

A regulator shall be considered to be leak tight if the leakage rate does not exceed 4 mm^3/s when tested as described in **7.5.**

NOTE
Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve these tests.

5.5.3.2 Outlet pressure setting(s)

Adjustment of the outlet pressure shall be made at a nominal flow at an inlet pressure declared by the manufacturer. The tolerance on the outlet pressure setting shall be ± 10 kPa or ±10 per cent whichever is greater.

5.5.3.3 Measurement of capacity

It shall be possible to vary the flow between 10 per cent and 100 per cent of the rated capacity under the conditions given in Table 5.

TABLE 5 - High pressure regulators for LPG

Gas and regulator Temperature ^{0}C **(1)**	**Inlet pressure applied kPa** **(2)**	**Permissible deviation of set outlet pressure kPa** **(3)**	**Permissible deviation of set outlet pressure at lock-up kPa** **(4)**
0 ± 2	P * to 200	+ 20 - 30 or +20% - 30% if greater	+ 30 or + 30% if greater
20 ± 5	P * to 300	± 20 kPa or ± 20% if greater	+ 30 kPa or + 30% if greater
50 ± 2	P * to 600	+ 20 - 30 or +20% -30% if greater	+30 or +30% if greater

* Where the minimum inlet pressure (P) is equal the set outlet pressure + 50 kPa.

NOTE
Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve these tests.

5.5.4 *Integral safety devices*

The means of adjustment of settings shall be sealed in such a way that unauthorized interference can be detected.

5.5.4.1 Relief valves

5.5.4.l a) High capacity relief valves

i. Where a high capacity relief valve is incorporated it shall be set to start discharging at a pressure not less than twice and not more than three times the outlet. pressure setting and to reseat as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure.

ii. The vent outlet shall be threaded.

NOTE
It is recommended that provision should be made for venting to outside the building in which the cylinder(s) may be stored or in which the valve may be fitted. It is not recommended that relief valves be incorporated in high pressure regulators for indoor use.

5.5.4.1 b) Limited capacity relief valves

i. The relief valve shall vent gas to atmosphere when the outlet pressure of the regulator exceeds the relief pressure declared by the manufacturer and shall reseat before the pressure returns to the maximum lock-up pressure.

ii. The capacity of the relief valve shall not be greater than 5 per cent of the rated capacity of the regulator measured at a pressure of 0.2 kPa above the initial opening as described in **7.6**.

iii. The relief valve shall be set by the manufacturer before dispatch and shall be so designed as to deter unauthorized interference.

iv. The relief valve outlet shall be threaded.

NOTE
The relief valve may be integral with or independent of the main diaphragm assembly.

5.5.4.2 Under pressure shut-off device (UPSO)

5.5.4.2 a) The device shall close when the outlet Pressure of the regulator is between 2.5 kPa and 3.2 kPa when tested as described in **7.7**.

5.5.4.2 b) At an inlet pressure of 400 kPa and with the UPSO closed the leakage through the regulator shall not exceed 4mm ^{3}/s.

5.5.4.2 c) Pressure shut-off shall be achieved by a valve pad and seat which are separate from the regulator control valve pad and seat.

5.5.4.2 d) The adjustment of the device shall be sealed by the manufacturer before dispatch.

5.5.4.2 e) The device shall be designed for manual reset only.

5.5.4.3 Over pressure shut-off device (OPSO)

5.5.4.3 a) The mechanism of the device shall be completely independent of the main regulator mechanisms.

5.5.4.3 b) The device shall be set to close when the outlet pressure of the regulator exceed the normal outlet pressure by a pressure declared by the manufacturer when tested as described in **7.8**. The device shall close the supply upstream of the regulator control valve.

NOTE
The device will normally operate at a pressure of 7.5 ± 0.5 kPa.

5.5.4.3 c) Adjustable over pressure shut-off devices shall be sealed by the manufacturer before dispatch.

5.5.4.3 d) The device shall be designed for manual reset only.

5.5.4.3 e) The reset of an over pressure shut-off device shall only be accessible by means of tools and shall have provision for sealing.

5.5.5 *Performance*

5.5.5.1 Clip-on connection test

5.5.5.1 a) With the regulator connected, 10,000 operations of opening and closing the gas supply shall be effected, after which the regulator shall comply with 5.3.2.2 a) and 5.3.2.2 b).

5.5.5.1 b) The regulator shall be connected and disconnected 5,000 times to a cylinder valve which it is designed to fit, after which it shall comply with 5.3.2.2 a), 5.3.2.2 b), 5.5.5.1 c**)** and 5.5.5.1 d) when connected to a new valve.

5.5.5.1 c) The regulator attached to the cylinder shall be able to resist a force of 400 N applied in the opposite direction to the direction of coupling without disconnecting and shall still comply with 5.3.2.2 a) and 5.3.2.2 b) during the test.

5.5.5.1 d) The regulator attached to the cylinder valve shall comply with 5.3.2.2 a) and 5.3.2.2b) when a bending moment of 50 Nm is applied to the inlet connection in the least favorable direction for 10 s.

5.5.5.2 Gases used for testing

The performance tests shall be carried out using. LPG for which the regulator or device is designed. If this is not practicable, such alternative gases as air or nitrogen, etc. may be used provided that the regulator or device has been previously exposed for 72 hours to the LPG for which the regulator is designed.

5.5.5.3 Test temperature

Unless otherwise specified, setting and performance tests shall be carried out at 30 ± 5 ºC.

5.5.5.4 Chatter

A regulator or device shall not chatter or vibrate while being tested.

5.5.5.5 Orientation

The tests shall be carried out with the regulator or device in its recommended orientation.

The regulator shall comply with **5.5.5.10** in all orientations.

5.5.5.6 Rated flow rate

The rated flow rate shall be obtained with both:

a) the maximum designed bore size of outlet nozzle;

b) the maximum designed bore of inlet pipe.

5.5.5.7 Resistance to impact test

A complete regulator or device shall be dropped from a height of 1 m in any position on a hard surface (e.g. concrete). After the test the regulator shall remain functional and meet the requirements given in **5.5.1.1** as appropriate.

5.5.5.8 Endurance test

A regulator shall be functional after subjecting to 50,000 cycles of complete opening and closing of the valve under the test conditions specified in **7.3** without mechanical failure, impairment of operation, or the development of leakage. At the, completion of the test, the lockup pressure shall not exceed 110 per cent of that given in Tables 4 to 6 as appropriate.

5.5.5.9 Outlet pressure measurement

The pipe between the outlet of the regulator and the outlet pressure test gauge shall be of the same bore as the outlet of the regulator and between 8 and 10 bore diameters long. Readings shall be taken at time intervals of 10 s after completion of the necessary adjustments.

5.5.5.10 Lock-up

The device shall lock-up when flow is reduced to zero from nominal flow conditions over a period of 2 s. Lock-up shall be achieved at not more than 60 s after cessation of flow.

6 MARKING

6.1 A regulator shall be legibly and indelibly marked with the following :

a) Manufacturer's name or trade mark or symbol;

b) Unique type reference;

c) The year and the month of manufacture;

d) The direction of flow clearly visible on the body, e.g. by an arrow;

e) The type of gas;

f) The maximum inlet pressure for which the regulator or device complies with;

g) The nominal outlet pressure or pressure range;

h) A relief valve indication, where such is incorporated; and

i) The rated flow rate in kg/h.

6.2 Instructions shall be provided by the manufacturer for the user and the installer. They shall be clear and unambiguous with warnings clearly shown and grouped together. They shall be packed with the regulator or device and shall contain at least the following information, as applicable; which, in addition to the items in **6.1** (with the exception of the date of manufacture of the regulator), shall specify:

a) The manufacturer's address and, if necessary, his agent, country of origin if made outside Sri Lanka ;

b) The assembly conditions, in particular the use of a filter, the preferred position, and the instructions concerning the use of a spanner;

c) The installation, safety and soundness conditions, in particular with regard to the sealing means and their condition;

d) The absence of regulating function for adaptors;

e) The manufacturer shall recommend the replacement period from the date of manufacture.

f) A warning showing the type or types of gas for which the regulator is designed. A warning that the regulator may only be connected to the type of valve designed to accommodate it. For clip-on regulators, the valve size and/or system.

g) The installation conditions, including for regulating devices.

h) Instructions to the consumer that the regulator shall not be disconnected from the gas cylinder whilst the appliance remains alight and that in the event of the appliance failing to extinguish when the gas valve is turned off it is essential that the regulator is not disconnected from the cylinder.

i) Instructions for connecting, orientation, protection from rain, turning on and turning off the regulator including diagrams if required. Instructions for leak testing and the correct procedure in the event of a leak.

j) Warning regarding unauthorized interference.

7 METHODS OF TEST

7.1 Test for valve pads and diaphragms

Apply pressure (air or nitrogen is suitable) through the outlet connection to the underside of the diaphragm mounted in a regulator in the fully assembled condition (i.e. as it would be supplied by the manufacturer to a buyer). Block the inlet if required.

For adjustable regulators, carry out the test at the minimum outlet pressure adjustment. Incorporate a gauge in the test rig between the air or nitrogen supply and the regulator to indicate the applied pressure.

Apply the pressure at a rate of approximately 70 kPa/s up to the level specified and hold it for not less than 60 s.

NOTES

1. This test is designed to give a practical result on an assembled regulator, and is intended as a simple check method that may be applied by the regulator manufacturer to diaphragm material, which will usually have been previously tested by some other method by the supplier.

2. Where fitted relief valves should have vent; sealed and OPSO devices, where fitted, may require overriding for the purpose of these tests.

7.2 Torque and bending moment test

7.2.1 *Screwed inlet connection torque test*

With the body of the regulator rigidly clamped, apply the appropriate test torque given in Table 7 to the inlet connector for 10 s in each rotational direction.

7.2.2 *Screwed inlet connection bending moment test*

Fit a pipe 300 ± 25 mm in length terminated with a screwed inlet union complying with that of the regulator, to the inlet connection of the regulator or device. Apply the force required to give the appropriate test bending moment given in Table 7 to the pipe. Apply the force for 10 s in each of four directions, perpendicular to each other and to the axis of the pipe (see Figure 8).

TABLE 7 - Torque and bending moment requirements for screwed connections

Rated capacity kg/h (1)	**Torque N.m (2)**	**Bending moment N.m (3)**
Up to 1	30	30
Above 1 up to 2	35	35
Above 2 up to 3	40	40
Above 3	50	50

7.2.3 *Threaded connection torque test.*

Fit a suitably threaded pipe 300 ± 25 mm in length to the connections of the regulator or device. With the body of the regulator or device clamped apply the appropriate test torque given in Table 8 to the pipe for 10 s.

7.2.4 *Threaded connection bending moment test.*

Following the torque test of 7.2.3, apply the force required to give the appropriate test bending moment given in Table 8 to the pipe. Apply the force for 10 s in each of four directions, perpendicular to each other and to the axis of the pipe (see Figure 8).

TABLE 8 -Torque and bending moment requirements for threaded connections

Nominal pipe thread size (1)	**Nominal size mm (2)**	**Torque N.m (3)**	**Bending moment N.m (4)**
1/8	6	15	25
1/4	8	20	35
3/8	10	35	70
1/2	15	50	105
3/4	20	85	225
1	25	125	340

7.2.5 *Integral hose connections bending moment test*

Rigidly clamp the body of the regulator or device and apply the force required to give the test bending moment of 10 Nm to the connector. Apply the force for 10 s in each of four directions perpendicular to each other and to the axis of the outlet connector (see Figure 8).

For the purpose of carrying out the test it is permissible to extend the effective length of the outlet connector by the use of a length of a chose fitting steel tube fitted over the full useful length of the connector.

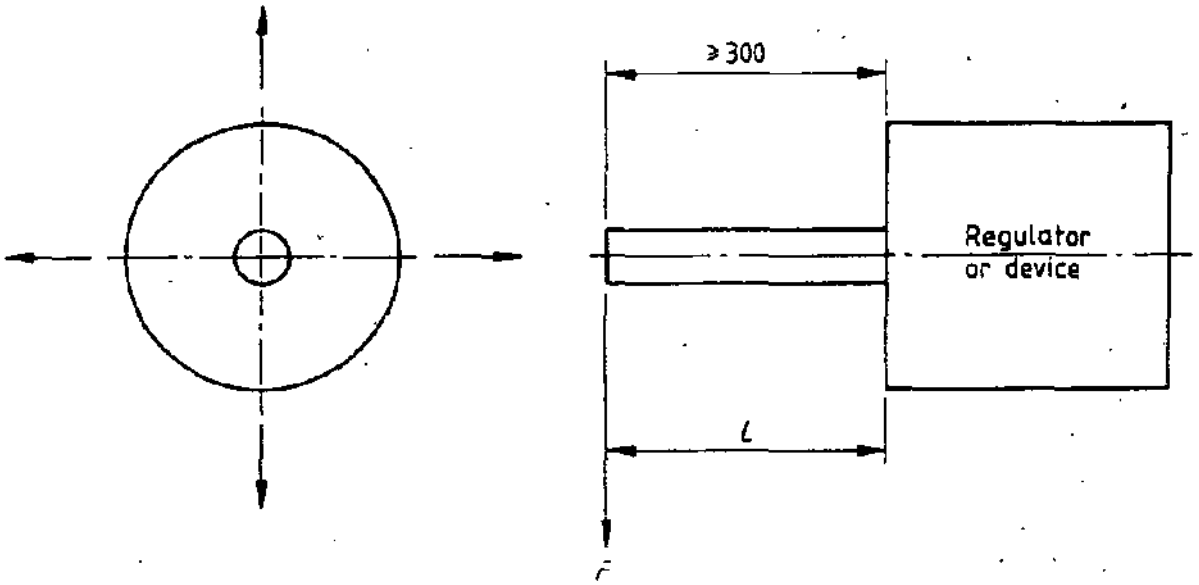


FIGURE.8- Bending moment test: schematic

7.3 Endurance test

Supply the regulator inlet with air at 140 kPa and at temperature of 30 ± 5 ºC.

Install quick-acting valves upstream and downstream of the regulator and the downstream valve exhaust to atmosphere.

Connect the valves to a suitable time switch so that as one opens the other closes with a complete cycle time of approximately 5 s. Arrange the test so that the diaphragm is fully flexed and the valve is held on its seat for a minimum of 1 s. After each 25,000 cycles of operation, the regulator is to be checked for leakage and the lockup pressure is to be recorded.

7.4 Soundness test for low pressure regulators

Test the completed regulator at a pressure of 15 kPa applied through the outlet connection and held for a period of not less than 60 s.

Test those parts normally subjected to at a pressure of 1.4 MPa applied through the inlet connection and held for a period than 120 s with the outlet connection sealed.

7.5 Soundness test for high pressure regulators

Test the completed regulator at a pressure of 1.5 times the maximum outlet pressure obtainable from the regulator, applied through the outlet connection and held for a period of not less than 60 s.

Test those parts normally subjected to cylinder pressure at a pressure of 1.4 MPa applied through the inlet connection and held for a period of not less than 120 s with the outlet connection sealed.

7.6 Relief valve test

Set up the regulator as shown in Figure 9 with the nominal flow valve open and the air bleed valve closed. Operate the regulator under the conditions given in 5.5.2.2. and then lock it up. Then gradually increase the outlet pressure by not more than 0.2 kPa/s to a point when the relief valve operates. Check that the relief valve resets before the pressure is reduced to the maximum lock-up outlet pressure.

Repeat test five times to confirm that the relief pressure remains consistently within the manufacturer's tolerances.

7.7 Under pressure shut-off device test

7.7.1 Set up the regulator as shown in Figure 9 with the nominal flow valve and the air bleed valve closed.

7.7.2 With no pressure in the system ensure that the UPSO is closed and the OPSO is open.

7.7.3 Gradually increase the inlet pressure of the regulator up to a maximum of 400 kPa and check that the UPSO does not open during the test.

7.7.4 Manually reset the UPSO and open the nominal flow valve to operate the regulator under the conditions specified in **5.5.2.2.**

7.7.5 Reduce inlet pressure of regulator at a rate of 100 Pa/s until the UPSO closes. Repeat the test five times to confirm that the shut-off pressure remains consistently within the specified tolerance.

7.8 Over pressure shut-off device test

Set up the regulator as shown in Figure 9 with the nominal flow valve open and the air bleed valve closed. Operate the regulator under the conditions given in **5.5.2.2.** and then lock it up. Then gradually increase the outlet pressure by not more than 0.2 kPa/s to a point when the over pressure shut-off device operates.

The limited relief, when fitted, shall continue to vent during the test.

Repeat test five times to confirm that the shut-off pressure remains consistently within the manufacturer's tolerances.

7.9 Corrosion resistance test

The complete unconnected device is tested according to SLS EN ISO 9227. Other test methods leading to equivalent results, for example the method described in informative Appendix E, are allowed.

The test chamber being in a steady state, the device is placed in the position of use recommended by the installation instructions and left for 96 h.

At the end of this test, the requirements of **5.2.5** shall be met.

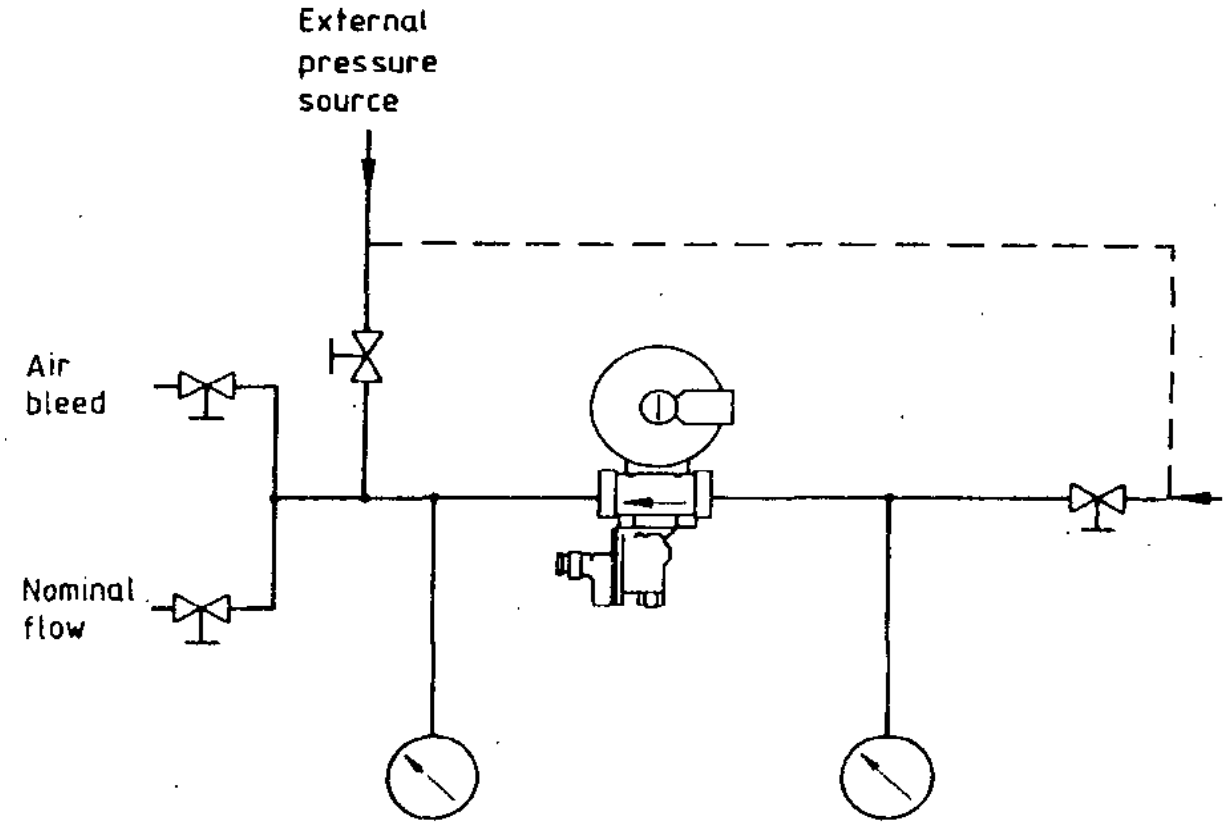


FIGURE 9 - General arrangement of equipment for over pressure, under pressure and relief valve tests.

APPENDIX A

(normative)

SPECIAL REQUIREMENTS FOR DEVICES FITTED WITH PRESSURE OR FLOW RATE OPERATED SAFETY FUNCTIONS

A.1 Regulating devices fitted with an over-pressure relief valve of a limited flow rate (PRV)

A.1.1 *Definition*

An over-pressure relief valve is a safety device which vents gas to the atmosphere when the gas pressure reaches a set pressure. It closes when the pressure is reduced to below the set pressure. This valve is closed during normal operation.

A.1.2 *Constructional characteristics*

The relief valve shall be integral with the regulating device or be an auxiliary safety device.
It may be part of the pressure sensing subassembly of the regulating device. The adjustment of the set point shall be protected against any unauthorized modification.
For designs where gas is discharged via the pressure sensing subassembly, the respective cross sectional area of the valve, vent holes and connection pipework to the atmosphere shall be chosen in such a way that no unacceptable rise in pressure can occur within the pressure subassembly.

If the regulating device is intended to be used inside a building, enclosure or other potentially hazardous area and if the national regulations require the relief discharge to be directed to the outside, the device shall incorporate a component enabling connection to a relief, for example via an Rp 1/8 internal thread. The tube connecting to the atmosphere may also be used as a vent.

The discharge orifice shall be protected against rain water.

A.1.3 *Performance characteristics*

A.1.3.1 Regulating devices with regulated pressures specified in SLS EN 437

The opening pressure of the relief valve shall be between 20 % above the maximum allowable lock up pressure and 150 mbar, except for regulating devices designed to operate with pressures of 112 mbar or 148 mbar where 150 mbar is replaced by 300 mbar.

The opening pressure shall be within ± 20 % of the nominal operating pressure.

At a pressure of 10 % greater than the opening measured pressure, the flow rate shall be at least 0,01 m^3/h (air, under the reference conditions) or 0.1 % of the regulating device guaranteed flow rate (whichever is the greater).

At a pressure of 10 % greater than the opening measured pressure, the maximum flow rate shall not exceed 0.2 m^3/h (air, under the reference conditions) or 5 % of the regulating device guaranteed flow rate (whichever is the greater).

A.1.3.2 Regulating devices with regulated pressures other than those specified in SLS EN 437

The opening pressure of the relief valve shall be at least 20 % above the maximum allowable lock up pressure. The opening pressure shall be within ± 20 % of the nominal operating pressure.

If a particular relief device flow rate is required by the regulation of the country of destination, it shall be within ± 30 % of the nominal flow rate.

A.1.4 *Test methods*

Only soundness through outlet connection tests, behavior in operation and discharge are verified for the relief valve, all the strength and soundness through inlet connection tests being carried out in compliance with the requirements for the regulating device.

Tests shall be carried out under the following conditions:

a) Soundness test through outlet connection before opening.

The relief valve is tested at 10 % above the maximum lock-up pressure (p_0). The test shall be carried out at a room temperature of (20 ± 5) ˚C. The relief valve shall be sound at that pressure, soundness is considered satisfactory if the value of leak measured complies with **5.5.2.1** and **5.5.3.1** as appropriate.

b) Opening and closing pressures and flow rate:

Pressure tests shall be carried out at the following temperatures:

1) (- 20 ± 2) °C for propane and LPG, (0 ± 2) °C for butane;

2) (+ 20 ± 5) °C; and

3) (+ 50 ± 2) °C,

Flow rate test shall be carried out at (+ 20 ± 5) °C.

The pressure is increased slowly until the relief valve discharges 2 Lz/h (air, under the reference conditions) or 0.02 % of the regulating device guaranteed flow rate (whichever is the greater). The corresponding pressure is the opening pressure of the PRV and shall be recorded and meet the requirements of A.1.3.1 or A.1.3.2. The pressure is then slowly increased up to a value of 10 % above this opening pressure and the flow rate is measured. This flow rate shall meet the requirements of A.1.3.1 or A.1.3.2, if required.

The pressure is then decreased slowly until 10 % above lock up pressure (p_0). The soundness is considered satisfactory if the value of leak measured complies with **5.5.2.1** and **5.5.3.1** as appropriate.

A.1.5 *Regulating device marking*

In addition to the information required in **6.1**, the regulating device fitted with a relief valve shall be marked "PRV". Where the regulating device capacity is greater than 4 kg/h, the nominal operating pressure shall also be marked in mbar or bar.
Where required by a particular national regulation, the nominal relief device flow rate shall be marked in g/h or kg/h of the declared gas.

A.1.6 *Instructions*

In addition to the provisions of **6.2**, the instructions shall:

— state that a pressure relief valve of a limited flow rate is incorporated in the regulating device;

— give a clear explanation of the pressure relief valve operation, and all necessary information for its installation and use including the explanation of the meaning of "PRV" (Pressure Relief Valve);

— specify that connection to the outside shall be carried out when a regulating device fitted with a

relief valve is to be used in a building, enclosure or other potentially hazardous area; they shall provide all necessary information on this connection and in particular the dimensions of the tube (minimum diameter and maximum length).

A.2 Regulating devices fitted with an over-pressure shut off safety device (OPSO)

A.2.1 *Definition*

Shut off safety device, triggered by an excessive regulated pressure, which causes the complete shut off of the gas flow for all values of supply pressure.

The restoration of the gas flow shall only be possible by manual intervention when the conditions which cause the shut-off device to operate have been rectified.

The manual device which enables the restoration of the gas flow is called the resetting device.

A.2.2 *Constructional characteristics*

A.2.2.1 General

The shut off device may be either integral with the regulating device or be an auxiliary safety device. In any case, the constructional requirements for the shut off device are the same as those for the regulating device.

The shut off device closing mechanism, measuring device and external impulse tube if any, shall be independent of the regulating mechanism.

The shut off device closing mechanism, shall have only two positions, fully open and fully closed. This mechanism is triggered by over pressure, closing instantly.

The resetting device shall be protected against any intervention which could impair the operation of the over pressure shut off.

After shut off, the gas flow shall remain cut off at any supply pressure below the maximum supply pressure and shall be sound according to **5.5.2.1** and **5.5.3.1** as appropriate, at pressures and temperatures given in **Table** 9.

Table 9 – Performance curves – Supply conditions

Type of Gas	Temperature ˚C	Pressure bar
LPG	+50 ±2	16
	+20 ± 5	0.3 or p_d + 0.2 if greater – 16
	- 20 ± 2	0.3 or p_d + 0.2 if greater

- for first or single stage regulating devices, the pressure values are those of Table A1, starting with maximum pressures;

- for second or third stage regulating devices, the supply pressure values are the minimum and maximum marked on the regulating device and declared in the instructions for the whole temperature range given in **Table** 9.

For temperatures other than 20 °C, the curve will be limited:

- to the guaranteed flow rate for regulating devices with a guaranteed flow rate ≤ 4 kg/h;

- to 10 % of the guaranteed flow rate (but not less than 4 kg/h) for regulating devices with a guaranteed flow rate > 4 kg/h.

All the curves define the typical operational range of the regulating device. If the points of the curve are distributed abnormally, additional tests shall be carried out at intermediate supply pressures, to ensure that all operational points are well within the typical range.

A.2.2.2 Closing force

The force which ensures the closing of the valve from the open position shall be at least equal to the resistance due to the maximum gas pressure and to the weight of relevant internal parts, plus five times the frictional force.

When the closing device is in the closed position, the closing force shall be at least equal to the force due to maximum supply pressure and to the weight of relevant internal parts plus twice the frictional force.

The frictional force is measured according to A.2.4.1; other forces are either measured or calculated.

A.2.2.3 Diaphragm strength

The diaphragm shall be designed and/or incorporated in such a way that it withstands a pressure equal to the maximum supply pressure.

A.2.3 *Performance characteristics*

A.2.3.1 Regulating devices with regulated pressures specified in EN 437

The operating pressure of the over pressure shut off device shall be between 20 % above the maximum allowable lock up pressure and 150 mbar, except for regulating devices designed to operate with pressures of 112 mbar or 148 mbar where 150 mbar is replaced by 300 mbar.

The operating pressure shall be within ± 15 % of the nominal operating pressure.

A.2.3.2 Regulating devices with regulated pressures other than those specified in EN 437

The operating pressure of the over pressure shut off device shall be greater than 20 % above the maximum allowable lock up pressure.

The operating pressure shall be within ± 15 % of the nominal operating pressure.

A.2.4 *Test methods*

A.2.4.1 Frictional force

The frictional force is measured with the closing spring removed and the valve in the open position. Prior to

testing, the mechanism is held at (20 ± 5) °C for 24 h.

The over-pressure shut off device shall be oriented so the weight of the components does not influence the measurement. The mechanism is moved in the direction of closure and the force needed to initiate the motion is recorded.
The test is first carried out at atmospheric pressure, the measured force F1 is the frictional force at the atmospheric pressure.
The test is then carried out at the maximum supply pressure, the measured force F2 is a force combining friction

and the effect of maximum supply pressure. The effect of the maximum supply pressure on a cross section area of the mechanism is calculated: F3. The frictional force at maximum supply pressure is F4 = F2 – F3.

The frictional force *F* equals to the highest value of F4 or F1.

A.2.4.2 Performance test

The test shall be carried out at the temperatures, supply pressures and regulator positions, as given in **Table 9** – Performance curves – Supply conditions, together with the description underneath.

The device under test is supplied with air through its impulse tube. The pressure is slowly increased until the device shuts off. The test shall be performed five times.

Each operating pressure shall be within the limits specified in A.2.3.

After shut off, the leakage flow rate shall not exceed 15 cm^3/h for regulating devices with a nominal connection diameter of less than or equal to DN 15 and 30 cm^3/h for regulating devices with a nominal connection diameter greater than DN 15.

A.2.4.3 Test for diaphragm strength

First a performance test as defined in A.2.4.2 shall be carried out at (20 ± 5) ˚C.

The diaphragm of the shut off device shall then be subjected to a test pressure equal to the maximum supply pressure.

This pressure shall be maintained for 10 min.

Another performance test shall then be carried out as defined in A.2.4.2. The measured values for the operating pressures shall not vary from the values recorded during the previous test by more than 10 %.

A.2.5 Regulating device marking

In addition to the information required in **6.1**, the regulating device fitted with an over pressure shut off shall be marked with “OPSO” followed by its nominal operating pressure in mbar or bar.

A.2.6 Instructions

In addition to the provisions of **6.2**, the instructions shall:

— where appropriate, state that an over pressure shut off device is incorporated in the regulating device;

— give a clear explanation of the over pressure shut off device operation, and all necessary information for its installation and use including the explanation of the meaning of "OPSO" (Over-Pressure Shut Off) in the language(s) of the destination countries of the regulating device;

— state the nominal operating pressure;

— when required by a particular national regulation, state the maximum operating pressure.

A.3 Regulating devices fitted with an under-pressure shut off safety device (UPSO)

A.3.1 *Definition*

Shut off safety device, triggered by a lack of regulated pressure, which causes the complete shut off of the

gas flow for all values of supply pressure.

The components which provide the regulating function may also provide this safety function.

The restoration of the gas flow shall only be possible by manual intervention when the conditions which cause the safety device to operate have been rectified.

The manual device which enables the restoration of the flow is called the resetting device.

A.3.2 *Constructional and performance characteristics*

The shut-off device shall not be influenced by the operation of any other safety device.

The shut-off device shall shut off the gas flow only when the pressure measured downstream of the regulating device is equal to or greater than:

— the minimum pressure required at the appliance's inlet (column "p_{min}" in Table 10) for EN 437 regulated pressures;
— the pressure marked according to A.3.4 for non-EN 437 regulated pressures.

Table 10 - Pressure characteristics of the regulator based on nominal pressures given in **SLS EN 437**

Gas	**Regulator Supply Pressure** bar	**Regulator regulated pressure** mbar				**Maximum downstream installation pressure loss** mbar	**Appliance supply Pressure*** mbar			**Appliance Categories***
		p_d	p_{Mg}	p_{Mp}	p_o		p_n	p_{min}	p_{max}	
LPG	0.3 – 16	29	27	35	40	2	29 (28-30)	25	35	3B/P
LPG	0.3 - 16	50	47.5	57.5	62.5	5	50	42.5	57.5	3B/P
* Data taken from EN 437										

It shall be designed in such a way that, without manual intervention, it can only be in the fully open position or fully closed position. If the resetting device also acts as a manual closing valve using a rotating handle, the sense of shutting off the gas shall be clockwise.

If the resetting device has no other function and if it is accessible, it shall be protected against any intervention which could impair the regulating device's normal operation when it is reset.

A.3.3 *Test methods*

Tests shall be carried out as given in 7.2 with the regulating device installed according to the instructions.

The regulating device is supplied with air at the maximum supply pressure and the outlet flow rate is adjusted to be equivalent to the guaranteed flow rate. Then the supply pressure is reduced to the pressure at which the shut-off device shuts off.

At the time of the shut off, the regulated pressure shall be:

— equal to or greater than the minimum pressure required at the appliance's inlet (column "p_{min}" in Table A2) for EN 437 regulated pressures;

— the pressure marked according to A.3.4 with a tolerance of ± 10 % for non EN 437 regulated pressures.

In the closed position, the supply pressure is reduced to zero. Then the supply pressure is slowly increased to maximum. The under pressure shut off shall remain closed during this test, and it is checked that the leakage rate complies with **5.5.2.1** and **5.5.3.1** as appropriate.

A.3.4 Regulating device marking

In addition to the information required in **6.1**, the regulating device fitted with an under pressure shut off shall be marked with “UPSO” (Under-Pressure Shut Off).

For regulated pressures not in accordance with SLS EN 437, the UPSO nominal operating pressure shall also be marked.

A.3.5 Instructions

In addition to the provisions of **6.2**, the instructions shall:

— where appropriate, state that an under pressure shut off device is incorporated in the regulating device;

— give a clear explanation of the under pressure shut off device operation, and all necessary information for its installation and use including the explanation of the meaning of "UPSO” (Under-Pressure Shut Off) in the language(s) of the destination countries of the regulating device.

A.4 Regulating devices fitted with an excess flow valve (EFV)

A.4.1 Definition

The excess flow valve is a safety device integral with the regulating device or an auxiliary safety device which causes the shut off of the gas flow for values of flow rate greater than the guaranteed flow rate for example when the downstream hose or pipe is disconnected.

The restoration of the gas flow may be by manual or automatic intervention, when the conditions which caused the safety device to operate have been rectified.

A.4.2 Performance characteristics

A.4.2.1 General requirements

The EFV shall not be influenced by the operation of any other safety device.

For devices intended to be directly connected to the gas cylinder, the following requirements shall be met with the device in its normal position and then with inclinations of +10° and -10° in the plane where the operation of the EFV is most influenced.
For automatic resetting EFV's, a maximum residual flow between 30 g/h and 60 g/h corresponding to the declared gas according to the national regulations is permitted.

For manual resetting EFV's, a maximum residual flow between 15 cm^3/h and 200 cm^3/h of air according to the national regulations is permitted.

If a manual closing device is integral with the regulating device, it is recommended that a two position manual closing device is used: one for full opening and one for complete closure in order to not influence the excess flow function.

A.4.2.2 Requirements for regulating devices with regulated pressures specified in EN 437

The EFV shall not shut off the gas for a flow rate less than 110 % of the guaranteed flow rate. It shall shut off the gas under the test conditions given in A.4.3.2.1 for the pressure loss given in Table 5 at the guaranteed flow rate.

A.4.2.3 Requirements for regulating devices with regulated pressures not specified in EN 437

The EFV shall shut off the gas for a flow rate between 110 % and 130 % of the guaranteed flow rate.

For variable pressure regulators this last requirement shall be met at the minimum declared regulated pressure.

A.4.3 Test methods

A.4.3.1 *General*

For regulating devices intended to be directly connected on a gas cylinder, the performance test (A.4.3.2), residual flow test (A.4.3.3) and re-setting test (A.4.3.4) are carried out at two angles of 10° as described in A.4.2.1.

For regulating devices not intended to be directly connected on a gas cylinder, the performance test (A.4.3.2), residual flow test (A.4.3.3) and re-setting test (A.4.3.4) are carried out in the most unfavourable position of those stated in the instructions.

Performance tests (A.4.3.2), residual flow tests (A.4.3.3), re-setting tests (A.4.3.4) are carried out in this order before and after the endurance tests (A.4.3.5) on one single sample.

The test is carried out after resistance to impact, resistance to pressure and mechanical strength of connection tests given in **5.5.1** to **5.5.3**.

The test is carried out both at the minimum and maximum supply pressures at (20 ± 5) ˚C.

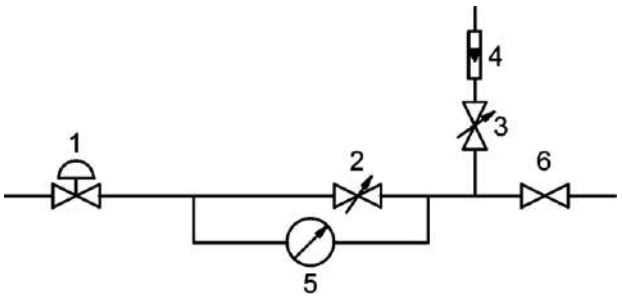
A.4.3.2 *Performance tests*

A.4.3.2.1 Regulating devices with regulated pressures specified in EN 437

The regulating device 1 is connected to a downstream test rig as described in Figure A.1. Valve 6 shall have sufficient flow capacity to obtain closure of the excess flow valve.

Valve 6 is closed.

The flow rate is adjusted to the guaranteed flow rate while achieving the maximum pressure loss given in Table 5 for the corresponding outlet pressure using both valves 2 and 3.
The flow rate is then adjusted to 110 % of the guaranteed rate using valve 3. The excess flow valve shall not close. Valve 6 is then opened and the excess flow valve shall close.



Key

1 regulating device with EFV under test	4 flow meter
2 pressure loss adjustment valve	5 pressure loss measurement
3 flow rate adjustment valve	6 excess flow activation valve

Figure A.1 - Test rig

A.4.3.2.2 Regulating devices with regulated pressures not specified in EN 437

The regulating device 1 is connected to a downstream test rig as described in Figure A.2. Valve 2 shall

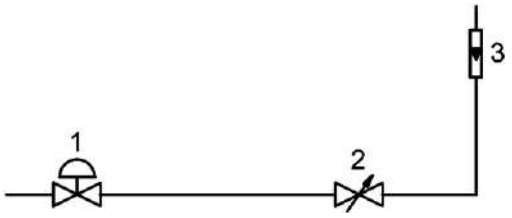
have sufficient flow capacity to obtain closure of the excess flow valve.

The flow rate is adjusted to the guaranteed flow rate with the minimum supply pressure using valve 2.

The flow rate is then adjusted to 110 % of the guaranteed flow rate using valve 2. The excess flow valve shall not close.

The flow rate is then increased using valve 2. The excess flow valve shall close before the flow rate reaches 130 % of the guaranteed flow rate.

The test is then repeated at the maximum supply pressure.



Key

1 regulating device with EFV under test	3 flow meter
2 flow rate adjustment valve	

Figure A.2 - Test rig

A.4.3.3 Residual flow test

The measured flow rate shall be lower than the residual flow rate specified in A.4.2. The test is carried out at the following supply pressure:

a) For single and first stage regulating devices:

1) butane 1.7 bar;

2) propane 6.8 bar;

3) LPG 3.2 bar.

b) For second and third stage regulating devices at the minimum and maximum values of supply pressure given in the instruction.

A.4.3.4 Re-setting test

A.4.3.4.1 Automatic re-setting excess flow valves

Using the test rig A1, with the nominal supply pressure given in A.4.3.3, the regulating device shall be tested to confirm automatic reset.

— Valve 2 is set as in A.4.3.2.1.

— Valve 3 is closed.

— Valve 6 is open.

— Ensure that EFV is closed.

— Close valve 6.

After a time corresponding to 2 min per litre of the test rig volume (from the regulating device under test up to valves 3 and 6), valve 3 is opened slowly and the guaranteed flow rate shall be re-established.

A.4.3.4.2 Manual re-setting excess flow valves

Using the test rig A1, with the nominal supply pressure given in A.4.3.3, the regulating device shall be tested to confirm manual reset.

— Valve 2 is set as in A.4.3.2.1.

— Valve 3 is closed.

— Valve 6 is open.

— Ensure that EFV is closed.

— Close valve 6.

The re-setting device is activated for 5 s, valve 3 is then opened slowly and the guaranteed flow rate shall be re-established.

A.4.3.5 Endurance test

The regulating device 1 to be tested is installed on a test rig as described in Figure A.3 and supplied with air at the supply pressures given in A.4.3.3.

— Valve 2 is opened.

— Valve 5 is closed.

— Valve 3 is adjusted to obtain 50 % of the guaranteed flow rate.

The endurance test sequence shall be as follows:

— Valve 5 is opened to create an excess flow.

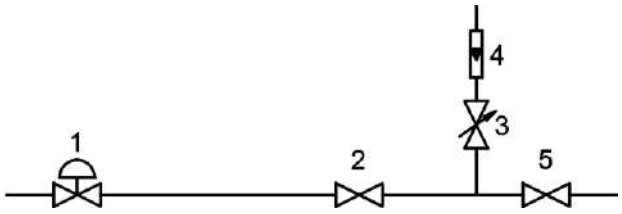
— After the EFV has closed valves 2 and 5 are closed.

— The EFV is reset.

— Valve 2 is opened.

After 1 000 shut off cycles, the regulating device is checked for compliance with the requirements of A.4.3.2 and A.4.3.3.

Where the excess flow valve re-setting device incorporates sealing elements through the body of the regulating device, a leakage test in accordance with 5.2.4 shall then be carried out and the requirement of 5.4.2.1 and 5.4.3.1. shall be met.



Key

1 regulating device with EFV under test
2 valve
3 flow rate adjustment valve
4 flow meter
5 excess flow activation valve

Figure A.3 - Endurance test rig

A.4.3.6 Resistance to impact test
For regulating devices intended to be directly connected on a gas cylinder, the excess flow valve shall operate after the test for resistance to impact carried out as described in **5.5.1.1** after the EFV endurance test.

A.4.4 Regulating device marking
In addition to the information required in **6.1,** the regulating device fitted with an excess flow valve shall be marked with "EFV".

A.4.5 Instructions
In addition to the information given in **6.2,** the instructions shall clearly indicate:

a) when used on a cylinder, the excess flow valve may close if the gas cylinder is moved during use;

b) close the valve (on the supply line, the cylinder, or regulating the device) in the event of

operation of the excess flow valve, and only open it after having rectified the cause of the EFV operating;

c) when the valve (on the supply line, the cylinder, or the regulating device) has intermediate positions between fully open and fully closed, the valve shall always be in the fully open position so as to allow the operation of the excess flow valve;

d) the value of the maximum residual flow rate in case of automatic resetting EFV's;

e) the explanation of the excess flow device operation, and method of re-setting;

f) all necessary information for its installation and use including the explanation of the meaning of "EFV" (Excess Flow Valve).

APPENDIX B
(normative)

Special requirements for devices fitted with a thermal shut off system.

B.1 Thermal shut off valve

B.1.1 *Definition*

A thermal shut off valve is a safety device which permanently closes the flow of gas above a certain temperature limit. All components, including the thermal valve, are designed in a way to guarantee soundness and strength up to a certain temperature above the activating temperature.

B.1.2 *Constructional characteristics*

The thermal shut off valve shall be integral with the regulating device or be an auxiliary safety device.

The closing device which closes under thermal action and all the parts necessary for its operation shall be either integral with the regulating device or a separate thermal shut off valve. The thermal shut off element shall be independent from the regulation subassembly.

All the components which are placed upstream of the thermal shut off valve, as well as the valve itself, shall be made of materials resistant to a temperature of 650 °C and at the maximum supply pressure.

B.1.3 *Performance characteristics*

The thermal shut off valve shall shut off the gas supply at a temperature between 80 °C and 100 °C.

Under the test conditions described in B.1.4, no leak or faulty operation of the device/valve assembly shall be noted before the activation of the closing device.

The valve shall remain in the closed position after the activation of the device.

B.1.4 *Test methods*

The test shall be carried out on two complete devices using nitrogen.

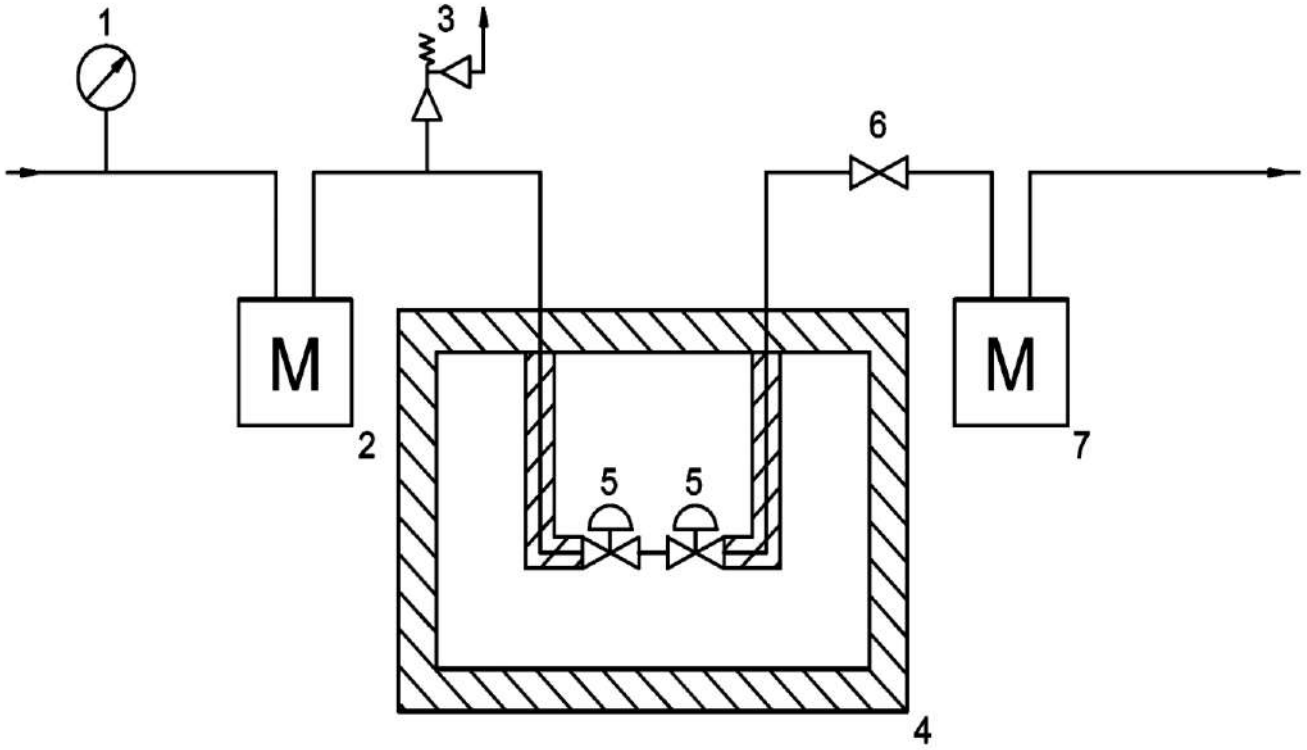
The device fitted with a thermal shut off valve is placed in an oven as shown in Figure B.1 and operated at maximum supply pressure given in Table A1 or the declared maximum operating pressure for a separate valve, at a flow rate equal to 50 % of the nominal flow rate.

The temperature inside the oven is increased so as to reach:

- a final temperature of (650 ± 20) °C in a period of 15 min (1st sample);
- a final temperature of (650 ± 20) °C in a period of 2 h (2nd sample).

During the rise in temperature, it shall be confirmed that the valve closes between the temperature limits given in

B.1.3. When the temperature reaches 650 °C this temperature and the supply pressure are maintained for 30 min. During this 30 min period, the shut off valve shall not leak more than 35 l of nitrogen (70 l/h) (under normal conditions).



Key
1 gauge – pressure test point
2 gas meter
3 pressure relief valve
4 oven
5 devices under test
6 isolating and adjusting valve
7 gas meter

Figure B.1— Diagram of the test bench for the regulator fitted with a thermal shut off valve

B.1.5 *Marking*

In addition to the information required in **6.1**, the device shall be marked with “T”.

B.1.6 *Instructions*

In addition to the provisions of **6.2**, the instructions shall:

- state that a thermal shut off device is incorporated in the device;
- give a clear explanation of the thermal shut off device operation, and the meaning of "T” (Thermal).

B.2 Thermal spindle on devices for self closing valve connection

B.2.1 *Definition*

Integral device which permanently closes the self closing cylinder valve above a certain temperature limit.

B.2.2 *Constructional characteristics*

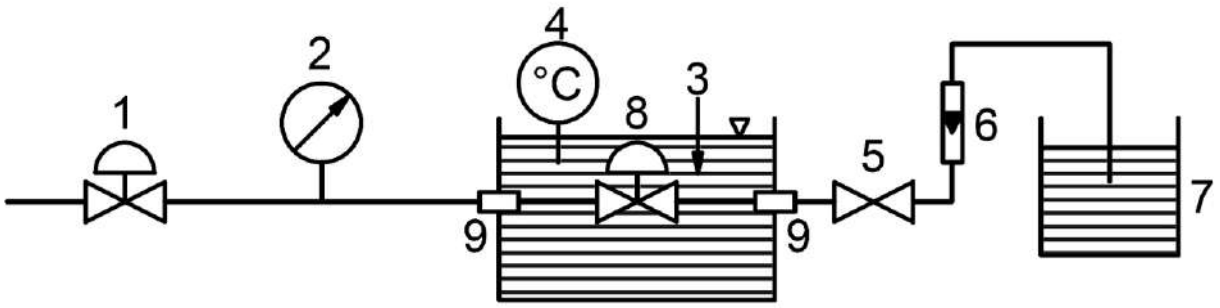
The thermal spindle deforms or melts when the target temperature is reached, resulting in the gas flow shutting off.

B.2.3 *Performance characteristics*

When the device is under the influence of the temperature, the thermal spindle shall act and shut off the gas flow at a temperature between 100 °C and 150 °C.

B.2.4 *Test methods*

The device fitted with a thermal spindle is placed in a test bench as shown in Figure B.2. It is connected to a self closing cylinder valve supplied with air at maximum supply pressure given in Table A1 and a flow rate through the device is adjusted to (100 ± 20) l/h. The oil is heated to 100 °C and stabilized for 15 min.



Key

1 regulating device	6 flow meter
2 manometer	7 vessel filled with water
3 vessel filled with oil	8 device under test
4 thermometer	9 connections
5 valve	

Figure B.2 — Diagram of the test bench for the thermal spindle

After this stabilization period, the flow rate through the device shall remain at (100 ± 20) l/h for 2 min to prove that the self closing valve has not closed.

The temperature of the oil is increased at a rate of 0.5 °C per minute until the cylinder valve closes. This shall be before the temperature reaches 150 °C.

B.2.5 *Marking*

In addition to the information required in **6.1**, the device shall be marked with “TSP” on the device.

B.2.6 *Instructions*

In addition to the provisions of **6.2**, the instructions shall:

- state that a thermal spindle is incorporated in the device;

- give a clear explanation of the thermal spindle operation, and the meaning of "TSP” (Thermal Spindle Protection) marked on the device.

APPENDIX C
(normative)
Complementary test requirements for non-metallic thermoplastic or thermosetting materials used in the construction of devices

C.1 Scope

The requirements in this appendix, cover devices made of non-metallic materials in accordance with **5.2**.

Table 11 — Minimum characteristics of non-metallic materials

Property	**Standard**	**Unit**	**Test method/ conditions**	**Minimum value**
Mechanical				
Elongation at break	EN ISO 527 (all parts)	%	23 °C	1
Bending resistance	EN ISO 178	N/mm^2	23 °C	150
Shock resistance	EN ISO 180	kJ/m^2	Method 1 at 23 °C	30
Thermal				
Dimensional stability	EN ISO 75 (all parts)	°C	Method A 1,80 MPa	190

Table C.2 summarizes the possibilities for using non-metallic materials on devices.

Table 12 - Use of non-metallic materials

		Non-metallic	
		PBTP or equivalent	Other
Body and cover which retain pressure		Yes Only for regulators, having a regulated pressure of up to 200 mbar and of a flow rate smaller than 4 kg/h, directly fitted onto the cylinder using a quick coupling with self closing valve and non-threaded outlet connection	No
Internal parts and cover not retaining the pressure except connections		Yes	Yes
Connections	threaded fixed parts	No	No
	non-threaded fixed parts	Yes Only for regulators, having a regulated pressure of up to 200 mbar and of a flow rate smaller than 4 kg/h, directly fitted onto the cylinder using a quick coupling with self closing valve and non-threaded outlet connection	No
Other (buttons,…)		Yes	Yes

C.2 Materials

The material for the body and/or cover and/or connections shall be polybutylene terephtalate (PBTP), with a 20 % to 30 % mass of glass fibre or an equivalent material. The characteristics of the material used shall not be lower than the values given in Table C.1.

C.3 Special requirements

C.3.1 *Accelerated ageing*

Devices incorporating one or several external parts made of non-metallic materials shall be subjected to the accelerated ageing test before carrying out the tests required by the standard.

Before carrying out the test cycles indicated below, the inlet and outlet of the device shall be sealed.

a) First cycle: UV

The device shall be subjected to an energy of 1 120 W/m^2 emitted by a xenon lamp under the conditions of EN ISO 4892-3.

The exposure cycle, consisting of 20 h radiation and 4 h darkness, shall be repeated for 10

cycles. The test shall be carried out at a temperature of 55°C with (90 $\pm$ 5) % humidity.

The device shall be fixed, in its normal operating position, onto a support which rotates so as to expose all sides to the energy.

b) Second cycle: thermal choc

The device shall be placed in a cryostatic cell at a temperature of (- 25 $\pm$ 2) °C.

The test cycle shall include the following stages:

1) The device shall be kept in the cell for 10 min.

2) The device shall then be withdrawn from the cell and maintained at room temperature for a period t such that 2 min $\leq t <$ 3 min.

3) The device shall then be placed in a thermostatic room at (55 ± 2) °C where it shall be maintained for 10 min.

4) Finally the device shall be removed and maintained at room temperature for a period t such that 2 min $\leq t <$ 3 min.
The device shall be subjected to five test cycles.

C.3.2 Resistance to hydrocarbons

A sample of non-metallic parts, which are likely to come into contact with butane, propane or their mixtures, shall be weighed, then immersed for (72^{0}_{-2}) h into pentane at (20 $\pm$ 5) °C. At the end of this period, the parts shall be withdrawn from pentane and wiped with absorbent paper.

Parts shall be weighed after 2 min, then 24 h after their withdrawal from pentane. Check that:

— 2 min after the withdrawal from pentane, the increase in weight is less than 0,3 % of the initial mass;

— 24 h after the withdrawal from pentane, the loss in mass is less than 0,3 % of the initial mass.

C.3.3 Resistance to cracking under stress and when chemical agents are present

C.3.3.1 If glues or lubricants are used, they shall be compatible with the materials used.

C.3.3.2 If assembly components (screws, rivets, inserts…) are essential for fixing, materials shall be such that the stresses created do not cause any cracking or deterioration of the material with time. It shall be checked that the maximum values of stresses applicable to materials are not exceeded.

C.3.4 Characteristics relating to fire resistance

The body and/or the cover and/or the connections and non-metallic parts of the device in contact with gas insulated from the atmosphere shall be made of materials belonging to self-extinction class FV-0 in compliance with EN 60695-11-10.

All the other external parts of the device which are made of non-metallic materials shall belong to class FV-2 in accordance with EN 60695-11-10.

The self-extinction class for the minimum thickness of the part to be tested shall be certified.

C.4 Special conditions for carrying out the tests mentioned in the body of the standard

C.4.1 *Resistance to impact (see 5.5.1.1 and 5.5.5.7)*

These tests shall be carried out at a temperature of (-20 ± 2) °C.

C.4.2 *Mechanical resistance of connections (see 5.5.1.2 and 7.2)*

These tests shall be carried out at (-20 ± 2) °C and at (+50 ± 2) °C.

The duration of application of the forces and torques shall not be less than 15 min.

C.4.3 *Soundness (see 5.5.2.1, 5.5.3.1, 7.4 and 7.5)*

For devices incorporating components which isolate an enclosure containing gas from the atmosphere and made of non-metallic materials, this test shall be carried out under the following conditions:

a) at (+50 ± 2) °C under the pressure conditions defined in **7.4** and **7.5**;

b) at (0 ± 2) °C for butane devices, under the following pressure conditions:

1) through the inlet connection, 0,5 bar;

2) through the outlet connection, 150 mbar (or 220 mbar);

c) at (-20 ± 2) °C for propane and LPG devices, under the following pressure conditions:

1) through the inlet connection, 1 bar;

2) through the outlet connection, 150 mbar (or 220 mbar).

C.4.4 *Ageing test*

The ageing test shall be carried out first in the case where the device incorporates external parts made of non-metallic materials as follows.

C.4.4.1 Accelerated ageing

Devices incorporating one or several external parts made of non-metallic materials shall be subjected to the accelerated ageing test before carrying out the tests required by the standard.

Before carrying out the test cycles indicated below, the inlet and outlet of the device shall be sealed.

a) First cycle: UV
The device shall be subjected to an energy of 1 120 W/m2 emitted by a xenon lamp under the conditions of EN ISO 4892-3.

The exposure cycle, consisting of 20 h radiation and 4 h darkness, shall be repeated for 10 cycles.
The test shall be carried out at a temperature of 55 °C with (90 + 5) % humidity.
The device shall be fixed, in its normal operating position, onto a support which rotates so as to expose all sides to the energy.

b) Second cycle: thermal choc
The device shall be placed in a cryostatic cell at a temperature of (-25 + 2) °C.

The test cycle shall include the following stages:

1) The device shall be kept in the cell for 10 min.

2) The device shall then be withdrawn from the cell and maintained at room temperature for a period t such that 2 min ≤ t < 3 min.

3) The device shall then be placed in a thermostatic room at (55 ± 2) °C where it shall be maintained for 10 min.

4) Finally the device shall be removed and maintained at room temperature for a period t such that 2 min ≤ t < 3 min.

The device shall be subjected to five test cycles.

APPENDIX D

(normative)

Requirements for elastomeric reinforced diaphragms

The reinforced material shall not show any sign of delamination when examined using two times magnification, during or after any of the tests carried out in accordance with SLS EN 549.

In addition, it shall not show any blisters in excess of 2 mm diameter, immediately after the 72 h immersion in liquid propene (95 % minimum propene) at (20 ± 5) ℃.

If necessary, the corresponding test may be carried out by limiting the contact with liquid propene to active surfaces of the diaphragm using an adequate test assembly.

APPENDIX E

(informative)

Test method for resistance to corrosion

E.1 Principle

Accelerated corrosion by salt mist of defined composition, under precise temperature and pressure conditions.

The degree of corrosion is assessed visually.

E.2 Reagents

E.2.1 *Saline solution*

The concentration shall be (5 ± 0,5) %

The sodium chloride shall not contain, in the dry state, more than 0.2 % of total impurities and more than 0.1 % of sodium iodide. It shall be free from nickel and copper.

The distilled water shall not contain more than 0,02 % of impurities. The procedure is as follows:

— dissolve five parts in mass of sodium chloride into 95 parts of distilled water;

— check the concentration by measuring the density of the solution at (35 ± 1) ˚C. Carry out this check every day. The density of the solution at 5 % shall be between 1 030 kg/m^3 and 1 040 kg/m^3;

— adjust the pH of the solution to the value of $(7.0_{-0.5}^{+0.2})$;

— before spraying, if necessary, remove the impurities in suspension by filtration or decantation.

E.2.2 *Compressed air*

Air shall be pure, maintained at 85 % to 90 % relative humidity at a temperature of (35 ± 1) ˚C and sent to the sprayers at a pressure of (1.0 ± 0.2) bar.

In order to purify it, pass it through a water purifier.

In order to maintain the concentration of the saline solution constant, humidify the air at a temperature greater than 35 °C by making it bubble, in finely divided bubbles, through a saturator containing water heated to a suitably adjusted temperature. The height of the water column is less important than the fineness of bubbles, the saturation of very fine bubbles being almost instantaneous. The humidifier water shall be replaced every week so as to remove impurities.

E.2.3 *Salt mist*

The salt mist is defined by the characteristics of the solution collected in the collectors during the test.

The intensity of the mist shall be such that for each horizontal collection surface of 80 cm^2, (2 ± 1) ml of solution is collected per hour, for a minimum duration of sixteen hours operation.

The solution collected shall have the density and the pH specified in E.2.1.

E.3 Apparatus

E.3.1 Spraying chamber

The dimensions and mode of construction of the spraying chamber are left to the manufacturers' and users'

initiative, provided that the following requirements are met:

a) The walls of the chamber, the framework and supports placed inside shall resist the corrosion of salt mist. Among the materials having a high resistance are: glass, rubber, types of stainless steel resistant to salt mist, certain plastics, cement.

b) The design of the chamber shall be such that the mist can form a deposit directly by gravity onto devices. To this end, suitable positioning of the sprayers and orifices for the exhaust of condensed liquid shall be designed.

c) The design of the walls of the chamber, the framework and supports shall be such that the liquid which trickles on their surface cannot pour out onto the devices. The condensed solution is discharged at the base of the chamber without being reused.

d) In order to facilitate homogeneous equipment, a type of recommended chamber is shown with its main dimensions in Figure E.1.

E.3.2 *Sprayers*

Use one or several compressed air sprayers. Figure E.2 describes a sprayer of this type as an example.

Previous tests shall enable the establishment, once and for all, of the angle of the deflector in relation to the jet axis and its distance from the sprayer so as to obtain the most homogeneous possible distribution of the mist, controlled by quantities of solutions collected in the various collectors.

E.3.3 Heating device

The heating device shall maintain a temperature of (35 ± 2) ˚C inside the spraying chamber. Various means may be used.

It is desirable that air enters the spraying chamber at a temperature greater than 35 ˚C. The degree of overheating depends on:

— the maintenance of the temperature inside the chamber at 35 ˚C,

— the thermal capacity of the walls and the ambient temperature,

— the volume of forced air,

— the air pressure which determines the temperature necessary for obtaining the required humidity. This temperature is between 43 ˚C and 47 ˚C for a pressure between 0.8 bar and 1.2 bar.

It is desirable, in general, that the ambient temperature around the spraying chamber be as even as possible. To this end, the chamber can be placed into a room at constant temperature or surrounded with a casing containing water at a suitable temperature. Chambers which are completely insulated may be heated with hot air. However this method can require the use of an auxiliary heating source with automatic control enabling a quick rise of temperature after the opening of the chamber.

It is practically impossible to comply with the temperature characteristics, when using heating elements dipped into the saline solution tank.

The device for measuring the temperature inside the chamber shall allow, either a continuous check, or at the rate of two checks per day.

E.3.4 Salt solution supply device

The salt solution is contained in containers made of materials that cannot influence the pH in the solution. To this end, rubber or plastic coated steel containers or glass containers or a type of stainless steel resistant to salt

mist may be used.

E.3.5 Compressed air supply device

The compressed air supply device includes:

— an air compressor at a pressure of (1.0 ± 0,2) bar;
— a pressure adjuster;
— gauges;
— an air coalescing filter;
— a water saturator.

E.3.6 Mist collectors.

Use glass or plastic funnels with a 10 cm diameter as collectors, fixed onto pierced plugs placed on measuring cylinders. A 10 cm diameter funnel has a surface opening of approximately 80 cm^2.

Place at least two collectors in the exposure area so as to collect the mist falling directly into the funnels, without the liquid which trickles from the test pieces exposed or from any other part of the chamber.

Collectors are placed in such a way that one of them is as near as possible to a sprayer and another as far as possible from all the sprayers.

E.4 Test method

E.4.1 Method of exposure of devices
The devices as delivered with their connections unprotected and inlet and outlet orifices blocked shall be placed in the chamber in such a way that they are not in the direct path of the mist sprayed. Deflectors can be fitted so as to avoid direct spraying of the solution on devices.

The supports of the devices shall be made of non-metallic inert materials: glass, plastics. If it is necessary to hang them, hanging materials shall, on no account, be metallic but of synthetic fibres.

Devices shall be positioned in such a way that they do not come in contact with each other and test surfaces are exposed to the free circulation of the mist. Devices may be placed on different levels in the spraying chamber provided that the solution cannot trickle from the devices placed on a given level onto the lower level.

E.4.2 Duration of tests

Spraying shall be continuous throughout the test duration specified in 5.2.5.

E.4.3 Checks

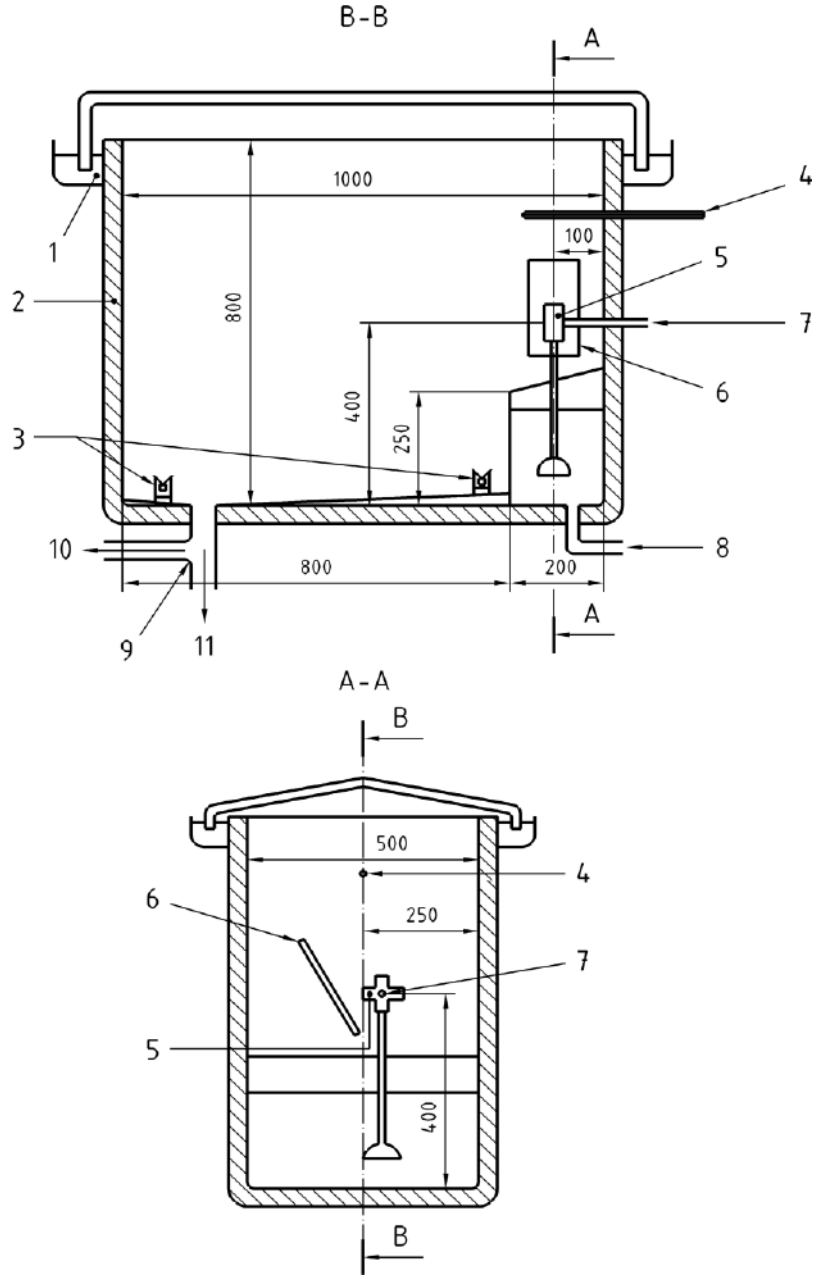
Check the temperature continuously or at least twice a day with a 7 h interval. Check the pressure. Measure the quantity of saline solution collected in the collectors. Check the concentration and pH of the solution collected.

E.4.4 *Cleaning of devices*
At the end of the test, the devices are lightly washed under running water at a temperature not exceeding 37 ˚C, so as to remove salt deposits, then they are immediately dried.

E.5 Results

The external surface is visually inspected.

After the performance tests, the device is dismantled and the internal parts visually examined.

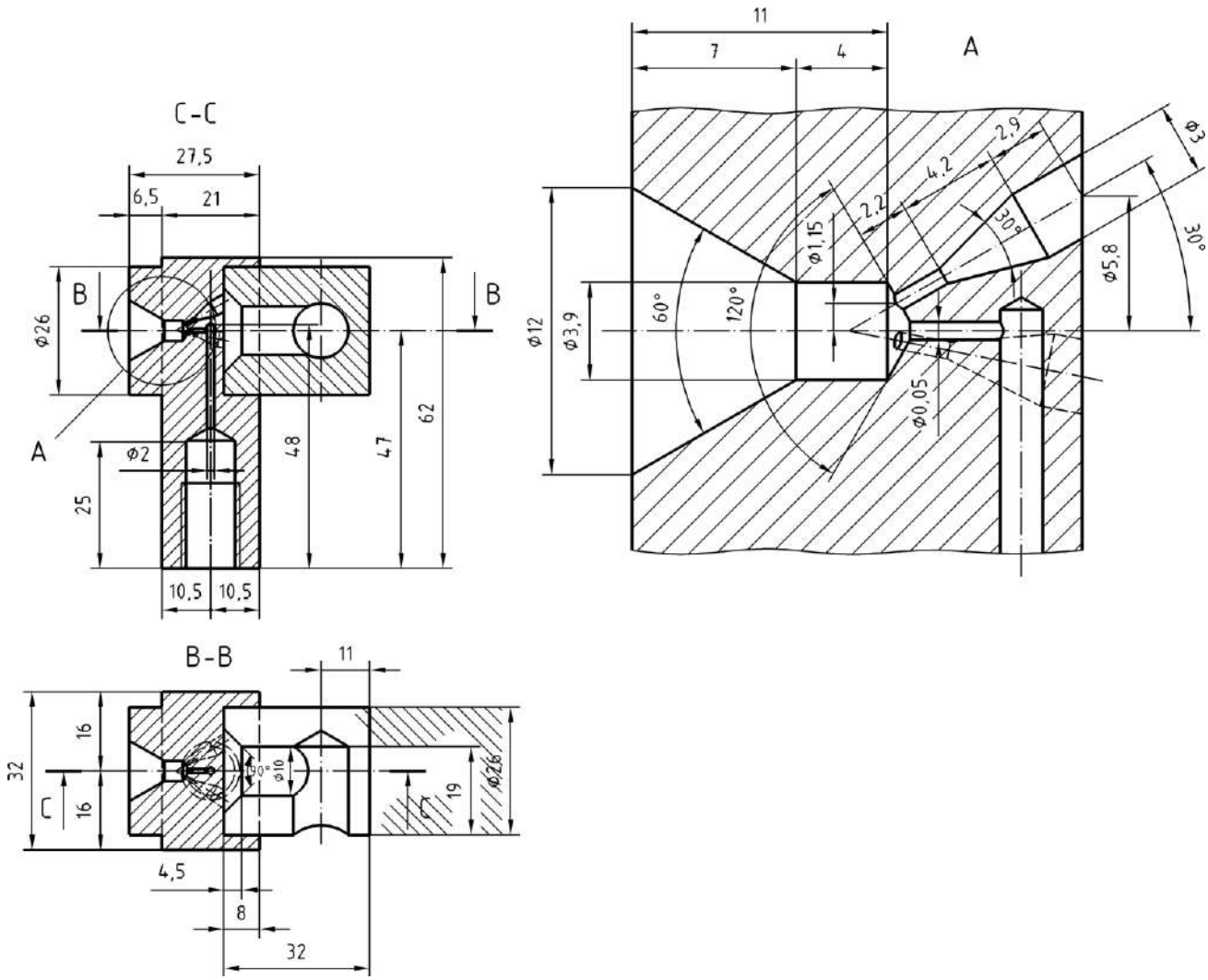


Dimensions in millimetres

Key

1 closure by water seal
2 insulated heating panel
3 2 collectors (horizontal read of 80 cm2
4 thermometer
5 sprayer orifice
6 deflector at a distance from the sprayer with variable slope
7 compressed air supply
8 salt solution supply
9 drain
10 air
11 water

Figure E.1 - Diagram of a spraying chamber



Dimensions in millimetres

The sprayer is generally made of durable and clear plastic.

Figure E.2 - Salt mist sprayer

APPENDIX F

TEST FOR SUSCEPTIBILITY TO STRESS CORROSION CRACKING OF BRASS PARTS

(Mercurous-nitrate immersion test)

This test is applicable to drawn brass or machined brass rod or bar stock containing more than 15 per cent zinc.

A 150 mm length specimen, in the condition offered for inspection shall be first degreased and then immersed in a solution of 50 per cent concentrated nitric acid (specific gravity 1.42) and 50 per cent distilled water, for a period not exceeding 30 s to remove all traces of carbonaceous and oxide films. It shall then be well rinsed in cold water and immediately immersed completely in an aqueous mercurous-nitrate solution containing 10 g of mercurous-nitrate and 10 ml of concentrated nitric acid (specific gravity 1.42) per liter of solution. The test specimen shall remain in the solution for 30 min and then removed, rinsed well in cold water and carefully wiped and examined immediately. The test shall show no evidence of cracking.

Should any specimen fail to meet the requirement of this test, all the material in the batch shall be withdrawn, but may be resubmitted for inspection after stress relieving treatment.

APPENDIX G

TEST GAS COMPOSITION

The test gas is nominally 50 per cent propane, 50 per cent propene. In practice this gas will conform to the following specification.

A hydrocarbon mixture consisting predominantly of C_3 hydrocarbons approximating on 50/50 propane/propene.

It shall have the following composition:

(a) The total content of propene shall not be less than 45 mole per cent and not greater than 55 mole per cent

(b) The total content of C_2 hydrocarbons shall not exceed 1 mole per cent.

(c) The total content of C_4 and higher, hydrocarbons shall not exceed 2 mole per cent.

APPENDIX H

COMPLIANCE OF A LOT

The sampling scheme given in Appendix H shall be applied where compliance of a lot to the requirements of this standard is to be assessed based on statistical sampling and inspection.

Where compliance with this standard is to be assured based on manufacturer's control systems coupled with type testing and check tests or any other procedure, appropriate schemes of sampling and inspection should be adopted.

H.1 LOT

H.1.1 In any consignment, all individual pressure regulators of same type and same connectors belonging to same batch of manufacture or supply shall constitute a lot.

H.2 SCALE OF SAMPLING

H.2.1 The samples shall be inspected and tested from each lot for ascertaining conformity of the lot to the requirements of this standard.

H.2.2 The number of pressure regulators to be selected as the sample from a lot shall be in accordance with Column **(1)** and Column **(2)** of Table **13**.

TABLE 13 – Scale of sampling

No. of individual pressure regulators in the lot (1)	**No. of pressure regulators to be selected for sample** (2)
Up to 10 000	32
10 001 to 35 000	50
35 001 to 500 000	80
500 001 and above	125

H.2.3 The individual pressure regulators shall be selected at random. In order to ensure randomness of selection, random number tables as given in **SLS 428** shall be used.

H.3 NUMBER OF TESTS

H.3.1 Each pressure regulator selected as in **H.2.2** shall be inspected for marking requirements specified in Clause **6.1**.

H.3.2 Each pressure regulator selected as in **H.2.2** shall be inspected for instructions packed with the regulator specified in Clause **6.2**.

H.3.3 Five pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the requirements specified in Clause **5.1**. (general requirements)

H.3.4 Five pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the non-destructive test requirements specified in Clause **5.2**. (materials requirements)

H.3.5 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clauses **5.2.2** (metal components) and **5.2.3**. (rubber type materials for diaphragms, valve pads and seals)

H.3.6 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.2.4**. (valve pads and diaphragms)

H.3.7 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.2.4.1**. (test for valve pads and diaphragms, specified in **7.1** and then soundness requirement)

H.3.8 Two pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.2.5**. (corrosion resistance test, specified in **7.9** and then endurance test, specified in **7.3** and soundness requirement, specified in **7.4** or **7.5**)

H.3.9 Five pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the non-destructive test requirements specified in Clause **5.3** (construction requirements) and **5.4**. (assembly and workmanship)

H.3.10 Eight pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.5.1.1**. (resistance to impact test, specified in **5.5.5.7**) After this test, one regulator from these tested units is used to perform soundness requirements, specified in **5.5.2.1** or **5.5.3.1** and other seven units are used to perform performance requirements, specified in **5.5.5**.

H.3.11 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.5.1.2**. (torque and bending moment test, specified in **7.2** and then soundness requirement)

H.3.12 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.5.2** or **5.5.3**. (soundness requirement, specified in **7.4** or **7.5**)

H.3.13 Five pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the non-destructive test requirements specified in Clause **5.5.4**. (integral safety devices) Each regulator shall be tested for the requirements given in **7.6**, (relief valve test) **7.7**, (under pressure shut-off device test) and **7.8**. (over pressure shut-off device test)

H.3.14 Six pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.5.5.1**. (clip-on connection test)

H.3.15 One pressure regulator taken from the sample selected as in **H.2.2** shall be tested for the destructive test requirements specified in Clause **5.5.5.8**. (endurance test, specified in **7.3**)

H.3.16 Five pressure regulators taken from the sample selected as in **H.2.2** shall be tested for the non-destructive test requirements specified in Clauses **5.5.5.9**, (outlet pressure measurement) and **5.5.5.10**. (lock-up)

H.4 CRITERIA FOR CONFORMITY

A lot shall be declared as conforming to the requirements of this specification if the following conditions are satisfied.

H.4.1 Each pressure regulator examined as in **H.3.1** shall satisfy the relevant requirements.

H.4.2 Each instruction sheet packed with the pressure regulator examined as in **H.3.2** shall satisfy the relevant requirements.

H.4.3 Each pressure regulator examined as in **H.3.3** and **A.3.4** shall satisfy the relevant requirements.

H.4.3 Pressure regulators examined as in **H.3.5**, **H.3.6**, **H.3.7** and **A.3.8** shall satisfy the relevant requirements.

H.4.4 Each pressure regulator examined as in **H.3.9** shall satisfy the relevant requirements.

H.4.5 Pressure regulators examined as in **H.3.10**, **H.3.11** and **H.3.12** shall satisfy the relevant requirements.

H.4.6 Each pressure regulator examined as in **H.3.13** shall satisfy the relevant requirements.

H.4.7 Pressure regulators examined as in **H.3.14** and **H.3.15** shall satisfy the relevant requirements.

H.4.8 Each pressure regulator examined as in **H.3.16** shall satisfy the relevant requirements.

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