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भारतीय मानक **मसौदा**

द्रवीत पैट्रोलियम गैस (एलपीजी) में प्रयोगार्थ कम दाब रेगुलेटर — विशिष्टि

(आई एस 9798 का *तीसरा पुनरीक्षण)*

Draft *Indian Standard*

LOW PRESSURE REGULATORS FOR USE WITH LIQUEFIED PETROLEUM GAS (LPG) — SPECIFICATION

(Third Revision of IS 9798 *)*

ICS 23.060.40; 75.160.30

Gas Cylinders Sectional Committee, MED 16	Last date for receipt of comments is **07 March 2024**

FOREWORD
(*Formal clause to be added later*)

This standard (Third Revision) was first published in 1981 and subsequently revised in 1995 and 2013. This standard is being revised again to keep pace with the latest technological developments and international practices. Also, in this revision, the standard has been brought into the latest style and format of Indian Standards, and references of Indian Standards, wherever applicable have been updated. BIS certification marking clause has been modified to align with the revised *Bureau of Indian Standards Act*, 2016. In this revision all the amendments have been incorporated. The following major modifications have been incorporated in this revision of the standard:

a) Exclusion of installation, commissioning, decommissioning;
b) Addition of new terms with their definitions;
c) Rewording of clause **5.5.3** and **5.5.4** (b) to ensure release of only unavoidable quantity of LPG during fitment;
d) Requirements for optional pressure gauge incorporated;
e) Addition of cycle test on on/off tap and quick coupling mechanism;
f) Listing of type tests and routine tests; and
g) Marking of batch number/serial number.

In the formulation of this standard considerable assistance has derived from ‘EN 16129 : 2013 pressure regulators, automatic changeover devices, having maximum regulated pressure of 4 bar, with a maximum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane or their mixtures'. The quantities in this standard have been expressed in technical

metric units. However, in view of the introduction of International System (SI) units in the country, the relevant SI units and corresponding conversion factors are given below for guidance:

1 kgf/cm^2 = 98.066 5 kPa (kilopascal) = 10 m of water column (WC)
= 0.098 066 5 MPa (megapascal)
= 0.980 665 bar

1 Pa = 1 N/m^2

Pressures indicated in the various requirements of this standard are gauge pressure unless otherwise stated. The composition of the committee responsible for the formulation of this standard is given in Annex.

The composition of the Committee responsible for the formulation of this standard is given at (*to be added later*).

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 analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft *Indian Standard*

LOW PRESSURE REGULATORS FOR USE WITH LIQUEFIED PETROLEUM GAS (LPG) — SPECIFICATION

(Third Revision)

1 SCOPE

1.1 This standard specifies materials, construction, performance and testing requirements for low pressure single or two stage regulators for use with liquefied petroleum gas mixtures in vapour phase up to 4.903 kN/m^2 [50 gf/cm^2 or 500 mm water column (WC)] outlet pressure.

NOTE — Low pressure is considered to be any pressure below 6.894 kN/m^2 (70.3 gf/cm^2). Domestic and commercial appliances normally operate at gas pressure of 2.942 kN/m^2 (30 gf/cm^2 or 300 mm water column).

1.2 This standard does not cover rules for installation, commissioning and decommissioning of devices during actual use and reference should be made to applicable rules.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

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

3.1 Liquefied Petroleum Gas — A hydrocarbon product composed predominantly of a mixture of butanes (n and iso) and/or butylenes with propane, and/or propylene of maximum vapour pressure of 1 653 kPa (16.87 kgf/cm^2) at 65 ^{o}C.

3.2 Inlet Sealing — Preventing inflow of gas from inlet passage into the regulator, when its on/off tap is in OFF position.

3.3 Excess Flow Check Valve — A device integral with the regulator, which causes shut-off of the gas flow for values of flow rate above the rated capacity of the regulator.

3.4 Lock-Up Pressure — The outlet pressure of the regulator under ‘no-flow’ conditions, which shall be achieved within 60 second after cessation of flow, with the inlet pressure to the regulator remaining on.

3.5 On/Off Tap — Arrangement in the regulator for manually starting or stopping gas flow, whenever required.

3.6 Nominal Outlet Pressure — The basic rated outlet pressure desirable in a regulator set at 50 percent rated capacity at a specific inlet pressure. The nominal outlet pressure rating for domestic regulator is 2.942 kN/m^2 (30 gf/cm^2 or 300 mm water column).

3.7 Operating Temperatures — The range of temperatures between which the regulator shall operate which is −20 °C to +65 °C.

3.8 Operating Inlet Pressures — The range of inlet pressures within which the regulator is designed to operate.

3.9 Types of Inlet Connections

3.9.1 *Quick Coupling* **—** A connection system which allows the fitting of a regulator to a cylinder valve without a threaded connection and without use of tools.

3.9.2 *Threaded Inlet* **—** A connection system which allows the fitting of a regulator to a cylinder valve by means of a threaded connection and/or use of tools for fitment/removal.

3.10 Rated Capacity — The standard rated capacity for LPG regulators for domestic use is up to 500 l/h of LPG vapour. For purpose other than domestic, higher capacity regulators can be used. For purposes of performance tests, the flows are stated in terms of percentages of rated capacity, so as to cover all low pressure whatever be the rated capacity.

3.11 Single Stage Regulator — Regulator in which the reduction of inlet pressure down to the desired regulated outlet pressure is achieved in one stage only.

3.12 Two Stage Regulators — In this configuration, the inlet pressure is reduced to the desired outlet pressure in two stages by a suitable arrangement within the same regulator itself. The first stage regulation governs the reduction of the inlet pressure to an intermediate pressure and the second stage regulation governs the reduction of this intermediate pressure to the desired outlet pressure. Both stages shall be incorporated within one body.

4 MATERIAL

4.1 All component parts of the regulator, shall be manufactured from or be treated with materials compatible with LPG as well as be unaffected by chemical or thermal influences that may be encountered in normal use.

4.1.1 Brass parts shall not be susceptible to season cracking. The susceptibility to season cracking shall be determined by the method given in IS 2305.

4.2 The body and cover of all regulators of rated capacity up to 1 000 l/h shall be manufactured from zinc base alloys by pressure die-casting. Chemical composition of material of the pressure die cast body and cover of the pressure regulator shall conform to IS 742.

NOTE — During die casting process, chromium gets added in the regulator body, cover and re-used zinc due to high content of chromium in the die punch. Hence, permissible limit of chromium is 0.02 percent.

4.2.1 *Finish* — The body and the cover of the regulator shall be electroplated or chemically treated (surface passivated) and painted or powder coated so as to resist the effect of atmospheric conditions to which the pressure regulator is exposed during its working life. The colour and type of finish shall be as agreed between the manufacturer and the customer.

4.2.1.1 The surface finished components shall be subjected to test for corrosion resistance as per IS 9844. The evaluation of the finish shall be done as per the method give in **6** of IS 6009.

4.2.1.2 The painted or powder coated surfaces shall be tested for adhesion of paint by the method described in Annex B.

4.3 Diaphragm Material — The material of diaphragm shall be of synthetic rubber or other material equally suitable for the application and shall satisfy the following requirements.

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

4.3.2 The material shall not show change of more than 10 IRHD or as mentioned in Table B.1 to Table B.14 of IS 3400 (Part 4), when subject to ageing in accordance with the method prescribed in Method A (low air speed) or Method B (high air speed) in Annex B of IS 3400 (Part 4).

NOTE — For guidance purpose, comparison of Shore A and IRHD hardness are given below:

Shore A	30	40	50	60	70	80	90	100
IRHD	28.9	39.5	50	60.5	70	80	89.5	100

4.3.3 The material shall be capable of withstanding a clamping pressure of 490 kPa (5 kgf/cm^2), whereby the material itself or the substance with which the fabric layer has been impregnated shall not be pressed away, flowed away or be bruised or otherwise damaged.

4.3.4 The material shall be such that when an assembled regulator is subjected to the test as specified in Annex C, the diaphragm shall not pull out or burst at a pressure less than 275 kPa (2.8 kgf/cm^2).

4.3.5 The material shall, after immersion in n-pentane or octet commercial LPG for 72 h, meet the appropriate requirements specified in Annex D. Changes in hardness, before and after the immersion shall not exceed 15 IRHD [*see* IS 3400 (Part 2)].

NOTE — The tests at **4.3.1** to **4.3.5** are work batch tests. On initial selection of a diaphragm material, it shall also be tested in commercial LPG in vapour phase for 72 h and shall not show a weight loss or volume change greater than 15 percent.

4.3.6 The material shall be such that the flexibility of the diaphragm shall not be impaired after the samples of the same have recovered completely to ambient temperatures from cooling to −20 ºC or heating to 65 ºC. For these tests, assembled regulators are cooled to −20 ºC or heated to 65 ºC and maintained at these temperatures for 10 minutes and then kept in atmosphere to recover completely to ambient temperature of its own (not by induced heating or cooling). After recovery, the setting and performance readings are taken. The readings shall be within the acceptable limits of performance as given in **7.7**.

4.3.7 The material shall have 25 percent max compression set when subjected to compression set test in accordance with the method prescribed in Annex E.

4.4 Valve Pad Material — Valve pad material shall be of synthetic rubber or other material equally suitable for the application and of a quality to satisfy the following minimum requirements.

4.4.1 The valve pad material shall be free from porosity, pits and foreign particles and shall have a smooth non-tacky surface with minimum talc or bloom. The material shall have low cold flow and creep characteristics and compression set as specified in **4.4.5**.

4.4.2 The material shall, after immersion in pentane or commercial LPG for 72 h, meet the appropriate requirements tabulated in Annex D. After this test, change in hardness value observed before and after the test shall not exceed 15 IRHD.

NOTE — The tests at **4.4.1** to **4.4.2** are work batch tests. On initial selection of a valve pad material, it shall also be tested in commercial LPG in vapour phase and shall not show any volumetric shrinkage or increase greater than 10 percent. The loss of plasticizers or other ingredients due to extraction shall not exceed 5 percent by weight.

4.4.3 The material shall not show change of more than 10 IRHD when subjected to ageing of 72 h at 70 ^{o}C in accordance with the method prescribed under **3** or **4** of IS 3400 (Part 4).

4.4.4 The valve pad fitted in its housing shall be immersed in pentane or commercial LPG in vapour phase for 72 h after which the valve pad shall not show evidence of being forced out of position due to swelling or other cause.

4.4.5 The material shall have 40 percent max compression set when subjected to compression set test in accordance with the method prescribed in Annex E.

4.5 Seals — O rings and rubber components other than diaphragm and valve pad shall withstand the requirement as laid down in **4.4.1** to **4.4.3** and **4.4.5**.

NOTE — All rubber materials which come in contact with LPG shall be tested.

5 CONSTRUCTION AND WORKMANSHIP

5.1 A typical regulator to match self-closing valve is shown in Fig. 1 for illustration purpose.

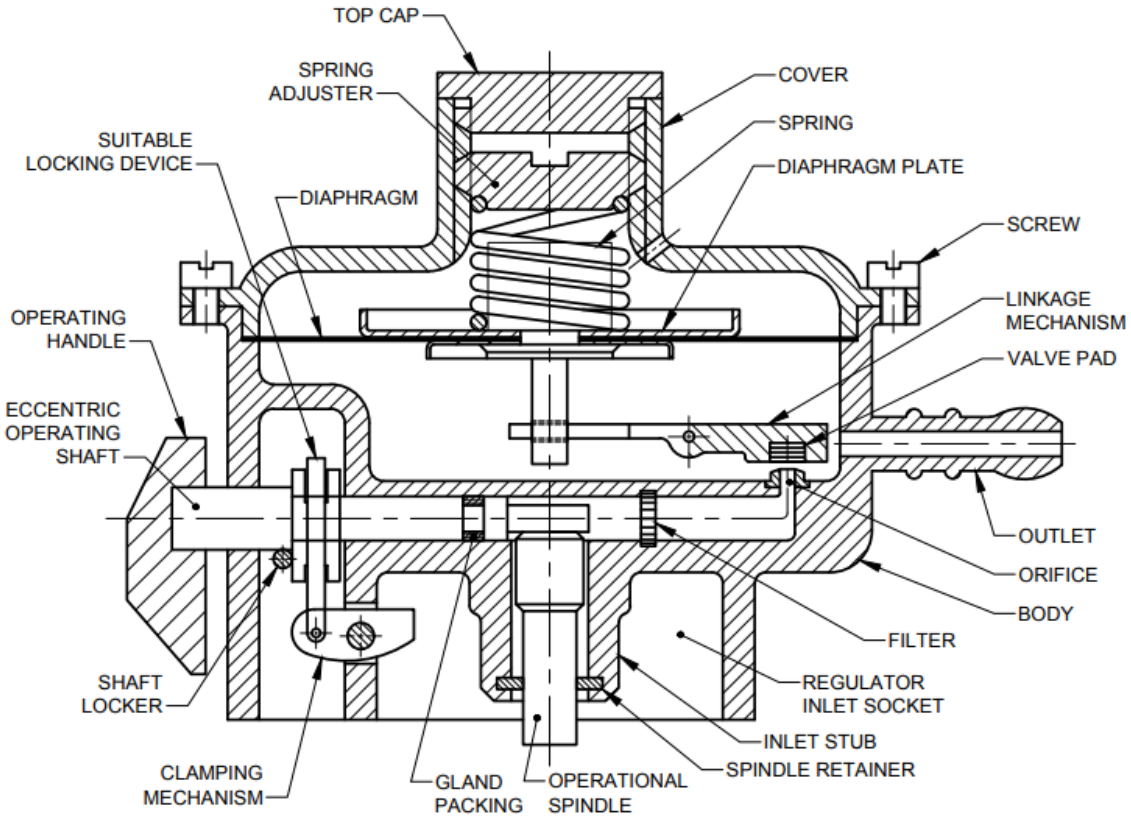


FIG. 1 DIAGRAMMATIC SECTIONAL ILLUSTRATION OF A PRESSURE REGULATOR USED WITH SELF-CLOSING SPRING LOADED TYPE VALVE FOR LPG

5.2 The regulator, including all the component parts, shall be mechanically strong, of sound construction and of high standard of workmanship and finish.

5.3 The components of a regulator shall be interchangeable with the corresponding components of any other regulator of the same model and size.

5.4 Screw Thread — Except for the screwed ends of regulators not fitted with inlet or outlet connectors, screw threads shall comply with the requirements of IS 554 or IS 2643 or IS 4218 (Part 1 to 4) and shall have sufficient length of threads to provide clearance and prevent bottoming.

5.5 Inlet Connection — Where screwed connections are not used, the inlet of the pressure regulator shall be cast integrally as an inseparable part of the body or so fixed that it cannot be separated without damaging the body. The size and the profile of the inlet connection shall match the outlet end of the spring actuated self-closing valve of LPG cylinder to achieve a leak proof coupled joint without use of a resilient packing or washer or gasket as a part of the regulator. However, the use of a gasket or packing shall be permitted so long as there is a leak proof joint with the valve, with the help of the gasket or packing as a part of the valve.

5.5.1 The inlet connection shall be designed and manufactured to withstand a minimum hydrostatic pressure of 1.5 times the saturated vapour pressure of the gas at 65 ^{o}C subject to a minimum of 18 kgf/cm^2 for 120 s.

5.5.2 The inlet connection shall also be capable to withstand a minimum pneumatic pressure equivalent to the maximum vapor pressure specified in **3.1** at ambient temperature.

5.5.3 Regulators intended to be coupled to self-closing valve by a quick coupling means, shall be provided with a handle or an operating tap, for manually turning ON and OFF the gas supply. The ON and OFF positions shall be clearly marked and visible in recommended orientation of use. It shall not be possible to connect or disconnect the regulator from the cylinder valve with the On/Off Tap turned to the "ON" position. Also, while turning the Tap "ON" or "OFF", intentional disconnection shall not be possible. Soundness shall be maintained during the operation of fitting or removing the device on the quick coupling valve. Only the escape of the volume of gas contained in the connection is allowed during disconnection.

5.5.4 Where screwed connections are used for inlet or outlet of regulator the following shall apply:

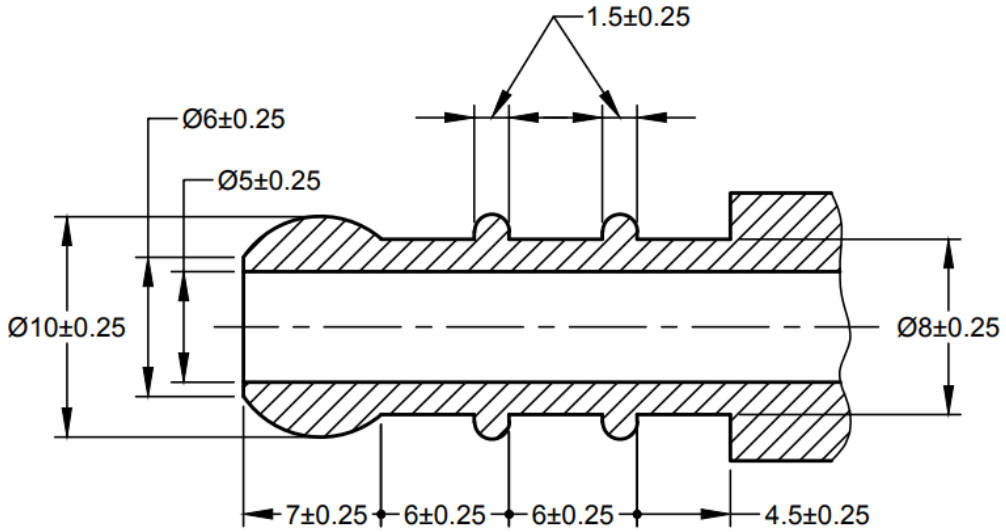
a) *Screwed ends* — Where inlet or outlet connector is not fitted, the inlet and outlet of a regulator with screwed ends shall comply with the requirements of IS 2643 or IS 4218 (Part 3);

b) *Inlet connections* — Where used, any washer, connector and nut of a screwed inlet union shall comply with the applicable mating valve outlet connections of IS 8737. Regulators intended to be fitted to a self-closing valve by means of a thread shall include a manual system of opening and closing of the gas supply at the inlet of the device, if such a feature does not exist on the valve. Soundness shall be maintained during the operation of fitting or removing the device on the quick coupling valve. Only the escape of the volume of gas contained in the connection is allowed during disconnection.

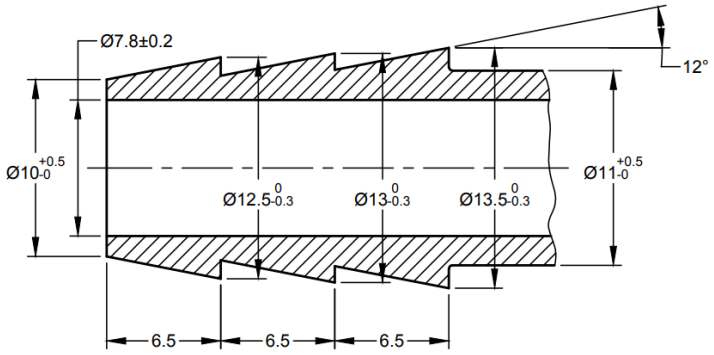
5.5.5 The inlet sealing of the regulator with the self-closing valve (SC valve as per IS 8737) shall be such that, when tested as per **7.5**, the regulator shall meet requirement of the DPR inlet sealing test given in Annex J.

5.6 Outlet Connection

5.6.1 *Non-threaded Outlet Connection* — For regulators for domestic service the outlet nozzle shall be horizontal cast integrally with the body. The nozzle shall be any of the two specified in Fig. 2A and 2B. The choice of type shall be as per the agreement between the manufacturer and the purchaser.



2A Outlet for 6.4 mm Rubber Tubing



2B Outlet for 7 mm Rubber Tubing

All dimensions in millimeters.

FIG. 2 OUTLETS FOR RUBBER TUBING

5.6.2 *Threaded Outlet Connection* — Threaded outlet connection shall be as per the agreement between the manufacturer and the purchaser subject to approval from statutory authority.

5.7 Body and Cover

5.7.1 The body and cover shall be strong enough to withstand the stress of connecting the regulator to the cylinder valve or piping installation and to withstand normal stress imposed by

service conditions, without developing leakage at joints, permanent deformation or other damage which might impair the serviceability of the regulator.

5.7.2 *Assembly Sealing* **—** If the regulator is permanently not crimped, the body and the cover of each regulator shall be sealed to discourage interference with the internal mechanism as well as the pressure setting. The manner of sealing shall be as agreed to between the purchaser and the manufacturer.

5.8 Vent — The breather hole (air vent above diaphragm space) shall be of such size, orientation and at such location on the cover that it:

a) Does not easily get clogged/blocked;
b) The accidental entry of foreign matter is minimized; and
c) It would be difficult for an instrument inserted through the air vent hole to reach the diaphragm.

5.9 Excess Flow Valve — If the regulator is provided with excess flow valve (EFV), then the activation of the EFV to shut-off the flow (under excess flow conditions) and restoration of flow (when the conditions which caused the EFV to operate have been rectified) shall be checked as per Annex F.

5.10 Valve Pad Fitting

5.10.1 A valve pad (resilient) shall be so retained without the use of adhesive that it cannot loosen or work out of position under service conditions.

5.10.2 The inlet orifice and the valve pad of the pressure regulator shall be protected by provision of a filter of suitable material compatible with LPG, of appropriate size of perforations that does not hamper flow of vapour but is yet effective against ingress of contaminating agents in the gas. Any acceptable arrangement meeting this requirement, as agreed to between the manufacturer and the purchaser is permitted.

5.11 Pressure Gauges — Where a pressure gauge is fitted as an integral part of the regulator, the maximum pressure (plus over pressure) which the gauge should be capable of withstanding shall be at least 30 percent higher than the maximum pressure to which the gauge shall be subjected (*see* IS 3624). Also, the diameter of the hole through the body of the regulator which communicates the pressure to the pressure gauge shall not exceed 1.5 mm.

5.12 Mechanical Strength of the Connections / Regulator Assembly

5.12.1 *For Inlet Connections* — The fixing of the inlet connection on to the regulator body, whether it is of the threaded or non-threaded type or in one piece, shall withstand the following tests, under the conditions defined in **7.11** (*see* Table 1):

a) A torque of at least 30 N-m in both directions; and
b) A tensile strength test of 2 000 N.

5.12.2 *For Outlet Connections* **—** The fixing of the outlet connection on to the regulator body, whether it is of the threaded, or non-threaded type or in one piece, shall resist the following tests, under the conditions defined in **7.11** (*see* Table 2):

a) For non-threaded hose connections: and

1) A torque of at least 30 N-m in one direction (verification not required for freely rotating connection);
2) Bending moment of 10 N-m; and
3) A tensile strength test of 2 000 N.

b) For threaded unions:
1) A torque of at least 30 N-m in both directions (verification not required for freely rotating connections);
2) A bending moment of 10 N-m; and
3) A tensile strength test of 2 000 N.

5.12.3 For freely rotating connections, the torque necessary for the rotation of the connection shall not be greater than 0.5 N-m at the end of all the tests carried out.

5.12.4 No distortion or breakage shall be evident and the regulators shall comply with the soundness test described in **6** after application of the forces

5.13 Strength of Regulator Assembly when Fitted on to a Cylinder Valve

5.13.1 The regulators when installed as indicated in the installation instruction shall resist the following tests under the conditions defined in **7.11** (*see* Table 3).

a) A torque in both directions;
1) Of at least 20 N-m for non-threaded hose outlet connections (15 N-m for quick coupling connections); and
2) Of at least 30 N-m for threaded outlet connections. In addition, regulators with screwed unions intended to be vertically mounted onto the cylinder valve, shall resist a torque of at least 20 N-m in the regulator plane (15 N-m for quick coupling connections).
b) A bending moment created by a force of 400 N directed upwards and whose application point is at the base of the outlet connection; and
c) A tensile strength test of 500 N, for quick coupling connections only.

5.13.2 The mechanical strength required shall be ensured for all the positions of fixing of the regulator (as indicated in the installation instructions) on to the cylinder.

5.13.3 There shall be no distortion or breakage that could affect the safety of the regulator. The regulator shall comply with the soundness test described in **6** after application of the forces.

6 SOUNDNESS

6.1 A regulator shall be considered leak tight when tested in accordance with **6.2** and **6.3** if the leakage rate does not exceed 4 $N.mm^3/s$ (the symbol N indicates conversion to normal temperature and pressure conditions, NTP that is 760 mm of Hg and 20 ^oC).

6.2 Hydrostatic Pressure — Those parts of the regulator which are normally subjected to the full cylinder pressure shall be leak tight at a minimum hydrostatic pressure of 1.5 times the saturated vapour pressure of the gas at 65 °C or minimum 18 kgf/cm^2 whichever is greater for a period of 120 s. To ensure that the hydrostatic pressure and medium extends only in and up to the high pressure sections, a pneumatic back pressure not exceeding 14.70 kN/m^2 (150 gf/cm^2) is applied to the outlet connection of the regulator before the start of the test and is kept

on throughout the test. Any change in the back pressure shall be construed as leakage through the pad/body and shall be treated as failure of the regulator.

6.3 Pneumatic Pressure

6.3.1 *At Outlet* **—** The regulator shall be leak tight when tested pneumatically at a pressure of 0.490 kN/m^2 (5 gf/cm^2) below twice the nominal outlet pressure when fitted with a relief valve or 14.70 kN/m^2 (150 gf/cm^2) when not fitted with a relief valve, applied through the outlet connection of a fully assembled regulator and held for not less than 30 s and not more than 60 s after stability has been achieved. To get stability, adequate time is allowed between introduction of test medium and the start of observation, so that the internal parts have attained balanced position.

6.3.2 *At Inlet* **—** Those parts of the regulator which are normally subjected to the full cylinder pressure shall also be tested for soundness at a pneumatic pressure of 1 666 kPa (17 kgf/cm^2) for a period of not less than 30 s and not more than 60 s, after stability has been achieved. To ensure that the pneumatic pressure and medium extends only in and up to the high pressure sections, a pneumatic back pressure not exceeding 14.70 kN/m^2 (150 gf/cm^2) is applied to the outlet connection of the regulator before the start of the test and is kept on throughout the test. Any change in the back pressure shall be construed as leakage through the pad/body and shall be treated as failure of the regulator.

7 TESTING

7.1 General

7.1.1 *Range of Pressure Adjustments*

7.1.1.1 The standard range of pressure adjustment, the range of inlet pressure and the range of outlet pressures is elaborated in **7.1.1.2** and **7.7.3.** This does not preclude any specific requirement deviating from the standard, as may be agreed to between the manufacturer and the purchaser, provided the essentials of the standard ranges are maintained.

7.1.1.2 For the purpose of performance test of domestic service regulators, the standard range of inlet pressures for use with LPG, shall extend from 49 kPa (0.5 kgf/cm^2) to 1 666 kPa (17 kgf/cm^2).

7.1.2 *Test Gases* **—** The performance tests shall be carried out using air, after making due provision for a factor of conversion representing the flow of appropriate gas for which the regulator is designed, that is, butane, propane, or mixture for the equivalent vapour condition.

The volume conversion factors for certain gases are given below:

Sl No.	*Multiply flow of*	*By*	*To obtain flow of*
(1)	(2)	(3)	(4)
i)	Air	0.707	Butane
		1.290	Natural gas
		0.808	Propane
		0.75	120 RVP Butane / Propane mixture

ii)	120 RVP Butane / Propane mixture	1.333	Air
iii)	Butane	1.414	Air
		1.826	Natural gas
		1.140	Propane
iv)	Natural gas	0.775	Air
		0.547	Butane
		0.625	Propane
v)	Propane	1.237	Air
		0.874	Butane
		1.598	Natural gas

The above data serves as a guide also in cases where the percentage composition of constituents in an LPG mixture are known.

7.1.3 *Chatter* — A regulator when tested shall not chatter or vibrate while being tested for performance as per **7.7**.

NOTE — It is improper to induce chatter by striking the regulator or by using an output in excess of the maximum rated capacity. Such conditions which may artificially induce vibrations of the internal components and give a false impression of chatter, shall be avoided.

7.1.4 *Orientation* — A regulator shall be installed in such a way that the performance of the safety feature shall not be affected. The standard performance tests shall be carried out with the regulator in its recommended orientation.

7.2 Outlet Pressure Measurement — For measurement of outlet or delivery pressures of the regulator, a water-in-glass-tube-manometer (or suitable pressure gauge) shall be used. The pipe between the outlet of the regulator and the outlet pressure gauge or manometer shall be of the bore not less than the outlet of the regulator and of length not so long as to create a significant pressure drop.

7.3 Outlet Flow Measurement — Outlet flow measurement shall be carried out using a direct indicating flowmeter (rotameter). Calibrated orifices may also be used.

7.4 Inlet Pressure Deviation — During the tests for performance as per **7.7** it may be noted that there is a slight deviation of the inlet pressure, especially at lower ranges, at varying outlet flows of the regulator under test. The inlet pressure should be readjusted appropriately when such deviation is experienced.

7.5 Inlet Sealing

7.5.1 Verification of satisfactory sealing by the inlet valve as per **5.5.5** shall be done by the procedure described in Annex J. The inlet passage of the regulator shall seal inflow of gas, with operating handle of device kept in OFF position and the inlet subjected to pressures of 0.5 kgf/cm^2 and the maximum working pressure of the gas.

7.5.2 The test shall be carried out for a minimum period of 30 s, for each pressure.

7.6 Drop Test — When a fully assembled regulator is dropped from a height of 1.0 m, in no specific orientation on to a hard surface, (such as a concrete floor). Exposed sealing faces which may incur damage that affects sealing only, due to this test may be protected. The protection method shall not affect any other aspect of the test. Only distortion due to the fall is allowed,

however the regulator shall meet requirements of soundness test as per **6.3** and performance test as per **7.7**.

7.7 Performance

7.7.1 Unless otherwise specified, performance tests shall be carried out at ambient temperatures.

7.7.2 During performance testing lock up shall be achieved within 60 s after cessation of flow.

7.7.3 The regulators shall be set such that, with inlet pressure ranging from 49 kPa (0.5 kgf/cm^2) to 1 666 kPa (17 kgf/cm^2) on gas flow rate of 10 to 100 percent of rated capacity, the delivery pressure shall not be less than 2.206 kN/m^2 (22.5 gf/cm^2 or 225 m of WC) and not more than 3.923 kN/m^2 (40 gf/cm^2 or 400 mm of WC). Static (lock up) pressure shall not exceed 4.41 kN/m^2 (45 gf/cm^2 or 450 mm of WC).

7.7.4 A regulator shall not chatter or vibrate while being tested at any flow or inlet pressure in the range prescribed for the performance tests or under condition simulating normal service. If chattering or vibration occurs the test shall be repeated.

7.7.5 The requirements of performance as given above shall also be satisfied before and after subjecting the regulator to tests specified in **7.8, 7.9** and **7.10**. Deviation in the initial setting, after these tests, is acceptable.

7.8 Cycle Test (Endurance Test)

7.8.1 When assessing a new design, a type approval test in accordance with Annex G shall be carried out. Fully assembled regulators shall withstand a minimum of the following tests conducted on 3 separate regulators.

7.8.1.1 *For flexibles* — 100 000 cycles of opening and closing operations as below, applied to the regulating mechanism of the regulator, with each cycle of minimum 5 s:

a) Interruption of the outlet flow to induce lock up;
b) Restoration of the outlet flow; and
c) Interruption of inlet flow to ensure that the diaphragm is completely relaxed. Each cycle should allow the diaphragm to flex and for the valve pad to be held on its seat for at least 1 s.

7.8.1.2 *For On/Off tap* — 5 000 cycles of opening and closing operations of the manual On/Off Tap of the regulator, with each cycle of minimum 5 s.

7.8.1.3 *For quick coupling mechanism* — 5 000 cycles of fixing and removing of the regulator to and from a matching valve, with each cycle of minimum 5 s.

7.8.2 After the above tests the regulators shall be subjected to a soundness test as in **6.1, 6.2, 6.3** and performance as in **7.7**.

7.9 Low Temperature Test — The regulator is exposed to a temperature of −20 ºC for a minimum period of 10 minutes for the complete assembled unit to attain this temperature. It is

then removed and left exposed to ambient conditions, after which it is tested. The method of carrying out the test is elaborated in Annex H.

7.9.1 If the regulator is fitted with excess flow valve, the performance of the EFV shall also be checked as per Annex F.

7.9.2 Subsequent to the cooling, forced heating shall not be applied to bring back the device to ambient temperature.

7.9.3 Care shall be taken to avoid intrusion of moisture into the regulator assembly during cooling and recovery. For this the outlet nozzle, the inlet and the breather hole shall be plugged.

7.10 High Temperature Test — The regulator is exposed to a temperature of 65 ^{o}C for a minimum period of 10 minutes for the complete assembled unit to attain this temperature. It is then removed and left exposed to ambient conditions, after which it is tested. The method of carrying out the test is elaborated in Annex H.

7.10.1 If the regulator is fitted with excess flow valve, the performance of the EFV shall also be checked as per Annex F.

7.10.2 Subsequent to the heating, forced cooling shall not be applied to reach the ambient temperature.

7.10.3 Care shall be taken to avoid intrusion of moisture into the regulator assembly during heating and cooling. For this the outlet nozzle, the inlet and the breather hole shall be plugged.

7.11 Mechanical Strength of Connections

7.11.1 *General* — Tests for mechanical strength shall be carried out using a dynamometric device allowing the measurement of forces to within ± 5 percent accuracy. For the torque test, a system which neutralizes bending moments shall be used (if a torque wrench is used, it is desirable that this is double handed). The duration of application of the torques, moments and forces shall be 60 s each.

7.11.2 *Regulators intended to be directly connected to a Cylinder Valve* — The point where the regulator is held and the test values are those shown in Tables 1, 2 and 3.

7.11.3 For tests given in Table 3.

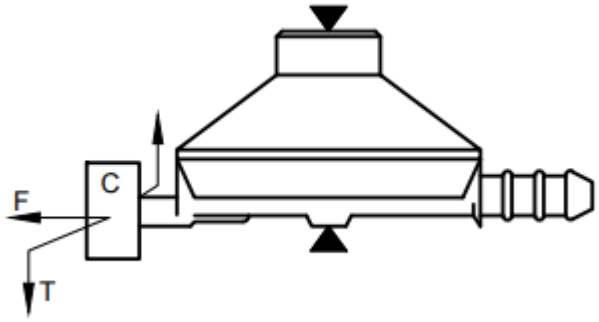
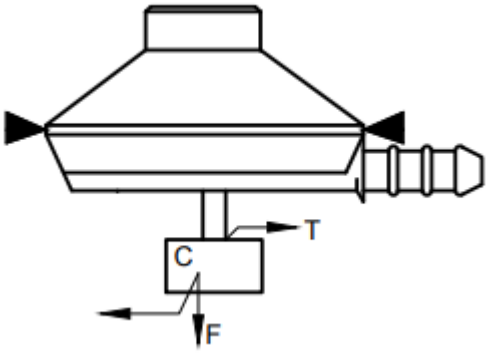
a) Regulators with threaded connections, shall be mounted on the valve as indicated in the installation instructions; and
b) Regulators with freely rotating quick coupling connections, the torque test of 15 N-m is not required.

In all cases the requirements of **5.12** shall be met.

Table 1 Mechanical Strength Test on Inlet Connections

(*Clauses* 5.12.1 *and* 7.11.2)

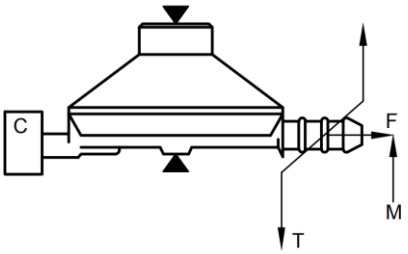
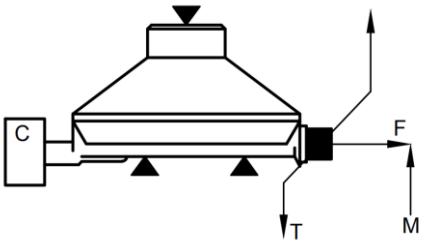
Sl. No.	**Test Diagram**	**Type of Load**	**Value**
(1)	(2)	(3)	(4)

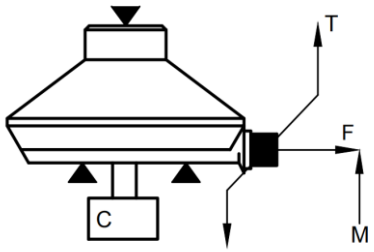
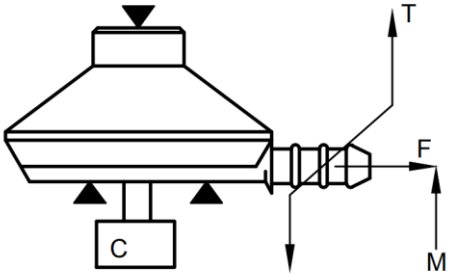
i)		T F	30 N-m 2 000 N
ii)		T F	30 N-m 2 000 N

Key
▼▲►◄Regulator holding points
C = Inlet connection (*see* 3.7)
T = Torque
F = Pulling force

Table 2 Mechanical Strength Test on Outlet Connections

(*Clauses* 5.12.2 *and* 7.11.2)

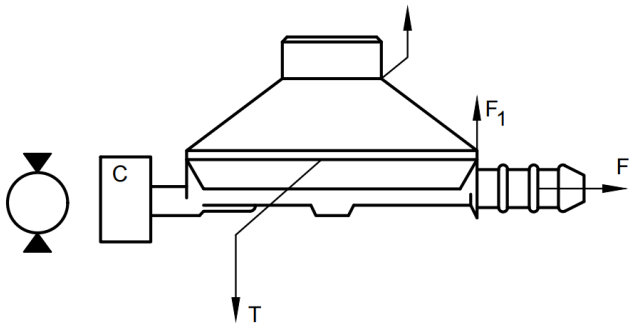
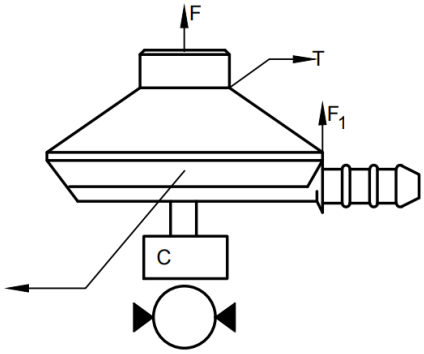
Sl. No.	**Test Diagram**	**Type of Load**	**Value**
(1)	(2)	(3)	(4)
i)		T F M	30 N-m 2 000 N 10 N-m
ii)			

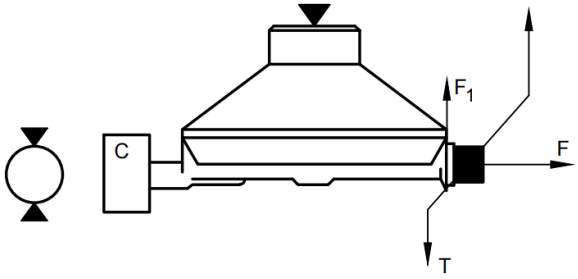
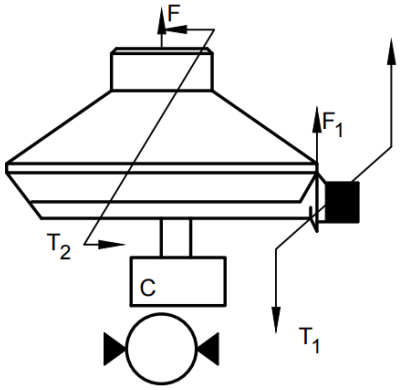
iii)		T	30 N-m
		F	2 000 N
		M	10 N-m
iv)			

Key
▼▲Regulator holding points
T = Torque
C = Inlet connection (*see* 3.7)
F = Pulling force
M = Bending moment

Table 3 – Mechanical Strength Tests for the Regulator Assembly Mounted on the Cylinder Valve

(*Clauses* 5.13.1, 7.11.2 *and* 7.11.3)

Sl No.	Test Diagram	Type of Load	Value for Threaded Inlet Connection	Value for Quick Coupling Connection
(1)	(2)	(3)	(4)	(5)
i)		T	20 N-m	15 N-m
		F	—	500 N
		F_1	400 N	400 N
ii)		T	20 N-m	15 Nm
		F	—	500 N
		F_1	400 N	400 N

iii)		T	30 Nm	30 Nm
		F	—	500 N
		F_1	400 N	400 N
iv)		T_1	30 Nm	30 Nm
		T_2	20 Nm	15 Nm
		F	—	500 N
		F_1	400 N	400 N

Key
▼▲►◄Regulator holding points
○ Valve
C = Inlet connection (*see* 3.7)
T T_1 T_2 = Torque (T and T_2 are not applied if the regulator is freely turning on its cylinder valve)
F = Pulling force
F_1 = Bending force

8 CLASSIFICATION OF TESTS

8.1 Type Tests

The following shall be carried out as type approval tests:

a) Susceptibility to season cracking (*see* **4.1.1**);
b) Rubber material test (*see* **4.3, 4.4** *and* **4.5**);
c) Soundness test (*see* **6**);
d) Inlet sealing (*see* **7.5**);
e) Drop test (*see* **7.6**);
f) Performance (*see* **7.7**);
g) Cycle tests (*see* **7.8**);
h) Low and high temperature tests (*see* **7.9** *and* **7.10**);
j) Mechanical strength of connections/regulator assembly (*see* **7.11**);
k) Excess flow device, if provided (*see* **5.9**); and
m) Test for pressure gauge, if provided (*see* **5.11**)

8.2 Routine Tests

The following shall be carried out as routine tests:

a) Finish (*see* **4.2.1**);
b) Construction and workmanship (*see* **5.2** *and* **5.3**);
c) Dimensions (*see* **5.4** *or* **5.5**);

d) Soundness test (*see* **6**);
e) Performance (*see* **7.7**);
f) Excess flow device, if provided (*see* **5.9**);
g) Cycle tests of only 5 000 cycles for flexibles as per **G-1** (*see* **7.8.1.1**).

9 MARKING

9.1 A regulator shall be clearly and permanently marked with the following:

a) Manufacturer's name or trademark;
b) Month and year of manufacture, for example 0821 for August 2021;
c) Rated capacity of LPG in m^3/h or l/h or kg/h;
d) Batch no./serial no.;
e) Number of this standard; and
f) Any other markings agreed to between the purchaser and the manufacturer.

9.2 BIS Certification Marking

The regulators may also be marked with Standard Mark.

9.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

9.3 The markings may be distributed over the body, cover and sealing plate/cap as found convenient and as agreed to between the purchaser and the manufacturer.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 554 : 1999/ ISO 7-1 : 1994	Pipe threads where pressure-tight joints are made on the threads — Dimensions, tolerances and designation (*fourth revision*)
IS 742 : 1981	Specification for zinc base alloy die castings (*second revision*)
IS 2305 : 1988	Method for mercurous nitrate test for copper and copper alloys (*first revision*)
IS 2643 : 2005/ ISO 228-1 : 2000	Pipe threads where pressure-tight joints are not made on the threads — Dimensions, tolerances and designation (*third revision*)
IS 3400	Method of test for vulcanized rubbers
(Part 2)	Determination of hardness
(Sec 1) : 2022/ ISO 48-1 : 2018	Introduction and guidance
(Sec 2) : 2023/ ISO 48-2 : 2018	Hardness between 10 IRHD and 100 IRHD (*fifth revision*)
(Sec 3) : 2022/ ISO 48-3 : 2018	Dead-load hardness using the very low rubber hardness (VLRH) scale
(Sec 4) : 2022/ ISO 48-4 : 2018	Indentation hardness by durometer method (shore hardness) (*second revision*)
(Sec 5) : 2022/ ISO 48-5 : 2018	Indentation hardness by IRHD pocket meter method (*second revision*)
(Sec 6) : 2023/ ISO 48-6 : 2018	Apparent hardness of rubber-covered rollers by IRHD method
(Sec 7) : 2022/ ISO 48-7 : 2018	Apparent hardness of rubber-covered rollers by shore-type durometer method
(Sec 8) : 2022/ ISO 48-8 : 2018	Apparent hardness of rubber-covered rollers by pusey and jones method
(Sec 9) : 2022/ ISO 48-9 : 2018	Calibration and verification of hardness testers
(Part 4): 2012/ ISO 188 : 2011	Accelerated ageing and heat resistance (*third revision*)
(Part 10)	Compression set
(Sec 1) : 2022/ ISO 815-1 : 2019	At ambient or elevated temperatures (*third revision*)
(Sec 2) : 2022/ ISO 815-2 : 2019	At low temperatures (*third revision*)
IS 4218	ISO general purpose metric screw threads
(Part 1) : 2001/	Basic profiles (*second revision*)

ISO 68-1 : 1998	
(Part 3) : 1999/ ISO 724 : 1993	Basic dimensions (*second revision*)
(Part 4) : 2001/ ISO 262 : 1998	Selected sizes of screws, bolts and nuts (*second revision*)
IS 6009 : 1970	Method for evaluation of results of accelerated corrosion test
IS 8737 : 1995	Valve fittings for use with liquefied petroleum gas (LPG) cylinders for more than 5 litre water capacity — Specification (*second revision*)
IS 9844 : 1981	Methods of testing corrosion resistance of electroplated and anodized aluminium coatings by neutral salt spray test

ANNEX B

(*Clauses* 4.2.1.2 *and* 4.3.2)

METHOD OF TEST FOR ADHESION OF PAINT

A square measuring 12 mm to 15 mm sides shall be marked on plain surface (not having raised or sunk markings) of randomly selected specimen from the lot of painted or powder coated components. Cross lines at a distance of 1 mm to 1.5 mm and inched at approximately 120° angle with each other shall be described over the marked portion with a sharp pointed instrument. Cellulose tape shall be applied over this portion and left for 2 minutes after which is shall be jerked free from the surface under test. If a more than 3 percent of the squares are ripped from the surface under test. The specimen shall be deemed to have failed test.

ANNEX C

(*Clause* 4.3.4)

BURSTING AND PULL OUT TEST OF DIAPHRAGM IN AN ASSEMBLED REGULATOR

C-1 GENERAL

C-1.1 The test is designed to give a practical result on assembled regulator, and is intended as simple check method which may be applied by the regulator manufacturer to diaphragm material which will usually have been previously tested.

C-1.2 The test takes the form of a simple application of pressure (air or nitrogen is suitable) through the outlet connection the underside of the diaphragm mounted in a regulator in fully assembled condition (that is, as it would be supplied by the manufacturer to a buyer).

C-2 TEST RIG

C-2.1 The outlet of the assembled regulator is connected to a supply of air or nitrogen.

C-2.2 A gauge is incorporated in the test rig between the air or nitrogen supply and the regulator to indicate the applied pressure.

C-3 TEST METHOD

The pressure is applied at approximately 78 kPa (0.8 kgf/cm^2) per second up to the level specified in **4.3.4** and maintained for 120 s.

ANNEX D

(*Clauses* 4.3.5 *and* 4.4.2)

IMMERSION TEST (RESISTANCE TO HYDROCARBONS)

D-1 GENERAL

The test is designed to evaluate the rubber material vis-à-vis its resistance to hydrocarbons.

D-2 PROCEDURE

Weigh the sample. W_o prior to test. Immerse the same in pentane or test gas (as defined in Annex D) maintained at a temperature of 20 °C ± 5 °C for 72 h. Remove the sample and expose it to atmosphere. After 5 minutes, weigh the sample W_1. Next, let it stay exposed to atmosphere for 24 h and weigh W_2 and calculate the following:

a) Percentage of test gas absorbed = $(W_1 - W_2) / W_o \times 100$; and

b) Percentage of matter extracted = $(W_0 - W_2) / W_0 \times 100$.

D-3 The results of the above test shall be in accordance with values as given below:

Sl No.	*Component*	*Extractable Percent*	*Absorbed Percent*
(1)	(2)	(3)	(4)
a)	Diaphragm	+ 5 to −15	±10
b)	Valve pad	+ 5 to −12	+10 to −9
c)	Seal	+ 5 to −12	+10 to −9

NOTE — It is permitted to wipe clean the component after removal from immersion.

ANNEX E

(*Clauses* 4.3.7 *and* 4.4.5)

METHOD OF COMPRESSION SET TEST FOR VALVE PAD MATERIAL, SEAL AND DIAPHRAGMS

E-1 GENERAL

The test is designed to difference between the original thickness of the test piece and that after recovery, expressed a percentage of the initial applied compression.

E-2 APPARATUS AND TEST PIECES

The apparatus shall as per clause **5** of IS 3400 (Part 10/Sec 1 and Part 10/Sec 2). The pieces for test shall be as per clause **7** of IS 3400 (Part 10/Sec 1 and Part 10/Sec 2).

E-3 PROCEDURE

Three mono-block test piece disc of (13 ± 0.5) mm diameter and (6.3 ± 0.3) mm thickness shall be tested as per clause **7** of IS 3400 (Part 10/Sec 1 and Part 10/Sec 2) subjected to following conditions:

a) Compression: 25 percent at (27 ± 2) ^{o}C;
b) Duration of test: 168 +0/−2 h for valve pad and seal material and 24 h ± 0.5 h for diaphragm; and
c) Test temperature: (70 ± 1) ^{o}C.

E-4 CALCULATION

Calculate the compression set expressed as a percentage of the initial deflection from the following formula:

Compression set, percent = $[(t_0 - t_1 / t_0 - t_8) \times 100]$

where

t_0 = initial thickness in mm of the test piece;

t_1 = thickness of the test piece in mm after recovery; and

t_8 = height of the spacer in mm.

The results for the three test pieces shall agree within 5 percent of the mean compression set value; if they do not, the test shall be repeated.

ANNEX F

(*Clauses* 5.9, 7.9.1 *and* 7.10.1)

REGULATORS FITTED WITH AN EXCESS FLOW CHECK VALVE

F-1 DEFINITION

The excess flow check valve is a device integral with the regulator which causes the shut off of the gas flow for values of flow rate above the rated capacity of the regulator.

In the case of a manual device the regulator device allowing the restoration of the flow can be a re-setting device or a valve generally appropriate for this type of regulator.

F-2 PERFORMANCE CHARACTERISTICS

The excess flow check valve shall shut off the gas flow in all the cases of disconnection of the flexible hose or tube fitted downstream of the regulator. This device shall operate for an increase in the rate between 120 percent and 200 percent of the rated capacity of the regulator at an angle of ±10° relative to its axis in the fixing position(s) of the regulator in the range and the rate obtained on hose or tube disconnections of minimum (−20 °C) and maximum temperature (+65 °C) conditions.

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

For manual re-setting devices a maximum residual leak 15cm³/h is permitted.

The regulator fitted with excess flow check valve in shut off condition shall be checked for any leakage. The regulator shall be connected to the bubble indicator through a flexible piping (*see* Fig. 3). The regulator shall be subjected to full inlet pressure and examine the bubble indicator for the appearance of the bubbles. The interval between successive bubbles passing through it shall not be less than 10 s.

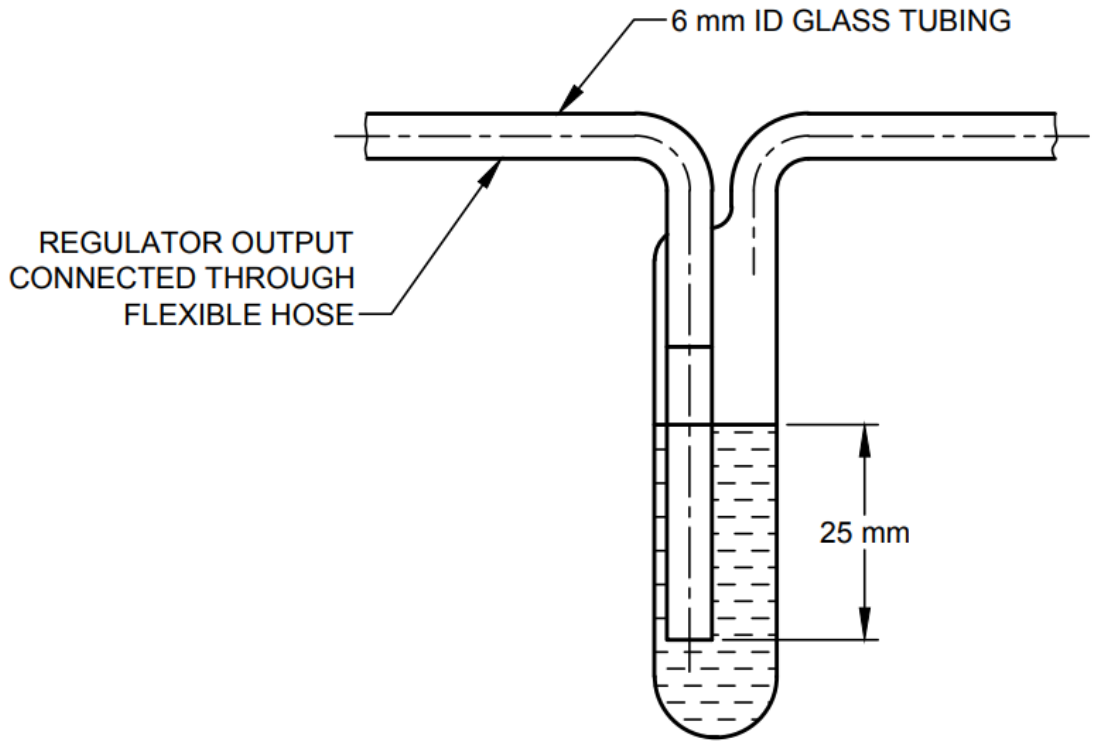


FIG. 3 BUBBLE INDICATOR

The presence of the device shall not modify the regulator performance.

F-3 TEST METHODS

F-3.1 Additional Tests for the Regulator

The closure caused by excess flow check valve shall be obtained in the range defined between 120 percent and 200 percent of the rated capacity of the regulator.

For the endurance test the device shall be subjected to a series of 100 cycles of opening/closing operations without change in operating forces, sensitivity of positioning device and without apparent traces of pitting. This test shall be carried out at ambient temperature.

F-4 USER AND MAINTENANCE INSTRUCTIONS

In addition to the regulator working instructions the manufacturer shall clearly indicate in the instructions the below information.

a) Do not move the cylinder during the use;
b) Switch off in the event of activation of the excess flow valve;
c) Only turn on the regulator after having rectified the cause of the EFV activating; and
d) Instructions on manual resetting of the excess flow check valve.

For the purpose of routine test the regulator when checked the excess flow check valve shall shut off the gas flow in all the cases of disconnection of the flexible hose fitted downstream of the regulator.

ANNEX G

(*Clause* 7.8.1)

CYCLE TEST (ENDURANCE TEST)

G-1 FOR FLEXIBLES

The purpose of the test is to evaluate, the quality of various flexibles, such as valve pad, diaphragm and spring, *vis-à-vis* retention of critical properties relevant to function, resistance to deformation/degradation, loss of flexibility under conditions of flexing and unflexing.

NOTE — This test does not purport to check any mechanical requirements of the construction/assembly and should not be taken as representative of actual service conditions and could introduce improper parameters of assessment of non-flexibles. The test should relate only to the flexibles referred to above.

G-1.1 The regulator is mounted on a valve or suitable inlet connection (whose outlet matches with the inlet of the regulator). The outlet of the regulator is connected to a system which will indicate flow or lack of it (that is, a burner, flow meter or orifice in parallel with a pressure indicating device such as a manometer column). Air/gas is introduced into the regulator at 7 kgf/cm^2 in such a manner that the diaphragm gets flexed and the valve pad is held on its seat for a minimum of 1 s, after which the inlet is shut off and the air/gas is vented via the outlet of the regulator to atmosphere.

G-1.2 One example of a set up to carry out this test is to install quick acting valves upstream and downstream of the regulator, wherein the downstream valve exhausts to atmosphere. The valves are connected to a suitable time switch so that as one opens, the other closes; with a complete cycle time of approximately 5 s.

G-1.3 Any other set up producing equivalent conditions and achieving the same objectives would be acceptable.

G-1.4 After completion of the test mentioned above, the regulator shall meet the requirements of soundness test as in **6.2**, hydrostatic test as in **6.3** and performance as in **8.9.1**. However, with the static (lock up) pressure not exceeding 110 percent of that allowable in relevant lock up clause.

G-2 FOR ON/OFF MECHANISM

The purpose of the test is to evaluate, the quality of the operating and sealing mechanism used for switching the regulator ON/OFF.

G-2.1 Each cycle shall consist of rotation from the closed position to the fully open position with air/gas is introduced into the regulator at 7 kgf/cm^2. The ‘opening and closing cycle’ shall be of at least 5 s.

G-2.2 After completion of this test, the manual closing device shall be closed and soundness shall be verified. Then the manual closing device shall be opened and with outlet blocked soundness shall be verified again.

G-3 For Quick Coupling Mechanism

The purpose of the test is to evaluate, the quality and effectiveness of the quick coupling mechanism used to fix the regulator to the self-closing valve.

G-3.1 Each cycle shall consist of connecting and disconnecting of the regulator to a new valve. Each 'disconnection and connection cycle' shall be of at least 5s. During this test air/gas is introduced into the regulator at 0.5 times the maximum working pressure.

G-3.2 After the above test, the forces described in **5.12.4** shall be applied to the regulator, followed by verification of soundness test as per **6**.

NOTE — If the tests are carried out using LPG vapour as test medium, sufficient precaution should be ensured to vent inflammable gas to environments where there should be no danger of fire. Alternatively, the venting could be done via gas burning devices.

ANNEX H

(*Clauses* 7.9 *and* 7.10)

LOW TEMPERATURE AND HIGH TEMPERATURE TESTS

H-1 LOW TEMPERATURE TEST

A fully assembled regulator set as in **8.9** is placed in a deep freezer (equipped with thermocouple, thermostat and temperature indicator) which has been cooled to a steady temperature of –20 °C and maintained at this temperature. It is kept long enough (minimum 10 minutes) for the complete assembly to attain –20 °C, after which it is removed and exposed to the atmosphere so that the assembly returns to ambient conditions. It is then tested in accordance with **8.9** for performance.

NOTES

1 Care should be taken to prevent moisture condensing inside, by ensuring that the regulator openings, are plugged before putting into the deep freezer and are unplugged only after the assembly (after taking it out) attains ambient conditions. Also, air shall not be forced through the assembly in an attempt to accelerate recovery as this is likely to result in condensation of moisture inside the assembly.

2 Stabilization of temperature at –20 °C may be ensured through two consecutive temperature readings taken one minute apart after the 10 minutes time period.

H-2 HIGH TEMPERATURE TEST

A fully assembled regulator set as in **8.9** is placed in a hot air oven (equipped with thermocouple, thermostat and temperature indicator) which has been heated to a steady temperature of 65 °C and maintained at this temperature. It is kept long enough (minimum 10 minutes) for the complete assembly to attain 65 °C, after which it is removed and exposed to the atmosphere so that the assembly returns to ambient conditions. It is then tested in accordance with **8.9** for performance.

NOTES

1 Care should be taken to prevent moisture condensing inside, by ensuring that the regulator openings, are plugged immediately after taking out from the hot air oven and are unplugged only after the assembly attains ambient conditions. Also, air shall not be forced through the assembly in an attempt to accelerate recovery as this is likely to result in condensation of moisture inside the assembly.

2 Stabilization of temperature at 65 °C may be ensured through two consecutive temperature readings taken one minute apart after the 10 minutes time period.

ANNEX J

(*Clauses* 5.5.5 *and* 7.5.1)

REGULATOR INLET SEALING TEST

J-1 The purpose of the test is to ensure that the flow of LPG does not take place from a regulator fitted to the self-closing of LPG filled cylinder, in case:

a) The regulator is in switched OFF condition; and

b) There is a leak from the self-closing valve fitted to the LPG cylinder.

J-2 The set up for this test shall include a test bench fitted with a self-closing valve body (without any internals simulating condition of self-closing valve leak). The inlet of this self-closing valve shall be provided with an air connection. The supply of air to the inlet of the self-closing valve shall be through an air pressure regulator. A pressure gauge shall be provided to read air pressure to the inlet of the self-closing valve.

J-3 A fully assembled regulator is placed on the self-closing valve as mentioned in **J-2** fitted onto the test bench. The regulator shall be kept in switched OFF position. The outlet of the regulator shall be connected to a small bubble indicator chamber using suitable tubing. Air is introduced into the regulator at a pressure of 0.5 kgf/cm^2 for a period not less than 30 s. Observe the bubble indicator chamber for appearance of bubbles. After completion of the test at 0.5 kgf/cm^2 (low pressure), the air pressure is increased to 17 kgf/cm^2 gradually and for a period not less than 30 s. Observe the bubble indicator chamber for appearance of bubbles. After completion of the test at 17 kgf/cm^2 (high pressure), the air supply to inlet is shut-off.

J-4 Appearance of bubbles in the bubble indicator chamber at low pressure test and high pressure test as mentioned in **J-3**, indicates that the inlet sealing of the regulator fails.