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नेपाल गुणस्तर

NEPAL STANDARD

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

Government of Nepal

Ministry of Industry, Commerce and Supplies

Nepal Bureau of Standards and Metrology (NBSM)

Kathmandu, Nepal

www.nbsm.gov.np

1 SCOPE

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 [50gf/ 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 (70.3gf/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).*

2 REFERENCES

The standards given in Annex A contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicted 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 indicated 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°C.

3.2 Lock-up Pressure — The outlet pressure of the regulator under 'no-flow' conditions, which shall be achieved within 60 s after cessation of flow, with the inlet pressure to the regulator remaining on.

3.3 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 (30gf/cm^2 or 300 mm water column).

3.4 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.

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

3.6 Two Stage Regulators — In this configuration, the inlet pressure is reduced to the desired outlet pressure in two stages by an arrangement in the same regulator only. 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 in one body.

4 MATERIALS

4.1 All component parts 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 NS… *(Method for mercurous nitrate test for copper and copper alloys).*

4.2 The body and cover of all regulators of rated capacity up to 1000 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 NS… *(Zinc Base Alloy Die Castings).*

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 type of finish shall be as agreed to between the manufacturer and the customer.

The surface finished components shall be subjected to test for corrosion resistance as per *NS… (Methods of Testing Corrosion Resistance of Electroplated and Anodized Aluminium Coatings by Neutral Salt Spray Test).* The evaluation of the finish shall be done as per the method given in *NS… (Evaluation of Results of Accelerated Corrosion Test – Method).*

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, when subjected to ageing of 72 h at 70 °C in accordance with method A (low air speed) or method B (high air speed) as prescribed in NS… *(Methods of Test for Vulcanized Rubbers Part 4 Accelerated Ageing and Heat Resistance).*

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* ISO 48-2: 2018 *(Methods of Test for Rubber, Vulcanized or Thermoplastic - Part 2 Determination of Hardness - Section 2 Hardness Between 10 IRHD and 100 IRHD)]*.

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°C or heating to 65°C.

For these tests, assembled regulators are cooled to -20°C or heated to 65°C and maintained at these temperatures for 10 min 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 **8.9**.

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 no 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 given 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°C in accordance with the method prescribed in NS… *(Methods of Test for Vulcanized Rubbers Part 4 Accelerated Ageing and Heat Resistance).*

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 maximum 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.

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.

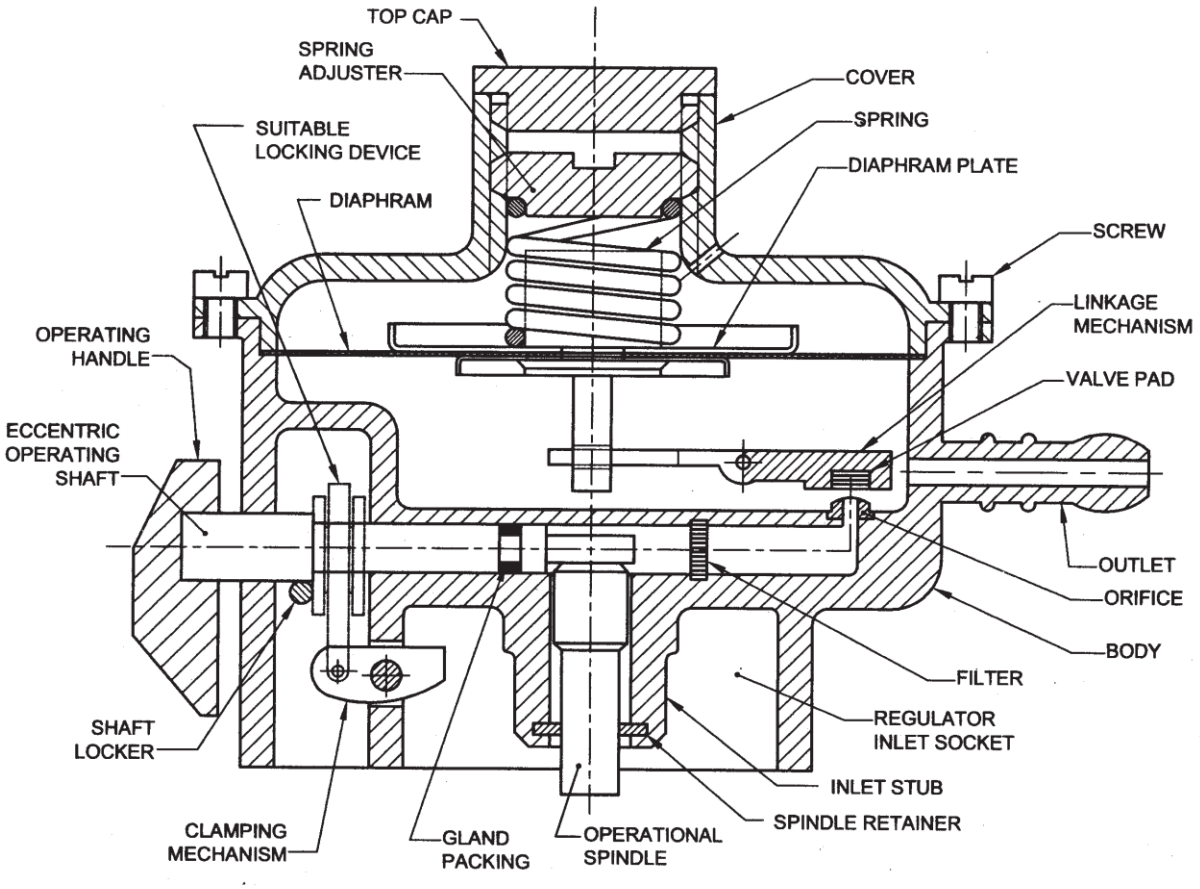


FIG. 1 DIAGRAMMATIC SECTIONAL ILLUSTRATION OF A PRESSURE REGULATOR USED WITH SELF CLOSING SPRING-LOADED TYPE VALVE FOR LPG

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 ISO 7-1: 1994 *(Pipe Threads Where Pressure-Tight Joints are Made on the Threads - Dimensions, Tolerances and Designation) or* ISO 228-1: 2000 *(Pipe Threads Where Pressure-Tight Joints are not Made on the Threads - Dimensions, Tolerances and Designation) or* ISO 68-1: 1998 *(ISO General Purpose Metric Screw Threads - Part 1: Basic and Design Profiles).*

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 to withstand a minimum hydrostatic pressure of 2490 KPa (25.4 kgf/cm^2) held for 120s.

5.5.2 The inlet connection shall also be capable to withstand at ambient temperature a minimum pneumatic pressure equivalent to the maximum inlet pressure specified in Table 1.

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

a) *Screwed ends* – Where inlet or outlet connections are not fitted, the inlet and outlet of a regulator with screwed ends shall comply with the requirements of ISO 228-1: 2000 *(Pipe Threads Where Pressure-Tight Joints are not Made on the Threads - Dimensions, Tolerances and Designation) or* ISO *724: 1993 (ISO General Purpose Metric Screw Threads - Part 3: Basic Dimensions*

b) *Inlet connections* – Where used, any washer, connector and nut of a screwed inlet union shall comply with the applicable mating dimensions of NS *374:2053 Valve Fitting for Use with Liquefied Petroleum Gas (LPG) Cylinders for More than 5 Litre Water Capacity - Specification.*

5.5.4 The inlet sealing of regulator with the self-closing valve (SC valve as per NS *374:2053 Valve Fitting for Use with Liquefied Petroleum Gas (LPG) Cylinders for More than 5 Litre Water Capacity - Specification)* shall be such that, it meets the requirement of the DPR inlet sealing test given in Annex K.

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 Fig. 2B. The choice of type shall be as per the agreement between the manufacturer and the purchaser.

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

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.

5.8 Vent

The breather hole (air vent above diaphragm space) shall be of such size and at such location on the cover that,

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 Check Valve, Pressure Relief Valve, Additional Safety Device

5.9.1 Excess Flow Check Valve

The excess flow Check valve, if provided shall meet the requirements given in Annex F.

5.9.2 Pressure Relief Valve

The regulator with pressure relief valve shall comply with the requirement of this standard.

5.9.3 Additional Safety Device

The regulator with additional safety device shall comply with requirements of this standard.

5.9.4 The regulators with excess flow Check valve, pressure relief valve or any additional safety device shall require approval from relevant competent authority.

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 Strength of Connections

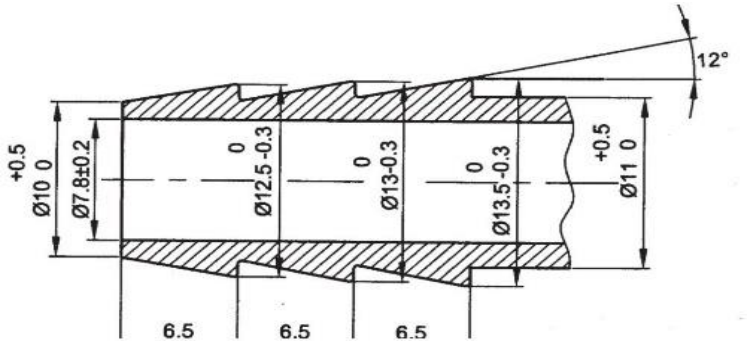
5.11.1 Strength of the Connection/Regulator Assembly

Whether the fixing of the inlet connection onto the regulator body is of the threaded or non-threaded type or in one piece, there shall be no damage or distortion that could affect the safety of the regulator at the end of the tests in **8.11** carried out with the following values:

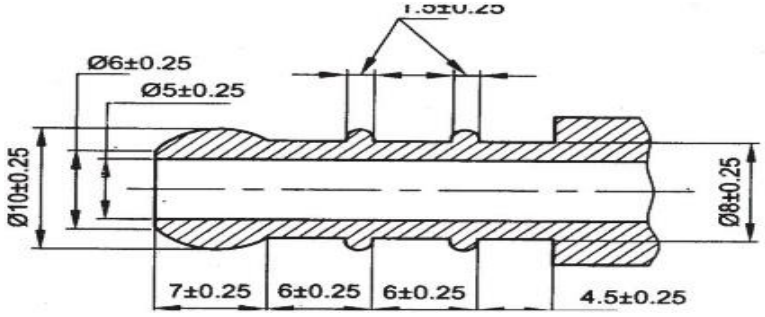
a) A torque of at least 30 Nm in both directions (*see* Table 1);

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 (*see* Table 3); and

c) A tensile strength test of 2 000 N (*see* Table 1).



2A Outlet for 6.4 mm Rubber Tubing



2B Outlet for 7 mm Rubber Tubing

All dimensions in millimetres.

FIG. 2 OUTLETS FOR RUBER TUBING

Whether the fixing of the outlet connection onto the regulator body is of the threaded or non-threaded type or in one piece, there shall be no damage or distortion that could affect the safety of the regulator at the end of the tests in **8.11** carried out with the following values:

1) Non-threaded hose connections:

i) A torque of at least 30 Nm in one direction (verification not required for one piece connection and for freely rotating connections);

ii) A bending moment of 10 Nm; and

iii) A tensile strength test of 2 000 N (verification not required for one piece connection).

2) Threaded connections:

i) A torque of at least 30 Nm in both directions (verification not required for freely rotating connections);

ii) A bending moment of 10 Nm (not required for one piece connection); and

iii) A tensile strength test of 2 000 N (not required for one piece connection).

In addition, for freely rotating connections, the torque necessary for the rotation of the connection shall not be greater than 0.5 Nm at the end of all the tests carried out.

***5.11.2** Strength of Regulator Assembly When Fitted onto its Cylinder Valve*

Following the tests in **8.11**, Table 4 carried out with the regulator fitted to the installation as indicated in the instructions with the following values, there shall be no damage or distortion that could affect the safety of the regulator:

a) A torque in both directions,

1) of at least 20 Nm for non-threaded hose outlet connections (15 Nm for quick coupling connections); and

2) of at least 30 Nm for threaded outlet connections. In addition, regulators with screwed unions vertically mounted onto the cylinder valve shall be subjected to a torque of at least 20 Nm in the regulator plane (15 Nm 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.

c) A tensile strength test of 500 N (verification not required for inlet connections screwed onto the cylinder valve).

The mechanical strength required shall be ensured whatever the position of fixing of the regulator onto the installation.

6 SOUNDNESS

6.1 A regulator shall be considered leak tight when tested in accordance with **6.2** and 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 0°C).

6.2 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 positions.

6.3 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 120s. 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.

6.4 Those parts of the regulator which are normally subjected to the full cylinder pressure shall also be tested for soundness at a pressure of 1666 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 RANGE OF PRESSURE ADJUSTMENT

7.1 The standard range of pressure adjustment, the range of inlet pressure and the range of outlet pressures is elaborated in **7.2** and **8.9.1.** 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.

7.2 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 1666 kPa (17 kgf/cm^2).

8 SETTING AND PERFORMANCE

8.1 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:

Multiply flow of	By	To obtain flow of
Air	0.707	Butane
	1.290	Natural gas
	0.808	Propane
	0.75	120 RVP Butane/Propane mixture
120 RVP Butane/Propane mixture	1.333	Air
Butane	1.414	Air
	1.826	Natural gas
	1.140	Propane
Natural gas	0.775	Air
	0.547	Butane
	0.625	Propane
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.

8.3 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.

8.4 OUTLET PRESSURE MEASUREMENT

For measurement of outlet or delivery pressures of the regulator, a water-in-glass-tube-manometer 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.

8.5 Flow measurement shall be carried out using a direct indicating flow meter (rota-meter). Calibrated orifices may also be used.

8.6 INLET PRESSURE DEVIATION

During the tests for performance, 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.

8.7 Lock up shall be achieved within 60 s after cessation of flow.

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

8.9 Performance

8.9.1 The regulators shall be set so that, with inlet pressure ranging from 49 kPa (0.5 kgf/cm^2) to 1666 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 (look up) pressure shall not exceed 4.41 kN/m^2 (45 gf/cm^2 or 450 mm of WC).

8.9.2 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.

8.10 The requirements of performance as given in **8.9** shall also be satisfied before and after subjecting the regulator to tests specified in **8.10.1, 8.10.2** and **8.10.3**.

Deviation in the initial setting, after these tests, is acceptable. If the regulator is fitted with excess flow check device, the performance of the excess flow check valve shall also be checked as per Annex F.

8.10.1 Cycle Test

When assessing a new design, a type approval test in accordance with Annex G shall be carried out. A fully assembled regulator shall withstand a minimum of 100,000 cycles of opening and closing operations, after which it shall be subjected to a soundness test as in **6.2, 6.3, 6.4** and performance as given in **8.9**.

8.10.2 Low Temperature Test

The regulator is exposed to a temperature of –20°C for a minimum period of 10 min 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 shall be as per Annex H. If the regulator is fitted with excess flow check device, the performance of the excess flow check valve shall also be checked as per Annex F.

8.10.2.1 Heating shall not be applied to reach the ambient temperature.

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

8.10.3 High Temperature Test

The regulator is exposed to a temperature of 65°C for a minimum period of 10 min 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 shall be as per Annex H.

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

8.10.3.1 Forced cooling shall not be applied to reach the ambient temperature.

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

8.11 Mechanical Strength of Connections

Tests for mechanical strength shall be carried out using a dynamometric device with an accuracy of ±5 percent. 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 regulator is fixed at the points indicated in the drawings in Tables 1, 2 and 3. The duration of application of the torques and forces shall be 1 min.

For the test carried out in accordance with Table 3. T and T2 are not applied, if the regulator is freely tuming on its cylinder valve.

i) Regulators with threaded connections, the connection shall be mounted on its valve as indicated in the Table 3;

ii) Regulators with quick couplings, if the inlet connection rotates, the tensile strength test of 15 Nm is not necessary; if the connection is locked in the original position, the regulator shall be tested as such. In all cases the requirements of **5.11** shall be met.

Table 1 Mechanical Strength Test on Inlet Connections (Union/Regulator Connection)

(*Clauses* 5.11.1 *and* 8.11)

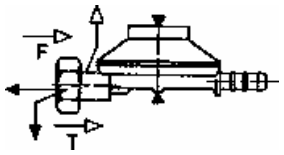
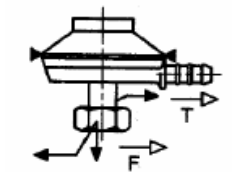
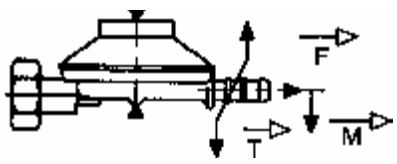
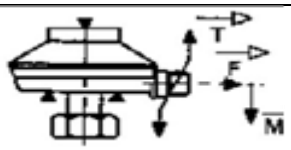
S. No. (1)	**Test Diagram** (2)	**Force** (3)	**Value** (4)	**Monobloc** (5)
i)	 5.11 (a)	T F	30 N.m 2 000 N	
ii)	 5.11 (b)	T F	30 N.m 2 000 N	

Table 2 Mechanical Strength Test on Outlet Connections (Union/Regulator Connection)

(*Clause* 8.11)

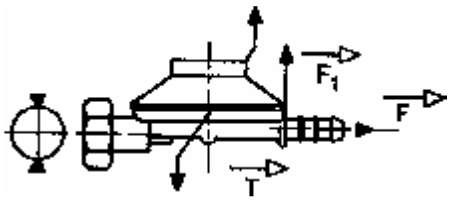
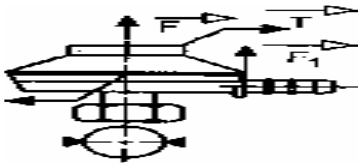
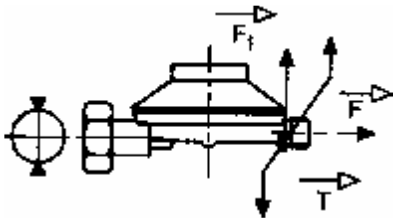
S. No. (1)	Test Diagram (2)	Force (3)	Value (4)	Monobloc (5)
i)	 5.11 (c)	T F **M**	30 N.m 2 000 N **10 N**	**10 N.m**
ii)				

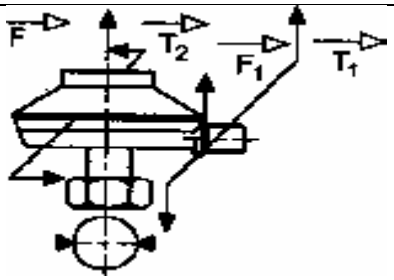
	 5.11 (d)	T F M	30 N.m 2 000 N 10 N	 **30 Nm**

Key: regulator fixing points, T = torque; F = tensile strength; M = bending moment

Table 3 Mechanical Strength Tests for the Regulator Assembly Mounted on its Cylinder Valve (Self Closing Valve or Manual Valve)

(*Clauses* 5.11 *and* 8.11)

S. No.	Test Diagram	Types of Inlet Connection		
		Force	Threaded	Quick Connection
i)	 5.11 (e)	T F F1	 20 N.m 400 N	 **15 N.m**
ii)	 5.11 (f)	T F F1	 20 N.m 400 N	15 N.m 500 N 400 N
iii)	 5.11 (g)	T F F1	30 N.m 400 N	30 N.m 500 N 400 N

iv)	 5.11 (h)	T1 T2 F F1	30 N.m 20 N.m 400 N	30 N.m 15 N.m 500 N 400 N

Key: Regulator fixing point T, T1, T2 Torque F, Tensile strength, F1, Bending strength O Valve

9 SEALING

9.1 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.

9.1.1 The manner of sealing shall be as agreed to between the purchaser and the manufacturer.

10 CLASSIFICATIONS OF TESTS

10.1 Type Tests

The following shall constitute type tests out of the various requirements:

a) Diaphragm material (*see* **4.3**);

b) Valve pad material (*see* **4.4**);

c) Hydrostatic test (*see* **6.3**);

d) Low and high temperature tests (*see* **8.10.2** and *see* **8.10.3**);

e) Mechanical strength of connection (*see* **8.11**); and

f) Tests for excess flow device, if provided (*see* **5.9**).

10.2 Routine Tests

The following shall be carried out as routine tests:

a) Pneumatic test (*see* 6.2 and 6.4); and

b) Chatter and performance test (*see* 8.9).

11 MARKING

11.1 A Regulator shall be clearly and permanently marked with the following:

a) Manufacturer's name or trade-mark;

b) Month and year of manufacture, for example 12-10 for December 2010;

c) Rated capacity, in m^3/h of LPG;

d) Number of this Nepal Standard; and

e) Safety feature as approved by competent authority, if any

11.2 NS Certification Marking

The regulators may also be marked with Standard Mark.

11.2.1 The use of Standard Mark is governed by the provisions of *Nepal Standards Act*, 2037 and the rules and Regulations made thereunder. The details of conditions under which the license for use of Standard Mark may be granted to manufacturers or producers may be obtained from the Nepal Bureau of Standards and Metrology.

11.3 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)

1. NS… (Method for mercurous nitrate test for copper and copper alloys).
2. NS… (Zinc Base Alloy Die Castings).
3. NS… (Methods of Testing Corrosion Resistance of Electroplated and Anodized Aluminium Coatings by Neutral Salt Spray Test)
4. NS**… (**Evaluation of Results of Accelerated Corrosion Test – Method).
5. NS… (Methods of Test for Vulcanized Rubbers Part 4 Accelerated Ageing and Heat Resistance).
6. ISO 48-2: 2018 (Methods of Test for Rubber, Vulcanized or Thermoplastic - Part 2 Determination of Hardness - Section 2 Hardness Between 10 IRHD and 100 IRHD)]
7. ISO 7-1: 1994 (Pipe Threads Where Pressure-Tight Joints are Made on the Threads - Dimensions, Tolerances and Designation)
8. ISO 228-1: 2000 **(**Pipe Threads Where Pressure-Tight Joints are not Made on the Threads - Dimensions, Tolerances and Designation)
9. ISO 68-1: 1998 (ISO General Purpose Metric Screw Threads - Part 1: Basic and Design Profiles).
10. ISO 724: 1993 (ISO General Purpose Metric Screw Threads - Part 3: Basic Dimensions
11. NS 374: 2053 (Valve Fitting for Use with Liquefied Petroleum Gas (LPG) Cylinders for More than 5 Litre Water Capacity – Specification

ANNEX B

(*Clause* 4.2.1)

METHOD OF TEST FOR ADHESION OF PAINT

B-1 A square measuring 12 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 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 min 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 shall 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_0 prior to test. Immerse the same in pentane or commercial LPG maintained at a temperature of 20 ± 5°C for 72 h. Remove the sample and expose it to atmosphere. After 5 min, 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 =

$$\frac{w_1 - w_2}{w_o} \times 100\ \%$$

b) Percentage of matter extracted

$$\frac{w_0 - w_2}{w_o} \times 100\%$$

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

Component (1)	Extractable Percent (2)	Absorbed Percent (3)
Diaphragm	+ 5 – -15	±10
Valve pad	+ 5 – -12	+10 – -9
Seal	+ 5 – -12	+10 – -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 differentiate 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 4 of NS… *(Methods of Test for Rubber, Vulcanized or Thermoplastic Part 10 Compression Set Section 2 At low temperatures).* The pieces for test shall be as per NS… *(Methods of Test for Rubber, Vulcanized or Thermoplastic Part 10 Compression Set Section 2 At low temperatures).*

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 NS… *(Methods of Test for Rubber, Vulcanized or Thermoplastic Part 10 Compression Set Section 2 At low temperatures)* subjected to following conditions:

a) Compression: 25 % at (27 ± 2°C)

b) Duration of test: 168^{+0}_{-2}h for valve pad and seal material and 24 ± 0.5 h for diaphragm.

c) Test temperature: 70 ±1°C

E-4 CALCULATION

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

Compression set, percent =

$$\frac{t_0 - t_1}{t_0 - t_8} \times 100\%$$

Where,

t_0 = initial thickness of the test piece, in mm;

t_1 = thickness of the test piece after recovery in mm; 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 and 8.10)

REGULATORS FITTED WITH AN EXCESS FLOW CHECK VALVE

F-1 GENERAL

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.

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 resetting devices a maximum residual leak of 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 10s. The presence of the device shall not modify the regulator performance.

F-3 TEST METHODS — 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 following information:

a) Do not move the cylinder during the use.

b) Switch off in the event of operation of the excess flow valve.

c) Only turn on the regulator after having rectified the cause of the device operating.

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.

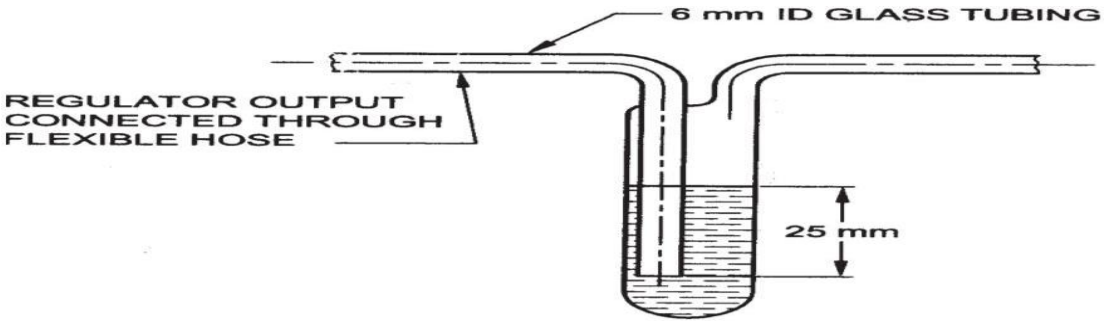


FIG. 3 BUBBLE INDICATOR

ANNEX G

(*Clause* 8.10.1)

CYCLE TEST (ENDURANCE TEST)

G-1 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. 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-2 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 shall 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 an appropriate pressure 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-2.1 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-2.2 Any other set up producing equivalent conditions and achieving the same objectives would be acceptable.

G-3 After completion of the test mentioned in **G-2**, 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.

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* 8.10.2 *and* 8.10.3)

LOW TEMPERATURE AND HIGH TEMPERATURE TESTS

H-1 LOW TEMPERATURE TEST

A fully assembled regulator, set as in 8.9 is placed in a sealed container and this container is immersed in a bath of any convenient fluid (namely, methanol or any suitable freezing mixture like salt + ice + calcium carbide) cooled to a steady temperature of –20°C and maintained at this temperature by some reliable means (by additions of dry ice). It is kept immersed long enough for the complete assembly to attain –20°C (10 min) after which it is removed and exposed to the atmosphere so that the assemble returns to ambient conditions. It is then tested in accordance with **8.9** for performance.

NOTE – Care should be taken to prevent the cooling fluid entering the assembly or of moisture condensing inside. This may be avoided by ensuring that the sealed container lid opened only after the assembly attains ambient conditions.

H-2 HIGH TEMPARATURE TEST

A fully assembled regulator set as in 8.9 is placed in a sealed container and this container, if placed in a bath of water heated to a steady temperature of 65°C. It is kept immersed long enough for the complete assembly to attain 65°C (10 min) after which it is removed and exposed to atmosphere so that the assembly returns to ambient conditions. It is then tested in accordance with 8.9 for performance.

NOTE – Care should be taken to prevent the bath water from entering the assembly, or of moisture forming inside. This may be avoided by ensuring that the sealed container is opened only after the assembly attains ambient conditions. Also, air shall not be forced through the assembly in an attempt to accelerate cooling as this is likely to result in condensation of moisture inside the assembly.

ANNEX K

(Clause 5.5.4)

REGULATOR INLET SEALING TEST

K-1 The purpose of the test is to ensure that the flow of LPG does not take place from the regulator in case:

a) The regulator is in switched OFF condition: and
b) There is a leak from the SC valve fitted on the LPG cylinder.

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

K-3 A fully assembled regulator is placed on the SC valve as mentioned in K-2 fitted onto the test bench. The regulator shall be kept in switch 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 30s. 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 30s. observe the bubble indicator chamber for appearance of bubbles. After completion of the test at 17 kgf/cm^2 (high pressure), the supply to inlet is shut-off.

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