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شرکت ملی گاز ایران

مدیریت پژوهش و فنآوری

امور تدوین استانداردها

IGS

مشخصات فنی خرید

رگولاتور خانگی

GAS PRESSURE REGULATOR, DOMESTIC

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ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۲۰۰۳ مورخ ۱۴۰۱/۱۲/۱۴ هیات مدیره، نامه شماره گ۹/۲۰۴۱۵۷/۰۰۰ مورخ ۱۴۰۱/۱۲/۰۳ مدیر پژوهش و فناوری درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱- مشخصات فنی خرید رگولاتور خانگی

IGS-M-IN-201(3)

سیدمحمد پیشوایی
دبیر هیات مدیره

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رونوشت : مدیرعامل محترم شرکت ملی گاز ایران و رئیس هیات مدیره
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رئیس محترم امور مجامع

Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.

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General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.

4- "SHALL ": is used where a provision is mandatory.

5- "SHOULD": is used where a provision is advised only.

6- "MAY": is used where a provision is completely discretionary.

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Contents

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1. SCOPE

This standard specifies the minimum design, material, performance, and painting, marking and testing and packing requirements of single stage type natural gas service regulators operating at inlet pressures 1 bar up to and including 4 bar. These regulators are used to control the gas delivery pressure to pressurize at a maximum 25.4 mbar.

2. REFERENCES

2.1. AGA XQ 9802 / ANSI B 109.4: self-operated diaphragm-type natural gas service regulators

2.2. ANSI B1.20.1: Pipe Threads, (Inch) General Purpose

2.3. ANSI B16.4: Malleable iron threaded fittings classes 150 and 300

2.4. ANSI B16.4: Gray Iron Threaded Fittings.

2.5. ASTM B85: Standard Specification for Aluminum-Alloy Die Castings

2.6. ASYM B16: Standard Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines

2.7. ASTM A126: Standard specification for gray iron castings for Valves, Flanges and Pipe fittings

2.8. ASTM A48: Standard for Gray Iron Castings

2.9. ASTM B117: Standard Practice for Operating Salt Spray (Fog) Apparatus

2.10. IGS-M-CH-033 (1): Specification for Iranian Natural Gas Quality

2.11. IGS-M-IN-308 (0): Specification for mechanical security seals

2.12. ANSI Z 21.15: Manually operated gas valves for appliances and appliances connector valves and holes end valves.

2.13. EN 13787: Elastomers for gas pressure regulators and associated safety devices for inlet pressures up to 100 bar.

2.14. EN 549: Rubber materials for seals and diaphragms for gas appliances and gas equipment

2.15. ISO 2409: Methods of test for paints and varnishes.

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3. DEFINITIONS

3.1. Diaphragm: A flexible element used to sense the outlet pressure and, in combination with the loading spring and linkage, to position the valve to control the downstream pressure.

3.2. Diaphragm case or casing: The housing for the diaphragm usually consists of an atmospheric or ambient casing and a gas casing. The gas casing and the diaphragm form the gas chamber. The atmospheric or ambient casing and the diaphragm form the atmospheric or ambient chamber. The diaphragm seals and separates the gas chamber from the atmospheric or ambient chamber. The atmospheric or ambient chamber houses the loading spring and vents into the atmosphere.

3.3. Droop: The drop in outlet pressure from set point with respect to increasing gas flow rate.

3.4. Hysteresis: Characteristic used to describe a deviation in the regulator performance based on internal friction, the diaphragm material and flow.

3.5. Internal relief valve (IRV): A relief valve that relieves excessive outlet pressure through the diaphragm and vent assembly.

3.6. Loading spring: A spring placed on the diaphragm or diaphragm plate and contained in the atmospheric casing, which opposes the gas pressure exerted against the opposite side of the diaphragm. The outlet pressure of the regulator is set by the compression of this spring.

3.7. Lock-up: The state of the regulator when inlet pressure is applied and no gas is flowing.

3.8. Lock-up pressure: The outlet pressure above which there is no flow through the regulator.

3.9. Orifice: The primary flow restrictor that is used to control the flow of gas. It is the position of the valve disk with respect to the seating surface of the orifice that determines the amount of gas flowing through the regulator.

3.10. Over-pressure shut-off: A device designed to stop the flow of gas when the outlet pressure increases above a pre-determined pressure.

3.11. Under-pressure shut-off: A device designed to stop the flow of gas when the outlet pressure drops below a pre-determined pressure.

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3.12. Pressure drop: The loss in pressure between two points in a system in which gas is flowing.

3.13. Gauge pressure: Pressure measured relative to the atmospheric pressure.

3.14. Pulsation, hunting or chattering: An unstable state in which there is oscillation of the regulator diaphragm, linkage and/or mechanisms that causes noise and/or fluctuating outlet pressure.

3.15. Seal cap: The cap serving as a weather seal and external closure for the loading spring and spring adjustment screw.

3.16. Set flow: The flow rate used for the initial setting of the regulator at a specified inlet pressure and outlet set pressure.

3.17. Set pressure, setting pressure or set point: The initial setting of the regulator outlet pressure at a specified set flow and inlet pressure.

3.18. Spring adjustment mechanism: Usually a threaded part by which the loading spring is adjusted to set the outlet pressure.

3.19. Valve: A valve consists of the valve orifice and valve disk, and it is used to control gas flow through the regulator.

3.20. Valve body: That part of the regulator that consists of inlet and outlet piping connections and the orifice.

3.21. Valve disk or valve seat: A resilient disk or similar device that is positioned with respect to the regulator valve orifice to control and shut off the flow of gas.

3.22. Valve linkage: A lever or mechanism connecting the diaphragm to the valve disk.

3.23. Vent: The opening to the atmospheric side of the diaphragm casing through which the regulator breathes.

3.24. Vent cap or vent screen: A cap that is inserted into the vent of the regulator to keep bugs, insects and water from getting into the regulator's atmospheric or ambient casing. It may also act as a restrictor in the vent to prevent pulsation or chattering.

3.25. Type tests: All tests mentioned in this standard those carried out in order to compatibility of specifications manufactured regulator with all requirements of this standard.

3.26. Sample tests: The tests those carried out on limited samples of each lot ready for shipment selected by inspector.

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3.27. Factory test: all test mentioned in this standard those carried out by the manufacture on regulators prepared for delivering.

3.28. Single stage regulator: A regulator that reduce inlet pressure to outlet set pressure directly in one step.

3.29. Water column (W.C.): As in a manometer, a means for measuring pressure, usually stated as inches of water column.

4. GENERAL REQUIEMENTS

4.1. Natural gas specifications are according to IGS-M-IN- 033.

4.2. Ambient temperature range is -25°c up to +55 °c.

4.3. Standard condition is 1.013 bar (14.696 Pisa) and 15. 6°c (60°F).

4.4. Inlet pressure range is 1 bar up to and including 4 bar.

4.5. Normal outlet pressure range is 15 to 25.4 mbar.

4.6. Set point of regulator shall be 7.0 inches W.C. (1.74 kPa) (17.4mbar) ±1 inch W.C. (0. 25 kPa) (2.5mbar).

4.7. The outlet pressure of regulator shall not rise above 25.4 mbar (10in.w.c) or fall below 15 mbar (6in.w.c) with flow variation between zero and full capacity of regulator inlet pressure variation between 1 bar to 4 bar (15psig to 60psig).

4.8 The regulator shall be equipped with under pressure shut off device (u.p.s.o), over pressure shut off device (o.p.s.o) & internal relief valve (i.r.v). The three safety devices and the regulator shall be integrated and comprise one unit.

4.9. Under pressure shut off (u.p.s.o) shall be adjustable and set at 8.7± 1.2 mbar (3.5± 0. 5in.w.c).

4.10. Under pressure shut off device shall be manually reset.

4.11. Over pressure shut off (o.p.s.o) shall be adjustable and set at 42.3± 2.5 mbar (17± 1in.w.c).

4.12. Over pressure shut off device shall be independent from the main diaphragm case and valve seat of the regulator.

4.13. Over pressure shut off device shall be manually reset

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4.14. Internal relief valve (I.R.V) shall be adjustable and set at 62.3± 7.5mbar (25 ± 3in.w.c).

4.15. Internal relief valve (I.R.V) shall be designed to relieve pressure at a rate that limits the downstream pressure to a maximum of 1.5psig (10.3 kPa) (103 mbar) for the maximum inlet pressure.

4.16. The regulator shall have easy moving parts without stresses and be constructed of quality materials in a workmanlike manner in order to attain gas tightness, stability of performance and sustained accurate regulation over a period of time and over the range of operating conditions with minimum of maintenance, when regulating natural gas

4.17. The regulator shall be for outdoor installation.

4.18. Regulators shall operate without objectionable noise, malfunction, hunting, pulsation or chattering over an ambient temperature range and at inlet pressure range.

4.19. The regulator shall incorporate an internal static pressure sense point with no external static or control lines.

4.20. The regulator valve body shall conform to the dimensions and pressure requirements of the ANSI B 16.4.

4.21. The valve body must meet the strength, casting integrity and leakage- performance testing requirements of this standard.

4.22. Assembled regulators shall with stand an outlet pressure of 2 psig without leakage (vents shall be blocked closed) or permanent deformation of any component.

4.23. The regulator shall with stand a cantilevered load of 250 lbs. (113.4 kg) without affecting performance or causing leakage, fracture or permanent deformation of any component.

4.24. The upper cover of the diaphragm case shall have a vent connection.

4.25. The diaphragm case, which contains the natural gas under normal operation, shall with stand a pressure of 10 psig (68.9 kPa)(689 mbar) without rupture.

4.26. All Screws, bolts and nuts shall conform to ANSI B1.20.1.

4.27. All parts coming in contact with the diaphragm shall not have sharp edges, burrs, projections or similar conditions, which might chafe or abrade the diaphragm.

4.28. Adequate means shall be provided to prevent the diaphragm and diaphragm plate from restricting the vent.

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4.29. The diaphragm shall with stand a differential pressure of at least 5 psig (34.5kpa) (345 mbar) without leakage or rupture.

4.30. The loading-spring mechanism shall be adjustable. The adjustment mechanism shall be constructed so that it may be adjusted using a common slotted screwdriver.

4.31. The adjustment mechanism seal-cap or cover shall be provided with a means for sealing that discourages unauthorized adjustments.

4.32. Seals shall be in according to IGS-M-IN-308(1).

4.33. The spring adjustment seal-cap or cover shall be of a gas-tight, weather-resistant construction that prevents the entry of water into the diaphragm chamber and contains the gas in the event of a regulator failure. This will direct discharge or relieve gas to the regulator vent.

4.34. The regulator shall be designed so that, through the full range of movement of the spring adjustment screw, the adjustment mechanism will not cause the regulator to bind or malfunction.

4.35. The loading springs shall be designed for the optimum set point pressure to minimize droop characteristics due to spring-compression effects.

4.36. The spring range should allow for an adjustment above and below the optimum set point pressure.

NOTE: Historically a spring range of approximately 3.5 inches W.C. (0.87kpa)(8.7 mbar) has been found to be adequate.

4.37. Inlet/outlet connection size, maximum capacity and flow rate for setting the regulator shall be according to appendix “A”

4.38. The design shall include a provision to prevent the spring from being fully compressed.

4.39. The spring shall be adjustable with a torque no greater than 2 foot-pounds (2.71 Nm).

4.40. Levers and linkages, when used, shall be held in place with a pivot, designed in a way that cannot work loose in normal operation and handling.

4.41. All moving parts of regulator shall be assembled workmanlike manner without any loose and detachment.

4.42. If a toggle-type linkage is used, there shall be a travel stop to prevent the linkage from reaching a dead-center position.

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4.43. The valve disk shall be made designed to withstand cutting by the valve orifice; and to resist permanent deformation when pressed against the valve orifice.

4.44. The valve disc shall be mounted so that align with the valve orifice.

4.45. The valve disk shall be securely fastened to its actuator so that it cannot become separated during shipping, handling or operation.

4.46. The valve disk shall be removable for inspection and replacement.

4.47. For internal relief regulators, a travel stop shall be incorporated to ensure relief-valve operation.

4.48. The valve orifice shall be easily removable without required special tools.

4.49. The valve orifice shall not be variable type.

4.50. The valve orifice threads, if used, shall be gas-tight.

4.51. If a thread sealant is used for fastening the valve orifice, it shall be with stood 250°F (121°C) without affecting the gas tightness of the thread.

4.52. Diaphragm case shall be design so that be able to rotate from zero to 180 degree with respect to the valve body.

4.53. The atmospheric side of the diaphragm case shall have a female threaded ¾ inch (19 mm), 1 inch (25.4 mm) or 1 ½ (38.1 mm) vent connection and shall conform to the NPT standards of ANS/ASME B1.20.1. The threads shall be countersunk or chamfered as set forth in ANSI B 16.3 to prevent damage to the threads when making a threaded connection.

4.54. The vent connection shall have a removable vent screen.

4.55. The vent opening shall be designed to resist blockage by ice, sleet, snow and insects, and be resistant to the formation of corrosion residue on the surfaces of screen ports.

Note" historically, if a screen is used, a 16-to-20-mesh screen has been shown to be effective. The vent opening shall be tested according to requirements in section 5.3.12," environmental tests." (ANSI B109-4-1998)

4.56. The inlet and outlet connections of regulator shall be in-line.

4.57. Inlet and outlet connections shall be N.P.T female threaded acc. to ANSI B 1.20.1.

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5. Materials

5.1. Regulators shall be constructed of material and component parts suitable for the intended use and shall be resistant to atmospheric corrosion and chemically resistant to constituents normally found in natural gas. Materials must meet the testing requirements of this standard.

5.2. The regulator valve body material shall be Cast Iron according to ASTM A126 Classes A & B, ASTM A48 Class 30.

5.3. The regulator valve body shall conform to the dimensions and pressure requirements the ANSI B 16.4

5.4. The atmospheric and gas diaphragm cases material shall be aluminum according to following specifications.

item	ASTM B85	UNS
1	S12A	A14130
2	S12B	A04130
3	SC102A	A03830
4	SC84B	A03800
5	SC102A	A03830

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5.5. The diaphragm casing shall be free of flash, cores, pits and burrs.

5.6. All fasteners and fastening components shall be corrosion-resistant.

5.7. The diaphragm case shall be of materials with a melting point of not less than 427°C.

5.8. Diaphragm shall be made of reinforced synthetic material and meet the tests described in this standard.

5.9. The loading spring shall be constructed of a corrosion-resistant material or be protected from corrosion.

5.10. The valve linkage shall be constructed of a corrosion-resistant material or be protected from corrosion.

5.11. The valve disk shall be made of resilient material to withstand abrasion by the gas or by impurities in the gas.

5.12. The valve orifice materials shall be brass according to ASTM B16 or stainless steel type 316 and meet the tests described in this standard.

5.13. If a thread sealant is used for fastening the valve orifice, it shall be of a permanent non-drying type and withstand against heating up to 121ºc (250 ºF) without affecting the gas tightness of thread sealant.
Manufacture shall use elastomer packing in which way that make high pressure levers completely gas tight.
The adhesive material shall not be used for tightness purposes.

5.14. The orifice seat gasket, if used, shall be made of a pressure-containing, non-galling, corrosion-resistant material.

5.15. Rubber parts materials such as "o" rings, valve disc and so on, shall be homogenous, free from porosity, grit, blisters and defects. They shall be met the tests described in this standard.

5.16. If threaded plastic parts are used, they shall be constructed by injection and the thread shall be provided on molds.

5.17. The external components of the regulator shall either be made of or protected by materials resistant to attack by the atmosphere, weather or sunlight, and to agents used in regulator repair and cleaning.

5.18. All parts of regulator made from corrosion resistant material or protected against corrosion such as springs, stems, valve linkage, vent screen, screws, nuts and bolts shall be met salt spray test during 500 hr. according to ASTM B117

5.19. All adjusting screws, caps, diaphragm plate, and relief valve cup shall be made from resistant material against any mechanical, chemical and thermal conditions which the regulator may be exposed to them. They shall be met test requirements of this standard.

6. Painting

6.1 The external surface of regulator shall be thoroughly cleaned by removing all rust and mill scale. Surface to be painted shall be completely free from grease, grit and other foreign material.

6.2 Aluminum casing shall receive a chromate conversion coating and shall be painted.

6.3 Final color shall be cream. RAL code 9002.

6.4 The total thickness of painting shall not be less than 60 microns.

6.5 Exteriors of the regulator shall be met the testing requirements of this standard.

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7. Marking

The following information shall appear in a permanent and legible form on the regulator. Adhesive quality and legibility of marking shall be satisfied test requirements of this standard.

7.1. General information

7.1.1. manufacturer's name or trademark

7.1.2. Regulator type or model

7.1.3. Serial no.

7.1.4. Year of manufacture

7.1.5. Minimum and maximum inlet pressure

7.1.6. Pressure adjusting spring range

7.1.7. Orifice size

7.1.8. The regulator and safety device set points

7.1.9. Regulator capacity in scm/h

7.1.10. Inlet, outlet and vent sizes.

7.2. Direction of the gas flow shall be clearly and permanently marked on the regulator body.

7.3. The vent outlet shall be clearly and permanently marked "VENT."

7.4. The following information shall be permanently marked on the molded diaphragm or master sheet of diaphragm:

7.4.1. The manufacturer name or trade mark.

7.4.2. Batch number.

7.4.3. Date of manufacture

7.5. NIGC indication embossed on the valve body

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8. Documentations

Manufacturer shall provide and present following documents:

8.1 original technical catalog(s)

8.2 Full Parts list

8.3 General drawing(s) showing outline dimensions

8.4 Manuals for installation, commissioning, operation and maintenance.

8.5 Typical performance curve for air with density of 1.2 kg/m3

8.6 Material test certificate of each part.

8.7 Type test certificate.

8.8 Manufacture test reports.

8.9 Factory test document

9. Inspection and testing

9.1. General

9.1.1. Type tests shall be carried out in the authorized laboratory by NIGC on the six samples of each type of complete regulator with same capacity. Each sample tested must pass all of the test requirements of this standard to demonstrate compliance with standard.

9.1.2. Type test certificates are valid while there aren't any changes in material, design, dimension, assembly and manufacturing process of regulators and their components. These certificates shall be renewing every two years.

9.1.3. Sample test shall be carried out by authorized NIGC inspectors according to inspection agreement between NIGC and supplier.

9.1.4. Factory test shall be carried out by manufacture on 0.2% of regulators prepared for delivering (minimum one regulator) and the test results must be documented.

9.1.5. All tests shall be conducted with air at room temperature.

9.2. Performance tests

9.2.1. Load Test

The regulator body and diaphragm case assembly, when tested as follows, shall not show evidence of fracture, permanent deformation, external leakage or impaired performance:
a) Mount the regulator in a vertical pipe stand with the diaphragm oriented horizontally.

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b) Apply a load of 250 lbs (113.4 kg) at that point of the regulator case that is farthest from the centerline of the pipe. The load shall be maintained for 10 minutes and then removed while the regulator is pressurized to a lock-up condition. During the loading cycle the regulator shall not leak.
c)After the load has been removed, examine the regulator to ensure that the load has not affected performance or caused leakage, fracture or permanent deformation of any component by carrying out the applicable performance tests, Leakage, Set Point, Lock-up, Relief Set Point and Relief Valve Performance Test.

9.2.2. Leakage test

Sample shall be tested for tightness when with closed vent port applying 4.2 bar (60 PSIG) pressure to the inlet and 138 mbar (2 PSIG) to the outlet.no leakage shall be witnessed.

9.2.3. Set Point and Hysteresis test

9.2.3.1. Set Point

a) Inlet pressure shall be 1bar.
b) Outlet pressure shall be 7.0 inches W.C. (1.74 kPa)(17.4 mbar) ±1 inch W.C. (0.025 KP a) c) Flow Rate shall be 52.5 scf /h (1.5 m3/h) to be set by slowly increasing the flow rate from zero (for regulator with capacity up to and including 25m3/h).
c) Outlet pressure shall be 7.0 inches W.C. (1.74 kPa) (17.4 mbar) ±1 inch W.C. (0.025 KPa)(0.25 mbar) c) Flow Rate shall be 210scf/h (6 m3/h) to be set by slowly increasing the flow rate from zero (for regulator with capacity above 25m3/h).
During tests to check the set point, the regulator should be stable with no evidence of hunting or chattering.

9.2.3.2. Hysteresis

d) Mount the regulator in a vertical pipe mount with the diaphragm oriented vertically. Set regulator as described in Section 9.2.3.1, "Set Point."
e) Close the downstream valve with a consistent closing speed over a period of 5 seconds, keep the valve closed for 5 seconds, and then reopen the valve over a period of 5 seconds to a flow of 50 scf/h (1.42 m^3/h) for a period of 5 seconds.
f) Record the outlet pressure. Repeat this step three times.
g) Open the downstream valve with a consistent opening speed over a period of 5 seconds to a flow of 200 scf/h (5.67 m3/h) of air. Keep the valve in this position for 5 seconds, and then close the valve over a period of 5 seconds to a flow rate of 50 scf/h (1.42 m3/h) for a period of 5 seconds. h) Record the outlet pressure. Repeat this step three times.
i) The recorded readings shall be within ±0.5in.w.c. (0.124 kPa)(1.24mbar) of the established set point.

9.2.4. Lock-up

AT the maximum inlet pressure, the outlet pressure under no-flow conditions or lock-up pressure shall not exceed 3.0 in.w.c. (0.75 kPa)(7.5 mbar) above the original set point.
Lock-up shall be demonstrated by maintaining the inlet pressure for a minimum of 10 seconds without any rise in the downstream pressure.

9.2.5. Flow Capacity

a) Apply 1bar inlet pressure to the regulator that be set according to section 9.2.3.1
b) Slowly increase the flow rate until the outlet pressure increases by 2in.w.c. (0.50 kPa)(5mbar) or decreases by 1in.w.c. (0.25 kPa)(2.5mbar) from the original set point.

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c) Log the flow rate when item “b” is met. Results are to be expressed in scf/h of 0.6 specific gravity gas.

$Qg = \sqrt{\frac{\rho Air}{\rho Gas}} \times QAir$

d) This flow rate is the regulator maximum capacity and shall not be lower than the nominal capacity specified by manufacturer.
e) Then apply 4bar inlet pressure to the regulator and perform steps of “b” and “c”.
f) This flow rate shall not be lower than the regulator maximum capacity.

9.2.6. Performance curve

Regulator outlet pressure per flow rate for the minimum and maximum inlet pressure (1bar and 4bar) shall be presented regulator performance graphically as following. Performance curve shall be smooth and without any fluctuation.

a) The abscissa (x-axis) shall represent the rate of flow in standard cubic meter per hour (scm/h).
b) The ordinate (y-axis) shall represent the outlet pressure in mbar.
c) Both the abscissa and ordinate scales shall be represented with linear scales.
d) The set point on which the graph is based shall be marked. All curves shall be based on the original set point as marked. The set point is not to be reset for the various inlet pressures.
e) The outlet pressure of regulator shall be recorded for 10, 20, 30,40,50,60,70,80,90, and 100 percent of regulator capacity.

9.2.7. Relief valve tests

9.2.7.1. Relief Set Point

The following design verification test must be performed
The regulator relief-valve assembly shall be tested to demonstrate its initial start-to-discharge pressure and its reseating pressure. To perform the test, a controlled back-pressure of 40 psig (275.8kpa) (2758mbar) of air should be slowly introduced into the outlet of the regulator inch. The flow rate shall approximately be 1 cubic foot per hour. The relief valve should begin to relieve as downstream pressure rises to 62.3± 7.5mbar (25 ± 3in.w.c)
To determine the relief-valve reseal point, lock in the pressure on the outlet side of the regulator and observe the pressure at which the relief valve ceases to release pressure. The relief valve shall reseat at a minimum of 2 inches W.C. (0.5 kPa) (5mbar) above the lock-up pressure. The reseat pressure should be checked to see that it remains constant for a minimum of 10 seconds.

9.2.7.2. Relief-Valve Performance

The relief valve shall be designed to relieve pressure at a rate that limits the downstream pressure to a maximum of 1.5psig (10.3 kPa) (103mbar) for the maximum inlet pressure. The internal relief-valve capacity shall be tested as follows.
a) Cause the regulator to fail by disconnecting the linkage between the diaphragm and valve mechanism

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NOTE: This should result in the most severe test for internal relief. If it is not obvious from this test that the most severe condition is created, more than one test must be conducted to determine the most severe condition.
b) Disconnect any vent piping to allow the regulator to vent the flow of gas freely and unrestricted to the atmosphere.
c) Close the valve downstream of regulator so that there is no flow of gas through the regulator.
d) Note the outlet pressure while slowly increasing the inlet pressure from zero psig to the maximum inlet pressure. Record the outlet pressure at the maximum inlet pressure, after the system reaches steady-state condition. The outlet pressure shall be limited to 2 psig (13.8 kpa) (138mbar) or less by the relief capacity.

9.2.8. Proof the shut off
When the regulator is in the shut of position (under pressure shut off or/and over pressure shut off), by applying the inlet pressure from zero up to and including 4bar, the outlet pressure must remain at zero and don't increase.

9.2.9. Over pressure shut off test
a) Maintain the regulator into the service
b) Apply 1bar inlet pressure to the regulator
c) Increase the outlet pressure from zero slowly and observe or monitor the outlet pressure of regulator until the over pressure shut off device activate
d) Record the outlet pressure when the over pressure shut off device activated
e) Repeat this test for ten times
f) Calculate the mean value of above measured value
g) Change the inlet pressure to 4bar
h) Perform steps of "c" to "f" again
9.2.9.1. None of above recorded outlet pressure must be greater than 44.8mbar (18in.w.c.)
9.2.9.2. Each calculated mean value must be within 39.8mbar to 44.8mbar (16in.w.c. to 18in.w.c.)

9.2.10. Under pressure shut off test
a) Maintain the regulator into the service
b) Apply 1bar inlet pressure to the regulator
c) Pass the flow through the regulator about 39 scf/h (1.1m3/h)
d) Decrease the inlet pressure slowly and observe or monitor the outlet pressure of regulator until the under pressure shut off device activate
d) Record the outlet pressure when the under pressure shut off device activated
e) Repeat this test for ten times
f) Calculate the mean value of above measured value
g) Again, maintain the regulator into the service and apply 1bar inlet pressure to the regulator
h) Increase the passing flow through the regulator from zero slowly until the under pressure shut off device activate. During the test and observe or monitor the outlet pressure of regulator until the under pressure shut off device activate

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i) Record the outlet pressure when the under pressure shut off device activated
j) Repeat this test for ten times
k) Calculate the mean value of above measured value
l) Then maintain the regulator into the service and apply 4bar inlet pressure to the regulator
m) Perform steps of “h” to “k” again

9.2.10.1. None of above recorded outlet pressure must be less than 7.5 mbar (3in.w.c.)

9.2.10.2. Each calculated mean value must be within 7.5mbar to 9.9mbar ((3in.w.c. to4in.w.c)

9.3. Endurance Test

A regulator shall withstand 100,000 cycles of opening and closing of the valve under the following test method.
a) Mount the regulator in a vertical pipe stand with the diaphragm oriented vertically
b) Slowly increase the inlet pressure to the regulator up to maximum inlet pressure
c) Pass the flow rate through the regulator equal to maximum regulator capacity
d) The outlet piping of the regulator shall be connected to a mechanism that will open and close the outlet piping to the atmosphere to vary flow rate between zero and maximum. This mechanism will establish an open/close cycling of the regulator valve
A cycling rate of 20 to 30 cycles per minute shall be used. The number of cycles shall be accurately determined by means of a counter
e) After each 25,000 cycles of operation, the regulator shall be checked for set pressure and lock-up the set pressures shall be within ±1.0in.w.c. (0.25kpa)(2.5mbar) of the original set point
f) The lock-up pressure shall not be greater than 3.0 inches W .C. (0.75kpa) (7.5mbar) above the set point.

9.4. Ambient temperature test

a) Regulator shall be kept in 55 °c environment for app. 12 hours.
b) Apply 1bar inlet pressure
c) Regulator shall operate without objectionable noise, malfunction, pulsation or chattering
d) At this temperature, carry out performance tests. The regulator shall be met related requirements.
e) Repeat above test at -25 °c temperature.

9.5. Shell Pressure Test

a) The diaphragm casing, which during normal operation contains the outlet pressure, shall be subjected to a minimum pressure of 10psig (68.9kpa) (689mbar) for 5 minutes. The casing shall contain the pressure without deformation or rupture.
b) Valve body pressure rating test, by closing the ports of regulator valve body sample while applying 12 bar (175 PSIG) hydrostatic pressure via inlet/outlet port for 2 hours, it shall with stand the pressure.no leakage failure or cracks shall be witnessed.

9.6. Twist test

Inlet and outlet connection must be withstood against twist test acc.to ANSI B16.33 section 3.4.2.

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9.7. Threaded adjusting screws and caps
Threaded adjusting screws and caps shall be resistance against 100 times full opening and closing at their positions without any defect.

9.8. Marking test

9.8.1. All labels shall remain securely fixed, in that their edges shall not lift from the backing surfaces.

9.8.2. Adhesive type marking materials shall exhibit:
9.8.2.1. Good adhesion and no curling at edges.
9.8.2.2. No illegible or defaced printing when rubbed with thumb or finger pressure.
9.8.2.3. Good adhesion when a dull metal blade (as the back of a pocketknife blade) is held at 90 degrees (1.57 rad) to the applied marking and scraped across the edges of the marking.

9.8.3. No adhesive type marking materials shall exhibit no illegible or defaced printing when rubbed with thumb or finger pressure.

9.8.4. The marking materials shall then be placed in an oven for a period of 2 weeks with the oven temperature maintained at +55°c. Following the oven test, adhesion and legibility of the samples shall be checked again as specified in 9.8.2 or 9.8.3 above samples shall then be immersed in water for a period of 24 h hours. After which adhesion and legibility shall be rechecked as specified in 9.8.2 or 9.8.3 above.

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9.9. Paint test

9.9.1. The color of paint shall be grey according to clause 6.3.

9.9.2. The thickness of paint shall be measured at five points on each diaphragm regulator casing. None of each individual point must be less than 60 microns.

9.9.3. Paint adhesion shall be carried out accordance to ISO 2409. The results must be better than or equal to classification 2

9.10. Visual inspection
Color, threads, seal of adjusting screw cap, markings, and regulator parts and assembling of the regulator shall be checked visually. No loose, detachment and defects must be observed.

9.11. Inlet, outlet and vent opening
Inlet, outlet and vent opening of the regulator shall be checked by using standard master plug gauges (Go-Nogo gauges) to identify conformity of size, hand-tight and wrench-tight threaded of them.

9.12. Nonmetallic parts test

9.12.1. Diaphragm

a) The thickness of diaphragm shall be measured at ten points of the same sections.

b) Calculate the average of above measured value.

c) Variation of diaphragm thickness on the same sections shall be ±10% 0f mean value.

d) Marking of diaphragm shall be tested according to clause 9.6

9.12.2. Diaphragm and other elastomeric

Elastomers shall conform to EN 13787 or EN 549.

9.13. Accelerated weathering test:

Samples of the regulator case or other specific external parts of the regulator that are to be tested shall be prepared and protected using exactly the same methods and materials employed in manufacturing the regulators. Samples shall be exposed to the following weathering tests, with reference to ASTM D822, for 14 days. The exposure cycle shall consist of the periods of ultraviolet light radiation and fresh water. Spray shown in the following table.

There shall be no appreciable progressive corrosion, electrolytic action, appreciable discoloration or harmful reaction as a result of this 14-day test.

Exposure cycle

Portion of Exposure Cycle	Time Period
Direct ultraviolet radiation Light Only:	102 minutes
Fresh water spray Light and spray:	18 minutes
Total Length of Each Exposure Cycle	120 minutes

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9.14. Salt spray test:

9.14.1. Samples, as in Section 9.1.1, shall be mounted in the salt- spray chamber in their normal operating position. They shall be subjected to a 24-hour salt-spray test in accordance with ASTM Method B-117-73, "Salt Spray (Fog) testing." As a result of this test, there shall be no appreciable signs of blistering, corrosion or deterioration of the surface. The samples shall then be placed, without cleaning or washing, in a dry indoor location for a period of six months. At the end of that time, there shall be no appreciable signs of progressive corrosion or electrolytic action.

9.14.2. All parts of regulator made from corrosion resistance material or protected against corrosion shall be tested according to ASTM B117 for 500 hours and met related requirements.

10. Packing and packaging

10.1. All openings such as inlet, outlet and vent shall be plugged by plastic /suitable caps.

10.2. Each individual regulator shall be closed in a plastic bag.

10.3. Each plastic bag shall be housed in a cardboard box,

10.4. The cardboard boxes shall be housed in wooden/cartonplast cases of appropriate size and with provisions for lifting by fork as per the requirement of NIGC order.

11. Guarantee

The supplier shall replace any regulator that failed under normal usage during 5 years after shipment by new one. Unless otherwise shall be specified in data sheet.

12. Warranty

The supplier shall undertake the service, maintenance and recalibration regulator at least 10 years.

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12. Appendices

12.1. Appendix "A": Table of connections, capacities and flow rate for setting

item	Regulator max. capacity (m3/h)	regulator inlet/out diameter (inch)	flow rate for adjustment of setting of regulator outlet pressure (m3/h)
1	4	¾ x ¾	1.5
2	6	¾ x 1	
3	10		
4	16		
5	25		
6	40	1 ½ x 1 ½	6
7	65		
8	100		
9	160		

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12.2. APPENDIX " B": Checklist of type tests:

Item	Tests	Clouse
1	Load Test	9.2.1
2	Leakage test	9.2.2
3	Set Point	9.2.3.1
4	Hysteresis	9.2.3.2
5	Lock-up	9.2.4
6	Flow Capacity	9.2.5
7	Performance curve	9.2.6
8	Relief Set Point	9.2.7.1
9	Relief-Valve Performance	9,7.2
10	proof the shut off	9.2.8
11	Over pressure shut off test	9.2.9
12	Under pressure shut off test	9.2.10
13	Endurance Test	9.3
14	Ambient temperature test	9.4
15	shell Pressure Test	9.5
16	twist test	9.6
17	Threaded adjusting screws and caps	9.7
18	marking test	9.8
19	paint test	9.9
20	visual inspection	9.10
21	Inlet, outlet and vent opening	9.11
22	diaphragm	9.11.1
23	diaphragm and other elastomeric	EN 13787 or EN 549
24	Accelerated weathering test	9.12
25	Salt spray test	9.13
26	Materials	5

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12.2. APPENDIX " C": Checklist of factory tests:

Item	Tests	Clouse
1	Load Test	9.2.1
2	Leakage test	9.2.2
3	Set Point	9.2.3.1
4	Hysteresis	9.2.3.2
5	Lock-up	9.2.4
6	Flow Capacity	9.2.5
7	Performance curve	9.2.6
8	Relief Set Point	9.2.7.1
9	Relief Valve Performance	9,7.2
10	proof the shut off	9.2.8
11	Over pressure shut off test	9.2.9
12	Under pressure shut off test	9.2.10
13	Endurance Test	9.3
14	shell Pressure Test	9.5
15	twist test	9.6
16	Threaded adjusting screws and caps	9.7
17	marking test	9.8
18	paint test	9.9
19	visual inspection	9.10

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12.3. APPENDIX " D": Checklist of sample tests:

Item	Tests	Clouse
1	Set Point	9.2.3.1
2	Lock-up	9.2.4
3	Flow Capacity	9.2.5
4	Relief Set Point	9.2.7.1
5	proof the shut off	9.2.8
6	Over pressure shut off test	9.2.9
7	Under pressure shut off test	9.2.10
8	shell Pressure Test	9.5
9	twist test	9.6
10	Threaded adjusting screws and caps	9.7
11	marking test	9.8
12	paint test	9.9
13	visual inspection	9.10
14	Inlet, outlet and vent opening	9.11
15	packaging control	10

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12.3. APPENDIX " E": DATA SHEET

DATA		REQUIRED BY NIGC	TO BE FILLED BY SUPPLIER
	GAS INLET PRESSURE	1-4 BAR (15-60 PSIG)	-
SERVICE & DESIGN	SET POINT OF REGULATOR	17.5±0.7 MBAR (7±0.3 IN.W.C)	-
	OUTLET PRESSURE AT MAX CAPACITY AND MININLET PRESSURE 1.03 BAR (15 PSIG)	MIN.15 MBAR (MIN.6 IN.W.C.)	-
	MAX LOCK-UP PRESSURE WITH INLET PRESSURE 4 BAR (60 PSIG)	23.7 MBAR (9.5 IN.W.C)	-
	LOW PRESSURE SHUT OFF DEVICE (L.P.S.O) SETTING	8.7±1.2 MBAR (3.5±0.5 IN.W.C)	-
	HIGH PRESSURE SHUT OFF DEVICE (H.P.S.O) SETTING	42.3±2.5 MBAR (17±1 IN.W.C)	-
	INTERNAL RELIEF VALVE (I.R.V) SETTING	62.3±7.5 MBAR (25±3 IN.W.C)	-
	INLET/OUTLET SIZE AND THREAD STD.OF CONNECTION	ACC.TO APP. A	-
	AMBIENT TEMPERATURE RANGE	-25 TO 55 DEG.C.	-
	STD FOR MATERIAL OF BODY/DIAPHRAGM CASING /ORIFICE/DIAPHRAGM & SEATS / SCREWS / NUT & BOLTS AND ETC.	ACC. TO MATERIAL SECTION (CLAUSE 5)	-
	GUARANTEE	60 MONTHS ACC. TO. CLAUSE 11	-
	MANUFACTURER SIGNATURE AND STAMP		

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