IGS-M-IN-204(0)	Oct 2023
Approved	مصوب

شرکت ملی گاز ایران

مدیریت پژوهش و فنآوری

امورتدوین استانداردها

IGS

مشخصات فنی خرید

رگولاتور گاز طبیعی (نوع دو مرحله ای)

Natural gas pressure regulator(Double stage type)

دفتر مدیرعامل

شرکت ملی گازایران

تاریخ : ۱۴۰۲/۰۹/۰۶

شماره گ۰/دب۰/۳۴۶-۲۱۶۵۴

ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۲۰۳۳ مورخ ۱۴۰۲/۰۸/۱۴ هیات مدیره، نامه شماره گ۹/۱۴۱۶۰۴/۰۰۰ مورخ ۱۴۰۲/۰۸/۱۳ آن مدیریت درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱- مشخصات فنی خرید رگولاتور گاز طبیعی (نوع دو مرحله ای)

IGS-M-IN-204(0)

سیدمحمد پیشوایی

دبیر هیات مدیره

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

اعضای محترم 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.

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

1. SCOPE

This standard specifies the minimum design, material, marking safety and packing construction, and performance requirements and testing for double stage pressure regulators and safety devices used for residential and commercial natural gas customers, hereafter referred to as “Regulators”. This standard is applicable to regulators with inlet pressures above 1 bar up to and including 4 bar.

These regulators are used to control the gas delivery pressures in two categories:

-Maximum out let pressure is:25.4mbar

-Maximum out let pressure is:172 mbar

This regulator shall be installed at the entrance of the meter and serve a meter, in such a way that the outlet of the meter is only connected to a domestic or commercial consumer.

2. REFERENCE

Throughout this standard the following dated and undated standards/codes are referred to. These referenced documents shall be, to the extent specified herein, from a part of this standard. For dated references, the edition cited applies. For undated references, the latest edition of the referenced documents applies.

2.1. EN 13611:2019, Safety and control devices for burners and appliances burning gaseous and/or liquid fuels-general requirements

2.2. EN 549:2019, Rubber materials for seals and diaphragms for gas appliances and gas equipment

2.3. EN 682:2022, Elastomeric seals - Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids

2.4. BS EN 88-2:2022, Safety and control devices for gas burners and gas burning appliances.

2.5.IGS-M-IN-201: Gas Pressure Regulator, Domestic.

3.Definitions

3.1. Pressure regulator

Device which maintains the outlet pressure constant independent of the variations in inlet pressure and/or flow rate within defined limits

3.2. Double stage regulator

A pressure regulator that reduces the inlet pressure to outlet set pressure in two stages in one integrated unit.

3.3. Control member

Movable part of the pressure regulator which varies flow rate and/or outlet pressure directly

3.4. Safety shut-off device (SSD)

Device having the function of staying in the open position under normal operating conditions and to shut off the gas flow automatically and completely when the monitored pressure deviates above or below the pre-set value.

3.5. Closure member

Movable part of the regulator which shuts off the gas flow.

3.6. Housing

Part of the pressure regulator and/or SSD that is the main pressure containing envelope.

3.7. Controller

Device which normally includes a setting element, normally a spring, to obtain a set value of the outlet pressure, and a pressure detector element, normally a diaphragm for the outlet pressure.

3.8. Actuator

Device or mechanism which changes the signal from the controller into a corresponding movement controlling the position of the control member.

3.9. Working diaphragm

Flexible member which, under the influence of the forces arising from loading and pressure, operates the control member.

Note 1 to entry: Diaphragms used as a control member are not covered by this definition.

3.10. Pressure containing part

Part where failure would result in release of gas to the atmosphere

Note 1 to entry: Such parts comprise housings, inner partition walls, control member, bonnets, the housing of the actuator, blind flanges and pipes for process and sensing lines.

3.11. Signal connection

Connection that is used to convey pressure from part of an installation to the signal chamber.

3.12. Breather line

Line between the controller and atmosphere which equalizes the pressure on a detector element when it changes its position.

3.13. Fixture

Functional device connected to the main components of the pressure regulator or SSD.

3.14. Exhaust line

Line to atmosphere between the pressure regulator or fixtures for the safe venting of gas in the event of a working diaphragm failure.

3.15. Trip mechanism

Mechanism that releases the closure member when activated by the controller.

3.16. SSD-actuator

Device that is activated by the trip mechanism which shuts the closure member.

3.17. Re latching device

Device that enables the complete opening of an SSD.

3.18. Motorization chamber

Chamber at the higher pressure of two chambers under pressure within the housing of actuator.

3.19. Monitored pressure

Pressure monitored and safeguarded by the SSD.

3.20. Trip pressure

Pressure value at which the closing member starts to move.

3.21. Upper trip pressure (p2o)

Upper limit of the monitored over-pressure.

3.22. Lower trip pressure (p2u)

Lower limit of the monitored under-pressure.

3.23. Outlet setting pressure (p2s)

Outlet pressure at which the pressure regulator is set for test purposes.

3.24. Maximum outlet pressure (p2max)

Upper limit of the outlet pressure, as stated in the instructions, at which the pressure regulator can be operated.

3.25. Minimum outlet pressure (p2min)

Lower limit of the outlet pressure, as stated in the instructions, at which the pressure regulator can be operated.

3.26. Outlet pressure range

Difference between maximum and minimum values of the outlet pressure, as stated in the instructions.

3.27. Maximum inlet pressure (p1max)

Highest inlet pressure, as stated in the instructions, at which the pressure regulator can be operated.

Note 1 to entry: The definition of “maximum inlet pressure” is also known as “maximum allowable pressure PS”.

Note 2 to entry: In accordance with the strength requirements of this document.

3.28. Minimum inlet pressure (p1min)

Lowest inlet pressure, as stated in the instructions, at which the pressure regulator can be operated.

3.29. Inlet pressure range

Difference between the maximum and minimum values of the inlet pressure, as stated in the instructions.

3.30. Maximum rated flow rate (q_{max})

Upper limit of the rated air flow rate, corrected to standard conditions, as stated in the instructions.

3.31. Minimum rated flow rate (q_{min})

Lower limit of the rated air flow rate, corrected to standard conditions, as stated in the instructions.

3.32. Steady state value

Outlet pressure measured after step response remains constant.

3.33. Settling tolerance

Maximum difference between the current outlet pressure and its steady state value.

3.34. Performance curve

Graphic representation of the outlet pressure as a function of the rated flow rate.

Note 1 to entry: This curve is determined by increasing and then decreasing the rated flow rate with constant inlet pressure and constant outlet setting pressure (see Figure BB.1 EN88.2).

3.35. Family of performance curves

Set of the performance curves for each value of inlet pressure determined for a given outlet setting pressure.

Note 1 to entry: See Figure BB.2 EN88.2.

3.36. Accuracy

Percentage of the outlet pressure relative to the outlet setting pressure within the operation range.

3.37. Accuracy class (AC)

Maximum permissible value of the accuracy.

3.38. Lock-up time (tf)

Time taken for the control member to move from an open position to the closed position.

3.39. Lock-up pressure (p2f)

Outlet pressure at which a pressure regulator closes when the outlet of the pressure regulator is sealed.

3.40. Lock-up pressure class (SG)

Maximum permissible positive difference between the actual lock-up pressure(s) p2f and the corresponding outlet setting pressure(s) at a certain percentage of the maximum rated flow rate q_{max}, expressed as a percentage of the outlet setting pressure.

Note 1 to entry: The lock-pressure pressure class SG is given by the following equation:

$SG = 100. [(p2f - p2s) / p2s]$

where

SG is the lock-up pressure class;

p2f is the lock-up pressure; and

p2s is the outlet setting pressure.

3.41. Limit pressure (pl)

Pressure at which yielding becomes apparent in any component of the pressure regulator or its fixtures.

3.42. Safety factor (Sb, S)

Ratio of the value of the limit pressure pl to the value of the maximum allowable pressure PS.

Note 1 to entry: This term applies to two separate discrete regions of the pressure regulator:

- applied to the pressure regulator housing: Sb;
- applied to the other pressure containing parts of the pressure regulator: S.

3.43. Creep relief device (CRD)

Small spring-loaded valve in the actuator of a direct acting pressure regulator which opens automatically if the controlled pressure is higher than the lock-up pressure (including tolerance).

3.44. Opening pressure [creep relief device]

Pressure at which the first internal leak occurs.

3.45. Closing pressure [creep relief device]

Pressure at which the creep relief device is leak tight after re-seating.

4.General Requirements

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

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

4.3. Standard condition is 1.013 bar and 15. 6°C.

4.4. Set point of regulator shall be according to data sheet (appendix A) as following:

4.4.1. 19 mbar ±1 mbar for regulator with maximum capacity from 4 sm^3/h to 160 sm^3/h.

4.4.2. 138 mbar ±2 mbar for regulator with maximum capacity up to 160 sm^3/h.

4.5. Normal outlet pressure range (with respect to regulator set point) shall be as following:

4.5.1. For regulator with 19 mbar set point: from 16 mbar to 22 mbar and the outlet pressure of regulator shall not rise or less more than 10 percent of set point with flow variation between q_{min} and q_{max} and pressure variation between 1 bar to 4 bar.

4.5.2. For regulator with 138 mbar set point: from 129 mbar to 147 mbar and the outlet pressure of regulator shall not rise or less more than 5 percent of set point with flow variation between q_{min} and q_{max} and pressure variation between 1 bar to 4 bar.

4.6. The regulator shall be equipped with under pressure shut off device (u.p.s.o), over pressure shut off device (o.p.s.o)و creep relief device (c.r.d) or (Relief valve (r.v)) and Blocking device due to excess flow (Excess flow valve (e.f.v)). These four safety devices and the regulator shall be integrated and comprise one unit.

4.7. When it is stated that a regulator with integrated safety shut-off device has the ability to lock-up, the trip pressure deviation shall be as following:

4.7.1. For regulator with 19 mbar set point: more than 10% of set point. This means the accuracy groups for over- and under-pressure shut-off devices are AC 10.

4.7.2. For regulator with 138 mbar set point: more than 5% of set point. This means the accuracy groups for over- and under-pressure shut-off devices are AC 5.

4.7.3. Such regulator shall be tested in accordance with the test method described in safety devices test and the mean set value calculated from the six actual values shall correspond to the specified accuracy group.

4.8. Over-pressure SSD shall close when the pressure reaches the pre-set trip pressure.

4.9. Over pressure shut off (o.p.s.o) device shall be adjustable.

4.10. Over pressure shut off (o.p.s.o) shall be set as following:

4.10.1. For regulator with 19 mbar set point: less than 40 mbar.

4.10.2. For regulator with 138 mbar set point: less than 200 mbar.

4.11. The shutting-off of the gas flow shall be automatic and shall not be interruptible until the closure member has reached the closed position.

4.12. When over pressure device tested in accordance with safety devices test, the response time t shall be < 2 s.

4.13. Re-set of over pressure device shall only be possible by manual means.

4.14. The under-pressure SSD shall close when the pressure reaches the lower trip pressure. for under-pressure shut-off devices the tolerance shall be ≤ 100 Pa.

4.15. Under pressure shut off (u.p.s.o) shall be adjustable.

4.16. Under pressure shut off (u.p.s.o) device shall be set as following:

4.16.1. For regulator with 19 mbar set point: more than 8 mbar.

4.16.2. For regulator with 138 mbar set point: more than 85 mbar.

4.17. Under-pressure devices shall be manually reset.

4.18. A creep relief device shall be built into a regulator to vent the gas to the atmosphere when the controlled pressure is higher than the lock-up pressure of the regulator with a limited capacity, and is an integral part of the regulator. Creep relief devices shall not be built in a control member of a safety shut-off device.

4.19. The connection for the CRD exhaust line shall be at least DN 10.

4.20. Relief valve (c.r.d) shall be adjustable.

4.21. Relief valve (c.r.d) device shall be set as following:

4.21.1. For regulator with 19 mbar set point: 30 mbar± 2mbar.

4.21.2. For regulator with 138 mbar set point: 160 mbar ± 10 mbar.

4.22. Excess flow valve (e.f.v) shall be interrupted the flowing flow through the regulator automatically when the flow rate exceeds between 110% q_{max} and 120% of q_{max}.

4.23. The reset of the Excess flow valve (e.f.v) shall be manually.

4.24. Regulator shall be reduced the inlet pressure to multiple of 100 mbar (e.g., 300 mbar) in first chamber and after that reduce to outlet set pressure (e.g., 18 mbar) in second chamber).

4.25. All parts of regulator shall withstand the mechanical and thermal stresses to which it is subjected without any deformation affecting safety.

4.26. Failures in any function shall not affect safe operation of the control function.

4.27. Regulator shall be free from sharp edges and corners which could cause damage, injury or incorrect operation.

4.28. Holes for screws, pins, etc., used for the assembly of parts of the regulator, shall not penetrate gas circuits. The wall thickness between these holes and gas circuits shall be at least 1 mm. Holes necessary for manufacture which connect gas circuits to atmosphere but which do not affect the operation of the regulator shall be permanently sealed by metallic means.

4.29. Breather holes shall be protected against blockage or they shall be located such that they do not easily become blocked. They shall be positioned in such a way that the diaphragm cannot be damaged by a sharp device inserted through the breather hole.

4.30. Screwed fastenings which can be removed for service or adjustment shall have metric threads that conform to ISO 262:1998 unless a different thread is essential for the correct operation or adjustment of the regulator.

Self-tapping screws which cut a thread and produce swarf that can fall into the gas carrying compartment shall not be used.

4.31. Jointing compounds for permanent assemblies shall provide a leak-tight connection under specified operating conditions.

Non-hardening jointing compounds for metallic threaded joints in contact with gas shall conform to EN 751-2:1996, class A for temperatures between –25 °C and 55 °C and pressures up to 5 bar. Soldering or other processes where the jointing material has a melting point below 450 °C after application shall not be used for connecting gas-carrying parts except for additional sealing.

4.32. The operation of moving parts (e.g., diaphragms, bellows) shall not be impaired by other parts. There shall be no exposed moving parts which could adversely affect the operation of regulator.

4.33. Sealing caps shall be capable of being removed and replaced with commonly available tools and sealed (e.g., by lacquer). A sealing cap shall not hinder adjustment within the whole range as stated in the instructions.

4.34. Parts which need to be dismantled for service or adjustment shall be capable of being dismantled and reassembled using commonly available tools. They shall be constructed or designated in such a way that incorrect assembly is impossible when following the instructions.

Parts which can be dismantled for service or adjustment shall be constructed such that leak-tightness is achieved by mechanical means (e.g., metal to-metal joints or O-rings) without using jointing compounds such as liquids, pastes or tapes.

4.35. A regulator shall only be adjustable by use of a tool. The means of adjustment shall be easily accessible and shall not change of its own accord. Interference with the means of adjustment other than stated in the instructions shall be visible by using a sealing according to IGS-M-IN-308.

4.36. Parts transmitting actuating forces shall be metallic and designed with a safety factor of ≥ 3 against permanent deformation according to table 1.

4.37. The adjustments (e.g., outlet pressure) shall be readily accessible to authorized personal, but there shall be provision for sealing after adjustment. Means shall be provided to discourage interference by unauthorized personal.

4.38. An integral safety shut-off device shall be functionally independent from the pressure regulator.

This requirement is met if the function of the safety shut-off device is not affected in the event of failure and/or loss of functionality of one or more of the following pressure regulator components.

- control member;
- seat ring;
- actuator;
- casing of actuator;
- controller.

If the pressure regulator incorporates more than one safety device the functional independence shall be met by each device.

4.39. Parts of the pressure regulator that are subjected to inlet pressure under normal operating conditions, or could be subjected to inlet pressure in the event of a failure, shall resist a pressure equal to the maximum allowable pressure PS multiplied by the safety factor f according to table 1.

If safety factor f not otherwise defined by harmonized design standards, a safety factor $f = 4$ shall be considered.

Table 1 — Minimum values of the safety factor ***f***

Group of materials	Minimum value of the safety factor f	
		For parts of the body stressed by forces from torque and bending moments (pipelines)only
Rolled and forged steel	1.7	2.13
Cast steel	2.00	2.50
Spheroidal graphite cast iron and malleable cast iron	2.50	3.13
Copper-zinc wrought alloys and aluminum alloys	2.00	2.50
Copper-tin cast alloys and copper-zinc cast alloys	2.50	3.13
Aluminum alloys	2,00	2,50
Aluminum cast alloys Amin 4 %	2,50	3,13
Aluminum cast alloys Amin 1,5 %	3,20	4,00
A = percentage elongation after fracture (according to the applicable document relevant to the chosen material).		

4.40. Regulator shall operate correctly under all combinations of the following:

- the full range of inlet pressures from1bar to 4bar;
- the ambient temperature ranges from -25 °C to 55 °C or wider limits, if stated in the instructions;
- in all mounting positions as stated in the instructions.

4.41. Regulator shall be leak tight.

4.42. Housing of regulator must be without external leakage after removal or fracture of non-metallic parts other than O-rings, gaskets and sealing parts of diaphragms, at the maximum inlet pressure, when tested according to leak test.

4.43. Inlet/outlet connection size and maximum capacity 0f regulator shall be according to table 2.

Table 2 — Inlet/outlet connection size

max. capacity (m3/h)	Inlet/outlet connection size	
	Inch	DN
4	3/4*3/4	20*20
6	3/4*1	20*25
10	3/4*1	20*25
16	3/4*1	20*25
25	3/4*1	20*25
40	3/4*1.5	20*40
65	3/4*1.5	20*40
100	3/4*1.5	20*40
160	3/4*1.5	20*40

4.44. The inlet and outlet connections of regulator shall be in-line. otherwise, is specified in data sheet.

4.45. It shall be possible to make connections using commonly available tools, e.g., by the provision of suitable spanner flats.

4.46. Inlet and outlet connections shall be N.P.T female threaded according to ANSI B 1.20.1. or female threaded according to ISO 228/1:2003, that is specified in data sheet.

Where connections are made with union joints, union nut shall be female threaded according to ISO 228-1:2003.

4.47. Regulator shall be constructed in such a way that they have adequate strength to withstand likely mechanical stress to which they can be subjected during installation and service. after Torsion and bending moments tests, there shall be no permanent deformation and any leakage.

4.48. Regulator shall withstand the torque and bending moments tests.

4.49. The performance of each function of regulator and integral safety shut-off device shall be considered separately.

4.50. Over the full range of inlet pressure from p1min to p1max at any rated flow rate q within the rated flow rate range from q_{min} (The stated minimum rated flow rate q_{min} shall be less than 10 % of q_{max}) to q_{max}, as stated in the instructions, the outlet pressure variation from the outlet setting pressure p2s shall be as following:

4.50.1. For regulator with 19 mbar set point: not exceed from 10% of set point. This means the Accuracy class of regulator is AC10.

4.50.2. For regulator with 138 mbar set point: not exceed from 5% of set point. This means the Accuracy class of regulator is AC5.

4.51. Lock-up pressure of regulator shall not be more than the following value:

4.51. 1. For regulator with 19 mbar set point: 24 mbar and lock-up pressure class shall be SG20.

4.51.2. For regulator with 138 mbar set point: 147 mbar and lock-up pressure class shall be SG10.

4.52. The internal leak-tightness, pressure accuracy, and response time of safety devices shall remain within the initial limits specified respectively, without further adjustment of the trip pressure after Endurance of safety device test.

5.Materials

5.1. The quality of materials, the dimensions used and the method of assembling the various parts shall be such that construction and performance characteristics are safe. Performance characteristics shall not alter significantly during a reasonable lifetime when used as stated in the instructions.

5.2. Elastomers in contact with gas (e.g., valve pads, O-rings, diaphragms and lip seals) shall conform to those requirements given in EN 549.

5.3. Springs with wire diameter up to and including 2.5 mm shall be made from corrosion-resistant materials.

Springs with wire diameter above 2.5 mm shall either be made from corrosion-resistant materials or shall be protected against corrosion.

5.4. All parts in contact with gas or atmosphere and springs shall either be made from corrosion-resistant materials or shall be suitably protected. The corrosion protection for springs and other moving parts shall not be impaired by any movement.

5.5. Parts of the housing which directly or indirectly separate a gas-carrying compartment from atmosphere shall be made from metallic materials that have a melting point (solidus temperature) of at least 427 °C. (According to EN13611).

5.6. Closure members shall conform to table 3.

Table 3 — Materials

Material Group	Properties	PS_{max} bar
	A_{min} (%)	
Aluminum wrought alloys	4	20
Aluminum cast alloys	1.5	10
	4	20
A = percentage elongation after fracture (according to the applicable document relevant to the chosen material).		

5.7. Seals for moving parts which pass through the body to atmosphere shall be made only of solid, mechanically stable material of a type which does not deform permanently.

Sealing paste shall not be used. Manually adjustable packing glands shall not be used for sealing moving parts. (Acc. to IGS-M-IN-308).

5.8. All metallic parts of regulator shall be resistance to salt spray according to ASTM B117For 500 hr.

6.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. They shall neither lift nor discolor such that the marking becomes illegible according to marking test requirements.

6.1. The following information, at least, shall be durably marked on the pressure regulator in a clearly visible position:

a) Manufacturer and/or his identification symbol

b) P_{IN} range

P_{OUT} range

c) Direction of gas flow (e.g., by cast or embossed arrow).

d) Date of manufacture (at least the year)

e) Vent connection.

f) Set range for upper trip pressure

g) Set range for lower trip pressure

h) Set range for Relief valve

6.1.2. Regulator type or model

6.1.3. Serial no.

6.1.4. Regulator capacity in scm/h

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

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

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

6.4.1. The manufacturer name or trade mark.

6.4.2. Batch number.

6.5. NIGC indication embossed on the valve body.

7.Documentations

Manufacturer shall provide and present following documents:

7.1. Original technical catalog(s)

7.2. Full Parts list

7.3. General drawing(s) showing outline dimensions

7.4. Data sheet

Data sheet shall include all relevant information on the use, installation, operating and servicing, in particular:

a) Pressure regulator accuracy class (AC),

b) Lock-up pressure class (SG);

c) Type of gas(es) for which the pressure regulator is suitable;

d) Maximum inlet pressure in Pa or kPa;

e) Maximum allowable pressure (PS) in Pa or kPa, if different from the maximum inlet pressure;

f) Ambient temperature ranges in °C;

g) Mounting position(s);

h) Gas connection(s);

i) Notice for installer to consider e.g. conditions for up-stream pressure (overpressure at the inlet in case of failure of upstream components), dirt, corrosion products;

j) Inlet pressure range in Pa or kPa;

k) Outlet pressure range in Pa or kPa;

l) Rated flow rate in m3/h (and rated flow rate range); alternatively, performance limits can be given in a curve;

m) Instructions for changing components that may be replaced to cover the whole outlet pressure range, i.e., orifices or springs;

n) In particular, instructions for the installation and operation of any integrated safety devices;

o) If fitted with a vent connection, the instructions shall state that the breather line shall be vented to a safe place.

p) Accuracy group (AG) for the SSD;

q) Function of the SSD: adjusting and operation of the SSD;

r) Manual opening of the SSD and – if applicable – manual closing of the SSD;

s) Information on life time for safe function (designed lifetime).

7.5. Material test certificate of each part.

7.6. Type test certificate.

7.7. Manufacture test reports.

7.8. Factory test document.

8.Inspection and Tests

The regulator and safety device(s) shall be tested in its (their) normal operating position(s). The generality tests are in accordance with EN 88-2-2022.

8.1. regulator performance test

The tests shall be performed on a test rig built as specified in Figure 1.

The nominal diameter of the pipework connecting the regulator inlet and the flow rate regulating valves with the regulator shall not be smaller than the nominal diameter of the regulator and so chosen as to ensure that in all operating conditions of the tests the velocity of the gas does not exceed 50 m/s.

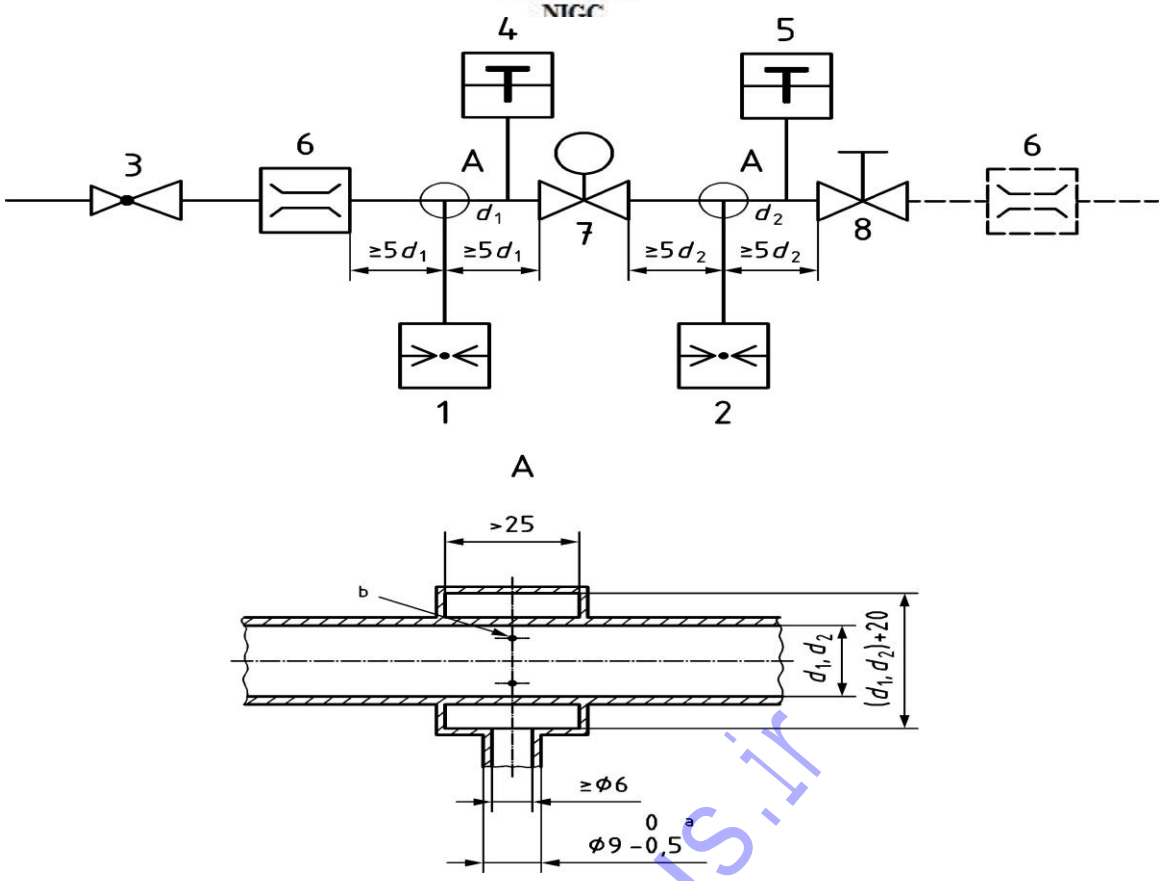


Figure 1 — Performance test apparatus

1 inlet pressure gauge p_1
2 outlet pressure gauge p_2
3 adjustable pressure regulator for inlet pressure
4 inlet temperature gauge
5 outlet temperature gauge
6 flow meter, positioned at inlet or outlet
7 pressure regulator under test
8 manual control taps for flow adjustment
9 [a] The connection possibility for an application is voluntary. The size of the outer diameter is given as an example and may vary. [b] 4 holes Ø 1,5 mm

Nominal size		Internal diameter d
Inch	DN	mm
3/4	20	22
1	25	28
1.5	40	41

The lock-up pressure tests shall always be performed on a test rig in which the downstream pipework has the minimum specified length; for these tests an additional downstream volume is not permitted. Pressure regulators shall be tested according to accuracy class and lock up pressure class. Tests shall be performed with air at ambient temperature. Steady-state conditions shall always be reached before readings are taken.

8.1.1. performance curve

a) Adjust the outlet pressure setting of the regulator. Set the outlet control tap to obtain a flow rate of 0.5 q_{max}. (or any other value which is appropriate).

For regulators, adjust the outlet pressure setting to the maximum value (p_{2max}),

the inlet pressure p_1 being the nominal pressure (or any other value) as stated in the instructions.

After the outlet pressure being set, there shall be no further adjustment of the regulator.

b) Vary the inlet pressure p_1 from the nominal pressure over the minimum (p_{1min}) to the maximum value (p_{1max}), as stated in the instructions, and back to p1min, and record the outlet pressure p_2 for, at least, 5 values of p_1 in each direction, without resetting the flow rate.

c) With inlet pressure p_{1min} kept constant, vary the flow rate from q_{max} to q_{min} and back by using the outlet control tap, the outlet pressure p_2 being recorded for, at least, 5 values of q in each case. Make sure, that there is no change of the inlet pressure during the whole time of this procedure.

d) Readjust the inlet pressure from p_{1min} to p_{1max}, as stated in the instructions, and then vary the flow rate from q_{max} to q_{min} (as in step c)).

e) For adjustable pressure regulators, repeat steps b) to d) after the outlet pressure setting has been readjusted according to step a) to the value p_{2min}.

- Plot the performance curves of a family in a semilog diagram with rated flow rates on the decimal scale of the abscissa and outlet pressure on the logarithmic scale of the ordinate;
- Ensure that q_{max} at p_{1min}, q_{max} at p_{1max}, q_{min} at p_{1min}, q_{min} at p_{1max}, AC and p_{2f} are as stated in the instructions.

8.1.2. Lock-up pressure class

When a regulator, has the ability to lock-up, an additional measurement at zero rated flow rate shall be taken for each pair of p1 and p2s values The lock-up pressure shall be determined together with tests performed to determine the performance curve of the outlet pressure. The time required to reduce the rated flow rate to zero shall not be less than the lock-up time of the pressure regulator.

The lock-up pressure p_{2f} shall be measured twice, 1 min and 2 min after the pressure regulator closure.

8.2. Endurance test

Position the regulator in a temperature-controlled chamber with an air supply at (20 ± 5) °C and at the maximum inlet pressure as stated in the instructions. The regulator is controlled as stated in the instructions to ensure that working diaphragm and safety diaphragm, if any, are fully flexed, the control member moves between fully open and fully closed position, and the control member is held on its seat for at least 5 s.

For the regulator, the test consists of 50 000 cycles.

Of the 50 000 cycles are:

a) 25 000 cycles with the pressure regulator environment at the maximum ambient temperature as stated in the instructions, but at least 60 °C;

b) 25 000 cycles with the pressure regulator environment at the minimum ambient temperature as stated in the instructions, but at most 0 °C.

After cycling, the regulator shall conform to the requirements of leak tightness and performance tests and remain within the initial limits without further adjustment of the outlet setting pressure of the regulator.

8.3. Safety devices test

8.3.1. Over-pressure safety shut-off devices

8.3.1.1. General

The test shall be performed in a test rig as shown in Figure 2 under the following operating conditions:

- The housing of the SSD is pressurized at inlet and outlet;
- The controller of the SSD is pressurized with a variable pressure representing the monitored pressure. The rate of the pressure change is kept constant;
-The whole unit is installed in a chamber with a controlled temperature for tests at limit temperatures.

The accuracy groups for over-pressure protection and under-pressure protection shall be determined separately.

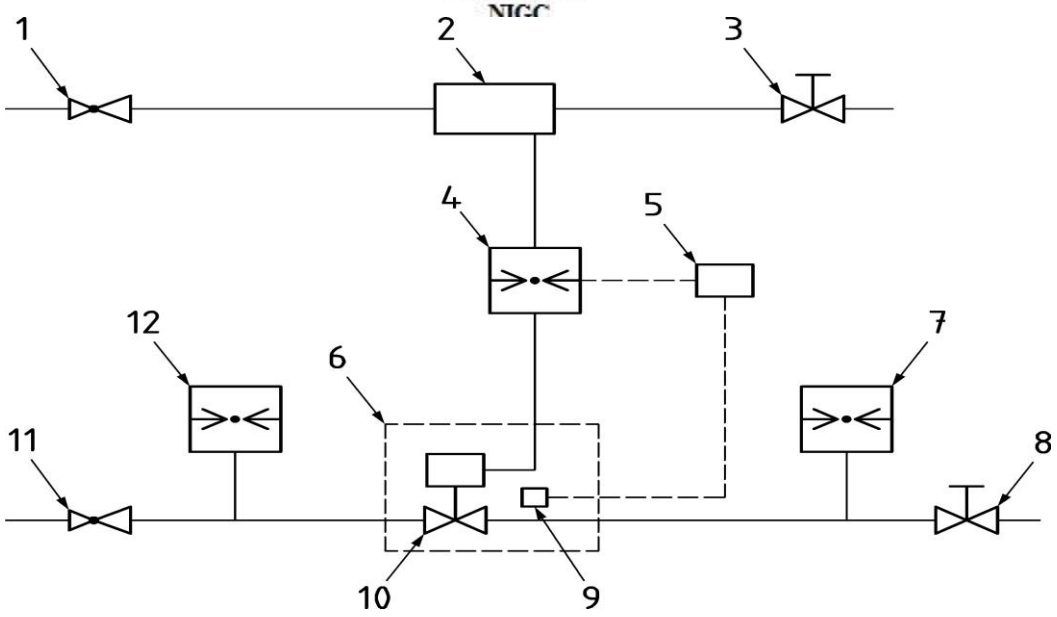


Figure 2 — Performance test apparatus for SSDs

Key

1 pressure regulator adjusts monitored pressure
2 pressure vessel
3 isolating or needle tap
4 pressure gauge
5 recorder
6 environmental cabinet
7 outlet pressure gauge
8 tap permits pressure release of the test line, testing for internal leakage and control of the flow rate
9 micro-switch or similar device
10 *SSD* under test (in the scheme including a vessel upstream inside the cabinet)
11 pressure regulator controlling the inlet pressure
12 inlet pressure gauge

8.3.1.2. Ambient temperature

- Maximum inlet pressure p_{1max}; and outlet pressure range:

a) Ensure that the housing is at atmospheric pressure;

b) Adjust the trip pressure to the lower limit of the set range;

c) With the SSD in the open position, starting from approximately 80 % of the selected trip pressure, increase the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;

d) Repeat test

c) Nine times; the set value is the arithmetic mean of the ten actual values;

e) Without further adjustment repeat the tests a) to d) with the housing pressurized to the

maximum inlet pressure (p1max);

f) The outlet setting pressure is the arithmetic mean of the two set values calculated in d) and e).

The test method for under-pressure protection is similar to that specified above. The starting pressure for this test shall be 120 % of the selected trip pressure.

8.3.1.3. limit temperatures

8.3.1.3.1. General

The tests shall be performed with dry test medium:

- At 0 °C or at the minimum ambient temperature, if lower; and
- At 60 °C or at the maximum ambient temperature, if higher;

As stated in the instructions.

There shall be no adjustment of the trip pressure between the test at ambient temperature and this test.

8.3.1.3.2. Test method

Pressurize the housing of the SSD in the open position and maintain the inlet pressure at 10 kPa or the maximum inlet pressure as stated in the instructions.

Adjust the temperature of the test chamber to the limit values.

8.3.1.3.3. Over-pressure protection

Starting from approximately 80 % of the selected trip pressure, increase the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs.

8.3.1.3.4. Verification of the upper limit of the highest set range

The test method is as follows:

a) Ensure that the housing is at atmospheric pressure;

b) Adjust the trip pressure to the upper limit of the highest set range;

c) Starting from approximately 80 % of the selected trip pressure, increase the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;

d) Repeat the test

c) Five times with the same pressure increasing rate as in c);

e) Calculate the arithmetic mean of the six measured values.

8.3.1.3.5. Response time

The response time for the upper trip pressure shall be determined at ambient temperature. The test starts with the closure member in the open position and with the SSD housing at the maximum inlet pressure.

If the response time is longer for lower inlet pressures the test shall also be performed at the minimum inlet pressure. The monitored pressure is set at approximately 50 % of the set value. The monitor pressure is raised so that the trip pressure plus the maximum value of deviation is reached within 0,2 s The response time shall be determined with an accuracy of < 0,1 s.

The response time shall be measured from when the monitored pressure reaches the highest limit value of the SG until the closure member has reached its closed position. The test shall comprise three consecutive operations and the response time is the arithmetic mean of the three measured values.

8.3.2 Under-pressure safety shut-off devices

8.3.2.1. Test

Conduct the test according to 8.3.1.1 and to 8.3.1.3.2

To verify under-pressure protection, start from approximately 120 % of the selected trip pressure, decrease the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs.

8.3.2.2. Verification of the lower limit of the highest set range

The test method is as follows:

a) Ensure that the housing is at atmospheric pressure;

b) Adjust the trip pressure to the upper limit of the highest set range;

c) Starting from approximately 120 % of the selected trip pressure decrease the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;

d) Repeat the test c) five times;

e) Calculate the arithmetic mean of the six measured values.

8.3.3. Blocking device due to excess flow

The test shall be performed in a test rig as shown in Figure 2.

a) Apply the minimum inlet pressure (p_{1min}) to the regulator.

b) Pass flow through the regulator from zero to q_{max}. Increase the flow rate gradually up to interrupt the flow by Excess flow vale activating and record this flow rate.

c) Repeat the test b) five times.

d) Calculate ratio of each of these values to q_{max}. All of them shall be 120%$q_{max.}$

e) Carry out test b) to d) by applying the maximum inlet pressure (p_{1max}) to the regulator.

8.3.4. Endurance of safety device test

Position the regulator with integrated shut-off device in a temperature-controlled chamber with an air supply at (20±5) °C and at the maximum inlet pressure as stated in the instructions. The regulator is controlled as stated in the instructions to ensure that working diaphragm and safety diaphragm, if any, are fully flexed, the control member moves between fully open and fully closed position, and the control member is held on its seat for at least 5s.

For safety shut-off devices, the test consists of 500 cycles, in each of which the device is activated. of the 500 cycles are:

a) 250 cycles with the safety shut-off environment at the maximum ambient temperature as stated in the instructions, but at least 60 °C;

b) 250 cycles with the safety shut-off environment at the minimum ambient temperature as stated in the instructions, but at most 0 °C.

After cycling, the safety shut-off device, the internal leak-tightness, pressure accuracy, and response time shall remain within the initial limits specified respectively.

8.4. hydrostatic pressure test

The hydrostatic pressure test is conducted after leakage and function tests. A pressure of f times the maximum allowable pressure (P_S) is applied to the control for a minimum of 5 min. After the test there shall be no visible damage.

8.5. Creep relief devices

The pressure regulator is adjusted to a medium outlet pressure and the set point of the creep relief device– if adjustable – is set also to a medium value within the range as stated in the instructions. The pressure regulator is pressurized on the inlet side with the maximum inlet pressure as stated in the instructions for these settings. The outlet connection is closed.

An additional pressure is applied to the outlet side and increased with the rate of change not greater than 1,5 % of the selected set pressure of the pressure regulator per second until

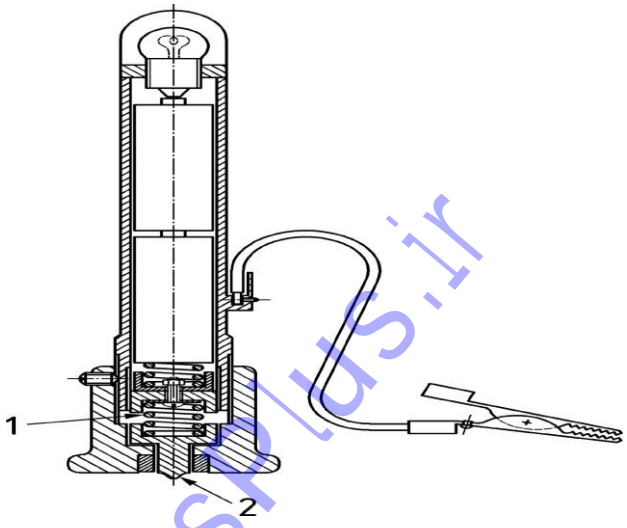
the first internal leak of the creep relief device is reached. The first appearance of leakage is considered as the opening pressure.

The outlet pressure is lowered until the creep relief device is closed and the internal sealing is verified.

The values of opening pressure and closing pressure are compared with the closing pressure including tolerance.

8.6. Scratch test

Draw a 1 mm diameter fixed steel ball across the surface of the gas control at a speed of 30 mm/s to 40 mm/s with a contact force of 10 N.



Key

1 spring loading = 10 N

2 scratching point (Ø 1 mm steel ball)

Repeat the scratch test after the humidity test.

8.7. Humidity test

Place the regulator in a chamber at an ambient temperature of (40 ± 2) °C with a relative humidity exceeding 95 % for 48 h. Remove the regulator from the chamber and examine it with the naked eye for signs of corrosion, lifting or blistering of the coated surface.

8.8. Leak Test

The external and internal leakage tests shall be carried out at the minimum temperature, at the maximum temperature and at (20 ± 5) °C.

8.8.1. Remove all non-metallic parts of the housing which separate a gas-carrying compartment from atmosphere, excluding O-rings, gaskets and sealing part of diaphragms. Any breather holes shall be blocked. Pressurize the inlet and outlet(s) of the regulator to the maximum inlet pressure and check the leakage.

8.8.2. For internal leakage of closure members carry out the tests with an initial test pressure of 0,6 k_{Pa} (6 mbar) then for both internal and external leakage repeat the tests at 1,5 times the maximum inlet pressure or 15 kPa (150 mbar), whichever is greater.

Use a method which gives reproducible results.

8.8.3. External leak-tightness

Pressurize the inlet and outlet(s) of the regulator to the test pressures of 1,5 times the maximum inlet pressure at inlet and outlet, and a pressure of 1,5 times the difference between the maximum inlet pressure and the maximum outlet pressure on the atmospheric side of the working diaphragm (including the safety diaphragm, if any) and check the leakage. dismantle and reassemble closure parts 5 times as stated in the instructions and repeat the test.

8.8.4. Internal leak-tightness

With any closure member in the closed position, pressurize the inlet of the pressure regulator in the direction of gas flow indicated, to two different pressures, 10 kpa and 1,5 times the maximum inlet pressure, and check the leakage.

The internal leakage test of the assembled SSD and its fixtures shall be performed with two different pressures, 10 kpa and 1,5 times the maximum inlet pressure, upstream of the closure member and at atmospheric pressure downstream of the closure member.

8.9. Torsion and bending moments test

Regulator shall withstand the torque and bending moments given in Table 4

Table 4 — Torque and bending moments

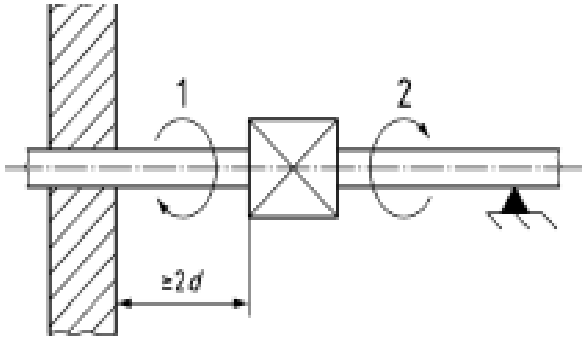
Nominal size		Torque Nm 10 s	Bending moment Nm 10 s
Inch	DN		
3/4	20	85	225
1	25	125	340
1.5	40	200	610

Use pipes in accordance with EN 10255:2004+A1:2007, medium series with a length of at least 40 × DN use only non-hardening sealing paste on connections.

If the inlet and outlet connections are not on a common axis, repeat the tests with the connections reversed.

If the inlet and outlet connections are not of the same nominal size, clamp the body of the regulator and apply the torque and bending moment appropriate to each connection in turn

Screw pipe 1 into the regulator with a torque not exceeding the values given in Table 4. Clamp pipe 1 at a distance at least 2d from the regulator



Key

d external diameter

Screw pipe 2 into the regulator with a torque not exceeding the values given in Table 4. Ensure that all joints are leak-tight.

Support pipe 2 such that no bending moment is applied to the regulator.

Progressively apply the appropriate torque to pipe 2 for 10 s without exceeding the values given in Table 4. Apply the last 10 % of the torque over a period not exceeding 1 min. After removal of the load, visually inspect the regulator for any deformation, then test the regulator for external leak-tightness and internal leak-tightness where applicable.

8.10. Marking test

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

8.10.2. Adhesive type marking materials shall exhibit:

8.10.2.1. Good adhesion and no curling at edges.

8.10.2.2. No illegible or defaced printing when rubbed with thumb or finger pressure.

8.10.2.3. 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.

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

8.10.4. 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 8.10.2 or 8.10.3 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 8.10.2 or 8.10.3 above.

8.11. Salt spray test:

All metallic parts of regulator shall be exposed to salt spray test according to ASTM B117 for 500 hr. The requirements of this standard shall be met.

8.12. Elastomer parts test:

Elastomer parts of regulator such as diaphragm, O-ring and so on shall be tested according to EN 549. All requirements of this standard shall be met.

9.Packing and Packaging

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

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

9.3. Each plastic bag shall be housed in a cardboard box.

9.4. 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.

10.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.

11. Warranty

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

12.Check list

12.1. Check list of factory tests:

item	Test	Clouse
1	Performance curve	8.1.1
2	Lock up pressure class	8.1.2
3	Blocking device due to excess flow	8.3.3
4	Hydrostatic pressure test	8.4
5	Set point	8.1.1.a
6	Verification of the upper limit of the highest set range	8.3.1.3.4
7	Verification of the lower limit of the highest set range	8.3.2.2
8	Leak Test	8.8

The generality tests are in accordance with EN 88-2-2022

12.2. Check list of type tests:

item	Test	Clouse
1	Performance curve	8.1.1
2	Lock up pressure class	8.1.2
3	Ambient temperature	8.3.1.2
4	Verification of the upper limit of the highest set rang	8.3.1.3.4
5	Response time	8.3.1.3.5
6	Verification of the lower limit of the highest set rang	8.3.2.2
7	Blocking device due to excess flow	8.3.3
8	Hydrostatic pressure test	8.4
9	Creep relief devices	8.5
10	Scratch test	8.6
11	Leak test	8.8
12	Torsion and bending moments test	8.9
13	Packing and packaging	9

The generality tests are in accordance with EN 88-2-2022

12.3. Check list of type tests:

item	Test	Clouse
1	Performance test	8.1
2	Performance curve	8.1.1
3	Lock up pressure class	8.1.2
4	Endurance test	8.2
5	Safety device test	8.3
6	Over pressure shut off test	8.3.1
7	Under pressure shut off test	8.3.2
8	Blocking device due to excess flow	8.3.3
9	Endurance of safety device	8.3.4
10	Hydrostatic pressure test	8.4
11	Creep relief devices	8.5
12	Scratch test	8.6
13	Humidity test	8.7
14	Leak test	8.8
15	Torsion and bending moments test	8.9
16	Marking test	8.10
17	Packing and packaging	9
18	Inlet & outlet connection	Clause 4.43 to 4.46
19	Ambient temperature test	8.3.1.2
20	Elastomer parts	8.12
21	Salt spray test	8.11

The generality tests are in accordance with EN 88-2-2022

13.Data Sheet(Informative)

DATA		Required by NIGC	To be filled by manufacture/ supplier
SERVICE & DESIGN	Gas inlet pressure	15 – 60 psi	
	Set point of regulator	19mbar ±1mbar 138mbar ±2mbar	□ □
	Outlet pressure	16 – 22 mbar 129 -147mbar	□ □
	Ambient temperature range	-25°c to + 55°c	
	Response time	≤ 2 Second	
	Accuracy class	%10 for 19 mbar (AC 10) %5 for 138 mbar(AC 5)	□ □
	Lock up pressure	24 mbar 147 mbar	□ □
Safety devices	Under pressure shut off setting	More than 8 mbar More than 85 mbar	□ □
	over pressure shut off setting	Less than 40 mbar Less than 200 mbar	□ □
	Relief setting	30 mbar ±2 mbar 160 mbar ±10 mbar	□ □
	Blocking device due to excess flow	110% to 120%	
	Inlet & outlet connection	Acc. to clause 4.43 to 4.46	
	Materials	Acc. to clause 5	
	Marking	Acc. to clause 6	
	Packing & packaging	Acc. to clause 9	
	Guaranty	5 years	

Manufacturer signature and stamp: