



DPC: 20/30401734 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 07 May 2020

Origin: European

Latest date for receipt of comments: 30 June 2020

Project No. 2019/02606

Responsible committee: GSE/22 Safety and control devices for gas and oil burners and gas burning appliances

Interested committees:

Title: Draft BS EN 88-2 Pressure regulators and associated safety devices for gas appliances. Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 30 June 2020

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

Responsible Committee Secretary: Ms Lachean Humphreys (BSI)
Direct tel:
E-mail: lachean.humphreys@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

Pressure regulators and associated safety devices for gas appliances - Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar

Dispositifs de sécurité et de contrôle pour les brûleurs à gaz et appareils utilisant des combustibles gazeux -
Partie 2 : Régulateurs de pression pour pressions amont comprises entre 50 kPa et 500 kPa et dispositifs de sécurité associés

Druckregler und zugehörige Sicherheitseinrichtungen für Gasgeräte - Teil 2: Druckregler für Eingangsdrücke über 50 kPa bis einschließlich 500 kPa und dazugehörige Sicherheitseinrichtungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 58.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword.....	5
Introduction	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	8
4 Classification.....	12
4.1 Classes of control.....	12
4.2 Groups of control.....	13
4.3 Classes of control function.....	13
4.4 Types of DC supplied controls	13
5 Test conditions and uncertainty of measurements.....	13
6 Design and construction.....	13
6.1 General.....	13
6.2 Mechanical parts of the control	13
6.2.1 Appearance.....	13
6.2.2 Holes	13
6.2.3 Breather holes.....	13
6.2.4 Screwed fastenings.....	13
6.2.5 Jointing.....	13
6.2.6 Moving parts	13
6.2.7 Sealing caps	13
6.2.8 Dismantling and reassembly	14
6.2.9 Auxiliary canals and orifices.....	14
6.2.10 Presetting device.....	14
6.2.101 External visual Indication of the position of the closure member.....	14
6.2.102 Parts transmitting actuating forces	14
6.2.103 Adjustments.....	14
6.2.104 Integral safety shut-off device.....	14
6.2.105 Resistance to pressure.....	15
6.2.106 Signal tube connections.....	15
6.2.107 Creep relief device.....	15
6.3 Materials.....	16
6.3.1 General material requirements.....	16
6.3.2 Housing.....	16
6.3.3 Zinc alloys	16
6.3.4 Springs	16
6.3.5 Resistance to corrosion and surface protection	16
6.3.6 Impregnation.....	16
6.3.7 Seals for glands for moving parts.....	16
6.4 Gas connections	16
6.5 Electrical parts of the control	16
6.6 Protection against internal faults for the purpose of functional safety	16
7 Performance	16
7.1 General.....	16
7.2 Leak-tightness	17

7.2.1	Requirements.....	17
7.2.2	Tests	17
7.3	Torsion and bending	17
7.4	Rated flow rate	17
7.4.1	Requirement.....	17
7.4.2	Test	17
7.4.3	Conversion of air flow rate.....	17
7.5	Durability.....	17
7.5.1	Elastomers in contact with gas	17
7.5.2	Marking	18
7.5.3	Resistance to scratching.....	18
7.5.4	Resistance to humidity	18
7.6	Performance tests for electronic controls.....	18
7.7	Long-term performance for electronic controls	18
7.8	Data exchange	18
7.101	Pressure regulator performance	18
7.101.1	General	18
7.101.2	General test procedure.....	18
7.102	Safety devices.....	24
7.102.1	Over-pressure safety shut-off devices	24
7.102.2	Under-pressure safety shut-off devices	28
7.102.3	Endurance	28
8	Electrical requirements.....	29
9	Electromagnetic compatibility (EMC)	29
10	Marking, installation and operating instructions.....	29
10.1	Marking	29
10.2	Installation and operating instructions	30
10.3	Warning notice	30
Annex A (informative)	Abbreviations and Symbols.....	31
Annex B (informative)	Leak-tightness tests for gas controls – volumetric method	32
Annex C (informative)	Leak-tightness tests for gas controls – pressure loss method.....	33
Annex D (normative)	Conversion of pressure loss into leakage rate	34
Annex E (normative)	Electrical/electronic component fault modes	35
Annex F (normative)	Additional requirements for safety accessories and pressure accessories as defined in EU Directive 97/23/EC.....	36
Annex G (normative)	Materials for pressurized parts	37
Annex H (normative)	Additional materials for pressurized parts	38
Annex I (normative)	Requirements for controls used in DC supplied burners and appliances burning gaseous or liquid fuels.....	39
Annex J (normative)	Method for the determination of a Safety Integrity Level (SIL).....	40
Annex K (normative)	Method for the determination of a Performance Level (PL).....	41
Annex L (informative)	Relationship between Safety Integrity Level (SIL) and Performance Level (PL).....	42
Annex M (normative)	Reset functions.....	43
Annex N (informative)	Guidance document on environmental aspects.....	44

Annex O (normative) Seals of elastomer, cork and synthetic fibre mixtures.....	45
Annex AA (informative) Typical pressure regulators and pressure regulator parts.....	46
AA.1 Main components of a pressure regulator	46
AA.2 Main components of a gas safety shut-off device.....	49
Annex BB (informative) Overview of requirements and test conditions (as given in Clause 7), and examples of performance curves for pressure regulators.....	51
Annex CC (normative) Creep relief device	54
CC.1 General.....	54
CC.2 Terms and definitions	54
CC.3 Design and construction.....	54
CC.4 Performance requirements.....	54
CC.5 Marking, installation and operating instructions	55
Annex DD (informative) Comparison between EN 334:2005+A1:2009 and prEN 88-2:2020.....	56
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Regulation (EU) 2016/426 aimed to be covered.....	57
Annex ZB (informative) Relationship between this European Standard and the essential requirements of Directive 2014/68/EU aimed to be covered.....	63
Bibliography.....	65

European foreword

This document (prEN 88-2:2020) has been prepared by Technical Committee CEN/TC 58 “Safety and control devices for burners and appliances burning gaseous or liquid fuels”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 88-2:2007.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are an integral part of this document.

prEN 88-2:2020 includes the following significant technical changes with respect to EN 88-2:2007:

- a) scope extended to “Pressure regulators incorporating safety devices”;
- b) alignment with EN 13611:2019;
- c) requirements and tests added for pressure regulators which use auxiliary energy;
- d) classifications according to accuracy, lock-up pressure, and over-pressure shut-off added;
- e) Clause 6 extended to “Design and construction”;
- f) Clause 6.2.104 “Integral safety shut-off device” added;
- g) Clause 6.2.105 “Resistance to pressure” added;
- h) Clause 6.2.107 “Creep relief device” added;
- i) Clause 7.2.2 “Test for leak-tightness”, new value for test pressure;
- j) design of all Figures adapted to design of Figures in EN 13611:2019;
- k) Annex BB “Overview of requirement and test conditions” added;
- l) Annex CC “Creep relief device” added;
- m) Annex DD “Comparison between EN 334:2005+A1:2009 and prEN 88-2:2020” added.

EN 88 consists of the following parts:

- *Part 1: Pressure regulators for inlet pressures up to and including 50 kPa;*
- *Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar;*
- *Part 3: Pressure and/or flow rate regulators for inlet pressures up to and including 500 kPa, electronic types.*

Introduction

This document is a particular standard for pressure Regulators for gas-burners and gas-burning appliances which cites the generic requirements of EN 13611:2019 wherever possible. This document supplements or modifies the corresponding clauses of EN 13611:2019. The construction and performance requirements are as far as applicable in total conformity with EN 13611:2019.

This document is intended to be used in conjunction with EN 13611:2019. This document refers to clauses of EN 13611:2019 or adapts clauses by stating “with the following modification”, “with the following addition”, “is replaced by the following” or “is not applicable” in the corresponding clause. This document adds clauses or subclauses to the structure of EN 13611:2019 which are particular to this document. It should be noted that these clauses and subclauses are not indicated as an addition. Subclauses which are additional to those in EN 13611:2019 are numbered starting from 101. Additional Annexes are designed as Annex AA, BB, CC, etc.

Performance Level (PL) or Safety Integrity Level (SIL) classifications according to EN ISO 13849-1 or EN 61508-1 cannot automatically be claimed based upon compliance with this document. Pressure regulators with SIL classification do not automatically meet the requirements of this document.

1 Scope

This document specifies the safety, design, construction as well as performance requirements and testing for pneumatic pressure regulators and safety devices for burners and appliances burning one or more gaseous fuels, hereafter referred to as 'pressure regulators'.

This document is applicable to:

- pressure regulators with declared maximum inlet pressure above 50 kPa up to and including 500 kPa, of nominal connection size up to and including DN 250 for use with one or more fuel gases in accordance with EN 437;
- pressure regulators incorporating safety devices;
- pressure regulators and safety devices which use auxiliary energy; and
- stand-alone pressure regulators or pressure regulators equipped with a control device for maximum or minimum gas pressure.

This document is not applicable to:

- pressure regulators that are connected directly to mains pipe-work or to a container that maintains a standard distribution pressure;
- pressure regulators intended for gas appliances to be installed in the open air and exposed to the environment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 682, *Elastomeric Seals - Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids*

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

EN 13787, *Elastomers for gas pressure regulators and associated safety devices for inlet pressures up to 100 bar*

EN 60534-2-3:2016, *Industrial-process control valves - Part 2-3: Flow capacity - Test procedures (IEC 60534-2-3)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13611:2019 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.101

pressure regulator

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

[SOURCE: EN 88-1:2011+A1:2016, 3.101]

3.102

control member

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

[SOURCE: EN 88-1:2011+A1:2016, 3.107]

3.103

safety shut-off device

SSD

device the function of which is to stay 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

3.104

housing

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

3.105

valve seat

corresponding sealing surfaces within a pressure regulator or SSD that make full contact only when the pressure regulator or SSD is in the closed position

3.106

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

3.107

actuator

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

3.108**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.

3.109**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.

3.110**signal connection**

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

3.111**breather line**

line between the controller and/or pilot regulator and atmosphere which equalizes the pressure on a detector element when it changes its position

3.112**fixture**

functional device connected to the main components of the pressure regulator or SSD

3.113**exhaust line**

line to atmosphere between the regulator or fixtures for the safe venting of gas in the event of a component failure

3.114**trip mechanism**

mechanism that releases the closure member when activated by the controller

3.115**SSD-actuator**

device that is activated by the trip mechanism which shuts the closure member

3.116**relatching device**

device that enables the complete opening of an SSD

3.117**motorization chamber**

chamber at the higher pressure of two chambers under pressure within the housing of actuator

3.118**monitored pressure**

pressure monitored and safeguarded by the SSD

3.119

trip pressure

pressure value at which the closing member starts to move

3.120

upper trip pressure

p_{do}

upper limit of the monitored over-pressure

3.121

lower trip pressure

p_u

lower limit of the monitored under-pressure

3.122

outlet setting pressure

p_{2s}

outlet pressure at which the pressure regulator is set for test purposes

[SOURCE: EN 88-1:2011+A1:2016, 3.113]

3.123

maximum outlet pressure

p_{2max}

upper limit of the outlet pressure, as stated in the installation and operating instructions

[SOURCE: EN 88-1:2011+A1:2016, 3.109]

3.124

minimum outlet pressure

p_{2min}

lower limit of the outlet pressure, as stated in the installation and operating instructions

[SOURCE: EN 88-1:2011+A1:2016, 3.110]

3.125

outlet pressure range

difference between minimum and maximum values of the outlet pressure

[SOURCE: EN 88-1:2011+A1:2016, 3.111]

3.126

steady state value

outlet pressure measured after step response (control signal remains constant)

[SOURCE: EN 88-1:2011+A1:2016, 3.127]

3.127

settling tolerance

maximum difference between the current outlet pressure and its steady state value

[SOURCE: EN 88-1:2011+A1:2016, 3.128]

3.128**regulation tolerance**

settling tolerance, expressed as a percentage of the outlet setting pressure

3.129**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).

3.130**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.

3.131**accuracy**

percentage of the outlet pressure relative to the outlet setting pressure within the operation range

3.132**accuracy class**

AC

maximum permissible value of the accuracy

3.133**inlet pressure range**

range between the minimum and maximum values of the inlet pressure

[SOURCE: EN 88-1:2011+A1:2016, 3.108]

3.134**lock-up time**

t_f

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

3.135**lock-up pressure**

p_{2f}

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

[SOURCE: EN 88-1:2011+A1:2016, 3.120]

3.136

lock-up pressure class

SG
maximum permissible positive difference between the actual lock-up pressure(s) p_{2f} 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:

$$SG = 100 \cdot \frac{(p_{2f} - p_2)}{p_2} \quad (1)$$

where

- SG is the lock-up pressure class;
- p_{2f} is the lock-up pressure; and
- p_2 is the outlet setting pressure.

3.137

maximum allowable pressure

PS
maximum pressure for which the pressure regulator and/or SSD is designed as stated in the installation and operating instructions

Note 1 to entry: In accordance with the strength requirements of this document.

3.138

limit pressure

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

3.139

safety factor

S_b, S
ratio of the value of the limit pressure p_l 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: S_b ;
- applied to the other pressure containing parts of the pressure regulator: S

4 Classification

4.1 Classes of control

EN 13611:2019, 4.1 is replaced by the following:

Pressure regulators shall be classified according to regulator accuracy class (7.101.2.4) $AC 1, AC 2,5, AC 5, AC 10,$ and $AC 20,$ according to lock-up pressure class (7.101.2.5) $SG 5, SG 10, SG 20,$ and $SG 30,$ and according to over-pressure shut-off accuracy group (7.102.1) $AG 5, AG 10, AG 20,$ and $AG 30.$

4.2 Groups of control

Shall be according to EN 13611:2019, 4.2 with the following addition:

Pressure regulators shall fulfil Group 2 classification.

4.3 Classes of control function

EN 13611:2019, 4.3 is not applicable.

4.4 Types of DC supplied controls

EN 13611:2019, 4.4 is not applicable.

5 Test conditions and uncertainty of measurements

Shall be according to EN 13611:2019, Clause 5.

6 Design and construction

6.1 General

Shall be according to EN 13611:2019, 6.1.

6.2 Mechanical parts of the control

6.2.1 Appearance

Shall be according to EN 13611:2019, 6.2.1.

6.2.2 Holes

Shall be according to EN 13611:2019, 6.2.2.

6.2.3 Breather holes

6.2.3.1 Requirements

Shall be according to EN 13611:2019, 6.2.3.1 with the following addition:

If the vented capacity is greater than 70 dm³/h of air, a connection for a vent pipe shall be provided.

6.2.3.2 Test for leakage of breather holes

Shall be according to EN 13611:2019, 6.2.3.2.

6.2.4 Screwed fastenings

Shall be according to EN 13611:2019, 6.2.4.

6.2.5 Jointing

Shall be according to EN 13611:2019, 6.2.5.

6.2.6 Moving parts

Shall be according to EN 13611:2019, 6.2.6.

6.2.7 Sealing caps

Shall be according to EN 13611:2019, 6.2.7.

6.2.8 Dismantling and reassembly

Shall be according to EN 13611:2019, 6.2.8.

6.2.9 Auxiliary canals and orifices

Shall be according to EN 13611:2019, 6.2.9.

6.2.10 Presetting device

Shall be according to EN 13611:2019, 6.2.10.

6.2.101 External visual indication of the position of the closure member

If an external visual device to indicate the closure member position is fitted to an SSD, it shall clearly indicate whether it is in the open or closed position.

6.2.102 Parts transmitting actuating forces

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

6.2.103 Adjustments

The adjustments (e.g. outlet pressure, offset and gas/air-ratio) shall be readily accessible to authorized persons, but there shall be provision for sealing after adjustment. Means shall be provided to discourage interference by unauthorized persons. If it is stated in the installation and operating instructions that a pressure regulator can be put out of action, appropriate means shall be provided to put the pressure regulator out of action, and the information how to do this shall be given in the operating and installation instructions.

6.2.104 Integral safety shut-off device

An integral safety shut-off device shall be functionally independent from the 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 regulator components:

- control member;
- seat ring;
- actuator;
- casing of actuator;
- controller;
- pilot (for pilot-controlled regulator types);
- sensing and process lines.

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

When the integral safety shut-off device utilizes pipework gas as a source of energy for its operation this shall be taken from upstream pipework of the pressure regulator. For any kind of pneumatic automation system there shall be no bypass around the safety shut-off device, also taking fault conditions into account.

6.2.105 Resistance to pressure

6.2.105.1 Requirements

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 .

Following safety factors in Table 1 shall be used:

Table 1 — Minimum value 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	1,70	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 aluminium alloys	2,00	2,50
Copper-tin cast alloys and copper-zinc cast alloys	2,50	3,13
Aluminium cast alloys A_{\min} 4 %	2,50	3,13
Aluminium cast alloys A_{\min} 1,5 %	3,20	4,00

6.2.105.2 Test

The hydrostatic pressure test is conducted after leakage and function tests. A pressure of f times the maximum allowable pressure (PS) is applied to the control for a minimum of 5 min.

After the test there shall be no visible damage.

6.2.106 Signal tube connections

Requirements on connections for gas pressure, air pressure or furnace pressure signal tubes shall be stated in the installation and operating instructions.

Gas carrying tubes shall be made of metal. Condensation in signal tubes shall not lead to blocked signals.

6.2.107 Creep relief device

A creep relief device can only be built into a spring-operated 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 spring-operated regulator. Creep relief devices shall not be built in a control member of a safety shut-off device, and shall be according to requirements and tests given in Annex CC.

6.3 Materials

6.3.1 General material requirements

Shall be according to EN 13611:2019, 6.3.1 with the following addition:

Closure members shall conform to EN 13611:2019, Annexes F to H.

Elastomers and vulcanized rubber shall conform to 7.5.1.

6.3.2 Housing

6.3.2.1 Requirements

Shall be according to EN 13611:2019, 6.3.2.1 with the following addition:

Materials shall conform to EN 13611:2019, Annexes F to H.

6.3.2.2 Test

Shall be according to EN 13611:2019, 6.3.2.2.

6.3.3 Zinc alloys

EN 13611:2019, 6.3.3 is replaced by:

Zinc alloys shall not be used.

6.3.4 Springs

Shall be according to EN 13611:2019, 6.3.4.

6.3.5 Resistance to corrosion and surface protection

Shall be according to EN 13611:2019, 6.3.5.

6.3.6 Impregnation

Shall be according to EN 13611:2019, 6.3.6.

6.3.7 Seals for glands for moving parts

Shall be according to EN 13611:2019, 6.3.7.

6.4 Gas connections

Shall be according to EN 13611:2019, 6.4.

6.5 Electrical parts of the control

EN 13611:2019, 6.5 is applicable.

6.6 Protection against internal faults for the purpose of functional safety

EN 13611:2019, 6.6 is not applicable.

7 Performance

7.1 General

Shall be according to EN 13611:2019, 7.1.

7.2 Leak-tightness

7.2.1 Requirements

Shall be according to EN 13611:2019, 7.2.1.

7.2.2 Tests

7.2.2.1 General

Shall be according to EN 13611:2019, 7.2.2.1.

7.2.2.2 External leak-tightness

Shall be according to EN 13611:2019, 7.2.2.2, with the following addition:

For external leakage perform the test with 1,5 times PS (maximal allowable pressure) at the inlet and outlet and on the atmospheric side of the working diaphragm (including the safety diaphragm, if any).

The test results shall meet the requirements of 7.2.1.

7.2.2.3 Internal leak-tightness

EN 13611:2019, 7.2.2.3 is replaced by the following:

This test is only applicable for SSDs and shall be performed with the pressure regulator, if any, in the open position.

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 PS, and measure the leakage rate.

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

7.3 Torsion and bending

Shall be according to EN 13611:2019, 7.3.

7.4 Rated flow rate

7.4.1 Requirement

Shall be according to EN 13611:2019, 7.4.1 with the following addition:

The requirement for the rated flow rate is only applicable for safety shut-off devices without regulator.

7.4.2 Test

Shall be according to EN 13611:2019, 7.4.2 with the following addition:

The test for the rated flow rate is only applicable for safety shut-off devices without regulator.

7.4.3 Conversion of air flow rate

Shall be according to EN 13611:2019, 7.4.3.

7.5 Durability

7.5.1 Elastomers in contact with gas

Shall be according EN 13611:2019, 7.5.1 with the following modification:

Elastomers and vulcanized rubber in contact with gas (e.g. valve pads, O-rings, diaphragms and lip seals) shall comply with requirements and tests given in EN 549, EN 682, EN 13611:2019, Annex O, or EN 13787.

7.5.2 Marking

Shall be according to EN 13611:2019, 7.5.2.

7.5.3 Resistance to scratching

Shall be according to EN 13611:2019, 7.5.3.

7.5.4 Resistance to humidity

Shall be according to EN 13611:2019, 7.5.4.

7.6 Performance tests for electronic controls

EN 13611:2019, 7.6 is not applicable.

7.7 Long-term performance for electronic controls

EN 13611:2019, 7.7 is not applicable.

7.8 Data exchange

EN 13611:2019, 7.8 is not applicable.

7.101 Pressure regulator performance

7.101.1 General

If more than one function exists (e.g. pressure regulator and integral safety shut-off device) then the performance of each function shall be considered separately.

If the pressure regulator has built-in safety device(s) it shall be tested with the safety device(s) in its (their) normal operating position.

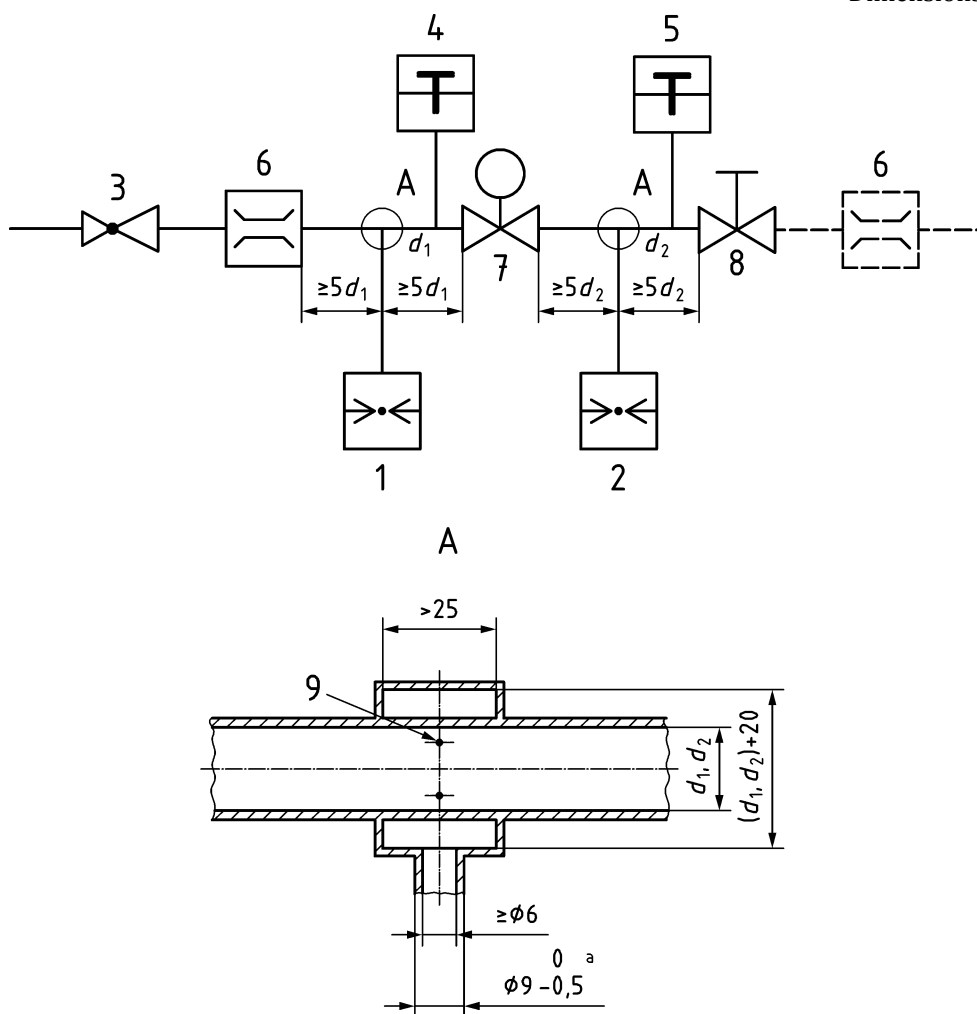
The external sensing/process lines shall be located on the downstream pipework as stated in the installation and operating instructions.

7.101.2 General test procedure

7.101.2.1 Apparatus

The tests shall be performed on a test rig built as specified in Figure 1 or in accordance with EN 60534-2-3:2016, Figure 1. The nominal diameter of the pipework connecting the pressure regulator inlet and the flow rate regulating valves with the pressure regulator shall not be smaller than the nominal diameter of the pressure 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 for pressures ≥ 50 kPa.

Dimensions in millimetres



Key

- 1 Inlet pressure gauge p_1
- 2 Outlet pressure gauge p_2
- 3 Adjustable 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 tap for flow adjustment
- 9 Hole, 4 holes each of 1,5 mm diameter

^a The connection possibility for an application is voluntary. The size of the outer diameter is given as an example and may vary

Nominal size (DN)	Internal diameter (mm)
6	6
8	9
10	13
15	16
20	22
25	28
32	35
40	41
50	52
65	67
80	80
100	106
125	131
150	159
200	209
250	260

Figure 1 — Performance test apparatus

The uncertainty of measurement shall not exceed 2 %. Pressure gauges shall have an accuracy of at least $AC/4$ (in %) in the range of the scale according to the applicable standard.

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. The flow meter shall be installed in accordance with its instructions.

7.101.2.2 Conversion of the air flow rate

Shall be according to EN 13611:2019, 7.4.3.

7.101.2.3 Methods of test

Pressure regulators shall be tested according to

- accuracy class, 7.101.2.4; and
- lock up pressure class, 7.101.2.5.

Tests shall be performed with air at ambient temperature.

Steady-state conditions shall always be reached before readings are taken.

EXAMPLE Examples of performance curves are shown in Figures BB.1 and BB.2.

7.101.2.4 Accuracy class

7.101.2.4.1 Requirement

Over the full range of inlet pressure from p_{1min} to p_{1max} and over the whole rated flow rate range from q_{min} to q_{max} as stated in the installation and operating instructions the outlet pressure variation from the outlet setting pressure p_{2s} shall not exceed the values given in Table 2. The stated minimum rated flow rate q_{min} shall not exceed 10 % of q_{max} .

When tested in accordance with 7.101.2.4.2, pressure regulators shall conform to accuracy requirements relevant to the declared accuracy class chosen from Table 2 within the declared class.

Table 2 — Accuracy classes

Accuracy class	Maximum regulation tolerance
AC 1	±1 %
AC 2,5	±2,5 %
AC 5	±5 %
AC 10	±10 %
AC 20	±20 %

NOTE The same type of pressure regulator can have different accuracy classes depending on the outlet pressure range and/or the inlet pressure range, as stated in the installation and operating instructions.

7.101.2.4.2 Test

To determine the variation of the inlet pressure p_1 and of the flow rate q for a performance curve, proceed as follows (see also Table BB.1):

- a) Adjust the outlet pressure setting of the pressure regulator. Set the outlet control tap to obtain a flow rate of $0,5 q_{\max}$ (or any other value which is appropriate). For adjustable pressure regulators, adjust the outlet pressure setting to the maximum value ($p_{2\max}$), the inlet pressure p_1 being the nominal pressure (or any other value) as stated in the installation and operating instructions. After the outlet pressure being set, there shall be no further adjustment of the pressure regulator.
- b) Vary the inlet pressure p_1 from the nominal pressure over the minimum ($p_{1\min}$) to the maximum value ($p_{1\max}$) as stated in the installation and operating instructions and back to $p_{1\min}$, 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 $p_{1\min}$ 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 $p_{1\min}$ to $p_{1\max}$ as stated in the installation and operating 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 $p_{2\min}$.

EXAMPLE The determination is based on optimal enveloping of each family of performance curves with the vertical and horizontal limit lines as shown in Figures BB.1 and BB.2).

Examples of optimal enveloping procedures are shown in Figures BB.1 and BB.2 and are described as follows:

- 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;
- locate on this diagram, in an optimized manner, three dashed lines spaced as shown in Figures BB.1 and BB.2; the optimization of the location of these lines is reached when the greatest possible number of performance requirements are met;
- identify the actual outlet setting pressure where the horizontal line intersects the ordinate;
- ensure that $q_{\max,p1\min}$, $q_{\max,p1\max}$, $q_{\min,p1\max}$, $q_{\min,p1\min}$, AC and p_{2f} are as stated in the operation and installation instructions.

NOTE Other equivalent optimal enveloping methods can be used.

7.101.2.5 Lock-up pressure class

7.101.2.5.1 Requirement

When a pressure regulator, as stated in the installation and operating instructions, has the ability to lock-up, the outlet pressure shall not rise by more than stated in Table 3. Such a pressure regulator shall be tested in accordance with the test method described in 7.101.2.5.2.

Table 3 — Lock-up pressure classes

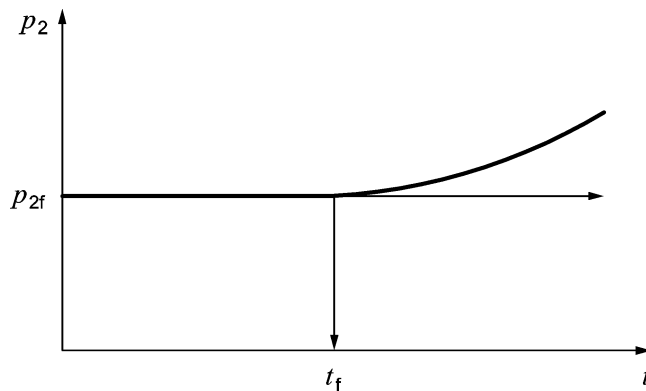
Lock-up pressure class	Maximum regulation tolerance within the lock-up pressure zone
SG 5	5 %
SG 10	10 %
SG 20	20 %
SG 30	30 %

NOTE The same type of pressure regulator can have different lock-up pressure classes depending on the outlet pressure range and/or the inlet pressure range, as stated in the installation and operating instructions.

7.101.2.5.2 Test

When a pressure regulator, as stated in the installation and operating instructions, has the ability to lock-up, an additional measurement at zero rated flow rate shall be taken for each pair of p_1 and p_{2s} values.

The lock-up pressure shall be determined in connection 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. This condition is deemed to be satisfied when the lock-up pressure is found to be independent of the time needed to reduce the rated flow rate to zero (see Figure 2).



- Key**
- t Time
 - p_2 outlet pressure with control member at closure position
 - t_f lock-up time
 - p_{2f} lock-up pressure

Figure 2 — Graphical representation of 7.101.2.5.2

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

Any lock up pressure value that can be affected by temperature variations of the fluid contained in the volume between the pressure regulator under test and the flow rate regulating valve, shall be recalculated and related to the initial temperature by using the following equation:

$$p_{2f} = \frac{t + 273}{t_i + 273} (p_{2fi} + p_a) - p_a \quad (2)$$

where

- P_a is the absolute ambient atmospheric pressure;
- p_{2fi} is the lock up pressure related to the second measurement;
- T is the gas temperature in °C related to the first measurement;
- T_i is the gas temperature in °C related to the second measurement.

The pressure regulator shall be deemed leak-tight if the last two lock-up pressures, corrected for the initial temperature, are comparable (taking account of the accuracy of the measuring system) or comply with the internal leakage rate requirements given in EN 13611:2019, Table 2.

The recorded values shall be used to draw a diagram.

EXAMPLE Examples of diagrams are shown in Figures BB.1 and BB.2.

7.101.2.6 Endurance

7.101.2.6.1 Requirement

The leak tightness and performance shall remain within the limits specified in 7.3, 7.101.2.4.1, and 7.101.2.5.1 respectively without further adjustment of the setting point of the pressure regulator after testing in accordance with 7.101.2.6.2.

7.101.2.6.2 Test

Position the pressure regulator in a temperature controlled chamber with an air supply at (20 ± 5) °C and at the maximum inlet pressure as stated in the installation and operating instructions. The pressure regulator is controlled as stated in the installation and operating 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 valve is held on its seat for at least 5 s.

For the pressure 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 installation and operating instructions, but at least 60 °C;
- b) 25 000 cycles with the pressure regulator environment at the minimum ambient temperature as stated in the installation and operating instructions, but at most 0 °C.

After cycling, the pressure regulator shall conform to the requirements of 7.101.2.6.1.

In addition, where the pressure regulator incorporates an electric device which can run continuously, it shall be additionally operated in a condition where the electric device operates continuously for a period of 3 000 h at 110 % of maximum rated voltage.

The period of 3 000 h shall consist of:

- 2 000 h at ambient temperature of 20 °C;

- 500 h at the maximum ambient temperature stated in the installation and operating instructions, but at least 60 °C; and
- 500 h at the minimum ambient temperature stated in the installation and operating instructions, but at most 0 °C.

This electric device shall be in accordance with Clause 8.

7.102 Safety devices

7.102.1 Over-pressure safety shut-off devices

7.102.1.1 Requirement

When it is stated in the installation and operating instructions that a pressure regulator has the ability to lock-up, the trip pressure deviation shall be as stated in Table 4. Such a pressure regulator shall be tested in accordance with the test method described in 7.102.1.2.

When tested in accordance with 7.102.1.2, the mean set value calculated from the six actual values shall correspond to the specified accuracy group.

Table 4 — Specified accuracy groups for over- and under-pressure shut-off devices

Accuracy group	Maximum deviation
AG 5	±5 % ^a
AG 10	±10 % ^a
AG 20	±20 % ^b
AG 30	±30 % ^b
For under-pressure shut-off devices the tolerance shall be ≤ 500 Pa. ^a Or 100 Pa, whichever is greater. ^b For set values ≤ 20 kPa only.	

NOTE 1 A safety shut-off device can conform to different accuracy groups as a function of the outlet pressure range and/or of the inlet pressure range, as stated in the installation and operating instructions.

NOTE 2 At the lower limit temperature, the permissible deviation for the declared accuracy group can rise to the values given in Table 4 for the next less stringent accuracy group.

When tested in accordance with 7.102.1.2 the over-pressure SSD shall close when the pressure reaches the pre-set trip pressure.

The shutting-off of the gas flow shall be automatic and shall not be interruptible until the closure member has reached the closed position. Re-set shall only be possible by manual means.

If an internal bypass is fitted for the purpose of pressure equalization, it shall close safely and automatically before or during tripping.

When tested in accordance with 7.102.1.2.5 the response time *t* shall be < 2 s.

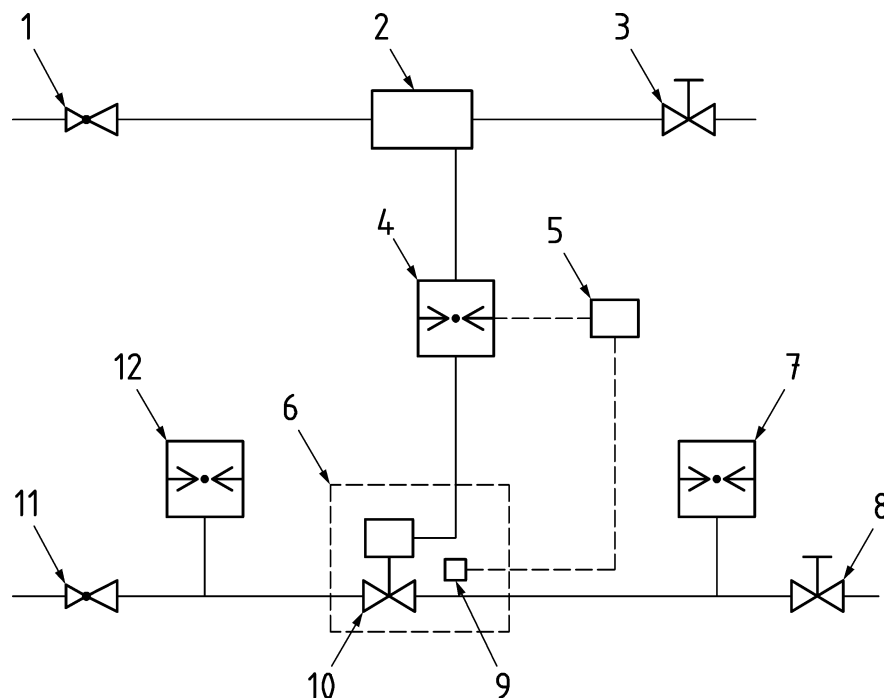
7.102.1.2 Test

7.102.1.2.1 General conditions and apparatus

The test shall be performed in a test rig as shown in Figure 3 under the following operating conditions:

- the housing of the SSD is pressurized from both ends;
- 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 between 0 °C and +60 °C for tests at limit temperatures.

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



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 (in the scheme including a vessel upstream inside the cabinet)
- 11 pressure regulator controls the operating pressure
- 12 inlet pressure gauge

Figure 3 — Performance test apparatus for SSDs

7.102.1.2.2 Test at ambient temperature

For each specified accuracy group and relevant

- maximum inlet pressure $p_{1\max}$; 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 ($p_{1\max}$);
 - 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 operation shall be 120 % of the selected trip pressure.

7.102.1.2.3 Test at the limit temperatures

7.102.1.2.3.1 General

The tests shall be performed with a 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 installation or operating instructions.

There shall be no adjustment of the trip pressure between the test at ambient temperature (7.102.1.2.2) and this test.

7.102.1.2.3.2 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 installation or operating instructions.

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

7.102.1.2.3.3 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.

7.102.1.2.4 Verification of the upper limit of the highest set range

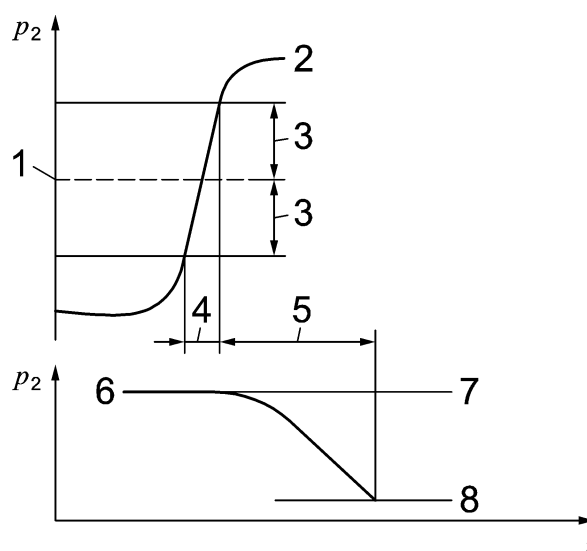
The test method is as follows:

- 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 actual values.

7.102.1.2.5 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 operating pressure. If the response time is longer for lower operating pressures the test shall also be performed at the minimum operating pressure. The monitored pressure is set at approx. 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 (see Figure 4). The response time shall be determined to an accuracy of < 0,1 s.



Key

- 1 set value of the trip pressure
- 2 monitored pressure
- 3 *AG*
- 4 $t < 0,2$ s
- 5 response time t
- 6 closing characteristic
- 7 open
- 8 closed

Figure 4 — Measurement of response time

The response time shall be measured from when the monitored pressure reaches the highest limit value of the *AG* 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.

7.102.2 Under-pressure safety shut-off devices

7.102.2.1 Requirement

When tested in accordance with 7.102.1.2 the under-pressure SSD shall close when the pressure reaches the lower trip pressure.

NOTE Under-pressure devices can by design have either manual or automatic resetting functions.

The device shall fulfil the leak tightness test in 7.2.2.3.

If an internal bypass is fitted for the purpose of pressure equalization, it shall close safely and automatically before or during tripping.

When tested in accordance with 7.102.1.2.5 the response time t shall be < 2 s.

7.102.2.2 Test

Conduct the test according to 7.102.1.2.1 and to 7.102.1.2.3.2.

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.

7.102.2.3 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 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;
- e) calculate the arithmetic mean of the six actual values.

7.102.3 Endurance

7.102.3.1 Requirement

The internal sealing, pressure accuracy and response time shall remain within the limits specified in 7.3 and 7.102.1.1, respectively, without further adjustment of the trip pressure after testing in accordance with 7.102.3.2.

7.102.3.2 Test

Position the pressure regulator in a temperature controlled chamber with an air supply at (20 ± 5) °C and at the maximum inlet pressure as stated in the installation and operating instructions. The pressure regulator is controlled according to manufacturer's 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 valve is held on its seat for at least 5 s.

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 installation and operating instructions, but at least 60 °C;
- b) 250 cycles with the safety shut-off environment at the minimum ambient temperature as stated in the installation and operating instructions, but at most 0 °C.

After cycling, the safety shut-off device shall conform to the requirements of 7.102.3.1.

In addition, where the pressure regulator incorporates an electric device which could be required to run continuously, it shall be additionally operated in a condition where the electric device operates continuously for a period of 3 000 h at 110 % of maximum rated voltage.

The period of 3 000 h shall consist of:

- 2 000 h at ambient temperature of 20 °C;
- 500 h at the maximum ambient temperature stated in the installation and operating instructions, but at least 60 °C; and
- 500 h at the minimum ambient temperature stated in the installation and operating instructions, but at most 0 °C.

This electric device shall be in accordance with Clause 8.

8 Electrical requirements

Shall be according to EN 13611:2019, Clause 8.

9 Electromagnetic compatibility (EMC)

Shall be according to EN 13611:2019, Clause 9.

10 Marking, installation and operating instructions

10.1 Marking

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) type reference;
- c) regulator accuracy class;
- d) maximum inlet pressure (inlet pressure range) in Pa or kPa;
- e) maximum allowable pressure (PS) in Pa or kPa;
- f) ambient temperature range;
- g) direction of gas flow by an arrow (e.g. cast or embossed);
- h) date of manufacture (at least the year) - may be in code;
- i) vent connection;

prEN 88-2:2020 (E)

For regulators with integral safety shut-off device:

- j) specific set range(s): for upper trip pressure and lower trip pressure (if any).

10.2 Installation and operating instructions

Instructions shall include all relevant information on the use, installation, operation and servicing, in particular:

- a) regulator accuracy class, *AC*, lock-up pressure class, *SG*;
- b) group 2;
- c) gas families for which the pressure regulator is suitable;
- d) ambient temperature range in °C;
- e) mounting position(s);
- f) gas connections;
- g) 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;
- h) inlet pressure range in Pa or kPa;
- i) outlet pressure range in Pa or kPa;
- j) rated flow rate in m³/h (and rated flow rate range); alternatively performance limits can be given in a curve (e.g. Figures BB.1 and BB.2);
- k) instructions for changing from one gas family to another;
- l) instructions for changing components that may be replaced to cover the whole outlet pressure range, i.e. orifices or springs;
- m) in particular, instructions for the installation and operation of any integrated safety devices;
- n) if fitted with a vent connection, the installation and operation instructions shall state that the breather shall be vented to a safe place;

For regulators with integral safety shut-off device:

- o) over-pressure shut-off accuracy group *AG* for the SSD;
- p) function of the SSD: breather line, sensing line, adjusting and operation of the SSD;
- q) manual opening of the SSD and – if any – manual closing of the SSD;
- r) bypass.

10.3 Warning notice

Shall be according to EN 13611:2019, 10.3.

Annex A
(informative)

Abbreviations and Symbols

Shall be according to EN 13611:2019, Annex A.

Annex B
(informative)

Leak-tightness tests for gas controls – volumetric method

Shall be according to EN 13611:2019, Annex B.

Annex C
(informative)

Leak-tightness tests for gas controls – pressure loss method

Shall be according to EN 13611:2019, Annex C.

Annex D
(normative)

Conversion of pressure loss into leakage rate

Shall be according to EN 13611:2019, Annex D.

Annex E
(normative)

Electrical/electronic component fault modes

EN 13611:2019, Annex E is not applicable.

Annex F
(normative)

Additional requirements for safety accessories and pressure accessories as defined in EU Directive 97/23/EC

Shall be according to EN 13611:2019, Annex F.

NOTE The DIRECTIVE 2014/68/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment (recast) will supersede EU Directive 97/23/EC.

Annex G
(normative)

Materials for pressurized parts

Shall be according to EN 13611:2019, Annex G.

Annex H
(normative)

Additional materials for pressurized parts

Shall be according to EN 13611:2019, Annex H.

Annex I
(normative)

**Requirements for controls used in *DC* supplied burners and appliances
burning gaseous or liquid fuels**

Shall be according to EN 13611:2019 07, Annex I.

Annex J
(normative)

Method for the determination of a Safety Integrity Level (SIL)

EN 13611:2019, Annex J is not applicable.

Annex K
(normative)

Method for the determination of a Performance Level (PL)

EN 13611:2019, Annex K is not applicable.

Annex L
(informative)

Relationship between Safety Integrity Level (SIL) and Performance Level (PL)

EN 13611:2019, Annex L is not applicable.

Annex M
(normative)

Reset functions

EN 13611:2019, Annex M is not applicable.

Annex N
(informative)

Guidance document on environmental aspects

Shall be according to EN 13611:2019, Annex N.

Annex O
(normative)

Seals of elastomer, cork and synthetic fibre mixtures

Shall be according to EN 13611:2019, Annex O.

Annex AA (informative)

Typical pressure regulators and pressure regulator parts

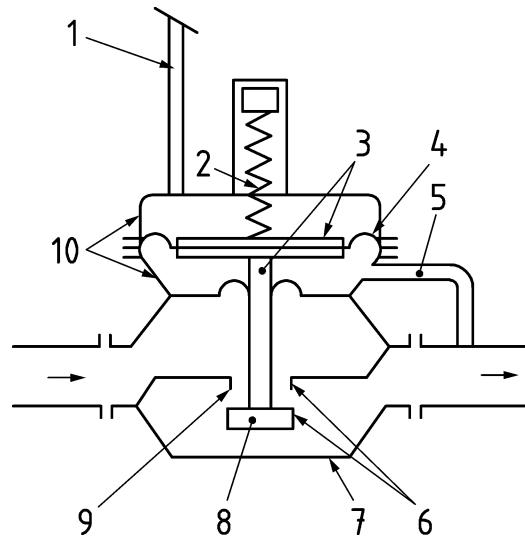
AA.1 Main components of a pressure regulator

The main components of a gas pressure regulator normally include:

- control member;
- pressure regulator housing;
- actuator;
- housing of actuator;
- controller; and
- pilot (only in pilot controlled pressure regulators).

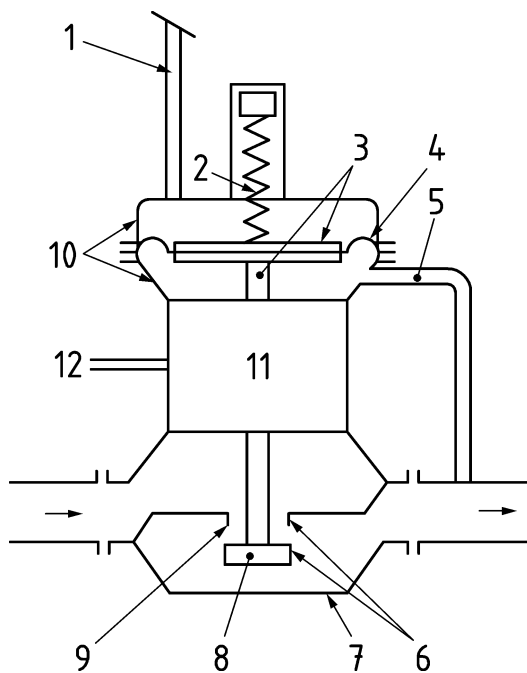
The pressure regulator might include additional units, for example a shut-off device, and other fixtures.

EXAMPLE Examples are shown in Figures AA.1, AA.2, AA.3 and AA.4.

**Key**

- 1 breather/exhaust line
- 2 setting element
- 3 actuator
- 4 detector element
- 2+4 controller
- 5 sensing/process line
- 6 valve disc/seat
- 7 regulator housing
- 8 control member
- 9 seat ring
- 10 housing of actuator

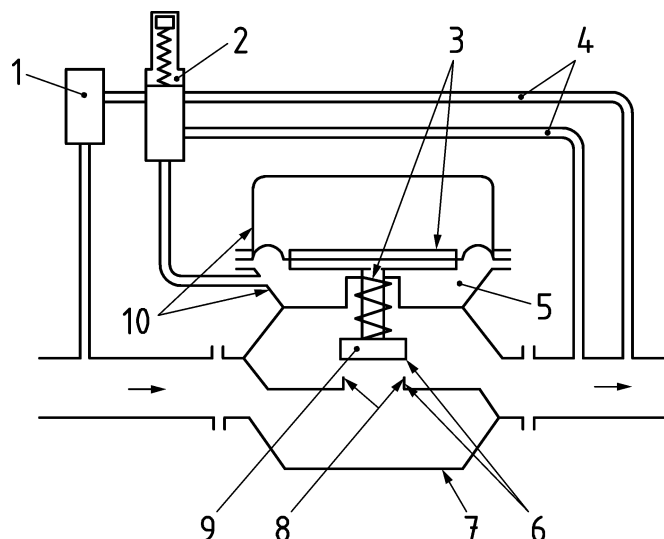
Figure AA.1 — Example of a direct acting regulator



Key

- 1 breather/exhaust line
- 2 setting element
- 3 actuator
- 4 detector element
- 2+4 controller
- 5 sensing/process line
- 6 valve disc/seat
- 7 regulator housing
- 8 control member
- 9 seat ring
- 10 housing of actuator
- 11 actuator part using auxiliary energy
- 12 auxiliary energy

Figure AA.2 — Example of regulator using auxiliary energy



Key

- 1 pre-regulator
- 2 pilot (adjustable)
- 3 actuator
- 4 sensing/process lines
- 5 motorization chamber
- 6 valve disc/seat
- 7 regulator housing
- 8 seat ring
- 9 control member
- 10 housing of actuator

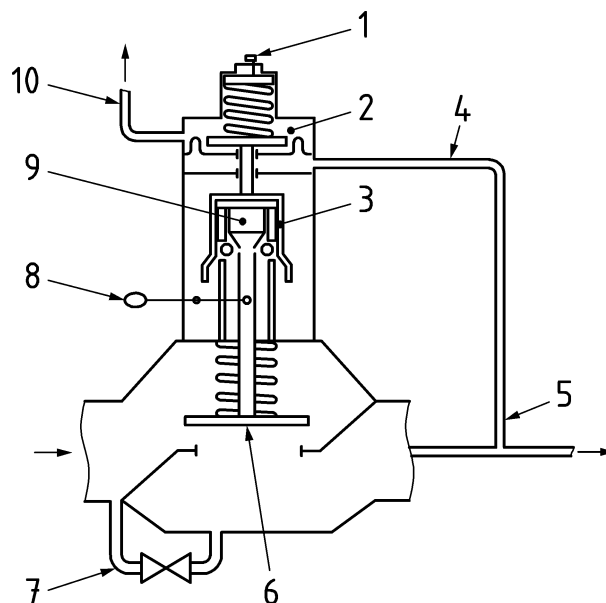
Figure AA.3 — Example of a pilot controlled regulator

AA.2 Main components of a gas safety shut-off device

The parts of a gas safety shut-off device normally include:

- controller;
- trip mechanism;
- SSD-actuator;
- closing member; and
- relatching device permitting the manual opening of the SSD.

Figure AA.4 shows a stand-alone safety shut-off device for information.



Key

- 1 bypass
- 2 relatching device
- 3 trip mechanism
- 4 breather line
- 5 setting element
- 6 controller
- 7 sensing line
- 8 SSD-actuator
- 9 sensing point
- 10 closure member

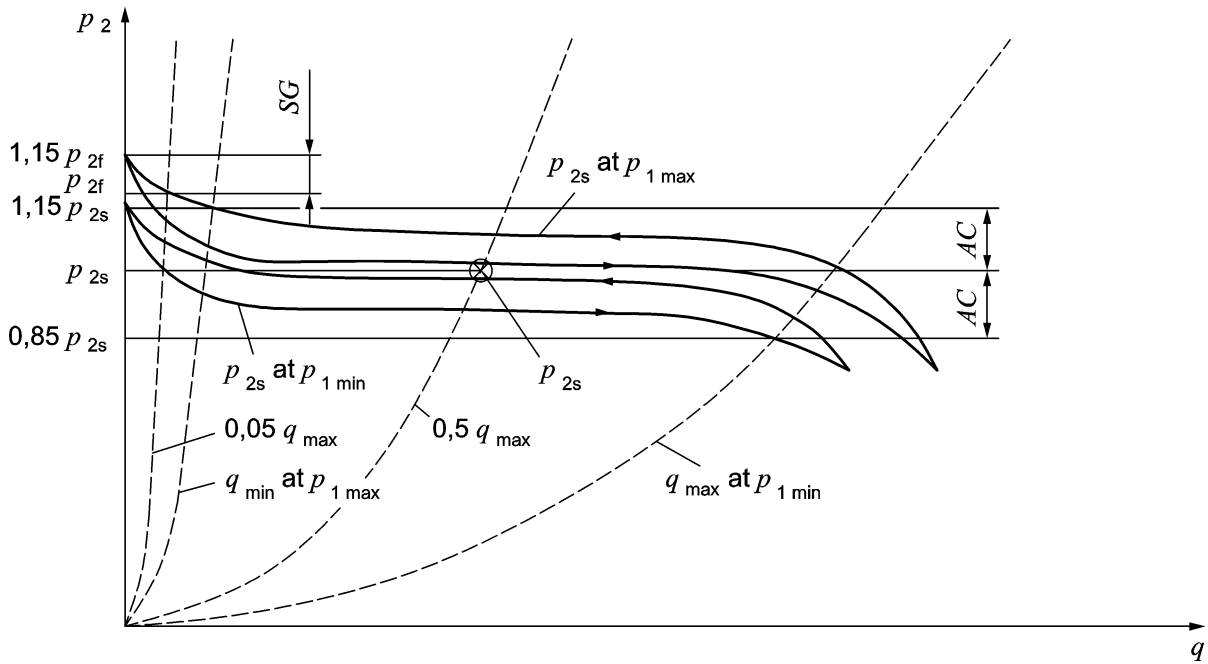
Figure AA.4 — Example of a direct acting safety shut-off device

Annex BB (informative)

Overview of requirements and test conditions (as given in Clause 7), and examples of performance curves for pressure regulators

Table BB.1 — Setting and performance

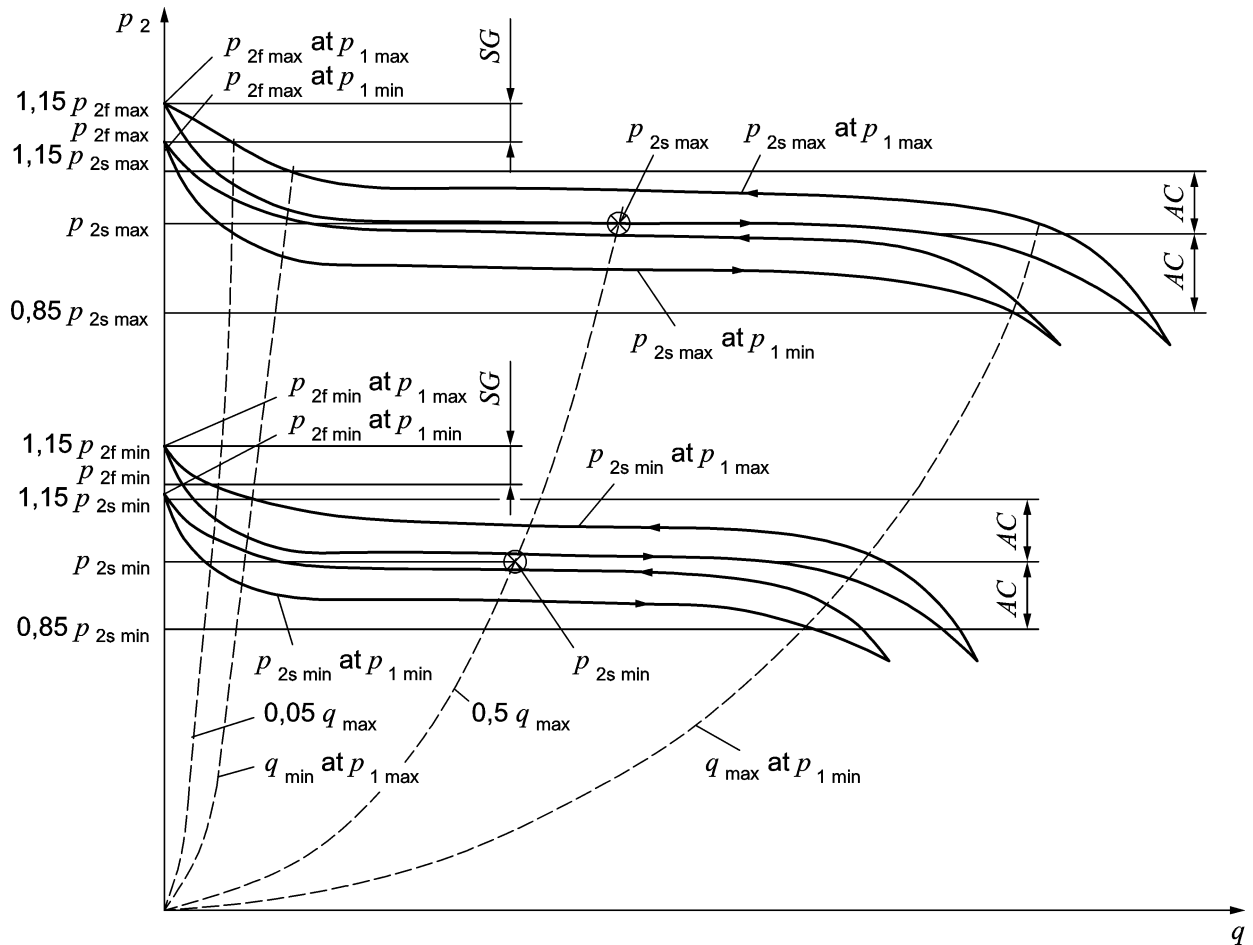
	p_1	p_2	q
setting	$\frac{p_{1\max} + p_{1\min}}{2}$	$p_{2\max}$	$0,5 q_{\max}$
performance	$p_{1\max}$ or as stated in the installation and operating instructions		$0,5 q_{\max} \rightarrow q_{\max} \rightarrow q_{\min} \rightarrow q_f \rightarrow q_{\min} \rightarrow 0,5 q_{\max}$
	$p_{1\min}$ or as stated in the installation and operating instructions		$0,5 q_{\max} \rightarrow q_{\max} \rightarrow q_{\min} \rightarrow q_f \rightarrow q_{\min} \rightarrow 0,5 q_{\max}$
setting	$\frac{p_{1\max} + p_{1\min}}{2}$	$p_{2\min}$	$0,5 q_{\max}$
performance	$p_{1\max}$ or as stated in the installation and operating instructions		$0,5 q_{\max} \rightarrow q_{\max} \rightarrow q_{\min} \rightarrow q_f \rightarrow q_{\min} \rightarrow 0,5 q_{\max}$
	$p_{1\min}$ or as stated in the installation and operating instructions		$0,5 q_{\max} \rightarrow q_{\max} \rightarrow q_{\min} \rightarrow q_f \rightarrow q_{\min} \rightarrow 0,5 q_{\max}$
<p>$p_{1\max}$ maximum inlet pressure as stated in the installation and operating instructions</p> <p>$p_{1\min}$ minimum inlet pressure (= $p_{2\max} + 10$ kPa or as stated in the installation and operating instructions)</p> <p>$p_{2\max}$ maximum outlet pressure as stated in the installation and operating instructions</p> <p>$p_{2\min}$ minimum outlet pressure as stated in the installation and operating instructions</p> <p>q_{\max} maximum flow rate (depending on the outlet pressure) as stated in the installation and operating instructions</p> <p>q_{\min} minimum flow rate ($\leq 0,1 q_{\max}$) as stated in the installation and operating instructions</p> <p>q_f lock-up flow rate</p>			



- Key**
- SG* lock-up pressure class
 - AC* accuracy class
 - q* rated flow rate
 - q_{min}* minimum rated flow rate
 - q_{max}* maximum rated flow rate
 - p_{1min}* minimum inlet pressure
 - p_{1max}* maximum inlet pressure
 - p₂* outlet pressure
 - p_{2f}* lock-up pressure
 - p_{2s}* outlet setting pressure

Figure BB.1 — Example for pressure regulator including maximum outlet pressure variations for constant outlet setting pressure p_{2s} and lock-up pressure p_{2f} including typical results

Licensed copy: University of Exeter, University of Exeter, Version correct as of 24/08/2020

**Key**

SG	lock-up pressure class	p_{2fmin}	minimum lock-up pressure
AC	accuracy class	p_{2fmax}	maximum lock-up pressure
q	rated flow rate	p_{2smin}	minimum outlet setting pressure
q_{min}	minimum rated flow rate	p_{2smax}	maximum outlet setting pressure
q_{max}	maximum rated flow rate	p_{1min}	minimum inlet pressure
p_2	outlet pressure	p_{1max}	maximum inlet pressure

Figure BB.2 — Example for pressure regulator including maximum outlet pressure variations for adjustable outlet setting pressures p_{2smin} , p_{2smax} , and lock-up pressures p_{2fmin} , p_{2fmax} , including typical results

Annex CC (normative)

Creep relief device

CC.1 General

Creep relief devices according to 6.2.107 shall conform to this Annex.

CC.2 Terms and definitions

CC.2.1

creep relief device

CRD

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

CC.2.2

opening pressure

pressure at which the first internal leak occurs

CC.2.3

closing pressure

pressure at which the relief device is leak tight after re-seating

CC.3 Design and construction

The connection for the CRD exhaust line shall be at least *DN* 10. The materials used for the construction of the CRD shall conform to the requirements of 6.3.

CC.4 Performance requirements

CC.4.1 Set point adjustment

CC.4.1.1 Requirements

The set point shall be higher than the lock-up pressure (including tolerance) of the regulator. The set point shall be adjusted, such that the opening and the closing pressure is above the regulator lock-up pressure including tolerance.

CC.4.1.2 Tests

The 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 foreseen by the manufacturer. The regulator is pressurized on the inlet side with the maximum inlet pressure foreseen from the manufacturer 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 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.

CC.5 Marking, installation and operating instructions

CC.5.1 Marking

Creep relief device (CRD).

CC.5.2 Installation and operating instructions

The setting of the creep relief device (if any) and the venting line (length and diameter) shall be described.

Annex DD
(informative)

Comparison between EN 334:2005+A1:2009 and prEN 88-2:2020

Table DD.1 — Comparison between EN 334:2005+A1:2009 and prEN 88-2:2020

Subject	EN 334:2005+A1:2009	Requirements and tests of this document
Scope	Regulators up to 100 bar and safety devices, for gas pressure regulating stations	Regulators up to 5 bar and safety devices for gas appliances, burners etc.
Terms and definitions	Addressed to the use in gas distribution systems, e.g. monitor as safety device	Addressed to gas appliances, burners etc. together with EN 13611, e.g. groups of control systems, classification
Design (general)	General requirements comparable in both standards, monitor as safety device in installations, where no interruption of the gas supply is allowed	Exception: a safety device is only mentioned as „safety shut off valve“, no monitor
End connections	In general flanges, or wafer type connections, also welded connections	Flanges, but also compression fittings and screwed connections
Materials (metals)	a) General requirements for material characteristics (minimum elongation and bending rupture energy) b) Tables of materials accepted	No general requirements, only tables similar to these of EN 334
Strength	General requirements for the housing (pressure containing parts) and inner partition walls and obturator Test sequence a) Strength test with 1,5 times PS: only elastic deformation allowed, leakage is possible b) Tightness test with 1,1 times PS (same item): no leakage c) Design strength: f times PS where $f = 1,7$ to $f = 3,2$ depending of the material (for parts stressed by forces from the piping system: up to $f = 4,0$): no cracking but permanent deformation allowed (alternative: calculation with same factors)	General requirements only for the housing (pressure containing parts), no differentiation between integral strength and differential pressure Remark: requirements under discussion, but some points are fixed a) Strength test with 4 times PS, no differentiation according to the material, no differentiation for parts stressed by pipeline forces or others (EN 13611:2019, F.7.9) (no requirements about elastic/plastic deformations) b) Tightness pressure: 600 Pa and 1,5 times PS (internal/external leakage, EN 13611:2019, 7.2.1, 7.2.2)
External forces	Torsion and bending No requirements	Torsion and bending Torque and bending moments are applied

Annex ZA (informative)

Relationship between this European Standard and the essential requirements of Regulation (EU) 2016/426 aimed to be covered

This European Standard has been prepared under a Commission's standardization request [TBD] to provide one voluntary means of conforming to essential requirements of Regulation (EU) 2016/426 of the European Parliament and of the council of 9 March 2016 on appliances burning gaseous fuels and repealing Directive 2009/142/EC.

Once this standard is cited in the Official Journal of the European Union under that Regulation, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Regulation, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Regulation (EU) 2016/426

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1	6.1, 7.1, Annex I	In particular following subclauses of EN 13611 apply: I: I.7.1 In addition Essential Requirements 2, 3.1.1, 3.1.4 to 3.1.13, 3.2.1, 3.6.1 and 3.6.2 apply
1.2	–	Requirements for risk analysis are not covered
1.3	–	Requirements for risk analysis are not covered
1.4	6.1, 7.1, 10.2, Annex I	In particular following subclauses of EN 13611 apply: I: I.7.1
1.5	–	not applicable to regulators
1.6.1	–	not applicable to regulators
1.6.2	–	not applicable to regulators

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.6.3	–	not applicable to regulators
1.7	10.2	Mounting instructions
2	6.2.5, 6.3.1, 6.3.2.1, 6.3.5, 6.3.6, 6.3.7, 6.5, 7.5, Annex O, 6.2.102, 6.2.105.1	Materials In particular following subclauses of EN 13611 apply: 6.5: 6.5.1, 7.5: 7.5.1, 7.5.2.1, 7.5.3.1, 7.5.4.1, 7.5.5, O: 0.4.1, 0.4.2.1, 0.5.1.1.1, 0.5.1.2.1, 0.5.1.3.1
3.1.1	6.2.1, 6.2.2, 6.2.3.1, 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.3.1, 6.3.2.1, 6.3.5, 6.3.6, 6.3.7, 6.4, 6.5, 7.2.1, 7.3, 7.4.1, 7.5, Annex I, Annex O, 6.2.102, 6.2.104, 6.105.1, 6.2.106, 7.101.1, 7.102.1.1, 7.102.2.1,	Mechanical stability In particular following subclauses of EN 13611 apply: 6.5: 6.5.1, 6.5.3.4.1, 7.3: 7.3.1, 7.3.2.1 7.5: 7.5.1, 7.5.2.1, 7.5.3.1, 7.5.4.1, 7.5.5, I: I.7.1, O: 0.4.1, 0.5.1.1.1, 0.5.1.2.1, 0.5.1.3.1
3.1.2	–	not applicable to regulators
3.1.3	–	not applicable to regulators

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
3.1.4	6.3.7, 6.4, 7.2.1, 7.3, 7.5,	Water penetration In particular following subclauses of EN 13611 apply: 7.3 7.3.1, 7.3.2.1 7.5: 7.5.1, 7.5.2.1, 7.5.3.1, 7.5.4.1
3.1.5	6.5, Annex I	Normal fluctuation of auxiliary energy In particular following subclauses of EN 13611 apply: 6.5 6.5.1 6.5.3: 6.5.3.4.1, I; I.7.1 I.9.3
3.1.6	6.5, Annex I	Abnormal fluctuation of auxiliary energy In particular following subclauses of EN 13611 apply: 6.5 6.5.1 I; I.9.3

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
3.1.7	6.5,	These requirements cover gas related risks due to hazards of electrical origin In particular following subclauses of EN 13611 apply: 6.5 6.5.1 6.5.3.1
3.1.8	9	These requirements cover gas related risks originating from electromagnetic phenomena
3.1.9	6.2.2, 6.2.3.1, 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.3.1, 6.3.2.1, 6.3.5, 6.3.6, 6.3.7, 6.4, 6.5, 7.2.1, 7.3, 7.5, Annex O, 6.2.102, 6.2.104, 6.2.105, 6.2.106,	Pressurized parts In particular following subclauses of EN 13611 apply: 6.5 6.5.1 6.5.3.4.1, 7.3 7.3.1 7.3.2.1 7.5: 7.5.1, O: 0.4.1, 0.5.1.1.1, 0.5.1.2.1, 0.5.1.3.1

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
3.1.10	6.5, 7.101.1, 7.101.2.4.1, 7.101.2.5.1, 7.101.2.6.1, 7.102.1.1, 7.102.2.1, 7.102.3.1,	Failure of safety, controlling and regulating devices In particular following subclauses of EN 13611 apply: 6.5 6.5.1 6.5.2.1 6.5.3.1: 6.5.3.4.1,
3.1.11		Safety may not be influence by control function
3.1.12	6.2.2, 6.2.3.1, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.3.7	Protection of adjustments set by the manufacturer
3.1.13	6.2.8, 6.2.3.1, 6.2.2, 6.2.10	Marking of controlling and setting devices
3.2.1	6.2.3.1, 6.2.4, 6.2.5, 6.2.7, 6.3.2.1, 6.3.7, 6.4, 7.2.1, 7.3, 7.5, Annex O 7.101.2.6.1, 7.101.1, 7.102.3.1, 6.2.105.1,	In particular following subclauses of EN 13611 apply: 7.3 7.3.1 7.3.2.1 7.5: 7.5.1, 0: 0.5.1.1.1, 0.5.1.2.1
3.2.2	–	to be covered by the specific controls standard
3.2.3	–	not applicable to regulators
3.2.4	–	not applicable to regulators

Essential Requirements of Regulation (EU) 2016/426	Clause(s)/subclause(s) of this EN	Remarks/Notes
3.3	–	not applicable to regulators
3.4.1	–	not applicable to regulators
3.4.2	–	not applicable to regulators
3.4.3	–	not applicable to regulators
3.4.4	–	not applicable to regulators
3.5	–	not applicable to regulators
3.6.1	–	not applicable to regulators
3.6.2	–	
3.6.3	–	
3.7	–	not applicable to regulators

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Annex ZB (informative)

Relationship between this European Standard and the essential requirements of Directive 2014/68/EU aimed to be covered

This European Standard has been prepared under a Commission's standardization request "M/BC/CEN/89/6 (Gas appliances)" to provide one voluntary means of conforming to essential requirements of Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment.

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZB.1 — Correspondence between this European Standard and Directive 2014/68/EU

Essential Requirements of Directive 2014/68/EU	Clause(s)/subclause(s) of this EN	Remarks/Notes
2.1	6.2.1, 6.2.2, 6.2.3.1, 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.3.1, 6.3.2.1, 6.3.3, 6.3.4, 6.3.5, 6.3.6, 6.3.7, 6.4, 7.1, 7.2.1, 7.5.2, Annex F, Annex O	
2.2.1	6.3.1, 6.3.4, 6.3.5, 6.3.6, 6.3.7, 6.4, 7.1, 7.3, Annex F	
2.2.3	Annex F	
2.2.4	6.2.3.2, 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.3.2.2, 7.2.2, 7.3, 7.5.1, 7.5.3, 7.5.4, Annex F, Annex O	
2.6	6.3.4, 6.3.5, 6.3.6, 6.3.7, 7.5.1, 7.5.2, 7.5.3, 7.5.4	
2.11	7.102	
2.11.1	Annex F	
2.11.2	Annex CC	
3.1.2	Annex F	
3.1.3	Annex F	
3.1.5	Annex F	
3.2.2	Annex F	
3.3	Annex F	
3.4	Annex F	
4.2 b)	Annex F	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

- EN 88-1:2011+A1:2016, *Pressure regulators and associated safety devices for gas appliances - Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*
- EN 126, *Multifunctional controls for gas burning appliances*
- EN 334, *Gas pressure regulators for inlet pressure up to 10 MPa (100 bar)*
- EN 1092 (all parts), *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated*
- EN 1759 (all parts), *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated*
- EN ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1)*
- EN 12627:1999, *Industrial valves - Butt welding ends for steel valves*