



BSI Standards Publication

Gas pressure safety and control devices for use in gas transmission, distribution and installations for inlet pressures up to and including 10 MPa

Part 1: General requirements

National foreword

This British Standard is the UK implementation of ISO 23555-1:2022.

The UK participation in its preparation was entrusted to Technical Committee GSE/22, Safety and control devices for gas and oil burners and gas burning appliances.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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**Gas pressure safety and control
devices for use in gas transmission,
distribution and installations for
inlet pressures up to and including 10
MPa —**

**Part 1:
General requirements**





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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 161, *Controls and protective devices for gas and/or oil*.

A list of all parts in the ISO 23555 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides general requirements for controls and protective devices and is intended to be used in conjunction with ISO 23555-2 and ISO 23555-3 for specific types of controls and protective devices or for controls for specific applications.

This document can also be applied, so far as reasonable, to controls not mentioned in a specific standard and to controls designed on new principles, in which case additional requirements can be necessary.

When no specific International Standard for a control exists, the control can be tested according to this document and further tests which take into account the intended use.

Controls and safety devices used with gases need to withstand the type of gas which is specified. Other ISO Technical Committees, such as ISO/TC 28, *Petroleum products and lubricants*, and ISO/TC 193, *Natural gas*, deal with the testing and properties of fuel gases.

Note that due to the differing properties of gas depending on its source/region of origin, certain differences in regulations exist at present in different regions, some of which are presented in [Annex E](#).

This document intends to provide a basic framework of requirements until these differences can be harmonized.

Gas pressure safety and control devices for use in gas transmission, distribution and installations for inlet pressures up to and including 10 MPa —

Part 1: General requirements

1 Scope

This document specifies generic safety, constructional, performance, testing and documentation requirements for high pressure controls for use in gas transmission, distribution and installations (hereafter referred to as controls).

This document is applicable to controls with operating pressures greater than 500 kPa (5 bar) and up to and including 10 MPa (100 bar) and nominal size up to DN 400 for use with fuel gases as natural gas, manufactured gas, biomethane or liquefied petroleum gas (LPG) in commercial, industrial installations, including fuel gas infrastructures.

The test methods given in this document are intended for product type test, routine tests and batch surveillance tests.

This document is not applicable to:

- controls upstream from/on/in domestic gas-consuming appliances which are installed downstream of domestic gas meters;
- controls designed with declared maximum capacity $\leq 200 \text{ m}^3/\text{h}$ (normal conditions) and declared maximum inlet pressure $\leq 500 \text{ kPa}$ (5 bar), to be incorporated into pressure control systems used in service lines (pipework from the main pipework in a gas infrastructure to the point of delivery of the gas);
- industrial process control valves, such as IEC 60534;
- controls used in aggressive/sour gas environments (gas environments containing water and H_2S are considered sour) or severely corrosive conditions;
- controls in service conditions with renewables (e.g. H_2NG with hydrogen more than 10 %) and/or waste gases (e.g. biogas, etc.), if additional information is not provided (e.g. contaminant, liquid, etc.).

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 amendments) applies.

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 1817, *Rubber, vulcanized – Determination of the effect of liquids*

ISO 3419, *Non-alloy and alloy steel butt-welding fittings*

ISO 7005 (all parts), *Pipe flanges*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*

ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys*

ISO 9606-4, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 10474:2013, *Steel and steel products — Inspection documents*

ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials*

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 15610, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables*

ISO 15611, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience*

ISO 15612, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure specification*

ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test*

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories*

IEC 60534-2-3, *Industrial-process control valves — Part 2-3: Flow capacity — Test procedures*

IEC 60534-4:2006, *Industrial-process control valves — Part 4: Inspection and routine testing*

EN 437, *Test gases — Test pressures — Appliance categories*

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

EN 12516-1:2014, *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valves shells*

EN 13445-4, *Unfired pressure vessels — Part 4: Fabrication*

EN 16129:2013, *Pressure regulators, automatic change-over devices, having a maximum regulated pressure of 4 bar, with a maximum capacity of 150 kg/h, associated safety devices and adaptors for butane, propane, and their mixtures*

MSS SP 55, *Quality standard for steel castings for valves, flanges and fittings and other piping components (Visual method)*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1.1 General terms

3.1.1.1

biomethane

methane-rich gas with the properties similar to natural gas derived from biogas produced by anaerobic digestion or gasification or from power to gas by upgrading

[SOURCE: ISO 20675:2018, 3.12]

3.1.1.2

failure

termination of the ability of a functional unit to provide a required function or operation

[SOURCE: IEC 60050-192:2015, 192-03-01]

3.1.1.3

finite element analysis

FEA

examination of a phenomenon with the *finite element method* (3.1.1.4)

Note 1 to entry: FEA as applied in engineering is a computational tool for performing engineering analysis. It includes the use of mesh generation techniques for dividing a complex problem into small elements, as well as the use of software program coded with FEM algorithm.

3.1.1.4

finite element method

FEM

numerical method for solving problems of engineering and mathematical physics

Note 1 to entry: FEM is best understood from its practical application, known as *finite element analysis* (3.1.1.3).

3.1.1.5

differential strength type

DS

control device which includes *pressure-containing parts* (3.1.2.7) with different *design pressure* (3.1.4.3)

3.1.1.6

gas infrastructure

pipeline systems including pipework and their associated stations or plants for the transmission and distribution of gas

Note 1 to entry: Natural gas infrastructure is a highly integrated system of transmission and distribution pipelines (including regulating, measuring and compression stations), and storage facilities.

[SOURCE: ISO 20675:2018, 3.26, modified — Note 1 to entry has been added.]

3.1.1.7

high pressure control

device which directly or indirectly controls the gas pressure/flow and/or provides a safety function

3.1.1.8

integral strength type

IS

control device which includes all *pressure-containing parts* ([3.1.2.7](#)) with the same *design pressure* ([3.1.4.3](#))

3.1.1.9

manufactured gas

synthetic gas

gas which has been treated and may contain components that are not typical of natural gas

Note 1 to entry: Manufactured (synthetic) gases may contain substantial amounts of chemical species that are not typical of natural gases or common species found in atypical proportions as in the case of wet and sour gases.

Note 2 to entry: Manufactured gases fall into two distinct categories, as follows:

- a) those that are intended as synthetic or substitute natural gases, and that closely match true natural gases in both composition and properties;
- b) those that, whether or not intended to replace or enhance natural gas in service, do not closely match natural gases in composition.

Case b) includes gases such as town gas, (undiluted) coke oven gas, and LPG/air mixtures, none of which is compositionally similar to a true natural gas (even though, in the latter case, it may be operationally interchangeable with natural gas).

[SOURCE: ISO 14532:2014, 2.1.1.4]

3.1.1.10

natural gas

NG

complex gaseous mixture of hydrocarbons, primarily methane, but generally also including ethane, propane and higher hydrocarbons in much smaller amounts and some non-combustible gases, such as nitrogen and carbon dioxide

[SOURCE: ISO 14532:2014, 2.1.1.1]

3.1.1.11

non-destructive testing

NDT

wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage

3.1.1.12

shell

pressure-containing envelope of the control

3.1.1.13

control nominal size

DN

alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

Note 1 to entry: The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 2 to entry: In standards which use the DN designation system, any relationship between DN and component dimensions should be given, e.g. DN/OD or DN/ID.

[SOURCE: ISO 23550:2018, 3.17]

3.1.1.14**series of controls**

controls with the same design concept, but differing only in size

3.1.2 Terms related to components**3.1.2.1****main component**

part including *control member* (3.1.2.2), *control body* (3.1.2.3), actuator, casing of actuator, controller, pilot (only in pilot-controlled controls)

Note 1 to entry: The control can include additional devices such as a relief device and other *auxiliary devices* (3.1.2.12).

3.1.2.2**control member**

movable part of the control which is positioned in the flow path to restrict or to shut down the flow through the control

Note 1 to entry: A control member can be a plug, ball, disk, vane, gate, *diaphragm* (3.1.2.6), etc.

3.1.2.3**body**

main pressure-containing envelop which provides the fluid flow passageway and the pipe end connections

Note 1 to entry: The body is part of the shell.

3.1.2.4**valve seat**

corresponding sealing surface within a control which make full contact only when the *control member* (3.1.2.2), is in the closed position

[SOURCE: IEC 60534-1:2005, 3.2.4.1]

3.1.2.5**seat ring**

part assembled in a component of the control to provide a replaceable seat

3.1.2.6**diaphragm**

flexible member used as main diaphragm and diaphragm used to separate one chamber subjected to pressure into two parts with different pressure (e.g. balancing diaphragm)

3.1.2.7**pressure-containing part**

part whose failure to function results in a release of the retained fuel gas to the atmosphere

Note 1 to entry: These include bodies, *control member* (3.1.2.2), bonnets, the casing of the actuator, blind flanges and pipes for *process and sensing lines* (3.1.2.9) but exclude compression fittings, *diaphragms* (3.1.2.6), bolts and other fasteners.

3.1.2.8**inner metallic partition wall**

metallic wall that separates a chamber into two individual pressure-containing chambers at different pressures under normal operating conditions

3.1.2.9**process and sensing line**

line which connects sensing points to the control

Note 1 to entry: Sensing point is the point from which the monitored variable is fed to the control

Note 2 to entry: Sensing and process lines can be integrated into the control or external to the control. Lines with no internal flow are called "sensing lines" and those with internal flow are called "process lines".

3.1.2.10

breather line

line connecting the atmosphere side of the pressure detector element to atmosphere

3.1.2.11

exhaust line

line connecting the control or its fixtures to atmosphere for the safe exhausting of gas in the event of failure of any part

3.1.2.12

auxiliary device

any device [e.g. throttle devices, creep devices, *vent limiter* ([3.1.2.13](#)), etc.] functionally connected to the *main components* ([3.1.2.1](#)) of the control

3.1.2.13

vent limiter

unit with an automatic valve reacting on gas flow and/or pressure

3.1.3 Terms related to components of functional performance

3.1.3.1

inlet pressure

p_u

gas pressure at the inlet of the control

Note 1 to entry: All pressures specified in this document are static gauge pressures unless otherwise stated.

Note 2 to entry: Pressure is expressed in Pa, unless otherwise stated. 1 Pa = 0,001 kPa = 10^{-6} MPa = 10^{-5} bar = 0,1 mbar.

Note 3 to entry: For pressure expressed in bar: 1 bar = 1 000 mbar = 10^5 N/m² = 10^5 Pa = 10^{-1} MPa.

3.1.3.2

outlet pressure

p_d

gas pressure at the outlet of the control

Note 1 to entry: All pressures specified in this document are static gauge pressures unless otherwise stated.

Note 2 to entry: Pressure is expressed in Pa, unless otherwise stated. 1 Pa = 0,001 kPa = 10^{-6} MPa = 10^{-5} bar = 0,1 mbar.

Note 3 to entry: For pressure expressed in bar: 1 bar = 1 000 mbar = 10^5 N/m² = 10^5 Pa = 10^{-1} MPa.

3.1.3.3

differential pressure

Δp

difference between two values of pressure at two different points

Note 1 to entry: All pressures specified in this document are static gauge pressures unless otherwise stated.

Note 2 to entry: Pressure is expressed in Pa, unless otherwise stated. 1 Pa = 0,001 kPa = 10^{-6} MPa = 10^{-5} bar = 0,1 mbar.

Note 3 to entry: For pressure expressed in bar: 1 bar = 1 000 mbar = 10^5 N/m² = 10^5 Pa = 10^{-1} MPa.

3.1.3.4 atmospheric pressure

p_b
local static atmospheric absolute pressure in Pa (bar)

Note 1 to entry: All pressures specified in this document are static gauge pressures unless otherwise stated.

Note 2 to entry: Pressure is expressed in Pa, unless otherwise stated. $1 \text{ Pa} = 0,001 \text{ kPa} = 10^{-6} \text{ MPa} = 10^{-5} \text{ bar} = 0,1 \text{ mbar}$.

Note 3 to entry: For pressure expressed in bar: $1 \text{ bar} = 1\,000 \text{ mbar} = 10^5 \text{ N/m}^2 = 10^5 \text{ Pa} = 10^{-1} \text{ MPa}$.

3.1.3.5 normal conditions

situation where absolute pressure, p_n , is 101,325 kPa (1 013,25 mbar) and temperature, T_n , is 0 °C (t_n of 273,15 K)

Note 1 to entry: For calculation purposes, a value of 273 K is used in this document.

3.1.3.6 standard conditions

situation where absolute pressure, p_n , is 101,325 kPa (1013,25 mbar) and temperature, T_n , is 15 °C (t_n of 288,15 K)

Note 1 to entry: For calculation purposes, a value of 288 K is used in this document.

3.1.3.7 volumetric flow rate

Q_n
volume of gas which flows through the control per unit of time, re-calculated to *normal conditions* ([3.1.3.5](#))

Note 1 to entry: Volumetric flow rate is expressed in m^3/h at normal conditions.

3.1.3.8 vented flow rate

Q_v
flow rate vented to atmosphere via the *vent limiter* ([3.1.2.13](#)) with any value of expected pressure inside the chamber at atmosphere side (in normal operating conditions) of the pressure detecting element

Note 1 to entry: The vented flow rate is expressed as air flow rate in l/h under *normal conditions* ([3.1.3.5](#)).

3.1.3.9 vented flow rate limit

Q_{vl}
maximum flow rate limited by the *vent limiter* ([3.1.2.13](#)) with any value of expected pressure inside the chamber at atmosphere side (in normal operating conditions) of the pressure detecting element

Note 1 to entry: The maximum *vented flow rate* ([3.1.3.8](#)) is expressed as air flow rate in l/h under *normal conditions* ([3.1.3.5](#)).

3.1.3.10 sound pressure level

L_{pA}
logarithmic measure of the effective pressure of a sound relative to a reference value and A-weighting, expressed in decibels (dB)

Note 1 to entry: 'A' frequency weighting is the standard weighting of the audible frequencies and reflects the response of the human ear to noise.

Note 2 to entry: All pressures specified in this document are static gauge pressures unless otherwise stated.

Note 3 to entry: Pressure is expressed in Pa, unless otherwise stated. $1 \text{ Pa} = 0,001 \text{ kPa} = 10^{-6} \text{ MPa} = 10^{-5} \text{ bar} = 0,1 \text{ mbar}$.

Note 4 to entry: For pressure expressed in bar: $1 \text{ bar} = 1\,000 \text{ mbar} = 10^5 \text{ N/m}^2 = 10^5 \text{ Pa} = 10^{-1} \text{ MPa}$.

[SOURCE: IEC 61672:2013, 3.2 and 3.3]

3.1.4 Terms related to design and tests

3.1.4.1

component operating pressure

p

gas pressure occurring in any part of a control during operation

3.1.4.2

maximum component operating pressure

$p_{\max}$

highest operating pressure at which a component of a control continuously operates within specified conditions

3.1.4.3

design pressure

DP

pressure on which design calculation are based

Note 1 to entry: In particular, maximum pressure for which the *body* (3.1.2.3), its *inner metallic partition walls* (3.1.2.8) and some other *pressure-containing parts* (3.1.2.7) are designed in accordance with the strength requirements in this document.

3.1.4.4

specific design pressure

DPD

pressure for which some *pressure-containing parts* (3.1.2.7) of differential strength controls are designed where $DPD < DP$

3.1.4.5

test pressure

PT

pressure applied to a section of the control for a limited period of time in order to prove certain characteristics

3.1.4.6

limit pressure

p_l

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

3.1.4.7

safety factors

ratio of the *limit pressure* (3.1.4.6), p_l , to the maximum allowable *design pressure* (3.1.4.3), DP, or to the maximum allowable *specific design pressure* (3.1.4.4), DPD, applied to:

- the control *body* (3.1.2.3), S_b ;
- the other *pressure-containing parts* (3.1.2.7) of the control, S .

3.1.4.8

maximum inlet pressure

p_{umax}

highest *inlet pressure* (3.1.3.1) at which the control can continuously operate within specified conditions

3.1.4.9**maximum differential pressure** $\Delta p_{\max}$

highest value of allowable pressure difference between two parts of the control

3.1.4.10**nominal pressure****PN**

alpha-numerical designation relating to pressure that is a convenient round number for reference purposes.

Note 1 to entry: It is intended that all equipment of the same nominal size (DN) designated by the same PN number shall have the same mating dimensions appropriate to the type of end connections.

Note 2 to entry: The permissible working pressure depends upon materials, design and working temperature and has to be selected from the pressure/temperature rating tables in corresponding standards.

Note 3 to entry: It comprises the letters PN followed by a dimensionless whole number.

EXAMPLE PN 16.

[SOURCE: ISO 7268:1983, Clause 2, modified — In the definition, "A numerical" has been replaced with "alpha-numerical"; the 2 paragraphs after the definition have been moved to Notes 1 and 2 to entry; Note 3 to entry and the EXAMPLE have been added.]

3.1.4.11**pressure class****pressure rating designation****CL**

alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system. It comprises the word Class followed by a dimensionless whole number

Note 1 to entry: The number following the word Class does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 2 to entry: The designation Class is not meaningful unless it is related to the relevant component standard number.

Note 3 to entry: It is intended that all components with the same Class and NPS (see below) designations should have the same mating dimensions for compatible flange types.

EXAMPLE Class 150.

[SOURCE: EN 1759-1:2004 and ASME B 16.5:2003]

3.1.4.13**operating temperature range**

temperature range at which the control components and fixtures are capable of operating continuously.

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and the abbreviated terms given in [Table 1](#) apply.

Table 1 — Symbols and abbreviated terms with relevant subclauses and units

Symbol	Description	Subclause	Unit
CL	Pressure rating designation	3.1.4.11	—
DN	Control nominal size	3.1.1.13	—
Δp	Differential pressure	3.1.3.3	MPa (bar)

Table 1 (continued)

Symbol	Description	Subclause	Unit
$\Delta p_{\max}$	Maximum differential pressure	3.1.4.9	MPa (bar)
DP	Design pressure	3.1.4.3	MPa (bar)
DPD	Specific design pressure	3.1.4.4	MPa (bar)
DS	Differential strength	3.1.1.7	—
IS	Integral Strength	3.1.1.10	—
L_{pA}	Sound pressure level	3.1.3.10	In accordance with IEC 61672-1
NDT	Non-destructive test	3.1.1.11	—
p	Component operating pressure	3.1.4.1	MPa (bar)
p_b	Atmospheric pressure (absolute pressure)	3.1.3.4	MPa (bar)
p_d	Outlet pressure	3.1.3.2	MPa (bar)
$p_{d\max}$	Maximum outlet pressure	3.1.4.9	MPa (bar)
p_l	Limit pressure	3.1.4.6	MPa (bar)
$p_{\max}$	Maximum component operating pressure	3.1.4.2	MPa (bar)
p_n	Reference absolute pressure for normal and standard conditions = 101,325 kPa (1,013 25 bar)	3.1.3.5 ; 3.1.3.6	kPa (mbar)
p_u	Inlet pressure	3.1.3.1	MPa (bar)
PN	Nominal pressure	3.1.4.10	MPa (bar)
Q_v	Vented flow rate	3.1.3.8	m ³ /h
Q_{vl}	Vented flow rate limit	3.1.3.9	
Q_n	Volumetric flow rate	3.1.3.7	m ³ /h
S	Design safety factor for all pressure-containing parts except bodies	3.1.4.7	/
S_b	Design safety factor for body		/
t_n	Reference temperature for normal or standard conditions	3.1.3.5	K
T_n	Reference temperature for normal or standard conditions	3.1.3.6	°C

4 Classification

4.1 General

Where appropriate, controls are classified for the application according to relevant criteria listed below:

- operating temperature;
- strength.

Additional criteria for gas pressure regulators and safety shut-off devices are detailed in their specific control standards.

4.2 Temperature classes

This document considers the following temperature classes:

- Class 1: operating temperature range from -10 °C to 60 °C;
- Class 2: operating temperature range from -20 °C to 60 °C.

4.3 Strength types

This document considers the following strength types of controls:

- Type IS: (integral strength type);
- Type DS: (differential strength type).

5 Materials

5.1 General

The quality of materials, the dimensions used and the method of assembling the various parts shall be such that construction and performance characteristics are satisfactory for the intended application.

Compliance of materials shall be verified by reviewing technical documentation and verifying specific conformity assessment as presented in [5.3](#).

In the documentation, the selected material standards shall be declared as presented in [5.3](#).

5.2 Requirements

5.2.1 Requirements for metallic materials

5.2.1.1 Pressure-containing parts and inner metallic partition walls

The pressure-containing parts, including those that become pressure-containing parts in the event of diaphragm or differential pressure seal failure, and the inner metallic partition walls shall be constructed of materials:

- chemically resistant to the fuel gases listed in [Clause 1](#) and to the additive substances normally used for odorization and conditioning of gases;
- resistant to the permissible impurities in the gas;
- complying with the relevant international material standard for pressure application (chemical composition, mechanical characteristics and test procedures) and the restrictions given in [Table 2](#).

NOTE A list of possible materials is given in [Annex A](#).

5.2.1.2 Auxiliary devices, threaded sealing plugs, integral process and sensing lines, connectors and fasteners

Auxiliary devices, threaded sealing plugs, integral process and sensing lines, connectors and fasteners shall be constructed of materials:

- chemically resistant to the fuel gases listed in [Clause 1](#) and to the additive substances normally used for odorization and conditioning of gases;
- resistant to the permissible impurities in the gas;
- complying with the relevant international material standard (chemical composition, mechanical characteristics and test procedures) and the restrictions given in [Table 2](#).

NOTE A list of possible materials is given in [Annex A](#).

5.2.1.3 Other parts

Parts of controls not subjected to differential pressure and not included in 5.2.1.1 and 5.2.1.2 shall be constructed of materials:

- chemically resistant to the fuel gases listed in [Clause 1](#) and to the additive substances normally used for odorization and conditioning of gases;
- resistant to the permissible impurities in the gas.

Table 2 — Materials

Material group	Properties	Restrictions		
	$A_{\min}^a$ %	$DP_{\max}$ MPa (bar)	$(DP \cdot DN^b)_{\max}$ MPa · mm (bar · mm)	$DN_{\max}^e$ mm
Pressure-containing parts and inner metallic partition walls				
Rolled and forged steel ^c	16	10 (100)	—	—
Cast steel ^c	15	10 (100)	—	—
Spheroidal graphite cast iron ^d	7	2 (20)	150 (1 500)	1 000
	15	5 (50)	500 (5 000)	300
Malleable cast iron	6	2 (20)	100 (1 000)	100
Copper-zinc wrought alloys	15	10 (100)	—	25
Copper-tin and copper-zinc cast alloys	5	2 (20)	100 (1 000)	100
	15	10 (100)	—	25
Aluminium wrought alloys	4	2 (20)	—	50
	7	5 (50)	—	50
		10 (100)	—	25
Aluminium cast alloys	1,5	1 (10)	25 (250)	150
	4	2 (20)	160 (1 600)	1 000
Integral process and sensing lines				
Copper	—	2,5 (25)	—	—
Steel	—	10 (100)	—	—
Connectors				
Steel	8	—	—	—
Fasteners				
Steel for bolts, screws, studs	9	5 (50)	—	—
	12	10 (100)	—	—
NOTE For castings, the specified mechanical characteristics are those measured on machined test piece prepared from separately cast test samples in accordance with the relevant document for the selected materials. ^a A percentage elongation after fracture (see ISO 6892-1:2016, 3.4.2) (according to the applicable document, relevant to the chosen material). ISO 2566-1 and ISO 2566-2 can be useful references for conversion of elongation values. ^b The body inlet nominal size has to be considered. For the bodies of any pilot and auxiliary device, this term shall refer to their inlet connections. ^c The bending rupture energy measured in accordance with ISO 148-1 shall be not less than 27 J as average of three test pieces with minimum individual of 20 J at minimum operating temperature. For a minimum operating temperature of -20 °C, a bending rupture energy at -46 °C of minimum 14 J is accepted instead of a bending rupture energy of 27 J at -20 °C. ^d The bending rupture energy measured in accordance with ISO 148-1 shall be not less than 12 J, as an average of three test pieces with minimum individual of 9 J, as a minimum operating temperature of -20 °C (class 2) for $DP > 2,5$ MPa (25 bar). ^e $DN_{\max}$ refers to both inlet and outlet connection including technical solutions with enlarged outlet.				

5.2.2 Requirements for non-metallic materials

5.2.2.1 General

Non-metallic materials used for functional parts in contact with the gas shall be chemically resistant to the fuel gases listed in [Clause 1](#) and to the additive substances normally used for odorization and conditioning of gases. Furthermore, these materials shall be resistant to the permissible impurities in the gas.

5.2.2.2 Requirements for elastomers (including vulcanized rubbers)

Elastomeric materials shall be in accordance with the requirements shown in [Annex B](#) for fuel distributed gases in accordance with the classification of gas families and groups according to EN 437.

The following supplementary requirements should be considered:

- for diaphragms in communication to environmental conditions, the resistance to ozone;
- for seat rings and other elastomeric components subjected to erosion by flowing gas, the abrasion resistance and tear strength related to the design of the relevant components.

The characteristics of elastomeric materials shall be proved by a declaration of compliance with the order type 2,1 in accordance with ISO 10474:2013.

For spare parts made of elastomeric material, the installation, operation and maintenance manual of the control shall specify appropriate packing and storage requirements in order to minimize the deterioration of the elastomeric material (against UV radiations and ozone cracking).

5.2.2.3 Requirements for non-metallic materials different from those in [5.2.2.2](#)

The resistance to liquids of functional non-metallic parts shall meet the requirements in [Table 3](#). The change in mass after immersion for 7 days with a tolerance of ± 2 h at (23 ± 2) °C in test liquid B in accordance with ISO 1817, and after drying, shall comply the requirements in [Table 3](#).

Table 3 — Requirements for non-metallic materials different than those in [5.2.2.2](#)

Property	Determination of changes in mass	Requirements
Maximum change in mass after one week at $23\text{ °C} \pm 2\text{ °C}$	ISO 175	$\pm 5\%$
Maximum change in mass after drying in an oven at $70\text{ °C} \pm 2\text{ °C}$	ISO 175	$+5\%/-2\%$

5.3 Validation and test of materials

5.3.1 Material inspection documents of metallic pressure-containing parts and inner metallic partition walls

Metallic pressure-containing parts and inner metallic partition walls shall be validated according to the following classification and requirements:

- a) Pressure-containing parts and inner metallic partition walls of control bodies
 - Bodies used for controls with $DP \times \text{Volume} \geq 5$ (50) shall be accompanied by a material inspection certificate type 3.2 in accordance with ISO 10474:2013.

For these bodies when the material manufacturer has an appropriate quality-assurance system, an inspection certificate type 3.1 in accordance with ISO 10474:2013 may be used.

- Bodies used for controls with no safety function and $DP \times \text{Volume} < 5$ (50) shall be accompanied by a material test report at least type 2.2 in accordance with ISO 10474:2013.
- b) Pressure-containing parts and inner metallic partition walls of other components used for controls:
 - $DP \leq 2,5$ MPa (25 bar) can be accompanied by a material test report at least type 2.2 in accordance with ISO 10474:2013;
 - $DP > 2,5$ MPa (25 bar) shall be accompanied by a material inspection certificate at least type 3.1 in accordance with ISO 10474:2013.

5.3.2 Material inspection documents of threaded sealing plugs, integral process and sensing lines, connectors and metallic fasteners

Fasteners (bolts, screws, studs, nuts) and connectors (compression fittings) used in the pressure-containing parts of the controls shall bear the marking in accordance with applicable technical standards. They shall also be accompanied by a material test report type 2.2 in accordance with ISO 10474:2013.

5.3.3 Material inspection documents of non-metallic functional parts

Conformity of non-metallic materials used for functional parts in contact with the gas shall be verified by technical documentation review to check compliance with the requirements of [5.2.2](#).

5.3.4 Non-destructive testing for steel bodies

Raw materials for steel bodies shall be non-destructively tested in accordance with [Tables 9](#) and [10](#).

In the case of random inspection, if a casting/forging does not conform to the acceptance criteria, a further inspection sample of twice the original sample size from the production batch shall be examined. If one of these castings/forgings fails, the examination shall be extended to all castings/forgings in the production batch.

Any casting/forging that does not conform to the acceptance criteria shall be repaired according to an applicable procedure and then re-examined.

6 Design

6.1 General

6.1.1 Design approach

Conformity with the design requirements given in ISO 23555-1 is verified by:

- the test methods given herein or in the specific control standard; and
- using the construction materials specified in this document.

Alternative materials may be used if they provide performance at least equivalent to the specified materials.

Verification of compliance with general design requirements shall be made by technical documentation review and a combination of methods detailed in [6.2.3.1](#) to [6.2.3.2](#):

- calculations;
- experimental methods (e.g. lab tests).

Design strength of metallic pressure-containing parts and inner metallic partition walls shall be tested according to [6.2.3.3](#) and a combination of methods/tests detailed in [6.2.3.1](#) and [6.2.3.2](#).

6.1.2 Basic requirements

Controls shall be designed, manufactured and assembled so that the various functions operate correctly when installed and used according to the manufacturer's instructions.

All pressurized parts of a control shall withstand the mechanical and thermal stresses to which they are subjected without any deformation affecting safety.

Jointing compounds, such as liquids and pastes, shall not be used. However, jointing compounds may be used for permanent assemblies and shall remain effective under normal operating conditions.

When external protrusions or other external parts need special care to cover the hazards during transport and handling, the manual shall include the provisions to cover these risks.

The controls may include:

- two or more safety or regulating control devices, complying with the requirements in ISO 23555-2;
- a token creep relief device, complying with the requirements in ISO 23555-2:2022, Annex H;
- a vent limiter, in accordance with the requirements in [Annex C](#);
- auxiliary devices.

When controls incorporate electric devices (e.g. micro-switches, proximity switches), these integral electric devices shall not impact with the performance of the control. The integral electric device shall comply with their relevant product standard.

The control shall be protected against the relevant environment.

6.1.3 Hazard identification and residual risks

The operating instructions (installation, operation and maintenance manual) shall include information concerning the pressure residual risks not covered by design (see also ISO/IEC 27000:2018, 3.57).

NOTE Regulators require suitable field surveillance to guard against unnoticed deterioration of key components such as the seat-ring, sensing element, O-ring seals, etc. The frequency of such checks depends on the operating duty.

6.1.4 End connections

End connections can be one of the following:

- flanged connections in accordance with the applicable parts of the ISO 7005 series (some parts of these documents can be replaced by the equivalent documents when they are available);
- flangeless type (e.g. wafer body);
- threaded connections in accordance with ISO 7-1 for:
 - $DN \leq 50$;
 - $DN \leq 80$ and $DP \leq 1,6 \text{ MPa}$ (16 bar);
 - compression fittings for $DN \leq 50$;
- butt weld connections in accordance with EN 12627.