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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

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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).

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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 ≤200 $m^3/h$ (normal conditions) and declared maximum inlet pressure ≤500 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 terminological 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/m$^2$ = $10^5$ 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/m$^2$ = $10^5$ Pa = $10^{-1}$ MPa.

**3.1.3.3**
**differential pressure**
$\Delta p$
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/m$^2$ = $10^5$ 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 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/m$^2$ = $10^5$ Pa = $10^{-1}$ 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 m³/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.