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Third edition
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Safety and control devices for gas and/or oil burners and appliances — General requirements

Dispositifs de commande et de sécurité pour brûleurs à gaz et appareils à gaz — Exigences générales

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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 on 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 the following URL: 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*.

This third edition cancels and replaces the second edition (ISO 23550:2011), which has been technically revised. The main changes compared to the previous edition are as follows:

— a new structure has been introduced with a clear separation between general statements, requirements and test;

— this document has been updated and aligned with the relevant parts of IEC 60730-1:2013;

— the Scope now specifies controls for use at maximum operating pressures up to and including 500 kPa;

— the Introduction and Clauses 2 and 3 have been updated;

— the structure of Clauses 4 to 10 have been modified;

— in Formula (2), the air flow rate at standard conditions has been corrected;

— Annexes D to H have been created;

— the Bibliography has been updated.

Introduction

This document provides general requirements for controls and safety devices for gas burners and gas burning appliances, and is intended to be used in conjunction with the ISO 23551, ISO 23552 and the ISO 23553 series for specific types of controls, 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.

Where 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 for gas burners and gas burning appliances using fuel need to withstand the type of gas which is specified. Other ISO Technical Committees, e.g. 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 fuel depending on its source/region of origin, certain differences in regulations exist at present in different regions, some of which are presented in Annexes F, G and H. This document intends to provide a basic framework of requirements until these differences can be harmonized.

Safety and control devices for gas and/or oil burners and appliances — General requirements

1 Scope

This document specifies safety, construction, performance and testing requirements for controls for gas burners and gas burning appliances for use with natural gas, manufactured gas or liquefied petroleum gas (LPG).

This document applies to controls for use at maximum operating pressures up to and including 500 kPa. This document provides the general requirements that are intended to be the basis for the specific control standards found in the ISO 23551 and ISO 23552 series. These include the following:

— automatic and semi-automatic gas valves;

— gas thermoelectric flame supervision controls;

— gas and oil /air ratio controls;

— gas pressure regulators;

— manual gas valves;

— mechanical gas thermostats;

— multifunctional gas controls;

— air and gas pressure-sensing devices;

— gas vent valves;

— gas valve-proving systems.

This document covers type testing only.

This document is also applicable to Gas Quick Connectors (GQC) for use inside appliances with connections up to, and including DN 25, and a maximum operating pressure up to and including 100 kPa. GQCs include:

— tube to tube connections;

— tube to control connections; and

— tube to fitting connections.

This document does not apply to mechanical controls for use with liquid fuels. It is also not applicable to corrosive and waste gases.

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.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 262, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*

ISO 815, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

ISO 1400, *Vulcanized rubbers of high hardness (85 to 100 IRHD) — Determination of hardness*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 7005-1, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60730-1, *Automatic electrical controls — Part 1: General requirements*

IEC 60079-11, *Explosive atmospheres — Part 11: Equipment protection by intrinsic safety "i"*

IEC 61643-11, *Low-voltage surge protective devices — Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods*

3 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
breather hole
orifice which allows atmospheric pressure to be maintained within a compartment of variable volume

3.2
closure member
movable part of the *control* (3.3) which shuts off the gas flow

3.3
control
device which directly or indirectly controls the gas flow and/or provides a safety function within a burner or gas-burning appliance

3.4
external leak-tightness
leak-tightness of a gas-carrying compartment with respect to the atmosphere

3.5
internal leak-tightness
leak-tightness of the *closure member* (3.2) (in the closed position) sealing a gas-carrying compartment with respect to another compartment or to the outlet of the *control* (3.3)

3.6
inlet pressure
pressure at the inlet of the *control* (3.3)

3.7
outlet pressure
pressure at the outlet of the *control* (3.3)

3.8
pressure difference
difference between the *inlet pressure* (3.6) and the *outlet pressure* (3.7)

3.9
operating pressure
pressure at which the *control* (3.3) operates

3.10
maximum operating pressure
highest inlet pressure declared by the manufacturer at which the *control* (3.3) may be operated

3.11
flow rate
volume flowing through the *control* (3.3) divided by time

3.12
rated flow rate
air *flow rate* (3.11) at a specified pressure difference declared by the manufacturer, corrected to standard conditions

3.13
maximum ambient temperature
highest temperature of the surrounding air declared by the manufacturer at which the *control* (3.3) may be operated

3.14
minimum ambient temperature
lowest temperature of the surrounding air declared by the manufacturer at which the *control* (3.3) may be operated

3.15
mounting position
position declared by the manufacturer for mounting the *control* (3.3)

Note 1 to entry: Mounting positions are for example as follows:

— upright: single position on a horizontal axis with respect to the inlet connection, as specified by the manufacturer;

— horizontal: any position on a horizontal axis with respect to the inlet connection;

— vertical: any position on a vertical axis with respect to the inlet connection;

— limited horizontal: any position from upright to 90° (1,57 rad) from upright on a horizontal axis with respect to the inlet connection;

— multi-positional (multipoise): any position on a horizontal, vertical or intermediate axis with respect to the inlet connection.

3.16
diameter nominal
DN
nominal size
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 those 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 6708:1995, 2.1, modified — The two sentences have been merged into one.]

3.17
type testing
conformity testing on the basis of one or more specimens of a product representative of the production

[SOURCE: ISO 8655-1:2002, 3.2.2]

3.18
main diaphragm
flexible member which, under the influence of the forces arising from loading and pressure, operates the *control member*

3.19
gas quick connector
GQC
connector consisting of *fastener* (3.20), *socket* (3.21), *plug* (3.22) and *seal* (3.23)

Note 1 to entry: Specific requirements for GQCs are found in Annex D.

3.20
fastener
clip retaining the connection of *plug* (3.22) and *socket* (3.21)

3.21
socket
outside part of the *GQC* (3.19)

3.22
plug
inside part of the *GQC* (3.19)

3.23
seal
gas seal between the *socket* (3.21) and the *plug* (3.22)

3.24
sealing cap
removable cover or device that allows access to make adjustments to the *control* (3.3)

3.25
auxiliary channel
passageway that supports the intended function of the *control* (3.3)

3.26
vent limiter
device to limit leakage to atmosphere

3.27
pre-setting device
device for adjusting an operating condition

3.28
installation and operating instructions
manufacturer's information to install, operate and maintain the control

4 Classification

4.1 Classes of control

Where appropriate, controls are classified for the application (for example. construction or performance characteristics, number of operations during their working life). For classification of controls, see the specific control standard.

4.2 Groups of controls

Controls are grouped according to the bending stresses which they are required to withstand (see Table 7):

a) **Group 1 controls** — Controls with connection sizes up to and including DN 25, for use in an appliance where they are not subjected to bending stresses imposed by installation pipe work or in an installation if used with rigid adjacent supports.

NOTE 1 In Canada, Japan and the USA, group 1 controls are not used.

b) **Group 2 controls** — Controls for use in any situation, either internal or external to the appliance, typically without support.

NOTE 2 Controls which meet the requirements of group 2 control also meet the requirements of group 1 control.

4.3 Types of DC supplied controls

DC supplied controls are classified in one of the three following types:

— Type A: Stand-alone battery systems;

— Type B: Battery systems for non-stationary applications (i.e. applications which are changing location or in motion);

— Type C: Systems which are intended to be connected to DC supply networks.

4.4 Classes of control functions

Classes of control functions are only applicable to functions consisting fully or partly out of electronics.

For the evaluation of protective measures for fault tolerance and avoidance of hazards, it is necessary to classify control functions with regard to their fault behaviour.

At the classification of control functions, their integration into the complete safety concept of the appliance shall be taken into account.

For the purpose of evaluating the design of a control function, the present requirements recognize three distinct classes according IEC 60730-1:2013, H.2.22, as follows:

— **Class A control function**: Control functions which are not intended to be relied upon for the safety of the application.

— **Class B control function**: Control functions which are intended to prevent an unsafe state of the appliance. Failure of the control function does not lead directly to a hazardous situation.

— **Class C control function**: Control functions which are intended to prevent special hazards such as explosion or whose failure can directly cause a hazard in the appliance.

This classification shall be specified in every product standard.

5 Test conditions and tolerances

5.1 Test conditions

Unless otherwise stated, the tests shall be carried out

— with air at (20 ± 5) °C; and

— at ambient temperature (20 ± 5) °C.

All measured values shall be corrected to standard conditions: 15 °C, 101,325 kPa (1 013,25 mbar) dry.

NOTE Specific regional requirements are given in H.2.1.

All measurements shall be made after stable conditions have been reached.

Controls which can be converted to another gas type by exchanging components are additionally tested with the conversion components.

Tests shall be carried out in the mounting position as stated in the installation and operating instructions. When multiple mounting positions are specified, tests shall be conducted with the control in the least favourable position.

Where possible, the tests already covered by other standards (e.g. by relevant parts of IEC 60730-1) shall be combined with tests presented in this document.

5.2 Tolerances

Unless otherwise stated in specific clauses, measurements shall be carried out with the maximum tolerances indicated below:

— Absolute pressure ±4 %;

— Relative pressure ±2 % of the measured value, whichever is greater (e.g. gauge pressures or differential pressures);

— Flow rate ±3 % of the measured value;

— Leakage rate ±10 cm^3/h (the apparatus shown schematically in Annex B or another device giving equivalent results is used.);

— Time ±0,1 % or ±0,2 s, whichever is greater;

— Temperatures ±1,5 K;

— Torque ±10 %;

— Force ±10 %;

— Current ±1 %;

— Voltage ±1 %;

— Electrical power ±2 %;

— Supply frequency ±0,1 Hz.

The full range of the measuring apparatus is chosen to be suitable for maximum anticipated value.

For uncertainty of measurements, refer to ISO/IEC Guide 98-3.

6 Construction

6.1 General

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

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

In general, conformity with the requirements given in ISO/IEC International Standards is verified by:

— the test methods given therein or in the specific control standards; or

— the use of the construction materials specified in the requirements.

Depending on the class of control function in 4.4, the control shall be tested according to the electrical requirements of the relevant clauses of IEC 60730-1:2013, Annex H.

6.2 Construction requirements

6.2.1 Appearance

6.2.1.1 General

Controls shall be suitable for the intended use. Handling, installation and maintenance shall be possible without special equipment.

6.2.1.2 Requirements

Controls shall be free from sharp edges and corners which can cause damage, injury or incorrect operation. All parts shall be clean internally and externally.

6.2.1.3 Test

Compliance shall be verified by visual inspection.

6.2.2 Holes

6.2.2.1 General

Holes for screws, pins, etc., used for the assembly of parts of the control or for mounting, shall not penetrate gas ways.

6.2.2.2 Requirements

The wall thickness between these holes and gas ways shall take into account the design, material selected and method of manufacturing and be at least 1 mm nominal for casted parts. Holes necessary during manufacture, which connect gas passageways to atmosphere but do not affect the operation of the control, shall be permanently sealed by metallic means. Suitable jointing compounds may additionally be used.

6.2.2.3 Test

Subject to verification by measurement and technical documentation.

6.2.3 Breather holes

6.2.3.1 General

Controls which utilize a partition diaphragm, bellows, or similar construction as the only seal against atmospheric pressure shall have provisions to limit the leakage against atmosphere.

6.2.3.2 Requirements

Breather holes shall be designed so that, when the main diaphragm is damaged, the air flow rate through the hole shall not exceed the maximum flow rate as declared by the manufacturer.

Breather holes shall be protected against blockage, or they shall be located such that they do not easily become blocked.

Breather holes shall be positioned or protected in such a way that the diaphragm cannot be damaged by a sharp device (like a pin of less than 1 mm diameter) inserted through the breather hole.

6.2.3.3 Test

Rupture the dynamic part of the main diaphragm. Ensure that the control is leak-tight except through the breather hole and that all closure members of the control, if any, are in the open position. Pressurize all gas-carrying compartments to the maximum operating pressure and measure the leakage rate.

6.2.4 Vent limiter

6.2.4.1 General

Particular provisions to limit the leakage against atmosphere can be provided by a vent limiter. Vent limiter are used according to specific installation and assembly requirements.

6.2.4.2 Requirements

Vent limiter shall be of material with a melting point of 427 °C or above. Vent limiters shall limit the flow through the vent, as shown in Table 1 when tested at room temperature.

Table 1 — Maximum allowable vent limiter venting rate

Type of vent limiter	Specific gravity	Maximum allowable flow rate dm^3/h
Vent limiter for use only with natural, manufactured, mixed gases and LP gas-air mixtures	0,64	70,8
Vent limiter for use with liquefied petroleum gas	1,53	28,3

6.2.4.3 Test

Separate vent limiters shall be mounted upright and pressurized in a gas tight apparatus so test air flows through the vent limiter only. Vent limiters integral to the control, shall have the control mounted upright and pressurized in a gas tight apparatus with the diaphragm substantially removed.

The flow rate shall be measured at pressures from 498 Pa to the maximum operating pressure of the control and corrected for a specific gravity of 1,53 for vent limiters used with liquefied petroleum

gases, and a specific gravity of 0,64 for natural, manufactured, mixed gases and LP gas-air mixtures. The corrected flow rate shall not exceed the maximum allowable specified values in Table 1.

If the vent limiter is not a limiting orifice type and is specified for additional mounting positions, retesting in the most critical specified position is necessary.

6.2.5 Screwed fastenings

6.2.5.1 General

Screwed fastenings which can be removed for servicing or adjustment shall have threads in accordance with ISO 262 unless a different thread is essential for the correct operation or adjustment of the control

6.2.5.2 Requirements

Self-tapping screws which cut a thread and produce swarf (metal residue) shall not be used for connecting gas-carrying parts or parts which can be removed for servicing.

Self-tapping screws which form a thread and do not produce swarf may be used provided that they can be replaced by screws conforming to ISO 262.

6.2.5.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.2.6 Moving parts

6.2.6.1 General

The operation of moving parts (e.g. diaphragms, drive shafts) shall not be impaired by other parts of the control.

6.2.6.2 Requirements

There shall be no exposed moving parts which can adversely affect the operation of controls.

6.2.6.3 Test

Compliance shall be verified by visual inspection.

6.2.7 Sealing caps

6.2.7.1 General

A sealing cap may be used to protect from unintentional access to internal components and can provide a means to indicate tampering.

6.2.7.2 Requirements

Sealing caps shall be capable of being removed and replaced with commonly available tools.

Sealing caps shall not hinder adjustment within the whole adjustment range as declared by the manufacturer.

6.2.7.3 Test

The device is tested for its specific function over the full range of adjustment with the sealing cap in place.

6.2.8 Disassembling and assembling for servicing and/or adjustment for controls

6.2.8.1 General

Parts of controls which are intended to be dismantled for servicing or adjustment shall be capable of being dismantled and reassembled considering specific provisions. Disassembling and assembling shall be in accordance with the installation and operating instructions.

6.2.8.2 Requirements

Parts of controls shall be constructed or marked in such a way that incorrect assembly is impossible when following the installation and operating instructions.

Closure parts, including those of measuring and test points, which are dismantled for servicing or adjustment shall be constructed such that leak-tightness is achieved by mechanical means (e.g. metal-to-metal joints, O-rings) without using jointing compounds such as liquids, pastes or tapes.

Closure parts not intended to be dismantled shall show evidence of interference (e.g. lacquer), or fixed by fasteners requiring tools that are not commonly available.

6.2.8.3 Test

Compliance shall be verified by technical documentation review and by the test presented in 7.2.

6.2.9 Auxiliary channels and orifices

6.2.9.1 General

Auxiliary channels and orifices, which can be used in a control for example in automatic valves, pressure regulators etc., have a risk of being blocked.

6.2.9.2 Requirements

Blockage of auxiliary channels and orifices shall not adversely affect the operation of the control. Otherwise, they shall be protected against blockage.

6.2.9.3 Test

Compliance shall be verified by visual inspection.

6.2.10 Pre-setting device

6.2.10.1 General

Pre-setting devices shall only be adjustable by use of a tool. The means of adjustment shall be easily accessible and shall not change of its own accord.

6.2.10.2 Requirements

Interference with the means of adjustment other than authorized in the installation and operating instructions shall be visible [for example, use of a sealing (lacquer)].

Pre-setting devices that connects a gas-carrying part to atmosphere shall be made sound by a means which shall not seal on the thread of the pre-setting means (for example, use of an O-ring seal).

The pre-setting devices shall not be able to fall off. If an O-ring or equivalent gasket provides a seal against the atmosphere, then when the pre-setting device is completely unscrewed, it shall not be able to be pushed out by gas pressure and shall remain tight at the maximum inlet pressure.

If pre-setting devices are used for different gas families, it shall have a fixed minimum orifice. A cover of any pre-setting device shall require a tool for removal and replacement and they shall not interfere with other settings.

6.2.10.3 Test

Compliance shall be verified by technical documentation review and by the test presented in 7.2.

6.3 Materials

6.3.1 General material requirements

6.3.1.1 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 safe.

6.3.1.2 Requirements

Performance characteristics shall not alter significantly during a reasonable lifetime when installed and used as stated in the installation and operating instructions.

6.3.1.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.3.2 Housing

6.3.2.1 General

Housings of controls shall fulfil a limited leakage rate removal or fracture non-metallic parts. Sealing elements shall not be removed.

6.3.2.2 Requirements

Parts of the housing which directly or indirectly separate a gas-carrying compartment from atmosphere shall either:

a) be made from metallic materials with a melting point (solidus temperature) of not less than 427 °C; or

b) on removal or fracture of non-metallic parts other than O-rings, gaskets, seals and the sealing part of diaphragms, allow no more than 30 $dm^3 \cdot h^{-1}$ of air to escape at the maximum operating pressure when tested in accordance with 6.3.2.3.

NOTE Specific regional requirements are given in F.2.1 and H.2.2.

6.3.2.3 Test

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

6.3.3 Springs providing closing force and sealing force

6.3.3.1 General

Springs providing closing force and sealing force are applicable to gas controls.

Springs providing the closing and sealing force shall be designed for oscillating loads and for fatigue resistance.

6.3.3.2 Requirements

Springs with wire diameters up to and including 2,5 mm shall be made from corrosion-resistant materials.

Springs with wire diameters above 2,5 mm shall either be made from corrosion-resistant materials or shall be protected against corrosion.

6.3.3.3 Test

Closure springs shall be calculated and designed in such a way as to withstand oscillating loads and at least 10^6 operations.

If no satisfactory result can be provided, the springs shall be subjected to an endurance test of 2×10^6 operations under normal operating conditions.

6.3.4 Resistance to corrosion and surface protection

6.3.4.1 General

Resistance to corrosion and surface protection is applicable to gas controls.

Corrosive effects at control parts in contact with atmosphere or medium shall be considered.

6.3.4.2 Requirements

All parts in contact with gas, lubricants or atmosphere, and springs other than those covered by 6.3.3, shall be resistant against corrosion. The corrosion protection for springs and other moving parts shall not impair movement.

6.3.4.3 Test

Subject to verification by technical documentation.

6.3.5 Impregnation

6.3.5.1 General

Impregnation, if required to achieve tightness, shall be applied.

6.3.5.2 Requirements

If impregnation is part of the manufacturing process, it shall be carried out using an appropriate procedure, (e.g. vacuum or internal pressure, using appropriate sealing materials).

6.3.5.3 Test

The test shall be carried out according to 7.2.

6.3.6 Seals for glands for moving parts

6.3.6.1 General

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

6.3.6.2 Requirements

Sealing paste shall not be used.

Manually adjustable packing glands shall not be used for sealing moving parts.

Bellows shall not be used as the sole sealing element against atmosphere.

NOTE An adjustable gland set by the manufacturer and protected against further adjustments is considered to be non-adjustable.

6.3.6.3 Test

Subject to verification by technical documentation.

Compliance is verified by visual inspection.

6.3.7 Jointing

6.3.7.1 General

Jointing compounds for permanent assemblies shall remain effective under all declared operating conditions.

6.3.7.2 Requirements

Soldering or other processes where the jointing material has a melting point below 427 °C after application shall not be used for connecting gas-carrying parts, except for additional sealing.

NOTE Specific regional requirements are given in H.2.3.

6.3.7.3 Test

Subject to verification by technical documentation.

6.4 Connections

6.4.1 General

The types and sizes of connection shall be considered as properties required in the scope of the controls.

6.4.2 Connection sizes

Connection sizes of controls shall be suitable to the existing pipework and appliances (e.g. local facilities and utilities). Examples are provided in Table 2.

Table 2 — Connection sizes

Nominal size	External thread pipe size or Internal thread size flange/ control	For compression fittings, fibre seal and flare connections[a] making use of internal or external thread						Gas quick connect (GQC)
		Compression fitting[b]		Fibre seal connection		Flare connection[c]		
		Spanner size for union/ tubing nut[a]	Tube outside diameter	Spanner size for union nut[a]	Tube outside diameter	Spanner size for union/ tubing nut[a]	Tube outside diameter	Tube outside diameter
DN	inch	mm	mm	mm	mm	mm	mm	mm
6	1/8	13	≤5	13	≤5	13	≤5	≤5
8	1/4	16	≤8	16	≤8	16	≤8	≤8
10	3/8	19	≤12	19	≤12	19	≤12	≤12
15	1/2	24	≤16	24	≤16	24	≤16	≤16
20	3/4	32	≤22	32	≤22	32	≤22	≤22
25	1	39	≤28	39	≤28	39	≤28	≤28

[a] For illustration refer to Figure 1.

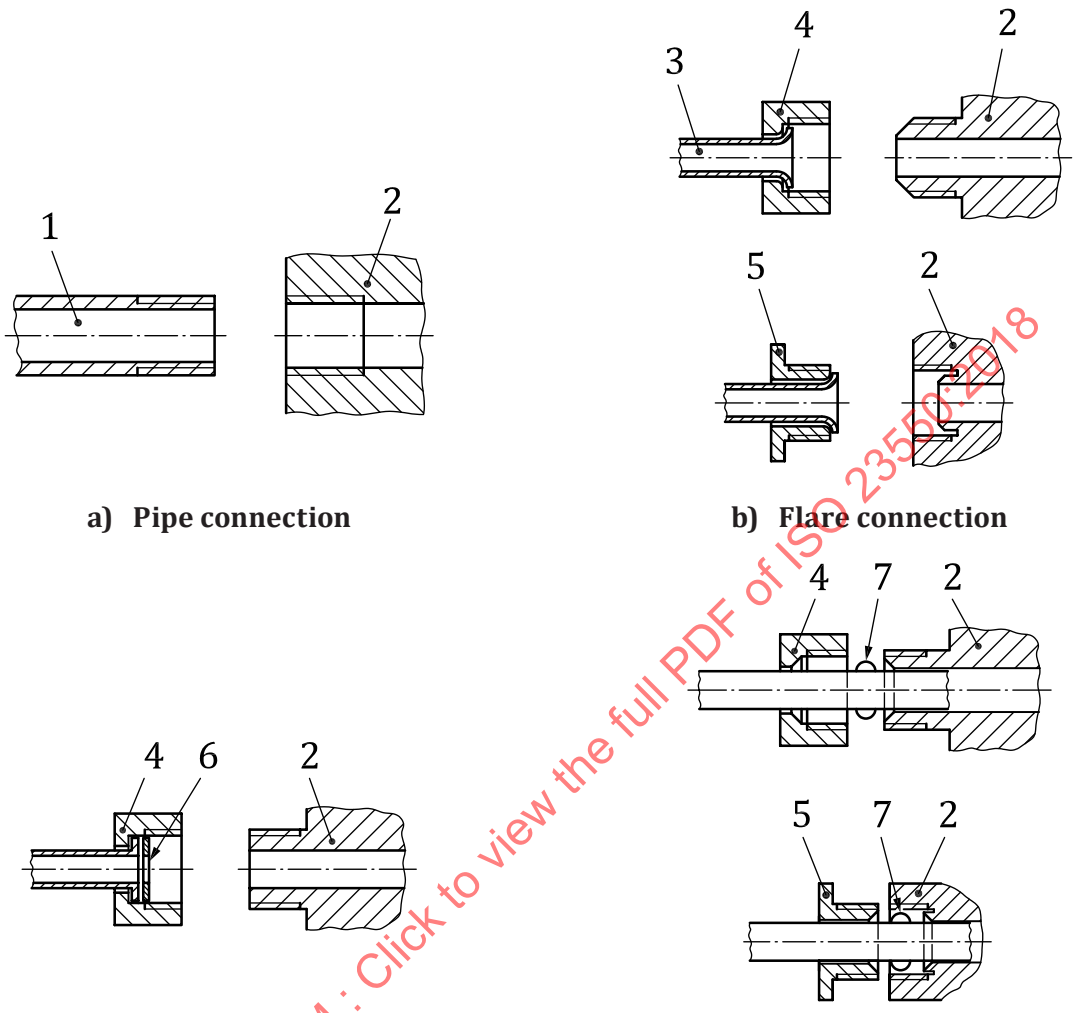
[b] So-called non-manipulative connection.

[c] So-called manipulative connection.

6.4.3 Connection types

The control housing shall be designed to accept commonly available tools in making all gas connections, e.g. by the provision of suitable spanner flats.

For illustration of common connection types see Figure 1.



a) Pipe connection

b) Flare connection

c) Fibre seal connection

d) Compression fitting

Key

1 pipe
2 control
3 tube
4 union nut
5 tubing nut
6 fibre nut
7 olive

Figure 1 — Types of connections

6.4.4 Threads

6.4.4.1 General

Threads shall conform to the relevant International Standards except where the infrastructure of gas supply and its connections are already established.

6.4.4.2 Requirements

Inlet and outlet threads shall conform to ISO 7-1 or ISO 228-1, and shall be chosen from the sizes given in Table 2.

Inlet and outlet gas connections shall be designed so that, when a pipe which is threaded two threads beyond standard size (for the size in question) is run into the threaded portion of a control body, it shall not adversely affect the operation of the control. The stop for the thread also satisfies the requirement.

6.4.4.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.5 Union joints

6.4.5.1 General

Union joints shall conform to the relevant International Standards except where the infrastructure of gas supply and its connections are already established.

6.4.5.2 Requirements

Connections with union joints shall conform to ISO 7-1 or ISO 228-1. When union joints do not comply with these standards, full details shall be provided.

6.4.5.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.6 Flanges

6.4.6.1 General

Flanges shall conform to the relevant International Standards. An exception to this shall be allowed for controls designed for use in countries where the infrastructure of gas supply and their connections are already established.

6.4.6.2 Requirements

Flanges shall conform to ISO 7005-1 and ISO 7005-2, PN (nominal pressure) 6 or PN 16.

When flanges do not comply with these standards, full details shall be provided.

6.4.6.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.7 Compression fittings

6.4.7.1 General

Connections with compression fittings shall consider the complete connection system.

6.4.7.2 Requirements

Compression fittings shall not be necessary to form the tubes before making connections. Olives shall be appropriate to the tubes for which they are intended. Non-symmetrical olives may be used provided they cannot be fitted incorrectly.

NOTE Specific regional requirements are given in G.2.1.

6.4.7.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.8 Flare connections

6.4.8.1 General

Connections with flare connections shall consider the complete connection system.

6.4.8.2 Requirements

Flare connections are necessary to form the tubes before making connections, following the installation and operating instructions.

6.4.8.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.9 Nipples for pressure tests

6.4.9.1 General

Nipples shall be designed to get connected to commonly available flexible tubes.

6.4.9.2 Requirements

The means for the pressure testing are provided, these shall either:

— be of the integral type with an outside diameter of $\left(9_{-0,5}^{\ 0}\right)$ mm and a useful length of at least 10 mm and the equivalent diameter of the bore shall not exceed 1 mm; or

— have a tapping sealed by a minimum 1/8 in NPT plug or cap with cleanly cut taper pipe threads in accordance with ANSI/ASME B 1.20.1 to accommodate a pressure test nipple. If the plug is of the slotted type, it shall also incorporate square or hexagonal flats.

When means for pressure testing do not comply with these testing accommodations, full details shall be provided.

6.4.9.3 Test

Compliance shall be verified by technical documentation review and visual inspection.

6.4.10 Strainers

6.4.10.1 General

Strainers are applicable to gas controls.

Strainer shall protect the control of particles which can have significant impact on safety related functional properties

6.4.10.2 Requirements

When an inlet strainer is used it shall prevent the passage of a 1 mm diameter pin gauge.

When an inlet strainer is not integral to the control, the installation instructions shall include relevant information on the use and installation of the strainer conforming to the above requirements.

6.4.10.3 Test

Subject to verification by technical documentation.

A 1 mm diameter pin gauge shall not pass through the strainer.

6.4.11 Gas connections by GQC

Shall be according to Annex D.

6.5 Gas controls employing with electrical components in the gas way

6.5.1 General

The use of electrical components in the gas way of a gas controls represents a risk of explosion in case an explosive gas/air mixture is present in the gas way. Such mixture can be the result of air diffusing into the gas valve.

6.5.2 Requirements

Gas controls employing electrical components in the gas way shall either

— meet the leakage requirements of 7.2 after the test of 6.5.3, or

— not represent an ignition source if tested according to 6.5.4.

This test shall not apply if the electrical components in the gas way are either

— rated less than 1 V and 0,5 W; or

— fulfil the requirements of IEC 60079-11.

6.5.3 Ignition trial test

Ignition test shall be performed by ignition trial from those points where un-insulated electrical parts are in contact with gas, which require a special preparation of the test sample.

The ignition test shall be done by making use of a sparking transformer with spark energy of at least 10 mJ.

Straight pipings of 1,5 m shall be attached to both the inlet and outlet connections of controls with a manual valve attached to each end of the straight piping. Piping diameter shall be equal to valve connections.

Test sequence:

— The test sample shall be activated to open position, if applicable.

— The two manual valves shall be opened.

— A gas-air test mixture comprised of 5 % propane and 95 % air (by volume) shall be introduced into the inlet end of the piping system.

— When a sufficient volume of the test mixture has been introduced to ensure uniform distribution of the gas-air test mixture throughout the piping system and the gas way of the test sample, the inlet manual valve shall be closed.

— The outlet manual valve shall be closed immediately thereafter.

— The control shall remain opened, if applicable and the sparking transformer activated ensuring that there is sparking on the ignition electrodes.

— After ignition of the gas-air test mixture, or if no ignition occurs after 10 seconds of sparking, the test is repeated with the test sample closed if applicable.

— In addition, for controls with a closure member, the following test shall be performed:

— After refilling the piping system and the gas way of the test sample with the gas-air test mixture, the inlet manual valve shall be closed. The control shall be closed immediately after.

— The outlet manual valve shall remain opened and the gas-air test mixture ignited.

These two tests shall be performed 3 times on each of two controls. If no ignition can be accomplished, the requirements are met.

If ignition can be accomplished, controls that are operable shall be cycled 5 times.

After that all controls, whether operable or not, shall be tested according to the leakage tests of 7.2.2.

6.5.4 Test of ignition source

The electrical components in the gas way shall be analysed with regard to specific standards (e.g. EN 1127-1:2011) as possible ignition sources in relation to the relevant gas compartment.

NOTE Electrical components representing an ignition source measures for avoidance by proper design or protective measures are specified in regional standards (e.g. EN 1127-1:2011).

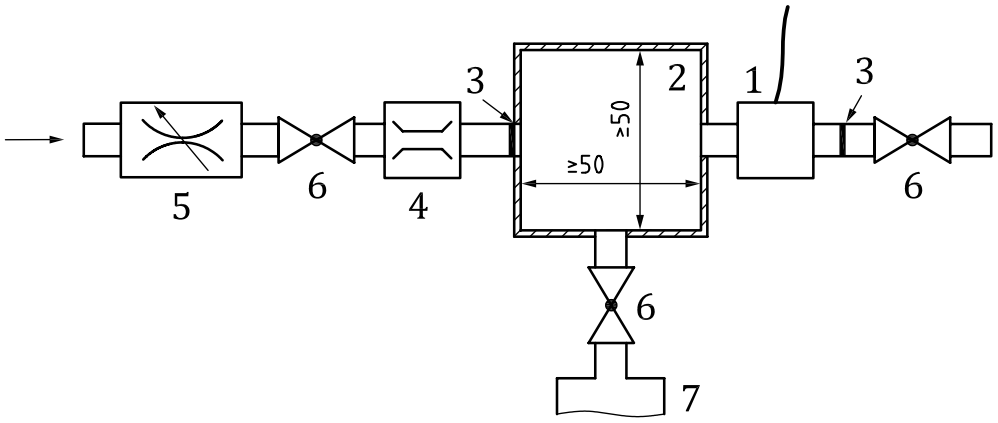
The experimental test setup is shown in Figure 2. The test chamber for explosion testing of the gas controls shall have a minimum volume of at least 1 dm^3 and shall withstand by choice of proper materials and design the changes of pressure and temperature during testing. The distance of opposite test chamber walls shall be at least 50 mm to avoid wall effects and to ensure in case of ignition, a proper ignition of the whole internal volume with the test gas.

— The gas-air test mixture shall consist of a mixture of 5,2 ± 0,5 Vol.-%.propane and 94,8 ± 0,5 Vol.-% air.

— The absolute pressure inside the test chamber shall be 101 kPa ± 10 %.

— The gas temperature inside the test chamber shall be at least 20 °C.

The control shall be adapted to the test chamber, the tapering of the cross-section of the connection to the test chamber shall be kept minimal. Alternatively, the part of the control that can be a possible ignition source is placed inside the test chamber. During the testing, the test chamber and the adapted gas control (if applicable) shall be gas tight. In case of a continuous flow, the test gas shall pass the gas control, or the test chamber and an appropriate flame retarding device at the exit. The test gas composition shall be ensured by measuring the gas concentration at the exit port of the test chamber. Inadmissible pressure increases in case of continuous flow mode and an ignition shall be avoided by use of burst discs or comparable means. The pressure relief of the burned gases and the exhaust gas of the test chamber shall be handled safely.



Key

1	test sample	7	restrictor
2	test chamber	8	valve
3	flame retarding device	9	burst disc
4	flow meter		

Figure 2 — Experimental setup for ignition testing

For the ignition testing with regard to the probability of ignition, the gas control shall be adapted to the test chamber as described by the manufacturer's installation manual, which comprises the pneumatical and electrical connections, power and control lines. Alternatively, the part of the control that is a possible ignition source is placed inside the test chamber. Exposed to the test gas, the gas control or the possible ignition source is operated such that each operating state is reached, but at least 10 times.

The control or the possible ignition source shall be operated under the following electrical conditions:

a) for AC supplied controls, at the most unfavourable voltage in the range from 85 % to 110 % of the rated supply voltage as stated in the installation and operating instructions (unfavourable in the sense of power input or a possible spark formation, e.g. in case of relay contacts);

b) for DC supplied controls a tolerance of 20 % to the minimum and the maximum rated voltage applies. For DC supplies of other types the tolerance shall be stated in the installation and operating instructions;

c) if any actuating member heats up, equilibrium shall be achieved (hottest surface temperatures).

These tests shall be performed on each of two test samples. If no ignition is accomplished, the controls are not representing an ignition source and the requirements are met.

7 Performance

7.1 General

Controls shall operate correctly under all combinations of the following:

— the full range of operating pressures, as stated in the installation and operating instructions;

— ambient temperature range from 0 °C to 55 °C or wider limits, if stated in the installation and operating instructions;

— in the mounting position declared by the manufacturer; if there are several mounting positions declared, tests shall be made in the least favourable position to check conformity to this requirement;

and additionally, for electrically operated controls:

— for AC supplied controls: voltage or current range from 85 % to 110 % of the rated supply value or from 85 % of the minimum rated value to 110 % of the maximum rated value and at rated frequency;

— for DC supplied controls (types A, B, and C as classified in 4.3), a tolerance of 20 % to the minimum and the maximum rated voltage applies. For DC supplied controls of other types, the tolerance shall be stated in the installation and operating instructions.

NOTE Specific regional requirements are given in H.2.5.

7.2 Leak-tightness

7.2.1 General

Controls shall be leak-tight when used in accordance with the installation and operating instructions.

7.2.2 Requirements

Controls shall not exceed the air leakage rates given in Table 3 and Table 4.

7.2.3 Test

7.2.3.1 General

Temperatures and pressures for leak-tightness are specified in Table 3 and Table 4.

Use a method which gives reproducible results. Examples of such methods are shown in Annex A (volumetric method) for test pressures up to and including 15 kPa.

Annex B (pressure loss method) for test pressures above 15 kPa.

Annex C shall be used to convert the pressure loss method to the volumetric method for pressures up to and including 15 kPa .

NOTE Specific regional requirements are given in G.2.2.

7.2.3.2 Test for external leak-tightness

Pressurize all gas carrying compartments of the control to the test pressures given in 7.2.3.1 and measure the leakage rate.

If the manufacturer declares its device as field serviceable (see 6.2.8), dismantle and reassemble closure parts five times in accordance with the manufacturer's instructions and repeat the test.

7.2.3.3 Test for internal leak-tightness of controls

For controls with any closure member in the closed position, pressurize the inlet of the control, in the direction of gas flow indicated, to the test pressures given in 7.2.3.1 and measure the leakage rate.

Table 3 — Maximum air leakage rates (external leak-tightness test)

Approach	Nominal inlet size mm	Leak-tightness $cm^3\ h^{-1}$	Test temperature	Test pressure
I[a]	DN < 10	20	Room temperature if between 0 °C and 55 °C or at minimum and maximum rated ambient temperature	The greater of 15 kPa or 150 % of the maximum operating pressure
	10 ≤ DN ≤ 25	40		
	25 < DN ≤ 250	60		
II[a]	All sizes	200		150 % of maximum operating pressure
III[a]	DN ≤ 25	30		125 % of maximum operating pressure
	DN > 25	60		110 % maximum operating pressure

[a] This document recognizes that different allowable leakage rates exist in various regions throughout the world. For this purpose, the country or region considering adoption of this document should choose the appropriate rates [i.e. approach I (China and Europe), II (USA and Canada) or III (Japan)] from the table above.

Table 4 — Maximum air leakage rates (internal leak-tightness test)

Approach	Nominal size mm	Leak-tightness $cm^3\ h^{-1}$	Test temperature	Test pressure
I[a]	DN < 10	20	Room temperature if between 0 °C and 55 °C or at minimum and maximum rated ambient temperature	0,5 kPa and the greater of 15 kPa or 150 % of the maximum operating pressure
	10 ≤ DN ≤ 25	40		
	25 < DN ≤ 80	60		
	80 < DN ≤ 150	100		
	150 < DN ≤ 250	150		
II[a]	Seal off diameter ≤ 25,4	235		For rated pressure ≤ 34,5, the test shall be performed at 0,5 kPa and 150 % of the maximum operating pressure
	DN > 25,4 seal off diameter	235 per 25,4 mm of seal-off diameter		For rated pressure > 34,5, the test shall be performed at 1,72 kPa and 150 % of maximum operating pressure
III[a]	DN ≤ 25	30		0,5 kPa and 4,2kPa for domestic use 125 % of maximum operating pressure for commercial and industrial use
	DN > 25	300 per 25,4 mm of seal-off diameter		0,5 kPa and 110 % maximum operating pressure

[a] This document recognizes that different allowable leakage rates exist in various regions throughout the world. For this purpose, the country or region considering adoption of this document should choose the appropriate rates [i.e. approach I (China and Europe), II (USA and Canada) or III (Japan)] from the table above.

7.3 Torsion and bending

7.3.1 General

Controls shall be constructed in such a way that they have adequate strength to withstand likely mechanical stress to which they may be subjected during installation and service.

After testing, there shall be no permanent deformation and any leakage shall not exceed the values specified in Table 3 and Table 4 or in the specific control standards.

7.3.2 Torsion

Controls shall withstand the torque specified in Table 7 when tested in accordance with 7.3.4.2 or 7.3.4.3.

7.3.3 Bending moment

Controls shall withstand the bending moment given in Table 7 when tested in accordance with 7.3.4.4. Group 1 controls shall additionally be tested in accordance with 7.3.4.5.

7.3.4 Torsion and bending tests

7.3.4.1 General

Use pipes in accordance with ISO 65, medium series.

Use only non-hardening sealing paste on connections.

Determine the appropriate tightening torque to be applied to flange bolts from the values in Table 5 in accordance with the standard series ISO 7005-1 and ISO 7005-2.

Table 5 — Tightening torque for flange bolts

Nominal size DN	6	8	10	15	20	25	32	40	50	65	80	100	125	≥150
Torque Nm	20	20	30	30	30	30	50	50	50	50	50	80	160	160

Test the gas control for external leak-tightness in accordance with 7.2.3.2 and internal leak-tightness in accordance with 7.2.3.3 where applicable, before carrying out torsion and bending tests.

Controls with compression fittings shall be subjected to the bending moment test by means of an adapter on the union threads.

NOTE 1 Torsion tests are not applicable to controls with flanged connections if these are the only means of connection.

NOTE 2 Bending moment tests are not applicable to controls with flanged or saddle-clamp inlet connections for attachment to cooking-appliance manifolds.

NOTE 3 Specific regional requirements are given in H.2.6.

7.3.4.2 Ten-second torsion test — Group 1 and group 2 controls with threaded connections

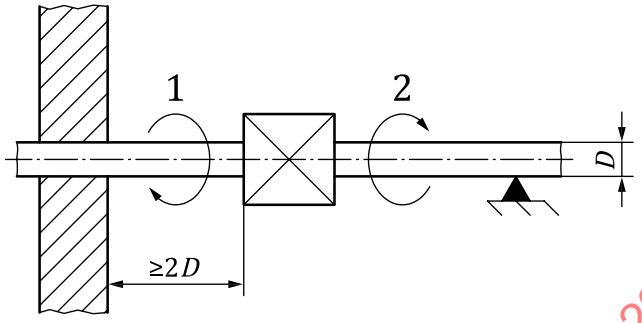
Screw pipe 1 into the control with a torque not exceeding the values given in Table 7. Clamp pipe at a distance at least 2*D* from the control (see Figure 3).

Screw pipe 2 into the control with a torque not exceeding the values given in Table 7. Ensure that all joints are leak-tight.

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

Progressively apply the appropriate torque to pipe 2 for 10 s without exceeding the values given in Table 7. Apply the last 10 % of the torque over a period not exceeding 1 min.

Remove the torque and visually inspect the control for any deformation, then test the control for external leak-tightness and internal leak-tightness where applicable.



Key

1 pipe 1

2 pipe 2

D = outside diameter

Figure 3 — Torsion test assembly

7.3.4.3 Ten-second torsion test — Group 1 and group 2 controls with compression joints

7.3.4.3.1 Olive-type compression joints

Use a steel tube with a new brass olive of the appropriate size.

Clamp the control body rigidly and apply the test torque given in Table 6 to every tubing nut in turn for 10 s.

Visually inspect the control for deformation, discounting any deformation of the olive seating or mating surfaces consistent with the applied torque. Test the gas control for external leak-tightness to 7.2.3.2 and internal leak-tightness to 7.2.3.3 where applicable.

7.3.4.3.2 Flared compression joints

Use a short length of steel tube with a flared end and follow the method given in 7.3.4.3.1, discounting any deformation of the cone seating or mating surfaces consistent with the applied torque.

7.3.4.3.3 Flanged or saddle-clamp inlet connections for attachment to cooking appliance gas manifolds

Attach the control to a manifold as recommended by the manufacturer and tighten the fixing screws to the recommended torque. Connect the olive or flared-type compression coupling and tighten to the specified torque, given in parentheses in column 2 (Copper, aluminium and thin wall steel tube) of Table 6 in accordance with the procedures given in 7.3.4.3.1 or 7.3.4.3.2, as appropriate.

7.3.4.4 Ten-second bending-moment test

Use the same control as for the torsion test, and the assembly as shown in Figure 4.

Calculate the force, *F*, from the required bending moment (Table 6 and Table 7) in accordance with Formula (1).

$$F = \frac{M}{l_v + 0{,}3} \tag{1}$$

where

F is the force in N;

M is the bending moment in Nm;

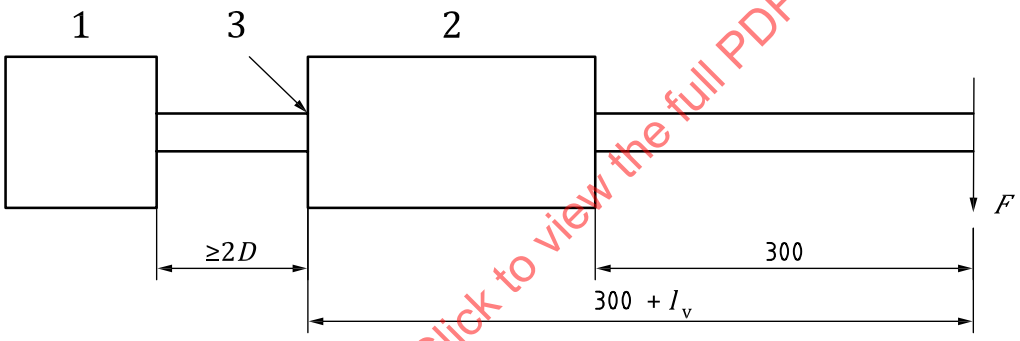
l_v is the length of the valve in m.

Apply the force at a distance of 300 mm from the control.

Remove the force and visually inspect the control for any deformation.

Test the gas control for external leak-tightness in accordance with 7.2.3.2 and internal leak-tightness in accordance with 7.2.3.3 where applicable.

Perform the test for each connection.



Key

1	clamp	*D*	tubing/pipe diameter
2	control	l_v	length of the valve
3	connection under test	*F*	force in N

Figure 4 — Bending-moment test assembly

7.3.4.5 900-s bending-moment test

Use the same control as for the torsion test and the assembly as shown in Figure 4.

Calculate the force, *F*, from the required bending moment (Table 6 and 7) in accordance with Formula (1).

Apply the force at a distance of 300 mm from the control.

With the force still applied, test the control for external leak-tightness in accordance with 7.2.3.2 and for internal leak-tightness in accordance with 7.2.3.3 where applicable.

Table 6 — Group 1 torque and bending moment for tubing

Tube size mm	Copper, aluminium and thin wall steel tube – Internal or external thread (for compression fittings CF/fibre seal/flare connections)			
	Torque Nm			Bending Nm
	CF	Fibre	Flare	900 s
≤5 mm	10	10	10	7
≤8 mm	15	15	15	10
≤12 mm	25	25	25	17
≤16 mm	40	40	40	35
≤22 mm	50	50	50	45
≤28 mm	75	75	75	80

Table 7 — Torque and bending moment for steel/iron pipe connections Group 1 and 2

Pipe thread connections inch	Thick wall steel/iron pipe			
	Torque Nm	Bending Nm		
		10 s (EU and China)		900 s
		Group 1	Group 2	EU = Group 1 US = Group 2 Japan = Group 2
1/8	15 (7) 19,2 15	15 —	25	7 2,78 18
1/4	20(10) 24,9 20	20 —	35	10 4,8 21
3/8	35(15) 31,6 30	35 —	70	20 6,9 24
1/2	50(15) 42,4 35	70 —	105	40 13,8 27
3/4	85 63,3 50	90 —	225	50 24,9 30
1	125 84,7 50	160 —	340	80 42 30
1 1/4	160	260	475	130 61
1 1/2	200	350	610	175 98

Table 7 *(continued)*

Pipe thread connections inch	Thick wall steel/iron pipe			
	Torque Nm	Bending Nm		
		10 s (EU and China)		900 s
		Group 1	Group 2	EU = Group 1 US = Group 2 Japan = Group 2
2	250	520	1 100	260 210
2 1/2	325	630	1 600	315 261
3	400	780	2 400	390 261
4	—	950	5 000	475 261
5	—	1 000	6 000	500 —
≥6	—	1 100	7 600	550 —

NOTE Values in parentheses are for controls with flanged or saddle-clamp inlet connections on cooking appliances.

7.4 Rated flow rate

7.4.1 General

Rated flow rates are applicable to gas controls.

The determination and indication of the rated flow rate is required to describe functional properties.

In some cases, the indicated flow rate can be a safety related control property.

7.4.2 Requirements

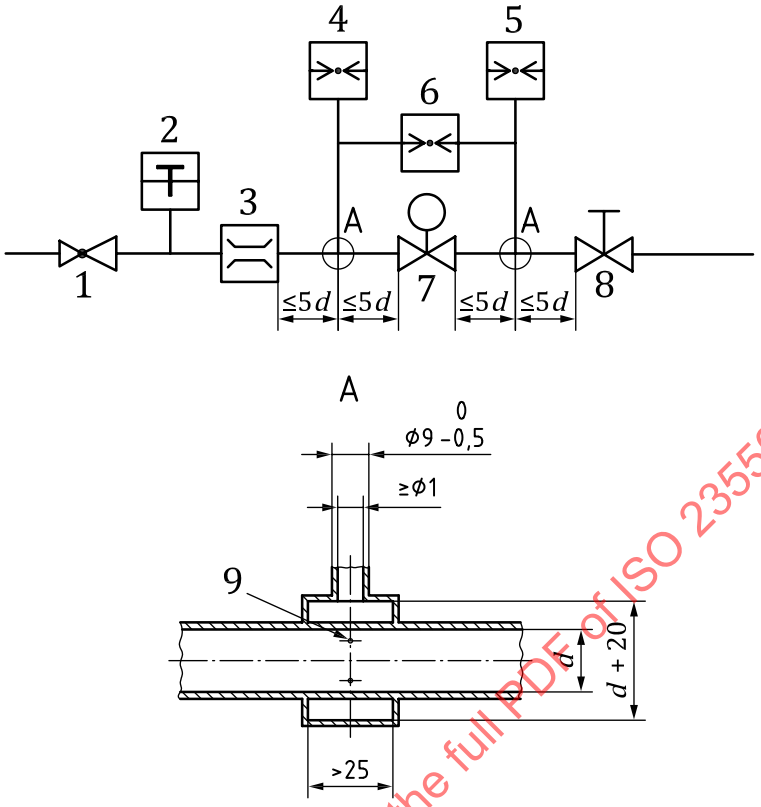
The maximum flow rate when measured according to 7.4.3 shall be at least 95 % of the rated flow rate.

7.4.3 Test

7.4.3.1 Apparatus

Carry out the test using the apparatus shown in Figure 5.

Dimension in millimetres



Key

1	adjustable governor for inlet pressure	6	differential pressure gauge
2	thermometer	7	control under test
3	flow meter	8	manual control tap
4	inlet pressure gauge	9	4 holes of 1,5 mm diameter
5	outlet pressure gauge	*d*	internal diameter

Nominal size DN	**Internal diameter** *d* mm
6	6
8	9
10	13
15	16
20	22
25	28
32	35
40	41
50	52
65	67
80	80

Figure 5 — Apparatus for flow rate test

7.4.3.2 Test procedure

Operate and adjust the control according to the manufacturer's instructions.

Adjust the air flow rate, keeping the inlet pressure constant to provide the manufacturer's declared pressure difference.

7.4.3.3 Conversion of air flow rate

Use Formula (2) for conversion of flow rate to standard conditions:

$$q_n = q \times \frac{p_a + p}{101{,}325} \times \frac{288{,}15}{273{,}15 + T} \quad (2)$$

where

q_n is the corrected air flow rate at standard conditions, in $m^3 \cdot h^{-1}$;

q is the measured air flow rate, in $m^3 \cdot h^{-1}$;

p is the test pressure, in kPa;

p_a is the atmospheric pressure, in kPa;

T is the air temperature, in °C.

NOTE Specific regional requirements are given in H.2.7.

7.5 Durability

7.5.1 Elastomers in contact with gas

7.5.1.1 General

Elastomers in contact with gases (e.g. valve pads, O-rings, diaphragms and lip seals) shall be homogeneous, free from porosity, inclusions, grit, blisters and other surface imperfections visible with the naked eye.

7.5.1.2 Requirements

Elastomers shall withstand gases.

7.5.1.3 Test

Subject to verification by technical documentation; applied gases shall be indicated.

7.5.2 Resistance of elastomers to lubricants and gases

7.5.2.1 General

Elastomers shall withstand the effects of gas and lubricants used at the control manufacturing or used for maintenance.

7.5.2.2 Requirements

Elastomers shall conform to the requirements in Annex E.

Alternatively, the following procedure is used:

Fill the control with the appropriate test liquids as specified in Annex E. After 70 h, drain the liquid and dry the control assembly for 70 h at 25 °C. The control shall function normally or fail in a safe manner (e.g. fail to open, etc.). The control shall also comply with 7.2.2.

7.5.2.3 Test

The resistance to gas of elastomers shall conform to the requirements in Annex E.

Alternatively, use the following procedure:

Use n-hexane to test controls designed for use with natural gas and LPG, and use ASTM swelling oil (IRM) to test controls designed only for use with natural gas.

Fill the control with the appropriate test liquids as specified in Table E.1, Note 2. After 70 h, drain the liquid and dry the control assembly for 70 h at 25 °C (77 °F). The control shall function normally or fail in a safe manner (e.g. fail to open, etc.). The control shall also comply with 7.2.3.

7.5.3 Marking resistance

7.5.3.1 General

Marking, e.g. labels, shall withstand the environmental influences within the appliance.

7.5.3.2 Requirements

Adhesive labels and all marking shall be tested for resistance to abrasion, humidity and temperature. Adhesive labels shall neither lift nor discolour such that the marking becomes illegible.

Specifically, markings on knobs shall survive the continual handling and rubbing resulting from manual operation.

7.5.3.3 Test

Carry out the tests according to the methods given in IEC 60730-1:2013, Annex A. Alternatively, the label shall be subject to verification by technical documentation to ensure equivalent marking resistance.

7.5.4 Resistance to scratching

7.5.4.1 General

Labels shall withstand mechanical impacts caused by mounting procedures, for example.

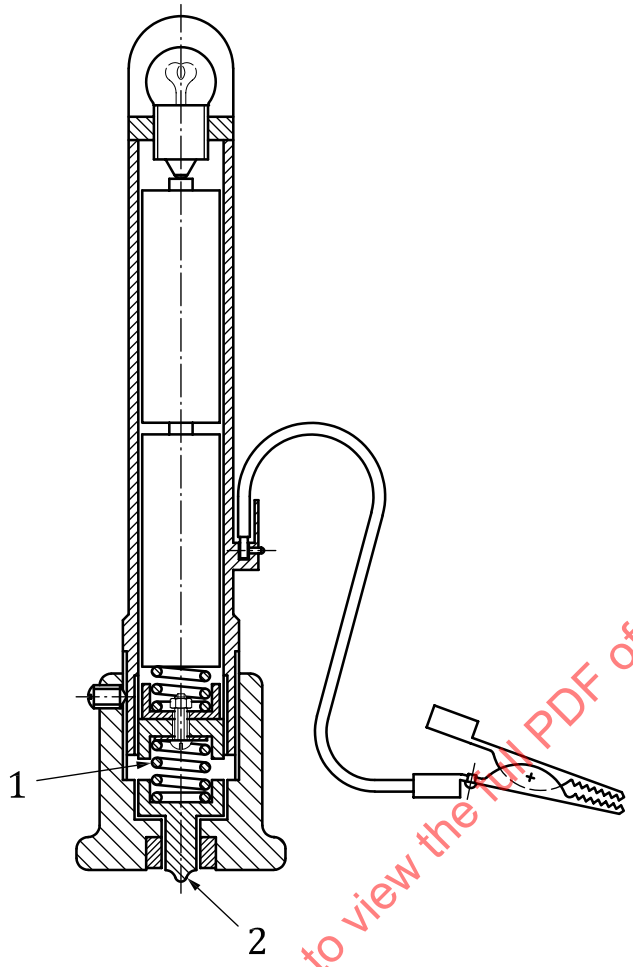
7.5.4.2 Requirements

Surfaces exclusively protected with paint shall withstand the scratch test before and after the humidity test without the ball penetrating the protective coating to expose bare metal.

7.5.4.3 Test

Draw a 1 mm diameter fixed steel ball across the surface of the control at a speed of 30 mm·s^{-1} to 40 mm·s^{-1} with a contact force of 10 N (see Figure 6).

Repeat the scratch test after the humidity test of 7.5.5.3.



Key

1 spring loading = 10 N

2 scratching point (steel ball, diameter 1 mm)

Figure 6 — Scratch test apparatus

7.5.5 Resistance to humidity

7.5.5.1 General

All parts, including those with protected surfaces (e.g. coated with paint or plating), shall withstand the humidity test without any signs of undue corrosion, lifting or blistering visible with the naked eye.

7.5.5.2 Requirements

If evidence of minor corrosion of a control part exists, the part shall be substantial enough to ensure an adequate margin for the safety of the control.

Nevertheless, those parts of the control whose corrosion can adversely affect the continued safe working of the control shall not show any signs of corrosion.

7.5.5.3 Test

Either the manufacturer shall show that all material used is resistant to corrosion caused by humidity, or the following test shall be applied.

Place the control in a chamber at an ambient temperature of (40 ± 2) °C with a relative humidity exceeding 95 % for 48 h. Remove the control from the chamber and examine it with the naked eye for signs of corrosion, lifting or blistering of the coated surface. Leave the control for a further 24 h at (20 ± 5) °C and carry out another examination.

7.6 Functional requirements

The requirements for functions and the relevant tests are given in the specific control standard.

7.7 Endurance

The requirements for endurance and the relevant tests are given in the specific control standard.

7.8 Vibration test

When resistance to vibration is declared by the manufacturer, the sinusoidal vibration test, as described below, shall be carried out.

The object of the test is to demonstrate the ability of the control to withstand the long-term effects of vibration at levels declared by the manufacturer.

During the exposures, the control shall be mounted on a rigid fixture by means of the specified fastening arrangement.

The test shall be performed in accordance with IEC 60068-2-6, test Fc.

The test is performed at least with the following severity conditions:

— Frequency range: 10 Hz to 150 Hz;

— Acceleration amplitude:

  — 10 Hz to 58 Hz: 0,075 mm or higher, if specified in the installation and operating instructions;

  — 58 Hz to 150 Hz: 9,8 m/s^2 or higher, if specified in the installation and operating instructions;

— Sweep rate: 1 octave per minute;

— Number of sweep cycles: 10 times;

— Number of axes: 3, mutually perpendicular;

A visual inspection shall be carried out after the termination of the exposure. No mechanical damage shall be found and the control shall comply with this document except for the construction requirements specified in the specific control standard. On completion of the vibration test, test the gas control for external leak-tightness to 7.2.3.2 and internal leak-tightness to 7.2.3.3 where applicable.

8 Electrical equipment

8.1 General

Controls with electrical and electronic components shall be subjected to testing to verify general and functional safety as specified in the product standard.

8.2 Requirements

The electrical equipment shall conform to the relevant requirements of IEC 60730-1:2013 concerning

— general electrical safety to avoid electric shock hazard, fire hazard and injury of moving parts;

— functional safety, when required, concerning class B control function or class C control function; and

— remotely actuated control functions with or without communication through public network (e.g. internet, cellular, wifi, Bluetooth, cloud).

Where relevant requirements are given in this document as well as in IEC 60730-1, the ones given in this document take precedence over those given in IEC 60730-1.

8.3 Test

For free standing and independently mounted controls, IEC 60730-1:2013, Clause 23 also applies.

If the supply voltage polarity can affect the safety, provisions shall be taken to avoid that the safety relevant output terminal(s) be unable to be de-energized, In case this is not feasible, clear warnings shall be given in the installation and operating instruction (see 10.2).

8.4 Protection by enclosure

The degree of protection for controls with their own enclosure shall be a minimum of IP40 in accordance with IEC 60529 or protection shall be provided by the appliance in which it is installed. For controls for use in the open air the protection shall conform to at least IEC 60529 IP 54.

9 Electromagnetic compatibility (EMC)

9.1 Protection against environmental influences

9.1.1 General

EMC applies to controls that incorporate electronic components.

EMC shall be applied during certain operating modes, e.g. stand-by, running, start-up or safe state, as specified in the product standards.

9.1.2 Requirements

Criterion **I:**

When tested at the test levels given in 9.2 to 9.12, the control shall continue to function in accordance with the relevant requirements of the specific control standards.

Criterion **II:**

When tested at the severity levels given in 9.2 to 9.12 the control shall:

— conform to Criterion I; or

— react within the fault reaction time by proceeding to a condition in which a safe situation is ensured; or

— for tests from 9.2 to 9.12, become inoperative and assuming a status in which a safe situation is ensured.

The tests on severity level 4 are only applicable if the control is intended to be used in appliances according to the IEC 60335 series.

NOTE 1 See IEC 60730-1:2013, Table 1, item 90.

A separate sample, as submitted, can be used for each test. As an option, multiple tests can be performed on a single sample.

NOTE 2 In EMC standards (e.g. IEC 61000-4-4), the term "control" is commonly referred to as EUT (equipment under test).

Additional test requirements for *DC* supplied controls of Type A, Type B or Type C (see 4.3) are included in the following clauses, with the reference to those type of controls.

9.1.3 Test

If any components specifically intended for protection against EMC disturbances fail during any of these tests, this shall lead to non-compliance with this document. Controls performing Class B or C control functions are considered to be protective controls as specified in IEC 60730-1:2013, H.26.2.

9.2 Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity

9.2.1 General

The control as constructed shall withstand the effects of mains-borne perturbation and electromagnetic phenomena which can occur in normal use.

9.2.2 Requirements

The control shall conform to Criterion II as specified in 9.1.

9.2.3 Test

The control shall be tested in accordance with IEC 60730-1:2013, H.26.4.

9.3 Voltage dips, voltage interruptions and voltage variations in the power supply network

9.3.1 Voltage dips and voltage interruptions

9.3.1.1 General

The control shall withstand the effects of voltage dips and voltage interruptions which can occur in normal use.

9.3.1.2 Requirements

For interruptions or decreases up to and including 0,03 s, the control shall conform to Criterion I as specified in 9.1.

For interruptions or decreases of 0,1 s and above, the control shall conform to Criterion II as specified in 9.1.

9.3.2 Test

The control shall be tested in accordance with IEC 60730-1:2013, H.26.5.1. For interruptions or dips up to and including one cycle of the supply wave form, the control shall conform to the Criterion I as specified in 9.1.

For interruptions or dips exceeding one cycle of the supply wave form, the control shall conform to Criterion II as specified in 9.1.

Controls intended to be connected to DC supply (type A, Type B and Type C) shall be tested according to IEC 60730-1:2013, H.26.5.1.

9.3.3 Voltage variation

9.3.3.1 General

The control shall withstand the effects of voltage variations which can occur in normal use.

9.3.3.2 Requirements

In the voltage range of operation (from rated voltage to the recorded value), the control shall conform to Criterion I, as specified in 9.1. In the voltage range below the recorded value, the control shall conform to Criterion II, as specified in 9.1. When the voltage is increased, Criterion II applies up to the voltage at which the control starts to operate.

9.3.3.3 Test

The control is supplied at rated voltage. After approximately 1 min, the power supply voltage is reduced to a level such that the control ceases to operate. This value of supply voltage is recorded.

The tests are performed according to IEC 60730-1:2013, H.26.5.2. For these tests, IEC 60730-1:2013, Table H.15 is replaced by Table 8.

Table 8 — Test levels

Voltage test level	Time for decreasing voltage	Time at reduced voltage	Time for increasing voltage
Recorded value – 10 %	(60 ± 12) s	(10 ± 2) s	(60 ± 12) s
0 V	(60 ± 12) s	(10 ± 2) s	(60 ± 12) s

The chosen time shall be suitable to determine the operating point.

For the test purpose, precautions shall be taken to assure that signals, e.g. from sensors or switches that can initiate a safety action and whose presence can normally be independent of the supply voltage, are present at any level of the supply voltage. The signal can be artificially simulated to prevent that the control de-energizes the safety-relevant output(s) as a result of disappearance of such signals. Any non-operation of an actuator connected to the safety relevant output(s) shall be ignored.

9.4 Test of influence of voltage unbalance

Shall be according to IEC 60730-1:2013, H.26.6.

9.5 Surge immunity tests

9.5.1 General

The control shall withstand the effects of voltage surges which can occur in normal use.

9.5.2 Requirements

When tested at test level 2, the control shall conform to Criterion I as specified in 9.1.

When tested at test level 3 or 4, the control shall conform to Criterion II as specified in 9.1.

9.5.3 Test

The control shall be tested in accordance with IEC 60730-1:2013, H.26.8 with the following modification:

NOTE 1 of Table H.16 is replaced by the following:

NOTE 1 For test level 2 requirements, apply the next lower installation class. For test level 3 requirements, apply installation class 3. For test level 4 requirements, apply the next higher installation class.

For controls having surge protective devices incorporating spark gaps, the tests at test levels 3 and 4 is repeated at a level that is 95 % of the flashover voltage.

If surge protective devices are used, they shall conform to IEC 61643-11. Additionally, they shall be selected to withstand the impulses corresponding to the overvoltage category for which the control is intended to be used.

For controls intended to be connected to a Type B DC supply (see 4.3), this test is not applicable.

9.6 Electrical fast transient/burst

9.6.1 General

The control shall withstand the effects of electrical fast transient/burst which can occur in normal use.

9.6.2 Requirements

When tested at test level 2 the control shall conform to Criterion I as specified in 9.1.

When tested at test levels 3 and 4 the control shall conform to Criterion II as specified in 9.1.

9.6.3 Test

The control shall be tested in accordance with IEC 60730-1:2013, H.26.9.

For controls intended to be connected to a Type B DC supply (see 4.3), this test is not applicable.

9.7 Ring wave immunity

9.7.1 General

The control shall withstand the effects of oscillatory transients (ring wave) which can occur in normal use.

9.7.2 Requirements

Following the test, the control shall conform to Criterion II as specified in 9.1.

9.7.3 Test

Shall be according to IEC 60730-1:2013, H.26.10.

9.8 Electrostatic discharge

9.8.1 General

The control shall withstand the effects of electrostatic discharge which can occur in normal use.

9.8.2 Requirements

When tested at test level 2, the control shall conform to Criterion I as specified in 9.1.

When tested at test levels 3 and 4, the control shall conform to Criterion II as specified in 9.1.

9.8.3 Test

The control shall be tested in accordance with IEC 60730-1:2013, H.26.11.

9.9 Radio-frequency electromagnetic field immunity

9.9.1 Immunity to conducted disturbances

9.9.1.1 General

The control shall withstand the effects of conducted disturbances which can occur in normal use.

9.9.1.2 Requirements

When tested at test level 2, the control shall conform to Criterion I as specified in 9.1.

When tested at test level 3, the control shall conform to Criterion II as specified in 9.1.

For controls intended to be connected to a Type B DC supply (see 4.3), the test shall be performed in accordance with IEC 60730-1:2013, H.26.12.2:

a) for the values of Table H.20 and H.21 assessment Criterion I: it shall continue to function in accordance with the requirements of this document. It shall neither go to safety shutdown or lock-out, nor reset from lock-out;

b) for the values of Table H.20 and H.21 assessment Criterion II: it shall either perform as in a) or proceed to safety shutdown, which can be followed by an automatic restart, or a volatile lock-out.

9.9.1.3 Test

Shall be in according to IEC 60730-1:2013, H.26.12.2.

9.9.2 Immunity to radiated disturbances

9.9.2.1 General

The control shall withstand the effects of radiated disturbances which can occur in normal use.

9.9.2.2 Requirements

When tested at test level 2, the control shall conform to Criterion I as specified in 9.1.

When tested at test level 3, the control shall conform to Criterion II as specified in 9.1.

9.9.2.3 Test

Shall be according to IEC 60730-1:2013, H.26.12.3.

9.10 Influence of supply frequency variations

9.10.1 General

The control shall withstand the effects of supply frequency variations which can occur in normal use.

9.10.2 Requirements

For test level 2, the control shall conform to the Criterion I as specified in 9.1.

For test level 3, the control shall conform to Criterion II as specified in 9.1. For controls intended to be connected to DC supply (see 4.3), this test is not applicable.

9.10.3 Test

Shall be according to IEC 60730-1:2013, Clause H.26.13.

9.11 Power frequency magnetic field immunity

9.11.1 General

The control shall withstand the effects of power frequency magnetic fields which can occur in normal use.

9.11.2 Requirements

When tested at test level 2, the control shall conform to Criterion I as specified in 9.1.

When tested at test level 3, the control shall conform to Criterion II as specified in 9.1.

9.11.3 Test

Shall be according to IEC 60730-1:2013, H.26.14.

9.12 Evaluation of compliance

Shall be according to IEC 60730-1:2013, H.26.15.

10 Marking, installation and operating instructions

10.1 Marking

The marking requirements are given in the specific control standards.

If not otherwise specified, the control shall be durably marked with at least the following information in clear and indelible characters:

— manufacturer and/or trademark;

— type reference;

— date-code or serial number.

NOTE Specific regional requirements are given in H.2.8.

10.2 Installation and operating instructions

Instructions shall be available in the language(s) of the countries into which the controls will be delivered.

They shall include all relevant information concerning use, installation, operation and servicing. Specific requirements are given in the specific control standard.

10.3 Warning notice

A warning notice or sign(s) shall be made available. The following are examples:

EXAMPLE 1 Registered symbols ISO 7010-W001 and ISO 7000-164.

Figure 7 — Warning signs

EXAMPLE 2

"WARNING — Read the instructions before use. This control shall be installed per manufacturing instructions." ISO/DIS 23550

Annex A
(informative)

Leak-tightness test — Volumetric method

A.1 Apparatus

The apparatus is shown schematically in Figure A.1.

The containers are made of glass. Manual taps 1 to 5 are also made of glass, and are spring-loaded. The liquid used is water.

The distance, *l*, between the water level in the constant-level bottle and the end of tube G is adjusted so that this height of water corresponds to the test pressure.

The apparatus is installed in a room with temperature control.

A.2 Test procedure

If this test method is chosen, the following procedure shall be followed.

Close taps 2 to 5 (tap 1 is opened and tap L is closed).

Fill C, then open tap 2 in order to fill D; and close tap 2 when the water in the constant level bottle D overflows into the overflow bottle E.

Open tap 5 to adjust water level to zero in H and close tap 5.

Open taps 1 and 4 in order to adjust the pressure of the compressed air at the inlet of 4 from the atmospheric pressure to the test pressure by setting the pressure regulator F.

Close 4 and connect the control under test B to the apparatus.

Open taps 3 and 4 and readjust 1 with the water level at the top of tube G by operating L and 2 if necessary.

Close tap 1 when the measuring burette H and control under test have become pressurized under 1.

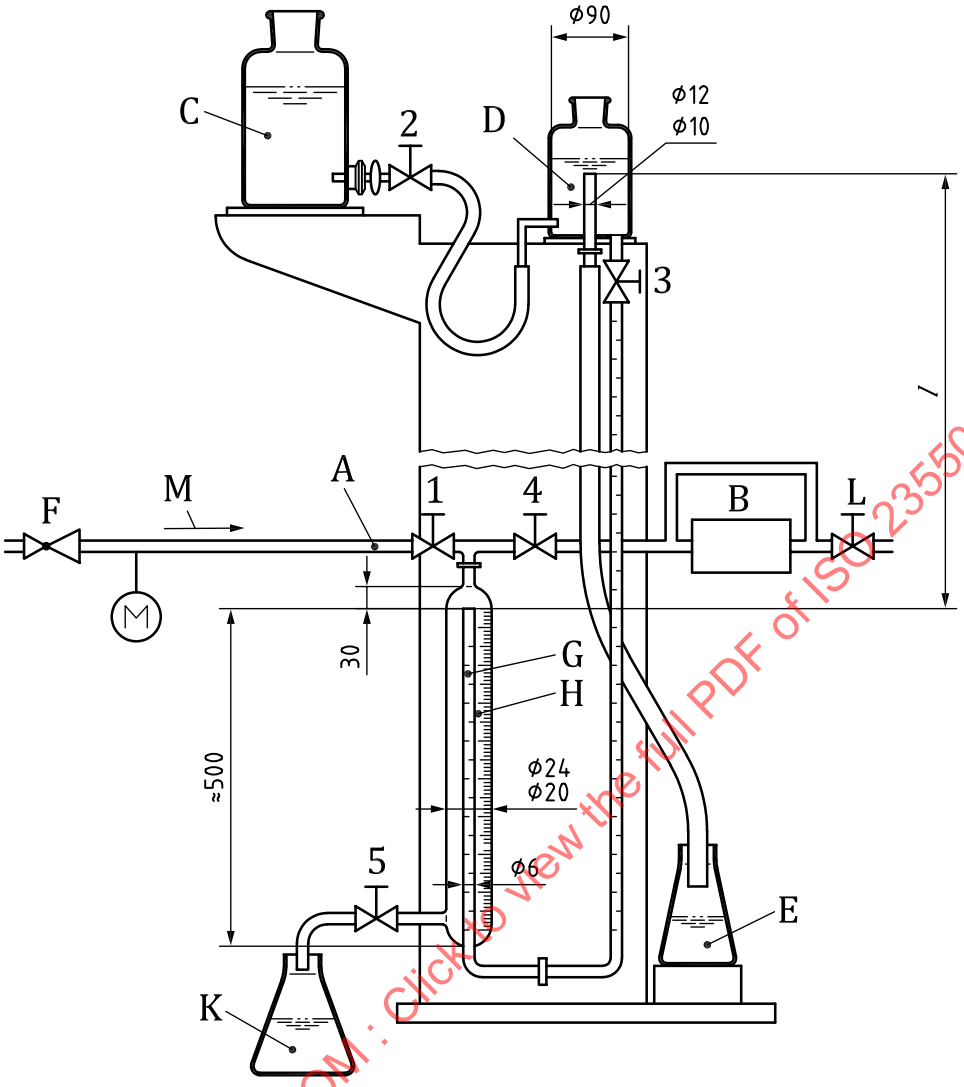
Allow approximately 15 min for the air in the test apparatus and the control under test to reach thermal equilibrium.

Any leakage is shown by water overflowing from tube G into measuring burette H. Measure the leakage by the water level rise in H within a given time.

Close taps 3 and 4 in order to disconnect the control.

Reduce the outlet regulator pressure to zero by opening taps 1 and 4.

Dimensions in millimetres



Key

A	inlet	G	pipe
B	test sample	H	measuring burette
C	water tank	K	draining bottle
D	constant level bottle	L	outlet tap
E	overflow bottle	M	compressed air flow
F	regulator	1 to 5	manual taps

Figure A.1 — Leak-tightness test apparatus (volumetric method)

Annex B
(informative)

Leak-tightness test — Pressure-loss method

B.1 Apparatus

The apparatus is shown schematically in Figure B.1. The apparatus consists of a thermally insulated pressure vessel A, which is filled with water such that the volume of air above the water is 1 dm^3. An open-ended glass tube B of internal diameter 5 mm has its lower end in the water in A. This tube is used to measure the pressure loss.

The test pressure is applied to a second tube C, which enters the air chamber of the pressure vessel to which the control under test is connected by means of a flexible tube of length 1 m and internal diameter 5 mm attached to connection D.

B.2 Test method

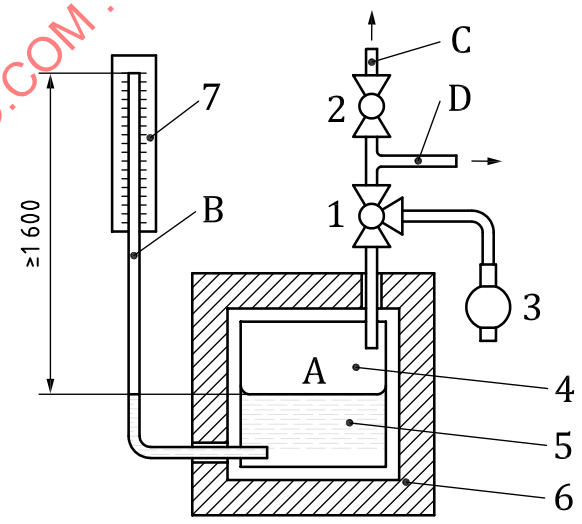
If this test method is chosen, the following procedure shall be followed.

Using a governor, adjust the air pressure through the three-way tap 1 to the test pressure. The increase in water level in the measuring tube B corresponds to the test pressure.

Open the three-way tap 1 to connect the control under test to A.

Allow 10 min for thermal equilibrium to be established. Wait a further 5 min and read the pressure loss directly from measuring tube B.

Dimensions in millimetres



Key

1	three-way tap	5	water	A	thermally insulated pressure vessel
2	tap	6	thermal solution	B	measuring tube
3	air pump	7	scale graduated in millimetres	C	vent pipe
4	1 dm^3 air volume			D	connection to control under test

Figure B.1 — Leak-tightness test apparatus (pressure-loss method)

Annex C
(normative)

Conversion of pressure loss into leakage rate

Formula (C.1) shall be used to calculate the leakage rate (e.g. in $cm^3 \cdot h^{-1}$) from the pressure loss.

$$q_L = 1{,}185 \cdot 10^{-1} V_g \left(\dot{p}_{abs} - \ddot{p}_{abs} \right) \quad \text{(C.1)}$$

where

q_L is the leakage rate, in $cm^3 \cdot h^{-1}$;

V_g is the total volume of the control under test and the test apparatus, in cm^3;

$\dot{p}_{abs}$ is the absolute pressure at the beginning of the test, in kPa;

$\ddot{p}_{abs}$ is the absolute pressure at the end of the test, in kPa.

The pressure loss is measured over a period of 5 min and the leakage rate is based on 1 h.

Annex D
(normative)

Gas quick connector (GQC)

D.1 General

This annex applies to Gas Quick Connectors (GQC) for use inside appliances with connections up to, and including DN 25, and a maximum pressure up to, and including 100 kPa.

This annex is applicable to:

— tube to tube connections,

— tube to control connections, and

— tube to fitting connections.

D.2 Classification

GQCs shall be classified as group 1 connections.

D.3 Construction

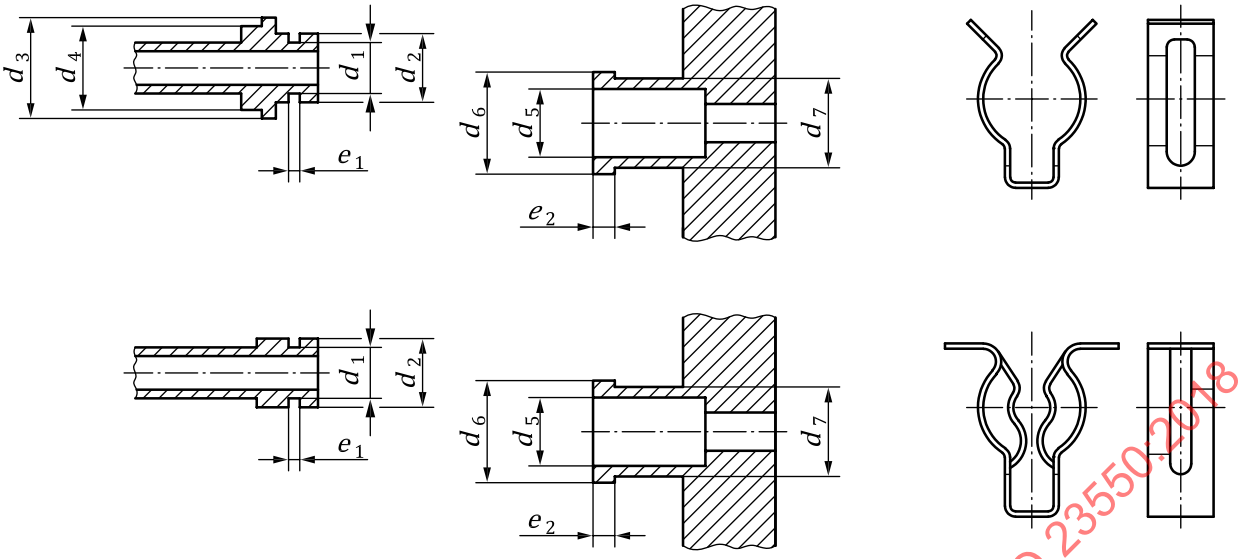
D.3.1 Gas connection

6.4.1 to 6.4.8 are not applicable.

D.3.2 Gas quick connector

Gas quick connects that can be disassembled without tools shall only be used in restricted access areas, which shall be specified in the operating and installation instructions (see 9.2).

Examples of GQC are given in Figure D.1.



a) Plug b) Socket c) Fastener

Key

d_1	diameter outside of the plug for the GQC seal	d_5	diameter inside of the socket
d_2	diameter outside of the plug for insertion into the socket	d_6	diameter outside of the socket for retaining of the fastener*1
d_3	diameter outside of the plug for retaining of the fastener*1	d_7	diameter outside of the socket for the base of the fastener
d_4	diameter outside of the plug for the base of the fastener	e_2	width of projection of the socket for retaining the fastener
e_1	width of channel in the plug for the GQC seal		

NOTE 1 Dimension d_3 of plugs and dimension d_6 of sockets are the same.

NOTE 2 Both sockets under b) are identical. For illustrative purposes, they are shown together with the plug and the fastener.

Figure D.1 — Examples for GQC

D.4 Performance

D.4.1 Leak-tightness

Shall be according to 7.2 with the following addition:

The test is carried out before and after the assembly test of 7.3.4.6.

D.4.2 Internal leak-tightness

7.2.2.3 is not applicable.

D.4.3 Torsion and bending

D.4.3.1 Torsion

Shall be according 7.3.2 with the following addition:

The torque requirement is not applicable in the case of a torque applied to the GQC, plug and socket which can freely turn around each other.

D.4.3.2 Bending moment

7.3.3 is replaced by the following.

GQC shall meet leakage requirements of 7.2.2 before, during, and after the test, as specified in D.7.3.4.5.

D.4.3.3 Torsion and bending test

D.4.3.3.1 General

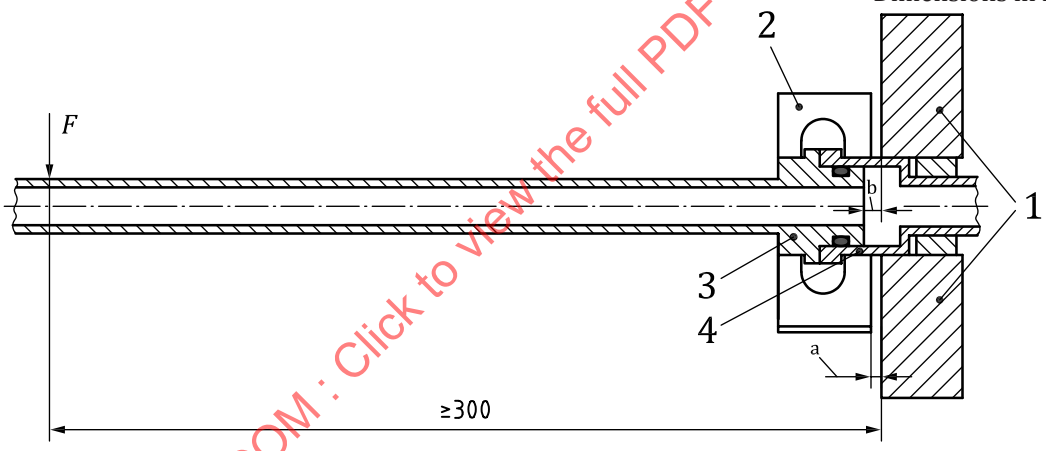
7.3.4.1 is replaced by the following:

GQC which are part of the control are tested under the same conditions as valid for that control.

For tube-to-tube and fitting-to-tube connections, the following applies:

Use the GQC, with the assembly, as shown in Figure D.2.

Dimensions in millimetres



Key

1	fixture	4	socket
2	fastener	*F*	force
3	plug		

a A clearance (see "a") shall be provided between the fixture and the fastener to prevent contact between the two parts which would impact results. This clearance is not required if the socket is integral to a control body.

b A clearance (see "b") between the fixture and the face of the plug during the bending-moment test.

Figure D.2 — Bending-moment test assembly for pipe-to-pipe connection (clamping on the connector part)

D.4.3.3.2 900-s bending-moment test — Group 1 controls only

Shall be according to 7.3.4.5 with the following modification:

For pipe to pipe connections replace Table 6 by Table D.1.

Table D.1 — Bending moment

Diameter nominal, DN	Bending moment N m
6	10
8	10
10	10
15	25
20	25
25	25

Apply force for the required bending moment given in Table D.1, taking the mass of the pipe into account.

Apply force at the point of greater than or equal to 300 mm from the fixture.

Remove force and visually inspect the GQC for deformation and verify that the 2 mm clearance shall be maintained, then test the GQC for external leak-tightness, in accordance with 7.2.3.2.

D.4.3.3.3 Assembly test

The clamping force/removing force shall be tested based on the following conditions:

Disassemble and re-assemble the GQC connection 30 times.

Remove fastener and visually inspect the GQC parts for deformation and damage, then reassemble the GQC and test for external leak-tightness in accordance with 7.2.3.2.

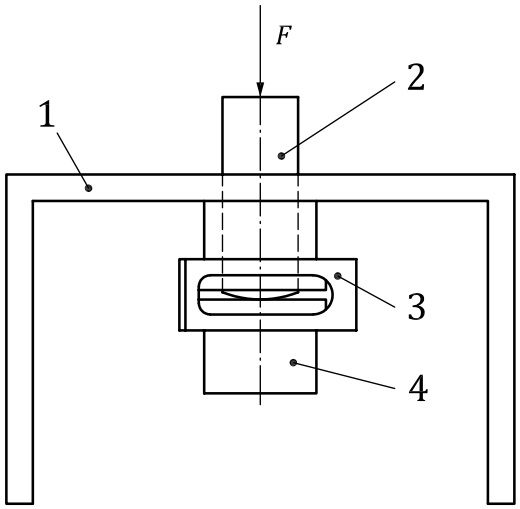
D.4.3.3.4 Tensile test

Use the fastener with the assembly, as shown in Figure D.3. Apply force for the required tensile strength according to Table D.2, taking the mass of the rod into consideration.

Table D.2 — Tensile test

DN size	Force N
6	6
8	10
10	16
15	33
20	67
25	100

Remove force and then verify that the fastener is still in place and functional and check for deformation of the fastener.



Key

1 base
2 pushing rod (impacting the test plug)
3 fastener
4 test socket (consists of solid material)
F force

NOTE A solid plug of the same outer size is used for the tensile test.

Figure D.3 — Example of tensile test assembly

D.5 High temperature test for non-metallic sealing means of GQC, not part of another control

D.5.1 Requirement

GQC shall withstand a temperature of 20 °C above its maximum temperature as specified in the installation and operating instructions.

D.5.2 Test

The assembled GQC shall be heated to 20 °C above its maximum temperature as specified in the installation and operating instructions for 15 min. At the end of this period the sample shall cool down to ambient temperature. The assembled GQC shall then meet the external leakage test given in 7.2.3.2.

D.6 Marking, installation and operating instructions

D.6.1 Marking

Shall be according to 9.1 with the following addition:

The following information, at least, shall be durably marked on the GQC in a clearly visible position:

— gas quick connects for tube-to-tube and fitting-to-tube connections shall be marked with maximum allowable temperature;

— if the gas quick connect is not suitable for use with all gases covered in the Scope of this document, it shall be marked accordingly.

D.6.2 Installation and operating instructions

Shall be according to 9.2 with the following addition:

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

a) requirement on use in areas of restricted access;

b) minimum and maximum allowable temperature, if outside the range of (0 to 55) °C;

c) maximum allowable pressure;

d) connection and disconnection means;

e) fixation measures where a control has a GQC on both sides and the performance of the control is specified for specific positions only.

Annex E
(normative)

Elastomers/requirements resistance to lubricants and gas

Table E.1 — Requirements for material used for manufacture of seals tab

Property	Reference to test method standard	Unit	Hardness class			Remarks
		IRHD	≤45	45 – 60	≥60	
Tolerance on stated nominal hardness if ≤ 85	ISO 48	IRHD	±5	±5	±5	Measure at 23 °C ± 2 °C
if > 85	ISO 1400		±5	±5	±5	Measure at 23 °C ± 2 °C
Tensile strength	ISO 37	Mpa	5	≥7	≥7	Measure at 23 °C ± 2 °C
Elongation at break	ISO 37	%	≥125	≥125	≥125	Measure at 23 °C ± 2 °C
Compression set [1]	ISO 815					Conditions — per test, three monoblock test piece discs of 13 (±0,5) mm diameter and 6,3 (±0.3) mm thickness
All temperature ranges at high temperature		%	≤40	≤40	≤0	— compression set of 25 % at 23 (±2) °C — duration of test = $\left(168\ ^{+0}_{-2}\right)$ h — test temperature - see Table 3 and Table 4
Range A1 - E1 at low temperature 0 °C		%	≤40	≤40	≤40	— compression set of 25 % at (23 ± 2) °C — duration of test = $\left(72\ ^{+0}_{-2}\right)$ h — test temperature (0 ± 1) °C — recovery time (30 ± 3) min
Range A2 - E2 at low temperature –20 °C		%	≤50	≤50	≤50	— compression set of 25 % at (23 ± 2) °C — duration of test = $\left(72\ ^{+0}_{-2}\right)$ h — test temperature (–20 ± 1) °C — recovery time (30 ± 3) min