INTERNATIONAL STANDARD

ISO 23550

Second edition
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Safety and control devices for gas burners and gas-burning appliances — General requirements

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

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 23550 was prepared by Technical Committee ISO/TC 161, *Control and protective devices for gas and/or oil burners and appliances*.

This second edition cancels and replaces the first edition (ISO 23550:2004), which has been technically revised, particularly regarding regional requirements in Japan (Annex G).

Introduction

This International Standard provides general requirements for controls and safety devices for gas burners and gas-burning appliances and is intended to be used in conjunction with ISO 23551 (all parts), ISO 23552-1 and ISO 23553-1 for specific types of controls, or for controls for specific applications.

This International Standard can also be applied, so far as is reasonable, to controls not mentioned in a specific standard and to controls designed on the basis of new principles, in which case additional requirements may be necessary.

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

Controls and safety devices for gas burners and gas burning appliances using fuel gases 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 gas depending on its source/region of origin, certain differences in regulations exist at present in different regions; some of these differences are presented in Annexes E, F and G. This International Standard intends to provide a basic framework of requirements until these differences can be harmonized.

Safety and control devices for gas burners and gas-burning appliances — General requirements

1 Scope

This International Standard specifies safety, constructional and performance requirements and testing of safety control or regulating devices and sub-assemblies or fittings (hereafter referred to as controls) for burners and gas-burning appliances using such fuel gases as natural gas, manufactured gas or liquefied petroleum gas (LPG). It is not applicable to corrosive and waste gases.

This International Standard is applicable to the following controls:

— automatic shut-off valves;

— burner controls;

— flame supervision devices;

— gas/air ratio controls;

— pressure regulators;

— manual taps;

— mechanical thermostats;

— multifunctional controls;

— pressure-sensing devices;

— valve-proving systems;

— zero regulators.

The test methods given in this International Standard are intended for product type testing. Tests intended for production testing are not specifically included.

NOTE This International Standard is intended to be used in conjunction with the specific control standards of the ISO 23551 series.

2 Normative references

The following referenced documents are indispensable for the application 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 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1*

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 301, *Zinc alloy ingots intended for castings*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 7005 (all parts), *Metallic flanges*

IEC 60730-1:1999, *Automatic electrical controls for household and similar use — Part 1: General requirements*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measuring techniques — Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measuring techniques — Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests*

3 Terms and definitions

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

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 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 gas 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 (in the closed position) sealing a gas-carrying compartment with respect to another compartment or to the outlet of the control

3.6
inlet pressure
pressure at the inlet of the control

3.7
outlet pressure
pressure at the outlet of the control

3.8
pressure difference
difference between the inlet and outlet pressures

3.9
maximum working pressure
highest inlet pressure declared by the manufacturer at which the control may be operated

3.10
minimum working pressure
lowest inlet pressure declared by the manufacturer at which the control may be operated

3.11
flow rate
volume flowing through the control divided by time

3.12
rated flow rate
air flow rate 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 may be operated

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

3.15
mounting position
position declared by the manufacturer for mounting the control

NOTE 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;

— 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 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 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.

NOTE 3 Adapted from ISO 6708:1995, definition 2.1.

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

[ISO 8655-1:2002, definition 3.2.2]

4 Classification

4.1 Classes of control

Where appropriate, controls are classified by application (e.g. sealing force, 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 4):

a) **Group 1 controls** — Controls for use in an appliance or installation where they are not subjected to bending stresses imposed by installation pipe work (e.g. by the use of rigid adjacent supports).

NOTE 1 In USA and Canada, 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 a group 2 control also meet the requirements of a group 1 control.

5 Test conditions

If no specific methods of test are given, conformity with these requirements shall be verified by inspection and/or measurement.

Tests shall be carried out with air at (20 ± 5) °C and at an ambient temperature of (20 ± 5) °C, unless otherwise specified.

All measured values shall be corrected to the standard conditions of 15 °C and 101,325 kPa, dry.

Controls which can be converted for use with another gas family by exchanging components are additionally tested with the conversion components.

Tests shall be carried out in the mounting position declared by the manufacturer. If there are several mounting positions, tests shall be carried out in the least favourable position.

Where possible, those tests already covered by other standards (e.g. IEC 60730-1:1999) shall be combined with those specified in this International Standard.

NOTE 1 These tests are specified in the specific control standard.

NOTE 2 Specific regional requirements are given in G.5.

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 manufacturer's instructions.

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

In general, conformity with the requirements given in this International Standard is verified by the test methods given herein or in the specific control standard, or by using the construction materials specified by the requirements. Alternative materials may be used if they provide performance at least equivalent to the materials specified.

6.2 Construction requirements

6.2.1 Appearance

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

6.2.2 Holes

Holes for screws, pins, etc., used for the assembly of parts of the control or for mounting, shall not penetrate gasways. The wall thickness between these holes and gasways shall be at least 1 mm.

Holes necessary during manufacture, which connect gasways to atmosphere but which do not affect the operation of the control, shall be permanently sealed by metallic means. Suitable jointing compounds may additionally be used.

6.2.3 Breather holes

6.2.3.1 Design

Breather holes shall be so designed that, when the diaphragm is damaged, either

a) the air flow rate through the hole does not exceed 70 dm^3/h at the maximum inlet pressure,

NOTE Specific regional requirements are given in G.6.2.3.1.

or

b) they can be connected to a suitable vent pipe, in which case the installation and operation instructions will state that the breather shall be vented safely.

For maximum working pressures up to 3 kPa, requirement a) above shall be deemed to be met if the diameter of the breather hole does not exceed 0,7 mm.

If compliance with a) above is achieved by using a leakage-rate limiter, this shall be able to withstand a pressure equal to three times the maximum working pressure. If a safety diaphragm is used as a leakage-rate limiter, it shall not take the place of the working diaphragm in case of a fault.

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

Conformity shall be verified using the method given in 6.2.3.2.

NOTE Specific regional requirements are given in F.6.2.3.1.

6.2.3.2 Test for leakage of breather holes

Rupture the dynamic part of the working diaphragm. Ensure all closure members of the control, if any, are in the open position. Pressurize all gas-carrying compartments to the maximum working pressure and measure the leakage rate.

6.2.4 Screwed fastenings

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

Self-tapping screws which cut a thread and produce swarf (metal residue) shall not be used for connecting gas-carrying parts or parts which may 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 metric machine screws conforming to ISO 262.

NOTE Specific regional requirements are given in F.6.2.4.

6.2.5 Jointing

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

Soldering or other processes where the jointing material has a melting point below 450 °C after application shall not be used for connecting gas-carrying parts except for additional sealing.

NOTE Specific regional requirements are given in F.6.2.5.

6.2.6 Moving parts

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

6.2.7 Sealing caps

Sealing caps shall be capable of being removed and replaced using commonly available tools and sealed (e.g. by lacquer). A sealing cap shall not hinder adjustment within the whole range declared by the manufacturer.

6.2.8 Dismantling and reassembling for servicing and/or adjustment

Parts which are intended to be dismantled for servicing or adjustment shall be capable of being dismantled and reassembled using commonly available tools. They shall be constructed or marked in such a way that incorrect assembly is impossible when following the manufacturer's instructions.

Closure parts, including those of measuring and test points, which may be 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 be either sealed by means which will show evidence of interference (e.g. lacquer), or fixed by fasteners requiring tools that are not commonly available.

6.2.9 Auxiliary channels

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

6.3 Materials

6.3.1 General material requirements

The quality of materials, the dimensions used and the method of assembling the various parts shall be such that construction and performance characteristics are safe. Performance characteristics shall not alter significantly during a reasonable lifetime when installed and used according to the manufacturer's instructions. Under these circumstances, all components shall withstand any mechanical, chemical and thermal conditions to which they may be subjected during service.

NOTE Specific regional requirements are given in F.6.3.1.

6.3.2 Housing

6.3.2.1 Housing design

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

a) be made from metallic materials,

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/h of air to escape at the maximum working pressure when tested in accordance with 6.3.2.2.

NOTE Specific regional requirements are given in E.6.3.2.1, F.6.3.2.1 and G.6.3.2.1.

6.3.2.2 Test for leakage of housing after removal of non-metallic parts

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 working pressure and measure the leakage rate.

6.3.3 Springs

6.3.3.1 Closure springs

Springs providing the sealing force for any closure member of the control shall be made of corrosion-resistant materials and shall be designed to be fatigue-resistant.

6.3.3.2 Springs providing closing force and sealing force

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

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.

6.3.4 Resistance to corrosion and surface protection

All parts in contact with gas or atmosphere, and springs other than those covered by 6.3.3, shall either be made from corrosion-resistant materials or be suitably protected. The corrosion protection for springs and other moving parts shall not be impaired by any movement.

6.3.5 Impregnation

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).

6.3.6 Seals for glands for moving parts

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

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

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

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

6.4 Gas connections

6.4.1 Making connections

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.

6.4.2 Connection sizes

Equivalent connection sizes are given in Table 1.

NOTE Specific regional requirements are given in E.6.4.2.

6.4.3 Threads

Inlet and outlet threads shall be in accordance with ISO 7-1 or ISO 228-1 and shall be chosen from the sizes given in Table 1.

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 will not adversely affect the operation of the control. A stop for the thread will also satisfy the requirement.

NOTE Specific regional requirements are given in F.6.4.3 and in G.6.4.3.

Table 1 — Connection sizes

Thread or flange diameter nominal, DN	**Thread or flange** in	**Outside diameter of compression-fitting tube** mm
6	1/8	2 to 5
8	1/4	6 to 8
10	3/8	10 to 12
15	1/2	14 to 16
20	3/4	18 to 22
25	1	25 to 28
32	1 1/4	30 to 32
40	1 1/2	35 to 40
50	2	42 to 50
65	2 1/2	
80	3	
100	4	
125	5	
150	6	
200	8	
250	10	

6.4.4 Union joints

If connections are made with union joints, either the joints shall be included with the control or full details shall be supplied if the threads do not conform to ISO 7-1 or ISO 228-1.

NOTE Specific regional requirements are given in F.6.4.4 and in G.6.4.4.

6.4.5 Flanges

If flanges are used on controls above DN 50, the controls shall be suitable for connection to flanges in accordance with all parts of ISO 7005, (nominal pressure) PN 6 or PN 16.

If flanges are used on controls up to and including DN 50 which are not suitable for connection to flanges in accordance with ISO 7005 (all parts), either suitable adapters shall be supplied to enable connection to standard flanges and threads, or full details of mating parts shall be supplied.

NOTE Specific regional requirements are given in F.6.4.5 and G.6.4.5.

6.4.6 Compression fittings

If compression fittings are used, it 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 F.6.4.6.

6.4.7 Nipples for pressure tests

Nipples for pressure tests shall have an external diameter of $(9\,^{0}_{-0,5})$ mm and a useful length of at least 10 mm for connection to tubing. The equivalent diameter of the bore shall not exceed 1 mm.

NOTE Specific regional requirements are given in F.6.4.7 and in G.6.4.7.

6.4.8 Strainers

If an inlet strainer is fitted, the maximum strainer-hole dimension shall not exceed 1,5 mm and it shall prevent the passage of a 1 mm diameter pin gauge.

If an inlet strainer is not fitted, the installation instructions shall include relevant information on the use and installation of a strainer conforming to the above requirements, to prevent the ingress of foreign matter.

NOTE Specific regional requirements are given in F.6.4.8.

7 Performance

7.1 General

Controls shall operate correctly under all combinations of the following:

a) the full range of working pressures;

b) an ambient temperature range from 0 °C to 60 °C, or wider limits if declared by the manufacturer;

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

and, additionally, for electrically operated controls:

d) the voltage or current range from 85 % to 110 % of the rated value or from 85 % of the minimum rated value to 110 % of the maximum rated value.

NOTE Specific regional requirements are given in F.7.1 and in G.7.1.

7.2 Leak-tightness

7.2.1 Criteria

Controls shall be leak-tight. They are considered to be leak-tight if the air leakage rates given in Table 2 are not exceeded.

Closure parts shall remain leak-tight after dismantling and reassembly (see 6.2.8).

NOTE Specific regional requirements are given in F.7.2.1 and G.7.2.1.

Table 2 — Maximum leakage rates

Inlet diameter nominal, DN	Maximum leakage rates cm^3/h	
	Internal leak-tightness	External leak-tightness
DN < 10	20	20
10 ⩽ DN ⩽ 25	40	40
25 < DN ⩽ 80	60	60
80 < DN ⩽ 150	100	60
150 < DN ⩽ 250	150	60

7.2.2 Test for leak-tightness

7.2.2.1 General

The limits of error of the apparatus used shall be ±1 cm^3 and ±10 Pa.

The accuracy of measurement of leakage rates shall be within ±5 cm^3/h.

For internal leakage of closure members, carry out the tests with an initial test pressure of 0,6 kPa, then for both internal and external leakage repeat the tests at 1,5 times the maximum working pressure or 15 kPa, whichever is greater.

If the control is suitable for use with gases at nominal inlet pressures of 11,2 kPa or 14,8 kPa, use a test pressure of at least 22 kPa.

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, and

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

The equation for conversion from the pressure-loss method to the volumetric method is given in Annex C.

NOTE Specific regional requirements are given in F.7.2.2.1.

7.2.2.2 External leak-tightness

Pressurize the inlet and outlet(s) of the control to the test pressures given in 7.2.2.1 and measure the leakage rate.

Dismantle and reassemble closure parts five times in accordance with the manufacturer's instructions and repeat the test.

NOTE Specific regional requirements are given in F.7.2.2.2.

7.2.2.3 Internal leak-tightness

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 7.2.2.1 and measure the leakage rate.

NOTE Specific regional requirements are given in F.7.2.2.3.

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 leakage shall not exceed the values specified in Table 2 or in the specific control standard.

7.3.2 Torsion

Controls shall withstand the torque specified in Table 4 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 4 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, with a length of

— at least 40 × DN for controls up to and including DN 50,

— at least 300 mm for controls above DN 50.

Use only non-hardening sealing paste on connections.

Determine the appropriate tightening torque to be applied to flange bolts in accordance with the ISO 7005 series from the values in Table 3.

Table 3 — Tightening torque for flange bolts

Diameter nominal, DN	6	8	10	15	20	25	32	40	50	65	80	100	125	⩾150
Torque N·m	20	20	30	30	30	30	50	50	50	50	50	80	160	160

Test the control for external leak-tightness in accordance with 7.2.2.2 and internal leak-tightness in accordance with 7.2.2.3 where applicable, before carrying out torsion and bending tests.

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

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

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 for controls with flanged or saddle-clamp inlet connections for attachment to cooking-appliance manifolds.

NOTE 3 Specific regional requirements are given in G.7.3.4.1.

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

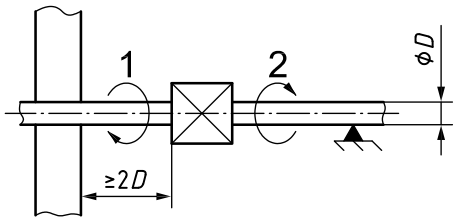
Screw pipe 1 into the control with a torque not exceeding the values given in Table 4. Clamp the pipe at a distance at least 2D from the control (see Figure 1).

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

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

Progressively apply the appropriate torque to pipe 2 for 10 s without exceeding the values given in Table 4. Apply the last 10 % of the torque over a period not exceeding 1 min.

Remove the torque and visually inspect the control for any deformation, then test the control for external leak-tightness in accordance with 7.2.2.2 and internal leak-tightness in accordance with 7.2.2.3 where applicable.



Key

1 pipe 1

2 pipe 2

D outside diameter

Figure 1 — 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 4 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 control for external leak-tightness to 7.2.2.2 and internal leak-tightness to 7.2.2.3 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 of Table 4, 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 — Group 1 and group 2 controls

Use the same control as for the torsion test, with the assembly as shown in Figure 2.

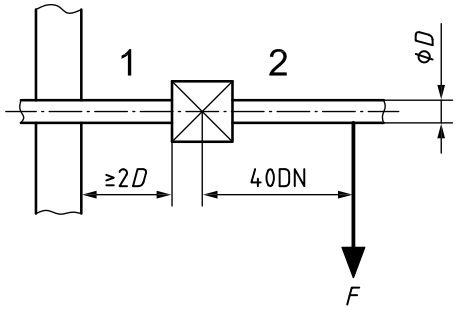
Apply the force for the required bending moment for a group 1 or group 2 control given in Table 4 for 10 s, taking the mass of the pipe into consideration.

Apply the force

— 40 × DN from the centre of the control for controls up to and including DN 50,

— at least 300 mm from the control connection for controls above DN 50.

Remove the force and visually inspect the control for any deformation, then test the control for external leak-tightness in accordance with 7.2.2.2 and internal leak-tightness in accordance with 7.2.2.3 where applicable.



Key

1 pipe 1
2 pipe 2
D outside diameter
F force

Figure 2 — Bending-moment test assembly

7.3.4.5 900-second bending-moment test — Group 1 controls only

Use the same control as for the torsion test, with the assembly as shown in Figure 2.

Apply the force for the required bending moment for a group 1 control, as given in Table 4, for 900 s, taking the mass of the pipe into consideration.

Apply the force

— at 40 × DN from the centre of the control for controls up to and including DN 50,

— at least 300 mm from the control connection for controls above DN 50.

With the force still applied, test the control for external leak-tightness in accordance with 7.2.2.2 and for internal leak-tightness in accordance with 7.2.2.3 where applicable.

Table 4 — Torque and bending moment

Diameter nominal, DN[a]	Torque[b] N·m	Bending moment N·m		
	Groups 1 and 2	Group 1		Group 2
	10 s test	10 s test	900 s test	10 s test
6	15 (7)	15	7	25
8	20 (10)	20	10	35
10	35 (15)	35	20	70
15	50 (15)	70	40	105
20	85	90	50	225
25	125	160	80	340
32	160	260	130	475
40	200	350	175	610
50	250	520	260	1 100
65	325	630	315	1 600
80	400	780	390	2 400
100	—	950	475	5 000
125	—	1 000	500	6 000
⩾150	—	1 100	550	7 600

[a] Equivalent connection sizes are given in Table 1.

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

7.4 Rated flow rate

7.4.1 Criterion

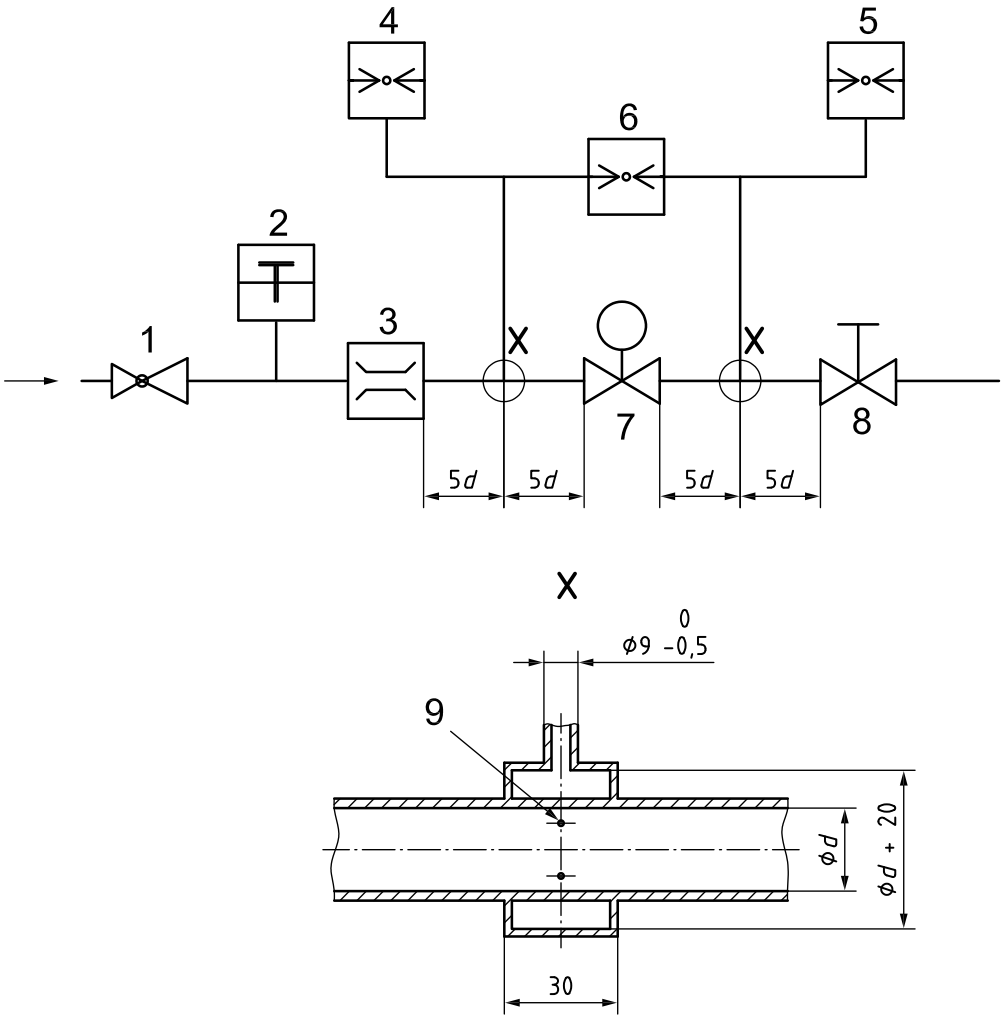
The maximum flow rate when measured according to 7.4.2 shall be at least 95 % of the rated flow rate.

7.4.2 Test for rated flow rate

7.4.2.1 Apparatus

Carry out the test using the apparatus shown in Figure 3. The accuracy of measurement shall be at least ±2 %.

Dimensions in millimetres



Key

1	adjustable regulator 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

Diameter nominal, 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 3 — Apparatus for flow rate test

7.4.2.2 Test procedure

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

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

7.4.2.3 Conversion of air flow rate

Use the following equation for conversion of flow rate to standard conditions:

$$q_{\mathrm{n}} = q\left[\frac{p_{\mathrm{a}} + p}{101{,}325} \times \frac{288{,}15}{273{,}15 + T}\right]^{\frac{1}{2}}$$

where

q_{n} is the corrected air flow rate at standard conditions, in m^3/h;

q is the measured air flow rate, in m^3/h;

p_{a} is the atmospheric pressure, in kPa;

p is the test pressure, in kPa;

T is the air temperature, in °C.

NOTE Specific regional requirements are given in G.7.4.2.3.

7.5 Durability

7.5.1 Elastomers in contact with gas

Elastomers in contact with gas (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.

7.5.2 Resistance to lubricants

7.5.2.1 Criterion

The resistance to lubricants of elastomers shall be tested according to 7.5.2.2. After this test, the change in mass shall be between −10 % and +10 %.

7.5.2.2 Test for resistance to lubricants

Carry out the test with the finished component or with parts of the finished component in accordance with ISO 1817:1985, 8.2, using the gravimetric method but with a duration of immersion of (168 ± 2) h in oil No. 2 at the maximum declared ambient temperature of the control.

Determine the relative change in mass, Δm, using the following equation:

$$\Delta m = \frac{m_3 - m_1}{m_1} \times 100$$

where

m_1 is the initial mass of the test piece in air;

m_3 is the mass of the test piece in air after immersion.

NOTE Specific regional requirements are given in F.7.5.2.2.

7.5.3 Resistance to gas

7.5.3.1 Criterion

The resistance to gas of elastomers shall be tested in accordance with 7.5.3.2. After this test, the change in mass shall be between −15 % and +5 %.

7.5.3.2 Test for resistance to gas

Carry out the test with the finished component or with parts of the finished component in accordance with ISO 1817:1985, 8.2, using the gravimetric method, and in accordance with ISO 1817:1985, Clause 9, using the method of determination of extracted soluble matter but with a duration of immersion of (72 ± 2) h at (23 ± 2) °C in *n*-pentane (minimum 98 % mass fraction of *n*-pentane, estimated by gas chromatography).

Dry the test pieces for a period of (168 ± 2) h in an oven at (40 ± 2) °C at atmospheric pressure.

Determine the relative change in mass, Δm, using the following equation:

$$\Delta m = \frac{m_5 - m_1}{m_1} \times 100$$

where

m_1 is the initial mass of the test piece in air;

m_5 is the mass of the test piece in air after drying.

NOTE Specific requirements are given in F.7.5.3.2.

7.5.4 Marking resistance

7.5.4.1 General

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

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

7.5.4.2 Tests for marking resistance

Carry out the tests according to the methods given in IEC 60730-1:1999, Annex A.

7.5.5 Resistance to scratching

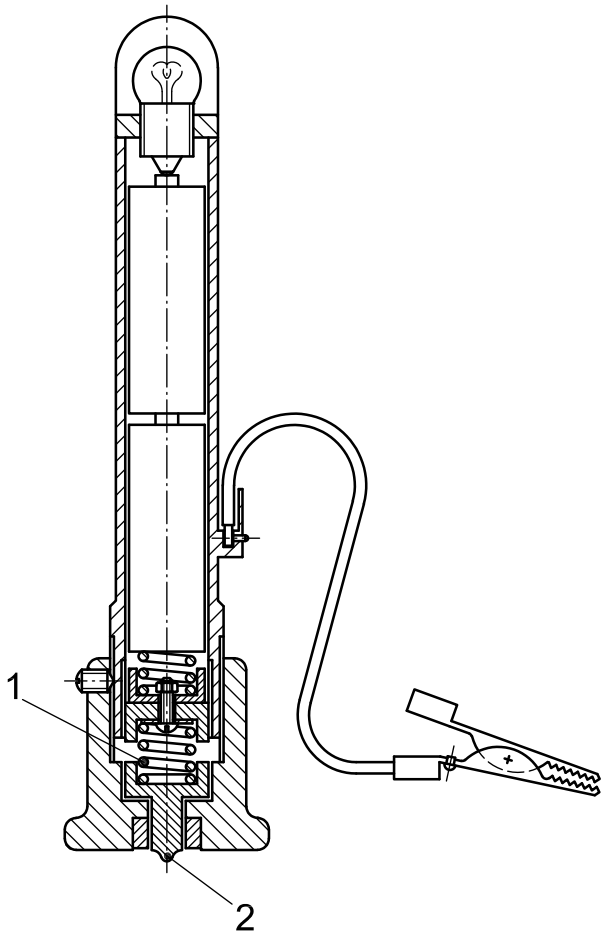
7.5.5.1 Criteria

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.

7.5.5.2 Scratch test

Draw a 1 mm diameter fixed steel ball across the surface of the control at a speed of 30 mm/s to 40 mm/s with a contact force of 10 N (see Figure 4).

Repeat the scratch test after the humidity test of 7.5.6.2.



Key

1 spring loading (10 N)

2 scratching point (steel ball, diameter 1 mm)

Figure 4 — Scratch test apparatus

7.5.6 Resistance to humidity

7.5.6.1 Criteria

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.

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 could adversely affect the continued safe working of the control shall not show any signs of corrosion.

7.5.6.2 Humidity 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.

8 EMC/electrical requirements

NOTE Relevant standards in IEC 60730-1:1999 concerning EMC are under preparation.

8.1 Protection against environmental influences

8.1.1 Assessment Criterion I

When tested at the severity levels given in 8.2 to 8.9, the control shall continue to function in accordance with the relevant requirements of the specific control standard.

8.1.2 Assessment Criterion II

When tested at the severity levels given in 8.2 to 8.9, the control shall maintain a safe state as specified in the specific control standard.

The test levels given in this International Standard are for general applications and environments. To ensure the safe use of gas in harsher environments, only Assessment Criterion I should be used.

If a specific control standard on a subject does not exist, the relevant requirements related to assessment criteria of this clause should be agreed between manufacturer and test agency.

8.2 Variations in supply voltage

The control shall be supplied with any voltage between 0,85 times and 1,1 times rated AC voltage or between 0,8 times and 1,2 times the rated DC voltage (battery mode), whichever is applicable. It shall be tested in accordance with IEC 61000-4-11. During the test, the control shall conform to Assessment Criterion I as specified in 8.1.1.

The test shall be repeated with the control supplied at any voltage less than 0,85 times rated AC voltage or 0,8 times rated DC voltage, whichever is applicable. Under the test conditions specified in the specific control standard, the control shall conform to Assessment Criterion II as specified in 8.1.2.

NOTE Specific regional requirements are given in G.8.2.

8.3 Short-term voltage interruptions and drops

The control shall be tested in accordance with IEC 61000-4-11.

The control shall be supplied with a voltage in accordance with the amplitudes and periods specified in Table 5. Intermediate as well as longer periods may be selected. The interruptions or drops at random phase with respect to the mains frequency shall be carried out at least three times under the test condition(s) specified in the specific control standard. There shall be an interval of at least 10 s between the interruptions or drops.

Table 5 — Short-term voltage interruptions and drops

Period of time	Percentage of the rated voltage or mean value of the rated voltage range	
ms	50 % (drop)	0 % (interruption)
10	no test	test
20	no test	test
50	test	test
500	test	test
2 000	test	test

For interruptions up to 20 ms, the control shall conform to Assessment Criterion I as specified in 8.1.1.

For interruptions or drops exceeding 20 ms, the control shall conform to Assessment Criterion II as specified in 8.1.2.

8.4 Variations in supply frequency

These tests shall be carried out only on controls incorporating clock circuitry which is synchronized with, or compared against, the supply frequency.

The control shall be supplied with rated voltage and at frequencies +2 % and −2 % of the rated supply frequency. The control shall be operated three times for the sequence of operation which could occur.

During the tests, the control shall conform to Assessment Criterion I as specified in 8.1.1.

Variation in programme timings (if applicable) shall not exceed the percentage of the frequency variations.

The test shall be repeated at frequencies +5 % and −5 % of the rated supply frequency. Under these conditions, the control shall conform to Assessment Criterion II as specified in 8.1.2.

8.5 Surge immunity test

The control shall be supplied with rated voltage. Test instrumentation, test set-up and test procedure shall be in accordance with IEC 61000-4-5, with the severity levels as specified in Table 6. Five pulses of each polarity (−, +) and each phase angle as described in IEC 61000-4-5 shall be delivered under the test conditions specified in the specific control standard.

Table 6 — Open-circuit test voltage ±10 % for AC mains systems

Severity level	Mains kV		DC inputs and DC outputs — Power ports kV		Ports for process measurement and control lines (sensors and actuators) kV	
	Line to line	Lines to earth	Line to line	Lines to earth	Line to line	Lines to earth
2	0,5	1,0	—	—	0,5	—
3	1,0	2,0	0,5	0,5	0,5	1,0

When tested at severity level 2, the control shall conform to Assessment Criterion I as specified in 8.1.1.

When tested at severity level 3, the control shall conform to Assessment Criterion II as specified in 8.1.2.

NOTE The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 10 m.

8.6 Electrical fast transient/burst

The control shall be supplied with rated voltage. Test instrumentation, test set-up, test procedure and repetition time shall be in accordance with IEC 61000-4-4, with the severity levels as specified in Table 7. The control shall be tested under the test conditions specified in the specific standard.

Table 7 — Test levels for electrical fast transient/burst

Severity level	On power supply port, PE kV	On input/output signal, data and control lines kV	Repetition rate kHz
2	1,0	0,5	5
3	2,0	1,0	5

When tested at severity level 2, the control shall conform to Assessment Criterion I as specified in 8.1.1.

When tested at severity level 3, the control shall conform to Assessment Criterion II as specified in 8.1.2.

NOTE 1 The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 3 m.

NOTE 2 Specific regional requirements are given in F.8.6.

8.7 Immunity to conducted disturbances

The control shall be supplied with rated voltage. Test instrumentation, test set-up and test procedure shall be in accordance with IEC 61000-4-6, with the severity levels as specified in Table 8, the complete frequency range being swept at least once with the control under the test conditions specified in the specific control standard.

Table 8 — Test voltages for conducted immunity on mains and input/output lines

Severity level	Voltage level — electromotive force (emf), U_o V	
	Frequency range 150 kHz to 80 MHz	**ISM and CB bands**[a]
2	3	6
3	10	20
[a] ISM: Industrial, scientific and medical radio-frequency equipment (13,56 ± 0,007) MHz, (40,68 ± 0,02) MHz; CB: Citizen band (27,125 ± 1,5) MHz.		

When tested at severity level 2, the control shall conform to Assessment Criterion I as specified in 8.1.1.

When tested at severity level 3, the control shall conform to Assessment Criterion II as specified in 8.1.2.

During sweeping through the frequency range, the dwell time at each frequency shall not be less than the time necessary for the control to be exercised and be able to respond. Sensitive frequencies or the frequencies of dominant interest may be analysed separately.

NOTE The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 1 m.

8.8 Immunity to radiated fields

The control shall be supplied with rated voltage. Test equipment, test set-up and test procedure shall be in accordance with IEC 61000-4-3, with the severity levels as specified in Table 9, the complete frequency range being swept at least once with the control under the test conditions specified in the specific control standard.

Table 9 — Test voltages for radiated immunity

Severity level	Field strength V/m	
	Frequency range 80 MHz to 1 000 MHz	**ISM and GSM bands**[a]
2	3	6
3	10	20
NOTE DECT: Digital European Cordless Telephone (1 890 ± 10) MHz, modulated by (200 ± 2) Hz pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off). Values of field strength are under consideration.		
[a] ISM: Industrial, scientific and medical radio-frequency equipment (433,92 ± 0,87) MHz; GSM: Group Special Mobile (900 ± 5,0) MHz, modulation by (200 ± 2) Hz pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off).		

When tested at severity level 2, the control shall conform to Assessment Criterion I as specified in 8.1.1.

When tested at severity level 3, the control shall conform to Assessment Criterion II as specified in 8.1.2.

During sweeping through the frequency range, the dwell time at each frequency shall not be less than the time necessary for the system to be exercised and be able to respond. Sensitive frequencies or the frequencies of dominant interest may be analysed separately.

8.9 Electrostatic discharge immunity test

The control shall be supplied with rated voltage. Test equipment, test set-up and test procedure shall be in accordance with IEC 61000-4-2, with the severity levels as specified in Table 10. The control shall be tested under the test conditions specified in the specific control standard.

Table 10 — Test voltages for direct and indirect electrostatic discharges

Severity level	Contact discharge kV	Air discharge kV
2	4	4
3	6	8

When tested at severity level 2, the control shall conform to Assessment Criterion I as specified in 8.1.1.

When tested at severity level 3, the control shall conform to Assessment Criterion II as specified in 8.1.2.

8.10 Test for immunity to power-frequency magnetic fields

Controls which may be affected by power-frequency magnetic fields (e.g. Hall effect) shall comply with the test in Annex D.

8.11 Electrical requirements

Controls shall conform to the relevant requirements of IEC 60730-1:1999, except for those aspects already covered in this International Standard or in the specific control standard.

NOTE 1 The exceptions concern in general the endurance test, EMC-immunity requirements, deviation and drift in accordance with IEC 60730-1:1999, subclauses 6.3, 6.4, 6.10, 6.11 and 6.16, Table 7.2, items 6, 26, 27, 28, 37, 38, 39, 40, 41, 42, 57, 58a, 58b, 71, 72 and 73, and Clauses 15, 17 and H26. Behaviour under fault conditions and protection against environmental influences are in general specified in this International Standard or in the specific control standard.

NOTE 2 For applications falling outside the scope of IEC 60730-1:1999, attention is drawn to the IEC 61010 series and IEC 61508 series, where the Safety Integrity Level (SIL) should be either level 2 or level 3.

9 Marking, installation and operating instructions

9.1 Marking

The marking requirements are given in the specific control standard.

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

— manufacturer and/or trade mark;

— type reference;

— date-code or serial number.

9.2 Installation and operating instructions

One set of instructions shall be supplied with each consignment, written in the language(s) of the countries to 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.

9.3 Warning notice

A warning notice shall be attached to each consignment of controls. This notice shall read as follows:

“WARNING — Read the instructions before use. This control shall be installed in accordance with the rules in force.”

Annex A
(informative)

Leak-tightness test — Volumetric method

A.1 Apparatus

The apparatus is shown schematically in Figure A.1.

The apparatus is 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 temperature-controlled room.

A.2 Test procedure

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

A.2.1 Close taps 2 to 5 (tap 1 is opened and tap L is closed).

A.2.2 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.

A.2.3 Open tap 5 to adjust water level to zero in H, and close tap 5.

A.2.4 Open taps 1 and 4 in order to adjust the pressure of the compressed air at the inlet of tap 4 from the atmospheric pressure to the test pressure by setting the pressure regulator F.

A.2.5 Close tap 4 and connect the control under test B to the apparatus.

A.2.6 Open taps 3 and 4 and readjust tap 1 with the water level at the top of pipe G by operating L and tap 2 if necessary.

A.2.7 Close tap 1 when the measuring burette H and control under test have become pressurized under tap 1.

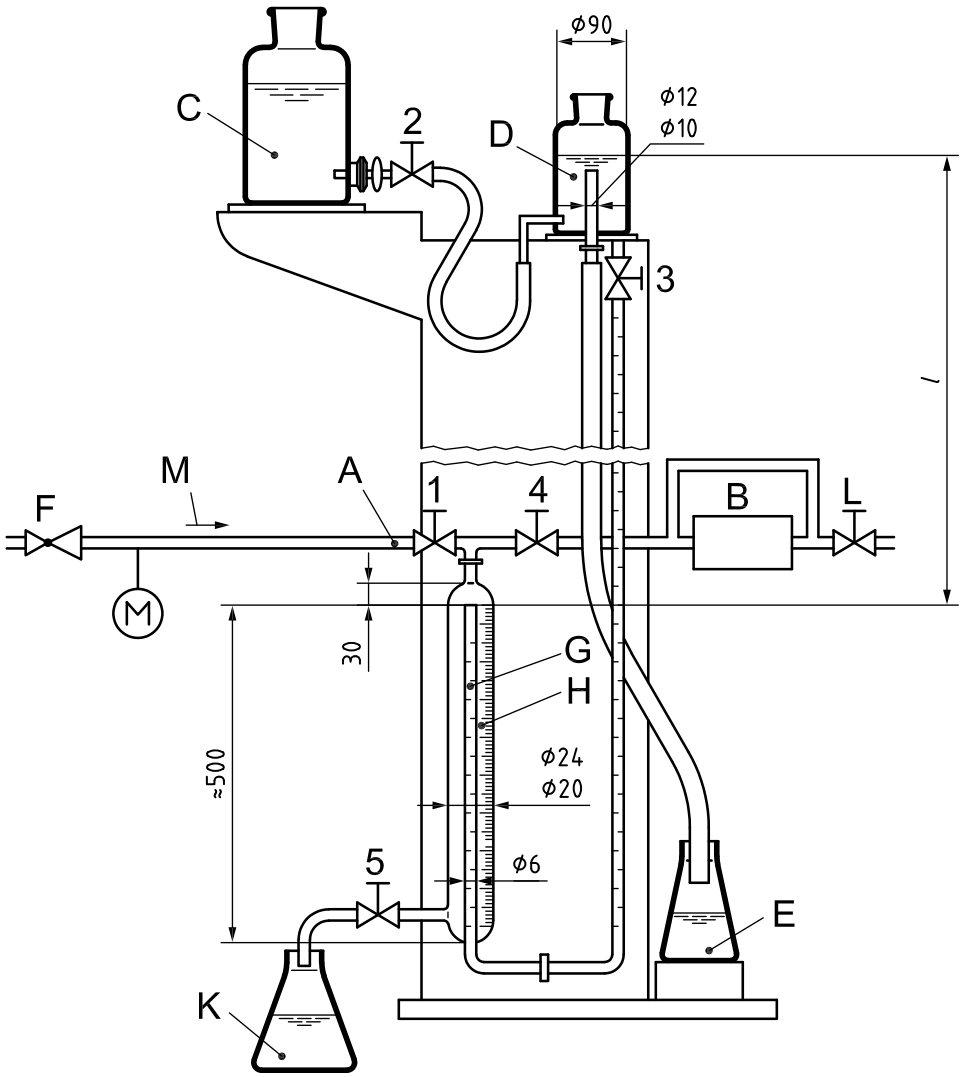
A.2.8 Allow approximately 15 min for the air in the test apparatus and the control under test to reach thermal equilibrium.

A.2.9 Any leakage is shown by water overflowing from pipe G into measuring burette H. Measure the leakage by the water level rise in H within a given time.

A.2.10 Close taps 3 and 4 in order to disconnect the control.

A.2.11 Reduce the outlet regulator pressure to zero by opening taps 1 and 4.

Dimensions in millimetres



Key

A	inlet
B	test sample
C	water tank
D	constant-level bottle
E	overflow bottle
F	regulator
G	pipe
H	measuring burette
K	draining bottle
L	outlet tap
M	compressed air flow
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. It consists of the following elements:

B.1.1 Thermally insulated pressure vessel A, filled with water such that the volume of air above the water is 1 dm^3.

B.1.2 Open-ended glass tube B, of internal diameter 5 mm with 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 and 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

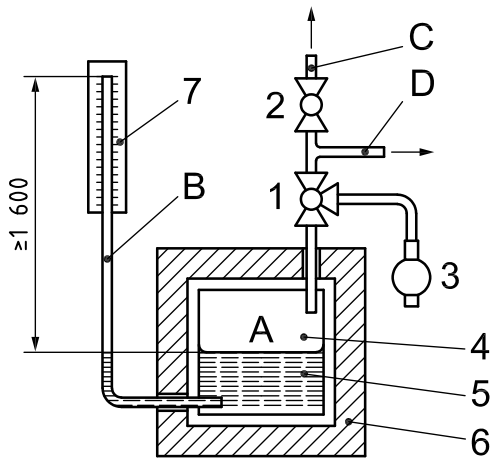
If this test method is chosen, the following procedure shall be followed.

B.2.1 Using a regulator, 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.

B.2.2 Open the three-way tap 1 to connect the control under test to A.

B.2.3 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
2 tap
3 air pump
4 1 dm^3 air volume
5 water
6 thermal insulation
7 scale graduated in millimetres
A thermally insulated pressure vessel
B measuring tube
C vent pipe
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

The following equation shall be used to calculate the leakage rate (e.g. in cm^3/h) from the pressure loss.

$$q_L = 11{,}85 \times 10^{-3} \, V_g \left(p'_{abs} - p''_{abs} \right)$$

where

q_L is the leakage rate, in cm^3/h;

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

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

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)

Test for immunity to power-frequency magnetic fields

D.1 General

A control which is susceptible to a magnetic field, such as controls which use Hall-effect devices, shall tolerate power-frequency magnetic fields.

Compliance shall be checked using the tests of D.4.

Examples of such controls include pressure sensors which use Hall-effect devices, controls incorporating reed relays and controls utilizing bi-stable relays.

D.2 Purpose of the test

The purpose of the test is to demonstrate the immunity of controls which may be affected by power-frequency magnetic fields related to the specific location and installation conditions of the control (e.g. proximity of the equipment to the source of disturbance).

The power-frequency magnetic field is generated by power-frequency currents in conductors or from other devices (e.g. leakage of transformers) in the proximity of equipment.

Only the influences of nearby conductors should be considered, where the current under normal operating conditions produces a steady (continuous) magnetic field with a comparatively small magnitude.

D.3 Test levels

The test levels shall be applied in accordance with Table D.1.

Table D.1 — Test level for continuous fields

Severity level	**Continuous field strength** A/m
2	3
3	10

D.4 Test procedure

The control is supplied at rated voltage. Test equipment, test set-up and test procedure shall be in accordance with IEC 61000-4-8. The control shall be tested under the test conditions specified in the relevant specific standard.

Annex E
(normative)

Specific regional requirements in European countries

E.1 General

For the purposes of this International Standard, the specific regional requirements given in E.2 are applicable in the following European countries (CEN Members): Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Only the affected subclauses are mentioned, hence the numbering is non-consecutive.

E.2 Additional requirements

E.6.3.2.1 Housing design

Addition to 6.3.2.1:

Zinc alloys may only be used for gas-carrying parts of controls up to DN 50, with maximum working pressures up to 20 kPa and of quality ZnAl4 in accordance with ISO 301, if the parts do not exceed a temperature of 80 °C. If the main inlet or outlet threaded connections are made of zinc alloys, threads shall be external and conform to ISO 228-1.

E.6.4.2 Connection sizes

Addition to 6.4.2:

Controls above DN 80 shall be fitted with flanges in accordance with ISO 7005 (all parts).

Annex F
(normative)

Specific regional requirements in Canada and USA

F.1 General

For the purposes of this International Standard, the specific regional requirements given in F.2 are applicable in Canada and the USA.

Only the affected subclauses are mentioned, hence the numbering is non-consecutive.

F.2 Additional requirements and modifications

F.6.2.3.1 Design

Addition to 6.2.3.1:

Vent limiters shall be of material with a melting point of 427 °C (800 °F) or above.

F.6.2.4 Screwed fastenings

Addition to 6.2.4:

Threads shall comply with ANSI/ASME B 1.1[8].

F.6.2.5 Jointing

Addition to 6.2.5:

The lowest allowable melting point shall be 427 °C (800 °F).

F.6.3.1 General material requirements

Addition to 6.3.1:

The manufacturer shall supply evidence that all materials have been evaluated and found suitable for their intended use.

F.6.3.2.1 Housing design

Addition to 6.3.2.1:

Control housings, castings and vent limiters shall be of material with a melting point of 427 °C (800 °F) or above.

F.6.4.3 Threads

Addition to 6.4.3:

Threads shall comply with ANSI/ASME B 1.20.1[9] (National Pipe Threads, NPT).

F.6.4.4 Union joints

Addition to 6.4.4:

If connections are made with union joints, either the joints shall be included with the control or full details shall be supplied if the threads do not conform to ANSI/ASME B 1.20.1[9].

F.6.4.5 Flanges

Addition to 6.4.5:

Flanges shall be constructed in accordance with the dimensional specifications for 125 lb cast iron flanges specified in ANSI/ASME B 16.1[10].

F.6.4.6 Compression fittings

Addition to 6.4.6:

Compression fittings shall be in accordance with, or interchangeable with, fittings described in the standard for automotive tube fittings, ANSI/SAE J 512[11], or the standard for hydraulic tube fittings, ANSI/SAE J 514[12], as applicable.

F.6.4.7 Nipples for pressure tests

Addition to 6.4.7:

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[9] is allowed. If the plug is of the slotted type, it shall also incorporate square or hexagonal flats.

F.6.4.8 Strainers

Addition to 6.4.8:

Neither strainer nor installation information is required.

F.7 Performance

F.7.1 General

Replace list item 7.1 b) as follows:

b) a minimum ambient temperature range from 0 °C (32 °F) to 51,5 °C (125 °F), or wider limits if declared by the manufacturer;

F.7.2 Leak-tightness

F.7.2.1 Criteria

Replace the entirety of 7.2.1 as follows:

Controls shall not have an external leak rate greater than 200 cm^3/h when tested at the manufacturer's specified minimum and maximum ambient temperatures with an inlet test pressure of 1,5 times the maximum working pressure of the control.

Controls having a seal-off diameter of 25,4 mm (1 in) or less shall not have an internal leak rate greater than 235 cm^3/h. Controls having a seal-off diameter greater than 25,4 mm (1 in) shall not have a leak rate greater than 235 cm^3/h per inch of seal-off diameter. The test for internal leak-tightness shall be conducted at the

manufacturer's specified minimum and maximum ambient temperatures and at both a maximum inlet test pressure of 1,5 times the maximum working pressure of the control and a minimum inlet test pressure of either 0,50 kPa (2 in water column) for controls with a maximum working pressure of 34,47 kPa (5 psi) or less, or 1,72 kPa (0,25 psi) for controls with a maximum working pressure greater than 34,47 kPa (5 psi). The following procedures apply to controls rated at 34,5 kPa (5 psi) or less. For controls rated at more than 34,5 kPa (5 psi), use the test method described in Annex B. Controls shall not exceed the leakage rate specified in Table F.1 when tested according to F.7.2.2.

Table F.1 — Maximum leakage rates

Inlet diameter nominal, DN	**Seal-off diameter** mm (in)	**Maximum leakage rates** cm^3/h of air	
		Internal leak-tightness	**External leak-tightness**
DN ⩽ 25	⩽25,4 (⩽1)	235	200
DN > 25	>25,4 (>1)	235/inch of seal-off diameter	200

F.7.2.2 Test for leak-tightness

F.7.2.2.1 General

Replace 7.2.2.1 as follows:

The test pressure for measuring external and internal leakage shall be 1,5 times the maximum working pressure. An additional test for measuring internal leakage shall be conducted at 0,50 kPa (2 in water column) for controls with a maximum working pressure of 34,47 kPa (5 psi) or less, or at 1,72 kPa (0,25 psi) for controls with a maximum working pressure greater than 34,47 kPa (5 psi).

The test temperature(s) shall be

a) room temperature if the specified ambient temperature range is 0 °C (32 °F) to 51,5 °C (125 °F),

b) room temperature and the maximum specified ambient temperature if that temperature is above 51,5 °C (125 °F),

c) room temperature and the minimum specified ambient temperature if that temperature is below 0 °C (32 °F), or

d) both the minimum and maximum specified ambient temperatures if the ambient temperature range extends below 0 °C (32 °F) and above 51,5 °C (125 °F).

F.7.2.2.2 External leak-tightness

Replace 7.2.2.2 as follows:

Any bypass or other opening not essential to the operation of the valve during this test shall be sealed. The inlet(s) and outlet(s) of the control shall be connected to a pneumatic system capable of supplying clean, dry air at the specified leakage-test pressures. With the control at the specified maximum test temperature, air shall be admitted slowly and maintained at the maximum specified leakage-test pressure. Leakage, corrected to standard conditions of 101,6 kPa (30 inches mercury) and 15,5 °C (60 °F), shall be determined by a flow-measuring device capable of accurately indicating the allowable flow, located at the inlet of the air supply.

The test shall be repeated at any additional test temperature as is appropriate for the control's specified ambient temperature range.

F.7.2.2.3 Internal leak-tightness

Replace 7.2.2.3 as follows:

The test for internal leak-tightness shall be conducted at the test temperature(s) applicable to the control's specified ambient temperature range and at both specified inlet test pressures.

When a bypass is incorporated as a part of the control and the control is designed so that bypass gas is discharged into the main gas supply before the outlet of the control, the bypass shall be sealed. The inlet of the control shall be connected to a pneumatic system capable of supplying clean, dry air at the specified range of leakage-test pressures. An airtight connection shall be made to the control outlet, terminating in a flow-measuring device capable of accurately indicating flow rates equal to the maximum permissible leakage, corrected to standard conditions of 101,3 kPa (30 inches mercury) and 15,5 °C (60 °F). The control shall be at the specified maximum test temperature.

With the control in the closed position assumed as the result of normal operation and after a few cycles of operation, two tests shall be conducted. In the first test, the maximum leakage-test pressure shall be applied to the control inlet for a period of not less than 2 min. During this time, the flow-measuring device shall not indicate a total internal leakage in excess of the maximum permitted. In the second test, the air pressure shall be reduced to the minimum leakage-test pressure with the other conditions remaining the same.

The tests at the two test pressures shall be repeated at any additional test temperatures as are appropriate for the control's specified ambient temperature range.

F.7.5.2.2 Test for resistance to lubricants

Addition to 7.5.2.2:

Alternatively, use the following procedure.

Fill the control with the appropriate test liquids as specified in 7.5.2.2 and 7.5.3.2. 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 7.2.2.

F.7.5.3.2 Test for resistance to gas

Addition to 7.5.3.2:

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.

Alternatively, use the following procedure.

Fill the control with the appropriate test liquids as specified in 7.5.3.2. 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 7.2.2.

F.8.6 Electrical fast transient/burst

Replace the test described in 8.6 as follows:

The test shall be carried out in accordance with IEC 60730-1:1999, H26.10.

Annex G
(normative)

Specific regional requirements in Japan

G.1 General

For the purposes of this International Standard, the specific regional requirements given in G.2 are applicable in Japan.

Only the affected subclauses are mentioned, hence the numbering is non-consecutive.

G.2 Additional requirements

G.5 Test conditions

Replace the second and third paragraphs of Clause 5 with the following:

Tests shall be carried out at an ambient temperature of (20 ± 15) °C and within ±5 K during testing.

The standard conditions shall be 20 °C and 101,325 kPa, dry.

G.6.2.3.1 Design

Replace 6.2.3.1 a) as follows:

a) the air flow rate through the hole does not exceed 140 dm^3/h at the maximum inlet pressure,

The requirement in the second paragraph of 6.2.3.1, specifying the diameter of a breather hole, shall not apply.

G.6.3.2.1 Housing design

Addition to 6.3.2.1:

Control housings, castings and vent limiters shall be incombustible and of materials with melting points of no less than 500 °C.

G.6.4.3 Threads

Replace 6.4.3 as follows:

Threads shall comply with JIS B 0202 or JIS B 0203.

G.6.4.4 Union joints

Replace 6.4.4 as follows:

Union joints shall comply with JIS B 0202 or JIS B 0203.

G.6.4.5 Flanges

Replace the second paragraph of 6.4.5 with the following:

Flanges shall comply with JIS B 2220, JIS B 2239, JIS B 2240, JIS B 2241 or JIS B 2301.

G.6.4.7 Nipples for pressure tests

Replace 6.4.7 as follows:

Nipples for pressure tests shall be rigid and designed so that nipples are securely closed by suitable means after testing. A device to prevent leakage through the nipple caused by the loosening of a screw should be provided upstream.

G.6.4.9 Pipe fittings

Addition to subclause 6.4:

Pipe fittings shall comply with JIS B 2301, JIS B 2302, JIS B 2311, JIS B 2312, JIS B 2316, or JIS H 3401.

G.7 Performance

G.7.1 General

Replace list item 7.1 b) as follows:

b) an ambient temperature range from 0 °C to 55 °C, or wider limits if declared by the manufacturer;

Replace list item 7.1 d) as follows:

d) the voltage or current range from 90 % to 110 %, or 85 % to 110 % if declared by the manufacturer, of the rated value; or from 90 %, or 85 % if declared by the manufacturer, of the minimum rated value to 110 % of the maximum rated value.

G.7.2 Leak-tightness

G.7.2.1 Criteria

Replace 7.2.1 as follows:

Controls up to and including DN 25 shall not exceed the air leakage rates specified in Table G.1 when tested at the manufacturer's specified minimum and maximum ambient temperatures with an inlet test pressure in the range from 0,5 kPa to 4,2 kPa.

Controls above DN 25 shall not exceed the air leakage rate specified in Table G.1 when tested at the manufacturer's specified minimum and maximum ambient temperatures at the inlet test pressure of 1,5 times the maximum working pressure.

Table G.1 — Maximum air leakage rates

Inlet diameter nominal, DN	**Maximum air leakage rates** cm^3/h	
	Internal leak-tightness	**External leak-tightness**
$DN \leqslant 25$	300	30
$DN > 25$	300 per 2,54 cm of seal-off diameter	60

G.7.3.4 Torsion and bending tests

G.7.3.4.1 General

Addition to 7.3.4.1:

Torsion and bending tests shall be carried out in accordance with the conditions given in Tables G.2 and G.3 and in Figure G.1.

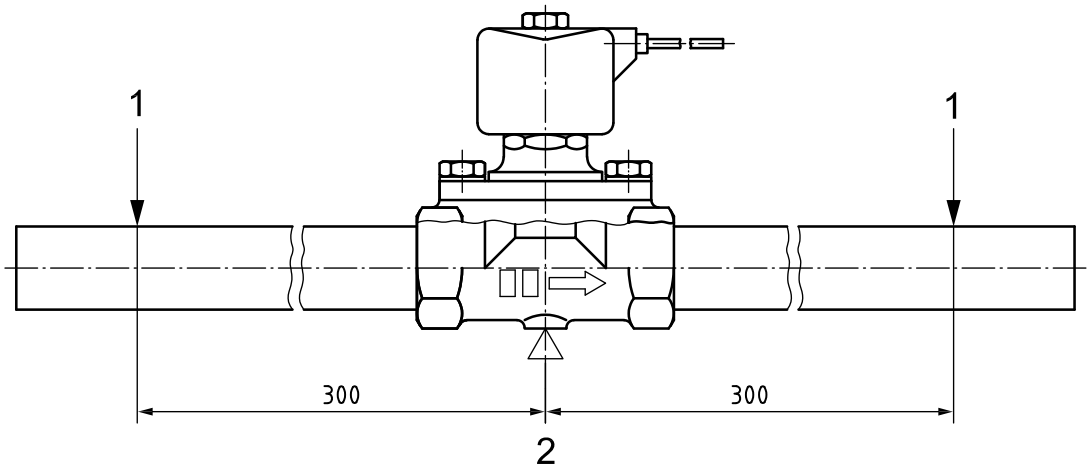
Table G.2 — Torque test

Diameter nominal, DN	**Torque** N·m (kgf·cm)
6	15 (150)
8	20 (200)
10	30 (300)
15	35 (350)
20	50 (500)
25	60 (600)
32	80 (800)
40	85 (850)
50	110 (1 100)
65	120 (1 120)
80	120 (1 120)
100	150 (1 150)

Table G.3 — Bending-moment test

Diameter nominal, DN	**Weight** N (kgf)
6	60 (6)
8	70 (7)
10	80 (8)
15	90 (9)
20	100 (10)
25	110 (11)
32	130 (13)
40	160 (16)
50	300 (30)
65	320 (32)
80	450 (45)
100	450 (45)

Dimensions in millimetres



Key

1 load

2 fulcrum

Figure G.1 — Bending-moment test assembly

G.7.4.2.3 Conversion of air flow rate

Modification to 7.4.2.3:

The following equation for conversion of flow rate to standard conditions applies:

$$q_{\mathrm{n}} = q \cdot \left(\frac{P_{\mathrm{a}} + P}{101{,}325} \cdot \frac{293{,}15}{273{,}15 + T} \right)^{\frac{1}{2}}$$

where

q_{n} is the corrected air flow rate at standard conditions, in m^3/h;

q is the measured air flow rate, in m^3/h;

P_{a} is the atmospheric pressure, in kPa;

P is the test pressure, in kPa;

T is the air temperature, in °C.

G.8.2 Variations in supply voltage

Modification to 8.2:

Replace the first sentence in the first paragraph of 8.2 with the following:

The lower limit shall be 0,90 times, or if declared by the manufacturer 0,85 times, the rated voltage for AC voltage and 0,85 times, or if declared by the manufacturer 0,80 times, the rated voltage for DC voltage.

Replace the value of 0,85 times rated voltage in the second paragraph of 8.2 with the minimum value as given by the following:

The lower limit shall be 0,90 times, or if declared by the manufacturer 0,85 times, the rated voltage for AC voltage and 0,85 times, or if declared by the manufacturer 0,80 times, the rated voltage for DC voltage.

Bibliography

[1] ISO 6708:1995, *Pipework components — Definition and selection of DN (nominal size)*

[2] ISO 8655-1:2002, *Piston-operated volumetric apparatus — Part 1: Terminology, general requirements and user recommendations*

[3] ISO 23551 (all parts), *Safety and control devices for gas burners and gas-burning appliances — Particular requirements*

[4] ISO 23552-1, *Safety and control devices for gas and/or oil burners and gas and/or oil appliances — Particular requirements — Part 1: Fuel/air ratio controls, electronic type*

[5] ISO 23553-1, *Safety and control devices for oil burners and oil-burning appliances — Particular requirements — Part 1: Shut-off devices for oil burners*

[6] IEC 61010 (all parts), *Safety requirements for electrical equipment for measurement, control and laboratory use*

[7] IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

[8] ANSI/ASME B 1.1:1989, *Unified inch screw threads (UN and UNR thread form)*

[9] ANSI/ASME B 1.20.1, *Pipe threads, general purpose (inch)*

[10] ANSI/ASME B 16.1, *Gray iron pipe flanges and flanged fittings: classes 25, 125, and 250*

[11] ANSI/SAE J 512, *Automotive tube fittings*

[12] ANSI/SAE J 514, *Hydraulic tube fittings*

[13] JIS B 0202, *Parallel pipe threads*

[14] JIS B 0203, *Taper pipe threads*

[15] JIS B 2220, *Steel pipe flanges*

[16] JIS B 2239, *Cast iron pipe flanges*

[17] JIS B 2240, *Copper alloy pipe flanges*

[18] JIS B 2241, *Aluminium alloy pipe flanges*

[19] JIS B 2301, *Screwed type malleable cast iron pipe fittings*

[20] JIS B 2302, *Screwed type steel pipe fittings*

[21] JIS B 2311, *Steel butt-welding pipe fittings for ordinary use*

[22] JIS B 2312, *Steel butt-welding pipe fittings*

[23] JIS B 2316, *Steel socket-welding pipe fittings*

[24] JIS H 3401, *Pipe fittings of copper and copper alloys*

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