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Third edition
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Safety and control devices for oil burners and oil-burning appliances — Particular requirements —

Part 1: Automatic and semi-automatic valves

Dispositifs de commande et de sécurité pour brûleurs à combustible liquide et pour appareils à combustible liquide — Exigences particulières —

Partie 1: Robinets automatiques et semi-automatiques

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: 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.

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

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

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

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

This document was prepared by Technical Committee ISO/TC 161, *Controls and protective devices for gas and/or oil,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 47, *Atomizing oil burners and their components — Function — Safety — Testing,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 23553-1:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— relevant references have been updated to ISO 23550 wherever possible;

— relevant references have been updated to IEC 60730-1:2013, modified + COR1:2014;

— references have been dated, where applicable.

A list of all parts in the ISO 23553 series can be found on the ISO website.

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

Introduction

This document is designed to be used as a stand-alone standard and no longer in combination with ISO 23550.

Whereas the previous edition referred to specific sections in ISO 23550, these have now been included directly in this document. Compared to the previous edition (ISO 23553-1:2014) no technical changes have been done and no further technical requirements have been added. For the same reason, reference to IEC 60730-1 is maintained. It will be updated in the next edition.

Safety and control devices for oil burners and oil-burning appliances — Particular requirements —

Part 1: Automatic and semi-automatic valves

1 Scope

This document specifies safety, constructional and performance requirements and testing of automatic and semi-automatic valves for oil.

It applies to automatic and semi-automatic valves which are:

— normally closed;

— used in combustion plants to interrupt the oil flow with or without delay on closing;

— for use with oil types (e.g. middle distillate fuel oil, crude oil, heavy fuel oil or kerosene) without gasoline;

NOTE 1 For other oil types (e.g. oil emulsions), additional test methods can be agreed between the manufacturer and the test authority.

NOTE 2 Oil types from petroleum refining processes are classified ISO-F-D in ISO 8216-99 and form part of a device having other function(s), such as oil pumps. In this case, the test methods apply to those parts or components of the device forming the automatic and semi-automatic valves, i.e. those parts which are necessary for the closing function.

— for use on burners or in appliances using oil;

— directly or indirectly operated, electrically or by mechanical or hydraulic means;

— fitted with or without closed-position indicator switches.

This document covers type testing only.

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 7-1:1994, *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 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*

ISO 10763, *Hydraulic fluid power — Plain-end, seamless and welded precision steel tubes — Dimensions and nominal working pressures*

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

IEC 60534-1, *Industrial-process control valves— Part 1: Control valve terminology and general considerations IEC 60534-2-3*

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

IEC 60730-1:2010, *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 measurement 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 61000-4-8:2009, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test*

IEC 61058-1, *Switches for appliances — Part 1: General requirements*

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
closure member
movable part of the *valve* (3.16) which shuts off the oil flow

3.2
control
device which directly or indirectly controls the oil flow and/or provides a safety function within an oil burner or oil-burning appliance

3.3
external leak-tightness
leak-tightness of an oil-carrying compartment with respect to the atmosphere

3.4
group 1 control
controls (3.2) 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 to entry: In Canada, Japan and the USA, group 1 controls are not used.

3.5
group 2 control
controls (3.2) for use in any situation, either internal or external to the appliance, typically without support

Note 1 to entry: *Controls* (3.2) which meet the requirements of group 2 control also meet the requirements of *group 1 control* (3.4).

3.6
internal leak-tightness
leak-tightness of the *closure member* (3.1) (in the closed position) sealing an oil-carrying compartment with respect to another compartment or to the outlet of the *control* (3.2)

3.7
pressure difference
difference between the pressure at the inlet of the control and outlet of the control

3.8
maximum operation pressure
highest inlet pressure declared by the manufacturer at which the *control* (3.2) may be operated

3.9
minimum operation pressure
lowest inlet pressure declared by the manufacturer at which the *control* (3.2) may be operated

3.10
flow rate
volume flowing through the *control* (3.2) divided by time

3.11
maximum ambient temperature
highest temperature of the surrounding air declared by the manufacturer at which the *control* (3.2) may be operated

3.12
minimum ambient temperature
lowest temperature of the surrounding air declared by the manufacturer at which the *control* (3.2) may be operated

3.13
mounting position
position declared by the manufacturer for mounting the *control* (3.2)

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 poise: any position on a horizontal, vertical or intermediate axis with respect to the inlet connection.

3.14
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 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.]

3.15
nominal pressure
PN
numerical designation relating to pressure that is a convenient round number for reference purposes

[SOURCE: ISO 7268:1983, Clause 2]

3.16
valve
device consisting essentially of a valve body, *closure member* (3.1), and *actuator* (3.24) that controls the oil flow

Note 1 to entry: The *actuator* (3.24) can be actuated by electrical or mechanical means.

Note 2 to entry: The actuation can be done by oil pressure, electrical, hydraulic or pneumatic energy.

3.17
normally closed valve
nc
valve (3.16) which is in closed position when no actuating energy is applied

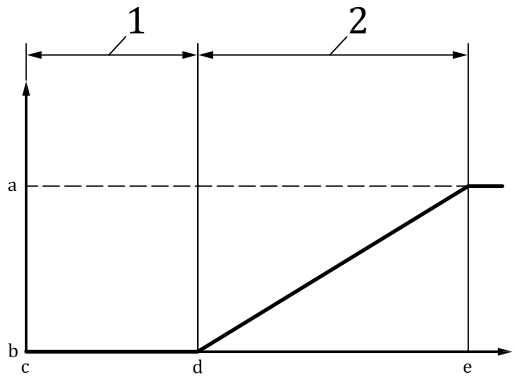
3.18
automatic valve
normally closed valve (3.17) that closes on removal of the actuating energy

3.19
semi-automatic valve
normally closed valve (3.17) that is actuated manually and returns to the closed position upon removal of the actuating energy

3.20
safety shut-off valve
normally closed valve (3.17), automatic or semi-automatic, that prevents the oil flow completely when de-energized

3.21
opening time
time from the beginning until the end of the change in position of the closure member from the closed to the open position

Note 1 to entry: See Figure 1.



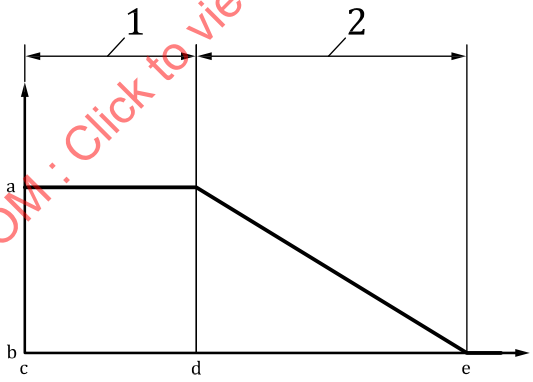
Key

1	delay time	c	Signal for opening.
2	opening time	d	Start of period of change in position.
a	Open.	e	End of period of change in position.
b	Closed.		

Figure 1 — Response time of *closure member* (3.1) during opening

3.22
closing time
time from the beginning until the end of the change in position of the *closure member* (3.1) from the open to the closed position

Note 1 to entry: See Figure 2.



Key

1	delay time	c	Signal for closing.
2	closing time	d	Start of period of change in position.
a	Open.	e	End of period of change in position.
b	Closed.		

Figure 2 — Response time of *closure member* (3.1) during closing

3.23
closing force
force which effects the closing of the *closure member* (3.1) in the case of failure or interruption of the externally applied actuating energy, such as spring force, independent of any force provided by oil pressure

3.24
actuator
part effecting the movement of the *closure member* (3.1)

Note 1 to entry: Media can also effect the movement.

3.25
auxiliary medium
medium used for actuating the moving parts of the system (pneumatic or hydraulic)

3.26
auxiliary medium pressure
pressure exerted by the *auxiliary medium* (3.25) during actuation of the moving parts

3.27
control valve
valve (3.16) which controls the hydraulic or pneumatic means supplied to the actuating mechanism

[SOURCE: ISO 23551-1:2012, 3.115]

4 Classification

4.1 Classes of control

Automatic and semi-automatic oil control valves are not classified.

4.2 Groups of control

Controls for use in any situation, either internal or external to the appliance and regardless of the kind of support, the listed torque, and bending moment in Table 5, shall be fulfilled (see 7.3.4.4).

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.

5 Test conditions

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

Controls which can be converted for use with another oil 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.

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

NOTE 2 Specific regional requirements are given in D.2.1.

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 document 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 can cause damage, injury or incorrect operation. All parts shall be clean internally and externally.

6.2.2 Holes

Holes for screws, pins, etc., which are used for the assembly of parts or used to install the valve shall not penetrate oil passageways.

Holes necessary in manufacture which connect oil passageways to the atmosphere, but which do not affect the function of the valve, shall be permanently sealed by metallic means. Suitable jointing compounds may additionally be used.

6.2.3 Flexible diaphragm, bellows or similar construction

Valves which utilize a flexible diaphragm, bellows, or similar construction as the only oil seal against atmospheric pressure, shall have:

— the atmospheric side enclosed in a casing to limit external leakage in the event of diaphragm or bellows rupture; or

— provisions for connection of pipe or tubing to carry away the occurring leakage.

Compliance is checked by rupturing the diaphragm or bellows and measuring the leakage according to 7.2.1.1. During this test, the connection ports for pipes or tubing shall be blocked.

Leakage through an unthreaded vent opening is included. Leakage through a vent opening which has provision for connection of pipe or tubing is not included.

The installation of suitable pipe or tubing shall be declared by the manufacturer if the valve employs provisions for pipe or tubing as a measure to protect the environment from leakage occurring because of a damaged flexible diaphragm, bellows or similar.

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 oil-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.

Specific regional requirements shall be as given in Annex C, C.2.1.

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 427 °C after application shall not be used for connecting oil-carrying parts except for additional sealing.

Specific regional requirements shall be as given in Annexes C and D, specifically C.2.2 and D.2.2.

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 can 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

6.2.8.1 General

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 can show evidence of interference (e.g. lacquer), or fixed by fasteners requiring tools that are not commonly available.

Adjustment means shall be secured by means providing protection against access by uninstructed persons or shall be declared as requiring such protection in the application.

NOTE For example, these means can be:

a) sealed with a material suitable for the temperature range of the valve such that tampering is apparent;

b) accessible only with the use of special purpose tools; or

c) accompanied by instructions requiring the equipment manufacturer to mount the valve such that the adjustment means is inaccessible.

6.2.8.2 Test of adjustment means

Compliance is checked by inspection. Where sealing is used, inspection is done before and after the endurance tests.

6.2.8.3 Maintaining of adjustments

Suitable means for maintaining all adjustments shall be provided.

NOTE Lock nuts or adjusting nuts held by springs or compression are acceptable unless their adjustment can be accidentally disturbed.

6.2.8.4 Field adjustments

Necessary field adjustments shall be capped or otherwise protected in such a manner as to resist tampering or accidental change.

6.2.8.5 Dismantling

If a valve can be partially or completely disassembled without the use of special tools, construction shall be such that either:

a) parts of the valve cannot be readily reassembled improperly in a manner which can result in an unsafe condition; or

b) threaded fasteners are covered with a sealing means to discourage disassembly. The sealing means shall be suitable for exposure to the minimum and maximum ambient temperatures declared for the valve.

This subclause does not apply to parts of a valve intended for field replacement or servicing.

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.

6.2.10 Resistance against pressure

Oil valves shall be designed for pressures of 1,5 times the maximum operation pressure. The mechanical strength for devices above PN 16 or above DN 80 shall be proven.

Manually adjustable packing glands are not permitted.

6.2.11 Connections

The connections shall be designed in such a way that the valves can be installed in the oil lines by welding, brazing, with flanges using suitable gasket, union joints, compression fittings or by threads.

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 can be subjected during service.

Specific regional requirements shall be as given in Annex C, C.2.3.

6.3.2 Springs

6.3.2.1 Closure springs

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

If a satisfactory calculation cannot be submitted to the test laboratory, the springs shall be subjected to an endurance test of 2×10^6 operations under normal operating conditions.

6.3.2.2 Parts other than springs

With the exception of closure springs (see 6.3.2.1), parts generating or transmitting the closing force, including parts of the actuator, shall be designed such that the breaking load is 5 times the maximum possible operating load. Deviations from this requirement are acceptable if the function is not rendered unsafe upon fracture of the part and if tightness is maintained.

6.3.3 Resistance to corrosion and surface protection

All parts in contact with oil or atmosphere, and springs other than those covered by 6.3.2, 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.

6.3.4 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).

6.3.5 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.

6.3.6 Non-metallic sealing materials

Non-metallic sealing materials (thermoplastics, elastomers, thermosetting plastics, fibre-reinforced plastics, etc.) in contact with the oil shall be resistant against those oil types they are in use with and heat-resistant for the maximum oil temperature as declared by the manufacturer.

NOTE For the selection and evaluation of non-metallic materials, ISO 3601-5, ISO 23936-1, ISO 23936-2 or ISO/TR 7620 can be used.

Specific regional requirements shall be as given in Annex C, C.2.4.

6.3.7 Actuators

6.3.7.1 Electromagnetic actuators

Electromagnetic actuators shall remain functional in the range of 85 % to 110 % of the rated voltage.

Specific regional requirements shall be as given in Annex C, C.2.5.

The actuators shall be designed in such a way that after an uninterrupted operation of more than 24 h at a rated voltage of 100 %, the force of retention (e. g. due to friction or remanence) does not prevent the automatic closing of the closure member. For electrically operated control valves for hydraulic or pneumatic actuators, automatic closing shall occur at a voltage not below 15 % of the rated voltage.

This is tested for 24 h at the minimum ambient temperature declared by the manufacturer and repeated for 24 h at the maximum ambient temperature.

6.3.7.2 Hydraulic and pneumatic actuators

Hydraulic or pneumatic actuators shall open and close the automatic valves or close the semi-automatic valves correctly at the highest operating pressure while at the lowest permissible auxiliary medium pressure. The necessary control pipes or nozzles shall be chosen such that their function is guaranteed.

Control valves may be exchanged without further testing, if the replacement valves have been previously tested as part of a type test to this document.

6.3.8 Enclosures

Specific regional requirements shall be as given in Annexes C and D, specifically C.2.6 and D.2.3.

6.3.9 Extra low voltage terminals

Specific regional requirements shall be as given in Annex C, C.2.6.

6.4 Oil connections

6.4.1 Making connections

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

NOTE For flats for spanners of hexagon products, see ISO 272.

6.4.2 Connection sizes

Equivalent connection sizes are given in Table 1.

Specific regional requirements shall be as given in Annex B, B.2.1.

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 oil 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 does not adversely affect the operation of the control. A stop for the thread also satisfies the requirement.

Specific regional requirements shall be as given in Annexes B, C and D, specifically B.2.2, C.2.7 and D.2.4.

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	

The manufacturer shall specify the method of sealing between housing and pipe and shall provide the gasket if the connection is a thread according to ISO 228-1.

For example, for threaded joints are:

— port according to ISO 1179-1 for stud connectors according to ISO 1179-2;

— port according to ISO 1179-1 for stud connectors according to ISO 1179-3;

— port according to ISO 1179-1 for stud connectors according to ISO 1179-4;

— port according to ISO 1179-1 for stud connectors with sealing ring according to EN 12514:2020, Annex K;

— port according to ISO 9974-1 for stud connectors according to ISO 9974-3;

— port according to ISO 6149-1 or stud connectors according to ISO 6149-3.

Specific regional requirements shall be as given in Annexes B, C and D, specifically B.2.2, C.2.8 and D.2.4.

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.

The manufacturer shall specify the method of sealing between housing and pipe and shall provide the gasket if the connection is a thread according to ISO 228-1.

Specific regional requirements shall be as given in Annexes B, C and D, specifically B.2.3, C.2.8 and D.2.5.

6.4.5 Flanges

6.4.5.1 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 oil supply and their connections are already established.

6.4.5.2 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.

Specific regional requirements shall be as given in Annexes B, C and D, specifically B.2.4, C.2.9 and D.2.6.

6.4.6 Compression fittings

Compression fittings shall be suitable for use with tubes of outside diameter, according to ISO 10763 or equivalent. It shall not be necessary to pre-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. For thin walled copper tubes, support sleeves shall be used.

For example, for compression fittings are:

— 24° cone connectors with cutting rings according to ISO 8434-1;

— welding nipple with sealing cone and O-ring for 24° cone connector according to ISO 8434-1;

— 37° flared connectors according to ISO 8434-2;

— O-ring face seal connectors in stud ends according to ISO 8434-3;

— 60° cone connectors with or without O-ring according to ISO 8434-6.

Specific regional requirements shall be as given in Annexes B and C, specifically B.2.5 and C.2.10.

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.

Specific regional requirements shall be as given in Annexes C and D, specifically C.2.11 and D.2.7.

6.4.8 Welded connections

Welding ends shall be used, if connections are made by welding.

Specific regional requirements shall be as given in Annex B, B.2.6.

6.5 Strainers

Each valve shall be protected with a strainer to prevent the penetration of large particles. If two devices are combined as a group with or without intermediate pipes, one built-in strainer before or in the first device is sufficient. The mesh size of the screen shall not exceed 0,5 mm. Regarding testing, the strainer shall be treated as a component of the device. It should be designed and arranged such that, in case of deformation, the function of the device is not affected.

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.

Specific regional requirements shall be as given in Annex C, C.2.12.

6.6 Indicator

6.6.1 Position indicator

The closed position of valves with position indicator [type "s", see 9.1 h)] shall be marked on the valve, which shall be fitted with a potential-free pair of contacts.

6.6.2 Closed position indicator switch

Closed position indicator switches, where fitted, shall not impair the correct operation of valves. Adjusters shall be sealed to indicate interference. Any drift of the switch and actuating mechanism from its setting shall not impair correct valve operation.

If a closed position indicator switch is used as proof-of-closure switch, the switch contacts shall close only after the valve port is closed and shall open before the valve port opens. Additional movement to operate the switch after the valve port is closed shall be provided either directly by the port closure member or by additional valve actuating mechanism movement, which relies on the port closure member being in the closed position. The switch shall be factory set and sealed to prevent field adjustment.

7 Performance

7.1 General

Controls shall operate correctly under all combinations of the following:

a) the full range between minimum and maximum operating pressures, as stated in the installation and operating instructions;

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

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. 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: the tolerance shall be stated in the installation and operating instructions.

Specific regional requirements shall be as given in Annexes C and D, specifically in C.2.13 and D.2.8.

7.2 Leak-tightness

7.2.1 Criteria

7.2.1.1 Criteria for external leak-tightness

At the end of the test in 7.2.2.2, the outer surface of the valve shall not show any leakage. Compliance is verified by visual inspection.

7.2.1.2 Criteria for internal leak-tightness

Valves shall close tightly at all differential pressures. The test shall be carried out according to 7.2.2.3.

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

Disassemble and reassemble parts of the closure member 5 times in accordance with the manufacturer's instructions (see 6.2.8) and repeat the test only if the valve is serviceable.

Table 2 — Internal leak-tightness

Nominal inlet size DN	Maximum leakage rates of test oil $cm^3 \cdot h^{-1}$
<10	1
10 ≤ DN ≤ 25	2
25 < DN ≤ 50	4
>DN 50	8

NOTE Specific regional requirements are given in C.2.14.

7.2.2 Test for leak-tightness

7.2.2.1 General

The test is carried out before and after the endurance test in 7.7.

Test oil shall be the least viscous fluid for which the valve is intended or a compatible fluid of similar viscosity. The accuracy of the leakage measurement for internal leakage shall be 10 %, or less, of the maximum leakage rate according to Table 2.

7.2.2.2 External leak-tightness

Pressurize the inlet and outlet of the valve to 1,5 times the maximum operating pressure. The test shall be carried out at the minimum and maximum temperature specified by the manufacturer.

The test shall be made with the valve in the open position. Test durations shall be 1 h.

Dismantle and reassemble closure parts 5 times in accordance with the manufacturer's instructions (see 6.2.8) and repeat the test only if the valve is serviceable.

Compliance is verified by visual inspection.

7.2.2.3 Internal leak-tightness

The leak-tightness test shall be performed at 1,5 times, 1,0 times and 0,1 times the operating pressure.

The test shall be performed with the valves in the closed position. The test shall be made using operating pressure with forward flow. The test duration at each appropriate test pressure shall be 60 min. The test shall be carried out at the minimum and maximum temperature specified by the manufacturer.

During the test, leaking oil shall be collected and the volume after 1 h shall be measured. The leakage rates shall not exceed those given in Table 2.

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 can be subjected during installation and service.

The following requirements focus on controls connected directly on pipes as they typically are exposed to a higher load.

After testing, there shall be no permanent deformation and leakage shall not exceed the values specified in Table 2.

7.3.2 Torsion

Controls shall withstand the torque specified in Table 4 and Table 5 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 and Table 5 when tested in accordance with 7.3.4.4.

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 3 in accordance with ISO 7005-1 and ISO 7005-2.

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 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 B.2.7.

7.3.4.2 Ten-second torsion test — Controls with threaded connections

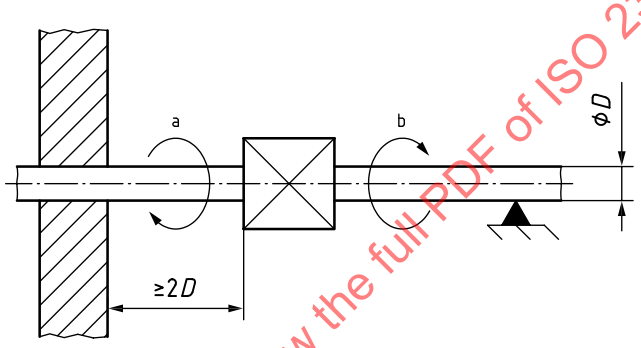
Screw pipe 1 into the control with a torque not exceeding the values given in Table 4. Clamp the pipe at a distance at least 2*D* from the control (see Figure 3).

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

D outside diameter

a Pipe 1.

b Pipe 2.

Figure 3 — Torsion test assembly

7.3.4.3 Ten-second torsion test — 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 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.

7.3.4.4 Ten-second bending-moment test

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

Calculate the force, *F*, from the required bending moment (see Table 4 and Table 5) 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;

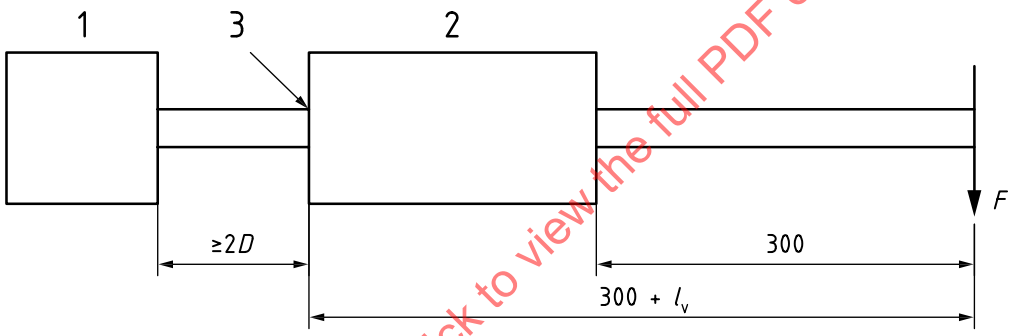
l_v is the length of the valve in m.

Apply the force 300 mm away from the control.

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

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.

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

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 (see Table 4 and 5) in accordance with Formula (1).

Apply the force 300 mm away from the control.

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 — 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 5 — Torque and bending moment for steel/iron pipe connections Group 1 and 2 controls

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

Table 5 *(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
1 1/2	200	350	610	175 98
2	250	520	1 100	260 210
2 1/2	325	630	1 600	315 261
NOTE Values in parentheses are for controls with flanged or saddle-clamp inlet connections on cooking appliances.				

7.3.5 Hydrostatic strength test

Specific regional requirements shall be as given in Annex C, C.2.15.

7.4 Rated oil flow

7.4.1 Criteria

If flow capacity of the valves is used as a safety criterion, the flow capacity K_V or C_V shall be used according to IEC 60534-1. The maximum flow capacity, measured according to 7.4.2, shall be at least 0,90 times the nominal flow capacity stated by the manufacturer.

7.4.2 Test of flow capacity

Test of flow capacity shall be done in open position according to IEC 60534-2-3.

7.5 Durability

7.5.1 Elastomers in contact with oil

Elastomers in contact with oil (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 oil

7.5.2.1 Criteria

The resistance of elastomers to oil 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 fuel

Carry out the test with the finished component or with parts of the finished component in accordance with ISO 1817:2015, 8.2, 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 Formula (2):

$$\Delta m = \frac{m_3 - m_1}{m_1} \times 100 \quad (2)$$

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.

7.5.3 Marking resistance

7.5.3.1 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.

7.5.3.2 Tests for marking resistance

Carry out the tests according to the methods given in IEC 60730-1.

7.5.4 Resistance to scratching

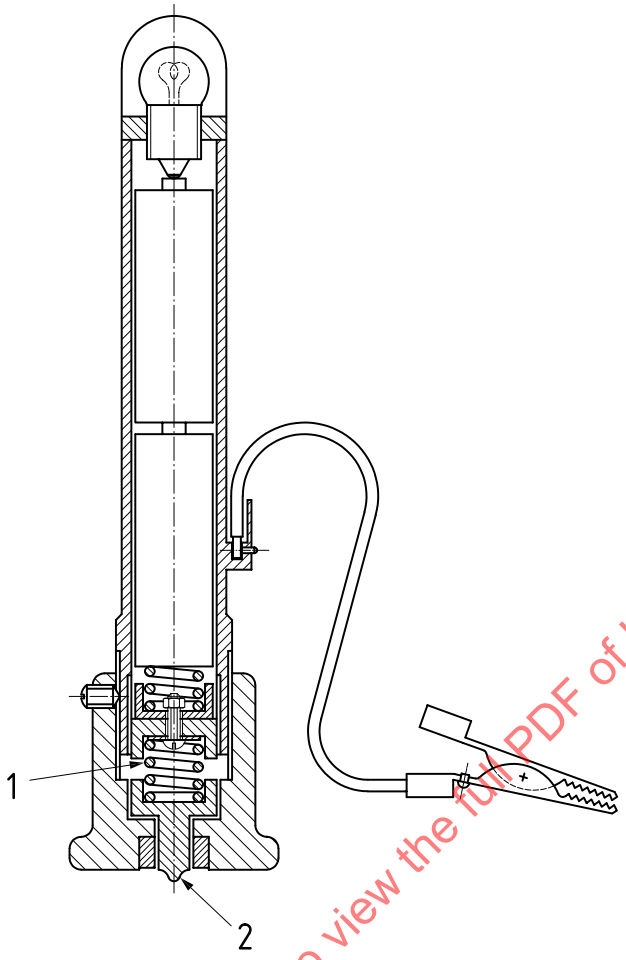
7.5.4.1 Criteria

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.

7.5.4.2 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 5).

Repeat the scratch test after the humidity test of 7.5.5.2.



Key

1 spring loading (10 N)

2 scratching point (steel ball, diameter 1 mm)

Figure 5 — Scratch test apparatus

7.5.5 Resistance to humidity

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

7.5.5.2 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

7.6.1 General

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

7.6.2 Closing function

7.6.2.1 Requirement

Automatic and semi-automatic valves shall close automatically on reducing the voltage or current to 15 % of the minimum rated value.

Automatic and semi-automatic valves with pneumatic or hydraulic actuating mechanisms shall close automatically on reducing the voltage or current to 15 % of the minimum rated voltage or current of the control valve. Automatic and semi-automatic valves shall close automatically on removal of the voltage or current of between 15 % of the minimum rated value and 110 % of the maximum rated value.

In all cases, the closing time shall be in accordance with 7.6.3.

Specific regional requirements shall be as given in Annexes C and D, specifically C.2.16 and D.2.10.

7.6.2.2 Test of closing function

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Slowly reduce the voltage or current to 15 % of the minimum rated value. Verify that the valve has closed.

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Increase the voltage or current to 110 % of the maximum rated value, keeping the actuating pressure, if any, unchanged. De-energize the valve and verify that it has closed. For AC valves, remove the voltage at the peak of the current waveform.

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Reduce the voltage or current to a value between 15 % of the minimum rated value and 85 % of the maximum rated value, keeping the actuating pressure, if any, unchanged. De-energize the valve and verify that it has closed. Carry out this test at 3 different voltages or currents between 15 % of the minimum rated value and 85 % of the maximum rated value.

After reaching stable thermal conditions, the voltage is slowly reduced.

Compliance is checked by connecting the normally closed valve to the supply at rated voltage, at ambient temperature and when mounted in the most unfavourable position as declared by the manufacturer and with or without oil at the maximum operation pressure connected to the valve inlet, whichever is more unfavourable. The voltage is then slowly reduced to 15 % of the minimum rated voltage for AC valve, and 2 % for DC valve, to check the valve is closed before this value is reached.

NOTE The value of 15 % is based on the usual normally closed valves where remanence, friction and possible rest currents due to control and signalling circuits can influence the closing force.

The test is repeated 3 times.

7.6.3 Valve closing time

The automatic and semiautomatic valve closing time shall not exceed 1 s.

NOTE Specific regional requirement is given in D.2.11.

7.6.4 Valve opening time

The valve opening time for automatic valves shall meet the time declared by the manufacturer.

7.7 Endurance

7.7.1 General

The test sample shall be submitted to a test to the requirements given in 7.2, 7.4 and 7.6.2 to 7.6.4 before and after the endurance test of 7.7.2.

7.7.2 Test of endurance

An endurance test at the operating pressure shall be carried out on the test sample, using the auxiliary medium with which the device is intended to be used. The number of cycles to be completed in the test is as follows:

— for sample installations up to and including DN 15: 100 000 cycles;

— for sample installations: 100 000 cycles.

The endurance test shall be carried out at the manufacturer's declared minimum and maximum temperature with an oil for which the valve is specified, with 50 % of the appropriate number of cycles at each temperature.

Specific regional requirements shall be as given in Annexes B and C, B.2.8 and C.2.17.

After the endurance test, the valves shall operate correctly at the manufacturer's declared minimum and maximum temperature at the maximum operation pressure.

7.7.3 Test of endurance of electrically operated valves

Energize the valve at 1,1 times the maximum rated voltage or current at maximum ambient temperature for a period of at least 24 h under no flow conditions. Without de-energizing the valve, slowly reduce the voltage or current to 15 % of the minimum rated value. Verify that the valve has closed.

The valve shall be maintained between maximum ambient temperature and 5 °C above that, or 1,05 times maximum ambient temperature, whichever is greater. If the minimum ambient temperature is less than 0 °C, additional tests shall be carried out with the valve maintained between minimum ambient temperature and 5 °C below it.

If the ambient temperature is declared greater than 25 °C, then use oil at the declared temperature during the maximum ambient temperature part of the test.

If the ambient temperature is declared less than 25 °C, then use oil at the declared temperature during the minimum ambient temperature part of the test.

If the ambient temperature is declared as 25 °C, then use oil at (25 ± 5) °C.

During the tests 50 % of each test is done at minimum ambient temperature and 50 % at maximum ambient temperature.

The automatic operation of the valve shall be tested by causing the valve to operate for the number of cycles according to 7.7.2 as declared.

The inlet is connected and supplied with oil at the lowest grade or type number and lowest viscosity value declared. The declared maximum operating pressure difference is to be achieved during each cycle. On each cycle, the valve shall reach the fully closed position. The rate of cycles and the method of operation shall be agreed between the testing authority and the manufacturer.

For the test at 25 °C, carry out 50 % of the cycles at the maximum rated voltage or current and 50 % at the minimum rated voltage or current.

For semi-automatic valves for manual actions, each cycle of actuation shall consist of a movement of the actuator such that the valve is successively moved into all positions appropriate to that action and then returned to its starting point. However, if the valve has more than one intended OFF position, then each manual action shall be a movement from one OFF position to the next OFF position.

The speed of movement of the actuator for the manual action shall be:

— for slow speed:

  — (9 ± 1)° per s for rotary actions;

  — (5 ± 0,5) mm/s for linear actions;

— for high speed: the actuator shall be actuated by hand as fast as possible. If an actuator is not supplied with the valve, then a suitable actuator shall be fitted by the testing authority for the purpose of this test;

— for accelerated speed:

  — (45 ± 5)° per s for rotary actions;

  — (25 ± 2,5) mm/s for linear actions.

After all the tests, a dielectric strength test shall be carried out with voltage test at 75 % of the values specified in IEC 60730-1:2010, Table 12.

8 EMC/Electrical requirements

8.1 Protection against environmental influences

8.1.1 Assessment Criterion I

When tested at the severity levels given in 8.2 to 8.6, 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 8.6, the control shall maintain a safe state as specified in the specific control standard.

The test levels given in this document are for general applications and environments. To ensure the safe use of oil 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 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.

8.3 Electrical fast transient/burst

For valves which include as electrical components only one coil with or without additional protection components such as VDR and capacitor, this clause is not applicable.

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 control 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 C.2.18.

8.4 Immunity to conducted disturbances

For valves which include as electrical components only one coil with or without additional protection components such as VDR and capacitor, this subclause is not applicable.

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 can be analysed separately.

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.

8.5 Immunity to radiated fields

For valves which include as electrical components only one coil with or without additional protection components such as VDR and capacitor, this subclause is not applicable.

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 can be analysed separately.

8.6 Electrostatic discharge immunity test

For valves which include as electrical components only one coil with or without additional protection components such as VDR and capacitor, this clause is not applicable

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.

8.7 Test for immunity to power-frequency magnetic field

This clause is only applicable for valves which include as electrical and electronic components more than one coil with or without additional protection components, such as VDR and capacitor.

Controls which can be affected by power-frequency magnetic fields (e.g. Hall effect) shall be in accordance with the test in Annex A

8.8 Electrical equipment

8.8.1 General

The electrical equipment shall conform with the relevant requirements of IEC 60730-1:2010, Clauses 8, 9, and 10, subclauses 11.1, 11.2, 11.7.2, 11.8, 11.9, 11.10, 11.11.1, 11.11.2, 11.11.4, 11.11.5, 11.11.7, 11.12, 13.1, 13.2, 18.1, 18.2, 18.4 and 18.9, Clauses 19, 20, 21 and 24, subclause 27.2 and Clause 28.

For applications falling outside the scope of IEC 60730-1:2010, 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.

8.8.2 Heating of oil valves

8.8.2.1 General

IEC 60730-1:2010, Clause 14 is applicable except as follows:

8.8.2.2 Heating test

The temperatures shall comply with the limits of IEC 60730-1:2010, Table 14.1. In addition, if any protective device provided does not cycle under stalled conditions, then the electric actuator is also considered to comply with 8.8.2.3. If stalling of the motorized electric actuator drive shaft is not part of normal operation, then the limits of IEC 60730-1:2010, Table 14.1 does not apply during stalling. The electric actuator shall comply with the requirements of 8.8.2.3.

The temperature of the motor of a motor-operated valve, when stalled, shall not exceed the values specified in IEC 60730-1:2010, Table 14.1 if stalling is part of normal operation.

8.8.2.3 Blocked output test (temperature)

Motorized electric actuators shall withstand the effects of blocked output without exceeding the temperatures indicated in Table 11. Temperatures are measured by the method specified in IEC 60730-1:2010, 14.7.1.

This test is not conducted on motorized electric actuators which meet the requirements of 8.8.2.2.

The motorized electric actuator is tested for 24 h with the output blocked at rated voltage and in an ambient temperature in the range of 15 °C to 30 °C, the resulting measured temperature being corrected to a 25 °C reference value.

The temperature of the motor of a motor-operated valve, when stalled, shall not exceed the values specified in IEC 60730-1:2010, Table 14.1 if stalling is part of normal operation.

NOTE Specific regional requirements are given in C.2.19.

For motorized electric actuators declared for three-phase operation, the test is to be carried out with any one phase disconnected.

Table 11 — Maximum winding temperature[a]

Condition	Temperature of insulation by class [d] °C							
	A	E	B	F	H	200	220	250
If impedance protected:	150	165	175	190	210	230	250	280
If protected by protective devices:								
During first hour:								
— maximum value [b, c]	200	215	225	240	260	280	300	330
After first hour:								
— maximum value [b]	175	190	200	215	235	255	275	305
— arithmetic average [b, d]	150	165	175	190	210	230	250	280

[a] For test of blocked output conditions and valves where the test methods shall be different to IEC 60730–1:2010, 4.1 and 4.2 based on declared of the manufacturer.

[b] Applicable to actuators with thermal motor protection.

[c] Applicable to actuators protected by incorporated fuses or thermal cut-outs.

[d] Applicable to actuators with no protection.

[e] These classifications correspond to the thermal classes specified in IEC 60085.

The average temperature shall be within the limits during both the second and the twenty-fourth hours of the test.

The average temperature of a winding is the arithmetic average of the maximum and minimum values of the winding temperature during the one-hour period.

During the test, power shall be continually supplied to the actuator.

Immediately upon completion of the test, the electric actuator shall be capable of withstanding the electric strength test specified in IEC 60730-1:2010, Clause 13, without first applying the humidity treatment of IEC 60730-1:2010, 12.2.

8.8.2.4 Test conditions

Instead of the test conditions according to IEC 60730-1:2010, 14.5 the tests of 8.8.2.2 and 8.8.2.3 are carried out under the following conditions.

— The ambient temperature is maintained at maximum ambient temperature as declared by the manufacturer.

— Valves declared with an oil temperature limit T_0 greater than 25 °C shall be tested both with oil flow at the declared T_0 and without oil flow through the valve

— If the valve includes switching devices or other auxiliary circuits, all such circuits shall be loaded to carry rated current during the temperature test.

— A modulating valve shall be caused to execute successive complete cycles of the modulating action for which it is designed until constant temperatures are reached. The time between successive cycles is chosen in accordance with the manufacturer's specifications

8.8.3 Heating for valves

The tests of IEC 60730-1:2010, 14.6 are applicable with the following modification:

Replacement:

— switch "head" with "valve".

The temperatures specified for the valve and circulating oil T_0 shall be attained in approximately 1 h.

8.8.4 Burnout test for valves

The tests of IEC 60730-1:2010, 27.2 are applicable with the following modification:

Replacement:

— "switch head" with "valve".

The temperature of the medium in which the valve is located shall be measured as near as possible to the centre of the space occupied by the samples and at a distance of approximately 50 mm from the valve.

8.8.5 Blocking of valve mechanism

8.8.5.1 Requirement

Valves shall withstand the effects of the blocking of the valve mechanism.

8.8.5.2 Test on blocking of the valve mechanism (Burn-out test)

The valve mechanism is blocked in the position assumed when the valve is de-energized. The valve is then energized at rated frequency and rated voltage.

The duration of the test is either 7 h; or until an internal protective device, if any, operates; or until burnout, whichever occurs first.

After this test the valve shall be deemed to comply if:

— there has been no emission of flame or molten metal, and there is no evidence of damage to the valve which would impair compliance with this document;

— the requirements of IEC 60730-1:2010, 13.2 are still met.

The control need not be operative following the test.

Except for valves with openings in the bottom of the enclosure, compliance with this requirement is established by successful completion of the endurance tests.

8.9 Electrical components

8.9.1 Degree of protection

The degree of protection shall be declared by the manufacturer in accordance with IEC 60529.

NOTE Specific regional requirements are given C.2.20.

For an independently mounted valve utilizing safety extra-low-voltage, the terminals shall be physically protected if grounding or shorting of the electric circuit can result in failure of the valve to close.

8.9.2 Switches

Switches shall conform to IEC 61058-1. The number of operating cycles shall be in accordance with 7.7.1 or 7.7.2.

8.9.3 Plug connector

Valves supplied with an assembled electrical plug connector in accordance with ISO 6952 or ISO 4400 shall have connections to the following pins and to earth:

— Single step valves

PE earth contact

Pin 1 N

Pin 2 L

— Two step valves

Pin 4 (e) earth contact

Pin 1 N

Pin 2 L step 1

Pin 3 L step 2

— Closed position indicators

Pin 4 (e) earth contact

Pin 1 common

Pin 2 open valve

Pin 3 closed valve

NOTE Specific regional requirements are given in C.2.21.

8.9.4 Power-saving circuit

8.9.4.1 Closing of the valve

Valves with power-saving circuits shall be designed such that any fault in the power-saving circuit does not affect the correct closing and the leak-tightness of the valve.

If the power-saving circuit has an independent power supply it has to fulfil IEC 60730-1:2010, H.27.1 for Class C control function.

8.9.4.2 Overheating

If the power-saving circuit meets the requirement of IEC 60730-1:2010, H.27.1 for Class C control function, the test under 8.9.4.3 does not apply.

8.9.4.3 Test of power-saving circuits

Energize the valve according to 7.1 of this document at maximum rated voltage or current and at maximum ambient temperature for a period of at least 24 h under no flow conditions with the power saving circuit taken out of function. The test shall be carried out according to 7.6.2.2 and meet the requirement of 7.6.2.1. Verify that the valve has closed and remains tight.

8.10 Ring wave

Specific regional requirements shall be as given in Annex C, C.2.22.

9 Marking, installation and operating instructions

9.1 Marking

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

a) ambient temperature range, if outside the range 0 °C to 55 °C;

b) maximum oil temperature, if above 55 °C;

c) maximum operating pressure.

If the safety shut-off valve shall be used only in connection with appliances within the operating pressure limits, no marking is necessary.

In addition, the valve shall be marked with:

d) direction of the oil flow;

e) marking of the earth connection (if applicable);

f) pressure for external hydraulic or pneumatic actuator in kPa (if applicable);

g) valves with electrical actuating mechanisms shall be marked according to IEC 60730-1:2010, 7.2;

h) additional marking as appropriate:

   — “nc” if valve is closed,

   — “s” if a position indicator (see 6.6.1) is fitted;

i) auxiliary medium, and minimum and maximum auxiliary medium pressures;

j) conformity mark.

In addition electrically operated devices which are an integral part of the valve, shall be provided with the same information.

The data a) to j) shall comply with the data given in the manufacturer's instructions.

If space is limited, marking of information a) to e) only is sufficient. The remaining data shall be listed in the manufacturer's instructions.

9.2 Installation and operating instructions

One set of instructions shall be supplied with each consignment, written in the language(s) of the country into which the valves will be delivered.

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

a) oil connection(s);

b) permitted oil types

NOTE 1 For example, oil types according to the oil specification numbers 1, 2, 4, 5 or 6 in ASTM D 396.

NOTE 2 For example, oil types derived from petroleum refining processes are listed in CEN/TR 15738.

NOTE 3 For example, oil types derived from petroleum refining processes are classified ISO-F-D in ISO 8216-99.

c) permitted oil viscosity types in mm^2/s (centistokes);

d) rated flow rate at a specified pressure difference;

e) electrical data;

f) ambient temperature range;

g) oil temperature range;

h) opening time, if greater than 1 s;

i) closing time (and maximum delay time if applicable), if greater than 1 s;

j) mounting position(s);

k) operating pressure range in Pa or in kPa;

l) strainer details;

m) safety class for safety-related electronics;

n) hydraulic or pneumatic connections, if applicable.

o) The identification of any parts which the manufacturer specifies as replacement service parts and instructions for the installation of such parts.

Installation and operation instructions for valves with electrical actuating mechanisms shall additionally be provided according to IEC 60730-1:2010, 7.2, if not already covered above.

The installation and operating instructions shall specify the necessity of the installation of pipes or tubing if required. Suitable pipes or tubing shall be specified in the installation and operating instructions.

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
(normative)

Test for immunity to power-frequency magnetic fields

A.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 A.1.

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

A.2 Purpose of the test

The purpose of the test is to demonstrate the immunity of controls which can 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.

A.3 Test levels

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

Table A.1 — Test level for continuous fields

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

A.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 control standard.