INTERNATIONAL STANDARD

ISO 23553-1

Second edition
2014-05-15

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

Reference number
ISO 23553-1:2014(E)

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

Published in Switzerland

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Foreword

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

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

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

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is 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 23553-1:2007), which has been technically revised. It also incorporates the Technical Corrigendum ISO 23553-1:2007/Cor1:2009).

ISO 23553 consists of the following parts, under the general title *Safety and control devices for oil burners and oil-burning appliances — Particular requirements*:

— *Part 1: Automatic and semi-automatic valves.*

It should be noted that the following significant technical changes compared to the previous edition have been incorporated in this part of ISO 23553:

a) change of the title from shut-off valves to automatic and semi-automatic valves;

b) extension of the scope to automatic and semi-automatic valves;

c) introduction of further classifications for valves;

d) inclusion of references to the general electrical requirements of IEC 60730-1:2010;

e) integration of non electrical requirements from IEC 60730-2-19;

f) integration of electrical requirements from IEC 60730-2-19 which are unalterable for valves;

g) inclusion of the subclause 7.7.103 "Test of endurance of electrically operated valves";

h) change of endurance cycles for valves up to DN 15;

i) extended limits of internal leakage for valves ≤ DN 50;

j) test of closing function updated.

Introduction

This part of ISO 23553 is designed to be used in combination with ISO 23550. This part together with ISO 23550 establishes the full requirements as they apply to the product covered by this part of ISO 23553. This part of ISO 23553 adapts ISO 23550, where needed, by stating "with the following modification", "with the following addition", "is replaced by the following" or "is not applicable," in the corresponding clause.

In order to identify specific requirements that are particular to this part of ISO 23553, that are not already covered by ISO 23550, this document may contain clauses or subclauses that are additional to the structure of ISO 23550. These clauses are numbered starting from 101 or, in the case of an Annex, are designated AA, BB, CC etc.

In an attempt to develop a fully International Standard, it has been necessary to take into consideration the differing requirements resulting from practical experience and installation practices in various regions of the world and to recognize the variation in basic infrastructure associated with oil controls and appliances, some of which are addressed in Annexes E, F and G. This part of ISO 23553 intends to provide a basic framework of requirements that recognizes these differences.

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

Part 1: Automatic and semi-automatic valves

IMPORTANT — When reference is made in this part of — ISO 23553 to ISO 23550, the word "gas" shall be replaced by "oil" as appropriate. The current base standard, ISO 23550:2011, focuses on gas controls only. It is, however, the intention to revise the base standard in such a fashion that both, gas and oil product standards can be used in conjunction with the base standard. Attention is drawn especially to the following subclauses: 6.4, 7.4 and 7.5.

1 Scope

This part of ISO 23553 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 functions), 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 part of ISO 23553 covers type testing only.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 272, *Fasteners — Hexagon products — Widths across flats*

ISO 1179-1, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 1: Threaded ports*

ISO 1179-2, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 2: Heavy-duty (S series) and light-duty (L series) stud ends with elastomeric sealing (type E)*

ISO 1179-3, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 3: Light-duty (L series) stud ends with sealing by O-ring with retaining ring (types G and H)*

ISO 1179-4, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 4: Stud ends for general use only with metal-to-metal sealing (type B)*

ISO 3601-5, *Fluid power systems — O-rings — Part 5: Specification of elastomeric materials for industrial applications*

ISO 6149-1, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 1: Ports with truncated housing for O-ring seal*

ISO 6149-3, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 3: Dimensions, design, test methods and requirements for light-duty (L series) stud ends*

ISO/TR 7620, *Rubber materials — Chemical resistance*

ISO 8216-99, *Petroleum products — Fuels (class F) — Classification — Part 99: General*

ISO 8434-1, *Metallic tube connections for fluid power and general use — Part 1: 24 degree cone connectors*

ISO 8434-2, *Metallic tube connections for fluid power and general use — Part 2: 37 degree flared connectors*

ISO 8434-3, *Metallic tube connections for fluid power and general use — Part 3: O-ring face seal connectors*

ISO 8434-6, *Metallic tube connections for fluid power and general use — Part 6: 60 degree cone connectors with or without O-ring*

ISO 9974-1, *Connections for general use and fluid power — Ports and stud ends with ISO 261 threads with elastomeric or metal-to-metal sealing — Part 1: Threaded ports*

ISO 9974-3, *Connections for general use and fluid power — Ports and stud ends with ISO 261 threads with elastomeric or metal-to-metal sealing — Part 3: Stud ends with metal-to-metal sealing (type B)*

ISO 23550:2011, *Safety and control devices for gas burners and gas-burning appliances — General requirements*

ISO 23553, *Safety and control devices for oil burners and oil-burning appliances — Particular requirements*

ISO 23936-1, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics*

ISO 23936-2, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 2: Elastomers*

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

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*

EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories PN designated — Part 3: Copper alloy flanges*

EN 1092-4, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 4: Aluminium alloy flanges*

EN 1254-1, *Copper and copper alloys — Plumbing fittings — Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes*

EN 1254-2, *Copper and copper alloys — Plumbing fittings — Part 2: Fittings with compression ends for use with copper tubes*

EN 1254-3, *Copper and copper alloys — Plumbing fittings — Part 3: Fittings with compression ends for use with plastics pipes*

EN 1254-5, *Copper and copper alloys — Plumbing fittings — Part 5: Fittings with short ends for capillary brazing to copper tubes*

EN 10226-1, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads; Dimensions, tolerances and designation*

EN 10226-2, *Pipe threads where pressure tight joints are made on the threads — Part 2: Taper external threads and taper internal threads - Dimensions, tolerances and designation*

EN 10241, *Steel threaded pipe fittings*

EN 10242, *Threaded pipe fitting in malleable cast iron*

EN 10284, *Malleable cast iron fittings with compression ends for polyethylene (PE) piping systems*

EN 10305-1, *Steel tubes for precision applications — Technical delivery conditions — Part 1: Seamless cold drawn tubes*

EN 10305-2, *Steel tubes for precision applications — Technical delivery conditions — Part 2: Welded cold drawn tubes*

EN 10305-3, *Steel tubes for precision applications — Technical delivery conditions — Part 3: Welded cold sized tubes*

EN 10305-4, *Steel tubes for precision applications — Technical delivery conditions — Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems*

EN 10305-6, *Steel tubes for precision applications — Technical delivery conditions — Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems*

EN 12516 (all parts), *Industrial valves — Shell design strength*

EN 12627, *Industrial valves — Butt welding ends for steels valves*

EN 12760, *Valves — Socket welding ends for steel valves*

prEN 10344, *Malleable cast iron fittings with compression ends for steel pipes*

prEN 12514-4:2009, *Parts for supply systems for consuming units with liquid fuels — Part 4: Safety requirements and tests — Pipings and parts within pipelines*

ANSI/ASME B 1.1, *Unified inch screw threads (UN and UNR thread form)*

ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch)*

ANSI/ASME B 16.1, *Cast iron pipe flanges and flanged fittings, class 25, 125, 250 and 800*

ANSI/ASME B 16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard*

ANSI/SAE J 512, *Automotive tube fittings*

ANSI/SAE J 514, *Hydraulic tube fittings*

ASTM D 396, *Standard Specification for Fuel Oils*

NEMA 250, *Enclosures for Electrical Equipment (1 000 V Maximum)*

UL 50, *Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23550:2011 and the following apply.

3.101
valves

3.101.1
valve
device consisting essentially of a valve body, closure member, and actuator that controls the oil flow

Note 1 to entry: The actuator may be actuated by electrical or mechanical means.

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

3.101.2
normally closed valve
nc
valve which is in closed position when no actuating energy is applied

3.101.3
automatic valve
normally closed valve that closes on removal of the actuating energy

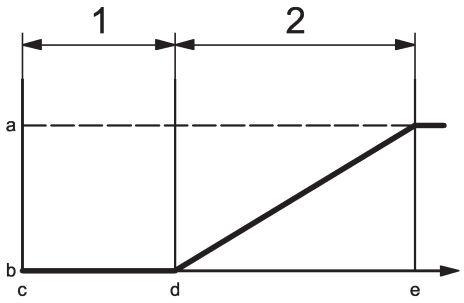
3.101.4
semi-automatic valve
normally closed valve that is actuated manually and returns to the closed position upon removal of the actuating energy

3.101.5
safety shut-off valve
normally closed valve, automatic or semi-automatic, that prevents the oil flow when de-energized

3.102
response times

3.102.1
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: For illustration refer to Figure 1.



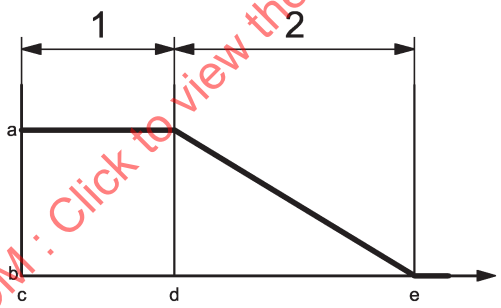
Key

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 during opening

3.102.2
closing time
time from the beginning until the end of the change in position of the closure member from the open to the closed position

Note 1 to entry: For illustration refer to 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 during closing

3.103
opening force
force which effects the opening of the automatic valve

3.104
closing force
force which effects the closing of the closure member 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

3.105
frictional force
largest force required to move the actuating mechanism and the closure member from the open position to the closed position with the closing force removed, independent of any force provided by oil pressure

Note 1 to entry: Adapted from ISO 23551-1:2012, 3.109.

3.106
opening (closing) characteristics
curve representing the movement of the closure member against time on opening (closing)

3.107
actuator
part effecting the movement of the closure member

Note 1 to entry: Also media could effect the movement.

3.108
auxiliary medium
medium used for actuating the moving parts of the system (pneumatic or hydraulic)

3.109
auxiliary medium pressure
pressure exerted by the auxiliary medium during actuation of the moving parts

3.110
commercial / industrial valve
C/I Valve
a normally closed automatic or semi-automatic shut-off valve

3.111
control valve
valve 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

Shall be according to ISO 23550:2011, 4.1.

4.2 Groups of control

Shall be according to ISO 23550:2011, 4.2 with the following modification:

Group 1 is not applicable.

5 Test conditions

Shall be according to ISO 23550:2011, Clause 5 with the following modification:

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

6 Construction

6.1 General

Shall be according to ISO 23550:2011, 6.1.

6.2 Construction requirements

6.2.1 Appearance

Shall be according to ISO 23550:2011, 6.2.1.

6.2.2 Holes

ISO 23550:2011, 6.2.2 shall be replaced by the following:

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 Breather holes

ISO 23550:2011, 6.2.3 is replaced by 6.2.104.

6.2.4 Screwed fastenings

Shall be according to ISO 23550:2011, 6.2.4.

NOTE Specific regional requirements are given in Annex F.

6.2.5 Jointing

Shall be according to ISO 23550:2011, 6.2.5.

6.2.6 Moving parts

Shall be according to ISO 23550:2011, 6.2.6

6.2.7 Sealing caps

Shall be according to ISO 23550:2011, 6.2.7.

6.2.8 Dismantling and reassembling for servicing and/or adjustment

Shall be according to ISO 23550:2011, 6.2.8 with the following addition:

6.2.8.101 General

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 may:

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

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

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

6.2.8.102 Test of adjustment means

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

6.2.8.103 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.

6.2.8.104 Field adjustments

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

6.2.8.105 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 could 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

Shall be according to ISO 23550:2011, 6.2.9.

6.2.101 Resistance against pressure

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

Manually adjustable packing glands are not permitted.

6.2.102 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.

6.2.103 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.

6.2.104 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 have provision 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 7.2.1.101. 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.

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

6.3 Materials

6.3.1 General material requirements

Shall be according to ISO 23550:2011, 6.3.1.

6.3.2 Housing

6.3.2.1 Housing design

ISO 23550:2011, 6.3.2.1 is not applicable.

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

ISO 23550:2011, 6.3.2.2 is not applicable.

6.3.3 Springs

ISO 23550:2011, 6.3.3 is replaced by the following:

6.3.3.101 Components generating or transmitting the closure force

6.3.3.101.1 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.

6.3.3.101.2 Parts other than springs

With the exception of closure springs (see 6.3.3.101.1), parts generating or transmitting the closure force, including parts of the actuator, shall be designed such that the breaking load is five 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.

6.3.4 Resistance to corrosion and surface protection

Shall be according to ISO 23550:2011, 6.3.4.

6.3.5 Impregnation

Shall be according to ISO 23550:2011, 6.3.5.

6.3.6 Seals for glands for moving parts

Shall be according to ISO 23550:2011, 6.3.6.

6.3.101 Actuators

6.3.101.1 Electromagnetic actuators

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

NOTE Specific regional requirements are given in Annex F and ISO 23550:2011, G.7.1.

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 %, and at the minimum ambient temperature declared by the manufacturer, the force of retention (e. g. due to friction or remanence) does not prevent that the automatic closing of the closure member shall occur at a voltage not below 15 % of the rated voltage.

This test shall be repeated for 24 h at maximum ambient temperature.

For electrically operated control valves for hydraulic or pneumatic actuators, automatic closure shall occur at a voltage not below 15 % of the rated voltage.

6.3.101.2 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 part of ISO 23553.

6.3.102 Enclosures

NOTE Specific regional requirements are given in F.6.3.102.

6.3.103 Extra low voltage terminals

NOTE Specific regional requirements are given in F.6.3.103.

6.4 Oil connections

6.4.1 Making connections

Shall be according to ISO 23550:2011, 6.4.1.

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

6.4.2 Connection sizes

Shall be according to ISO 23550:2011, 6.4.2.

6.4.3 Threads

Shall be according to ISO 23550:2011, 6.4.3 with the following addition:

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

E.g. 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 prEN 12514-4:2009, Annex C;

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

— port according to ISO 6149-1 for stud connectors according to ISO 6149-3;

NOTE Specific regional requirements are given in Annex E and Annex F.

6.4.4 Union Joints

Shall be according to ISO 23550:2011, 6.4.4.

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.

NOTE Specific regional requirements are given in Annex E and Annex F.

6.4.5 Flanges

Shall be according to ISO 23550:2011, 6.4.5 with the following addition:

C/I valves larger than DN 80 (3 inches) shall use flange connections.

NOTE Specific regional requirements are given in Annex E and in Annex F.

6.4.6 Compression fittings

ISO 23550:2011, 6.4.6 is replaced by the following:

Compression fittings shall be suitable for use with tubes of outside diameter, e.g. according to ISO 10763. 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.

E.g. 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.

NOTE Specific regional requirements are given in Annex E and in Annex F.

6.4.7 Nipples for pressure tests

Shall be according to ISO 23550:2011, 6.4.7.

NOTE Specific regional requirements are given in Annex F.

6.4.8 Strainers

ISO 23550:2011, 6.4.8 is replaced by the following:

Each valve shall be equipped 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.

6.101 Welded connections

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

NOTE Specific regional requirements are given in Annex E.

6.102 Indicator

6.102.1 Position indicator

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

6.102.2 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

Shall be according to ISO 23550:2011, 7.1

7.2 Leak-tightness

7.2.1 Criteria

ISO 23550:2011, 7.2.1 is replaced by the following:

7.2.1.101 Criteria for external leak-tightness

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

7.2.1.102 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 1 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.

Table 1 — 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 Annex G.

7.2.2 Test for leak-tightness

7.2.2.1 General

ISO 23550:2011, 7.2.2.1 is replaced by the following:

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

Test medium 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 1.

7.2.2.2 External leak-tightness

ISO 23550:2011, 7.2.2.2 is replaced by the following:

Pressurize the inlet and outlet of the valve to 1,5 times the 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.

Compliance is verified by visual inspection.

7.2.2.3 Internal leak-tightness

ISO 23550:2011, 7.2.2.3 is replaced by the following:

The leak-tightness test shall be performed at 1,5 times, 1,0 times and 0,1 times the rated 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 one hour shall be measured. The leakage rates shall not exceed those given in Table 1.

7.3 Torsion and bending

7.3.1 General

Shall be according to ISO 23550:2011, 7.3.1.

7.3.2 Torsion

Shall be according to ISO 23550:2011, 7.3.2.

7.3.3 Bending moment

Shall be according to ISO 23550:2011, 7.3.3.

7.3.4 Torsion and bending tests

7.3.4.1 General

Shall be according to ISO 23550:2011, 7.3.4.1

NOTE Specific regional requirements are given in E.7.3.4.1

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

Shall be according to ISO 23550:2011, 7.3.4.2.

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

Shall be according to ISO 23550:2011, 7.3.4.3.1.

7.3.4.3.2 Flared compression joints

Shall be according to ISO 23550:2011, 7.3.4.3.2.

7.3.4.3.3 Flanged or saddle-clamp inlet connections

ISO 23550:2011, 7.3.4.3.3 is not applicable.

7.3.4.4 Ten-second bending-moment test — Group 1 and Group 2 controls

Shall be according to ISO 23550:2011, 7.3.4.4.

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

ISO 23550:2011, 7.3.4.5 is not applicable.

7.3.101 Hydrostatic strength test

NOTE Specific regional requirements are given in F.7.3.101.

7.4 Rated flow rate

NOTE The term rated flow rate according to ISO 23550:2011 is applicable for the rated oil flow.

ISO 23550:2011, 7.4 is replaced by the following:

7.4.101 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 7.4.102, shall be at least 0,90 times the nominal flow capacity stated by the manufacturer.

7.4.102 Test of flow capacity

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

7.5 Durability

7.5.1 Elastomers in contact with gas

ISO 23550:2011, 7.5.1 is replaced by 7.5.101.

7.5.2 Resistance to lubricants

ISO 23550:2011, 7.5.2 is replaced by 7.5.102.

7.5.3 Resistance to gas

ISO 23550:2011, 7.5.3 is not applicable.

7.5.4 Marking resistance

7.5.4.1 General

Shall be according to ISO 23550:2011, 7.5.4.1.

7.5.4.2 Tests for marking resistance

Shall be according to ISO 23550:2011, 7.5.4.2.

7.5.5 Resistance to scratching

7.5.5.1 Criteria

Shall be according to ISO 23550:2011, 7.5.5.1.

7.5.5.2 Scratch test

Shall be according to ISO 23550:2011, 7.5.5.2.

7.5.6 Resistance to humidity

7.5.6.1 Criteria

Shall be according to ISO 23550:2011, 7.5.6.1.

7.5.6.2 Humidity test

Shall be according to ISO 23550:2011, 7.5.6.2.

7.5.101 Elastomers in contact with fuel

Elastomers in contact with fuel (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.

7.5.102 Resistance to fuel

7.5.102.1 Criteria

Shall be according to ISO 23550:2011, 7.5.2.1.

7.5.102.2 Test for resistance to fuel

Shall be according to ISO 23550:2011, 7.5.2.2.

7.6 Functional requirements

Shall be according to ISO 23550:2011, 7.6 with the following addition:

7.6.101 Closing function

7.6.101.1 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 7.6.102.

NOTE Specific regional requirements are given in F.7.6.101.1 and G.7.6.101.1.

7.6.101.2 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 a.c. 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 working 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.

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

The test is repeated three times.

7.6.102 Valve closing time

Automatic and semiautomatic valve closing time shall not exceed 1 s.

NOTE Specific regional requirement is given in G.7.6.102.

7.6.103 Valve opening time

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

7.7 Endurance

7.7.101 General

The test sample shall be submitted to a test to the requirements given in 7.2, 7.4 and 7.6.101 to 7.6.103 before and after the endurance test of 7.7.102.

7.7.102 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 above DN 15: 50 000 cycles.

The endurance test shall be carried out at the manufacturers 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.

NOTE Specific regional requirements are given in E.7.7.102.

After the endurance test, the valves shall operate correctly at the manufacturers declared minimum and maximum temperature at the maximum working pressure.

7.7.103 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 oil at the declared temperature shall be used during the maximum ambient temperature part of the test.

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

If the ambient temperature is declared as 25 °C, then (25 ± 5) °C oil shall be used.

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 7.7.102 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; except that 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 dielectric strength test shall be carried out with voltage test at 75 % of the values specified in IEC 60730-1:2010, Table 13.2.

8 EMC/Electrical requirements

8.1 Protection against environmental influences

Shall be according to ISO 23550:2011, 8.1.

8.2 Variations in supply voltage

ISO 23550:2011, 8.2 is not applicable.

8.3 Short-term voltage interruptions and drops

ISO 23550:2011, 8.3 is not applicable.

8.4 Variations in supply frequency

ISO 23550:2011, 8.4 is not applicable.

8.5 Surge immunity test

Shall be according to ISO 23550:2011, 8.5.

8.6 Electrical fast transient/burst

Shall be according to ISO 23550:2011, 8.6 with the following modification:

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.

8.7 Immunity to conducted disturbances

Shall be according to ISO 23550:2011, 8.7 with the following modification:

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.

8.8 Immunity to radiated fields

Shall be according to ISO 23550:2011, 8.8 with the following modification:

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.

8.9 Electrostatic discharge immunity test

Shall be according to ISO 23550:2011, 8.9 with the following modification:

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.

8.10 Test for immunity to power-frequency magnetic field

ISO 23550:2011, 8.10 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.

8.11 Electrical equipment

Shall be according to ISO 23550:2011, 8.11 with the following modifications and additions:

Modification:

Delete Note 1.

Addition:

The electrical equipment shall comply with the relevant requirements of IEC 60730-1:2010, Clauses 8, 9, 10,11.1, 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, 18.9, 19, 20, 21, 24, 27.2 and 28.

8.11.101 Heating of oil valves

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

8.11.101.1 Heating test

If stalling of the motorized electric actuator drive shaft is part of normal operation, then the drive shaft of motorized actuators shall be stalled and temperatures measured after steady-state conditions are reached.

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 8.11.101.2

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 8.11.101.2.

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.

8.11.101.2 Blocked output test (temperature)

Motorized electric actuators shall withstand the effects of blocked output without exceeding the temperatures indicated in Table 2. 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 8.11.101.1.

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 F.8.11.101.2.

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

Table 2 — Maximum winding temperature (for test of blocked output conditions and valves where the test methods shall different to IEC 60730–1, 4.1 and 4.2 based on declared of the manufacturer)

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 [a b]	200	215	225	240	260	280	300	330
After first hour:								
– maximum value [a]	175	190	200	215	235	255	275	305
– arithmetic average [a c]	150	165	175	190	210	230	250	280

[a] Applicable to actuators with thermal motor protection.

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

[c] Applicable to actuators with no protection.

[d] 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.

8.11.101.3 Test conditions

Instead of the test conditions according to IEC 60730-1:2010, 14.5 the tests of 8.11.101.1 and 8.11.101.2 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.

8.11.102 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.

8.11.103 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.

8.11.104 Blocking of valve mechanism

8.11.104.1 Requirement

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

8.11.104.2 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 standard;

— 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.

8.101 Electrical components

8.101.1 Degree of protection

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

NOTE Specific regional requirements are given F.8.101.1.

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

8.101.2 Switches

Switches shall conform to IEC 61058-1. The number of operating cycles shall be in accordance with 7.7.101 or 7.7.102.

8.101.3 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 F.8.101.3.

8.101.4 Power-saving circuit

8.101.4.1 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.

8.101.4.2 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 8.101.4.3 does not apply.

8.101.4.3 Test of power-saving circuits

Energize the valve according to 7.1 of this part of ISO 23553 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 7.6.101.2 and meet the requirement of 7.6.101.1. Verify that the valve has closed and remains tight.

8.102 Ring wave

NOTE Specific regional requirements are given F.8.102.

9 Marking, installation and operating instructions

9.1 Marking

Shall be according to ISO 23550:2011, 9.1 with the following addition:

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 60 °C;

b) maximum oil temperature, if above 60 °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 6.102.1) is fitted;

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

j) conformity mark.

NOTE Specific regional requirements are given in Annex F.

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

The data a) to o) 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

Shall be according to ISO 23550:2011, 9.2 with the following addition:

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 E.g. according to the oil specification numbers 1, 2, 4, 5 or 6 in ASTM D 396.

NOTE 2 E.g. oil types derived from petroleum refining processes are listed in CEN/TR 15738.

NOTE 3 E.g. 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) working 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

Shall be according to ISO 23550:2011, 9.3.

Annex A
(informative)

Leak-tightness test — Volumetric method

ISO 23550:2011, Annex A is not applicable.

Annex B
(informative)

Leak-tightness test — Pressure-loss method

ISO 23550:2011, Annex B is not applicable.

Annex C
(normative)

Conversion of pressure loss into leakage rate

ISO 23550:2011, Annex C is not applicable.

Annex D
(normative)

Test for immunity to power-frequency magnetic fields

Shall be according to ISO 23550:2011, Annex D.