International Standard

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

Part 11: Automatic and semi-automatic shut-off valves for operating pressure of above 500 kPa up to and including 6 300 kPa

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

Partie 11: Robinets automatiques et semi-automatiques de sectionnement pour une pression de fonctionnement supérieure à 500 kPa et jusqu'à 6 300 kPa inclus

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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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 gaseous and liquid fuels*.

A list of all parts in the ISO 23551 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 in combination with ISO 23550. Together, they establish the full requirements as they apply to the product covered by this document.

Where needed, this document adapts ISO 23550 by stating in the corresponding clause:

— “with the following modification”;

— “with the following addition”;

— “is replaced by the following”; or

— “is not applicable”.

In order to identify specific requirements that are particular to this document, that are not already covered by ISO 23550, this document can contain clauses or subclauses that are additional to the structure of ISO 23550. These subclauses are indicated by the introductory sentence: “Subclause (or Annex) specific to this document.”

To ensure global relevance of this document, the differing requirements resulting from practical experience and installation practices in various regions of the world have been taken into account. The variations in basic infrastructure associated with gas controls and appliances have also been recognized, some of which are addressed in Annexes A, B, C and D. This document intends to provide a basic framework of requirements that recognize these differences.

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

Part 11: Automatic and semi-automatic shut-off valves for operating pressure of above 500 kPa up to and including 6 300 kPa

1 Scope

This document specifies safety, constructional and performance requirements and testing of automatic, semi-automatic shut-off valves, and general purpose valves for gas burners, gas appliances and appliances of similar use excluding use in fuel gas infrastructures (transportation and distribution systems).

This document applies to controls for use at maximum operating pressures above 500 kPa up to and including 6 300 kPa with sizes up to DN 250 for use on burners or in appliances using fuel gases, such as natural gas, manufactured gas or liquefied petroleum gas (LPG).

This document applies to:

— valves being mounted in gas installations;

— valves directly or indirectly actuated, electrically or by mechanical means;

— valves actuated by hydraulic or pneumatic means, including the pilot valves for these fluids if actuated electrically and including release valves, but not to any external electrical devices for switching the actuating energy;

— valves where the flow rate is controlled by external electrical signals, either in discrete steps or proportional to the applied signal and valves fitted with closed position indicator switches;

— valves to be used in appliances, but not in gas transfer systems outside appliances.

This document covers type testing only.

This document does not apply to valves covered under the scope of ISO 23551-1 or the ISO 23555 series.

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 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 7005-3, *Pipe flanges — Part 3: Copper alloy and composite flanges*

ISO 9692-1, *Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 23550:2018, *Safety and control devices for gas and/or oil burners and appliances — General requirements*

ISO 23551-1:2024, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 1: Automatic and semi-automatic shut-off valves*

IEC 60730-1:2022, *Automatic electrical controls— Part 1: General requirements*

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

IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23550, ISO 23551-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

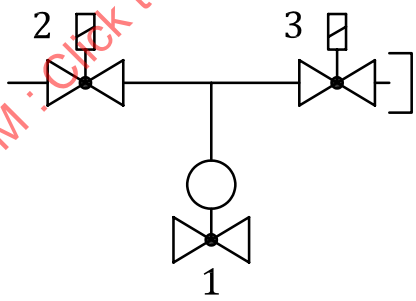
— IEC Electropedia: available at https://www.electropedia.org/

3.1
pilot valve
valve which controls the fluid (e.g. compressed air) supplied to the actuating mechanism

Note 1 to entry: A typical pilot and *release valve* (3.2) application is shown in Figure 1.

3.2
release valve
valve in the line from the *pilot valve* (3.1) to the actuating mechanism which closes the vent automatically when the actuating fluid is released by the pilot valve and opens it automatically when the pilot valve is closed

Note 1 to entry: A typical pilot and release valve application is shown in Figure 1.



Key
1 control under test
2 pilot valve (normally closed)
3 release valve (normally open)

Figure 1 — Typical pilot and release valve application

3.3
design pressure
DP
pressure on which design calculations are based

Note 1 to entry: In particular, DP is the maximum pressure for which the body, its inner metallic partition walls and some other pressure-containing parts are designed.

Note 2 to entry: According to local regulations, DP can be defined as maximum allowable pressure.

[SOURCE: ISO 23555-1:2022, 3.1.4.3 modified — Note 2 to entry has been added.]

4 Classification

4.1 Classes of controls

Shall be according to ISO 23550:2018, 4.1, with the following addition:

4.1.1 Classification based on sealing force

Subclause specific to this document.

Automatic shut-off valves where the sealing force is not decreased by the gas inlet pressure are classified according to sealing force requirements and shall be designated according to Class A (see Tables 1, 4, 6, 7 and 8).

These valves may also have:

— modulating control function, or

— step control function/multi-stage.

4.1.2 Classifications based on pressure surge

Subclause specific to this document.

Automatic and semi-automatic valves with pressure surge requirements shall be designated according to class C/I (see ISO 23551-1:2024 3.1.4 and Tables 1, 4, 6, 7 and 8).

4.1.3 Classification with neither sealing force nor pressure surge

Subclause specific to this document.

Automatic and semi-automatic shut-off valves without sealing force and without pressure surge requirements shall be designated according to Class E (see Tables 1, 4, 6, 7 and 8).

4.1.4 Classification of flow control valves for general purpose

Subclause specific to this document.

General purpose valves with modulating control that do not provide a shut-off function shall be designated according to Class D (see Tables 1, 4, 6, 7 and 8).

These valves include:

— valves with modulating control function,

— valves with step control function/multi-stage.

4.2 Groups of controls

Shall be according to ISO 23550:2018, 4.2.

4.3 Types of DC supplied controls

Shall be according to ISO 23550:2018, 4.3.

4.4 Classes of control function

Shall be according to ISO 23550:2018, 4.4.

5 Test conditions and tolerances

5.1 Test conditions

Shall be according to ISO 23550:2018, 5.1.

5.2 Tolerances

Shall be according to ISO 23550:2018, 5.2 with the following addition:

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

The measurement uncertainties concern individual measurements. For measurements requiring a combination of individual measurements (e.g. efficiency measurements), lower uncertainties for the individual measurements can be necessary to limit the total uncertainty.

Testing labs performing equipment calibration and testing measurement uncertainty are in conformity with ISO/IEC 17025.

Therefore, where specified, the tolerances in this document apply. Otherwise, ISO/IEC 17025 applies.

6 Construction

6.1 General

Shall be according to ISO 23550:2018, 6.1, with the following addition:

If an automatic shut-off valve requires a release and/or a pilot valve to fulfil the requirements of this document, these are considered to be part of the automatic shut-off valve and shall be specified in the installation and operating instructions.

The combination of automatic shut-off valve and release and/or pilot valve shall conform to all requirements of this document.

The interaction of all valves participating in the closing mechanism shall be evaluated. An appropriate risk assessment shall be carried out.

For each pressurized compartment, the local maximum pressure shall be considered for the strength design and for the selection of the material. It shall be ensured by mechanical means that parts for different pressures are separated. A diaphragm shall not be used for this purpose.

Table 1 describes applicable constructions requirements and tests for the classified valves. Combination of valve types are not excluded (e.g. automatic Class A and C/I valve). If the respective construction requirement is used, the design shall be according to the assigned clause in Table 1, if applicable.

The marking "x" identifies the minimum requirements to be verified by the given subclauses in this document.

Requirements without existing construction or performance properties cannot be verified and those associated clauses are therefore not applicable.

EXAMPLE Strainers are an optional element in the design of the valve. Therefore, 6.4.10 is not always applicable even though the assignment is given in Table 1.

Table 1 — Assignment of valve construction requirements and tests

Clause	Title	Shut-off valve (Classes)					General purpose valve (Class)
		automatic	automatic	semi-automatic	automatic	semi-automatic	
		A	C/I	C/I	E	E	D
6.2	Construction requirements						
6.2.1	Appearance	x	x	x	x	x	x
6.2.2	Holes	x	x	x	x	x	x
6.2.3	Breather holes	x	x	x	x	x	x
6.2.4	Vent limiter	x	x	x	x	x	x
6.2.5	Screwed fastenings	x	x	x	x	x	x
6.2.6	Moving parts	x	x	x	x	x	x
6.2.7	Sealing caps	x	x	x	x	x	x
6.2.8	Disassembling and assembling for servicing and/or adjustment for controls	x	x	x	x	x	x
6.2.9	Auxiliary channels and orifices	x	x	x	x	x	x
6.2.10	Pre-setting device	x	x	x	x	x	x
6.2.11	Closed position indication	x	x	x	x	x	—
6.2.12	Specific construction	x	x	x	—	—	—
6.2.13	Flow rates of valves with modulating control	x	x	x	x	x	x
6.2.14	Bypass	x	x	x	x	x	—
6.2.15	Semi-automatic shut-off valve	—	—	x	—	x	—
6.2.16	Other controls assembled to a valve	x	x	x	x	x	x
6.2.17	Balanced valves	x	x	x	x	x	x
6.3	Materials	x	x	x	x	x	X
6.4	Connections						
6.4.1	General	x	x	x	x	x	x
6.4.2	Connection sizes	x	x	x	x	x	x
6.4.3	Connection types	x	x	x	x	x	x
6.4.4	Threads	x	x	x	x	x	x
6.4.5	Union joints	x	x	x	x	x	x
6.4.6	Flanges	x	x	x	x	x	x
6.4.7	Compression fittings	x	x	x	x	x	x
6.4.8	Flare connections	x	x	x	x	x	x
6.4.9	Nipples for pressure tests	x	x	x	x	x	x
6.4.10	Strainers	x	x	x	x	x	x
6.4.11	Gas connections by GQC	x	x	x	x	x	x

Key

x required only if the construction is present in the design of the valve

— no requirement even if the function is present

GQC gas quick connector

Table 1 *(continued)*

Clause	Title	Shut-off valve (Classes)					General purpose valve (Class)
		automatic	automatic	semi-automatic	automatic	semi-automatic	
		A	C/I	C/I	E	E	D
6.4.12	Welded connections	x	x	x	x	x	x
6.5	Gas controls employing electrical components in the gas way	x	x	x	x	x	x
6.6	Pneumatic and hydraulic actuating mechanisms	x	x	x	x	x	x

Key

x required only if the construction is present in the design of the valve

— no requirement even if the function is present

GQC gas quick connector

6.2 Construction requirements

6.2.1 Appearance

Shall be according to ISO 23550:2018, 6.2.1.

6.2.2 Holes

6.2.2.1 General

Shall be according to ISO 23550:2018, 6.2.2.1.

6.2.2.2 Requirements

ISO 23550:2018, 6.2.2.2 is replaced by the following:

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

6.2.2.3 Test

Shall be according to ISO 23550:2018, 6.2.2.3.

6.2.3 Breather holes

ISO 23550:2018, 6.2.3, is not applicable.

6.2.4 Vent limiter

ISO 23550:2018, 6.2.4, is not applicable.

6.2.5 Screwed fastenings

Shall be according to ISO 23550:2018, 6.2.5.

6.2.6 Moving parts

Shall be according to ISO 23550:2018, 6.2.6, with the following modification to 6.2.6.1:

6.2.6.1 General

Shall be according to ISO 23550:2018, 6.2.6.1 with the following addition:

Fastening parts (e.g. screws and nuts) shall be secured to prevent loosening under the conditions of actual use.

6.2.7 Sealing caps

Shall be according to ISO 23550:2018, 6.2.7.

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

Shall be according to ISO 23550:2018 6.2.8, with the following modification:

6.2.8.1 General

Shall be according to ISO 23550:2018, 6.2.8.1.

6.2.8.2 Requirements

Shall be according to ISO 23550:2018, 6.2.8.2.

6.2.8.3 Test

Shall be according to ISO 23550:2018, 6.2.8.3.

6.2.8.4 Factory adjustment

Subclause specific to this document.

6.2.8.4.1 General

Factory adjustment, not intended for field adjustment, shall be securely protected.

6.2.8.4.2 Requirements

Factory adjustment not intended for field adjustment shall be secured by suitable means that provides protection against access or shall be declared as requiring such protection in the application.

Examples of "suitable means" include the following:

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

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

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

6.2.8.4.3 Test

Conformance is checked by inspection. Where sealing is used, inspection is carried out before and after the endurance tests.

6.2.8.5 Maintaining of adjustments

Subclause specific to this document.

6.2.8.5.1 General

All factory adjustments shall be designed so that they are maintained in the field.

6.2.8.5.2 Requirements

Suitable means for maintaining all adjustments shall be provided.

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

6.2.8.5.3 Test

Conformance is checked by inspection.

6.2.8.6 Field adjustments

Subclause specific to this document.

6.2.8.6.1 General

Field adjustments shall be protected.

6.2.8.6.2 Requirements

Necessary field adjustments shall be capped according to 6.2.7 or otherwise protected in such a manner as to resist tampering and prevent accidental change.

6.2.8.6.3 Test

Conformance is checked by inspection.

6.2.9 Auxiliary channels and orifices

Shall be according to ISO 23550:2018, 6.2.9.

6.2.10 Pre-setting device

Shall be according to ISO 23550:2018, 6.2.10.

6.2.11 Closed position indication

Subclause specific to this document.

6.2.11.1 Visual indicator (VI)

A valve may incorporate a visual indicator that is connected to the valve closure member and indicates when the valve is open or closed. This operation shall be mechanical and independent from any auxiliary energy source.

This indicator shall be of a colour contrasting from its background or shall be incorporated into the valve so as to be obvious to the user.

6.2.11.2 Closed position switch (CPS)

6.2.11.2.1 General

When the valve design incorporates an auxiliary switch intended to indicate the closed position (CPS), the valve and switch shall fulfil the following requirements and test.

6.2.11.2.2 Requirements

The CPS shall indicate the closed position under the following conditions:

— the flow rate is equal to or less than 10 % of the equivalent fully open flow rate at the same pressure difference;

— the closure member is within 1 mm of its closed position.

A valve that incorporates a CPS shall have the switch setting factory set and sealed.

The instructions shall state that the CPS is not a POC switch and does not satisfy the additional requirements for a POC.

If field adjustment is provided, then the arrangement shall minimize the possibility of tampering, and instructions shall identify proper switch setting procedures.

6.2.11.2.3 Test

Modify a single valve to enable the closure member to be moved and positioned in any partially open position. Then move the closure member until the switch just indicates valve closure. Measure either the flow or the opening, as appropriate, according to 6.2.11.2.2.

Where the switch has not been type tested, carry out electrical tests in accordance with the methods given in IEC 61058-1.

Carry out the endurance test on an unmodified valve with the maximum inductive or capacitive load declared by the manufacturer on the closed position indicator switch.

During the test, monitor the switch to verify that it indicates that the valve is closed when it is de-energized and open when the valve is energized.

6.2.11.3 Proof of closure switch (POC)

6.2.11.3.1 General

When the valve design incorporates a POC, the valve and switch shall fulfil the following requirements and test.

6.2.11.3.2 Requirements

A POC switch shall have the switch setting factory set and sealed. Field adjustment of the POC switch is not permitted.

The switch shall include at least one set of contacts that close only after the valve port is closed, and that open prior to the opening of the valve port. Additional movement to activate the switch while the port is closed shall be either:

a) provided directly by the port-closing element; or

b) provided by additional valve operator movement that relies on the port-closing element being in the closed position. The valve port is considered closed when leakage through the valve does not exceed 0,028 m^3/h gas at 150 % of rated inlet pressure applied to the valve inlet.

The instructions shall state that this is a POC switch and not a CPS and that it satisfies the relevant requirements for a POC.

6.2.11.3.3 Test

Modify a single valve to enable the closure member to be moved and positioned in any partially open position. Then move the closure member until the POC switch just indicates POC. Measure and verify the closing as appropriate according to 6.2.11.3.2.

Where the switch has not been type tested, carry out electrical tests in accordance with the methods given in IEC 61058-1.

Carry out the endurance test on an unmodified valve with the maximum inductive or capacitive load declared by the manufacturer on the closed position indicator switch.

During the test, monitor the switch to verify that it indicates that the valve is closed when the valve is de-energized and open when the valve is energized.

6.2.12 Specific construction

Subclause specific to this document.

A valve shall not utilize fuel gas pressure/flow through the valve or an external power source for closure.

6.2.13 Flow rates of valves with modulating control

Subclause specific to this document.

6.2.13.1 General

Flow rates of valves with modulating control shall be adjustable over the full range as stated in the installation and operating instructions.

6.2.13.2 Requirements

If the adjustment of one flow rate affects the setting of any other flow rate, this shall be clearly indicated in the installation and operating instructions. The setting of any flow rate shall require the use of tools and shall be designed to discourage unauthorized adjustment.

6.2.13.3 Test

First, adjust the inlet pressure to the manufacturer's minimum specified inlet pressure and adjust the valve to the manufacturer's maximum specified flow rate.

Next, adjust the inlet pressure to the manufacturer's maximum specified inlet pressure and adjust the valve to the manufacturer's minimum specified flow rate.

Verify that the valve meets the requirements in 6.2.13.2.

6.2.14 Bypass

Subclause specific to this document.

Shut-off valves shall not incorporate a bypass.

6.2.15 Semi-automatic shut-off valve

Subclause specific to this document.

A semi-automatic valve that is manually open shall only allow a fully open position.

6.2.16 Other controls assembled to a valve

Subclause specific to this document.

6.2.16.1 General

Other controls assembled to a valve shall not interfere with its shut-off function.

6.2.16.2 Requirement

The shut-off function shall not be interfered with by any other control assembled to the valve.

6.2.16.3 Test

Conformance shall be verified by technical documentation review.

6.2.17 Balanced valves

Subclause specific to this document.

6.2.17.1 General

The closure member of a balanced valve (see ISO 23551-1:2024, Figures 2 or 3) shall have a resulting force in the closing direction where the sealing force is not decreased by the gas inlet pressure.

6.2.17.2 Requirements

For a balanced valve with one valve seat, a resulting force in the closing direction shall remain if the balancing force is removed. Also, the closure member shall have the same closing direction as the flow direction through the valve.

6.2.17.3 Test

Conformance shall be verified by technical documentation review.

6.2.17.4 Additional requirements for shut-off function

6.2.17.4.1 Diaphragms that assist the shut-off function

Shut-off functions using a diaphragm to apply a portion of the closing force to the closure member shall be designed in such a way that, when the diaphragm is damaged, the closure member closes and the maximum internal leakage rate of the valve is limited to 1 dm^3/h. Conformity shall be verified by the leakage test method given in 6.2.17.4.2.

6.2.17.4.2 Leakage test

Remove or rupture the part(s) assisting the shut-off function. De-energize the valve. Measure the internal leakage rate of the valve according to the procedure of 7.2.

6.3 Materials

6.3.1 General material requirements

Shall be according to ISO 23550:2018, 6.3.1.

6.3.2 Housing

6.3.2.1 General

Shall be according to ISO 23550:2018, 6.3.2.1.

6.3.2.2 Requirements

Shall be according to ISO 23550:2018, 6.3.2.2, with the following addition:

The body and the internal parts of a valve, except the soft part of valve disk, gasket, O-rings and the like, shall be of metallic materials with a melting point not less than 427 °C and shall conform to the relevant International material Standard (chemical composition, mechanical characteristics and test procedures) and the requirements given in Table 2.

NOTE Specific regional requirements are given in Annex A, B, C and D.

Table 2 — Materials

Restrictions				
Material		Control		
Group	Properties			
	A_{min} %	$\rho_{d,max}$ MPa	$(\rho_d \cdot d_n)_{max}$ [a] MPa · m	$d_{n,max}$ [a] m
Pressure-containing parts and inner metallic partition walls				
Rolled and forged steel [b]	16	10	—	—
Cast steel [b]	15	10	—	—
Spheroidal graphite cast iron [c]	7	2	0,15	1
	15	5	0,5	0,3
Malleable cast iron	6	2	0,1	0,1
Copper-zinc wrought alloys	15	10	—	0,025
Copper-tin and copper—zinc cast alloys	5	2	0,1	0,1
	15	10	—	0,025
Aluminium wrought alloys	4	2	—	0,05
	7	5	—	0,05
		10	—	0,025
Aluminium cast alloys	1,5	1	0,025	0,15
	4	2	0,16	1

NOTE For castings, the specified mechanical characteristics are those measured on a machined test piece prepared from separately cast test samples in accordance with the relevant document for the selected materials.

Key

A is the percentage of elongation after fracture (according to the applicable document, relevant to the chosen material);

ρ_d is the design pressure, DP;

d_n is the nominal diameter.

[a] For the bodies of pilots or fixtures, DN (d_n) shall refer to their inlet connections.

[b] Bending rupture energy measured in accordance with ISO 148-1 shall be not less than 27 J as average of three test pieces with minimum individual of 20 J at minimum operating temperature (–10 °C or –20 °C).

[c] Bending rupture energy measured in accordance with ISO 148-1 shall be not less than 12 J as an average of three test pieces and no less than 9 J as a minimum individual value at a temperature of –20 °C for DP > 2 500 kPa when used in control class 2.

[d] Justified by engineering: materials that are not yet elaborated are justified by manufacturer through risk assessment, taken into account the state of the art knowledge of the material, for example, control complying to 6.3.12 hydrostatic withstand pressure test with safety factor 5 meets this requirement.

Table 2 *(continued)*

Restrictions				
Material		**Control**		
Group	**Properties**			
	A_{min} %	$\rho_{d,max}$ MPa	$(\rho_d \cdot d_n)_{max}$ [a] MPa · m	$d_{n,max}$ [a] m
Integral process and sensing lines				
Copper	—	2,5	—	—
Steel	—	10	—	—
Connectors				
Steel	8	—	—	—
Fasteners				
Steel for bolts, screws, studs	9	5	—	—
	12	10	—	—
Others [d]				

NOTE For castings, the specified mechanical characteristics are those measured on a machined test piece prepared from separately cast test samples in accordance with the relevant document for the selected materials.

Key

A is the percentage of elongation after fracture (according to the applicable document, relevant to the chosen material);

ρ_d is the design pressure, DP;

d_n is the nominal diameter.

[a] For the bodies of pilots or fixtures, DN (d_n) shall refer to their inlet connections.

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[c] Bending rupture energy measured in accordance with ISO 148-1 shall be not less than 12 J as an average of three test pieces and no less than 9 J as a minimum individual value at a temperature of –20 °C for DP > 2 500 kPa when used in control class 2.

[d] Justified by engineering: materials that are not yet elaborated are justified by manufacturer through risk assessment, taken into account the state of the art knowledge of the material, for example, control complying to 6.3.12 hydrostatic withstand pressure test with safety factor 5 meets this requirement.

6.3.2.3 Test

Shall be according to ISO 23550:2018, 6.3.2.3.

6.3.3 Springs providing closing force and sealing force

6.3.3.1 General

Shall be according to ISO 23550:2018, 6.3.3.1.

6.3.3.2 Requirements

Shall be according to ISO 23550:2018, 6.3.3.2, with the following addition:

Springs shall be protected against abrasion and guided or arranged to minimize binding, buckling or other interference with their free movement.

This requirement applies also for pilot and release valves for pneumatic or hydraulic actuators.

6.3.3.3 Test

Shall be according to ISO 23550:2018, 6.3.3.3.

6.3.4 Resistance to corrosion and surface protection

Shall be according to ISO 23550:2018, 6.3.4.

6.3.5 Impregnation

ISO 23550:2018, 6.3.5, is replaced by the following:

Valves shall not be impregnated. C/I valves may be impregnated.

6.3.6 Seals for glands for moving parts

Shall be according to ISO 23550:2018, 6.3.6.

6.3.7 Jointing

Shall be according to ISO 23550:2018, 6.3.7.

6.3.8 Closure members

Subclause specific to this document.

6.3.8.1 General

Closure members of valves shall be stable enough to transmit forces.

6.3.8.2 Requirements

Closure members of valves shall either have a mechanical support (e.g. metallic) or shall be made of metal. This requirement also applies to parts transmitting the closing force.

6.3.8.3 Test

Subject to verification by technical documentation.

6.3.9 Parts transmitting the closing force

Subclause specific to this document.

6.3.9.1 General

Parts transmitting the closing force shall be designed to withstand the closing force.

6.3.9.2 Requirements

Parts transmitting the closing force shall be made of metal and shall be designed to withstand a force equal to two times the closing force or maximum operating torque of the actuator.

6.3.9.3 Test

Subject to verification by technical documentation.

6.3.10 Balanced valves

Subclause specific to this document.

6.3.10.1 General

The closure members of a balanced valve shall withstand the sealing force.

6.3.10.2 Requirements

The strength of the connection between closure members shall be at least five multiplied by the maximum inlet pressure multiplied by the total opening area of the closure members.

6.3.10.3 Test

Subject to verification by technical documentation.

6.3.11 Bellows

Subclause specific to this document.

6.3.11.1 General

Bellows used as sealing elements shall be designed to avoid premature fatigue.

6.3.11.2 Requirements

When bellows are used as sealing elements, proof of limiting fatigue stress shall be provided for at least the number of cycles stated in Table 7.

6.3.11.3 Test

Subject to verification by technical documentation.

6.3.12 Hydrostatic withstand pressure test

Subclause specific to this document.

6.3.12.1 General

Pressure-containing components of a valve shall be designed to withstand the design pressure.

6.3.12.2 Requirement

Parts of the valve that are subjected to inlet pressure under normal operating conditions shall be designed to meet requirements as per the declared design pressure multiplied by a safety factor, *F*, according to Table 3.

Table 3 — Safety factors

Material group	Minimum safety factor
Rolled or forged steel	2,13
Cast steel	2,50
Ductile iron and malleable iron	3,13
Copper-zinc-wrought alloy	2,50
Copper-zinc-cast alloy	3,13
Cast aluminium A_{min} 4 %	3,13
Cast aluminium A_{min} 1,5 %	4,00
Alternative method regardless of the group of material	5,00 [a]

[a] Test time specified in 6.3.12.3 shall be 1 min.

6.3.12.3 Test

A separate valve not to be used for conducting other tests can be used.

The test is carried out in such a manner that deformations of the test sample in all directions are possible. There shall be no additional stresses due to bending, torque or tension during the conduct of the test.

The test is carried out with the valve in the fully open position (energized) and with the valve and hydraulic fluid at ambient temperature or by pressurizing the valve from both upstream and downstream so that the entire valve is pressurized uniformly

The test is carried out with water at ambient temperature. The test may also be carried out with air or nitrogen, if the necessary safety measures are taken. The pressure is to be raised gradually to the design pressure multiplied by a safety factor *F* from Table 3 for 5 min and 1 min for safety factor 5,00 respectively.

For a diaphragm valve, the diaphragm shall be substantially removed to permit the test media to flow freely to both sides of the diaphragm.

After the test, upon visual inspection there shall be no sign of rupture or mechanical dislocation of parts of the enclosure communicating with the atmosphere.

Specific requirements for Canada and the USA shall be as specified in Annex B.

6.4 Connections

6.4.1 General

Shall be according to ISO 23550:2018, 6.4.1.

6.4.2 Connection sizes

Shall be according to ISO 23550:2018, 6.4.2.

6.4.3 Connections types

Shall be according to ISO 23550:2018, 6.4.3.

6.4.4 Threads

6.4.4.1 General

Shall be according to ISO 23550:2018, 6.4.4.1.

6.4.4.2 Requirements

Shall be according to ISO 23550:2018, 6.4.4.2, with the following addition:

Valves up to a size of DN 80 may have thread or flange connection.

Specific requirements for Canada and the USA shall be as specified in Annex B.

6.4.4.3 Test

Shall be according to ISO 23550:2018, 6.4.4.3.

6.4.5 Union joints

Shall be according to ISO 23550:2018, 6.4.5.

6.4.6 Flanges

6.4.6.1 General

Shall be according to ISO 23550:2018, 6.4.6.1.

6.4.6.2 Requirements

ISO 23550:2018, 6.4.6.2, is replaced by the following:

Flanges on end connections of controls shall be suitable for connection to the flange in accordance with ISO 7005-1, ISO 7005-2 or ISO 7005-3 as appropriate, PN (nominal pressure) up to PN 64.

When flanges do not conform to these documents, full details shall be provided.

Valves larger than DN 80 shall incorporate flange connections.

Specific requirements for Canada and the USA shall be as specified in Annex B. Specific requirements for Japan shall be as specified in Annex C. Specific requirements for China shall be as specified in Annex D.

6.4.6.3 Test

Shall be according to ISO 23550:2018, 6.4.6.3.

6.4.7 Compression fittings

6.4.7.1 General

Shall be according to ISO 23550:2018, 6.4.7.1, with the following addition:

The use of compression fittings is limited to valves up to and including DN 25.

Compression fitting shall not be used on C/I valves.

6.4.7.2 Requirements

Shall be according to ISO 23550:2018, 6.4.7.2.

6.4.7.3 Test

Shall be according to ISO 23550:2018, 6.4.7.3.

6.4.8 Flare connections

ISO 23550:2018, 6.4.8, is replaced by the following:

Flare connections shall not be used.

6.4.9 Nipples for pressure tests

6.4.9.1 General

ISO 23550:2018, 6.4.9.1, is replaced by the following:

Pressure test nipples for high pressure controls can be connected with the control under pressure.

6.4.9.2 Requirements

ISO 23550:2018, 6.4.9.2, is replaced by the following:

Nipples shall not be used on C/I valves.

The closing member of the nipple shall not be able to be pushed out by gas pressure when completely unscrewed.

6.4.9.3 Test

ISO 23550:2018, 6.4.9.3, is replaced by the following:

Subject to verification by technical review and documentation.

6.4.10 Strainers

Shall be according to ISO 23550:2018, 6.4.10.

6.4.11 Gas connections by GQC

ISO 23550:2018, 6.4.11, is not applicable.

6.4.12 Welded connections

Subclause specific to this document.

6.4.12.1 General

If gas-tight connections are made by welding, welding shall be performed according to 6.4.12.3.

Welded pipe connections are not allowed for C/I valves.

6.4.12.2 Requirements

Welded connections shall conform to ISO 9692-1.

Specific requirements for European countries shall be as specified in Annex A. Specific requirements for Canada and the USA shall be as specified in Annex B. Specific requirements for Japan shall be as specified in Annex C.

6.4.12.3 Test

Subject to verification by technical documentation as required by ISO 9692-1.

6.5 Gas controls employing electrical components in the gas way

Shall be according to ISO 23550:2018, 6.5.

6.6 Pneumatic and hydraulic actuating mechanisms

Subclause specific to this document.

Pneumatic or hydraulic actuated valves shall be provided with protection to ensure that the blockage of an orifice in the control system does not adversely affect the performance requirements as given in Clause 7. If the performance of the actuating mechanism depends on the quality of compressed air or hydraulic fluid, appropriate information shall be given in the installation and operating instructions.

7 Performance

7.1 General

Shall be according to ISO 23550:2018, 7.1 with the following addition:

The electrical control valve of hydraulic or pneumatic actuating mechanisms shall also meet the following requirements.

The closing of hydraulically or pneumatically actuated valves shall be ensured over the range from 85 % to 110 % of the actuating pressure or pressure range declared by the manufacturer.

For semi-automatic shut-off valves, suitable means shall be provided to prevent the permanent blocking of the manual actuating mechanism in the open position.

Where valves are specified for using pilot and/or release valves, the assembly shall fulfil all performance requirements and tests.

Valves shall close automatically when de-energized or in the absence of actuating energy.

Table 4 describes applicable performance requirements and tests for the classified valves. Combination of valve types are included (e.g. automatic Class A and C/I valve).

The marking "x" identifies the minimum requirements to be verified by the given subclauses in this document.

Requirements without existing construction or performance properties cannot be verified and those associated clauses are therefore not applicable.

Specific minimum requirements related to the valve classifications of 4.1 are identified by a superscript associated with the marking "x" (e.g. x^{A} or $x^{C/I}$).

Table 4 — Assignment of valve performance requirements and tests

Clause	Title	Shut-off valve (Classes)					General purpose valve (Class)
		automatic	automatic	semi-automatic	automatic	semi-automatic	
		A	C/I	C/I	E	E	D
7.2	Leak-tightness						
7.2.1	General	x	x	x	x	x	x
7.2.2	Requirement	x	x	x	x	x	x
7.2.3	Test	x	x	x	x	x	x
7.2.4	Pressure surge test	—	$x^{C/I}$	$x^{C/I}$	—	—	—
7.3	Torsion and bending	x	x	x	x	x	x
7.4	Rated flow rate	x	x	x	x	x	x
7.5	Durability	x	x	x	x	x	x
7.6	Functional requirements						
7.6.1	Closing function	x	—	—	x	x	—
7.6.1.2	Requirement 1	—	—	—	x	x	—

Key

x required only if the construction is present in the design of the valve

— no requirement even if the function is present

Table 4 *(continued)*

Clause	Title	Shut-off valve (Classes)					General purpose valve (Class)
		automatic	automatic	semi-automatic	automatic	semi-automatic	
		A	C/I	C/I	E	E	D
7.6.1.3	Test method 1	—	—	—	x	x	—
7.6.1.4	Requirement 2	x	—	—	—	—	—
7.6.1.5	Test method 2	x	—	—	—	—	—
7.6.2	Closing force	x	—	—	—	—	—
7.6.3	Delay time and opening time	x	—	—	x	—	—
7.6.4	Closing time	x	$x^{C/I}$	$x^{C/I}$	x	x	—
7.6.5	Sealing force	x^{A}	—	—	—	—	—
7.7	Endurance test	x	x	x	x	x	x
7.8	Vibration	x	—	—	x	x	x

Key

x required only if the construction is present in the design of the valve

— no requirement even if the function is present

7.2 Leak-tightness

7.2.1 General

Shall be according to ISO 23550:2018, 7.2.1.

7.2.2 Requirements

ISO 23550:2018, 7.2.2 is replaced by the following:

Controls shall not exceed the air leakage rates given in Table 5 and Table 6.

Table 5 — Maximum air leakage rates (internal leak-tightness test)

Approach	Nominal size mm	Leak-tightness cm^3/h	Test temperature	Test pressure
Class A and D	DN < 10	90	Room temperature if rating is between 0 °C and 55 °C or at minimum and maximum rated ambient temperature	0,5 kPa and the greater of 15 kPa or 150 % of the maximum operating pressure
	10 ≤ DN ≤ 25	90		
	25 < DN ≤ 80	90		
	80 < DN ≤ 150	100		
	150 < DN ≤ 250	150		

Table 5 *(continued)*

Approach	Nominal size mm	Leak-tightness cm^3/h	Test temperature	Test pressure
Class C/I	Seal off diameter ≤ 25,4	235		The test shall be performed at 1,72 kPa and 150 % of the maximum operating pressure
	DN > 25,4 seal off diameter	235 per 25,4 mm of seal-off diameter		Same as above
Class E	DN ≤ 25	90		0,5 kPa and 4,2 kPa for domestic use 125 % of maximum operating pressure for commercial and industrial use
	DN > 25	300 per 25,4 mm of seal-off diameter		0,5 kPa and 110 % maximum operating pressure

Table 6 — Maximum air leakage rates (external leak-tightness test)

Approach	Nominal size mm	Leak-tightness cm^3/h	Test temperature	Test pressure
Class A and D	DN < 10	90	Room temperature if rating is between 0 °C and 55 °C or at minimum and maximum rated ambient temperature	The greater of 15 kPa or 150 % of the maximum operating pressure
	10 ≤ DN ≤ 25	90		
	25 < DN ≤ 250	90		
Class C/I	All sizes	200		150 % of the maximum operating pressure
Class E	DN ≤ 25	90		125 % of maximum operating pressure
	DN > 25	90		110 % maximum operating pressure

The result for internal and external leak-tightness of the test is satisfactory if one of the following conditions is met:

— the test system is bubble-tight for a time of 5 s at the end of the 15 min test.

— both internal and external leakage not higher than the values stated in Table 5 and 6 and according to methods listed in 7.2.3.

7.2.3 Test

7.2.3.1 General

Shall be according to ISO 23550:2018, 7.2.3.1, with the following modification:

This test shall be carried out on a valve that is pressurized for at least 15 min.

The test is carried out in such a manner that deformations of the control in all directions are possible. There shall be no additional stresses due to bending, torque or tension.

Forces from fastening systems shall be similar to those experienced under normal installation conditions, at least during the test.

For the test at the limit temperatures when applicable, the control shall be installed in a suitable thermostatically-controlled enclosure.

The test shall include in the listing order a test at lowest limit temperature and subsequently a test at highest limit temperature.

7.2.3.2 Test for external leak-tightness

Shall be according to ISO 23550:2018, 7.2.3.2 with following modification:

This test may be carried out by covering the control with a foaming liquid, by immersing the control in a tank of water or by other equivalent methods.

7.2.3.3 Test for internal leak-tightness of controls

ISO 23550:2018, 7.2.3.3, is replaced by the following:

For internal leakage of closure members, the test is carried out at ambient temperature with two different test pressures specified in Table 5, upstream of the closing members, and atmospheric pressure downstream of the control.

7.2.4 Pressure surge test

Subclause specific to this document.

A closed valve shall remain closed on a sudden change of upstream pressure over a range of 0 % to 150 % of the maximum rated inlet pressure.

1) The maximum leakage test pressure is applied within 0,5 s.
2) The pressure is maintained and leakage is accumulated over a 2 min test period.
3) Using accumulated total leakage from steps 1) and 2), calculate an equivalent leakage rate per hour.
4) The test shall be repeated 5 times. The highest internal leakage for any one test shall not exceed the leakage allowed in Table 5, when tested according to 7.2.3.

7.3 Torsion and bending

7.3.1 General

Shall be according to ISO 23550:2018, 7.3.1.

7.3.2 Torsion

Shall be according to ISO 23550:2018, 7.3.2.

7.3.3 Bending moment

Shall be according to ISO 23550:2018, 7.3.3.

7.3.4 Torsion and bending tests

7.3.4.1 General

Shall be according to ISO 23550:2018, 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 23550:2018, 7.3.4.2.

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

Shall be according to ISO 23550:2018, 7.3.4.3, with following addition:

Compression joints shall not be used.

7.3.4.4 Ten-second bending-moment test

Shall be according to ISO 23550:2018, 7.3.4.4.

7.3.4.5 900-s bending-moment test

Shall be according to ISO 23550:2018, 7.3.4.5.

7.4 Rated flow rate

7.4.1 General

Shall be according to ISO 23550:2018, 7.4.1.

7.4.2 Requirements

Shall be according to ISO 23550:2018, 7.4.2, with the following addition:

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

Where the manufacturer declares opening and closing characteristics for valves with modulating control, these shall be within ±10 % of the manufacturer's declared value.

For valves with step control, where applicable, the manufacturer shall declare the maximum flow rate for each step as a percentage of the fully open flow rate. It shall not be possible to adjust the maximum flow rate for each step in excess of 1,1 times the declared value when tested according to 7.4.3.

When the flow rate changes in response to external electrical signals, it shall not, when tested according to 7.4.3, overshoot in either direction while attaining the new flow rate by more than 20 % of the flow rate at that particular set point, or as declared by the manufacturer.

7.4.3 Test

Shall be according to ISO 23550:2018, 7.4.3, with the following addition:

For valves with modulating or step control, verify the declared opening and closing characteristics at rated voltage or current before and after the endurance test for conformity with 7.4.2.

7.5 Durability

Shall be according to ISO 23550:2018, 7.5.

7.6 Functional requirements

Subclause specific to this document.

7.6.1 Closing function

7.6.1.1 General

Shut-off valves shall close upon either completely removing (7.6.1.2 and 7.6.1.3) or reducing the energy source (7.6.1.4 and 7.6.1.5).

7.6.1.2 Requirement 1

The valve shall close upon completely removing the energy source.

7.6.1.3 Test method 1

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Allow adequate time for the power to the valve to stabilize. Completely disconnect or interrupt the power to the valve. Verify that the valve has closed.

7.6.1.4 Requirement 2

Valves shall close automatically upon reducing the voltage or current to 15 % of the minimum rated value.

Shut-off valves with pneumatic or hydraulic actuating mechanisms shall close automatically upon reducing the voltage or current to 15 % of the minimum rated voltage of the control valve. Shut-off valves shall close automatically upon removal of the voltage or current of between 15 % of the minimum rated and the maximum rated value increased by the tolerance according to 7.1.

In all cases, the closing time shall be in accordance with 7.6.4.

7.6.1.5 Test method 2

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 the maximum rated value increased by the tolerance according to 7.1, keeping the actuating pressure, if any, unchanged. De-energize the valve and verify that it has closed.

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 the maximum rated value decreased by the tolerance according to 7.1, 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 the maximum rated value decreased by the tolerance according to 7.1.

7.6.2 Closing force

7.6.2.1 General

This test is applicable to valves where the sealing force is independent of the closing force (e.g. ball valve, guillotine valve, etc.) and to disc-on-seat valves.

7.6.2.2 Requirements

Valves with sealing force independent of the closing force (e.g. ball valve, guillotine valve, etc.) shall have a closing force of:

— at least 5 times the value of the frictional force where the frictional force is up to and including 5 N;

— at least 2,5 times the value of the frictional force but at least 25 N where the frictional force is above 5 N.

For ¼ turn valves the shaft shall be capable of 2 times the maximum operating torque, as specified by the manufacturer.

7.6.2.3 Test

The frictional force measurement shall be performed in the ungreased condition.

Measure the minimum closing force over the travel of the closure member from the open position to the closed position.

Remove the spring(s) providing the closing force from the valve and measure the maximum force required to move the closure member from the open position to the closed position.

7.6.3 Delay time and opening time

7.6.3.1 General

The deviation of the delay time and the opening time before and after the endurance test shall be limited specified in 7.6.3.2.

7.6.3.2 Requirements

The deviation of the delay time and the opening time before and after the endurance test shall be within ±20 % of the initial measured delay and opening time.

This requirement does not apply to semi-automatic and motorized valves or to automatic valves that open fully in less than 1 s.

7.6.3.3 Test

Measure the time interval between energizing the valve and the start of the release of the closure member (delay time).

Measure the time interval between energizing the valve and the attainment of the fully open position or a flow rate equal to 80 % of the rated flow rate (opening time).

Carry out the tests under the following conditions, allowing the de-energized valve to reach thermal equilibrium before carrying out the tests at:

— 20 °C,

— the maximum inlet pressure,

— the minimum rated voltage or current increased by the tolerance according to 7.1, and

— the minimum actuating pressure, if applicable.

7.6.4 Closing time

7.6.4.1 General

The closing time for valves shall not exceed given limits when tested according to 7.6.4.3.

7.6.4.2 Requirements

The closing time for valves of Class A shall not exceed 1 s when tested according to 7.6.4.3.

The closing time for a valve declared as C/I or Class E shall not exceed 2 s. The test according to 7.6.4.3 shall be repeated during the period of opening of the valve.

The closing time of the controlling function shall be within ±10 % of the manufacturer's declared value.

7.6.4.3 Test

Measure the time interval between de-energizing the valve and the closure member attaining the closed position, under the following conditions:

— at 60 °C (or at the maximum ambient temperature, if higher), at the maximum working pressure, at a pressure difference declared by the manufacturer, at the maximum rated voltage or current increased by the tolerance according to 7.1, and at the maximum actuating pressure, if applicable;

— at 0 °C (or at the minimum ambient temperature, if lower) at a working pressure of 0,6 kPa, at the minimum pressure difference declared by the manufacturer, at the maximum rated voltage or current increased by the tolerance according to 7.1, and at the maximum actuating pressure, if applicable.

For C/I and Class E valves, the following test procedure applies:

One sample used for the closing time test shall be used for endurance testing and shall also conform following endurance.

The test shall be performed at ambient temperature for valves with a declared minimum temperature of 0 °C, or at the minimum temperature for valves with a lower declared minimum ambient. The valve shall be mounted in the most critical position declared by the manufacturer, a means to read the downstream pressure attached, and energized at rated voltage. If the valve incorporates a POC switch, it may be used to indicate when the valve is closed. The valve shall be de-energized and the closing time measured. The test shall be repeated as the valve is being energized.

7.6.5 Sealing force

7.6.5.1 General

Valves shall have a minimum sealing force over the closure member orifice area.

7.6.5.2 Requirement

Class A valves shall have a minimum sealing force over the closure member orifice area providing a maximum leakage rate for internal leakage according to 7.2 at a test pressure of 15 kPa when tested according to 7.6.5.3.

The test pressure is opposing the flow direction.

For balanced valves with more than one opening of the closure member, the force of the closing spring shall be calculated to be at least 50 % of the total opening area multiplied by 50 kPa multiplied by 1,25.

Balanced valves with one valve seat shall have a minimum sealing force over the closure member orifice area. This sealing force shall be provided only by the closing spring, and shall be tested according to 7.6.5.3.

The test pressure opposing the flow direction for balanced valves with more than one opening of the closure member is 30 kPa.

Where the test methods of 7.6.5.3 are unsuitable for other designs of valve, the sealing force shall be verified by calculation or by a combined method of test and calculation.

7.6.5.3 Test

Connect an air supply through a flow meter to the outlet of the valve such that the air pressure opposes the closing direction of the closure member. Energize and de-energize the valve twice.

Pressurize the valve slowly to the appropriate pressure (e.g. 15 kPa) and measure the leakage rate after the test system is stabilized or bubble-tight for a time of 5 s.

7.7 Endurance

Shall be according to ISO 23550:2018, 7.7, with the following addition:

7.7.1 Requirement

The test cycles for the specific valve types are given in Table 7.

Table 7 describes the applicable number of endurance cycles for each of the valve classes. The following explains the method for calculating the number of cycles to be done at ambient, minimum and/or maximum temperatures.

Table 7 — Operating cycles for endurance test

	Shut-off valve (Classes)					General purpose valves (Class)
	automatic	automatic	semi-automatic	automatic	semi-automatic	
Valve sizes	A	C/I	C/I	E	E	D
≤DN25	(1) **200 000** (2) 25 000 (3) 150 000 (4) 50 000	(1) **100 000** (2) 10 000 (3) n/a (4) 90 000	(1) **20 000** (2) 2 000 (3) n/a (4) 18 000	(1) **100 000** (2) 10 000 (3) n/a (4) 90 000	(1) **6 000** (2) 600 (3) n/a (4) 5 400	as declared by manufacturer or stated in instructions
25 < DN ≤80	(1) **100 000** (2) 25 000 (3) 75 000 (4) 25 000					
80 < DN ≤150	**(1) 50 000** (2) 25 000 (3) 25 000 (4) 25 000					
150 < DN ≤250	**(1) 25 000** (2) 5 000 (3) 20 000 (4) 5 000					

Key
(1) (CR total) Total number of cycles. Total amount of (2), (3) and (4).
(2) (CR at T_{min}) cycle rate (CR) at minimum rated voltage or current if minimum ambient temperature T_{min} < 0 °C is declared by the manufacturer or stated in instructions. C/I valves shall be tested at rated voltage or current.
(3) (CR at T_{amb}) cycle rate at ambient temperature, T_{amb}, with 50 % of the cycles at minimum and 50 % of the cycles at maximum rated voltage or current. If minimum ambient temperature < 0 °C is declared by the manufacturer or stated in the instructions, the number of cycles shall be reduced by value (2), CR at T_{min}.
(4) (CR at T_{max}) cycle rate at maximum temperature, T_{max}, and maximum rated voltage or current. C/I valves shall be tested at rated voltage or current.
(n/a) Not applicable.

EXAMPLE 1: Valve size 80 < DN ≤150 for Class A valve; declared for 0 °C to 50 °C.
Test cycles:
(2) zero cycles at minimum temperature (i.e. declared temperature = 0 °C).
(4) 25 000 cycles at maximum temperature.
(3) 25 000 cycles at ambient temperature.
Total number of cycles: (1) = (2) + [(3) – (2)] + (4) = 0 + [(25 000 – 0)] + 25 000 = 50 000

EXAMPLE 2: Valve size 25 < DN < 80 for Class A value; declared for –20 °C to 50 °C.
Test cycles:
(2) 25 000 at –20 °C (i.e. declared temperature < 0 °C).
(4) 25 000 at maximum temperature.
(3) 25 000 at ambient temperature.
Total number of cycles: (1) = (2) + [(3) – (2)] + (4) = 25 000 + [(25 000 – 25 000)] + 25 000 = 50 000

7.7.2 Test

7.7.2.1 Test sequence

Tests should be carried out in the sequence as described in Table 8 before the endurance test in 7.7.2.2. The tests as described in Table 9 shall be carried out after the endurance test described in 7.7.2.2.

The marking "x" in Table 8 and Table 9 identifies the relevant test to be conducted for each valve class.

Requirements without existing construction or performance properties cannot be verified and those associated clauses are therefore not applicable.

Table 8 — Test sequence before endurance test

Test	Test sequence	Shut-off valve (Classes)					General purpose valves (Class)
		automatic	automatic	semi-auto-matic	automatic	semi-auto-matic	
		A	C/I	C/I	E	E	D
8.3	Dielectric strength test	x	—	—	x	x	x
7.2	Leak-tightness[a]	x	x	x	x	x	x (only external)
7.6.1	Closing function	x	—	—	x	x	—
7.6.4	Closing time	x	—	—	x	x	—
7.3	Torsion and bending	x	x	x	x	x	x

[a] The leak-tightness test needs to be performed after each temperature change (min, ambient, max); see 7.7.2.2.

Table 9 — Test sequence after endurance test

Test	Test sequence	Shut-off valve (Classes)					General purpose valves (Class)
		automatic	automatic	semi-auto-matic	automatic	semi-auto-matic	
		A	C/I	C/I	E	E	D
8.3	Dielectric strength test	—	x	x	—	—	—
7.2	Leak-tightness[a]	x	x	x	x	x	x (only external)
7.6.2	Closing force	x	—	—	—	—	—
7.6.5	Sealing force	x	—	—	—	—	—
7.6.3	Delay time and opening time	x	x	x	x	x	—
7.6.1	Closing function	x	—	—	x	x	—
7.6.4	Closing time	x	x	x	x	x	—
7.7.2.3	Rated flow rate[b]	x	x	x	x	x	x
7.2.4	Pressure surge test[b]	—	x	x	—	—	—
6.2.11.1	VI	x	x	x	x	x	—
6.2.11.2	CPS	x	x	x	x	x	—
6.2.11.3	POC	x	x	x	x	x	—

[a] The leak-tightness test needs to be performed after each temperature change (min, ambient, max); see 7.7.2.2.

[b] This test can be performed before the endurance test.

7.7.2.2 Endurance test

Before and after each endurance test, the leak-tightness test (7.2.3) shall be carried out according to Table 5 and 6.

Connect the gas inlet to an air supply at the maximum operating pressure. Do not exceed 10 % of the maximum rated flow rate.

Operate the valve to the number of cycles given in Table 7. Ensure that the valve travels to the fully open and fully closed position during each cycle.

Where the valve has a hydraulic or pneumatic actuating mechanism, carry out the endurance test at the maximum actuating pressure.

Check the operation of the valve throughout the endurance test, for example by recording the outlet pressure or the flow rate.

For C/I valves, one sample shall be subjected to the test. If the manufacturer builds the same basic valve in a range of pipe sizes, this test shall be performed on the largest size.

For a C/I valve, air or nitrogen is maintained at the maximum rated inlet pressure to the inlet of the valve and a minimum pressure drop of 0,25 kPa maintained across the valve when the valve is in the fully open position. If the C/I valve incorporates a CPS or POC switch, they shall be connected to an electric load, which makes and breaks its declared maximum electrical rating on each cycle.

A C/I valve shall be cycled between 6 and 10 cycles per minute unless the manufacturer specifies a slower rate. The rate shall in no case be less than 2 cycles per minute unless the inherent design of the valve results in a slower rate. If inherent design results in a rate exceeding 10 cycles per minute the test may be performed at this increased rate. The C/I valve shall not exhibit any sticking or become inoperative.

7.7.2.3 Rated flow rate test

For valves with modulating control, test the valve for opening to the lowest set point as declared by the manufacturer and to the mid-point in the closing direction according to 7.4.2.

For valves with step control, test the valve for opening and closing to the mid-point of the adjustment range for each step according to 7.4.2.

7.8 Vibration

Shall be according to ISO 23550:2018, 7.8.

8 Electrical requirements

8.1 General

Shall be according to ISO 23550:2018, 8.1.

8.2 Requirements

Shall be according to ISO 23550:2018, 8.2 with the following modification:

The electrical equipment shall conform to the relevant requirements of IEC 60730-1:2022, Clauses 6, 7, 8, 9.1, 9.2, 9.7.2, 9.8, 9.9, 9.10, 9.11.1, 9.11.2, 9.11.4, 9.11.5, 9.11.7, 9.12, 15.1, 15.2, 16, 20.1, 20.2, 20.4, 20.9, 10, 11, 21, 12, 26.1.1 and 27.

8.3 Test

Shall be according to ISO 23550:2018, 8.3, with the following modification:

The first sentence is not applicable.

8.4 Protection by enclosure

ISO 23550:2018, 8.4, is replaced by the following:

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