International Standard

ISO 23551-1

Third edition
2024-11

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

Part 1: Automatic and semi-automatic shut-off valves

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

Partie 1: Robinets automatiques et semi-automatiques

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Foreword

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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).

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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*.

This third edition cancels and replaces the second edition (ISO 23551-1:2012), which has been technically revised.

The main changes are as follows:

— definitions for specific valve types have been updated and a flow chart for valve types has been added (Clause 3, Table 1);

— the classification of the valve types has been restructured, including the addition of a new classification Class E and the definition of valves without safety shut-off function as general purpose valve Class D (Clause 4);

— common requirements and tests for specific valve types have been summarized in tabular form (see Tables 1 and 2);

— visual indicator (VI), closed position switch (CPS) and proof of closure switch (POC) have been summarized in 6.2.11;

— the endurance test has been restructured, with the assignment of the test cycles and tests summarized in tabular form (see Tables 4, 5 and 6);

— a hydrostatic withstand pressure test has been added;

— a resistance to permanent damage at excessive supply pressure test has been added;

— the document has been updated to align technically and with the revised format of the latest edition of ISO 23550;

— specific regional requirements that were previously contained in regional Annexes have been moved into the main body of the text;

— the document has been updated to align with the application of Electromagnetic compatibility (EMC) testing from IEC 60730-2-17 (withdrawn 2017-02-20 and replaced by ISO 23551-1);

— the document has been updated and aligned with IEC 60730-1:2022.

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 and that are not already covered by ISO 23550, this document contains certain 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 and B. 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 1:
Automatic and semi-automatic shut-off valves

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, hereinafter referred to as valves.

This document applies to normally closed valves and general purpose valves mounted upstream to gas burners and gas appliances with declared maximum operating pressures up to and including 500 kPa, for use on burners or in appliances using fuel gases such as natural gas, manufactured gas or liquefied petroleum gas (LPG). It is not applicable to corrosive and waste gases.

This document applies to:

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

— valves actuated by hydraulic or pneumatic means;

— 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.

This document covers type testing only.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23550 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 Terms related to valves

3.1.1
valve
device consisting essentially of a valve body, closure member and *valve actuator* (3.2.18) that controls the flow of gas

Note 1 to entry: The valve actuation can be achieved by gas pressure, electrical, hydraulic, manual or pneumatic energy.

Note 2 to entry: See Figure 1.

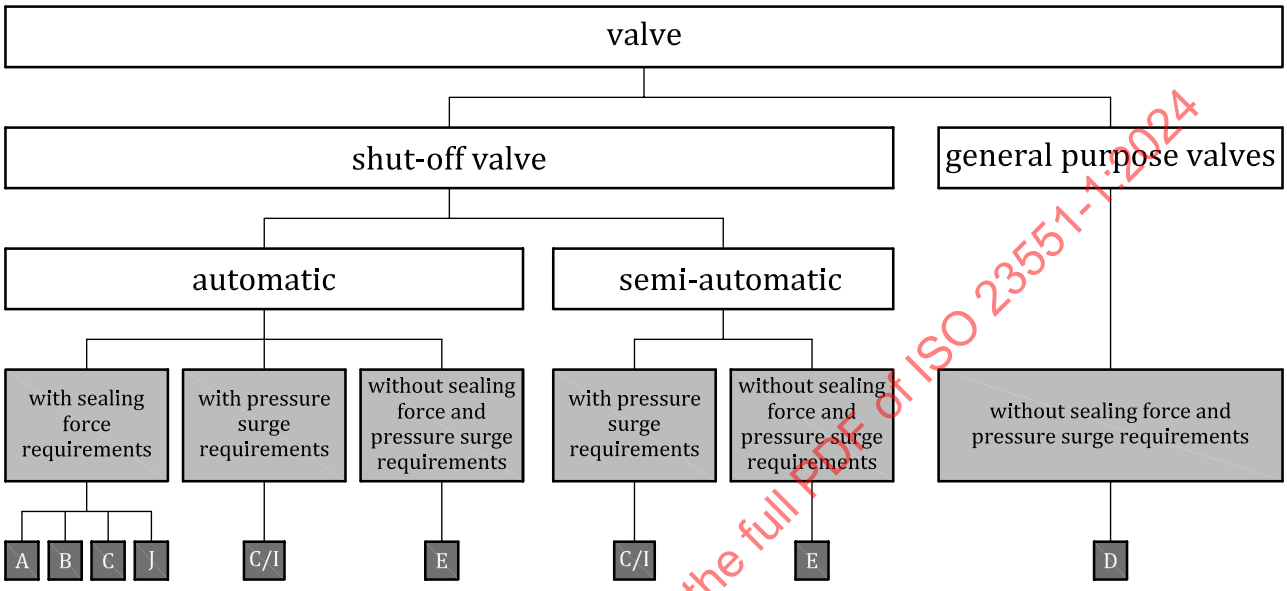


Figure 1 — Valve type flow chart

3.1.2
semi-automatic shut-off valve
valve (3.1.1) that is opened manually and closes automatically upon removal of the *actuating energy* (3.2.2)

Note 1 to entry: See Figure 1.

3.1.3
automatic shut-off valve
valve (3.1.1) which opens when energized and closes automatically when de-energized

Note 1 to entry: See Figure 1.

3.1.4
C/I valve
commercial/industrial valve
normally closed *automatic* or *semi-automatic shut-off valve* (3.1.3; 3.1.2) having an operating pressure of 3,5 kPa or greater

Note 1 to entry: See Figure 1.

3.1.5
general purpose valve
valve (3.1.1) intended to control the flow of gas that does not provide a shut-off function

Note 1 to entry: A combination of a general purpose valve and a shut-off valve is primarily considered as a shut-off valve.

Note 2 to entry: See Figure 1.

3.1.6
thermoelectric valve
semi-automatic shut-off valve (3.1.2) that receives its electrical actuating energy by means of a thermoelectric source

Note 1 to entry: Not applicable for *C/I valves* (3.1.4).

Note 2 to entry: See Figure 1.

3.1.7
diaphragm type valve
automatic shut-off valve (3.1.3) where a closing member is opened by application of gas pressure upon a flexible diaphragm

Note 1 to entry: See Figure 1.

3.1.8
valve with step control
multi-stage valve
valve (3.1.1) which controls the flow rate in steps

Note 1 to entry: See Figure 1.

3.1.9
valve with modulating control
modulating valve
valve (3.1.1) which controls the flow rate continuously between two limits in response to external signals

Note 1 to entry: See Figure 1.

3.2 General terms

3.2.1
actuating mechanism
part of the *valve* (3.1.1) which moves the closure member to the open position

3.2.2
actuating energy
required energy for the *actuating mechanism* (3.2.1) to move the closure member to the open position

Note 1 to entry: The actuating energy may have an external source (electrical, hydraulic or pneumatic) and can be transformed inside the *valve* (3.1.1).

3.2.3
closing force
force available to close the *valve* (3.1.1), independent of any force provided by gas pressure

3.2.4
sealing force
force acting on the *valve* (3.1.1) seat when the closure member is in the closed position, independent of any force provided by gas pressure

3.2.5
frictional force
largest force required to move the *actuating mechanism* (3.2.1) and the closure member from the open position to the closed position with the closure spring removed, independent of any force provided by gas pressure

3.2.6
actuating pressure
hydraulic or pneumatic pressure supplied to the *actuating mechanism* (3.2.1) of the *valve* (3.1.1)

3.2.7
opening time
time interval between energizing the *valve* (3.1.1) and the attainment of the maximum or other defined flow rate

3.2.8
closing time
time interval between de-energizing the *valve* (3.1.1) and the closure member attaining the closed position

3.2.9
delay time
time interval between energizing the *valve* (3.1.1) and the start of flow

3.2.10
control valve
valve (3.1.1) which controls the hydraulic or pneumatic means supplied to the *actuating mechanism* (3.2.1)

3.2.11
rated voltage
voltage declared by the manufacturer at which the *valve* (3.1.1) may be operated

3.2.12
rated current
current declared by the manufacturer at which the *valve* (3.1.1) may be operated

3.2.13
bypass
passage, provided in the body of the device or in a gas line around the body, which permits a gas flow from the inlet to the outlet connections of the device entirely independent of the action of the *valve* (3.1.1)

3.2.14
interlock
control or device to prove the physical state of a required condition, and to furnish proof to the automatic gas ignition system or other safety control circuit

3.2.15
proof of closure switch
POC
electrical switch which monitors the closed position of the *valve* (3.1.1) closure member, and which is used as an *interlock* (3.2.14)

3.2.16
closed position switch
CPS
switch fitted to a *valve* (3.1.1) which indicates when the closure member is in the closed position, and which is used as an *interlock* (3.2.14)

Note 1 to entry: For certain applications, a CPS is also known as a closed position indicator (CPI) switch.

3.2.17
switching element
electrical switch actuated by the *valve actuator* (3.2.18) and used as an electrical output

3.2.18
valve actuator
electrically operated mechanism (for example an electric motor or stepping solenoid), an electro-thermal device (for example the heating element of an energy regulator) or a mechanical device, used to effect the operation of a *valve* (3.1.1)

3.2.19
balanced valve with two ports
valve (3.1.1) with a balanced closure member, two valve discs and two valve seats where the inlet pressure acts on the closure member in the closing direction

Note 1 to entry: Examples are shown in Figure 2.

3.2.20
balanced valve with one port
valve (3.1.1) with a balanced closure member, one valve disc and balancing means where the inlet pressure acts on the closure member in the closing direction

Note 1 to entry: An example is shown in Figure 3.

3.2.21
hydrostatic withstand pressure
pressure resistance
pressure which acts on the pressure carrying parts of a *valve* (3.1.1) under an abnormal overpressure condition

Note 1 to entry: Functional properties are not considered.

4 Classification

4.1 Classes of control

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, B, C or J (see Tables 1, 2, 4 and 6).

These valves may also have:

— modulating control function, or

— step control function/multi-stage.

4.1.2 Classification based on pressure surge

Subclause specific to this document.

Automatic and semi-automatic shut-off valves with pressure surge requirements shall be designated according to Class C/I (see 3.1.4 and Tables 1, 2, 4 and 6).

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, 2, 4 and 6).

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, 2, 4 and 6).

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 functions

Shall be according to ISO 23550:2018, 4.4.

5 Test conditions and tolerances

Shall be according to ISO 23550:2018, Clause 5.

6 Construction

6.1 General

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

Table 1 describes the applicable construction requirements and tests for the classified valves. Combinations of valve types are not excluded (e.g. automatic Class A and automatic C/I). 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 such 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				auto-matic	semi-au-tomatic	auto-matic	semi-au-tomatic	
		A	B	C	J	C/I	C/I	E	E	D
6.2	Construction requirements									
6.2.1	Appearance	x	x	x	x	x	x	x	x	x
6.2.2	Holes	x	x	x	x	x	x	x	x	x
6.2.3	Breather holes	x	x	x	x	x	x	x	x	x
6.2.4	Vent limiter	x	x	x	x	x	x	x	x	x
6.2.5	Screwed fastenings	x	x	x	x	x	x	x	x	x
6.2.6	Moving parts	x	x	x	x	x	x	x	x	x
6.2.7	Sealing caps	x	x	x	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	x	x	x
6.2.9	Auxiliary channels and orifices	x	x	x	x	x	x	x	x	x
6.2.10	Pre-setting device	x	x	x	x	x	x	x	x	x
6.2.11	Closed position indication	x	x	x	x	x	x	x	x	—
6.2.12	Specific construction	x	x	x	—	x	x	—	—	—
6.2.13	Flow rates of valves with modulating control	x	x	x	x	x	x	x	x	x
6.2.14	Bypass	x	x	x	x	x	x	x	x	—
6.2.15	Semi-automatic shut-off valve	—	—	—	—	—	x	—	x	—
6.2.16	Diaphragm type valve	x	x	x	x	x	x	x	x	x
6.2.17	Balanced valves with one or two ports	x	—	—	—	—	—	x	x	x
6.3	Materials	x	x	x	x	x	x	x	x	x
6.4	Connections	—	—	—	—	—	—	—	—	—
6.4.1	General	x	x	x	x	x	x	x	x	x
6.4.2	Connection sizes	x	x	x	x	x	x	x	x	x
6.4.3	Connection types	x	x	x	x	x	x	x	x	x
6.4.4	Threads	x	x	x	x	x	x	x	x	x
6.4.5	Union joints	x	x	x	x	x	x	x	x	x
6.4.6	Flanges	x	x	x	x	x	x	x	x	x
6.4.7	Compression fittings	x	x	x	x	x	x	x	x	x
6.4.8	Flare connections	x	x	x	x	x	x	x	x	x
6.4.9	Nipples for pressure tests	x	x	x	x	x	x	x	x	x
6.4.10	Strainers	x	x	x	x	x	x	x	x	x
6.4.11	Gas connections by GQC	x	x	x	x	x	x	x	x	x
6.4.12	Hydraulic and pneumatic actuating mechanisms	x	x	x	x	x	x	x	x	x
6.5	Gas controls employing electrical components in the gas way	x	x	x	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

Shall be according to ISO 23550:2018, 6.2.2.

6.2.3 Breather holes

Shall be according to ISO 23550:2018, 6.2.3.

6.2.4 Vent limiter

Shall be according to ISO 23550:2018, 6.2.4

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 addition:

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 done 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 closure. 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 it 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 gas pressure or 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 the valve meets the requirement 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 Diaphragm type valve

Subclause specific to this document.

Parts of the valve coming in contact with the diaphragm shall not have sharp edges which can chafe or abrade it.

6.2.17 Balanced valves with one or two ports

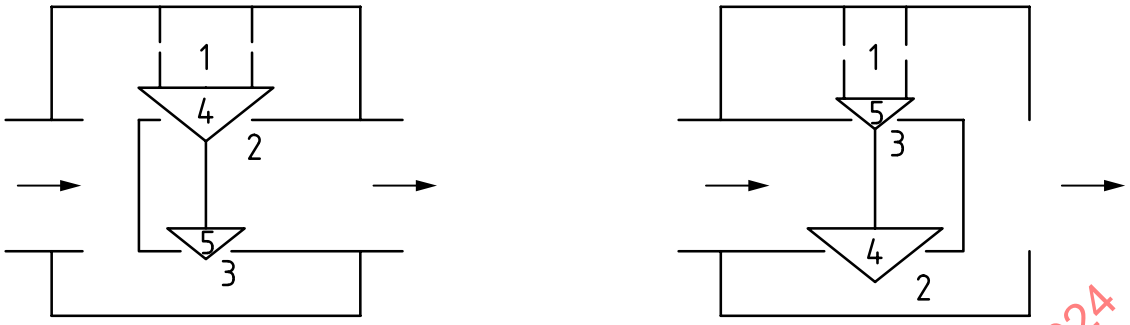
Subclause specific to this document.

6.2.17.1 General

The closure member of a balanced valve with one or two ports (see 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.

For a balanced valve with one port, 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.

Examples are shown in Figure 2 and Figure 3.

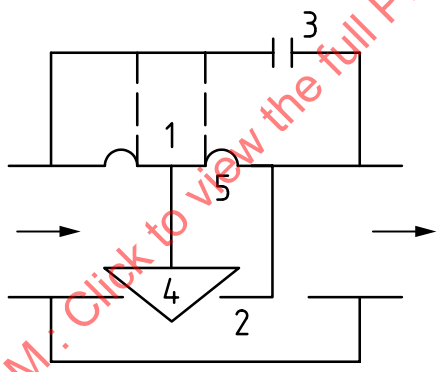


a) Example 1 **b) Example 2**

Key

1 spring
2 valve seat (large)
3 valve seat (small)
4 valve disc (large)
5 valve disc (small)

Figure 2 — Balanced valve with two ports



Key

1 spring
2 valve seat
3 breather hole[a]
4 valve disc
5 compensating diaphragm (smaller than the valve seat)

[a] Breather hole as bypass to valve port is not allowed.

Figure 3 — Balanced valve with one port

6.2.17.2 Additional requirements for shut-off function

6.2.17.2.1 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 6.2.17.2.2.

6.2.17.2.2 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:

When a diaphragm separates parts of the housing from the gas-carrying compartment from atmosphere, then it is considered to be indirectly separated. These parts shall be made from metallic material.

For C/I valves, the body and its internal parts, except the soft part of valve disk, gasket, O-rings and similar shall be of material having melting points not less than 427 °C.

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.

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

Shall be according to ISO 23550:2018, 6.3.5.

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.

6.4 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

Shall be according to ISO 23550:2018, 6.4.4, with the following addition:

C/I valves up to a size of DN 80 may have thread or flange connection.

6.4.5 Union joints

Shall be according to ISO 23550:2018, 6.4.5.

6.4.6 Flanges

Shall be according to ISO 23550:2018, 6.4.6, with the following addition:

Threaded connections shall not be used on valves larger than DN 80.

6.4.7 Compression fittings

Shall be according to ISO 23550:2018, 6.4.7 with the following addition to ISO 23550:2018, 6.4.7.1:

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.

6.4.8 Flare connections

Shall be according to ISO 23550:2018, 6.4.8 with the following addition:

Flare connections shall not be used on C/I valves.

6.4.9 Nipples for pressure tests

Shall be according to ISO 23550:2018, 6.4.9 with the following addition:

Nipples shall not be used on C/I valves.

6.4.10 Strainers

Shall be according to ISO 23550:2018, 6.4.10, with the following addition:

Class J valves shall incorporate an inlet strainer. The maximum strainer hole dimension shall not exceed 0,28 mm and it shall prevent the passage of a 0,2 mm diameter pin gauge.

Strainers fitted to valves of DN 25 and above shall be accessible for cleaning or replacement without removing the valve body pipe connections from the pipe work.

6.4.11 Gas connections by GQC

Shall be according to ISO 23550:2018, 6.4.11 with the following addition:

Gas connection by GQC shall not be used on C/I valves.

6.4.12 Hydraulic and pneumatic actuating mechanisms

Subclause specific to this document.

Hydraulically or pneumatically actuated valves shall be provided with protection to ensure that the blockage of an orifice in the control system does not adversely affect the ability of the valve to close.

6.5 Gas controls employing electrical components in the gas way

Shall be according to ISO 23550:2018, 6.5.

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.

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

Table 2 describes the applicable performance requirements and tests for the classified valves. Combinations of valve types are not excluded (e.g. automatic Class A and automatic C/I).

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 such 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 2 — Assignment of valve performance requirements and tests

Clause	Title	Shut-off valve (Classes)								General purpose valve
		automatic				auto-matic	semi-auto-matic	automatic	semi-auto-matic	
		A	B	C	J	C/I	C/I	E	E	D
7.2	Leak-tightness									
7.2.1	General	x	x	x	x	x	x	x	x	x
7.2.2	Requirement	x	x	x	x	x	x	x	x	x
7.2.3	Test	x	x	x	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	x	x	x
7.4	Rated flow rate	x	x	x	x	x	x	x	x	x
7.5	Durability	x	x	x	x	x	x	x	x	x
7.6.1	Closing function	x	x	x	x		—	x	x	—
7.6.1.2	Requirement 1	—	—	—	—	—	—	x	x	—
7.6.1.3	Test method 1	—	—	—	—	—	—	x	x	—
7.6.1.4	Requirement 2	x	x	x	x	—	—	—	—	—
7.6.1.5	Test method 2	x	x	x	x	—	—	x	—	—
7.6.2	Opening and closing function of thermoelectric valves	—	—	—	—	—	—	—	x	—
7.6.3	Closing force	x	x	x	x	x	x	x	x	
7.6.4	Delay time and opening time	x	x	x	x	—	—	—	—	—
7.6.5	Closing time	x	x	x	x	$x^{C/I}$	$x^{C/I}$	x	x	—
7.6.6	Sealing force	x^{A}	x^{B}	x^{C}	x^{J}	—	—	—	—	—
7.6.7	Gas cracking	x	x	x	x	x	x	x	x	x
7.7	Endurance	x	x	x	x	x	x	x	x	x
7.8	Hydrostatic withstand pressure test	x	x	x	x	x	x	x	x	x
7.9	Resistance to permanent damage at excessive supply pressure	x	x	x	x	—	—	x	x	x

Key

x required only if present in the valve design

— no performance test required

7.2 Leak-tightness

7.2.1 General

Shall be according to ISO 23550:2018, 7.2.1.

7.2.2 Requirements

Shall be according to ISO 23550:2018, 7.2.2.

7.2.3 Test

Shall be according to ISO 23550:2018, 7.2.3.

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-minute test period.
3) Using accumulated total leakage from above, calculate an equivalent leakage rate per hour.
4) The test shall be repeated 5 times and the highest internal leakage for any one test shall not exceed the leakage allowed in ISO 23550:2018, 7.2.2, when tested according to ISO 23550:2018, 7.2.3.

7.3 Torsion and bending

Shall be according to ISO 23550:2018, 7.3.

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:

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 in accordance with 7.4.3.

When the flow rate changes in response to external electrical signals, it shall not, when tested in accordance with 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 on 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 on reducing the voltage or current to 15 % of the minimum rated value. Shut-off valves with hydraulic or pneumatic actuating mechanisms shall close automatically on reducing the voltage or current to 15 % of the minimum rated voltage of the control valve. Shut-off valves shall close automatically on removal of the voltage or current of between 15 % of the minimum rated value and the maximum rated value increased by the tolerance according to 7.1.

In all cases, the closing time shall be in accordance with 7.6.6.

Specific requirements for Japan shall be as specified in Annex B.

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 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. Conduct 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 Opening and closing function of thermoelectric valves

7.6.2.1 General

The manufacturer shall specify the range of the drop-out, and if applicable, the pull-in current of a thermoelectric valve.

7.6.2.2 Requirement

For a thermoelectric valve, the drop-out current, and if applicable, the pull-in current shall be within the manufacturer's specified range.

7.6.2.3 Test

A direct current power source of appropriate voltage in series with an ammeter shall be used. Each device shall be tested 3 times under each of the following test conditions, as applicable. For automatic pull-in devices, the current shall be set below the manufacturer's specified pull-in current. The current shall be slowly increased. The current at which the device pulls in, shall not be less than the minimum or greater than the maximum value specified by the manufacturer. The current shall be set at the manufacturer's specified maximum operating current. The resetting mechanism, if provided, shall be operated in accordance with the manufacturer's instructions. The current at which the valve drops out shall not be less than the minimum or greater than the maximum value specified by the manufacturer.

7.6.3 Closing force

7.6.3.1 General

This test is applicable to valves where the sealing force is independent of the closing force (e.g. ball valve, gate valve, etc.) and to disc-on-seat valves with a maximum operating pressure above 50 kPa.

7.6.3.2 Requirement

Valves with a sealing force independent of the closing force 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;

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

7.6.3.3 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.

7.6.4 Delay time and opening time

7.6.4.1 General

The opening time for valves, including those that incorporate a delay time to open, shall not exceed the limits specified in 7.6.4.2.

7.6.4.2 Requirement

The delay time and the opening time shall be:

— within ±20 % of the manufacturer's declared value for times above 1 s;

— less than 1 s for declared times up to and including 1 s.

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

7.6.4.3 Test

Opening time: Measure the time interval between energizing the valve and the attainment of a flow rate equal to 80 % of the rated flow rate.

This test is also used to measure the time interval between energizing the valve and the start of the release of the closure member (delay time).

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

— at 60 °C (or at the maximum ambient temperature, if higher):
  — at the maximum operating pressure,
  — at 110 % of the maximum rated voltage or current, and
  — at the maximum actuating pressure, if applicable;
— at 0 °C (or at the minimum ambient temperature, if lower):
  — at an operating pressure of 0,6 kPa,
  — at 85 % of the minimum rated voltage or current, and
  — at the minimum actuating pressure, if applicable.

7.6.5 Closing time

7.6.5.1 General

The closing time for valves shall not exceed those specified in 7.6.5.2, as applicable.

7.6.5.2 Requirement

The closing time for valves of Classes A, B and C shall not exceed 1 s when tested according to 7.6.5.3.

The closing time for Class J valves shall not exceed 5 s or any lower value declared by the manufacturer.

The closing time for C/I and Class E valves shall not exceed 2 s. The test in 7.6.5.3 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.

7.6.5.3 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 operating 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 an inlet pressure of 600 Pa,
- 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.

The test shall be performed at ambient temperature for valves with a declared minimum temperature of 0 °C or at the minimum 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 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.

7.6.6 Sealing force

7.6.6.1 General

Valves shall be subjected to the sealing force test, as applicable.

7.6.6.2 Requirement

Class A, B and C valves shall have a minimum sealing force over the closure member orifice area in accordance with Table 3 when tested according to 7.6.6.3.

Table 3 — Sealing force requirements

Valve	Test pressure kPa	Maximum leakage rate
Class A	15	For the values for internal leak-tightness, see ISO 23550:2018, Table 4.
Class B	5	
Class C	1	

Class J valves shall have a minimum sealing force of 1 N for every metre length of seal. This is calculated from the spring force in the closed position of the valve divided by the circumference or length of the seal. The spring compression shall be declared by the manufacturer.

For balanced valves with two ports, the force of the closing spring shall be calculated to be at least 50 % of the total opening area multiplied by 15 kPa multiplied by 1,25. The test pressure opposing the flow direction for balanced valves with two ports is 30 kPa.

Balanced valves with one port shall have a minimum sealing force over the closure member port area according to the declared class in accordance with Table 3. This sealing force shall be provided only by the closing spring and shall be tested in accordance with 7.6.6.3.

Where the test methods in 7.6.7.3 are unsuitable for some designs of valve, the sealing force shall be verified by calculation or by a combined method of test and calculation. The minimum sealing force is calculated using pressures equal to 1,25 times the values given in Table 3, as appropriate to the class of valve.

7.6.6.3 Test

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

For Class A, B and C valves, slowly pressurize the valve (from 0 to maximum within 15 s ± 5 s) to the appropriate pressure given in Table 3 and measure the leakage rate after the test system is stabilized.

For balanced valves with two ports, slowly pressurize the valve (from 0 to maximum within 15 s ± 5 s) to the appropriate pressure given in 7.6.7.2 and measure the leakage rate after the test system is stabilized.

For J valves, remove the spring(s) providing the sealing force and measure the spring force at a spring compression corresponding to the closed position of the valve.

7.6.7 Gas cracking

7.6.7.1 General

This test applies to valves containing electrical components in the gas way.

7.6.7.2 Requirement

Carbon shall not be deposited within thermoelectric valves containing electrical components in the gas way when operated on an easily cracked gas for 48 h at elevated temperatures.

7.6.7.3 Test

Two sample valves shall be operated in a suitable test oven at the manufacturer's maximum specified operating temperature (but not less than 60 °C) and shall be continuously energized at 110 % of rated voltage. Pure (99 %) isobutylene shall be passed through each valve at a rate of approximately 880 W/h. After 48 h of operation, the sample valves shall be removed from the oven, dismantled, and examined for carbon deposit.

There shall be no visible carbon deposit within the valve bodies.

7.7 Endurance

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

7.7.1 Requirements

The test cycles for the specific valve types are given in Table 4 and Table 5.

Tables 4 and 5 describes the applicable number of endurance cycles for each of the valve classes. An explanation of the method for calculating the number of cycles to be done at ambient, minimum and/or maximum temperatures is included in at the end of Table 4.

Table 4 — Operating cycles for endurance test

	Shut-off valve (Classes)						General purpose valves
	automatic		automatic	semi-automatic	automatic	semi-automatic	
Valve sizes	A | B | C | J		C/I	C/I	E	E	D
DN ≤ 25 & opening time ≤ 1 s & maximum operating pressure ≤ 15 kPa	(1) **500 000** (2) 25 000 (3) 400 000 (4) 100 000						
DN ≤ 25 & opening time ≤ 1 s & maximum operating pressure > 15 kPa, or DN ≤ 25 & opening time > 1 s	(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) 12 500 (3) 37 500 (4) 12 500						
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 < 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 the value (2) CR at T_{min}.

(4) (CR at T_{max}) cycle rate at maximum temperature 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 25 < DN < 80 for Class A valve; declared for temperatures from 0 °C to 50 °C.

Test cycles:

(2) zero cycles at minimum temperature because the declared temperature is not < 0 °C.

(3) 75 000 cycles at ambient temperature.

(4) 25 000 cycles at maximum temperature 50 °C.

Total number of cycles: (1) = (2) + [(3) – (2)] + (4) = 0 + [(75 000 – 0)] + 25 000 = 100 000

EXAMPLE 2: Valve size 25 < DN < 80 for Class B valve; declared for –20 °C to 50 °C.

Test cycles:

(2) 25 000 cycles at minimum temperature –20 °C.

(3) 75 000 cycles at ambient temperature.

(4) 25 000 cycles at maximum temperature 50 °C.

Total number of cycles: (1) = (2) + [(3) – (2)] + (4) = 25 000 + [(75 000 – 25 000)] + 25 000 = 100 000

Table 5 — Operating cycles for automatic shut-off valves for cookers

Nominal size	Number of cycles at:	
DN	Maximum ambient temperature according to 7.1	(20 ± 5) °C
DN ≤ 25 Opening time ≤ 1 s maximum operating pressure ≤ 15 kPa	800 000	200 000

7.7.2 Test

7.7.2.1 Test sequence

Tests should be carried out in the sequence as described in Table 6 before the endurance test in 7.7.2.4. The tests as described in Table 7 shall be carried out after the endurance test described in 7.7.2.4.

The marking "x" in Table 6 identifies the relevant test to be conducted for each valve class.

Table 6 — Test sequence before endurance test

Test	Test description	Shut-off valve (Classes)								General purpose valves
		automatic				auto-matic	semi-auto-matic	auto-matic	semi-auto-matic	
		A	B	C	J	C/I	C/I	E	E	D
8.3	Dielectric strength test	x	x	x	x	—	—	x	x	x
7.7.2.2	Voltage drop-out test	x	x	x	x	—	—	—	—	—
7.2	Leak-tightness[a]	x	x	x	x	x	x	x	x	x (only external)
7.6.1	Closing function	x	x	x	x	—	—	x	x	—
7.6.5	Closing time	x	x	x	x	—	—	x	x	—
7.3	Torsion and bending	x	x	x	x	x	x	x	x	x

[a] The leakage test needs to be performed after each temperature change (min, ambient, max); see 7.7.2.4.

The marking "x" in Table 7 identifies the relevant test to be conducted for each valve class.

Table 7 — test sequence after endurance test

Test	Test description	Shut-off valve (Classes)								General purpose valves
		automatic				auto-matic	semi-auto-matic	auto-matic	semi-auto-matic	
		A	B	C	J	C/I	C/I	E	E	D
7.2	Leak-tightness[a]	x	x	x	x	x	x	x	x	x (only external)
7.6.3.3	Closing force	—	—	—	—	x	x	—	—	—
7.6.6	Sealing force	x	x	x	x	—	—	—	—	—
7.7.2.1	Voltage drop out test	x	x	x	x	—	—	—	—	—
7.6.4.3	Delay time and opening time	x	x	x	x	—	—	—	—	—

[a] The leakage test needs to be performed after each temperature change (min, ambient, max); see 7.7.2.4.

Table 7 *(continued)*

Test	Test description	Shut-off valve (Classes)								General purpose valves
		automatic				auto-matic	semi-auto-matic	auto-matic	semi-auto-matic	
		A	B	C	J	C/I	C/I	E	E	D
7.6.1	Closing function	x	x	x	x	—	—	x	x	—
7.6.5	Closing time	x	x	x	x	x	x	x	x	—
7.7.2.3	Rated flow rate	x	x	x	x	x	x	x	x	x
7.2.4	Pressure surge test	—	—	—	—	x	x	—	—	—
6.2.11.1	VI	x	x	x	x	x	x	x	x	—
6.2.11.2	CPS	x	x	x	x	x	x	x	x	—
6.2.11.3	POC	x	x	x	x	x	x	x	x	—
[a] The leakage test needs to be performed after each temperature change (min, ambient, max); see 7.7.2.4.										

7.7.2.2 Voltage drop-out test

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.

7.7.2.3 Rated flow rate test

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

7.7.2.4 Endurance test

Before and after each endurance test, the leak-tightness test (7.2.3) shall be carried out according to ISO 23550:2018, Table 3 and Table 4.

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 Tables 4 and 5. 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 C/I valves, 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 not be less than two cycles per minute in any case 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.

7.8 Hydrostatic withstand pressure test

Subclause specific to this document.

7.8.1 General

All pressure-carrying parts of a valve exposed to gas pressure under normal operating conditions, except a diaphragm, shall be subjected to the following hydrostatic withstand pressure test.

7.8.2 Requirements

Valves shall withstand a hydrostatic pressure equal to the declared maximum operating pressure multiplied by the minimum safety factor.

The minimum safety factor shall be 5 for all valves with a declared maximum operating pressure of 50 kPa or less and constructed of any material.

The minimum safety factor for valves with a declared maximum operating pressure greater than 50 kPa, shall be according to Table 8, and based on the material used.

Table 8 — Minimum 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
Other as declared by the manufacturer	5,00
NOTE For cast aluminium, A_{min} is the minimum percentage elongation after fracture (according to the applicable document) relevant to the chosen material.	

7.8.3 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 tensing whilst the test is being conducted.

The test is carried out with the valve in the fully open position and with the valve and hydraulic fluid at ambient temperature.

The inlet and outlet of the valve shall be connected to a suitable hydraulic system and the pressure gradually increased to the test pressure as determined in 7.8.2 and held for 1 min. Alternatively, the test may be carried out with air or nitrogen at ambient temperature using a suitable pneumatic test system if the necessary safety measures are taken.

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 and the valve shall conform to the external leak-tightness test according to 7.2.2, at ambient temperature only.