



International
Standard

ISO 23555-3

**Gas pressure safety and control
devices for use in gas transmission,
distribution and installations for
inlet pressures up to and including
10 MPa —**

**Part 3:
Safety shut-off devices**

*Dispositifs de commande et de sécurité de la pression de gaz
destinés à être utilisés dans les installations de transport, de
distribution et de stockage de gaz pour des pressions en entrée
jusqu'à 10 MPa inclus —*

Partie 3: Dispositifs d'arrêt de sécurité

**First edition
2024-06**

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Published in Switzerland

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO 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*.

A list of all parts in the ISO 23555 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 23555-1 and it applies to the specific control covered by this document.

Where necessary, this document builds on the provisions of ISO 23555-1 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 requirements that are specific to this document and that are not already covered by ISO 23555-1, this document contains certain clauses or subclauses that are additional to the structure of ISO 23555-1. These subclauses are indicated by the introductory sentence: “Subclause (or Annex) specific to this document.”.

To ensure the 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.

This document is intended to provide a basic framework of requirements.

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Gas pressure safety and control devices for use in gas transmission, distribution and installations for inlet pressures up to and including 10 MPa —

Part 3: Safety shut-off devices

1 Scope

This document specifies safety, constructional, performance, testing and documentation requirements of gas safety shut-off devices (SSDs).

This document is applicable to SSDs with operating pressures greater than 500 kPa (5 bar¹⁾) up to 10 MPa (100 bar) of nominal connection sizes up to and including DN 400 for use with fuel gases such as natural gas, manufactured gas, biomethane or liquefied petroleum gas (LPG) in commercial industrial installations, including fuel gas infrastructures.

This document is applicable to SSDs for an operating temperature range from –20 °C to +60 °C;

This document is applicable to:

- test methods which are intended for product type tests, routine tests and batch surveillance tests;
- SSDs which use the pipeline gas as a source of control energy unassisted by any external power source;
- SSDs integrating on the same body a second SSD, conforming to the requirements in this document;
- SSDs integrating a gas pressure regulator conforming to ISO 23555-2;
- SSDs incorporating a creep (venting) relief device and/or a vent limiter conforming to the requirements in this document;

This document does not apply to:

- SSDs upstream from/on/in domestic gas-consuming appliances which are installed downstream of domestic gas meters;
- SSDs designed to be incorporated into pressure control systems used in service lines (pipework from the main pipework in a gas infrastructure to the point of delivery of the gas) with declared volumetric flow rate $\leq 200 \text{ m}^3/\text{h}$ (n);
- industrial process control valves on/off type (see IEC 60534 for information on the design, classification and tests for this type of valve);

NOTE Such valves cannot be declared conformant to this document.

- SSDs used in sour gas environments (gas environments containing water and H₂S are considered sour) or corrosive conditions;
- SSDs in service conditions with waste gases (e.g. biogas etc.), if additional information is not provided (e.g. contaminant, liquid etc.).

1) 1 bar = 0,1 MPa = 10⁵ Pa; 1 MPa = 1 N/mm².

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 23555-1, *Gas pressure safety and control devices for use in gas transmission, distribution and installations for inlet pressures up to and including 10 MPa — Part 1: General requirements*

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

IEC 60534-4:2006, *Industrial-process control valves - Part 4: Inspection and routine testing*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 23555-1 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 Terms and definitions

3.1.1 Terms related to safety shut-off devices in general

3.1.1.1

gas safety shut-off device

device whose function is to stay in the open position under normal operating conditions and to shut-off the gas flow automatically and completely when the monitored pressure exceeds the pre-set values (over-pressure monitoring and/or under-pressure monitoring)

3.1.1.2

direct acting gas safety shut-off device

safety shut-off device (SSD) in which the pressure-detecting element is directly connected to the trip mechanism

Note 1 to entry: See [Figure 1](#).

3.1.1.3

indirect acting gas safety shut-off device

safety shut-off device (SSD) without mechanical connection between the pressure detecting element and the trip mechanism and where (pressure) energy from an internal or external source is used for activating the trip mechanism and moving the closing element

Note 1 to entry: See [Figures 2, 3](#) and [4](#).

3.1.1.4

gas cut-off device

safety shut-off device (SSD) designed to shut off the gas flow, which responds dynamically slower than a slam shut device when the monitored pressure exceeds the pre-set values

3.1.1.5

gas slam shut device

safety shut-off device (SSD) designed to quickly shut off the gas flow when the monitored pressure exceeds the pre-set values

EXAMPLE Spring or weight-loaded SSD.

3.1.1.6

auxiliary pressure source

energy coming from pressure of the system (internal energy) or from any external source (compressed air or gas)

3.1.2 Terms related to components of safety shut-off devices

3.1.2.1

closing member

part which shuts off the gas flow completely

3.1.2.2

trip mechanism

mechanism which releases the closing member when activated by the controller

3.1.2.3

actuator

device activated by the trip mechanism which shuts the closing member

3.1.2.4

relatching device

device which enables the complete opening of the safety shut-off device (SSD)

3.1.2.5

controller

device which includes:

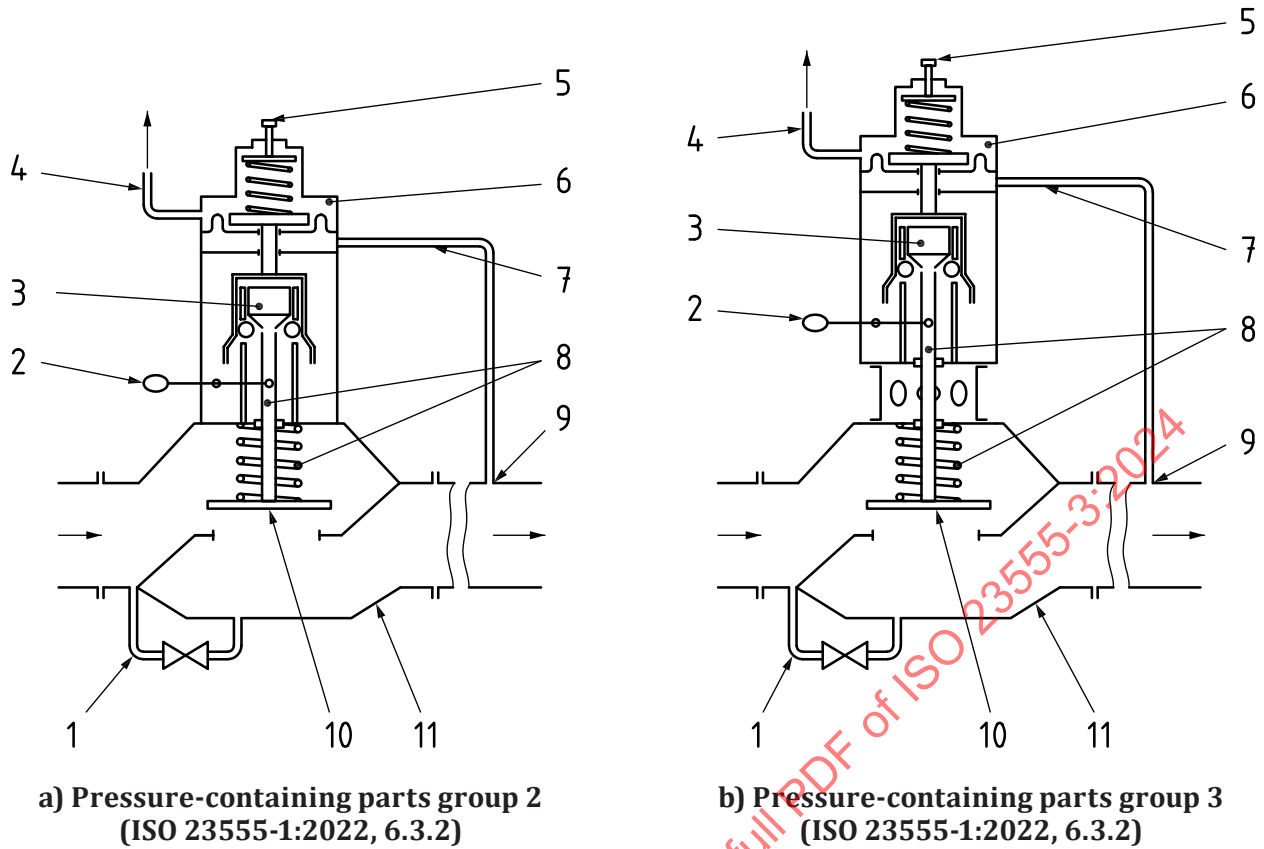
- a setting element to adjust the set value of the trip pressure;
- a pressure-detecting element which has the function to detect the feedback of the monitored pressure (e.g. a diaphragm);
- a unit which compares the set value of the trip pressure with the monitored pressure;
- a system which gives the energy to operate the trip mechanism

3.1.2.6

bypass

device permitting manual equalization of pressure across a closed safety shut-off device (SSD)

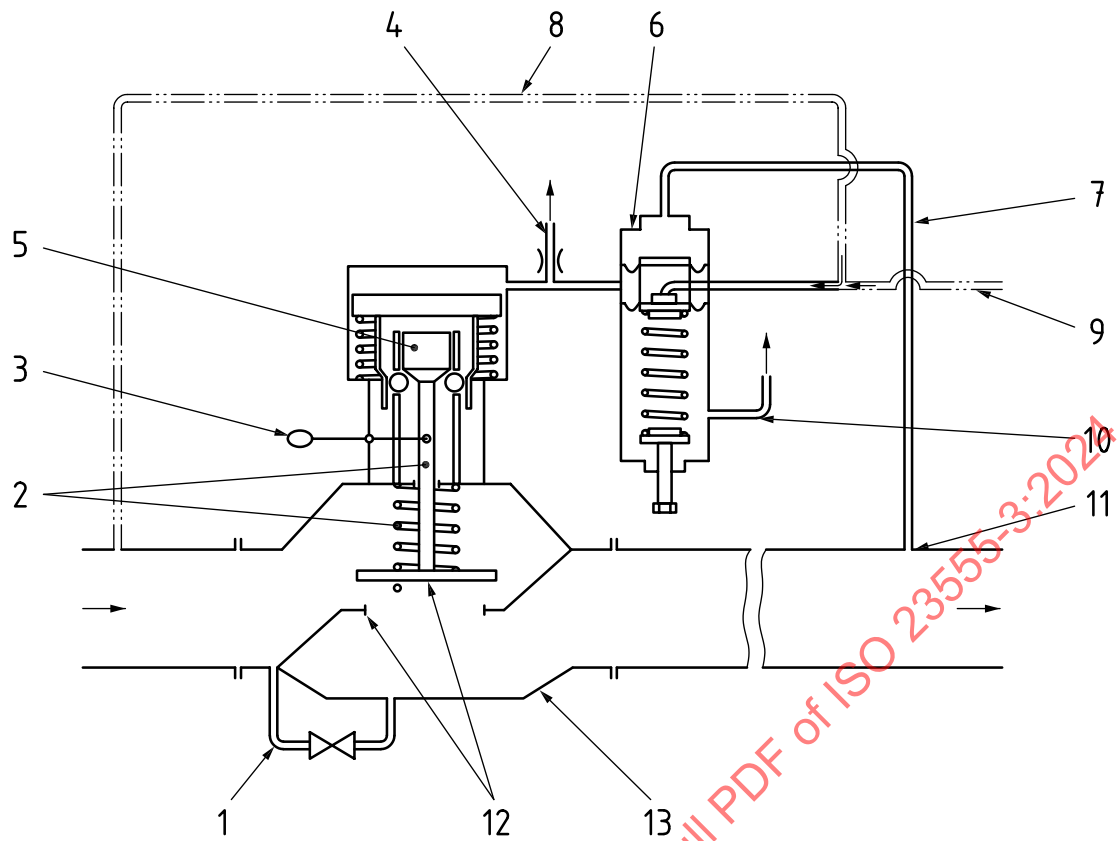
Note 1 to entry: See examples in [Figure 1](#) to [Figure 4](#).



Key

- | | | | |
|---|-------------------|----|---|
| 1 | bypass | 7 | sensing line |
| 2 | relatching device | 8 | actuator |
| 3 | trip mechanism | 9 | sensing point at the location to be monitored |
| 4 | breather line | 10 | closing member |
| 5 | setting element | 11 | SSD body |
| 6 | controller | | |

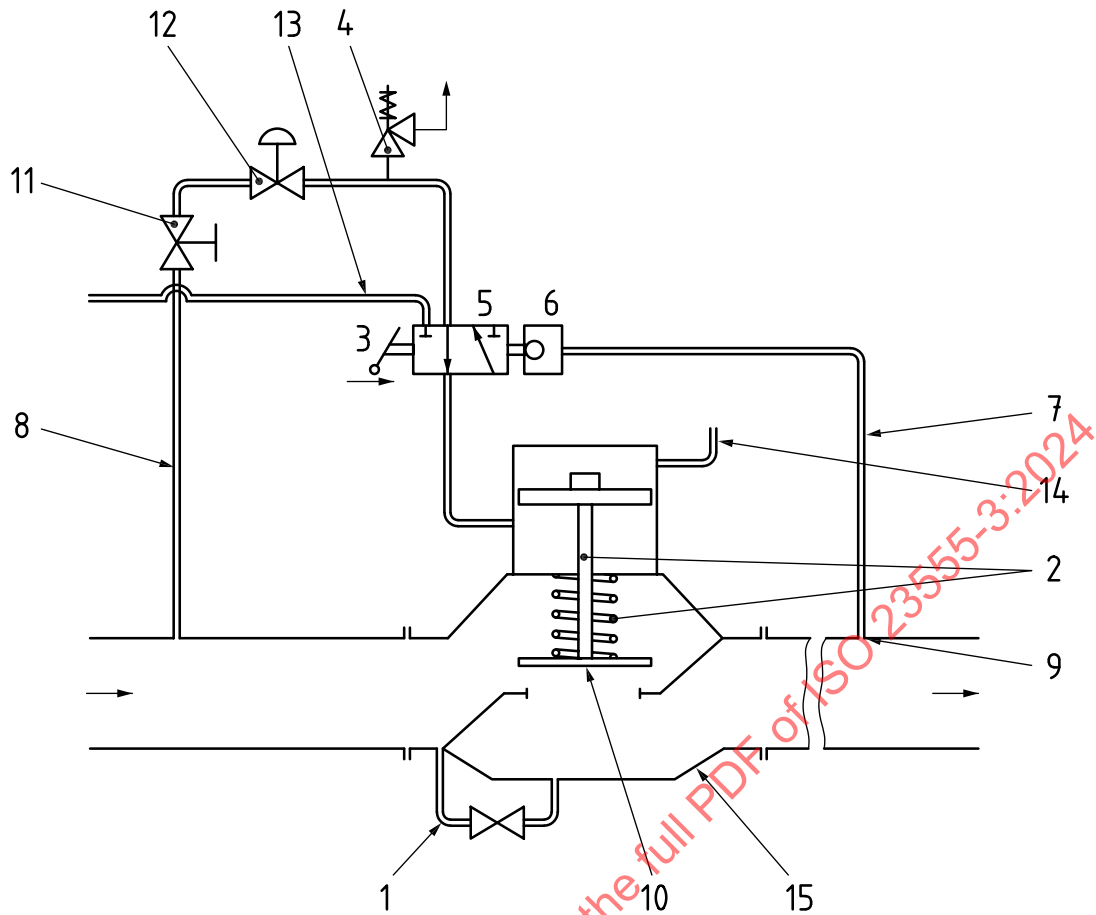
Figure 1 — Example of direct acting gas safety shut-off devices



Key

- | | | | |
|---|-------------------|----|---|
| 1 | bypass | 8 | loading pressure line (from internal auxiliary pressure source) |
| 2 | actuator | 9 | loading pressure line (from external auxiliary pressure source) |
| 3 | relatching device | 10 | breather/exhaust line |
| 4 | exhaust line | 11 | sensing point |
| 5 | trip mechanism | 12 | closing member |
| 6 | controller | 13 | SSD body |
| 7 | sensing line | | |

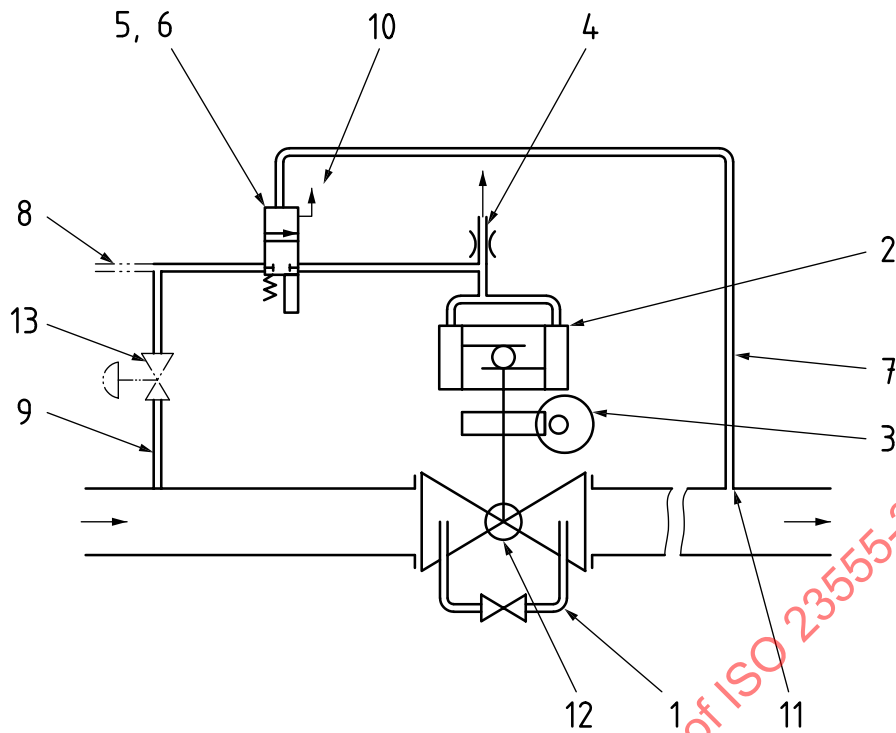
Figure 2 — Example No. 1 of an indirect acting gas safety shut-off device



Key

- | | | | |
|---|---|----|--------------------|
| 1 | bypass | 9 | sensing point |
| 2 | actuator | 10 | closing member |
| 3 | relatching device | 11 | isolating valve |
| 4 | safety relief valve | 12 | pressure regulator |
| 5 | trip mechanism (directional control valve) | 13 | exhaust line |
| 6 | controller | 14 | breather line |
| 7 | sensing line | 15 | SSD body |
| 8 | loading pressure line (from internal auxiliary pressure source) | | |

Figure 3 — Example No. 2 of an indirect acting gas safety shut-off device



Key

- | | | | |
|---|-------------------|----|---|
| 1 | bypass | 8 | loading pressure line (from external auxiliary pressure source) |
| 2 | actuator | 9 | loading pressure line (from internal auxiliary pressure source) |
| 3 | relatching device | 10 | breather/exhaust line |
| 4 | exhaust line | 11 | sensing point |
| 5 | trip mechanism | 12 | closing member |
| 6 | controller | 13 | pressure reducer (if applicable) |
| 7 | sensing line | | |

Figure 4 — Example No. 3 of an indirect acting gas safety shut-off device

3.1.2.7

loading pressure line

line connecting the controller and/or actuator to the internal or external power source

3.1.3 Terms related to variables in the controlling process

3.1.3.1

monitored pressure

pressure monitored and safeguarded by the safety shut-off device (SSD), normally the outlet pressure of the pressure control station/installation

3.1.3.2

maximum value

highest value to which any variable can be adjusted or to which it is limited, or which any variable may reach during a series of measurements, or during a certain time period

Note 1 to entry: The maximum value is specified by the index "max" added to the symbol of the variable.

3.1.3.3

minimum value

lowest value to which any variable can be adjusted or to which it is limited, or which any variable may reach during a series of measurements or during a certain time period

Note 1 to entry: The minimum value is specified by the index "min" added to the symbol of the variable.

3.1.4 Terms related to the controlled process and to the set value of the trip pressure

3.1.4.1

loading pressure

pressure of the gas from the upstream or downstream pipeline or of the air from an external source used as an energy source for the controller and/or actuator

3.1.4.2

trip pressure

pressure value at which the closing member reaches the closed position

Note 1 to entry: The trip pressure for over-pressure monitoring is represented using the symbol p_{do} .

Note 2 to entry: The trip pressure for under-pressure monitoring is represented using the symbol p_{du} .

3.1.4.3

actual value of the trip pressure

pressure value at which the closing member of a safety shut-off device (SSD) starts to move

Note 1 to entry: The actual value of the trip pressure for over-pressure monitoring is represented using the symbol p_{dio} .

Note 2 to entry: The actual value of the trip pressure for under-pressure monitoring is represented using the symbol p_{diu} .

3.1.4.4

set point

nominal trip pressure value under specified conditions

Note 1 to entry: The set point for over-pressure monitoring is represented using the symbol p_{dso} .

Note 2 to entry: The set point for under-pressure monitoring is represented using the symbol p_{dsu} .

3.1.4.5

set range

whole range of set points which can be obtained with a safety shut-off device (SSD) by adjustment and/or the replacement of some components (e.g. replacement of the setting mean, or pressure detecting element)

Note 1 to entry: The set range for over-pressure monitoring is represented using the symbol W_{do} .

Note 2 to entry: The set range for under-pressure monitoring is represented using the symbol W_{du} .

3.1.4.6

specific set range

whole range of set points which can be obtained with a safety shut-off device (SSD) by adjustment and without replacement of any component

Note 1 to entry: The specific set range for over-pressure monitoring is represented using the symbol W_{dso} .

Note 2 to entry: The specific set range for under-pressure monitoring is represented using the symbol W_{dsu} .

3.1.5 Terms related to functional performances

3.1.5.1

trip pressure deviation

difference between the actual value of the trip pressure and the set point as a percentage of the set value

Note 1 to entry: See [Figure 5](#).

3.1.5.2

accuracy group

AG

maximum permissible absolute value of trip pressure deviation

Note 1 to entry: See [Figure 5](#).

3.1.5.3

inlet operating pressure range

b_{pu}

range of inlet operating pressure for which the safety shut-off device (SSD) ensures a given accuracy group

3.1.5.4

response time

t_a

time interval between attaining the permissible limit value of the trip pressure at the sensing point and complete closure of the closing member

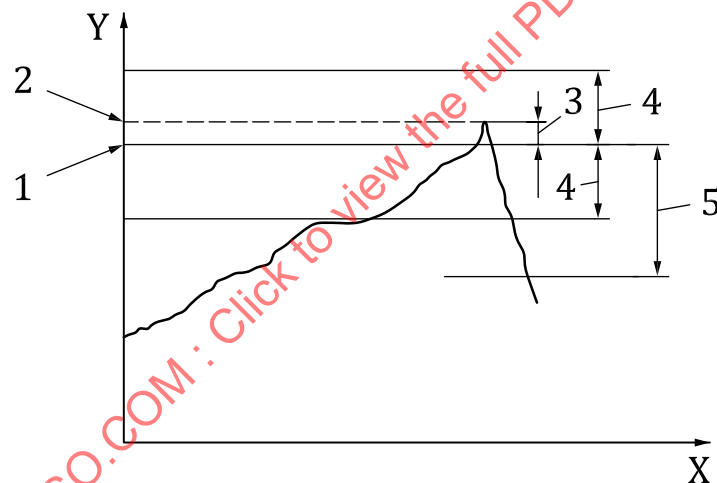
3.1.5.5

relatching pressure difference

Δp_w

minimum difference between the set value of the trip pressure and the monitored pressure which is required for the correct resetting of the safety shut-off device (SSD)

Note 1 to entry: See [Figure 5](#).



Key

- X time, t
- Y pressure, p_d
- 1 set value of trip pressure, p_{dso}
- 2 trip pressure, p_{do}
- 3 trip pressure deviation
- 4 accuracy group (AG)
- 5 relatching pressure difference, Δp_w

Figure 5 — Monitored pressure and trip pressure

3.1.5.6

pressure drop

drop in pressure, at specified operating conditions, of gas passing through the safety shut-off device (SSD)

3.1.6 Terms related to the design and tests

3.1.6.1 closing force

F_S

force created by a spring, by a weight-piece or by pressure to operate the closing member

3.1.6.2 Functional class A

class describing safety shut-off devices (SSDs) which close when damage to the pressure-detecting element occurs or when external power fails and for which re-opening is possible only manually

3.1.6.3 Functional class B

class describing safety shut-off devices (SSDs) which do not close when damage to the pressure-detecting element occurs but which provide suitable and reliable protection and for which re-opening is possible only manually

3.2 Symbols, abbreviated terms and units

[Table 1](#) summarizes the symbols, abbreviated terms and units used in this document. The symbols are listed in alphabetic order.

Table 1 — Symbols, abbreviated terms and units

Symbol	Definition	Subclause	Unit
Δp_w	relatching pressure difference	3.1.5.5	bar
AG	accuracy group	3.1.5.2	—
b_{pu}	inlet operating pressure range	3.1.5.3	bar
F_S	closing force	3.1.6.1	N
p_{dio}	actual value of the trip pressure for over-pressure monitoring	3.1.4.3	bar
p_{diu}	actual value of the trip pressure for under-pressure monitoring		bar
p_{do}	trip pressure for over-pressure monitoring	3.1.4.2	bar
p_{du}	trip pressure for under-pressure monitoring		bar
p_{dso}	set point for over-pressure monitoring	3.1.4.4	bar
p_{dsu}	set point for under-pressure monitoring		bar
t_a	response time	3.1.5.4	sec
W_{do}	set range for over-pressure monitoring	3.1.4.5	bar
W_{du}	set range for under-pressure monitoring		bar
W_{dso}	specific set range for over-pressure monitoring	3.1.4.6	bar
W_{dsu}	specific set range for under-pressure monitoring		bar

NOTE 1 bar = 0,1 MPa = 10⁵ Pa; 1 MPa = 1 N/mm².

4 Classification

4.1 General

Shall be according to ISO 23555-1:2022, 4.1 with the following addition:

— fail conditions.

4.2 Temperature classes

Shall be according to ISO 23555-1:2022, 4.2.

4.3 Strength types

Shall be according to ISO 23555-1:2022, 4.3.

4.4 Fail conditions

Subclause specific to this document.

This document considers the following closing behaviour.

SSDs are classified as either:

- Functional class A (see [3.1.6.2](#)); or
- Functional class B (see [3.1.6.3](#)).

5 Materials

Shall be according to ISO 23555-1:2022, Clause 5 with the following modification:

- a list of possible metallic materials is given in [Annex A](#);
- elastomeric materials requirements shall be in accordance with [Annex B](#).

6 Design

6.1 General

Shall be according to ISO 23555-1:2022, 6.1.

The minimum values of safety factor listed in ISO 23555-1:2022, Table 8, refer to yield strength and shall be used to limit the stresses in the walls of metallic pressure containing parts and inner metallic partition walls at the design pressure.

NOTE Differential pressure seal failure can be excluded based on the risk assessment in accordance with the design documentation.

6.2 Strength of metallic body and its inner metallic partition walls

Requirements shall be according to ISO 23555-1:2022, 6.2.2; verification shall be according to ISO 23555-1:2022, 6.2.3.

6.3 Other pressure-containing metallic parts of integral and differential strength SSDs

Requirements shall be according to ISO 23555-1:2022, 6.3.2; verification shall be according to ISO 23555-1:2022, 6.3.3.

6.4 Strength of parts transmitting actuating forces

Requirements shall be according to ISO 23555-1:2022, 6.4.2; verification shall be according to ISO 23555-1:2022, 6.4.3.

6.5 Strength of diaphragms (elastomeric parts)

6.5.1 General

[Subclause 6.5](#) is specific to this document.

The strength of a diaphragm shall ensure the correct performances under stress.

6.5.2 Diaphragms of gas safety shut-off devices (Functional class A)

The diaphragms to be used in Functional class A SSDs shall conform to ISO 23555-1:2022, 6.5.2 when tested according to ISO 23555-1:2022, 6.5.3.

6.5.3 Diaphragms of gas safety shut-off devices (Functional class B)

The diaphragms to be used in Functional class B SSDs shall have fabric reinforcement if the maximum set point is 1 bar and above.

When the design foresees a mechanical support, during the test, the diaphragm shall be mechanically supported accordingly.

Diaphragms used as pressure-containing parts in chambers that are subjected to a maximum differential pressure shall withstand without bursting when tested at room temperature.

For integral strength (IS) SSDs, diaphragms shall withstand the design pressure (DP).

For differential strength (DS) SSDs, diaphragms shall withstand a specific design pressure (DPD) multiplied by a safety factor as specified:

- for set point up to and including 5 bar: 2,5 but at least 1 bar;
- for set point from 5 bar to ≤ 16 bar: 2,0 but at least 12,5 bar;
- for set point from 16 bar to ≤ 40 bar: 1,75 but at least 32 bar;
- for set point greater than 40 bar: 1,5 but at least 70 bar.

The requirements in this subclause shall be validated by test according to ISO 23555-1:2022, 6.5.3.

6.6 Welding

Shall be according to ISO 23555-1:2022, 6.6.

6.7 Main function of a safety shut-off device

6.7.1 General

[Subclause 6.7](#) is specific to this document.

6.7.2 Basic requirements for SSDs

SSDs shall not have any continuous discharge of gas into the atmosphere, however, temporary discharges from auxiliary devices may occur.

SSDs shall be so designed that external and internal tightness meet the requirements of [7.2.5.1](#) and [7.2.5.2](#).

If in the event of failure (e.g. of a diaphragm), leakage to the atmosphere is possible. In this case, the breather shall be provided with a threaded connection of at least DN 10 to enable an exhaust line to be connected; this threaded connection shall be protected in such a way as to prevent the entry of foreign materials.

The manual force required to operate the relatching device shall be:

- ≤ 250 N;
- ≤ 150 N when the relatching device needs more than 10 operations (e.g. for a cut-off device).

After relatching, all functional units shall have returned to their starting position without impeding the closing function and the SSD shall be ready for operation. The handle of the relatching device may be detachable. Any device to lock the SSD in the open position is not permitted.

Pressure-containing parts not intended to be dismantled during servicing, adjustment or conversion shall be sealed by means which will show evidence of interference (e.g. lacquer).

Pressure-containing parts, including measuring and test points, which may be dismantled for servicing, adjustment or conversion, shall be made pressure-tight by mechanical means (e.g. metal to metal joints, o-rings, gaskets). Jointing compounds, such as liquids and pastes, shall not be used.

However, jointing compounds may be used for permanent assemblies and shall remain effective under normal operating conditions.

Functional class B SSDs shall be equipped with a safe by design pressure detecting element such as a piston, metallic bellow or supported reinforced diaphragm.

Functional class B SSDs shall not be combined with a built-in vent limiter (as described in [Annex C](#)).

Where pipeline gas pressure is utilized as an auxiliary pressure source for indirect acting SSDs, the location on the pipeline of the loading pressure connection shall not affect the safety performance of the SSD. If applicable, this information shall be given in the operating instructions.

Where there is the possibility of damage to external protrusions or other parts during transport and handling, the operating instructions shall describe precautions to be taken to prevent the risk.

For cut-off devices, the operating and maintenance manual shall specify whether a by-pass shall be provided and how this will be accomplished.

6.7.3 Stand-alone gas safety shut-off devices

SSDs may be designed as independent units for separate installation. A stand-alone SSD comprises all the main components (see ISO 23555-1:2022, 3.1.2.1).

6.7.4 Safety shut-off devices integrated into a gas pressure regulator

SSDs are functionally independent from the components of the gas pressure regulator and from other safety devices.

The function of the SSD is not affected in the event of the failure and/or loss of functionality of one or more of the following components of the gas pressure regulator or other safety devices:

- control/closing/relieving member;
- seat ring;
- actuator;
- actuator casing;
- controller;
- sensing and process lines.

6.7.5 Safety shut-off devices with an in-line gas pressure regulator

The system includes a gas pressure regulator with the function of active gas pressure regulator and an in-line SSD (in series).

The SSD is installed directly upstream of the gas pressure regulator and both devices are controlling the pressure at the same location.

The associated in-line gas pressure regulator is functionally independent from the SSD and:

- a) the function of the gas pressure regulator is not affected in the event of the failure and/or loss of functionality of one or more of the following SSD components:

- controller;
- sensing and process lines.

and

- b) the function of the SSD is not affected in the event of the failure and/or loss of functionality and/or functionality of one or more of the following gas pressure regulator components:

- pilot (in case of pilot-controlled gas pressure regulator);
- sensing and process lines.

The motorization energy for a gas pressure regulator in case of pilot-controlled type is taken downstream from the SSD.

6.7.6 Safety shut-off device plus a second safety shut-off device.

The system may include either two in-line SSDs or two integrated SSDs.

The two SSDs are functionally independent and both devices are controlling the pressure at the same location.

The function of any SSD is not affected in the event of the failure and/or loss of functionality of one or more of the following components of the other SSD:

- controller;
- sensing and process lines.

6.7.7 Set range

Components may be replaced to cover the whole set range. In this case, the manufacturer shall specify the necessary procedure in the installation, operation and maintenance manual.

6.7.8 External visual indication of the position of the closing member

For SSDs, it shall be possible to check whether the closing member is in the fully open position by visual inspection.

6.7.9 Shutting-off and opening

The shutting-off of the gas flow shall be automatic and shall not be interruptible until the closed position of the closing member has been reached.

The opening of SSDs shall only be possible by manual operation.

6.7.10 By-pass

If an internal bypass is fitted for the purpose of pressure equalization it shall close safely and automatically after closing of the SSD.

7 Performance requirements and testing

7.1 General

7.1.1 Approach to stable product phase

Shall be according to ISO 23555-1:2022, 7.1.1.

7.1.2 Test conditions

Shall be according to ISO 23555-1:2022, 7.1.2.

7.1.3 Test tolerances

Shall be according to ISO 23555-1:2022, 7.1.3.

7.1.4 Overview table

Shall be according to ISO 23555-1:2022, 7.1.4 with the replacement of Table 11 by [Table 2](#):

NOTE For routine tests carried out on finished SSDs by the manufacturer in the presence of the purchaser's inspector, refer to [Annex K](#).

Table 2 — Summary of tests and requirements

Test schedule			Requirements	Test method	
T	M	S	Clause	Title	Clause
Constructional tests					
A	A	A	7.2.3	Dimensional check and visual inspection	ISO 23555-1:2022, 7.3.2
A	A	A	5	Materials check	ISO 23555-1:2022, 7.3.1
A			ISO 23555-1:2022, 6.2.2 and 6.3.2	Verification of the strength of body and its inner metallic partition walls and of other pressure-containing metallic parts of integral and differential strength SSDs	ISO 23555-1:2022, 6.2.3 and 6.3.3
A			ISO 23555-1:2022, 6.4.2	Verification of the strength of parts transmitting actuating forces	ISO 23555-1:2022, 6.4.3

A = Applicable

S = Batch surveillance

M = Routine tests

T = Type test

^a Test: generally, as described in [7.3.9.2](#), but only at ambient temperature. Make six consecutive operations for test "S" and two consecutive operations for test "M". Select the set range or the specific set range or the trip pressure in accordance with order specifications or at the manufacturer's discretion when not otherwise specified.

^b This test shall be carried out on SSDs only if there is a dynamic impact on the closure member in its fully open position.

^c This test shall be mandatory only on the non-metallic parts having an influence on the operation of the device.

^d Test and requirements of sound emission and requirements of ice formation ([7.2.19](#)) shall be carried out if requested in the order specification or at the option of the manufacturer.

Table 2 (continued)

Test schedule			Requirements	Test method	
T	M	S	Clause	Title	Clause
A			6.5.2	Verification of strength of diaphragm used as pressure containing parts (class A)	ISO 23555-1:2022, 6.5.3
A			6.5.3	Verification of strength of diaphragm used as pressure containing parts (class B)	ISO 23555-1:2022, 6.5.3
A		A	ISO 23555-1:2022, 7.2.6	Test method and acceptance criteria to verify the antistatic characteristics	ISO 23555-1:2022, 7.3.7
A ^c		A ^c	ISO 23555-1:2022, 5.2.2	Resistance to gas of non-metallic parts	ISO 23555-1:2022, 5.2.2
A			ISO 23555-1:2022, 7.2.8	Resistance of external surfaces to corrosion	ISO 23555-1:2022, 7.3.9
Functional tests^d					
A	A	A	ISO 23555-1:2022, 7.2.4	Shell and inner metallic partition walls strength test	ISO 23555-1:2022, 7.3.4
A	A	A	7.2.5.1	External tightness test	7.3.5
A	A	A	7.2.5.2	Internal tightness test	7.3.6
A	A ^a	A ^a	7.2.11	Accuracy Group test at ambient temperature	7.3.9.2
A			7.2.11	Accuracy Group test at the limit temperatures –20 °C or –10 °C and 60 °C	7.3.9.3
A			7.2.11	Verification of the upper limit of highest set range for over-pressure monitoring	7.3.9.4
A		A	7.2.12	Response time	7.3.11
A			7.2.13	Relatching difference and unlatching	7.3.12
A			7.2.14	Closing force	7.3.13
A			7.2.15	Endurance and accelerated ageing	7.3.14
A			7.2.16	Verification of the strength of the trip mechanism, valve seat and closing member against dynamic impact ^b	7.3.17
A			7.2.17	Determination of the flow coefficients	7.3.10 and ISO 23555-2:2022, 7.3.9.2
A			ISO 23555-1:2022, 7.2.3	Final visual inspection after type test	ISO 23555-1:2022, 7.3.2.2
	A	A	ISO 23555-1:2022, 7.2.3	Final visual inspection after routine tests and batch surveillance	ISO 23555-1:2022, 7.3.2.2

A = Applicable

S = Batch surveillance

M = Routine tests

T = Type test

^a Test: generally, as described in [7.3.9.2](#), but only at ambient temperature. Make six consecutive operations for test “S” and two consecutive operations for test “M”. Select the set range or the specific set range or the trip pressure in accordance with order specifications or at the manufacturer’s discretion when not otherwise specified.

^b This test shall be carried out on SSDs only if there is a dynamic impact on the closure member in its fully open position.

^c This test shall be mandatory only on the non-metallic parts having an influence on the operation of the device.

^d Test and requirements of sound emission and requirements of ice formation ([7.2.19](#)) shall be carried out if requested in the order specification or at the option of the manufacturer.

7.2 Requirements

7.2.1 Test rig

The requirements detailed in this subclause are applicable only for type testing.

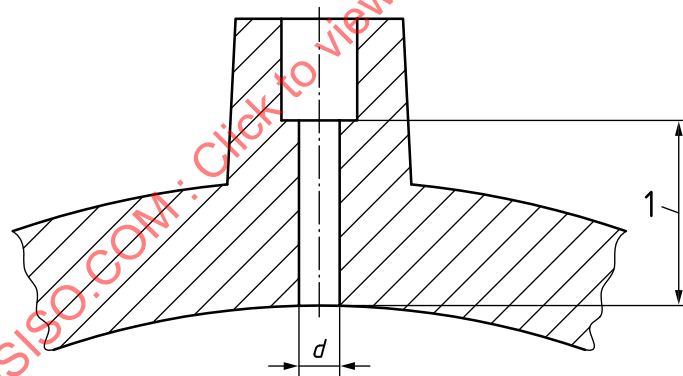
The tests shall be carried out on a test rig built as specified in [Figure 7](#) or in accordance with IEC 60534-2-3, as appropriate. The nominal diameter of the pipework connecting the full-bore valves and the flow-regulating valves with the SSD shall not be smaller than the nominal diameter of the SSD. It shall be chosen so as to ensure that, in all operating conditions during the tests, the velocity of the fluid where the impulse is taken does not exceed:

- 50 m/s for pressure ≥ 50 kPa (0,5 bar);
- 25 m/s for pressures < 50 kPa (0,5 bar).

The connections between the SSD and the test rig pipework shall be made using concentric reducers according to ISO 3419 or equivalent (e.g. ASME B 16.9, EN 10253). The pressure tapping diameter, d , shown in [Figure 6](#) shall be at least 3 mm and shall be no larger than 12 mm or one-tenth of the nominal pipe diameter, whichever is the lesser. The tapping shall be circular, and its edge shall be clean and sharp or slightly rounded and free from burrs or other irregularities. Any suitable method of making a physical connection should be acceptable provided the above recommendations are followed. However, fittings shall not protrude inside the pipework.

In the event of unstable conditions due to volumetric flow rate variations impacting the operation of the flow-regulating valve 9 (see [Figure 7](#)), it is permissible to increase the length of the pipework connecting the flow regulating valve 9 (see [Figure 7](#)) to the SSD, or to provide for an additional volume by installing a parallel line or reservoir.

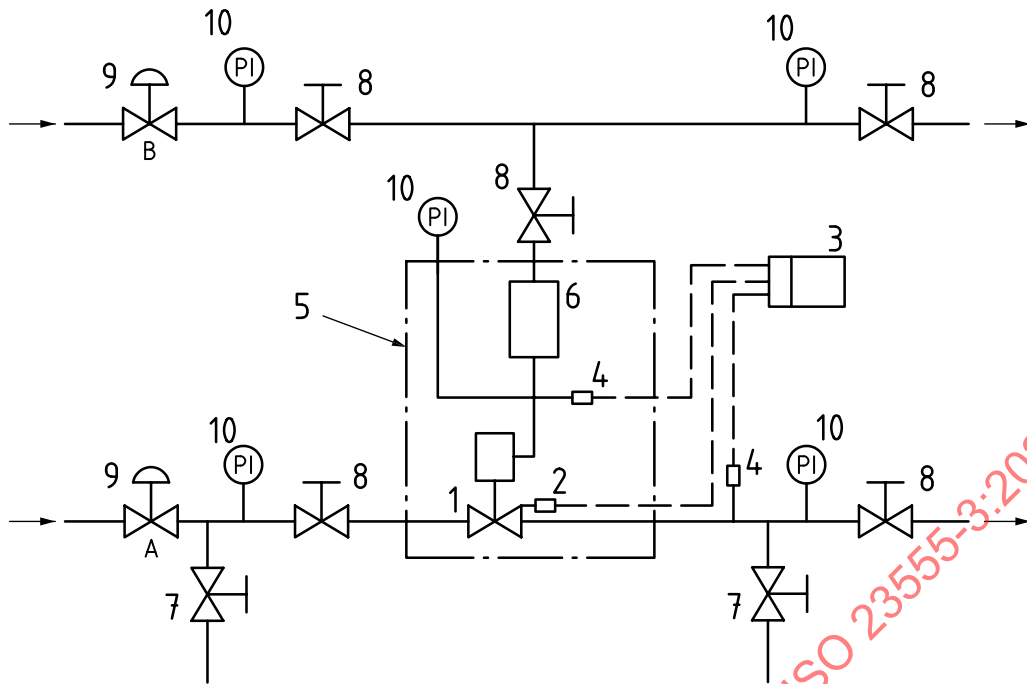
The flow meter shall be installed in accordance with the instructions of the manufacturer.



Key

- d pressure tapping diameter
 1 minimum $2,5 d$, recommended $5 d$

Figure 6 — Recommended pressure tapping



Key

- 1 SSD (in the scheme including a vessel upstream inside the environmental cabinet)
- 2 microswitch or similar device
- 3 recorder
- 4 pressure transducer
- 5 environmental cabinet
- 6 pressure vessel (in the scheme to be included in the environmental cabinet)
- 7 leakage control valve
- 8 isolating or needle valve
- 9 pressure regulator
- 10 pressure indicator

NOTE Gas pressure regulator A controls the operating pressure of the SSD. Gas pressure regulator B adjusts monitored pressure.

Figure 7 — Test rig configuration for SSDs

7.2.2 Classification of tests

7.2.2.1 Type tests

The tests in [Table 2](#) are carried out to establish the performance classification of the SSD or the series of SSDs. These tests include verification of the documentation listed in [Clause 8](#).

When changes are made to the design of an SSD or a series of SSDs in a manner that affects the tests, the manufacturer shall inform the parties involved in the evaluation of conformance to this document, if such an evaluation exists.

7.2.2.2 Selection of test samples for type test

The number and types of SSD to be subjected to type testing shall be selected according to the following requirements:

- one SSD for each type of fixture and controller;

- two sizes from a series of up to six sizes and three sizes from a series greater than six in number;
- one SSD for each accuracy group (AG).

If the same SSD can be used as a stand-alone or combined device it will be tested only once.

7.2.2.3 Routine tests

Routine tests are those tests (see [Table 2](#)) carried out on each SSD by the manufacturer during the production process.

NOTE See exceptions in ISO 23555-1:2022, 7.3.4, where applicable.

The tests verify that materials, dimensions, external conditions and accuracy groups remain in conformance with the results of the type test.

Routine tests for integrated pressure regulators, are detailed in ISO 23555-2.

7.2.2.4 Batch surveillance tests

Batch surveillance tests are those tests and verifications (see [Table 2](#)) carried out in order to confirm continuing conformance with this document.

The tests and verifications additionally include:

- verification of routine tests records;
- verification of drawings and material certificates.

The further provisions [Annex D](#) shall apply.

7.2.3 Dimensional check and visual inspection

Shall be according to ISO 23555-1:2022, 7.2.3.

7.2.4 Shell strength

Shall be according to ISO 23555-1:2022, 7.2.4.

7.2.5 External/Internal tightness

7.2.5.1 External tightness

The pressure-containing parts and all connecting joints shall be leak-proof when tested in accordance with [7.3.5.1](#).

The test result is satisfactory if one of the following conditions is met:

- bubble burst occurs no earlier than the relevant time detailed in [Table 5](#), in case this test is carried out by covering the whole SSD or its parts (in case of large size) with a foaming liquid;
- bubble tight for the relevant time detailed in [Table 5](#), in case this test is carried out by completely immersing the SSD into a tank of water or by other equivalent methods;
- external leakage not higher than the values listed in [Table 5](#).

Recognized alternative detection methods may be used for checking the external leakage (e.g. electronic device).

7.2.5.2 Internal tightness

The requirements of internal tightness for SSDs are satisfied if one of the following conditions is met:

- bubble burst occurs no earlier than the relevant time detailed in [Table 5](#);
- bubble tight for the relevant time detailed in [Table 5](#) by test carried out according to IEC 60534-4:2021, 5.5.4 “Leakage specifications”, Table 2– Note b;
- leakage is no higher than the value given in [Table 5](#).

These values are to be used both in the test at ambient temperature and the tests at limit temperatures.

Recognized alternative detection methods may be used for checking the internal leakage (e.g. electronic device).

For such methods the equivalence to the above acceptance criteria shall be demonstrated.

The accumulated internal leakage from internal walls, the closing member in its closed position, any bypass and connecting joints shall not exceed the values shown in [Table 5](#).

7.2.6 Antistatic characteristics

Shall be according to ISO 23555-1:2022, 7.2.6

7.2.7 Sound emission

Shall be according to ISO 23555-1:2022, 7.2.7

7.2.8 Resistance of external surfaces to corrosion

Shall be according to ISO 23555-1:2022, 7.2.8

For protection against outdoor specific environment conditions, additional information should be provided.

7.2.9 Failure modes

7.2.9.1 General

A failure of a bellows or piston-type pressure detecting element does not need to be considered.

7.2.9.2 SSDs of Functional class A

SSDs of Functional class A shall close in the following cases:

- damage to the diaphragm of the pressure-detecting element;
- reduction of auxiliary energy to less than 1,5 times of the minimum required for moving the closing element to its closed position, unless:
 - 1) a backup system is used;
 - 2) pressurized gas from the system itself is used as auxiliary energy and this pressure has dropped.

7.2.9.3 SSDs of Functional class B

SSDs of Functional class B shall close in the following case:

- failure of continuous supply of the auxiliary energy and with pressure lower than 1,5 times the minimum required value to bring the closing member to its closed position without any backup system. Exception:

when using internal energy as auxiliary energy and in case of no pressure in pipeline system, SSDs do not need to close automatically.

7.2.10 Safety shut-off sizing

For stand-alone SSDs, the manufacturer shall declare the pressure drop in terms of diagrams or applicable equations, such as those detailed in [Annex G](#).

The pressure drop across the SSD body in relation to the operating conditions shall be specified by the manufacturer.

For a stand-alone SSD, sizing (flow rate calculation) shall be done by using flow coefficients (C_g or K_G or C_v) determined by methods detailed in [7.3.10](#).

7.2.11 Accuracy group

The trip pressure deviation for an SSD shall conform to an accuracy group (AG) from [Table 3](#).

Table 3 — Specified accuracy groups

Accuracy group	Permissible deviation
AG 1	$\pm 1\%$ ^a
AG 2,5	$\pm 2,5\%$ ^a
AG 5	$\pm 5\%$ ^a
AG 10	$\pm 10\%$ ^a
AG 20	$\pm 20\%$ ^b
AG 30	$\pm 30\%$ ^b
^a Or 1 mbar, whichever is greater. ^b For set values ≤ 200 mbar only. NOTE 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm ² .	

An SSD type can conform to different accuracy groups as a function of the set range W_{do} and W_{du} or of the inlet operating pressure range b_{pu} .

At the lower limit temperature, the permissible deviation for the declared accuracy group may move to a less stringent group as detailed in [7.3.9.3](#).

7.2.12 Response time

The response time, t_a , shall be:

- for gas slam shut devices: ≤ 2 s;
- for gas cut-off devices $\leq 0,08$ s for $DN \leq 250$ and $\leq 0,06$ s for $DN > 250$.

For gas cut-off devices, lower and/or adjustable response times may be specified in the order specification.

7.2.13 Relatching difference and unlatching

7.2.13.1 Relatching difference

The relatching pressure difference, Δp_{vr} , shall be measured in accordance with [7.3.12](#).

7.2.13.2 Unlatching under mechanical impact

When subjected to the test in accordance with [7.3.12](#), no unlatching of the SSD shall occur.

7.2.14 Closing force

When tested in accordance with [7.3.13](#), the closing force shall ensure closing of the closing member by a sufficient safety factor under all operating conditions. In the case of closing springs, appropriate measures against breakage as detailed in ISO 23555-1:2022, 6.1.13, shall apply.

The closing forces shall correspond to [Formulae \(1\)](#) and [\(2\)](#) for the open and closed position:

— open position:

$$F_s \geq 5 \times R \pm f \times S \pm f \times W + f \times D \quad (1)$$

— closed position:

$$F_s \geq 2,5 \times R \pm f \times S \pm f \times W \quad (2)$$

where

R is the friction force in N (non-static friction);

S is the unbalanced load in N on the closing member and actuator from static inlet pressure;

W is the weight in N of the moving parts;

D is the dynamic force in N on the closing member from the mass flowing through the SSD;

$f = 1,1$ where the force (S, W, D) opposes the closing of the closing member;

$f = 0,9$ where the force (S, W) assists the closing of the closing member.

The addition (+) is applied when the force opposes the closing of the closing member and the subtraction (–) is applied when the force assists the closing of the closing member.

The dynamic force, D , is considered zero if it assists the closing of the closing member.

When there is any torque developed in moving parts by the flowing mass it shall be considered when calculating F_s .

Both [Formulae \(1\)](#) and [\(2\)](#) shall be verified at the most critical operating conditions in the most critical mounting position.

7.2.15 Endurance and accelerated ageing

When tested in accordance with [7.3.14](#) the SSD shall meet the tightness requirements in accordance with [7.2.5.1](#) and [7.2.5.2](#) and the set pressure deviations shall remain within its AG.

7.2.16 Strength of the trip mechanism, valve seat and closing member against the dynamic impact of flowing gas

This requirement shall be applied to SSDs where there is a dynamic impact on the closing member in its fully open position.

After testing in accordance with [7.3.17](#), the SSD shall meet the internal tightness requirements of [7.2.5.2](#).

7.2.17 Flow coefficient

When the SSD is incorporated in a gas pressure regulator the flow coefficients in accordance with ISO 23555-2:2022, 7.3.9.2 are used.

For stand-alone SSDs, a flow coefficient in accordance with [7.3.10](#) may be used.

7.2.18 SSDS with incorporated vent limiters

Vent limiters incorporated in the SSD shall meet the requirements in [Annex C](#).

7.2.19 Ice formation

If requested in the order specification, the SSD shall be type-tested in accordance with the customer requirements, for example in accordance with [Annex F](#).

7.3 Tests**7.3.1 Materials check at stable production phase**

Shall be according to ISO 23555-1:2022, 7.3.1.

7.3.2 Dimensional check and visual inspection

Shall be according to ISO 23555-1:2022, 7.3.2.

7.3.3 Mounting position

Shall be according to ISO 23555-1:2022, 7.3.3.

7.3.4 Shell strength

Shall be according to ISO 23555-1:2022, 7.3.4.

7.3.5 External tightness test**7.3.5.1 External tightness test of metallic housing**

The assembled SSD and its auxiliary devices are pneumatically tested to assess compliance with the requirements detailed in this subclause. The test is carried out at ambient temperature with air or gas at the test pressure specified in [Table 4](#). This test shall be carried out for at least:

- 15 min in the type test;
- 1 min in the routine tests and in the batch surveillance.

The test pressures in [Table 4](#) do not apply to any chambers bounded on at least one side by a diaphragm, even if they are subjected to gas pressure under normal operating conditions.

The test is carried out in such a manner that deformations of the SSD 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 type test.

Table 4 — Pressure values in the external tightness test

Chambers with the maximum design pressure (DP)		Chambers with specific maximum design pressure (DPD)
Chamber of controller	Other chambers	All chambers
Test pressures		
1,2 $p_{dso,max}$, but at least 0,5 DP, whichever is the greater	1,1 DP	1,1 DPD

Table 5 — Maximum external and internal leakage rates

Nominal size	Air leakage rate (cm ³ /h) ^a		No bubble burst (s) or bubble tight time (s) between bubbles	
	External	Internal	External	Internal
25	90	90	5	5
40 to 80	90	90	5	5
100 to 150	100	90	5	5
200 to 250	150	90	3	5
300 to 350	200	100	2	5
400	400	300	2	2

^a At normal conditions.

7.3.5.2 External tightness test of chambers bounded on at least one side by a diaphragm

Such chambers shall be pneumatically tested at a test pressure equal to at least:

- 0,2 bar if $\Delta p_{\max} < 0,15$ bar;
- $1,33 \Delta p_{\max}$ if $0,15 \text{ bar} \leq \Delta p_{\max} < 5 \text{ bar}$;
- $1,1 \Delta p_{\max}$ but at least 6,65 bar if $\Delta p_{\max} \geq 5 \text{ bar}$.

The test method and acceptance criteria shall be in accordance with [7.3.5.1](#).

7.3.6 Internal tightness test

The internal tightness test is carried out at ambient temperature with two different test pressures of 0,1 bar and $1,1 \times DP$ upstream of the closing member and atmospheric pressure downstream of the assembled SSD and its auxiliary devices to assess compliance with the requirements of [7.2.5.2](#). This test is carried out before or after the functional tests specified in [7.3.9.2](#).

SSDs built into gas pressure regulators are tested with the gas pressure regulator in the open position.

7.3.7 Antistatic characteristics

Shall be according to ISO 23555-1:2022, 7.3.7.

7.3.8 Methods for calculating and measuring the sound pressure level

Shall be according to ISO 23555-1:2022, 7.3.8.

7.3.9 Accuracy group tests

7.3.9.1 General conditions

The tests shall be carried out with either air or gas. Wherever necessary, measured flow rates are converted into values that are related to air at normal conditions. Pressure measurement devices shall have an accuracy of at least 0,25 AG with full scale not greater than twice the value of the variable to be measured. Tests shall be carried out at ambient temperature. SSDs shall be tested in the mounting position specified by the manufacturer.

The external sensing and loading pressure lines shall be located on the pipeline according to the prescription of the manufacturer.

The test is carried out in a test rig (equivalent to [Figure 6](#)) under the following operating conditions:

- the body of the SSD is pressurized from both ends;

- the controller of the SSD is pressurized with a variable pressure representing the monitored pressure. The rate of the pressure change is kept constant;
- the whole unit is installed in a chamber with a controlled temperature between -10 °C (or -20 °C) and $+60\text{ °C}$ for tests at limit temperatures.

The accuracy groups for overpressure protection and under-pressure protection, if applicable, are determined separately.

7.3.9.2 Accuracy group test at ambient temperature

The test method for over-pressure protection for each specified AG, according to a defined specific set range and operating pressure range, is as follows:

- a) ensure that the body is at atmospheric pressure;
- b) adjust the trip pressure to the lower limit of the set range;
- c) with the SSD in the open position, starting from approximately 80 % of the selected trip pressure, increase the monitored pressure with a pressure change rate not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;
- d) repeat test c) five times; the set value is the arithmetic mean of the six actual values; the routine tests are repeated once only and the set value is the arithmetic mean of the two actual values;
- e) without further adjustment, repeat the tests c) to d) with the body pressurized to the maximum inlet pressure, $p_{u,max}$;
- f) the set point is the arithmetic mean of the two set values calculated in d) and e).

The test method for under-pressure protection is similar to that specified above; the starting pressure for operation c) shall be 120 % of the selected trip pressure.

The test requirements are met if all the values of the trip pressure in c), d) and e) are within the value expressed in [Formula \(3\)](#):

$$p_{ds} \times \left(1 \pm \frac{G}{100} \right) \quad (3)$$

where

p_{ds} is the set point for pressure monitoring;

G is the accuracy group.

7.3.9.3 Accuracy group test at the limit temperatures -20 °C or -10 °C and 60 °C

The tests are carried out in a temperature-controlled chamber, at the lowest limits of $(-20 \pm 2)\text{ °C}$ or $(-10 \pm 2)\text{ °C}$ with a dry test medium (dew point $\leq -25\text{ °C}$) and at $(60 \pm 2)\text{ °C}$.

There shall be no adjustment of the trip pressure between the test at ambient temperature ([7.3.9.2](#)) and this test.

Test method:

- a) pressurize the body of SSD in the open position and maintain the inlet pressure at 0,1 bar;
- b) adjust the temperature of the test chamber to the limit value; the test begins when the temperature becomes uniform in all parts of the SSD with a tolerance of $\pm 2\text{ °C}$;
- c) starting from approximately 80 % of the selected trip pressure, increase the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;

- d) verify the internal tightness;
- e) the test method for under-pressure protection is similar to that specified above; the starting pressure for operations c) shall be 120 % of the selected trip pressure.

The test requirements are met if the internal tightness conforms to the requirement in [7.2.5.2](#) and the value of the trip pressure in c) corresponds to the specified accuracy group.

For the tests at -20 °C and at -10 °C only, the results may correspond to accuracy groups at ambient temperature multiplied by 2, except when, at ambient temperature, AG = 30. In this case the AG = 30 may be multiplied by 1,5 (at ambient temperature, AG 5 can change to AG 10 both at -20 °C and at -10 °C).

7.3.9.4 Verification of the upper limit of the highest specific set range for over-pressure monitoring

Test method:

- a) ensure that the body is at atmospheric pressure;
- b) adjust the trip pressure to the upper limit of the highest specific set range;
- c) starting from approximately 80 % of the selected trip pressure increase the monitored pressure at a rate of change not greater than 1,5 % of the selected trip pressure per second until closure of the SSD occurs;
- d) repeat test c) five times;
- e) calculate the arithmetic mean of the six actual values.

The test requirements are met if the set value calculated in e) corresponds to the specified accuracy group.

7.3.10 Determination of flow coefficients

The following methods can be used to determine the flow coefficients:

- those appropriate in ISO 23555-2:2022, 7.3.10.2 referring to sub-critical conditions:
 - 7.3.10.2.1 by calculation method;
 - 7.3.10.2.2 (Cg) and 7.3.10.2.3 (KG) by practical methods;
 - 7.3.10.2.4 by computational fluid dynamics (CFD);

or

- Cv flow coefficient (see below).

For a stand-alone SSD, flow coefficients (Cg or KG) shall be determined by testing the SSD with its closing member in fully open position, in a test rig in accordance with [7.2.1](#).

The Cv coefficient shall be determined for at least three different operating conditions by following method:

- a) install the SSD in a test rig as given in IEC 60534-2-3;
- b) set the test conditions so that the velocity at the inlet of the SSD is the maximum possible;
- c) determine the flow coefficients Cv_i using [Formula \(4\)](#):

$$Cv_i = \frac{Q_{ni}}{404,83 \times \sqrt{\Delta p_i \times \frac{p_{ui} + p_b}{d \times (t_{ui} + 273,15)}}} \quad (4)$$

where

Cv_i is the Cv flow coefficient;

Q_{ni} is the test volumetric flow rate at normal conditions in m³/h of the fluid with relative density d and inlet temperature of t_{ui} ;

t_{ui} is the test fluid temperature measured at the inlet of the SSD in °C;

p_{ui} is the test fluid pressure measured with volumetric flow rate Q_i at the inlet of the SSD in bar;

Δp_i is the measured pressure drop with volumetric flow rate Q_{ni} across the SSD in bar;

d is the relative density of test fluid (air = 1, non-dimensional value).

- d) repeat the test and calculations b) and c) respectively with two different operating conditions, changing the value of volumetric flow rate and/or the inlet pressure;
- e) calculate the flow coefficient as the arithmetic mean as shown in [Formula \(5\)](#):

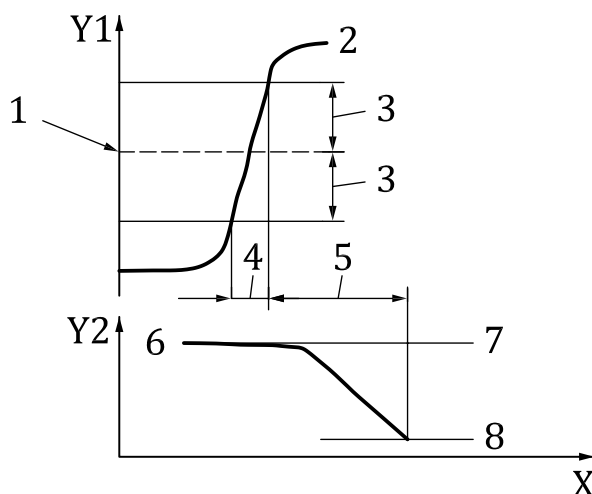
$$Cv = \frac{Cv_1 + Cv_2 + Cv_3}{3} \quad (5)$$

The Cv flow coefficient shall be assumed to be equal to the arithmetic mean of the three values. For Cv values, a tolerance of ±10 % against the declared value is permitted.

7.3.11 Response time

The response time for the trip pressure for over-pressure monitoring is determined at ambient temperature. The test starts with the closing member in the open position and with the SSD body at the maximum operating pressure. If the response time is longer for lower operating pressures the test will also be carried out at the minimum operating pressure. The monitored pressure is set at approximately 50 % of the set value. The monitor pressure is raised so that the AG range is covered within 0,2 s (see [Figure 8](#)). The response time shall be determined to an accuracy of <0,1 s.

The response time is measured from when the monitored pressure reaches the highest limit value of the AG until the closing member has reached its closed position. The test comprises three consecutive operations and the response time is the arithmetic mean of the three measured values. The response time shall be stated in the type and batch surveillance test report (with a special note if it is longer than 2 s), together with a description of the test conditions.



Key

- X time, t
- Y1 pressure, p
- Y2 closing member position
- 1 set value of the trip pressure
- 2 monitored pressure
- 3 AG
- 4 $t \leq 0,2 \text{ s}$
- 5 response time, t_a
- 6 closing characteristic
- 7 open position
- 8 closed position

Figure 8 — Measurement of the response time

7.3.12 Relatching difference and unlatching

7.3.12.1 Trip pressure for over-pressure monitoring

The tests are carried out at ambient temperature with the closing member in the closed position, the monitored pressure at the highest trip pressure for over-pressure monitoring and with the SSD body at maximum operating pressure.

The test starts with the monitored pressure in excess of the set value established in 7.3.9.4. The pressure is slowly lowered to the minimum value within the accuracy group, at which point it shall not be possible to re-latch the closing member.

Following this operation, the monitored pressure is adjusted to the relatching difference value specified by the manufacturer. In this condition the device is latched and for devices $DN \leq 150$ impact tests are carried out in accordance with Figure 9 and Table 6 (or an equivalent arrangement). The impact loads in accordance with Table 6, or other loads with equivalent energies, are applied 10 times directly to the outlet connection of the SSD by a drop hammer.

The test requirements are met if no unlatching of the shut-off device occurs.

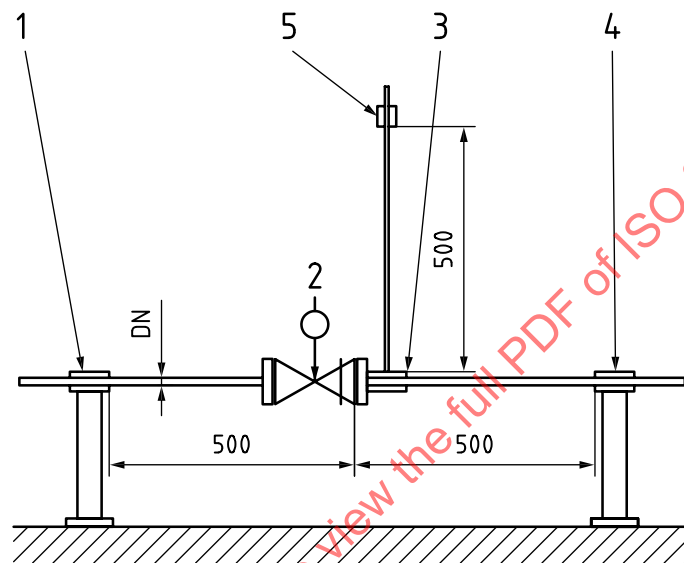
The established relatching difference and the test conditions shall be stated in the test report.

7.3.12.2 Lower trip pressure

The test for lower trip pressure is carried out in a similar way to that described in 7.3.12.1. The drop hammer's weights, M , are listed in Table 6.

Table 6 — Drop hammer's weights

DN	M (kg)	
	$DP \leq 16$	$DP > 16$
$DN \leq 50$	0,2	0,3
$65 \leq DN \leq 150$	0,4	0,6



Key

- 1 rigid clamping
- 2 test sample
- 3 impact absorbing plate
- 4 rigid clamping
- 5 drop hammer's weights, M
- DN nominal diameter

Figure 9 — Impact test rig

7.3.13 Verification of closing force

The data specified by the manufacturer for all relevant loads are checked by testing the SSD under operating conditions at ambient temperature. The test shall be carried out at the most unfavourable operating conditions, to be specified by the manufacturer.

For this purpose, the closing force F_s for both the initial and final position of the closing member are determined as the arithmetic mean of 3 tests respectively. Similarly, the friction, R , is determined. The friction to be considered is that measured with motion (not static friction). The resulting loads, S and W , are calculated.

The dynamic force, D , shall be considered only if in the fully open position it opposes the closing of the closing member. It is measured either at the most unfavourable conditions or calculated in accordance with [Formula \(6\)](#):

$$D = C_r \times A \times \rho_{ul} \times c_{ul}^2 \quad (6)$$

where

C_r is the dynamic factor (see [Annex I](#));

A is the area of closing member in contact with the fluid (see [Annex I](#)), in m^2 ;

ρ_{ul} is the density of the fluid with flow Q_u (see [7.3.17](#)) in kg/m^3 ;

c_{ul} is the velocity of gas at the inlet flange under volumetric flow rate Q_u (see [7.3.17](#)) in m/s .

The test is passed if the requirements of [7.2.16](#) are met.

For SSDs with variable mounting positions (see [7.3.3](#)) the most unfavourable case shall be considered.

7.3.14 Endurance and accelerated ageing

Test method:

- fit the SSD with the over-pressure setting element for the lowest specific set range and set to its mid-point;
- subject the SSD to a total of 100 closure cycles (which may include closure cycles previously carried out);
- subject the SSD to the internal tightness test in accordance with [7.3.6](#) and to accuracy group test according to [7.3.9](#);
- subject the SSD to a further 50 closure cycles with the temperature reduced to the lower limit value;
- after allowing the temperature to return to ambient temperature, subject the SSD to internal tightness and accuracy group tests in accordance with [7.3.6](#) and [7.3.9](#) respectively.

7.3.15 Method for testing of resistance of external surfaces to corrosion

Shall be according to ISO 23555-1:2022, 7.3.9.

7.3.16 Resistance to gas of non-metallic parts

This test shall be mandatory only on the non-metallic parts having an influence on the operation of the device.

Verification is carried out in accordance with the requirement in ISO 23555-1:2022, 5.2.2.

7.3.17 Verification of the strength of the trip mechanism, valve seat and closing member against dynamic impact of flowing gas

This test shall only be carried out on SSDs where there is a dynamic impact on the closing member in its fully open position.

The test shall be carried out with the closing member in its fully open position, on a test rig in accordance with [7.2.1](#).

Flow conditions shall be such that the product calculated according to [Formula \(7\)](#) is a maximum:

$$(Q_{ul}^2 \times \rho_{ul})_{\max} \quad (7)$$

where

Q_{ul} is the volumetric flow rate at the inlet flange at operating conditions (not at normal conditions), in m³/h;

ρ_{ul} is the density of the fluid with Q_{ul} at inlet flange in kg/m³.

Both the values of Q_{ul} and that of ρ_{ul} shall be chosen from those declared by the manufacturer.

The test operating conditions shall be such that [Formula \(8\)](#) applies:

$$(Q_{ut}^2 \times \rho_{ut}) = 1,5 \times (Q_{ul}^2 \times \rho_{ul})_{\max} \quad (8)$$

where

Q_{ut} is the volumetric flow rate at the inlet flange at test conditions (not at normal conditions), in m³/h;

ρ_{ut} is the density of the test fluid with Q_{ut} at the inlet flange in kg/m³.

The test is carried out on an SSD equipped with an over-pressure monitoring unit as follows:

- fit the SSD with the over-pressure setting element for the lowest specific set range and set to its mid-point;
- adjust the inlet pressure so that the density at the inlet is equal to outlet;
- increase the volumetric flow to Q_{ut} ;
- close the SSD by increasing the controlled pressure in the controller;
- decrease the controlled pressure in the controller and re-open the SSD;
- close the SSD by increasing the controlled pressure in the controller;
- repeat the operations e) and f) twice;
- check internal tightness and the accuracy group in accordance with [7.2.5.2](#) and [7.2.11](#) respectively;

Repeat the test with the SSD equipped with an under-pressure monitoring unit, using the following test method:

- fit the SSD with the under-pressure setting element for the highest specific set range and set to its mid-point;
- adjust the inlet pressure so that the density at the inlet is equal to the density at the outlet;
- increase the volumetric flow to Q_{ut} ;
- close the SSD by decreasing the controlled pressure in the controller;
- increase the controlled pressure in the controller and re-open the SSD;
- close the SSD by decreasing the controlled pressure in the controller;
- repeat the operations m) and n) twice;
- check internal tightness and the accuracy group in accordance with [7.2.5.2](#) and [7.2.11](#) respectively.

Alternative test methods may be used, e.g. those detailed in [Annex H](#).

8 Documentation

8.1 General

Shall be according to ISO 23555-1:2022, 8.1.

8.2 Documentation related to type test

Shall be according to ISO 23555-1:2022, 8.2 with the following additions:

- response time;
- notice for users of SSDs Functional class B on residual hazards on premature and/or unnoticed failure of pressure detecting element.

8.3 Documentation related to batch surveillance

Shall be according to ISO 23555-1:2022, 8.3.

8.4 Documentation related to the routine tests

8.4.1 Documentation provided at the request of the customer

Shall be according to ISO 23555-1:2022, 8.4.1.

8.4.2 Documentation provided with the safety shut-off device

8.4.2.1 General

Shall be according to ISO 23555-1:2022, 8.4.2 with the following addition:

8.4.2.2 Information on sizing

The manufacturer shall specify the sizing equation and the operational limits in terms of one of the following options:

- maximum allowable pressure drop through the SSD;
- maximum value of the product $(Q_u^2 \times \rho_u)_{\max}$

where:

- Q_u is the volumetric flow rate at the inlet flange at operating conditions (not at normal conditions), in m³/h;
- ρ_u is the density of fluid with Q_u at the inlet flange in kg/m³.
- in other equivalent terms.

This shall be specified in the operating instructions or in the relevant catalogue.

The maximum allowable flow rate for maximum allowable pressure drop may be calculated with the formulae detailed in [Annex I](#).

9 Marking

9.1 General

Shall be according to ISO 23555-1:2022, Clause 9, with the following addition.

NOTE For further information see [Annex E](#).

9.2 Basic requirements

Shall be according to ISO 23555-1:2022, 9.2.

9.3 Marking of various connections

Each of the following connections shall be marked:

- bypass;
- relatching device;
- manual closing device (see [Clause J.3](#)).

9.4 Marking of integrated gas pressure regulators

Shall be according to ISO 23555-1:2022, 9.2 and ISO 23555-2:2022, 9.5.

9.5 Other additional requirements

Subclause specific to this document.

The following further information shall be included in the marking:

- SSD model;
- maximum design pressure DP;
- fluid type;
- end connection type (flanged, threaded, etc.).
- specific set range W_{do} , W_{du} ;
- type of SSD (IS or DS);
- Functional class A or Functional class B;
- maximum component operating pressure, p_{max} , and the specific maximum design pressure (DPD) of safeguarded chambers (for differential strength SSDs only).

10 Packaging and transportation of finished product

Shall be according to ISO 23555-1:2022, Clause 10.

Annex A
(informative)

List of material

Shall be in accordance with ISO 23555-1:2022, Annex A.

STANDARDSISO.COM : Click to view the full PDF of ISO 23555-3:2024

Annex B
(normative)

Elastomeric material

Shall be in accordance with ISO 23555-1:2022, Annex B.

STANDARDSISO.COM : Click to view the full PDF of ISO 23555-3:2024

Annex C
(normative)

Vent limiter

Shall be in accordance with ISO 23555-1:2022, Annex C.

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Annex D
(normative)

Compliance evaluation

Shall be in accordance with ISO 23555-1:2022, Annex D and the additional specific test method and requirements as detailed in [Clause 7](#) of this document.

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Annex E

(informative)

Inspection certificate

This annex provides an example of the format which may be used for an inspection certificate and declaration of conformity with this document. When the SSD is built into a pressure regulator, the certificate shall also include information relevant to both the pressure regulator and the SSD (see ISO 23555-2:2022, Annex F).

MANUFACTURER'S TRADE MARK/NAME		Declaration of conformity according to ISO/IEC 17050-1		N° _____	Date _____
TYPE					
SERIAL NO.					
END CONNECTIONS:		DN	PN	FACE-TO-FACE _____	
assembly drawing.			overall dim. drawing.		
PRESSURE-CONTAINING PARTS		MATERIALS			
AUXILIARY DEVICES					
FUNCTIONAL CHARACTERISTICS					
Allowable pressure			PS	_____	bar
Maximum operating pressure			p_{umax}	_____	bar
Specific set range for over-pressure			W_{dso}	___to___	bar
Specific set range for under-pressure			W_{dsu}	___to___	bar
			b_p	_____	mm
Max. loading pressure ^{a)}				_____	bar
Response time			t_a	_____	s
Specific maximum design pressure of (chamber in differential strength SSD) ^{a)}			DPD	_____	bar
Max. operating pressure of (chamber in differential strength SSD) ^{a)}			p_{max}	_____	bar
Temperature class				_____	
Functional class				_____	
Leakage class in accordance with IEC 60534-4:2022, Table 2 ^{b)}				_____	
Settings: p_{dso} _____ bar p_{dsu} _____ bar (only if at shipment the adjusting screw is sealed)					
Accuracy group: AG ____ for over-pressure AG ____ for under-pressure b_{pu} _____ bar					
^{a)} When applicable ^{b)} When specified in the order specification. ^{c)} Type 3.2 in accordance with ISO 10474:2013.					

ISO 23555-3:2024(en)

TESTS	Strength test		
	Body and inner metallic partition walls 1,5 DP (min. DP + 2) _____ bar	Controller _____ bar	auxiliary devices _____ bar
	External tightness test		
	Body 1,1 DP _____ bar	Controller _____ bar	auxiliary devices _____ bar
	Internal tightness test at 0,1 bar and at 1,1 DP _____ bar		
	Setting of: _____ at _____ bar _____ at _____ bar _____ at _____ bar		
The above-described product(s) is(are) in compliance with ISO 23555-3.			
SIGNATURE OF THE PERSON RESPONSIBLE FOR THE TESTS		SIGNATURE OF THE PERSON AUTHORIZED BY THE MANUFACTURER	SIGNATURE OF THE INSPECTOR DESIGNATED BY A THIRD PARTY OR PURCHASER'S AUTHORIZED REPRESENTATIVE ^{c)} (for witnessing the acceptance test only)
a) When applicable b) When specified in the order specification. c) Type 3.2 in accordance with ISO 10474:2013.			

Annex F (informative)

Ice formation

F.1 General

The requirements and tests listed in this annex apply only to SSDs whose function could be impaired by external ice formation.

F.2 Requirements

These SSDs should be constructed or protected by a design suitable for avoiding negative influences of ice formation due to humidification.

F.3 Tests

The SSD is installed in a test rig and the trip pressure is adjusted for the lowest value of its set range. The relevant tests of [7.3.6](#) (internal tightness) and [7.3.9.3](#) (AG at limit temperatures) are carried out as follows.

- a) The SSD with its closing member in the open position is cooled down to the minimum operating temperature, and the value of the operating pressure is set to approximately 50 % of DP.
- b) After temperature stabilization, the ambient temperature is raised to $(0 \pm 2) ^\circ\text{C}$. Water is sprayed on the SSD from above and around (as if from a hemisphere) until a homogeneous layer of ice has formed.
- c) The ambient temperature is again lowered to the minimum operating temperature. After temperature stabilization the following items are verified in accordance with [7.3.9](#) and [7.3.6](#) by varying the pressure in the sensing line:
 - trip pressure;
 - internal leakage.

Check if the requirements of [7.2.5.2](#) (internal tightness) and [7.2.11](#) (Accuracy Group) are met.