INTERNATIONAL STANDARD

ISO 4126-1

Third edition
2013-07-15

Safety devices for protection against excessive pressure —

Part 1: Safety valves

Dispositifs de sécurité pour protection contre les pressions excessives — Partie 1: Soupapes de sûreté

Reference number
ISO 4126-1:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword .... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Symbols and units **4**

5 Design **4**
- 5.1 General 4
- 5.2 Valve end connections 5
- 5.3 Minimum requirements for springs 5
- 5.4 Materials 6

6 Production testing **6**
- 6.1 Purpose 6
- 6.2 General 6
- 6.3 Hydrostatic testing 6
- 6.4 Pneumatic testing 7
- 6.5 Adjustment of set or cold differential test pressure 8
- 6.6 Seat leakage test 8

7 Type testing **8**
- 7.1 General 8
- 7.2 Tests to determine operating characteristics 9
- 7.3 Tests to determine flow characteristics 11
- 7.4 Determination of the coefficient of discharge 12
- 7.5 Certification of coefficient of discharge 12

8 Determination of safety valve performance **13**

9 Sizing of safety valves **13**

10 Marking and sealing **13**
- 10.1 Marking 13
- 10.2 Sealing of a safety valve 13

Bibliography **14**

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4126-1 was prepared by Technical Committee ISO/TC 185, *Safety devices for protection against excessive pressure*.

This third edition cancels and replaces the second edition (ISO 4126-1:2004), which has been technically revised. It also incorporates the Technical Corrigendum ISO 4126-1:2004/Cor.1:2007.

ISO 4126 consists of the following parts, under the general title *Safety devices for protection against excessive pressure*:

— *Part 1: Safety valves*

— *Part 2: Bursting disc safety devices*

— *Part 3: Safety valves and bursting disc safety devices in combination*

— *Part 4: Pilot operated safety valves*

— *Part 5: Controlled safety pressure relief systems (CSPRS)*

— *Part 6: Application, selection and installation of bursting disc safety devices*

— *Part 7: Common data*

— *Part 9: Application and installation of safety devices excluding stand-alone bursting disc safety devices*

— *Part 10: Sizing of safety valves for gas/liquid two-phase flow*

— *Part 11: Performance testing*[1)]

Part 7 contains data that is common to more than one of the parts of ISO 4126 to avoid unnecessary repetition.

1) Under preparation.

Safety devices for protection against excessive pressure —

Part 1: Safety valves

1 Scope

This part of ISO 4126 specifies general requirements for safety valves irrespective of the fluid for which they are designed.

It is applicable to safety valves having a flow diameter of 4 mm and above which are for use at set pressures of 0,1 bar gauge and above. No limitation is placed on temperature.

This is a product standard and is not applicable to applications of safety valves.

2 Normative references

The following referenced documents are indispensable for the application 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 4126-7:2013, *Safety devices for protection against excessive pressure — Part 7: Common data*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
safety valve
valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges a quantity of the fluid so as to prevent a predetermined safe pressure being exceeded, and which is designed to re-close and prevent further flow of fluid after normal pressure conditions of service have been restored

Note 1 to entry: The valve can be characterized either by pop action (rapid opening) or by opening in proportion (not necessarily linear) to the increase in pressure over the set pressure.

3.2
direct loaded safety valve
safety valve in which the loading due to the fluid pressure underneath the valve disc is opposed only by a direct mechanical loading device such as a weight, lever and weight, or spring

3.3
assisted safety valve
safety valve which, by means of a powered assistance mechanism, may additionally be lifted at a pressure lower than the set pressure and will, even in the event of failure of the assistance mechanism, comply with all the requirements for safety valves given in ISO 4126

3.4
supplementary loaded safety valve
safety valve which has, until the pressure at the inlet to the safety valve reaches the set pressure, an additional force which increases the sealing force

Note 1 to entry: This additional force (supplementary load), which may be provided by means of an extraneous power source, is reliably released when the pressure at the inlet of the safety valve reaches the set pressure. The amount of supplementary loading is so arranged that if such supplementary loading is not released, the safety valve will attain its certified discharge capacity at a pressure not greater than 1,1 times the maximum allowable pressure of the equipment to be protected.

Note 2 to entry: Other types of supplementary loaded safety devices are dealt with in ISO 4126-5.

3.5
set pressure
predetermined pressure at which a safety valve under operating conditions commences to open

Note 1 to entry: It is the gauge pressure measured at the valve inlet at which the pressure forces tending to open the valve for the specific service conditions are in equilibrium with the forces retaining the valve disc on its seat.

3.6
maximum allowable pressure
PS
maximum pressure for which the protected equipment is designed

3.7
overpressure
pressure increase over the set pressure

Note 1 to entry: Overpressure is usually expressed as a percentage of the set pressure.

3.8
reseating pressure
value of the inlet static pressure at which the disc re-establishes contact with the seat or at which the lift becomes zero

3.9
cold differential test pressure
inlet static pressure at which a safety valve is set to commence to open on the test bench

Note 1 to entry: This test pressure includes corrections for service conditions, e.g. back pressure and/or temperature.

3.10
relieving pressure
pressure used for the sizing of a safety valve which is greater than or equal to the set pressure plus overpressure

3.11
back pressure
pressure that exists at the outlet of a safety valve as a result of the pressure in the discharge system

Note 1 to entry: The back pressure is the sum of the superimposed and built-up back pressures.

3.12
built-up back pressure
pressure existing at the outlet of a safety valve caused by flow through the valve and the discharge system

3.13
superimposed back pressure
pressure existing at the outlet of a safety valve at the time when the device is required to operate

Note 1 to entry: It is the result of pressure in the discharge system from other sources.

3.14
balanced bellows
device which minimizes the effect of back pressure on the set pressure and/or the operation of a safety valve

3.15
blowdown
difference between set and reseating pressures

Note 1 to entry: Blowdown is normally stated as a percentage of set pressure except for pressures of less than 3 bar when the blowdown is expressed in bar.

3.16
lift
actual travel of the valve disc away from the closed position

3.17
flow area
minimum cross-sectional flow area (but not the smallest area between disc and seat) between inlet and seat which is used to calculate the theoretical flow capacity, with no deduction for any obstruction

3.18
flow diameter
diameter corresponding to the flow area

3.19
theoretical discharge capacity
calculated capacity expressed in mass or volumetric units of a theoretically perfect nozzle having a cross-sectional flow area equal to the flow area of a safety valve

3.20
coefficient of discharge
value of actual flowing capacity (from tests) divided by the theoretical flowing capacity (from calculation)

3.21
certified (discharge) capacity
that portion of the measured capacity permitted to be used as a basis for the application of a safety valve

Note 1 to entry: It may, for example, equal the: a) measured flow rate times the derating factor; or b) theoretical flow rate times the coefficient of discharge times the derating factor; or c) theoretical flow rate times the certified de-rated coefficient of discharge.

3.22
DN (nominal size)
alphanumeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters DN followed by a dimensionless number having an indirect correspondence to the physical size of the bore or outside diameter of the component end connection

Note 1 to entry: The dimensionless number does not represent a measurable value and is not used for calculation purposes.

Note 2 to entry: Prefix DN usage is applicable to components bearing PN designations according to ISO 7268.

Note 3 to entry: Adapted from ISO 6708:1995, definition 2.1.

4 Symbols and units

Table 1 — Symbols and their descriptions

Symbol	Description	Unit
A	Flow area of a safety valve (not smallest area between seat and disc)	mm^2
K_d	Coefficient of discharge[a]	—
K_{dr}	Certified de-rated coefficient of discharge (K_d × 0,9)[a]	—
n	Number of tests	—
q_m	Theoretical specific discharge capacity	kg/(h·mm^2)
q'_m	Specific discharge capacity determined by tests	kg/(h·mm^2)

[a] K_d and K_{dr} are expressed as 0,xxx.

5 Design

5.1 General

5.1.1 The design shall incorporate guiding arrangements necessary to ensure consistent operation and seat tightness.

5.1.2 The seat of a safety valve, other than when it is an integral part of the valve shell, shall be fastened securely to prevent the seat becoming loose in service.

5.1.3 In the case of valves where the lift can be reduced to conform to the required discharge capacity, restriction of the lift shall not interfere with the operation of the valve. The lift restricting device shall be designed so that, if adjustable, the adjustable feature can be mechanically locked and access sealed. The lift restricting device shall be installed and sealed in accordance with the design of the manufacturer.

Valve lift shall not be restricted to a value less than 30 % of unrestricted lift or 1 mm, whichever is the greater.

5.1.4 Means shall be provided to lock and/or to seal all external adjustments in such a manner so as to prevent or reveal unauthorized adjustments of the safety valve.

5.1.5 Safety valves for toxic or flammable fluids shall be of the closed bonnet type to prevent leakage to atmosphere, or if vented, it shall be disposed of in a safe place.

5.1.6 Provision shall be made to prevent liquid collecting on the discharge side of the safety valve shell.

5.1.7 The design stress of pressure-retaining shells shall not exceed that specified in the appropriate standards.

NOTE For example, EN 12516 or ANSI/ASME B 16.34 may be used as reference.

5.1.8 The materials for adjacent sliding surfaces such as guide(s) and disc/disc holder/spindle shall be selected to ensure corrosion resistance and to minimize wear and avoid galling.

5.1.9 The materials for the seat and disc of safety valves shall be selected to ensure resistance to metallic bonding between these two surfaces in order to prevent an increase of set pressure, e.g. sticking or cold working.

5.1.10 Sealing elements which may adversely affect the operating characteristics by frictional forces are not permitted.

5.1.11 Easing gear shall be provided when specified.

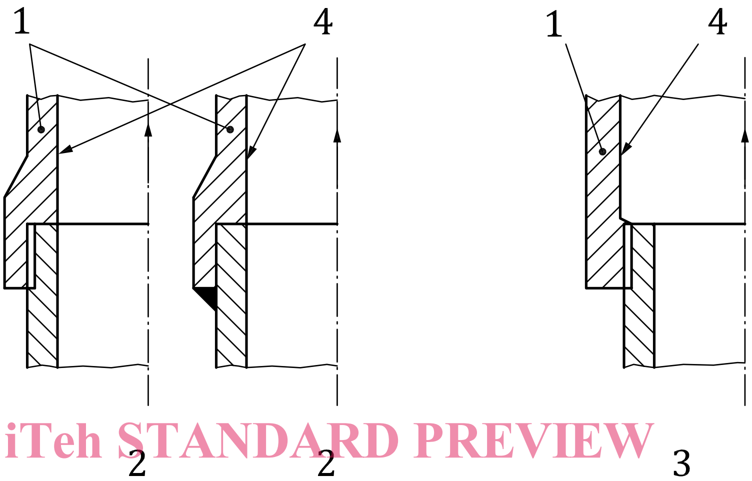
5.1.12 Safety valves shall be constructed so that breakage of any part, or failure of any device, will not obstruct free and full discharge through the valve.

5.2 Valve end connections

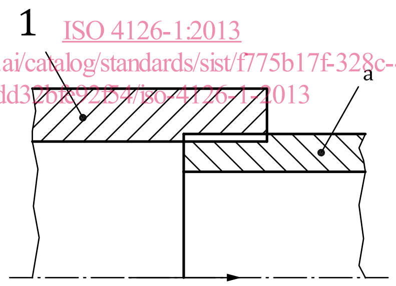
The inlet design of valve end connections, regardless of type, shall be such that the internal area of the external pipe or stub connection at the safety valve inlet is at least equal to that of the valve inlet connection [see Figure 1 a)].

The outlet design of valve end connections, regardless of type, shall be such that the internal area of the external pipe connection at the safety valve outlet is at least equal to that of the valve outlet, except those valves with female threaded outlet connections [see Figure 1 b)].

NOTE See Clause 7 regarding type testing.



a) Inlet



b) Outlet

Key

1 valve

2 satisfactory

3 unsatisfactory

4 required internal diameter of the safety valve for the valve to function properly

a If the nominal diameter of the pipe is not equal to the nominal diameter of the valve outlet, as shown, then a suitable pipe shall be fitted during testing as specified in 7.1.5.

Figure 1 — Design of end connections

5.3 Minimum requirements for springs

Springs shall be in accordance with ISO 4126-7.

5.4 Materials

Only approved materials shall be used for pressure-retaining shells.

NOTE For example, EN 12516 or any other published national or international material standards (e.g. ASME, ASTM, JIS, etc.) may be used as reference.

These materials and their temperature limitations shall be suitable for pressure-containing function.

6 Production testing

6.1 Purpose

The purpose of these tests is to ensure that all safety valves meet the requirements for which they have been designed without exhibiting any form of leakage from pressure-retaining components or joints.

6.2 General

It is permissible to adopt an alternative test of equal validity (e.g. proof of design tests associated with statistical sampling) to the hydrostatic test for valve shells with:

— threaded ends; and

— a maximum inlet diameter of 32 mm; and

— a ratio of bursting pressure to design pressure of at least 8; and

— a design pressure equal to or less than 40 bar; and

— for use with non-hazardous fluids;

and also for valves as above but with:

— a design pressure greater than 40 bar; and

— a ratio of bursting pressure to design pressure of at least 10; and

— material which is either wrought or forged.

All temporary pipes and connections and blanking devices shall be adequate to safely withstand the test pressure.

Any temporary welded-on attachments shall be carefully removed and the resulting weld scars shall be ground flush with the parent material. After grinding, all such scars shall be inspected by using magnetic particle or fluid penetrant techniques.

6.3 Hydrostatic testing

6.3.1 Application

The portion of the valve from the inlet to the seat shall be tested to a pressure 1,5 times the manufacturer's stated maximum pressure for which the safety valve is designed.

The shell on the discharge side of the seat shall be tested to 1,5 times the manufacturer's stated maximum back pressure for which the valve is designed. This pressure can be lower than that given by the outlet flange rating.

6.3.2 Duration

The test pressure shall be applied and maintained at the required magnitude for a sufficient length of time to permit a visual examination to be made of all surfaces and joints, but in any case for not less than the times given in Table 2. For tests on the discharge side of the seat, the testing time shall be based on the pressure specified in 6.3.1 and the discharge size.

Table 2 — Minimum duration of hydrostatic test

Nominal size DN	**Minimum duration** in seconds
DN ≤ 50	15
65 ≤ DN ≤ 200	60
DN ≥ 250	180

6.3.3 Acceptance criteria

No leakage from the tested parts as defined in 6.3.1 is accepted.

6.3.4 Safety requirements

Water of suitable purity shall normally be used as the test medium. Where other liquids are used, additional precautions may be necessary. Valve bodies shall be properly vented to remove entrapped air.

If materials which are liable to failure by brittle fracture are incorporated in that part of the safety valve which is to be hydrostatically tested, then both the safety valve, or part thereof, and the testing medium shall be at a sufficient temperature to prevent the possibility of such failure.

No valve or part thereof undergoing pressure testing shall be subjected to any form of shock loading, for example hammer testing.

6.4 Pneumatic testing

6.4.1 Application and duration of test

Pressure testing with air or other suitable gas should be avoided but may be carried out in place of the standard shell hydrostatic test with the agreement of all parties involved in the following cases:

a) valves of such design and construction that make it not practicable for them to be filled with liquid; and/or

b) valves that are to be used in service where even small traces of water cannot be tolerated.

The portions of the valve to be tested, test pressure and duration of application shall be as specified in 6.3.

6.4.2 Safety requirements

The hazards involved in pneumatic pressure testing shall be considered and adequate precautions taken.

Particular attention is drawn to some relevant factors as follows:

a) if a major rupture of the valve should occur at some stage during application of pressure, considerable energy will be released; hence no personnel should be in the immediate vicinity during pressure raising (for example a given volume of air contains 200 times the amount of energy that a similar volume of water contains, when both are at the same pressure);

b) the risk of brittle failure under test conditions shall have been critically assessed at the design stage and the choice of materials for valves that are to be pneumatically tested shall be such as to avoid