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Safety devices for protection against excessive pressure —

Part 5: Controlled safety pressure relief systems (CSPRS)

Dispositifs de sécurité pour protection contre les pressions excessives — Partie 5: Dispositifs de sécurité asservis (CSPRS)

Reference number
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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.

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 4126-5 was prepared by Technical Committee ISO/TC 185, *Safety devices for protection against excessive pressure*.

This second edition cancels and replaces the first edition (ISO 4126-5:2004), which has been technically revised. It also incorporates the Technical Corrigenda ISO 4126-5:2004/Cor 1:2006 and ISO 4126-5:2004/Cor 2:2007.

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 development.

Safety devices for protection against excessive pressure —

Part 5:
Controlled safety pressure relief systems (CSPRS)

1 Scope

This part of ISO 4126 specifies the requirements for controlled safety pressure relief systems (CSPRS) irrespective of the fluid for which they are designed.

It is applicable for main valves having a flow diameter of 4 mm and above which are for use at 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.

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
controlled safety pressure relief system
CSPRS
system consisting of a main valve in combination with a control unit

Note 1 to entry: See Figure 1 for the components of a CSPRS.

Note 2 to entry: On reaching the set pressure, the operating forces on the main valve are by means of the control unit automatically applied, released or so reduced that a main valve discharges a specified quantity of the fluid so as to prevent the predetermined pressure being exceeded. The system is so designed that the main valve re-closes and prevents a further flow of fluid after normal pressure conditions of service have been restored.

Note 3 to entry: Specific types of CSPRS are installed to protect the downstream system by preventing further fluid input (safety shut-off valve). In this case the closing function shall meet the same requirements as the opening function of the relief valve (see 5.1.5).

3.2
main valve
valve consisting of the parts of a CSPRS through which the discharge capacity is achieved, and the actuator

3.3
relieving principle
principle in which a main valve opens when the operating force is released or reduced, and in which the main valve closes when the operating force is re-applied

Note 1 to entry: See Figure 2, Type 1.

3.4
loading principle
principle in which a main valve opens when the operating force is applied, and in which the main valve closes when the operating force is removed

Note 1 to entry: See Figure 2, Type 2.

3.5
control unit
unit which establishes the opening and closing of the main valve

Note 1 to entry: The arrangement shall consist of redundant individual control paths in operation (see 5.1.13 and 5.1.15). The individual control path may consist of pressure tapping line, pressure sensor, sensing line, control module and control line [see Figures 1 a), 1 b) and 1 c), principle for two control paths].

3.6
pressure tapping line
line to the pressure sensor

3.7
sensing line
line between the pressure sensor and control module

3.8
control line
line between the control module and the main valve

3.9
pressure sensor
comparator in which a predetermined adjustable value of pressure is compared with the actual system pressure

Note 1 to entry: On reaching the predetermined pressure, a signal is transmitted to the control unit. The signal to the control unit is removed when the system pressure has been lowered to a predetermined pressure.

3.10
control module
module which transforms the signal from the pressure sensor into a force to operate the actuator of the main valve

3.11
closed circuit principle
principle characterized by the fact that on failure of the external control energy, the control unit effects the loading or relief of the main valve

3.12
open circuit principle
principle characterized by the fact that on failure of the external control energy the control unit does not change the loading or relief of the main valve

3.13
operating force
force which causes the main valve to operate

3.14
set pressure of a CSPRS
predetermined pressure at which a main valve disc under operating conditions commences to open

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

3.15
maximum allowable pressure
PS
maximum pressure for which the protected equipment is designed

3.16
overpressure
pressure increase over the set pressure, usually expressed as a percentage of the set pressure

3.17
reseating pressure
value of the inlet static pressure at which the main valve disc re-establishes contact with the seat or at which the lift becomes zero

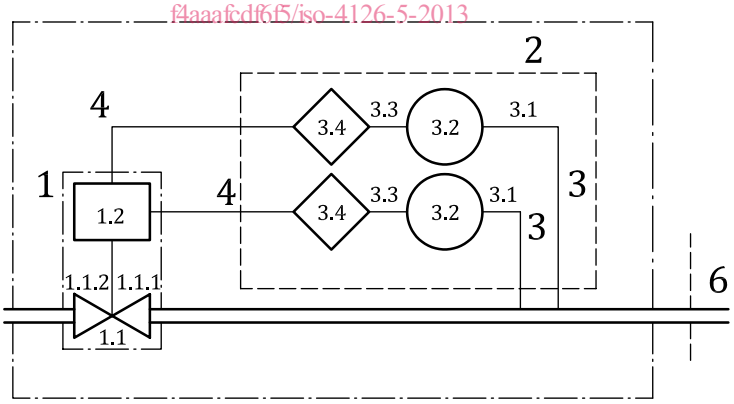
3.18
cold differential test pressure
inlet static pressure at which the main valve is set to commence to open on the test bench

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

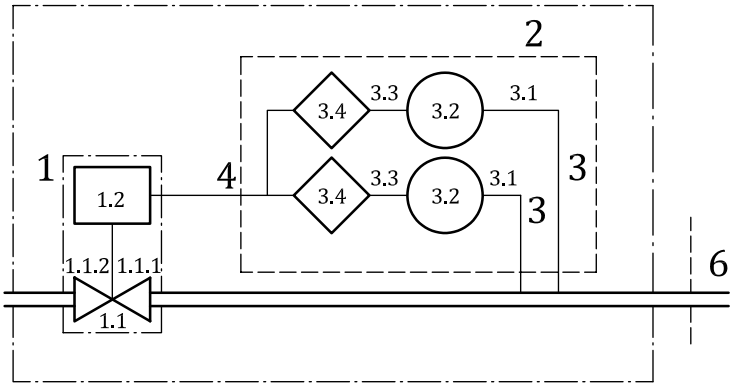
3.19
relieving pressure
pressure used for the sizing of a CSPRS which is greater than or equal to the set pressure plus overpressure

3.20
blowdown
difference between set and reseating pressures, normally stated as a percentage of set pressure except for pressures of less than 3 bar when the blowdown is expressed in bar

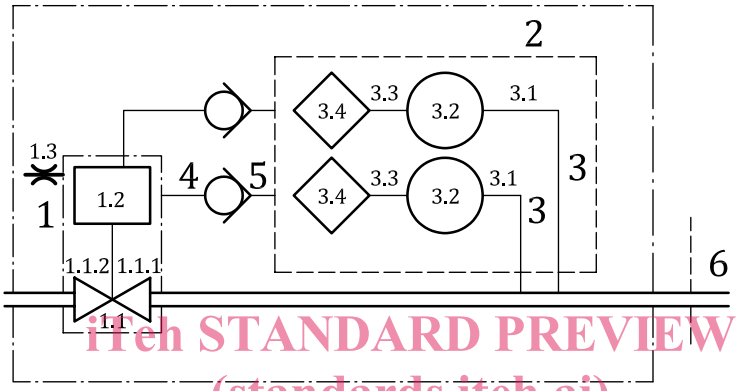
3.21
opening sensing pressure
predetermined pressure which activates the pressure sensor



a) Two control lines, relieving principle



b) One control line, relieving principle

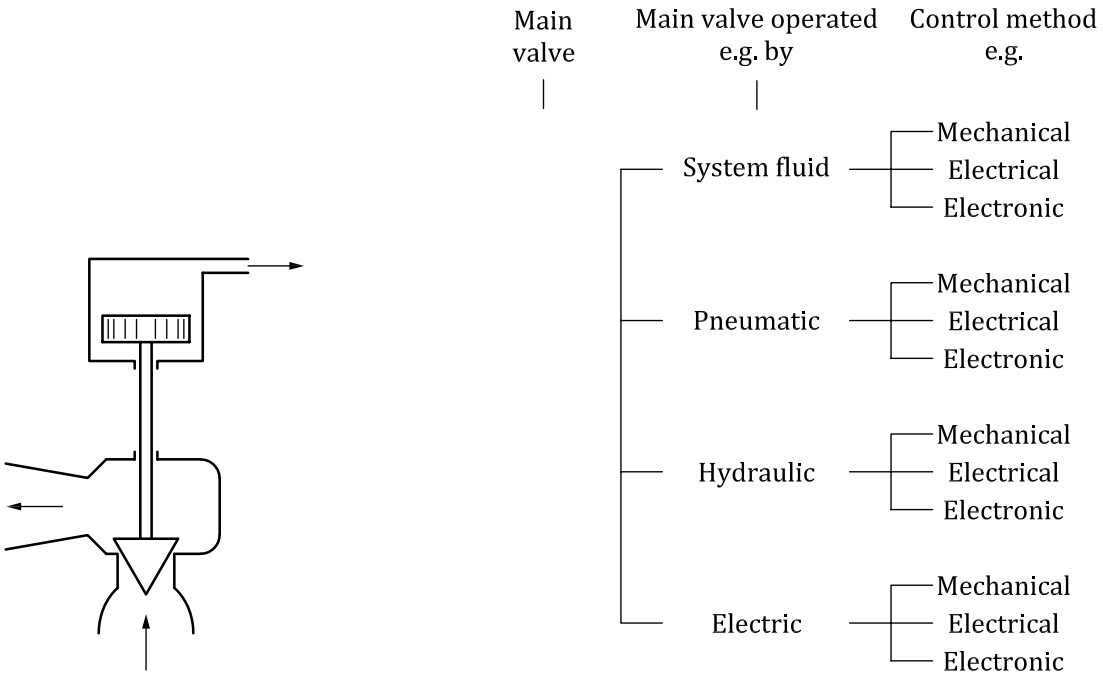


c) Two control lines, loading principle

Key

1 main valve
1.1 body
1.1.1 inlet port
1.1.2 outlet port
1.2 actuator
1.3 vent
2 control unit
3 individual control path
3.1 pressure tapping line
3.2 pressure sensor
3.3 sensing line
3.4 control module
4 control line
5 check valve
6 protected system

Figure 1 — Typical examples of redundancy for two individual control paths



a) Type 1: Relieving principle

b) Type 2: Loading principle

Figure 2 — Operating principle of the main valve

3.22
closing sensing pressure
predetermined pressure which deactivates the pressure sensor

3.23
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.

3.24
built-up back pressure
pressure existing at the outlet of the main valve caused by flow through the main valve and the discharge system

3.25
superimposed back pressure
pressure existing at the outlet of the main 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.

3.26
balanced bellows
bellows device which minimizes the effect of superimposed back pressure on the set pressure of a safety valve

3.27
lift
actual travel of the main valve disc away from the closed position

3.28
flow area
minimum cross-sectional flow area (but not the smallest area between seat and disc) between inlet and seat which is used to calculate the theoretical flow capacity, with no deduction for any obstruction

3.29
flow diameter
diameter corresponding to the flow area

3.30
theoretical discharge capacity
calculated capacity of a theoretically perfect nozzle having a cross-sectional flow area equal to the flow area of the main valve

Note 1 to entry: Expressed in mass or volumetric units.

3.31
coefficient of discharge
value of actual flowing capacity (from tests) divided by the theoretical flowing capacity (from calculation)

3.32
certified (discharge) capacity
that portion of the measured capacity permitted to be used as a basis for the application of the CSPRS

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

3.33
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.

3.34
opening time
time interval for the main valve disc to move from the closed to the fully open position

3.35
reseating time
time interval for the main valve disc to move from the fully open to the closed position

3.36
opening dead time
time interval from the detection of the opening sensing pressure and the commencement of the opening of the main valve

3.37
reseating dead time
time interval from the detection of the closing sensing pressure and the commencement of the closing of the main valve

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 ($K_d \times 0,9$)[a]	—
n	Number of tests	—
q_m	Theoretical specific discharge capacity	$kg/(h \cdot mm^2)$
q'_m	Specific discharge capacity determined by tests	$kg/(h \cdot mm^2)$

[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 any valve in the system, other than where it is an integral part of the valve shell, shall be fastened securely to prevent the seat becoming loose in service.

5.1.3 All external adjustments shall be locked and/or sealed in such a manner so as to prevent or reveal unauthorized adjustments of the CSPRS.

5.1.4 In the case of main valves with restricted lift, the lift restricting device shall limit the main valve lift but shall not otherwise interfere with the operation of the main valve. The lift restricting device shall be designed so that, if adjustable, the adjustable feature can be mechanically locked and sealed. The lift restricting device shall be installed and sealed in accordance with the design of the manufacturer.

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

5.1.5 For CSPRS working as safety shut-off valves it has to be assumed that the main valve cannot be closed completely as a result of particles in the fluid. Upstream of the main valves, devices such as perforated discs or strainers shall be installed. With the size of these bores or perforations, the leakage rate of the main valve shall be determined.

5.1.6 Any CSPRS for toxic or flammable fluids shall be so designed to prevent leakage to atmosphere or if vented it shall be disposed of in a safe place.