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Safety devices for protection against excessive pressure —

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

Dispositifs de sécurité pour protection contre les pressions excessives —

Partie 3: Soupapes de sûreté et dispositifs de sûreté à disque de rupture en combinaison

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Contents

Page

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 4126-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves*, ISO/TC 185, *Safety devices for protection against excessive pressure*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 4126-3 cancels and replaces ISO 6718:1991, of which it constitutes a technical revision.

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 7 contains data which is common to more than one of the parts of this standard to avoid unnecessary repetition.

Introduction

Bursting disc safety devices can be used in conjunction with safety valves in following cases:

a) to protect the safety valve against corrosion, fouling or operating conditions which could affect the safety valve performance;

b) to prevent leakage;

c) to prevent total loss of contents from the protected equipment following the bursting of the bursting disc.

The term *combination* is used to describe the close-coupled (i.e. within 5 pipe diameters) assembly of a bursting disc safety device with a safety valve or CSPRS, as defined by this part of ISO 4126. In some cases, the bursting disc safety device and the safety valve or CSPRS are connected together to form the combination by a short length of pipe or a spool piece.

Safety devices for protection against excessive pressure —

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

1 Scope

This part of ISO 4126 specifies the requirements for a product assembled from the in-series combination of safety valves or CSPRS (controlled safety pressure relief systems) according to ISO 4126-1, ISO 4126-4 and ISO 4126-5, and bursting disc safety devices according to ISO 4126-2 installed within no more than five pipe diameters from the valve inlet. It specifies the design, application and marking requirements for such products, which are used to protect pressure vessels, piping or other enclosures from excessive pressure, and which comprise the bursting disc safety device, a safety valve or CSPRS and, where applicable, a short length of connecting pipe or spool piece. In addition, it gives a method for establishing the combination discharge factor used in sizing combinations.

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 4126-1:2004, *Safety devices for protection against excessive pressure — Part 1: Safety valves*

ISO 4126-2:2003, *Safety devices for protection against excessive pressure — Part 2: Bursting disc safety devices*

ISO 4126-4:2004, *Safety devices for protection against excessive pressure — Part 4: Pilot-operated safety valves*

ISO 4126-5:2004, *Safety devices for protection against excessive pressure — Part 5: Controlled safety pressure relief systems (CSPRS)*

ISO 4126-6:2003, *Safety devices for protection against excessive pressure — Part 6: Application, selection and installation of bursting disc safety devices*

EN 764-7:2002, *Pressure equipment — Part 7: Safety systems for unfired pressure equipment*

EN 13480-1:2002, *Metallic industrial piping — Part 1: General*

EN 13480-2:2002, *Metallic industrial piping — Part 2: Materials*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2002, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2002, *Metallic industrial piping — Part 5: Inspection and testing*

EN 13480-6:2002, *Metallic industrial piping — Part 6: Additional requirements for buried piping*

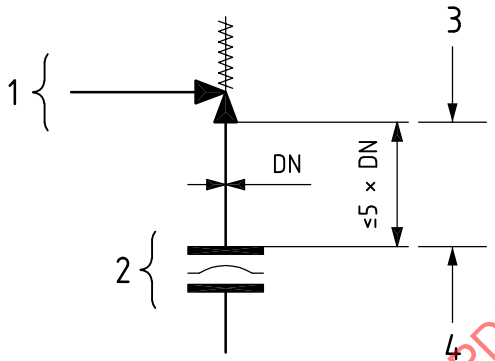
CEN/TR 13480-7:2002, *Metallic industrial piping — Part 7: Guidance on the use of conformity assessment procedures*

3 Terms and definitions

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

3.1
combination
installation which comprises a bursting disc safety device installed within five pipe diameters (from outlet of bursting disc holder to inlet of valve) before the inlet of a safety valve or a CSPRS

See Figure 1.



Key
1 safety valve or CSPRS
2 bursting disc safety device
3 safety valve or CSPRS inlet
4 bursting disc safety device outlet

NOTE Other bursting disc safety device configurations used in conjunction with safety valves or CSPRS are specified in ISO 4126-6.

Figure 1 — Diagram of combination showing relative distance

3.2
combination discharge capacity factor
F_d
factor used to determine the discharge capacity of a safety valve or CSPRS when the safety valve or CSPRS is used in combination with a bursting disc safety device installed upstream of the safety valve or CSPRS

3.3
flow resistance factor
K_r
factor which determines the resistance to flow in a pipe work system caused by the presence therein of a burst bursting disc, forming part of a bursting disc safety device, installed in the system

NOTE Its symbol, K_r, is a dimensionless factor expressed as the velocity head loss.

3.4
bursting disc safety device
non-reclosing pressure relief device actuated by differential pressure and designed to function by the bursting of the bursting disc(s)

NOTE It is the complete assembly of installed components including, where appropriate, the bursting disc holder.

3.5
bursting disc assembly
complete assembly of the components installed in the bursting disc holder to perform the desired function

3.6
bursting disc
pressure-containing and pressure-sensitive component of a bursting disc safety device

3.7
bursting disc holder
part of a bursting disc safety device that retains the bursting disc assembly in position

3.8
specified bursting pressure
bursting pressure quoted with a coincident temperature when defining the bursting disc requirements

NOTE It is used in conjunction with a **performance tolerance** (3.11).

3.9
specified maximum bursting pressure
maximum bursting pressure quoted with the coincident temperature when defining the bursting disc requirements

NOTE It is used in conjunction with a **specified minimum bursting pressure** (3.10).

3.10
specified minimum bursting pressure
minimum bursting pressure quoted with the coincident temperature when defining the bursting disc requirements

NOTE It is used in conjunction with a **specified maximum bursting pressure** (3.9).

3.11
performance tolerance
range of pressure between the specified minimum bursting pressure and the specified maximum bursting pressure or the range of pressure in positive and negative percentages or quantities which is related to the specified bursting pressure

3.12
operating pressure
pressure existing at normal operating conditions within the system being protected

3.13
relieving pressure
maximum pressure under discharge conditions in the pressurized system

NOTE It may differ from the bursting pressure of the bursting disc.

3.14
bursting disc safety device discharge area
minimum cross-sectional flow area of the bursting disc safety device, taking into consideration the possible reduction of the cross-section by, for example, back pressure supports, catching devices or parts of the bursting disc which remain after bursting

3.15
batch
quantity of bursting discs or bursting disc safety devices made as a single group of the same type, size, materials and specified bursting pressure requirements, and where the bursting discs are manufactured from the same lot of material

3.16
bursting pressure
value of the differential pressure between the upstream side and the downstream side of the bursting disc when it bursts

3.17
bursting disc safety device discharge capacity
rate at which a bursting disc safety device can discharge fluid after bursting of the bursting disc

3.18
replacement period
time period beginning at the installation of a bursting disc assembly and ending with its replacement

3.19
pressure relief system
system intended for the safe relief of fluids from pressure equipment for prevention of excessive pressure

NOTE It can consist of equipment nozzle, inlet piping, pressure relief device(s) and discharge piping to atmosphere/collecting vessel/header.

3.20
discharge coefficient
α
coefficient which determines reduction of theoretical discharge capacity of a pressure relief system by the simplified approach which incorporates a burst bursting disc, forming part of a bursting disc safety device

NOTE For details of the simplified approach, see ISO 4126-6:2003, Annex C.

3.21
certified derated coefficient of discharge
K_{dr}
adjusted coefficient of discharge for the safety valve

NOTE See ISO 4126-1.

4 Symbols

A flow area of a safety valve (not curtain area), in square millimetres

F_d combination discharge capacity factor

K_d certified coefficient of discharge of the combination

K_{dr} certified derated coefficient of discharge for safety valve

K_r flow resistance factor

α discharge coefficient for bursting disc safety device

5 Design of combination

5.1 Bursting disc safety devices shall comply with ISO 4126-2 and meet the requirements of 6.2.

5.2 Safety valves shall comply with ISO 4126-1 or ISO 4126-4.

5.3 CSPRS shall comply with ISO 4126-5.

5.4 Where additional components are used to combine the bursting disc safety device and the safety valve or CSPRS into a combination (e.g. spool piece), these shall comply with EN 13480.

5.5 The space between the bursting disc safety device and the safety valve or CSPRS shall be provided with a connection to prevent or detect an unacceptable build up in pressure.

NOTE Bursting discs, being pressure-differential devices, require a higher pressure in the protected equipment to burst the bursting disc if pressure builds up in the space between the bursting disc and the safety valve or the CSPRS. This occurs when leakage develops through the bursting disc due to corrosion, due to back pressure in the discharge piping or other cause.

5.6 After bursting, the bursting disc petals shall not protrude into the valve inlet unless the influence of the petals on the capacity and performance of the safety valve or CSPRS have been assessed and proven to meet the requirements of Clause 7.

5.7 The design of the bursting disc safety device shall be such that on bursting, release of bursting disc material shall not impair the performance of the safety valve or the CSPRS.

5.8 The nominal pipe size of the bursting disc safety device shall be not less than the nominal size of the inlet of the safety valve or CSPRS.

6 Installation of combination

6.1 The combination shall be installed in accordance with ISO 4126-6.

6.2 The connection from the protected equipment to the safety valve inlet should be as short as practicable and designed so that the total pressure drop to the safety valve or CSPRS inlet, including the effect of the bursting disc safety device (based on ISO 4126-6:2003, Annex C) shall not exceed 3 % of the set pressure of the safety valve or the CSPRS.

NOTE The 3 % pressure drop is determined from the flow through the combination at maximum relieving pressure of the safety valve or the CSPRS.

6.3 The discharge of the combination shall be disposed of safely and be prevented from unintentional flowing into other equipment to create a hazard (for example, into equipment out of service or undergoing maintenance). The discharge pipe, between the outlet of the combination and the atmosphere or venting system, shall be adequately drained at all times. Provision shall be made to absorb the reaction forces expected during the discharge of material (see also ISO 4126-6:2003, 7.2.5). It can be difficult to provide drainage points in a closed disposal system, but in this case the routing of the pipe work should avoid any low points where liquids can accumulate.

6.4 The supplier of the combination shall provide assembly and installation instructions in addition to the instructions provided by the manufacturers of the bursting disc safety device and the safety valve or CSPRS, taking into consideration the results of a hazard analysis.

7 Combination performance

7.1 The pressure in the equipment to be protected shall never exceed the allowable limits, e.g. as specified in EN 764-7:2002, 6.1.2 and 6.1.4.

7.2 The maximum limit of bursting pressure of the bursting disc safety device shall not exceed 110 % of the safety valve or CSPRS set pressure or a gauge pressure of 0,1 bar [1)], whichever is greater (see also EN 764-7:2002, 6.3.2.2). The minimum limit of the bursting disc safety device bursting pressure should be not less than 90 % of the safety valve or CSPRS set pressure.

7.3 When the combination is intended for liquid service, the bursting disc safety device and safety valve or CSPRS manufacturers shall be consulted.

NOTE Special attention needs to be given to the possibility of particular circumstances (e.g. thermal relief systems or hydraulic service) that can result in a flow of media insufficient to open the safety valve, when advice from the bursting disc safety device and safety valve or CSPRS manufacturers could be necessary.

7.4 The combination shall be characterized by a combination discharge capacity factor, F_d, determined according to Clause 8, 9 or 10 and to be applied in accordance with Clause 12.

8 Determination of combination discharge capacity factor, F_d, by testing

8.1 General

In order to determine the effect of the proximity of the burst bursting disc safety device on the coefficient of discharge of the safety valve, the manufacturer of the combination shall conduct tests to determine the combination discharge capacity factor, F_d.

Two different approaches to testing are permitted by this part of ISO 4126: the one-size method and the three-size method (see 8.4).

The one-size method can involve testing a specific combination intended for installation in a particular application. Alternatively, by selecting the largest flow area used in that size and type of safety valve and the lowest burst pressure of the bursting disc safety device design to be used in the combination, the one-size method can be used to provide a bounding and conservative value of F_d for a limited range of parameters (e.g. one size and type of safety valve but for a limited range of flow areas).

The three-size method is normally used where series manufacture of combinations takes place and the manufacturer of the combination wishes to derive a conservative value of F_d that can be used to cover the full product range.

8.2 Test requirements

8.2.1 For combinations to be used for compressible fluids, tests shall be carried out using dry saturated steam, superheated steam, air or compressible fluid of other known characteristics.

NOTE *Dry saturated steam* in this context refers to steam with a minimum dryness fraction of 98 % or a maximum degree of superheat of 10 °C. *Superheated steam* in this context refers to steam with a degree of superheat greater than 10 °C.

8.2.2 For combination devices to be used in liquid service, tests shall be carried out using water or liquid of known characteristics.

NOTE Methods to derive values of K_r for incompressible fluids are currently being developed and are to be included in future versions of the relevant parts of ISO 4126.

1) 1 bar = 0,1 MPa = 0,1 N/mm^2 = 10^5 N/m^2.

8.2.3 The test equipment shall be designed and operated such that the actual test flowing capacity measurement shall be accurate to within ± 2 %.

8.2.4 The safety valve or CSPRS tested shall have the largest flow area used in that size and type of valve, except where combination discharge capacity factor, F_d, is specified for smaller flow areas.

8.2.5 The bursting disc safety device shall be mounted on the inlet of the safety valve or CSPRS, taking into consideration the requirements of Clause 5, if applicable.

8.2.6 The tests shall use the lowest burst pressure of the bursting disc safety device design that is to be used in combination with the safety valve or CSPRS design.

8.2.7 The certification shall apply to the combination of the same design of safety valve or CSPRS and the same design of bursting disc safety device (internal flow path of holder) as those tested, irrespective of the external bursting disc holder geometry.

8.2.8 The test records shall include all observations, measurements, and instrument readings and calibration records necessary to attain the objectives of the tests. Original test records shall remain in the custody of the organization responsible for the test. Copies of all test records shall be furnished to each of the parties concerned with the tests. Corrections and corrected values shall be entered separately in the test record.

8.3 Test rig

Details for the test rig(s) and test conditions, including the proposed instrumentation and calibration procedures, shall be specified before testing commences.

8.4 Test method

The following two alternative methods of testing are permitted.

a) One-size combination

1) The combination discharge capacity factor determined by this method shall apply only to the size and type tested.

2) For each type or model of bursting disc safety device and safety valve or CSPRS, three bursting discs of the same specified bursting pressure shall be individually burst and flow tested in accordance with 8.5.

The test results so obtained may be used as applicable in the three-size method according to b).

b) Three-size combination

1) Three sequential sizes of combinations shall be tested.

2) For each of the three sizes of bursting disc safety device, three bursting discs of the same specified bursting pressure shall burst and be flow tested in accordance with 8.5. It is permissible to carry out the tests with one holder for each size of bursting disc.

8.5 Test procedure

8.5.1 The certified coefficient of discharge, K_d, of the safety valve or CSPRS used for the test shall be established without the bursting disc safety device, in accordance with ISO 4126-1, ISO 4126-4 or ISO 4126-5, at a relieving pressure no greater than 10 % above the valve set pressure or a gauge pressure of 0,1 bar, whichever is greater.

8.5.2 The bursting disc device shall then be installed at the inlet of the safety valve or the CSPRS and the bursting disc burst in accordance with 8.5.4 in order to operate the valve.

8.5.3 The appropriate safety precautions shall be observed when carrying out tests.

8.5.4 The combination shall be tested as follows.

a) With the combination installed in the test rig, the pressure at the inlet shall be increased to 90 % of the expected minimum bursting pressure in a time not less than 5 s. Thereafter, the pressure at the inlet shall be increased at a rate that allows accurate recording of the pressure until the bursting disc bursts.

b) The combination capacity test shall be performed at 10 % or a gauge pressure of 0,1 bar (whichever is greater) above the safety valve or CSPRS set pressure duplicating the individual safety valve or CSPRS capacity test. Maintain this pressure for a sufficient period of time to permit the rate of flow, temperature and pressure to reach stable conditions before recording the test data.

c) Determine K_d from the test of the combination by determining the ratio of the actual flow to the theoretical flow.

d) Repeat a), b) and c) for the remaining bursting disc safety devices of the same size.

8.6 Acceptance criteria of the tests

8.6.1 General

The results shall be approved and a combination discharge factor certified only if the following conditions are met.

8.6.2 Conditions applicable to the safety valve

The measured capacity of the tested safety valve shall be equal to or greater than the certified values of K_{dr} (see also ISO 4126-1:2004, Clause 7).

8.6.3 Conditions applicable to the bursting disc safety device

8.6.3.1 The bursting pressure of all bursting discs tested shall fall within the performance tolerance of the specified bursting pressure or within the maximum and minimum specified bursting pressure, whichever is marked on the bursting disc, and shall be in accordance with ISO 4126-2.

8.6.3.2 If any bursting disc does not burst in accordance with 8.6.3.1, the following conditions shall be satisfied.

a) If the bursting pressure of only one of the bursting discs of any one batch is not in accordance with 8.6.3.1, two additional tests shall be performed using bursting discs from the same batch and the results from these two substituted for the rejected results.

b) If more than one of the total of the bursting discs tested of any one batch, including any substitute test [see a)], bursts at a pressure not in accordance with 8.6.3.1, then that batch shall be rejected, and new tests of a different batch shall be conducted in accordance with 8.5.

c) The results of the test of capacity shall fall within 10 % of the average capacity of the three tests. Failure to meet this requirement shall be cause to require retesting to determine the cause of the discrepancies.