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Bursting discs and bursting disc devices

Disques de rupture et dispositifs à disque de rupture

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Contents

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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.

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.

International Standard ISO 6718 was prepared by Technical Committee ISO/TC 185, *Safety devices for protection against excessive pressure*, Sub-Committee SC 2, *Bursting discs*.

This second edition cancels and replaces the first edition (ISO 6718:1985), of which it constitutes a technical revision.

Annexes A, B, C and D of this International Standard are for information only.

Bursting discs and bursting disc devices

Section 1: General

1.1 Scope

This International Standard specifies requirements for bursting discs and bursting disc devices used to protect pressure vessels, piping or other enclosures from excessive pressure or vacuum. They are designed to burst or vent when the pressure differential across the bursting disc exceeds a predetermined value at a predetermined temperature.

1.2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9001:1987, *Quality systems — Model for quality assurance in design/development, production, installation and servicing.*

1.3 Definitions

For the purposes of this International Standard, the following definitions apply.

1.3.1 purchaser: Organization or individual who purchases the finished bursting disc or bursting disc device.

1.3.2 manufacturer: Organization which designs, constructs and tests the bursting disc or bursting disc device in accordance with the purchaser's specification.

1.3.3 bursting pressure: Value of the pressure differential across the bursting disc at which a bursting disc device functions.

It may be specified as a maximum or minimum value.

1.3.4 specified bursting pressure: Pressure, quoted with a coincident temperature, specified by the purchaser when defining the bursting disc requirement.

It may be specified as a maximum or minimum value.

1.3.5 average bursting pressure: Arithmetic average value of the bursting pressures, at the coincident temperature of the test bursts carried out, of a batch of bursting discs.

1.3.6 coincident temperature: Temperature used in conjunction with a bursting pressure.

1.3.7 operating temperature: Average temperature of the bursting disc and the surrounding parts during normal operation.

1.3.8 bursting tolerance: Maximum variation in test results in equal positive and negative quantities or percentages related to the average bursting pressure. When a zero manufacturing range is stated, the tolerance applies directly to the specified bursting pressure.

1.3.9 manufacturing range: Range of pressure within which the average bursting pressure of a batch of bursting discs shall fall in order to be acceptable for a particular application as agreed between the manufacturer and the purchaser.

1.3.10 performance tolerance: Range of pressure, in positive and negative quantities or percentages, which includes both the manufacturing range and

the bursting tolerance at a coincident temperature, and which is applied directly to the specified bursting pressure.

1.3.11 foil: Sheet or strip used for the manufacture of metallic bursting discs.

1.3.12 batch: Group of bursting discs of the same type, size, average bursting pressure and coincident temperature, manufactured from material of the same identity and properties, and made as a single group.

1.3.13 bursting disc device: Non-reclosing pressure-relief device actuated by differential pressure and designed to function by the bursting or venting of the bursting disc(s). It is the complete assembly of installed components including, where appropriate, the bursting disc holder.

1.3.14 bursting disc assembly: Complete assembly of components which are installed in the bursting disc holder to perform the desired function.

1.3.15 bursting disc: Pressure-containing and pressure-sensitive component of a bursting disc device.

1.3.16 bursting disc holder: That part of a bursting disc device which retains the bursting disc assembly in position.

1.3.17 back pressure: Static pressure existing at the outlet of a bursting disc device at the time the device is required to operate.

It is the result of pressure in the discharge system from other sources or as a result of vacuum on the upstream side.

1.3.18 back pressure support: That component of a bursting disc assembly which prevents the failure of the bursting disc due to back pressure differential.

A back pressure support which is intended to prevent the failure of the bursting disc when the system pressure falls below atmospheric pressure is sometimes referred to as a vacuum support.

1.3.19 baffle plate: Plate attached to the vent side of a bursting disc device or system to redirect discharge and/or to reduce recoil.

1.3.20 muffled outlet: Component of a bursting disc device which disperses the discharge.

1.3.21 stiffening ring: Integral component of the bursting disc assembly used primarily for the stiffening of fragile bursting discs.

1.3.22 coating: Layer of metallic or non-metallic material applied by brush, spraying, dipping, fluidized bed or other similar method to components of a bursting disc device.

1.3.23 lining: Additional sheet or sheets of material forming part of the bursting disc assembly or holder. The lining may be metallic or non-metallic.

1.3.24 plating: Metal layer applied to a bursting disc or disc holder by a plating process.

1.3.25 excess flow valve: Device which permits limited flow. When this flow is exceeded the valve closes.

1.3.26 conventional domed bursting disc: Bursting disc which is domed in the direction of the bursting pressure and designed to fail in tension.

(See figures 1 and 2.)

1.3.27 conventional slotted lined bursting disc: Conventional domed bursting disc made up of two or more layers, one of which is slit or slotted so as to reduce its strength and to control the bursting pressure of the bursting disc.

(See figure 3.)

1.3.28 reverse domed bursting disc: Bursting disc which is domed against the direction of the bursting pressure and designed to fail by buckling, bending or shearing.

(See figure 4.)

1.3.29 graphite bursting disc: Bursting disc manufactured in graphite and designed to fail by bending or shearing.

1.3.30 temperature shield: Device which protects a bursting disc from excessive temperature.

1.3.31 bursting disc device discharge area: Area which is the minimum cross-sectional flow area of the bursting disc device taking into consideration the possible reduction in the cross-section owing to, for example, back pressure supports, catching devices or parts of the bursting disc which remain after bursting or venting.

1.3.32 bursting disc device discharge capacity: Rate at which a bursting disc device can discharge fluid after bursting or venting of the bursting disc.

1.3.33 independent authority: That authority which, in the country concerned, bears responsibility for all aspects of surveillance of tests, checking of calculations and certification of bursting disc device discharge capacities.

1.3.34 service life: Time period beginning at the installation of a bursting disc assembly and ending when the bursting disc is replaced or when it bursts.

1.3.35 operating pressure: Pressure to which the bursting disc is exposed during normal operation.

1.3.36 inspection authority: Independent authority or association which verifies compliance with this International Standard.

1.3.37 lot of material: Unless otherwise stated in appropriate regulations or standards,

a) for metal; all material issuing from the same heat number and heat treatment batch and having a specified thickness with tolerances to an appropriate standard;

b) for impregnated graphite; all material of a specific grade and impregnant.

1.3.38 relieving pressure: Maximum pressure under discharge conditions in the pressurized system. It may differ from the bursting pressure of the bursting disc device (see A.1.5).

1.3.39 relieving temperature: Maximum temperature under discharge conditions in the pressurized system. It may differ from the coincident temperature specified for the bursting disc device.

1.4 Selection

1.4.1 Bursting discs are differential pressure devices, and therefore the pressure on each side of the bursting disc shall be taken into account.

1.4.2 As highly stressed components, bursting discs have a limited service life and may require replacement at regular intervals. The frequency of replacement depends on the type and material of the bursting disc, the corrosive nature of the environment, the fluctuations in operating temperature, operating pressure and back pressure, the ratio of differential pressure to minimum bursting pressure, the resistance to creep and fatigue and other operating conditions.

1.4.3 Bursting disc devices are frequently required to work in corrosive environments where corrosion may cause premature failure of the bursting disc. Materials likely to be affected by corrosion may be protected by coating, plating, lining or other suitable means which shall be supplied only by the manufacturer (see section 3).

1.4.4 The choice of the appropriate bursting disc material depends on the chemical and physical conditions that will be met on each side of the bursting disc when it is in service.

1.4.5 To function properly, bursting discs, and back pressure supports where required, shall be installed in accordance with the recommendations of the manufacturer.

1.4.6 When requested by the purchaser, data regarding the variation in bursting pressure with relation to the temperature for a batch of bursting discs shall be provided by the manufacturer.

NOTE 1 The bursting pressure of a bursting disc according to its material and type may vary with temperature. Generally a bursting disc operating at high temperatures has a lower bursting pressure than that at room temperature; a bursting disc operating at below room temperature has a higer bursting pressure than that at room temperature.

When a bursting disc is specified with a bursting pressure at a coincident temperature to protect a system, the bursting disc may not give the necessary protection at a lower temperature. The system has to be considered with regard to the bursting pressures of the bursting disc over the temperature range of the system.

Bursting discs may be protected from excessive temperature by suitable location, a temperature shield or by other means. The influence of the temperature protection should be considered when establishing the coincident temperature of the bursting disc.

1.4.7 The manufacturer's advice shall be sought when selecting a bursting disc for a particular application.

1.4.8 When reverse domed bursting discs are required for liquid relief the manufacturer shall be consulted.

1.5 Application

1.5.1 Subject to the requirements of appropriate regulations or standards, bursting discs may be used either as the sole safety device or in conjunction with safety valves.

1.5.2 The use of a bursting disc as a pressure-relieving device may be preferred in the following cases:

a) where pressure rise may be so rapid that the inertia of a safety valve would be a disadvantage;

b) where even minute leakage of the fluid cannot be tolerated under normal conditions;

c) where service conditions may involve deposition which could render a safety valve inoperative;

d) where cold service conditions could prevent a safety valve from operating.

1.5.3 Where a bursting disc alone is used as the relieving device, its maximum bursting pressure at the coincident temperature shall comply with the appropriate regulations or standards covering the system to be protected.

1.5.4 The selection of bursting discs for use on vessels which may be involved with extremely rapid and uncontrolled changes in pressure requires special consideration not covered by this International Standard.

1.5.5 Bursting disc devices may be used in combination with safety valves as permitted by the appropriate regulations or standards, and as specified below. The application of the bursting discs shall not adversely affect the operation of the safety valve nor result in excess pressure to the system.

1.5.5.1 Bursting disc devices in combination with safety valve(s) may be used in the following cases:

a) in series, to protect the safety valve against corrosion, fouling or service conditions which may affect the safety valve performance;

b) in series, to prevent leakage;

c) in series, to prevent total loss of contents from the pressure system following venting of the bursting disc;

d) in parallel, as an additional safeguard.

1.5.5.2 A bursting disc device may be installed before the inlet of a safety valve if the following requirements are met.

a) The maximum bursting pressure at the coincident temperature shall comply with the appropriate regulations or standards for the system being protected.

b) If the discharge capacity and the operating characteristics of the particular combination of safety valve and bursting disc device have been established by test in accordance with appropriate regulations or standards the test results shall be used.

c) Where a combination has not been tested

   1) the bursting disc device discharge area shall be such as to satisfy the safety valve inlet piping pressure drop requirements stated in the appropriate regulations or standards,

   2) the bursting disc device discharge area shall be not less than 80 % of the nominal area of the safety valve inlet, and

   3) the flow capacity of the combination shall be assumed to be no greater than 80 % of the rated relieving capacity of the safety valve alone.

d) The space between the bursting disc and safety valve shall be provided with a means for monitoring any pressure build-up. This cavity may also be vented by means of an excess-flow valve.

   NOTE 2 Bursting discs, since they are pressure differential devices, require a higher system pressure to burst if pressure builds up in the space between the bursting disc and safety valve, which will occur should leakage develop in the bursting disc due to corrosion or other causes.

e) In situations where fragmentation or release of bursting disc material may occur, the installation shall be designed so that parts or particles of the bursting disc cannot render the safety valve inoperative nor reduce the flow area of the safety valve.

1.5.5.3 A bursting disc device may be installed after the outlet of a safety valve if the following requirements are met.

a) The safety valve is so designed that its operating characteristics shall not be adversely affected by the bursting disc installed.

b) The system shall be designed so that the safety valve opens at its set pressure. The space between the safety valve disc and the bursting disc shall be vented or drained to prevent pressure build-up.

c) The maximum bursting pressure of the bursting disc at the coincident temperature plus any pressure in the discharge piping shall not exceed

   1) the pressure permitted by the safety valve manufacturer,

   2) the design pressure of any pipe or fitting between the safety valve and the bursting disc, and

   3) the pressure permitted by the appropriate regulations or standards.

d) In installations where fragmentation or release of bursting disc material may occur, the system shall be designed so that the performance of the safety valve is not impaired and adequate venting is provided.

e) On bursting, the bursting disc device discharge area shall not affect the discharge capacity and the operating characteristics of the safety valve.

f) The contents of the protected system shall be clean fluids, free from gumming or fouling matter, so that accumulation in the space between the safety valve inlet and the bursting disc (or in any other outlet that may be provided) does not obstruct the outlet.

NOTE 3 A bursting disc assembly on the discharge side of a safety valve should not be replaced while there is any possibility of the safety valve opening.

1.5.5.4 A bursting disc device may be installed both before and after a safety valve provided that the requirements of 1.5.5.2 and 1.5.5.3 are taken into consideration.

1.5.5.5 A bursting disc device fitted in parallel with a safety valve as an additional safeguard, such as to protect the system against the consequence of a rapid rise in pressure, shall be specified to burst at a pressure not exceeding that specified in the appropriate regulations or standards.

1.5.5.6 A bursting disc device may be fitted in series with a second bursting disc device. In such cases the system shall be designed in accordance with the following requirements.

a) The space between the bursting discs shall be large enough to ensure the correct functioning of the bursting discs.

b) The space between the bursting discs shall be provided with a means of monitoring any pressure build-up. This space may also be vented by means of an excess-flow valve.

NOTE 4 Bursting discs, since they are pressure differential devices, require a higher system pressure to burst if pressure builds up in the space between the bursting discs, which will occur should leakage develop in the bursting disc due to corrosion or other causes.

1.6 Installation

1.6.1 A bursting disc device shall be placed as close as practicable to the space it is intended to protect, taking into account pressure pulses, temperature conditions, etc. The discharge system shall be of ample size and as straight and as short as practicable, terminating in such a way as to avoid dangerous or damaging conditions arising on venting.

1.6.2 Bursting disc devices shall be mounted so that they are accessible for replacement and protected from accidental damage. Consideration shall be given to the effects of weather, including freezing of the discharge pipe and possible corrosion due to the atmosphere.

1.6.3 Adequate precautions shall be taken to prevent deposition on the pressure side of the bursting disc, and in the part leading to it, of sublimates or other solids that could affect the safe operation of the bursting disc.

Casual liquid or foreign matter shall, for similar reasons, be prevented from accumulating on the vent side of the bursting disc and within the discharge pipe.

The application of an additional protective film or coating to an installed bursting disc is not allowed, except when approved by the manufacturer, since this may considerably affect the bursting pressure of the bursting disc.

1.6.4 The purchaser shall ensure that provision is made to absorb the effect of reaction forces on the vessel and associated pipework which will arise when the bursting disc bursts or vents.

1.6.5 If the bursting of a bursting disc can discharge a flammable fluid, the danger of ignition in the discharge pipe shall be considered and appropriate measures taken to minimize the hazard.

1.6.6 Bursting discs shall be examined for defects immediately before installation and care shall be taken during their assembly, and particularly during that of thin bursting discs.

1.6.7 In situations where fragmentation or release of bursting disc material may occur, any piping beyond the bursting disc shall be so designed that it shall not be obstructed by fragments from the bursting disc device.

1.6.8 The manufacturer's installation instructions, and in particular the directional arrow, bolting torque instructions and the reference to the use of gaskets, shall be strictly followed.

NOTE 5 If the components are assembled incorrectly or the bursting disc device is installed incorrectly, the bursting disc may burst or vent at a system pressure higher or lower than that expected.

1.7 Discharge capacity

1.7.1 Guidance for determining the mass flow rate, for single-phase flow, through a discharge system containing a bursting disc device is given in annex A.

The manufacturer shall, when requested by the purchaser, provide information relating to the bursting disc device.

Such information may include

a) the bursting disc device discharge area (see 1.3.31), and

b) the pressure loss (resistance coefficient).

Unless specified otherwise in appropriate regulations or standards, the information may be established by

a) tests on actual bursting disc devices, or

b) using established scientific data.

Alternatively, by agreement between the purchaser and the manufacturer, conservative values may be used.

1.7.2 The discharge area of a bursting disc device, used as the primary relief device, shall be sufficient to discharge the maximum quantity of fluid that can be generated or supplied to a pressure system whilst preventing the pressure from exceeding the pressures permitted by appropriate regulations or standards covering the system to be protected.

1.8 Information to be supplied by the purchaser

1.8.1 General

Where possible, the minimum information specified in 1.8.2 to 1.8.5 shall be supplied by the purchaser with every enquiry, to assist the manufacturer in specifying a suitable bursting disc device for a particular application.

1.8.2 Application details

The following shall be specified:

a) description of the vessel, equipment or system to be protected, and vessel design code where appropriate;

b) intended application of the bursting disc device; state whether the device is required to operate for example as the primary relief device, secondary relief device, for safety valve protection or in some other capacity;

c) performance specification and relative position of any safety valves or other safety devices fitted to the equipment or system;

d) the fluid which may come in contact with any part of the bursting disc device; physical properties of the fluid, e.g. gas, vapour, liquid or solid, wet or dry, at all stages of the process (including venting); chemical properties of the fluid which may affect bursting disc performance;

e) all conditions of temperature and pressure (including back pressure) to which the bursting disc device may be subjected; rate and frequency of pressure changes, if applicable;

f) expected maximum pressure and temperature during relieving conditions.

1.8.3 Bursting disc device operating details

The following shall be specified:

a) maximum specified bursting pressure and coincident temperature;

b) minimum specified bursting pressure and coincident temperature;

c) rate of change in the pressure with respect to the bursting pressure, where appropriate;

d) bursting disc device theoretical discharge capacity, required to prevent accumulated pressure exceeding allowed maximum;

e) minimum bursting disc device discharge area required;

f) materials which the purchaser, from a knowledge of the process, regards as suitable for consideration in the selection of the bursting disc device material(s);

g) materials which may not be used for safety, corrosion or other reasons.

1.8.4 Installation details

The following shall be specified:

a) physical location of the bursting disc device in the system, preferably in the form of a sketch;

b) method of fitting the bursting disc device in the system (e.g. between flanges, direct fitting to one flange, direct weld to outlet);

c) diameter of inlet pipe to bursting disc device and diameter of discharge pipe from bursting disc device, including flange size, rating, type and specification or other fixing details (e.g. thread specification and size);

d) type and preferred material of bursting disc holder (see 2.2);

e) form and finish of external mating surfaces if different than the manufacturer's standard.

1.8.5 Special details

The following shall be specified:

a) inspection and certification requirements additional to those defined in this International Standard;

b) special features required in the bursting disc device (e.g. excess-flow valve, pressure-monitoring device, jacking bolts, lifting rings);

c) special features of application not stated elsewhere.

1.9 Quality assurance

The manufacturer shall establish, document and maintain an effective and economical quality assurance system to ensure and demonstrate that the bursting discs and bursting disc devices conform to the specified requirements (see ISO 9001).

The manufacturer shall make available to the inspection authority at the manufacturer's works a current copy of the written description of the quality system.

The manufacturer's quality system shall provide for the inspection authority at the manufacturer's works to have reasonable access to all documents necessary for the inspection authority to perform its duties. Such access to documentation shall be subject to any confidentiality requirements and procedures laid down in the manufacturer's quality system. The manufacturer may provide such access either to his own files of such documents or by providing copies to the inspection authority.

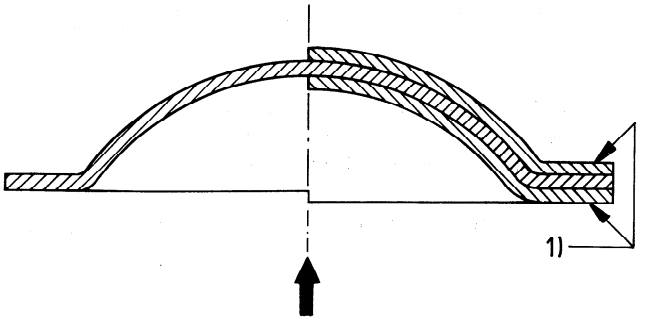
NOTE 6 Annex C provides a typical outline of subjects for inclusion in the quality system.

Section 2: Components of bursting disc devices

2.1 Bursting discs

2.1.1 Materials

All materials including linings, coatings and platings used for the manufacture of bursting discs shall have uniform properties suitable for the working environment in which the bursting discs are to be used. The material in the final form shall be free from defects which may lead to premature failure.



1) The bursting disc may be multilayered.

Figure 2 — Conventional simple domed bursting disc with flat seat

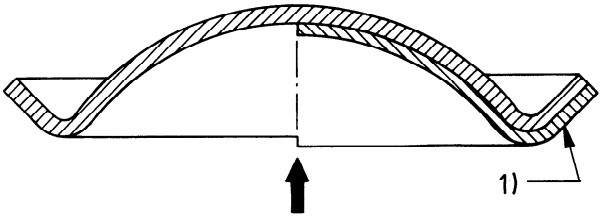
2.1.2 Conventional domed bursting discs

Conventional domed bursting discs are domed in the direction of the subsequent applied bursting pressure. These bursting discs shall be domed by a means capable of producing a permanent set such that no further plastic flow will occur initially when the bursting disc is subjected to its intended operating conditions. Conventional domed bursting discs burst or vent in tension and comprise the following types:

a) conventional simple domed bursting discs (see figures 1 and 2);

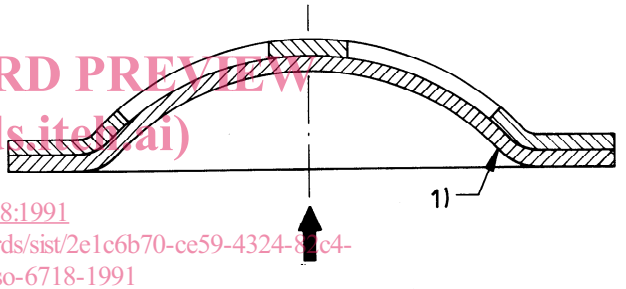
b) conventional slotted lined bursting discs (see figure 3);

c) other types which meet the requirements of this International Standard.



1) The bursting disc may be multilayered.

Figure 1 — Conventional simple domed bursting disc with angle seat



1) The bursting disc may be multilayered.

Figure 3 — Conventional slotted lined bursting disc

2.1.3 Reverse domed bursting discs

Reverse domed bursting discs are domed against the direction of the bursting pressure (see figure 4) and are designed to fail by buckling under pressure. They include the following types:

a) reverse domed bursting discs with knife blades, which open by being cut during reversal of the dome;

b) reverse domed bursting discs having lines of weakness (without knife blades), which open along these lines when the dome reverses at the bursting pressure;

c) reverse domed bursting discs having a slip or tear-away design (without knife blades), which vent by being expelled downstream from the holder; a catching device may be provided;