BRITISH STANDARD

BS EN 1626:1999

Cryogenic vessels — Valves for cryogenic service

The European Standard EN 1626:1999 has the status of a British Standard

ICS 23.060.20

National foreword

This British Standard is the English language version of EN 1626:1999.

The UK participation in its preparation was entrusted to Technical Committee PVE/18, Cryogenic vessels, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 8, an inside back cover and a back cover.

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Cryogenic vessels — Valves for cryogenic service

Récipients cryogéniques — Robinets pour usage cryogénique

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CEN

European Committee for Standardization

Comité Européen de Normalisation

Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 1626:1999 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 268, Cryogenic vessels, the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1999, and conflicting national standards shall be withdrawn at the latest by September 1999.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this standard.

This document also supports the objectives of the framework Directives on Transport of Dangerous Goods. This standard has been submitted for reference into the RID and/or the technical annexes of the ADR.

Therefore, the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present document are normative only when the standards themselves are referred to in the RID and/or in the technical annexes of the ADR.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This standard specifies the requirements for the design, manufacture and testing of valves for cryogenic service, i.e. for operation with cryogenic fluids (as defined in prEN 1251-1:1995) below −10 °C as well as at ambient conditions, to allow for start-up and run-down. It specifies additional requirements for cryogenic service for the appropriate valve product standard.

It applies to sizes up to DN 150 and vacuum-jacketed cryogenic valves.

This standard is not applicable to safety valves and valves for liquefied natural gas (LNG).

It is intended that the valve be designed and tested to satisfy the generally accepted nominal pressure, e.g. PN 40. Valves may then be selected with a PN equal to or greater than the maximum allowable pressure (PS) of the equipment with which they are to be used.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

prEN 19:1996, *Industrial valves — Marking.*

prEN 1251-1:1995, *Cryogenic vessels — Transportable vacuum-insulated of not more than 1 000 litres volume — Part 1: Fundamental requirements.*

EN 1252-1, *Cryogenic vessels — Materials — Part 1: Toughness requirements for temperatures below −80* °C.

EN 1333, *Pipework components — Definition and selection of PN.*

prEN 1503-1:1994, *Valves — Shell materials — Part 1: Steels.*

prEN 1503-2:1994, *Valves — Shell materials — Part 2: ISO steels.*

prEN 1503-3:1994, *Valves — Shell materials — Part 3: Cast iron.*

prEN 1503-4:1997, *Valves — Shell materials — Part 4: Copper alloys specified in European Standards.*

EN 1797-1, *Cryogenic vessels — Gas/material compatibility — Part 1: Oxygen compatibility.*

EN 12300, *Cryogenic vessels — Cleanliness for cryogenic service.*

EN ISO 6708, *Pipework components — Definition and selection of DN (nominal size)* (ISO 6708:1995).

ISO 5208, *Industrial valves — Pressure testing of valves.*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1

nominal size (DN)

is defined in accordance with EN ISO 6708

3.2

nominal pressure (PN)

is defined in accordance with EN 1333

3.3

specified minimum temperature

the lowest temperature for which the valve is specified

3.4

valve category A

valves intended to be operated with normal frequency (above 20 cycles a year)

3.5

valve category B

valves intended to be operated only occasionally, i.e. with a frequency below 20 cycles a year

4 Requirements

4.1 Materials

4.1.1 *Metallic materials*

Metallic materials to be used in the construction of cryogenic valves shall be suitable for general valve uses as defined in prEN 1503-1:1994, prEN 1503-2:1994, prEN 1503-3:1994 and prEN 1503-4:1997. In addition, the following requirements apply.

4.1.1.1 *Toughness requirements*

Materials which exhibit a ductile/brittle transition shall have the minimum impact test values specified in EN 1252-1. These requirements apply only to the valve parts exposed to critical temperatures (and not to control elements, for example).

Non-ferrous materials which can be shown to have no ductile/brittle transition do not require additional impact tests.

4.1.1.2 *Corrosion resistance*

Materials shall be resistant to normal atmospheric corrosion and to the medium handled.

4.1.1.3 *Oxygen compatibility*

If the specified minimum temperature is equal to or below the boiling point of air, or the valve is intended for oxygen service, the materials which are, or likely to be, in contact with oxygen or an oxygen-enriched air shall be oxygen-compatible in accordance with EN 1797-1.

4.1.1.4 *Flammable gas compatibility*

For hydrogen service, see relevant standards.

Copper alloys containing more than 70 % of copper shall not be used for fluids containing acetylene.

4.1.2 *Non-metallic materials*

Non-metallic materials to be used in packing and glands shall:

- — have mechanical properties which will allow the valves to pass the sample valve test for category A valves as defined in this standard (see **5.2**);
- — be oxygen-compatible as defined in **4.1.1.3**.

If non-metallic materials are used for structural parts, their suitability shall be proven.

4.2 Design

4.2.1 *General*

The valves shall fulfil their function in a safe manner within the temperature range from +65 °C to their specified minimum temperature and the pressure range intended for use.

4.2.2 *Packing gland*

Valves can have an extended stem. The length of the extension shall be sufficient to maintain the stem packing at a temperature high enough to permit operation within the normal temperature range of the packing material.

Valves without an extended stem shall have a stem packing capable of operating at the specified minimum temperature. The handle shall be designed to remain operable for the duration of the sample valve test in accordance with **5.2.3.2**.

Gland designs incorporating a gland nut with a male or female thread shall be designed in such a way that they will not unscrew unintentionally, for example when the valve is operated.

4.2.3 *Operating positions*

As a minimum requirement, valves with extended stem shall be capable of operation with the valve stem at any position from the vertical to 25° above the horizontal.

4.2.4 *Trapped liquid*

Cavities where liquid can be trapped and build up detrimental pressures due to evaporation of the liquid during warming-up of the valve are not permitted.

NOTE For ball and gate valves, this requirement can be met by the provision of a pressure-relief hole or passage or other means, e.g. pressure-relieving seats, to relieve pressure in the bonnet and body cavities to the upstream side of the valve.

4.2.5 *Valve bonnet*

Valve bonnets may be brazed, welded, bolted, screwed or union type. Union type bonnets shall not be used on valves greater than DN 50. Union nuts shall be locked to the body. Screwed bonnets shall also be secured by a union nut or another device offering equivalent safety.

4.2.6 *Securing of gland extension*

For bronze or copper alloy valves of PN 100 or greater, the gland extensions shall be mechanically secured in the bonnet prior to brazing (for instance by screwing).

4.2.7 *Seat*

Valves may have a metal/metal or metal/soft seat or insert. Soft seats shall be backed by a secondary metal seat. Soft seat materials shall be adequately supported to prevent cold flow of the seat material.

4.2.8 *Blow-off safety of the stem*

The valve stem shall be secured so that it cannot be blown out of the body if the gland is removed while the valve is under pressure.

4.2.9 *Torque*

The maximum torque, in newton metres, to operate the valves manually under service conditions, when applied at the rim of the handwheel or lever, shall not exceed $350 \times R$, except for valve seating and unseating, when it shall not exceed $500 \times R$. For a handwheel, R is the radius of the wheel in metres. For a lever, R is the length of the lever in metres, minus 0,05 m.

The valve shall be robust enough to withstand 3 times the maximum torque as specified above without damage.

Valves intended for actuator operation may have torque or linear force requirements deviating from the above. The sample valve tests shall then be performed using a suitable actuator to operate the valve.

4.2.10 *Electric continuity and explosion protection*

All valves shall have a maximum electrical resistance of 10 Ω, in order to ensure electrical continuity to prevent build-up of static electricity.

For flammable fluids, any equipment attached to or associated with a valve shall be suitable for the hazard zone.

5 Testing

5.1 Production tests

The production test shall be performed in accordance with the requirements of applicable valve product standards. If these standards refer to ISO 5208, closure test leakage rate A is required.

5.2 Sample valve tests

5.2.1 *Selection of sample valves*

One sample valve shall be tested. It shall be representative of the valves to be produced. If a range of valves of identical design but different sizes is to be tested, one sample of the smallest and one sample of the largest shall be tested.

5.2.2 *Verification of the design*

A second sample valve shall be inspected to ensure that the design satisfies the requirements of clause **4**.

5.2.3 *Ambient condition tests*

5.2.3.1 *Initial tests*

The sample valve shall first pass the tests as described in **5.1**.

5.2.3.2 *Strength test*

The valve in the open position shall be hydraulically tested with a pressure 4 times PN for PN < 100 bar and 2,25 times PN for PN ≥ 100 bar. Leakage of joints shall be accepted, but failure by bursting is unacceptable. Certain components (e.g. membranes or bellow seals) may be temporarily removed or replaced by a dummy during this test. The strength test shall be performed after all other tests or on separate samples.

5.2.4 ***Cryogenic tests***

5.2.4.1 *General test conditions*

Valves with a specified minimum temperature not lower than −196 °C shall be tested at a temperature not greater than the specified minimum temperature. Valves with a design temperature lower than −196 °C shall be tested at a temperature not greater than −196 °C. A deviation in the temperature measured of ±10 % (in degrees Celsius) is allowed, depending on the practical conditions of testing. Ambient temperature shall not exceed 25 °C and the humidity shall be not less than 40 %.

5.2.4.2 *Leak-tightness tests*

5.2.4.2.1 *General*

The external and internal tightness shall be tested both before and after the operation simulation test described in **5.2.4.3**.

For a more detailed outline of a suitable test method see annex A.

5.2.4.2.2 *External tightness test*

With the valve in the open position, it shall be cycled from ambient temperature down to the specified minimum temperature and back to ambient temperature again. At the start of the cycle, the valve interior shall be filled to a pressure equal to PN with helium gas. During the test the helium gas pressure is allowed to drop as a result of cooling of the enclosed test gas. The maximum allowable average leak rate to the exterior during the cycle shall be less than 14 N·mm^3/s (0,014 mbar·l/s). The test shall include connections of the normal type intended for the sample valve.

For flammable fluids, this maximum allowable average leak rate is reduced to 10 N·mm^3/s.

For vacuum-jacketed valves, the jacket shall be open during this test.

5.2.4.2.3 *Internal tightness test*

It can be accepted that the lowest temperature is reached when the cooling fluid has finished severe boiling.

The valve shall then be closed to the torque specified in **4.2.9**.

Helium pressure shall be applied in stages up to PN.

In these conditions, the acceptable leak rate shall be less than 1 000 N·mm^3/s × DN (1 mbar·l/s × DN) for all valves.

This leak rate shall apply to valves for flammable and non-flammable service.

5.2.4.3 *Operation simulation*

While maintaining the valve at the specified minimum temperature, either by letting a cryogenic fluid pass through the valve or by immersing the valve body in the cryogenic fluid, it shall be fully opened and closed against a differential pressure equal to at least PN/2. When an immersion test is chosen, the pressure across the valve seat may be developed using gaseous helium or by using the test cryogen vapour. The torque used shall be equal to that applied in the first internal tightness test. The number of cycles shall be 2 000. The cycle rate shall not be higher than 6 cycles per minute.

For category B valves, the number of cycles is reduced to 100.

The immersion test is particularly suitable for large diameter (DN) valves.

After the test, the valve shall pass the tightness tests a second time. It shall also be dismantled and inspected for any excessive wear, e.g. pitting in rubbing surfaces.

Tightening of the gland packing is allowed after this test before the second tightness test.

5.2.5 ***Test report***

A test report, including fully dimensional drawings with tolerances, test procedures and test results, shall be kept as a reference.

6 Cleanliness

All valve parts and the assembled valve shall meet the cleanliness requirement of EN 12300.

7 Marking

The marking of the valve shall be made in accordance with the applicable valve product standard and the general requirements of prEN 19:1996, with the following modifications:

1) the specified minimum temperature shall be marked on the valve body or the identification plate;

2) the number of this standard, with the addition of "/B" in the case of a category B valve.

Annex A (informative)

Recommended methods for leak-tightness testing of cryogenic valves

A.1 Test set-up

The sample valve is installed in a line so that it can be pressurized with helium gas up to the PN pressure while maintaining the valve body at the test temperature. A temperature sensor shall be installed to measure the valve body temperature unless the cooling of the valve body is achieved by immersing the body in the cryogenic fluid.

The supply of helium, a pressure gauge and a known dead volume are connected to the inlet side of the sample valve, and a device to measure gas flow to the outlet side (see Figure A.1). If the sample valve is intended for bidirectional operation, it shall be possible to switch the equipment from one line end to the other.

A.2 External tightness (see Figure A.1)

Establish the dead volume, V_d, of the sample valve and its connecting lines by flushing the whole system with helium at 0 bar (gauge). Close valve C and fill the system to a suitable pressure, P_s. Then isolate the known dead volume, V_n , by closing valve B. Empty the sample dead volume to 0 bar (gauge) by closing valve C and venting through valve A. After closing valve A, open valve B and read the final pressure, P_f. The dead volume of the sample system then is:

$$V_d = \frac{V_n \times (P_s - P_f)}{P_f}$$

where

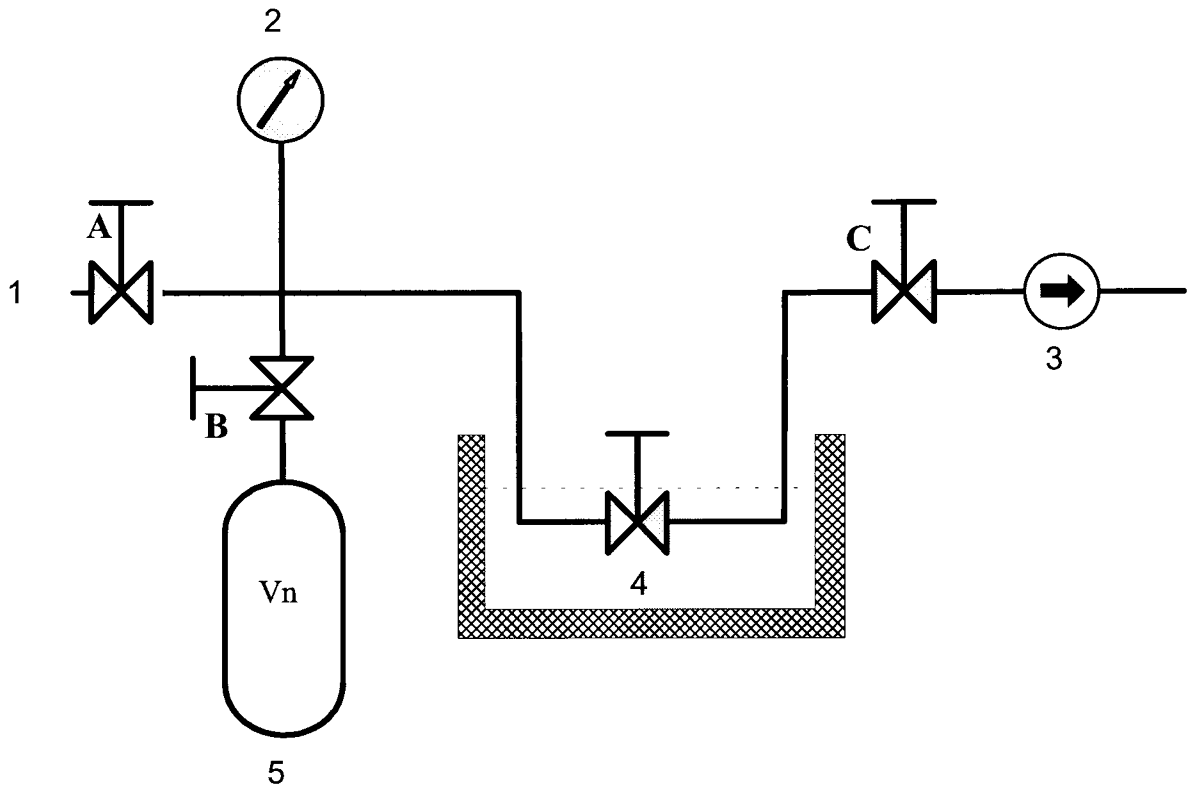
V_d, V_n are in litres;

P_s, P_f are in bars.

The sample system while at ambient temperature is filled with helium to the PN pressure and then sealed off by closing the valve B. The sample system is then cooled down to the design temperature and kept there for a time period of $10 \times V_d$ (hours), where V_d is measured in cubic decimetres. It is then allowed to warm up back to ambient temperature (i.e. the filling temperature). To pass the test, the pressure decrease shall be smaller than 0,5 bar, corresponding to a leak rate smaller than 14 N·mm^3/s (0,014 mbar·l/s).

A.3 Internal tightness

With the shut-off valve to the gas flow measuring device open and the sample valve closed with a torque not exceeding the maximum torque as defined in **4.2.9**, apply helium pressure in steps of ¼ of the PN pressure up to the PN pressure. Measure the leak rate at the flowmeter for each pressure step. For valves intended for bidirectional operation, repeat the test with the pressure applied in the second direction.



1 Helium supply

2 Pressure gauge

3 Gas flow measuring device

4 Sample valve

5 Known dead volume

Figure A.1 — Valve test system

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC.

WARNING Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The clauses of this standard given in Table ZA.1 are likely to support requirements of Directive 97/23/EC.

Table ZA.1 — Comparison between this European Standard and Directive 97/23/EC

Harmonized clauses of EN 1626	Content	Directive 97/23/EC
§ **5**	Final assessment	Annex 1, § 3.2
§ **5.2**	Proof test	Annex 1, § 3.2.2

Compliance with these clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

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