BSI Standards Publication

Tanks for the transport of dangerous goods — Tank equipment for the transport of liquid chemicals and liquefied gases — Foot valves

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National foreword

This British Standard is the UK implementation of EN 14433:2023. It supersedes BS EN 14433:2014, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/18, Tanks for the transport of dangerous goods.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Tanks for the transport of dangerous goods - Tank equipment for the transport of liquid chemicals and liquefied gases - Foot valves

Citernes destinées au transport de matières dangereuses - Équipements de la citerne pour le transport de produits chimiques liquides et de gaz liquéfiés - Clapets de fond

Tanks für die Beförderung gefährlicher Güter - Ausrüstung für Tanks für die Beförderung von flüssigen Chemieprodukten und Flüssiggasen - Bodenventile

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European foreword

This document (EN 14433:2023) has been prepared by Technical Committee CEN/TC 296 “Tanks for transport of dangerous goods”, 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of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.

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

This document supersedes EN 14433:2014.

This document has been submitted for reference in:

— the RID; and

— the technical annexes of the ADR.

NOTE These regulations take precedence over any clause of this document. It is emphasized that RID/ADR are being revised regularly at intervals of two years which may lead to temporary non-compliances of the clauses of this document with the regulations.

The main changes compared to the previous edition are listed below:

a) the Scope has been revised;

b) Normative references have been updated;

c) the definition and source for 3.4 has been changed;

d) a Note has been added to 5.2.6;

e) revision of Clause 5 “Design and materials”;

f) a new Clause 6 “Welding” has been introduced.

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1 Scope

This document specifies the requirements for foot valves for use on tanks with a minimum working pressure greater than 50 kPa for the transport of dangerous goods by road and rail.

It is applicable to metallic equipment on tanks for the following functions for internal stop valves:

— primary closure of gravity discharge lines (liquid substances);

— primary closure of bottom discharge lines (liquid gases: liquid phase and gas phase);

— primary closure of top discharge (poisonous liquefied gases: liquid phase and gas phase);

— and other internal valves as specified in Annex A of EN 14564:2019 according to the scope of this document.

NOTE 1 The document is also applicable to liquefied gases including LPG; however, for a dedicated LPG standard see EN 13175 [3].

NOTE 2 Valves according to this document can be used as primary closure in case of top discharge of liquids and other products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 10204, *Metallic products - Types of inspection documents*

EN 12266-1:2012, *Industrial valves - Testing of metallic valves - Part 1: Pressure tests, test procedures and acceptance criteria - Mandatory requirements*

EN 12266-2:2012, *Industrial valves - Testing of metallic valves - Part 2: Tests, test procedures and acceptance criteria - Supplementary requirements*

EN 12516-1, *Industrial valves - Shell design strength - Part 1: Tabulation method for steel valve shells*

EN 12516-2, *Industrial valves - Shell design strength - Part 2: Calculation method for steel valve shells*

EN 12516-3:2002, *Valves - Shell design strength - Part 3: Experimental method*

EN 13445-3, *Unfired pressure vessels - Part 3: Design*

EN ISO 3834-1, *Quality requirements for fusion welding of metallic materials - Part 1: Criteria for the selection of the appropriate level of quality requirements (ISO 3834-1)*

EN ISO 3834-3, *Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements (ISO 3834-3:2021)*

EN ISO 9606 (all parts), *Approval testing of welders - Fusion welding - Part 4: Nickel and nickel alloys (ISO 9606 (all parts))*

EN ISO 14732, *Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test (ISO 15613)*

EN ISO 15614 (all parts), *Specification and qualification of welding procedures for metallic materials - Welding procedure test (ISO 15614 (all parts))*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
maximum working pressure
MWP
maximum pressure up to which the valve can be operated, not more than the test pressure divided by 1,3

[SOURCE: ADR/RID chapter 6.8]

3.2
maximum allowable working pressure
MAWP
maximum pressure up to which the valve can be operated, not more than the test pressure divided by 1,3 (liquified gases) respectively 1,5 (liquids)

[SOURCE: ADR/RID chapter 6.7]

3.3
test pressure
pressure used for the pressure tests

3.4
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

Note 1 to entry: The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 2 to entry: In those standards which use the DN designation system, any relationship between DN and component dimensions should be given, e.g. DN/OD or DN/ID.

[SOURCE: EN ISO 6708:1995]

4 Function

The foot valve is a primary valve located in the lower part of the tank to allow the controlled loading and discharge of the product and to ensure leak tightness in the closed condition.

5 Design and materials

5.1 General

The foot valve shall be designed for a working pressure of at least 300 kPa. The foot valve shall normally be a non-pressure balanced design. If the valve is a pressure balanced design, a surge pressure of 5 times the MWP shall not jeopardize the tightness of the housing or the function of the valve. The manufacturer shall specify in drawings and other papers, the design and the materials of the foot valve. The valve specification shall include information regarding mating tank flange details.

5.2 Design

5.2.1 The valve shall provide a closure located within the tank shell.

5.2.2 The valve closure shall be positioned so that the pressure in the tank acts to increase the force on the valve seat, and shall be so designed as to prevent self-opening of the valve.

5.2.3 The opening of the valve shall be such as to give a minimum flow path through the valve of a diameter equal to the DN designation of the valve.

5.2.4 The operating mechanism shall be protected from inadvertent operation in transit either by a latching device or by locating within an enclosure.

5.2.5 The internal stop-valve of all filling and all discharge openings of tanks (for tank containers with a capacity greater than 1 m^3) intended for the carriage of liquefied flammable or toxic gases shall be instant-closing and shall close automatically in the event of an unintended movement of the tank or in the event of fire. It shall also be possible to operate the internal stop-valve by remote control.

NOTE This function can be achieved by additional components, which are not in the scope of this document.

5.2.6 The operating mechanism of each valve shall have an indicator for the direction of opening and/or closing.

This may be added at the valve, tank or vehicle. In this case, this shall be stated in the manual or type approval of the valve.

5.2.7 The external valve casing shall have a weakened section (e.g. a shear groove in the external casing or other appropriate means) so positioned that should the valve casing be removed by a severe impact, the sealing capability of the valve shall not be affected. This requires that, in the case of a bottom-operated valve, the operating mechanism of the valve be not directly connected to the valve closure.

5.2.8 Regarding the calculation of flanges and body wall thickness the requirements given in EN 12516-1, EN 12516-2 and EN 12516-3 or EN 13445-3 apply.

5.3 Materials

5.3.1 The manufacturer shall provide, with the equipment, the material specification for those parts that may come into contact with the product.

5.3.2 The material elongation at fracture of the pressure-loaded components of the valve shall be a minimum of 12 %.

5.3.3 The materials for the valve casing shall be permanently marked with the material designation corresponding to European pressure vessel material standards or with an equivalent national standard designation.

5.3.4 Proof of the quality characteristics for the valve body shall be provided by means of an inspection certificate 3.1 in accordance with EN 10204 for metallic materials (with additional consideration of EN 764-4 and -5) or an equivalent document.

6 Welding

6.1 Qualification

6.1.1 Manufacturers of welded service equipment shall have a manufacturing system for welding which respects the principles of EN ISO 3834-1 and EN ISO 3834-3 as a minimum.

6.1.2 Welding procedures shall be qualified according to EN ISO 15613 and EN ISO 15614 (all parts) (level 1 or level 2 for EN ISO 15614-1).

6.1.3 Welders shall be qualified according to EN ISO 9606 (all parts) and operators of welding equipment shall be qualified according to EN ISO 14732.

6.2 Welded joints

Recommended weld shapes are given in EN 1708-1.

7 Test media

7.1 Hydraulic tests

Hydraulic tests shall be carried out using a fluid in accordance with EN 12266-2:2012, A.1.5.

7.2 Pneumatic tests

Pneumatic tests shall be carried out using a gas in accordance with EN 12266-2:2012, A.1.5.

8 Type tests

8.1 General

Each valve used for testing shall conform to the drawings and dimensions specified and specification provided by the manufacturer. Each design of valve, as verified in Annex A, shall be subjected to a type test. Type testing according to 8.2 to 8.6 shall be carried out under ambient conditions. If the valve is required to operate outside the temperature range –40 °C to +50 °C, the design shall be taken into account either in the type testing or by a validated calculation method. For the calculation of the test pressure, EN 12516-3:2002, 6.3 and 6.4 apply.

The tests shall be carried out with the casing/valve attached to a flange equivalent to that for which its use is intended.

8.2 Valve casing hydraulic pressure test

The valve casing shall be hydraulically tested, using a test medium conforming to 6.1 at a pressure equal to a minimum of 2,25 times the MWP or 400 kPa whichever is the greater. The test pressure shall be maintained for a minimum of 5 min on the valve casing without permanent deformation occurring.

8.3 Valve assembly pressure test

The valve assembly shall be hydraulically or pneumatically tested, using a test medium conforming to 7.1 or 7.2 at a pressure equal to 1,5 times the MWP (MAWP), or 400 kPa, whichever is the greater. The test pressure shall be maintained for a minimum of 10 min on the valve assembly. The leakage shall

not exceed Rate A as specified in EN 12266-1:2012, Table A.5. Each assembly pressure test shall be carried out:

a) with the valve in the closed position and the outlet open to test for leakage from the seats;

b) with the valve in the open position and the outlet closed off to test for leakage from gland seals and body joints.

8.4 Closure, casing and valve assembly pneumatic tightness tests

For each design of the valve, as specified in Annex A, the closure, the casing and the valve assembly shall be pneumatically tested, using a test medium conforming to 7.2, at pressures equal to 20 kPa and 1,0 times the MWP (MAWP).

The valve closure, casing and valve assembly shall be totally immersed in a water bath, or, where total immersion of the valve closure, casing and valve assembly is not possible, a suitable leak detection fluid shall be applied. The test pressure shall be maintained for a minimum of 10 min on the valve closure, casing and valve assembly. The leakage shall not exceed Rate A as specified in EN 12266-1:2012, Table A.5. Each pneumatic tightness test shall be carried out:

a) with the valve in the closed position and the outlet open to test for leakage from the valve seats;

b) with the valve in the open position and the outlet closed off to test for leakage from gland seals or body joints.

If the tests specified above do not cover all seals to the environment, these seals of the valve assembly shall also be tested.

8.5 Cyclic test

The valve assembly shall be subjected to a mechanical cycle test to a minimum of 1 000 full cycles ("open" to "closed") without pressure and 10 full cycles ("open" to "closed") at MWP (MAWP) or maximum rating opening pressure at ambient temperature being applied. After completion of the cyclic test, the valve assembly shall be tested in accordance with 8.4 and the leakage shall not exceed Rate A as specified in EN 12266-1:2012, Table A.5.

8.6 Breakaway test

8.6.1 General

The foot valve shall be attached with a suitable gasket to a flange of requirements as specified in 5.1. The flange shall be attached to a test vessel which simulates the tank connection. All bolts intended for tank attaching of the valve shall be tightened. Vertical drop valves that are intended to be mounted to the tank and followed immediately by a tee pipe to the side of the tank should have a tee/elbow fitted to the outlet flange prior to the rigid beam. Following the breakaway of the valve body, the valve shall be hydraulically tested at pressures equal to 20 kPa and 1,0 times the MWP (MAWP). The test pressure shall be maintained for a minimum of 10 min and the leakage shall not exceed Rate B as specified in EN 12266-1:2012, Table A.5. For examples of breakaway vectors, see Annex B.

8.6.2 Test apparatus

The test apparatus consists of the following:

— a rigid beam capable of transmitting the impact load to the valve without permanent deformation, 1 000 mm long, rigidly attached to the foot valve outlet flange;

— a test vessel which is a pressurizable test chamber which simulates the tank and has an MWP (MAWP) at least equal to the valve to be tested;

— a suitable gasket material which is either the specific gasket material to be specified with the valve or which is specified for a range of gasket material with the lowest required seating stresses with compression recovery rate;

— a tee/elbow to change the direction of the outlet pipe simulating the piping connection to the tank.

8.6.3 Test procedure for valves conforming to ADR/RID chapter 6.8

Apply, to the beam 1 000 mm from the centre line of the inlet flange, a sufficient force, perpendicular to the valve outlet pipe and in the same plane as the foot valve/tank flange, until the valve body breaks away at the shear device, or the outlet deforms more than 30° (see Figure B.1 a), b) and c)).

8.6.4 Test procedure for valves conforming to ADR/RID chapter 6.7

Apply, load slowly and directly on to the outlet flange or as close as is practicable. The load shall be applied in a vector perpendicular to the ground relative to the perceived fitting of the valve consistent and with the valve being struck from mis-stacking. The load shall be applied until the valve body breaks away at the shear groove, or the outlet takes permanent set and deforms more than 30° (see Figure B.1 d)).

8.6.5 Test procedure for top operated valves

The top operated valve shall be connected to the test vessel in such a manner that the valve poppet is located in the closed position by the connecting rod/tube/wire. The outlet tee/elbow containing the shear device shall be attached to the suitable flange of the test vessel with the extension beam and the test procedure shall follow 8.6.3.

8.6.6 Post impact adjustments

a) Manual reseating of the valves poppet is not permitted;

b) retightened fasteners to stop any leakage from the valve gasket is not permitted;

c) non breakage of shear device is permitted provided that the outlet deflection is greater than 30° and that the leakage rate is less than EN 12266-1:2012 rate B into the valve body after the initial impact and all operating mechanism are attached to the valve.

8.6.7 Test report

The test report shall contain at least the following information:

a) a reference to this document (i.e. EN 14433:2023);

b) gasket material and contact sealing dimensions;

c) bolting material and size.

9 Production tests

9.1 General

Each foot valve produced shall conform to the drawings and other papers in which the design and the materials were specified by the manufacturer. The production testing according to 8.2 to 8.4 shall be carried out under ambient conditions.

If the production tests are not be able to be done in the full scope e.g. due to specific design. These tests shall be done in mounted conditions. This shall be specified in the type approval and manual of the valve.

9.2 Function test

Each valve shall be opened and closed once.

9.3 Valve casing pressure test

Each valve casing shall be hydraulically or pneumatically tested, using a test medium conforming to 7.1 or 7.2, at a pressure equal to 1,5 times the MWP (MAWP). The casing shall be held in a position in which the valve will be used. The test pressure shall be maintained as given in EN 12266-1 on the valve casing and the leakage shall not exceed Rate A as specified in EN 12266-1:2012, Table A.5.

9.4 Closure, casing and valve assembly pneumatic tests

Each closure, valve casing and valve assembly shall be pneumatically tested using a test medium conforming to 7.2, at pressures equal to 20 kPa and at least 25 % of the test pressure. The closure, casing and valve assembly shall be totally immersed in a water bath, or where total immersion of the valve closure, casing and valve assembly is not possible, a suitable leak detection fluid shall be applied. The test pressure shall be maintained as given in EN 12266-1 on the valve closure, casing and valve assembly and the leakage shall not exceed Rate A as specified in EN 12266-1:2012, Table A.5. Each pneumatic tightness test shall be carried out:

a) with the valve in the closed position and the outlet open to test for leakage from the valve seats;

b) with the valve in the open position and the outlet closed off to test for leakage from gland seals or body joints. For this test, all parts of the valve casing shall be attached to a flange equivalent to that for which its use is intended.

10 Marking

The valve shall be permanently marked with the following information:

a) DN (nominal size) of the valve;

b) manufacturers name or symbol;

c) manufacturers type (part or drawing number);

d) material of the valve casing:

   — materials shall be used as specified in EN standards, where possible;

e) maximum working pressure (MWP) or maximum allowable working pressure (MAWP);

f) year of manufacture;

g) unique serial number (batch signing is prohibited);

h) reference number of this document (i.e. EN 14433:2023);

i) temperature range.

11 Supply requirements

11.1 Order information

Information such as, product characteristics to be carried in the tank, nominal size of the valve, MWP (MAWP) of the valve, connection type and size of the valve, and maximum and minimum operating temperatures shall be provided by the customer at the time of ordering.

11.2 Installation and operation

The manufacturer shall provide with each valve installation, operating and maintenance instructions for correct use of the equipment in accordance with the manufacturer's recommendations.

Annex A
(normative)

Verification of valve design type

A valve design type shall be verified as follows:

a) it shall have the same construction and MWP but may have a different DN (nominal size);

b) the size in bold shall be tested for each valve design type. Generally, the lowest and the highest size shall be tested and this covers all sizes in between. For example, where the range is DN 50 – DN 150 then sizes shown in bold type shall be type tested: **50,** 80, 100, 125, **150**;

c) where different seal materials or sealing systems are used in the same valve design type, the tests in 8.4 shall be performed on the valve design type for each combination of seal material group (Table A.1) and system, followed by the cyclic test in 8.5;

Table A.1 — Sealing group

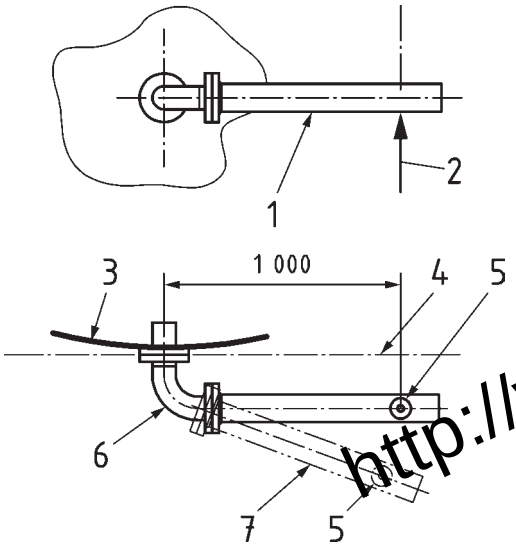
Sealing material (sealing group)	Samples
Metal-to-metal sealing/metallic sealing	Soft aluminium Soft copper or brass Iron or mild steel Stainless steel
Elastomeric sealing	FPM/FKM EPDM NBR HNBR FFKM (Perfluorelastomer) Silicon Nitrile Butyl PUR
(Thermo-) Plastic sealing	PTFE PA ECTFE FEP
Composite sealing	PTFE/FEP-covered elastomer Fibre-filled elastomeric sealing Spring loaded PTFE-sealing
Fibre sealing	Fibre gaskets Plant fibre sealing

d) where a valve casing is constructed from a material that has a lower strength than the type-tested valve, tests in 8.2 and 8.3 shall be performed; where a valve casing is constructed from a material that has a higher strength than the type-tested valve with a similar ductility, the tests in 8.2 and 8.3 are considered to be fulfilled.

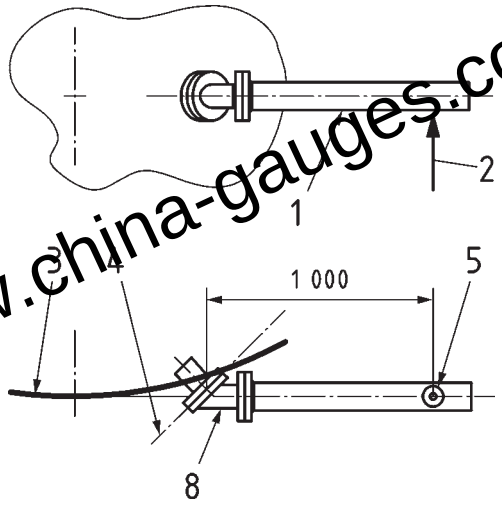
Annex B
(informative)

Examples of breakaway vectors

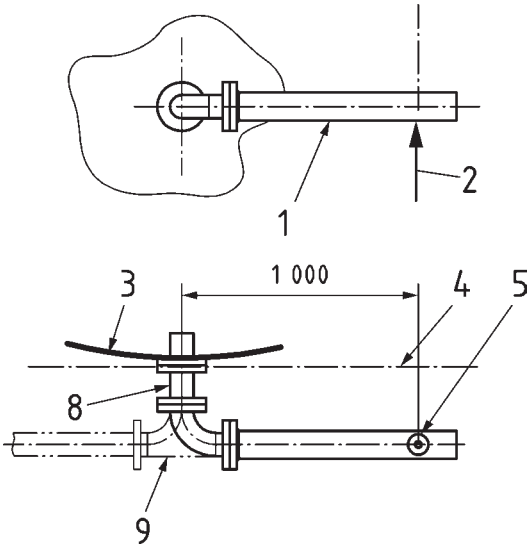
Dimensions in millimetres



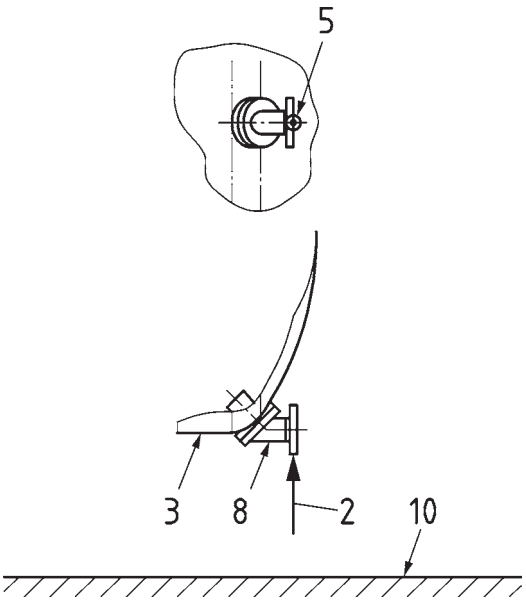
a) ADR/RID chapter 6.8 Angled centre drop valve



b) ADR/RID chapter 6.8 Tank side entry valve



c) ADR/RID chapter 6.8 Tee centre drop valve



d) ADR/RID chapter 6.7 Portable tank test vector

Key

1	ridged beam	5	strike point	8	test valve
2	strike vector	6	angled test valve	9	tee adapter
3	tank shell	7	alternative drop angled outlet	10	perceived ground orientation
4	footvalve tank flange plane				

Figure B.1 — Examples of breakaway vectors

Bibliography

[1] Regulation concerning the International Carriage of Dangerous Goods by Rail (RID)

[2] Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)

[3] EN 764-4, *Pressure equipment - Part 4: Establishment of technical delivery conditions for metallic materials*

[4] EN 764-5, *Pressure equipment - Part 5: Inspection documentation of metallic materials and compliance with the material specification*

[5] EN 1708-1, *Welding - Basic welded joint details in steel - Part 1: Pressurized components*

[6] EN 13175, *LPG Equipment and accessories - Specification and testing for Liquefied Petroleum Gas (LPG) pressure vessel valves and fittings*

[7] EN ISO 6708:1995, *Pipework components - Definition and selection of DN (nominal size) (ISO 6708:1995)*

[8] EN 14564:2019, *Tanks for transport of dangerous goods - Terminology*

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