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Industrial valves — Isolating valves for low-temperature applications —

Part 1: Design, manufacturing and production testing

Robinetterie industrielle — Robinets d'isolement pour application à basses températures —

Partie 1: Conception, essais de fabrication et de production

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 153, *Valves*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 28921-1:2013), which has been technically revised.

The main changes are as follows:

— extension of the scope to include sizes DN 950 to 1 800, NPS 38 to 72, and pressure designations PN 400 and Class 2 500;

— addition of a new terminological entry for shell (3.14);

— addition of a new terminological entry for drip plate (3.15);

— exclusion of safety valves and control valves;

— in 5.2, addition of type test requirement in accordance with ISO 28921-2;

— update of Annex A giving the test procedure for production testing of valves at low temperature.

A list of all parts in the ISO 28921 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The purpose of this document is the establishment of basic requirements and practices for design, fabrication, material selection and production testing of valves used in low-temperature services. The intention is to provide requirements for design, material selection and valve preparation for valves to be used in low-temperature service.

Industrial valves — Isolating valves for low-temperature applications —

Part 1: Design, manufacturing and production testing

1 Scope

This document specifies requirements for design, dimensions, material, fabrication and production testing of gate, globe, ball/plug and butterfly valve design types used as isolation valves and check valves for low-temperature applications.

This document is applicable to isolation valves for use in low and cryogenic temperature service where the design low-temperature service is -50 °C down to –196 °C.

This document does not apply to valves for cryogenic services, designed in accordance with ISO 21011, used with cryogenic vessels.

Where the requirements of this document vary from those given in the valve product standards, the requirements of this document apply.

This document is applicable to valves with body, bonnet, bonnet extension or cover made of metallic materials.

This document is applicable to:

— valves of nominal sizes DN: 10; 15; 20; 25; 32; 40; 50; 65; 80; 100; 125; 150; 200; 250; 300; 350; 400; 450; 500; 600; 650; 700; 750; 800; 850; 900; 950; 1 000; 1 050; 1 200; 1 350; 1 400; 1 500; 1 600; 1 650; 1 800,

— corresponding to nominal pipe sizes NPS: ⅜; ½; ¾; 1; 1 ¼; 1 ½; 2; 2 ½; 3; 4; 5; 6; 8; 10; 12; 14; 16; 18; 20; 24; 26; 28; 30; 32; 34; 36; 38; 40; 42; 48; 54; 56; 60; 64; 66; 72,

and applies to pressure designations:

— PN 16; 25; 40; 100; 160; 250; 400,

— Class 150; 300; 600; 800; 900; 1 500; 2 500.

NOTE Not all type and size combination are available in all pressure ratings.

This document does not apply to safety valves and control valves.

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.

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

ISO 5209, *General purpose industrial valves — Marking*

ISO 10434, *Bolted bonnet steel gate valves for the petroleum, petrochemical and allied industries*

ISO 10497, *Testing of valves — Fire type-testing requirements*

ISO 10631, *Industrial valves — Metallic butterfly valves*

ISO 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*

ISO 15761, *Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries*

ISO 15848-1:2015, *Industrial valves — Measurement, test and qualification procedures for fugitive emissions — Part 1: Classification system and qualification procedures for type testing of valves*

ISO 17292, *Metal ball valves for petroleum, petrochemical and allied industries*

ISO 28921-2, *Industrial valves — Isolating valves for low-temperature applications — Part 2: Type testing*

EN 1515-1, *Flanges and their joints — Bolting — Part 1: Selection of bolting*

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 12516-4, *Industrial valves — Shell design strength — Part 4: Calculation method for valve shells manufactured in metallic materials other than steel*

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

API 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*

API 6FA, *Standard for Fire Test of Valves*

ASME B16.34, *Valves — Flanged, Threaded, and Welding End*

ASME B31.3, *Process Piping*

ASME *Boiler and Pressure Vessel Code, Section VIII*

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
DN
nominal size
alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising 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

[SOURCE: ISO 6708:1995, 2.1, modified — Notes to entry removed.]

3.2
PN
nominal pressure
numerical designation relating to pressure that is a convenient rounded number for reference purposes, and which comprises the letters PN followed by the appropriate reference number

Note 1 to entry: It is intended that all equipment of the same *nominal size (DN)* (3.1) designated by the same PN number shall have compatible mating dimensions.

Note 2 to entry: The maximum allowable pressure depends on materials, design and working temperature, and is to be selected from the tables of pressure/temperature ratings given in the appropriate standards.

[SOURCE: ISO 7268:1983, Clause 2, modified — The phrase "and which comprises the letters PN followed by the appropriate reference number" has been added.]

3.3
NPS
alphanumeric designation of size for components of a pipework system, which is used for reference purposes, and which comprises the letters NPS followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connections

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

3.4
Class
alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system, which comprises the word "Class" followed by a dimensionless whole number

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

3.5
cold box
enclosure that insulates equipment from the environment without the need for insulation of each individual component inside the enclosure

3.6
valve body extension
extended valve body that locates the operating mechanism and packing away from the cold media in the valve

Note 1 to entry: The body extension allows the formation of a vapour barrier between the liquefied gas in the valve and the packing.

3.7
extended bonnet
bonnet extension that locates the operating mechanism and packing away from the cold media in the valve

Note 1 to entry: The bonnet extension allows the formation of a vapour barrier between the liquefied gas in the valve and the packing.

3.8
vapour column
portion of body/bonnet extension that allows for the formation of an insulating column of vapour

3.9
vapour column length for non-cold box application
distance between the bottom of the packing box and the top of the lower stem guide bushing or the beginning of the bonnet extension

Note 1 to entry: See Figure 1.

3.10
bonnet extension length for cold box application
length measured from the centre-line of the valve flow passage up to the bottom of the packing chamber

Note 1 to entry: See Figure 1.

3.11
CWP
cold working pressure
maximum fluid pressure assigned to a valve for operation at a fluid temperature of –20 °C to 38 °C

3.12
cryogenic
science of materials at low temperature

3.13
test gas
minimum 97 % pure helium or nitrogen

3.14
shell
pressure containing envelope of the valve normally comprised of the body and when included in the design a bonnet or cover and the body bonnet or body cover joint excluding sealing parts

3.15
drip plate
plate attached to the *extended bonnet* (3.7) to prevent condensation from entering the insulation layer

3.16
obturator
movable component of the valve whose position in the fluid flow path permits, restricts or obstructs the fluid flow

3.17
DBB valve
double block and bleed valve
single valve with two seating surfaces that, in the closed position, provides a seal against pressure from both ends of the valve with a means of venting/bleeding the cavity between seating surfaces

Note 1 to entry: This valve does not provide positive double isolation when only one side is under pressure.

3.18
DIB valve
double isolation and bleed valve
single valve with two seating surfaces, each of which, in the closed position, provides a seal against pressure from a single source, with a means of venting/bleeding the cavity between the seating surfaces

Note 1 to entry: This feature can be provided in one direction or in both directions: DIB-1 (both seats bidirectional) or DIB-2 (one seat unidirectional and one seat bidirectional).

4 Requirements

4.1 Materials

4.1.1 General

Materials in contact with cold process fluid or exposed to low temperatures shall be suitable for use at the minimum design temperature specified by the purchase order. Galling, friction heating, galvanic corrosion and material compatibility with the fluid shall also be considered in the selection of materials.

4.1.2 Metallic materials

4.1.2.1 Shell

For material suitability at low temperature, use ASME B31.3 or EN 13480-2.

The material of body, bonnet, bonnet extension and cover, and other parts of the shell, shall be selected from the following:

a) low alloy and austenitic stainless-steel materials listed in ASME B16.34 or EN 12516-1 for Class-designated valves or EN 12516-1 for PN-designated valves;

b) nickel alloy materials listed in ASME B16.34 for Class-designated valves;

c) copper alloy materials listed in EN 12516-4 for Class- and PN- designated valves.

4.1.2.2 Bolting

Unless otherwise specified by the purchaser, bolting for assembling shell pressure-retaining components shall be selected from materials listed in ASME B16.34 for Class-designated valves or EN 1515-1 for PN-designated valves.

If low-strength bolting, such as non-strain hardened austenitic stainless steel, for example, ISO 3506-1 grade A1-50 and A4-50 or ASTM A320 and ASTM A193 grade B8 Class 1, is being used, the design shall comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2.

4.1.2.3 Internal metallic parts

Internal metallic parts, for example, stem, wedge, disc, ball, plug, seats, back seat and guide bushings, shall be made of materials suitable for use at the entire design temperature range.

4.1.3 Internal non-metallic materials

Valve parts, for example, packing, gasket, seats and other non-metallic valve parts exposed to low temperature, shall be capable of functioning at the entire design temperature range.

4.2 Design

4.2.1 General

Unless otherwise specified in the purchase order, valves shall have a bonnet extension that protects the stem packing and valve operating mechanism from the low-temperature fluid that could otherwise damage or impair the function of these items.

This document shall be applied in conjunction with the specific requirements of a valve product standard, such as ISO 10434, ISO 10631, ISO 14313, ISO 15761 and ISO 17292 or other recognized standards, such as API, ASME or EN, based on an agreement between the purchaser and the manufacturer.

4.2.2 Body/bonnet wall thickness

The minimum valve body and bonnet wall thickness shall meet the requirements of ASME B16.34 or EN 12516-1 or EN 12516-4 for Class-designated valves and EN 12516-1 or EN 12516-2 or EN 12516-4 for PN-designated valves. The pressure rating of the valve at or below service temperatures –50 °C shall not exceed the cold working pressure (CWP) for the applicable valve body material and appropriate Class or PN designation.

4.2.3 Valve body extension and extended bonnet

4.2.3.1 The length of the extension shall be sufficient to maintain the stem packing at a temperature high enough to permit operation within the temperature range of the packing material.

4.2.3.2 The minimum vapour column length or bonnet extension length shall be in accordance with Table 1 or Table 2 and Figure 1, unless otherwise specified in the purchase order.