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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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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 28921-1 was prepared by Technical Committee ISO/TC 153, *Valves*, Subcommittee SC 1, *Design, manufacture, marking and testing*.

ISO 28921 consists of the following parts, under the general title *Industrial valves — Isolating valves for low-temperature applications*:

— *Part 1: Design, manufacturing and production testing*

— *Part 2: Type testing*

Introduction

The purpose of this part of ISO 28921 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 part of ISO 28921 specifies requirements for design, dimensions, material, fabrication and production testing of isolation valves for low-temperature applications.

It applies to gate, globe, check, butterfly and ball valves and can be used for other valve types used in low-temperature services.

This part of ISO 28921 covers isolation valves for use in cryogenic temperature service where the design low-temperature service is –50 °C down to –196 °C.

This part of ISO 28921 does not apply to valves for cryogenic services, designed in accordance with ISO 21011, used with cryogenic vessels.

Where the requirements of this part of ISO 28921 vary from those given in the valve product standards, the requirements of this part of ISO 28921 apply.

This part of ISO 28921 covers valves with body, bonnet, bonnet extension or cover made of metallic materials.

It covers 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,

corresponding to nominal pipe sizes NPS: 3/8; 1/2; 3/4; 1; 11/4; 11/2; 2; 21/2; 3; 4; 5; 6; 8; 10; 12; 14; 16; 18; 20; 24; 26; 28; 30; 32; 34; 36,

and applies to pressure designations:

— PN 16; 25; 40; 100; 160; 250.

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

NOTE PN 250 and Class 1 500 in sizes DN > 100 and NPS > 4 are not covered in this part of ISO 28921.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. 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, *Metallic butterfly valves for general purposes*

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

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, *Valves — Shell design strength — Part 3: Experimental method*

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

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, *Specification for Fire Test for Valves*

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

ASME B31.3, *Process Piping*

ASME, *ASME Boiler and Pressure Vessel Code, Section VIII*

3 Terms and definitions

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

3.1
nominal size
DN

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, definition 2.1]

3.2
nominal pressure
PN

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) 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.]

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

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

3.7
vapour column
portion of body/bonnet extension that allows for the formation of an insulating column of vapour

3.8
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
See Figure 1.

3.9
length of bonnet extension for cold box applications
length measured from the centre-line of the valve flow passage up to the bottom of the packing chamber
See Figure 1.

3.10
cold working pressure
CWP
maximum fluid pressure assigned to a valve for operation at a fluid temperature of –20 °C to 38 °C

3.11
cryogenics
science of materials at low temperature

3.12
test gas
minimum 97 % pure helium or nitrogen mixed with 10 % helium

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 Pressure-retaining boundary

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

Body, bonnet, bonnet extension and cover, and other parts of the pressure retaining boundary, shall be selected from materials listed in ASME B16-34 or EN 12516-1 for Class-designated valves or EN 12516-1 for 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, e.g. stem, wedge, disc, 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, e.g. packing, gasket, seatings 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 part of ISO 28921 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.

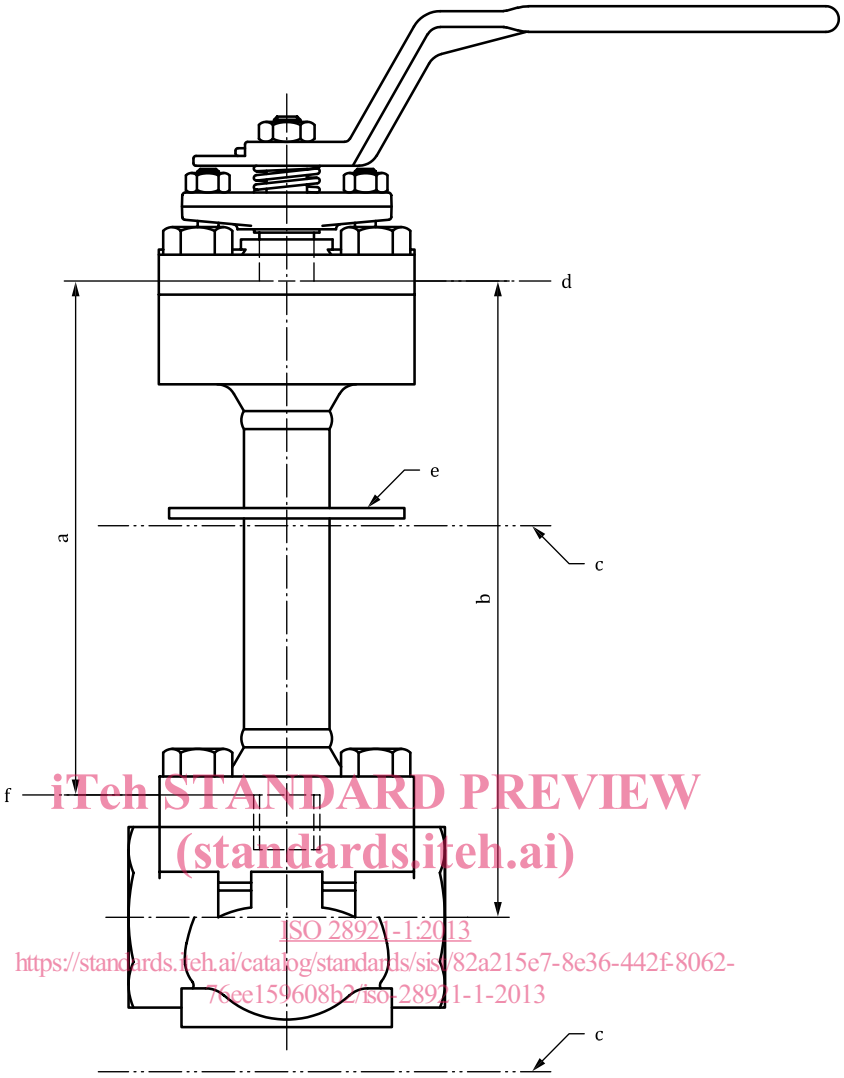
4.2.2 Body/bonnet wall thickness

The minimum valve body and bonnet wall thickness shall meet the requirements of ASME B16-34 or EN 12516-1 for Class-designated valves and EN 12516-1, EN 12516-2 or EN 12516-3 for PN designated valves. The pressure rating of the valve at or below service temperatures –50 °C shall not exceed the pressure rating at room temperature for the applicable valve body material and appropriate Class or PN designation.

4.2.3 Body and bonnet extension

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 shall be in accordance with Table 1 or Table 2 and Figure 1, unless otherwise specified in the purchase order.



a Minimum vapour column length for non-cold box application (see Table 1).
b Extension for cold box application (see Table 2).
c Outline of cold box enclosure.
d Bottom of the packing chamber.
e Optional drip plate.
f Top of stem guide or bonnet.

Figure 1 — Valve with extended bonnet

Table 1 — Minimum vapour column length for non-cold box extension

Valve size range DN	Minimum vapour column length mm				Valve size range NPS
	Minimum design temperature °C				
	minimum	maximum	minimum	maximum	
	–196	–110	–109	–51	
DN ≤ 25	200		100		NPS ≤ 1
32 ≤ DN ≤ 65	250		125		1 ¼ ≤ NPS ≤ 2 ½
80 ≤ DN ≤ 125	300		150		3 ≤ NPS ≤ 5
150 ≤ DN ≤ 200	350		175		6 ≤ NPS ≤ 8
250 ≤ DN ≤ 300	400		200		10 ≤ NPS ≤ 12
350 ≤ DN ≤ 400	450		250		14 ≤ NPS ≤ 16
450 ≤ DN ≤ 650	500		300		18 ≤ NPS ≤ 26
700 ≤ DN ≤ 850	600		400		28 ≤ NPS ≤ 34
DN 900	700		500		NPS 36

Table 2 — Minimum bonnet extension length for cold box applications

Valve size DN	Minimum bonnet extension length mm		Valve size NPS
	Rising stem valves[a]	Quarter-turn valves	
DN ≤ 25	450	400	NPS ≤ 1
32 ≤ DN ≤ 65	550	500	1 ¼ ≤ NPS ≤ 2 ½
80 ≤ DN ≤ 125	650	600	3 ≤ NPS ≤ 5
150	760	610	6
200	865	660	8
250	1 120	710	10
300	1 150	810	12
350	1 200	850	14
400	1 300	850	16
450	1 400	900	18
500	1 500	950	20
600	1 600	1 000	24
650	1 700	1 050	26
700	1 800	1 100	28
750	1 900	1 150	30
800	2 000	1 200	32
850	2 100	1 250	34
900	2 200	1 300	36

[a] For globe valves, bonnet extension is shown up to DN 300 – NPS 12 only.

4.2.3.3 In case of a bonnet extension made of material having lower pressure/temperature rating than the body, then the extension thickness shall be increased proportionally to meet the pressure/temperature