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Ships and marine technology — Check valves for use in low temperature applications — Design and testing requirements

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

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.

Ships and marine technology — Check valves for use in low temperature applications — Design and testing requirements

1 Scope

This document specifies requirements of design, manufacture, and test methods for cryogenic check valves to have excellent quality of leakage stability in very low temperature environments (–50 °C to –196 °C).

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 5209, *General purpose industrial valves — Marking*

ISO 28921-1, *Industrial valves — Isolating valves for low-temperature applications — Part 1: Design, manufacturing and production testing*

API 594, *Check Valves: Flanged, Lug, Wafer, and Butt-welding*

API 598:2016, *Valve Inspection and Testing*

API 6FA, *Specification for Fire Test for Valves*

ASME B16.5, *Pipe Flanges and Flanged Fittings*

ASME B16.10, *Face-to-Face and End-to-End Dimensions of Valves*

ASME B16.25, *Buttwelding Ends*

ASME B16.34:2017, *Valves-Flanged, Threaded, and Welding End*

ASME BPVC Sec. V, *Nondestructive Examination*

ASME BPVC Sec. VIII, Div.1:2018,*Pressure Vessels*

ASTM A182, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*

ASTM A194, *Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

ASTM A320, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service*

ASTM A351/A351M, *Standard Specification for Castings, Austenitic, for Pressure-Containing Parts*

ASTM E186/280/446, *Standard Reference Radiographs for Heavy-Walled Steel Castings*

BS 1868, *Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries*

BS 6364, *Specification for valves for cryogenic service*

MSS SP-55, *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities*

3 Terms and definitions

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

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

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

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

3.1
nominal diameter
DN
alphanumeric designation of size for components of a pipework system, used for reference purposes which comprises the letters DN followed by a dimensionless whole number that is 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 measured value and shall not be used for calculation purposes except where specified in the relevant standard.

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

[SOURCE: ISO 18139:2017, 3.1]

3.2
nominal pressure
PN
numerical designation relating to pressure that is a convenient round number for reference purposes

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

Note 2 to entry: The permissible working pressure depends upon materials, design and working temperature and has to be selected from the pressure/temperature rating tables in corresponding standards.

[SOURCE: ISO 18139:2017, 3.2]

3.3
nominal pipe size
NPS
dimensionless number for the purpose of pipe, flange, or flanged fitting end connection size identification

Note 1 to entry: The number is not necessarily the same as the flange or flanged fitting inside diameter.

[SOURCE: ISO 18139:2017, 3.3]

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

[SOURCE: ISO 18139:2017, 3.4]

4 Pressure temperature rating

4.1 Types of fluids

The types of fluids are shown in Table 1.

Table 1 — Types of fluids

Type	Temperature (in atmospheric pressure)	Liquid density (density)
LNG (Liquefied natural gas)	–163 °C to –88 °C	(434 kg to 478 kg/m^3)
NG (Natural gas)	–160 °C to –65 °C	(0,7 kg to 0,89 kg/ m^3)
LN2 (Liquefied nitrogen)	–196 °C	(804 kg/m^3)
N2 (Nitrogen)	–196 °C to –65 °C	(1,184 kg/ m^3)

4.2 Working pressure and designed temperature

The valve shall be designed to operate without failure or leakage at the extreme temperatures and pressure ranges expected in service.

Class and maximum working pressure shall meet the requirements of the standard class specified in ASME B16.34.

The manufacturers and the purchasers may reach an agreement when Class exceeds 900.

The working pressure and design temperature for these valves are shown in Table 2.

Table 2 — Working pressure and design temperature

PN	Class	Maximum pressure MPa	Note
20	150	2,0	in ambient temperature
50	300	5,2	
100	600	10,3	
128	800	13,8	
150	900	15,5	

NOTE Working pressure is based on the piping design condition provided by the purchasers.

5 Design

5.1 General structure of a check valve

The valve shall be designed as a 'swing', 'dual plate' or 'lift' configuration. Function and standardization of the valve shall be satisfied with the following requirements. The manufacturers shall follow agreements with each other if there are minor differences from this document.

5.2 Materials — General

Throughout this document, materials are specified for each of the various parts of the valve. In lieu of the materials specified, other materials may be used provided they are manufactured by the same

process as the material specified, such as forging, casting, bar, or seamless pipe. In addition, the material shall be suitable for the operating temperatures of the valve and the materials shall have mechanical properties, including low temperature impact resistance, and resistance to corrosion equal to or better than the material specified for the specific valve part.

5.3 Body

5.3.1 Materials

Materials shall be equal quality or better than the materials shown in Table 3; welded ends type valve materials may be used for 'flanged ends' type.

Table 3 — Materials by manufacturing method

Manufacturing method	Materials	
	Flanged ends type	Welding ends type
Forging	ASTM A182 F304, F316	ASTM A182 F304L, F316L
Casting	ASTM A351 CF8, CF8M	ASTM A351 CF3, CF3M

5.3.2 Manufacturing

The valve shall be manufactured according to the following procedures.

5.3.2.1 Face-to-face and end-to-end dimensions shall meet the requirements of the following standards:

a) swing type: ASME B16.10;

b) dual plate type: API 594;

c) lift type: ASME B16.10.

5.3.2.2 Minimum wall thickness shall be thicker than the values shown in ASME B16.34 to account for corrosion, thermal stress, etc.

5.3.2.3 The end connection of the body is classified as 'welding ends' type or 'flanged ends' type and shall be manufactured as below.

5.3.2.3.1 Welding ends type

a) Socket welding ends

- Class 150, 300: to the requirements of Class 3 000 in ASME B16.11
- Class 600: to the requirements of Class 6 000 in ASME B16.11
- Class 800 to 1 500: to the requirements of Class 9 000 in ASME B16.11

b) Butt welding ends

- Thickness of connected pipes under Sch. 40s shall meet the requirements of Sch. 40s and be manufactured according to ASME B16.25.
- Thickness of connected pipes over Sch. 40s: shall be at least the thickness of connected pipes and be manufactured according to ASME B16.25.
- Thickness of connected pipes shall meet the requirements of 'pipe schedules' given by the purchasers.