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

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Foreword

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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 — Gate 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 gate 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 5208, *Industrial valves — Pressure testing of metallic valves*

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 598:2016, *Valve Inspection and Testing*

API 600:2015, *Steel Gate Valves, Flanged and Butt-Welding Ends*

ASME B1.5, *Acme Screw Threads*

ASME B1.8, *Stub Acme Screw Threads*

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

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

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

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASME B16.25, *Butt-welding Ends*

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

ASME B46.1, *Surface Texture (Surface Roughness, Waviness, and Lay)*

ASME B16.47, *Large diameter steel flanges: NPS 26 through NPS 60 Metric/Inch Standard*

ASME Sec. V, *Nondestructive examination, RT, UT, PT mentioned in this document*

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

ASTM A53, *Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*

ASTM A105/A105M, *Forgings, Carbon Steel, for Piping Components*

ASTM A106, *Seamless Carbon Steel Pipe for High-Temperature Service*

ASTM A182/A182M, *Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings and Valves and Parts for High-temperature Service*

ASTM A194/A194M, *Carbon and Alloy Steel Nuts and Bolts for High-Pressure and High Temperature Service*

ASTM A216/216M, *Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service*

ASTM A312, *Grade TP304L, TP316*

ASTM A320/A320M, *Alloys-Steel Bolting Material for Low-Temperature Service*

ASTM A350/A350M, *Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components*

ASTM A351/A351M, *Casting, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts*

ASTM A358, *Grade 304L, 316L*

ASTM A694/694M, *Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission service*

ASTM E186, *Reference Radiographs for Heavy-Walled (2 to 41/2-in) Steel Castings*

ASTM E446, *Reference Radiographs for Steel Castings up to 2in. in Thickness*

MSS SP-55, *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components (Visual Method)*

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:

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

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

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 and associated temperatures 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 design 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 satisfy 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 this valve are shown in Table 2.

Table 2 — Working pressure and design temperature

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

NOTE Working pressure is set following a piping design condition that is provided by the purchasers.

5 Design

5.1 General structure of a gate valve

This valve shall be structured as outside screw and yoke (OS&Y), bolted bonnet (BB), flexible wedge and extended bonnet. When the valve is opening, the stem of the valve shall be rising. The hand wheel shall be rising or non-rising. Composition, function and standardization of the valve shall be satisfied with the requirements of the following sections.

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 Types and materials of body

5.3.1 Types

a) The gate valve shall be a top entry bolted bonnet type.

b) 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 types.

Table 3 — Materials by manufacturing method

Manufacturing method	Materials	
	Flanged ends type	Welded 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 per the following procedure except for special orders by the purchaser.

5.3.2.1 A port shall be a 'full port (full bore) type', and the inside diameter shall comply with ASME B16.34:2017, Annex A.

5.3.2.2 Face-to-face and end-to-end dimensions shall satisfy ASME B16.10.