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

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Foreword

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For an explanation on 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*.

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

1 Scope

This document specifies design, manufacture and test method requirements for cryogenic globe valves for excellent quality leakage stability for use in a very low temperature environment (–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*

ASME B1.5, *Acme Screw Threads*

ASME B1.8, *Stub Acme Screw Flanged Fittings*

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, *Valves-Flanged, Threads, and Welding End*

ASME B16.47, *Large Diameter Steel Flanges*

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

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 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 A536/A536M, *Standard Specification for Ductile Iron Castings*

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. (50.8 to 114-mm)) Steel Castings*

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

ASME Sec. V, *Non-destructive Examination*

ASME Sec. VIII, *Pressure vessels*

API 598, *Valve Inspection and Testing*

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

BS 1873, *Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries*

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.

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.

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.

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

4 Pressure temperature rating

4.1 Types of fluid

The types of fluid are shown in Table 1.

Table 1 — Types of fluid (example)

Type	Temperature (in atmospheric pressure)	Liquid density(density)
LNG (Liquefied natural gas)	−163°C to −88°C	434 to 478 kg/m^3
NG (Natural gas)	−160°C to −65°C	(0,7 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 working pressure and design temperature for this valve are shown in Table 2.

Table 2 — Working pressure and design temperature

Class	Maximum pressure MPa(psi)	Note
150	2,0 (290)	in ambient temperature
300	5,2 (750)	
600	10,3 (1 500)	
800	13,8 (2 000)	
900	15,5 (2 250)	

Class and maximum working pressure shall satisfy the standard class specified in ASME B16.34.

NOTE 1 The manufacturers and the purchasers may reach an agreement when Class exceeds 900.

NOTE 2 Working pressure is set following a piping design condition that is provided by the purchasers.

Design temperature shall be between −196°C and +100°C.

5 Structure

5.1 General structure of a globe valve

The globe valve is an ‘inside screw (IS)‘ type or ‘outside screw and Yoke (OS&Y)‘ type and has a ‘bolted bonnet (BB)’, ‘solid plug’, ‘extended bonnet’, etc. The stem rises when the valve is open and the hand wheel has a ‘rising’ or ‘non-rising’ structure. The constitution and functions of the globe valve are shown in this document. If there are some differences from this document, the manufacturers can make a decision after reaching an agreement with purchasers (the general structure of this valve is shown in Figure 1).

5.2 Body type and material

5.2.1 Type

The globe valve is normally a ‘top entry bolted bonnet type’.

5.2.2 Materials

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

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

5.2.3 Manufacturing

The valve shall be manufactured per the following procedure except if there are purchaser's special orders.

a) Face-to-Face and End-to-End dimensions of the body shall satisfy ASME B16.10.

b) Body wall thickness shall be greater than minimum wall thickness as shown in ASME B16.34, Tables 3 and 4.

c) The end connection of the body is 'welding ends' type or 'end flanges' type and manufactured as below

1) 'Welding ends' type

1.1) socket welding ends

— Class 150, 300: to satisfy Class 3000 in ASME B16.11.

— Class 600: to satisfy Class 6000 in ASME B16.11.

— Class 800 to 1500: to satisfy Class 9000 in ASME B16.11.

1.2) butt welding ends

— Thickness of connected pipes less than Schedule 40: to satisfy Schedule 40 and manufactured according to ASME B16.25 or BS 1873.

— Thickness of connected pipes greater than Schedule 40: to satisfy thickness of connected pipes and be manufactured according to ASME B16.25 or BS 1873.

— Thickness of connected pipes shall satisfy 'line schedules', which is given by the purchasers.

2) 'End flanges' type

2.1) Under NPS 24: to be manufactured according to ASME B16.5

— Class 150, Class 300: Raised Face(RF) type flange.

— Over Class 600: Large Groove Face(LGF) type flange or Raised Face(RF) type flange 2.2).

2.2) Over NPS 26: to be manufactured according to ASME B16.47

— Class 150, Class 300: Raised Face(RF) type flange.

— Over Class 600: Large Groove Face(LGF) type flange or Raised Face(RF) type flange.

2.3) Processing accuracy of face shall satisfy ASME B16.5 and ASME B16.47, and be measured in accordance with ASME B46.1.

5.3 Types and materials of extended bonnet

5.3.1 Design

Types of the extended bonnet are shown as below.

a) Minimum wall thickness shall be thicker than the value in ASME B16.34, Table 4, but thickness of the neck behind the back seat shall satisfy ASME B16.34, 6.1.3.

b) The flange connection of the bonnet connected to the body shall satisfy API 600, 2.2.2 to 2.2.4 or BS 1873.

a) The length of the extended bonnet shall satisfy ISO 28921-1.

b) The insulation collar and drip plate may be installed on the extended bonnet where not insulated.

c) The insulation line shall be specified on a design drawing so that the valve operating area is not frozen.

d) The back seat ring is to be installed inside of the extended bonnet.

5.3.2 Materials

Manufacturing methods shall be casting or welding casting (forging) part and connected pipe.

a) In case of casting: bonnet materials should be higher quality than the materials of the body;

b) Welding casting (forging) part and connected pipe

— Casting area: ASTM A351 CF3, CF3M.

— Forging area: ASTM A182 F304L, F316L.

— Connected pipe area: ASTM A312 or equal to ASTM A358 304L, 316L or better.

— Connected pipe shall be made as seamless pipe; longitudinal seams and orbital welding methods are not allowed.

5.4 Plug types and materials

5.4.1 Design

a) The plug shall be a one-piece type and the port that blocks flow shall be a seated type.

Note When the temperature range is −52°C to −80°C, a soft seat type plug can be used.

b) Seat wear shall be minimized as the plug and shell are working.

c) The plug guide shall be installed to align the plug and stem straight.

d) A seat ring is not necessary if there is a body port.

5.4.2 Materials

Materials shall be equal to ASTM A182, F316, ASTM A351 CF8M or better. The part that adheres to the seat ring needs a hard surface treatment to improve wear resistance. The thickness of hard surface treatment shall be thicker than 1,6 mm.