BS ISO 18139:2017

BSI Standards Publication

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

bsi.

National foreword

This British Standard is the UK implementation of ISO 18139:2017.

The UK participation in its preparation was entrusted to Technical Committee SME/32, Ships and marine technology - Steering committee.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2017

ISBN 978 0 580 88214 2

ICS 47.020.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2017.

Amendments/corrigenda issued since publication

Date	Text affected

BS ISO 18139:2017

INTERNATIONAL STANDARD

ISO 18139

First edition
2017-02

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

Navires et technologie maritime — Robinets à soupape pour des applications à basse température — Exigences de conception et d'essais

Reference number
ISO 18139:2017(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

INTERNATIONAL STANDARD ISO 18139:2017(E)

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.

5.5 Stem types and materials

5.5.1 Design

a) A stem shall be an 'extended stem type' unless there are special orders.

b) The minimum diameter of the stem shall be larger than the value in BS 1873. In case of a 'Reduced port type', the manufacturers and the purchasers may reach an agreement.

c) The part of the stem that is connected to the plug shall not be detached as the valve is working and has enough strength.

d) The outer surface of the stem shall precisely adhere to the packing to retain sealing, and be accurately fabricated (surface roughness: less than 0,8 μm) to avoid damage as the valve is working.

e) When the valve is fully open, the part of the stem that contacts the back seat shall be made as a 'coning type' or 'spherical type' to adhere to the back seat perfectly.

f) Stem threads shall satisfy ASME B1.5 or ASME B1.8.

5.5.2 Materials

Stem materials shall be equal to ASTM A182, F316 or better than the body's materials.

5.6 Stem sealing

a) The stem shall be sealed with an appropriate structure (ex. stem packing, lantern ring) to prevent leakage.

b) The packing for stem sealing should have enough sealing characteristics and strength to prevent damage when the valve is open/closed and working for a long time.

c) Packing materials for stem sealing may be equal to or better than graphite, PTFE, diagonal braid of carbon fibers impregnated with PTFE. Manufacturers and the purchasers may reach an agreement, however packing shall not have a chemical reaction to the working fluid or make deposits or otherwise physically affect the working of the valve.

d) The packing for stem sealing shall be made such that it can be replaced easily.

5.7 Seat ring types and materials

5.7.1 Design

The seat ring (or integral seat) in the body shall be a single seated (or integral seated) type that is united with a port to block the flow.

5.7.2 Materials

Materials for the seat ring shall be equal to ASTM A182, F316 or better than the body's materials. A part that adheres to the face of a plug needs hard facing treatment to improve wear resistance. In case of the soft seat type plug (disc), hard facing of the seat face is not required. The thickness of hard surface treatment shall be thicker than 1,6 mm.

5.8 Bolts and nuts types and materials

5.8.1 Design

Bolts and nuts for bonnet flanges, yokes and gland flanges shall satisfy BS 1873.

5.8.2 Materials

Materials for bolts and nuts are shown as below.

a) Bolts materials shall be equal to or better than ASTM A320 Gr. B8 class 2.

b) Nuts materials shall be equal to or better than ASTM A194 Gr.8.

5.9 Driving system and operating device requirements

5.9.1 Driving system of the valve

Driving methods shall be direct hand wheel types (in low differential pressure) or geared operation types (in high differential pressure), but it can be changed to another type (chain wheel type/pneumatic type/hydraulic type/electric type) along with driving conditions. The drive system shall be controlled easily without using special tools and excessive force.

5.9.2 Manual operation of the valve

The manual operation shall be a hand wheel type and the operating effort needed at the end of the manual operating device shall not exceed maximum 360 N (36 kgf) under differential pressure conditions of working pressure. Also the diameter of the hand wheel may be less than 760 mm.

5.9.3 Materials for operating devices

Materials for manual operating devices shall be equal to or better than those listed below, and need treatment to prevent corrosion, e.g. galvanizing. It shall be durable enough against the stress made by working under differential pressure conditions of nominal pressure.

a) Gear box materials

   — Forged steel: ASTM A105, A350 LF2, A694 F52.

   — Casting steel: ASTM A216 WCC.

   — Ductile cast iron: ASTM A536.

b) Hand wheel materials

   — Ductile cast iron.

   — Equal to or better than carbon steel pipe.

5.9.4 Explosion proof class

The explosion class of auto-operating devices (especially electric explosion proof devices) shall satisfy the criteria of the hazardous area where a valve is installed (if applicable).

5.9.5 Checking open degree

A position indicator shall be installed to check the open degree of the valve.

5.9.6 Auto-operating devices

A position indicator and a limit switch shall be installed on auto-operating devices to check the open degree of the valve, and not to apply excessive force to the stem and the seat ring when the valve is open. Also, manufacturers and the purchasers may reach an agreement on the design standard of this requirement.

5.9.7 Sealing class for gear boxes

It shall be a water-proof structure.

5.9.8 Installation direction of operating devices

The manufacturers and the purchasers may reach an agreement on installation direction and position of hand wheel.

5.9.9 Direction of open and closed

The direction of the opening valve shall be counter clockwise.

5.9.10 Special requirement

If an actuator is too heavy, the manufacturers shall design a self-supported operator structure so that the valve stem is not damaged.

5.10 Surface treatment

All valves shall have pickling and passivation treatments to make passive state.

5.11 Welding and heat treatment

5.11.1 Welding

a) Welding shall be conducted by the Welding Procedure Specification (WPS) and the Procedure Qualification Record (PQR).

b) Repair welding shall be conducted by the Repair Welding Procedure Specification (RWPS) that are agreed between purchasers and manufactures.

c) Non-destructive inspection for repair welding part shall be conducted according to 6.2.

d) Manufacturers shall document any defect on main valve parts (body, plug, seat ring, and extended bonnet) prior to any repair work as soon as possible. Defect reports shall be provided to inspectors.

5.11.2 Heat treatment

Heat treatment shall be conducted by the heat treatment standard appropriate to the materials.

6 Test and inspection

All tests and inspections shall be conducted by related standards, test procedures, inspection procedures and working drawings that are agreed between the purchasers and the manufacturers. Also these may be conducted by the purchasers or third parties whom the purchasers select.

6.1 Material test

Mill certificates and cryogenic impact test reports that specify chemical analysis and physical test results for main components (body, plug, seat ring, and extended bonnet) shall be prepared and test results shall meet the values of related standards.

6.2 Non-destructive inspection

Purchasers and manufacturers may reach an agreement before inspection. Radiographic testing radiographs and non-destructive inspection interpretation result reports shall be stored and

maintained at least for five years. Related radiographs and reports shall be submitted upon the purchaser's request.

6.2.1 Radiographic testing (RT)

a) The test scope is as below:

   1) It shall satisfy ASME B16.34 Chapter 8. Radiographic testing shall be conducted at the welded part of every casting valve and critical area, but the end part of bodies shall be inspected before machining bevels.

   2) In case of casting valves, 5 % (at least one) of all the numbers (casting parts) are sampled and then tested at the critical areas shown in ASME 16.34. If there are defects, an additional 10 % of all the numbers (casting parts) are sampled and tested. If further defects are revealed at this time, all casting parts are considered failures.

b) Test procedure and acceptance criteria are as below:

   1) It shall satisfy ASME Sec. V and ASME B16.34 Mandatory appendix.

   2) In case of casting parts, it shall be compared with reference radiographs that satisfy ASTM E446 (wall thickness: less than 50,8 mm) and ASTM E186 (wall thickness between 50,8 mm and 114,3 mm), and then radiograph interpretation shall be conducted.

   3) Acceptance criteria of casting parts shall satisfy ASME 16.34.

   4) Acceptance criteria of welding parts shall satisfy ASME Sec. VIII Div.1 UW-51 and Appendix 4.

6.2.2 Penetrant testing (PT)

Penetrant testing is as below:

a) The test scope is as below:

   1) Penetrating testing shall be conducted 100 % on the body, the outside surface of the bonnet and the inside surface of the bonnet that can be inspected, machined surface of bevels at the end, sockets and welded fillets (lifting lug, supporting leg etc.) where radiographic testing is impossible.

   2) Where a casting crack exists, penetrating testing shall be conducted 100 % on the elimination areas of the crack.

   3) Penetrating testing shall be conducted 100 % on bolts over 25,4 mm length.

   4) Penetrating testing shall be conducted 100 % on plug and body seating surfaces. Also it shall be conducted after surface machining on the plug and body seat ring where hard surface treating is conducted by high hardness materials.

   5) Penetrating testing shall be conducted 100 % on every welded sealing area.

b) The test procedure shall satisfy ASME Sec. V and ASME B16.34 Appendix 3.

c) The acceptance criteria is as below:

   1) Casting, forging: ASME B16.34 Annex D.

   2) Welded areas: ASME Sec. VIII Div.1 Appendix 8.

6.2.3 Ultrasonic testing (UT)

a) The test scope is as below:

   1) Ultrasonic testing shall be conducted 100 % on the body and bonnet of forging valves according to ASME B16.34 Chapter 8.

   2) Ultrasonic testing shall be conducted 100 % on stems of every valve.

b) The test procedure shall satisfy ASME Sec. V and ASME B16.34 Appendix IV.

c) The acceptance criteria shall satisfy ASME B16.34 Annex E.

6.2.4 Retest

If an inspection result is a failure, relevant areas shall be retested after repair work.

6.2.5 Submission of inspection results

Manufacturers shall submit inspection test results in a report to the purchasers. Inspection reports shall include drawings indicating which areas have been inspected.

6.3 Dimension check

Main valve dimensions shall be verified against the relevant standards and drawings which the manufacturers provide.

6.4 Visual inspection

Scratches, cracks, creases, contractions, spurs, moulding sand and corrosion etc., on the surface of the valve shall be evaluated in accordance with MSS-SP-55. The machining/seat ring surface shall be checked for damage. There shall not be flaws, under-cutting, arc strikes etc., on the welded parts and the height of bead on welding parts shall not be lower than the basic material surface.

6.5 Heat treatment inspection

The inspection shall be conducted by standards by which the purchasers and manufacturers reach an agreement. Heating temperature, heating methods, heating time, holding time, cooling speed and cooling methods are specified in the standards.

6.6 Operating tests

Operating tests of finished valves shall be conducted for at least five cycles. Tests shall be conducted without any pressure the first five cycles, and then with nominal pressure for 10 cycles, and then checked for errors. The errors shall be conducted and checked more than one time under differential pressure condition of nominal pressure and operating effort shall not exceed maximum 360 N (36 kgf).

6.7 Pressure tests, back seat tests and leak tests

These tests shall be conducted in accordance with API 598 to check strength and leakage of valves on every finished valve. The test results shall be submitted as a record. When blocking the entry and exit of ports for pressure and leak tests, appropriate test devices shall be prepared in order not to apply stress to the valve body.

6.7.1 Pressure tests

Table 4 — Pressure tests

Clause	Shell pressure test	Low pressure closure test	High pressure closure test
Test medium	Volatile liquids as kerosene, methanol, alcohol etc.	Dried air or nitrogen	Volatile liquids as kerosene, methanol, alcohol etc.
Test pressure	1,5 times pressure rating at 38°C, specified in ASME B16.34 Table 2-2.1B and 2.2B(special class) (slightly open)	0,7 MPa (closed)	1,1 times pressure rating at 38°C, specified in ASME B16.34 Table 2-2.1B and 2.2B(special class) (closed)
Test time	Minimum 5 min	Minimum 5 min (bubble test time)	Minimum 5 min
Test method	Tightening packing gland completely	Tightening packing gland completely	Tightening packing gland completely
Acceptable criteria	No leakage	API 598	API 598

NOTE 1 Manufacturers and purchasers may reach an agreement regarding additional test mediums except those shown in Table 4.

6.7.2 Back seat tests

Back seat tests may be conducted upon request of the purchaser.

Table 5 — Back seat tests

Clause	High pressure back seat test	Low pressure back seat test
Test medium	Volatile fluids as kerosene, methanol, alcohol etc.	Dried air or nitrogen
Test pressure	1,5 times pressure rating at 38°C, specified in ASME B16.34 table 2	0,7 MPa (closed)
Test time	Minimum 5 min	Minimum 5 min
Test method	Loosening packing gland completely	Loosening packing gland completely
Acceptable criteria	No leakage	No leakage

NOTE 1 Manufacturers and purchasers may reach an agreement regarding additional test mediums except shown in Table 5.

6.8 Fire safety test

The fire safety test can be replaced by an API 6FA certificate.

6.9 Cryogenic test

It shall be conducted as below.

6.9.1 Scope of tests

a) 5 % (at least one) of all numbers classified by sizes and pressure classes are to be sampled and tested. (100 % of emergency shutdown valves shall be tested).

b) If there is failure, an additional 10 % of all numbers are sampled and tested. Defects shown at this time result in all of the valves failing. An acceptable criterion of cryogenic tests means each test

result, e.g. initial proving test, cryogenic performance test, returning ambient temperature test, disassemble test etc, satisfy each acceptable criteria.

6.9.2 Test procedure

Cryogenic tests shall be conducted in the following order in case of type tests: a) initial proving test, b) cryogenic performance test, c) returning ambient temperature test. In the case of product testing, only test b) is required. Test methods and procedures are as below.

a) Initial proving test: This test is conducted before cryogenic tests to check leakage from valves. It shall be conducted when the valve is closed as below.

   1) Test temperature: ambient temperature

   2) Test medium: helium, N2 gas or dry air

   3) Test pressure: 1,1 times working pressure putting on upstream area

   4) Test time: 5 min

   5) Acceptable leakage amount: no visible leaks

b) Cryogenic performance tests

   1) Preparing tests

      1.1) Appropriate test devices for cryogenic tests shall be manufactured to ISO 28921-1. The thermocouple shall be installed in an appropriate position on the valve body, bonnet, gland housing etc.

      1.2) The body and the bonnet connection shall be cooled down in a liquid nitrogen container. The inside of the valve shall be purged by helium during cooling down, and then the temperature shall be checked on the inside and outside of the valve body, bonnet, gland housing by the thermocouple.

   2) Test types and methods: When −196°C is set steadily, it shall be tested as below.

      2.1) Cryogenic closure test: It shall be conducted according to 6.9.2. At this time temperature shall be −196°C and acceptable leakage rate is less than 10 cm^3/(min./inch) by NPS. Stage of pressure rising methods to test pressure is in Table 6.

      2.2) Cryogenic operating test (for type test only): Open-close test shall be conducted at least one time under differential pressure conditions of working pressure at −196°C. Operating effort shall be checked at the end of operating device when the valve is open or closed and recorded. [Acceptable criteria is under 400 N (40 kgf)]. Also it shall be conducted more than five times under working pressure with no differential pressure.

Table 6 — Stage of pressure rising classified by valve pressure (reference)

Valve pressure class	Pressure rising value classified stage [MPa(bar)]	Holding time classified pressure rising stage	Note
Class 150	0,35 (3,5)	10 min	Checking and recording leakage classified by pressure rising stage
Class 300	0,75 (7,5)	10 min	
Class 600	1,0 (10,0)	10 min	
Over class 800	2,0 (20,0)	10 min	

c) Returning ambient temperature test

When the cryogenic test is finished, the following shall be conducted after the valve reaches ambient temperature:

1) Leakage test in ambient temperature

Leakage of valve shall be checked by 6.9.2 a). Maximum acceptable leakage rate classified by NPS shall satisfy API 598, Table 5.

2) Working test

Open-close test shall be conducted at least one time under differential pressure condition of working pressure. Operating effort shall be checked at the end of operating device when the valve is open or closed and the result recorded [Acceptable criteria is under 400 N (40 kgf)].

6.9.3 Submission of test result

After the cryogenic tests, a test report including the following contents shall be submitted:

a) Initial proving test result at ambient temperature [6.9.2 a)]

b) Temperature check result at cryogenic temperature [6.9.2 b) 1.2)]

c) Leakage test result classified by pressure stages at cryogenic temperature [6.9.2 b) 2.1)]

d) Working test (open-close test) result at cryogenic temperature [6.9.2 b) 2.3)]

e) Leakage test result at ambient temperature [6.9.2 c) 1)]

f) Working test (open-close test) result after returning to ambient temperature [6.9.2 c) 2)]

6.9.4 Marking

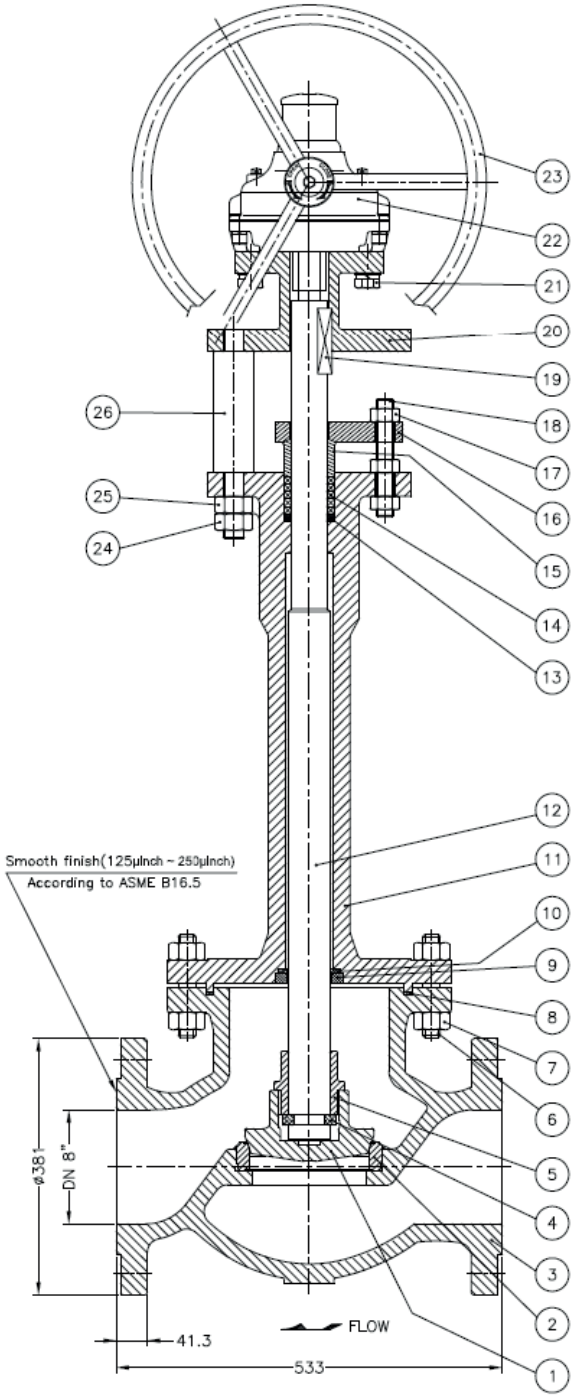
a) Contents marked on valve body shall satisfy ISO 5209. Fluid flow direction shall be indicated. Also it shall be marked “LT” on upper or lower (centre of body) of flow direction.

b) Contents marked on name tag shall satisfy ISO 5209, marked tag number.

c) Open-close direction shall be marked on the operator.

Annex A
(informative)

Cryogenic globe valve



Key

1	plug (disk)	14	packing
2	seat ring	15	gland
3	body	16	gland flange
4	retaining ring	17	nut
5	disk stem nut	18	stud bolt
6	stud bolt	19	key
7	nut	20	upper plate
8	gasket	21	screw
9	retaining ring	22	electrical motor
10	centering ring	23	hand wheel
11	bonnet	24	counter nut
12	stem	25	nut
13	bottom ring	26	tie rod

Figure A.1 — Cryogenic globe valve (example)

Bibliography

[1] ISO 68-1:1998, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

[2] ISO 261:1998, *ISO general purpose metric screw threads — General plan*

[3] ISO 262:1998, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*

[4] ISO 724:1993, *ISO general-purpose metric screw threads — Basic dimensions*

[5] ISO 2901:2016, *ISO metric trapezoidal screw threads — Basic and design profiles*

[6] ISO 2902:2016, *ISO metric trapezoidal screw threads — General plan*

[7] ISO 4990, *Steel castings — General technical delivery requirements*

[8] ISO 6708:1995, *Pipework components — Definition and selection of DN (nominal size)*

[9] ISO 7268:1983, *Pipe components — Definition of nominal pressure*

[10] ISO 9477, *High strength cast steels for general engineering and structural purposes*

[11] API 6D: 2012, *Specification for Pipeline Valves*

[12] API 6FA:2011, *Specification for Fire Test for Valves*

[13] ASTM A370:2012, *Test Methods and Definition for Mechanical Testing of Steel Products*

[14] Sec A.S.M.E. IX. Welding and Brazing Qualifications, 2013

[15] BS 6364:1984, *Valves for Cryogenic Service*

[16] IACS UR A2, *Shipboard fittings and supporting hull structures associated with towing and mooring on conventional vessels*

[17] OCIMF, *Mooring Equipment Guidelines (MEG 3)*

ICS 47.020.30
Price based on 17 pages

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services
Tel: +44 345 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 345 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.