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Steel valves

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS B 2071 : 1995** is replaced with **JIS B 2071 : 2000**.

This revision adopts **JIS B 2071 : 1995** and **ISO** Standards as the basis in order to conform to the International Standards.

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Steel valves

Introduction This Japanese Industrial Standard has been prepared based on **JIS B 2071 : 1995** and **ISO Standards**. This Standard consists of the following Sections 1 through 3, and Annexes 1 through 5 which are the collections of common contents of the above mentioned Sections.

Section 1 Cast steel flanged valves: This Section is a revision of the former **JIS B 2071**, 1995 edition, and defines the cast steel flanged valves for general mechanical equipment, chemical equipment and others, of nominal pressure 10 K and 20 K.

Section 2 Steel valves for general purpose application: This Section has been prepared based on **ISO 6002 : 1992** *Bolted bonnet steel gate valves* and **ISO 12149 : 1999** *Bolted bonnet steel globe valves for general purpose application*, enlarged the contents with the fundamental concept keeping as a standard, and the check valves are added. And this section defines the steel valves used for general purpose of nominal pressure PN.

Section 3 Bolted bonnet steel valves for petroleum and natural gas industries: This Section has been prepared based on **ISO 10434 : 1998** *Bolted bonnet steel gate valves for petroleum and natural gas industries*, with the fundamental concept keeping as a standard, and the globe valves and check valves are added. And this Section defines the steel valves of nominal pressure PN which are to be used for petroleum and natural gas industries.

The relationship between nominal pressure PN indication and class indication is as follows:

PN 20:	Class 150
PN 50:	Class 300
PN 110:	Class 600
PN 150:	Class 900
PN 260:	Class 1500
PN 420:	Class 2500

The portions underlined with dots or with sidelines in this Standard are matters not included in the corresponding International Standards.

Section 1 Cast steel flanged valves

1 Scope This Section specifies the cast steel flanged valves to be used in general mechanical equipment, chemical equipment and others (hereafter referred to as "valves").

Remarks : All the expression of pressure is of gauge pressure.

1.2 Normative references The following standards contain provisions which, through reference in this Section, constitute provisions of this Section. The most recent editions of the standards shall be applied.

- JIS B 0100 *Glossary of terms for valves*
- JIS B 2001 *Nominal size and bore of valves*
- JIS B 2002 *Face-to-face and end-to-end dimensions of valves*
- JIS B 2003 *General rules for inspection of valves*
- JIS B 2004 *General rules for marking on valves*
- JIS B 2238 *General rules for steel pipe flanges*
- JIS B 8270 *Pressure vessels (General standard)*
- JIS G 4051 *Carbon steels for machine structural use*
- JIS G 4107 *Alloy steel bolting materials for high temperature service*
- JIS G 4303 *Stainless steel bars*
- JIS G 5121 *Stainless steel castings*
- JIS G 5151 *Steel castings for high temperature and high pressure service*
- JIS H 4553 *Nickel and nickel alloy bars*
- JIS Z 3221 *Stainless steel covered electrodes*
- JIS Z 3224 *Nickel and Nickel-alloy covered electrodes*
- JIS Z 3251 *Covered electrodes for hardfacing*
- JIS Z 3321 *Stainless steel, welding rods and solid wires*

1.3 Definitions For the purposes of this Section, the definitions in JIS B 0100 apply, and others are in accordance with the following:

- a) **cladding by welding** A depositing method of the metal of required texture and dimensions, corresponding to the objects of hardening, corrosion resistance and others, on the base metal surface of the solid valve disc, disc seat ring or body seat ring.
- b) **hardfacing** A depositing method of hard metal on the base metal surface of the solid valve disc, disc seat ring or body seat ring, which is applied for the purpose of enduring abrasion.

Remarks : The hardfacing is a kind of cladding by welding.

1.4 Classification The valves shall be classified as given in Table 1.1, according to the combinations of the nominal pressure, type of valve and nominal diameter.

Table 1.1 Classification

Nominal pressure	Type of valve	Nominal diameter (A)									
		40	50	65	80	100	125	150	200	250	300
10 K	Flanged globe valve	—	○	○	○	○	○	○	○	—	—
	Flanged angle valve	—	○	○	○	○	○	○	○	—	—
	Flanged gate valve	—	○	○	○	○	○	○	○	○	○
	Flanged swing check valve	—	○	○	○	○	○	○	○	○	○
20 K	Flanged globe valve	○	○	○	○	○	○	○	○	—	—
	Flanged angle valve	○	○	○	○	○	○	○	○	—	—
	Flanged gate valve	—	○	○	○	○	○	○	○	○	○
	Flanged swing check valve	—	○	○	○	○	○	○	○	○	○

1.5 Relation between the condition of fluid and the maximum permissible working pressure The relation between the condition of fluid and the maximum permissible working pressure of valve shall be in accordance with Table 1.2.

Table 1.2 Relation between the condition of fluid and the maximum permissible working pressure

Unit : MPa

Condition of fluid	Maximum permissible working pressure	
	Valves of nominal pressure 10 K	Valves of nominal pressure 20 K
Steam, air, gas, oil and others of 425 °C max. and creeping may be considered	—	2.0
Steam, air, gas and oil of 400 °C max.	—	2.3
Steam, air, gas, oil or pulsating flow water of 350 °C max.	—	2.6
Steam, air, gas, oil or pulsating flow water of 300 °C max.	1.0	2.9
Steam, air, gas, oil or pulsating flow water of 220 °C max.	1.2	3.1
Steady flow water of 120 °C max.	1.4	3.4

Remarks : When the working temperature or pressure of the fluid comes between the values of Table 1.2, the interpolation method given in Remarks 5 of Attached Table 1 of **JIS B 2238** applies.

1.6 Designing requirements

1.6.1 Common requirements The common requirements of construction, shapes and dimensions of valves shall be as follows.

- a) Face-to-face dimension of valves shall be in accordance with **JIS B 2002**.
- b) Bore of the valve shall be in accordance with **JIS B 2001**.
- c) Each dimension of flange shall be in accordance with Attached Tables 4-1, 6, 10 and 11 of **JIS B 2238**.
- d) Minimum wall thickness of valve body and bonnet shall be in accordance with a or a_1 of Table 1.3.

Table 1.3 Minimum wall thickness

Unit : mm

Nominal pressure		Nominal diameter (A)									
		40	50	65	80	100	125	150	200	250	300
10 K	a	—	5.6	5.6	5.9	6.4	7.1	7.1	8.1	8.6	9.6
	a_1	—	8.6	9.7	10.4	11.2	11.6	11.9	12.7	14.2	16.0
20 K	a	4.8	6.3	6.5	7.2	7.8	8.7	9.6	11.2	12.6	14.1
	a_1	7.9	9.7	11.2	11.9	12.7	14.3	16.0	17.5	19.1	20.6

- e) The valve shall be opened by the counterclockwise turning of the handwheel and closed by the clockwise turning of that.
- f) The gasket seat of the flange connected with a pipe shall be of a large raised face unless otherwise designated.
- g) The bonnet flange of the valve body shall be of a round shape, however, that of 4-bolts of not larger than 65 in nominal diameter may be of a square shape.

Furthermore, the gate valve of nominal pressure 10 K may be of an oval shape.

- h) The joint face of the valve body with the bonnet shall be of a male-female type, however, a tongue and grooved type or ring joint gasket type may also be used.

Further, for the gate valve of nominal pressure 10 K, the flat face may also be used.

- i) The stress which the bonnet bolts receive shall not be larger than the value specified in **JIS B 8270**.
- j) The valve seat face may be any one of the solid type, separated seat type or cladding by welding. However, it shall be that of an appropriate type for the working conditions.
- k) In the case where valve seats are to be attached to the valve disc and body, they shall be attached by such as screwing in or welding so that they are not loosened during working.
- l) The gland flange shall have sufficient strength against breakage due to the fastening of the gland flange bolts.
- m) Connection of auxiliary equipment shall be in accordance with Annex 3.

- n) The examples of construction, shapes and names of parts are indicated in Attached Table 1.

1.6.2 Globe valves and angle valves The construction, shapes and dimensions for globe valves and angle valves shall be as given in the following:

- a) The shape of the valve seat may be any of flat face, cone or others which are suitable for working conditions.
- b) The valve disc and valve stem are attached by the disc stem nut to rotate smoothly each other and it shall be so constructed that these are not loosened.
- c) The bonnet or bonnet bush and valve stem or disc stem nut should preferably be provided with respective back seats.
- d) The valve stem shall be of a solid body.
- e) The screw of valve stem shall be of trapezoid.
- f) The length of engagement of the threads of the valve stem and the yoke bush shall be not less than 1.5 times the valve stem diameter.

1.6.3 Gate valve The construction, shape and dimensions of the gate valve shall be as given in the following:

- a) Suitable ribs may be provided to reinforce the valve body.
- b) Suitable guides shall be provided on the valve body and valve disc.
- c) The valve disc shall be of a wedge shape.
- d) The width of valve sheet face of the valve disc shall maintain the abrasion allowance sufficient to keep the contact surface with valve sheet face of the valve body in the case when the closing position of valve disc becomes lower by the abrasion.
- e) On the valve stem and bonnet or bonnet bush, respective back seats should preferably be provided.
- f) The valve stem shall be solid, and the connecting part with the valve disc shall be T-shaped or button-shaped.
- g) The top of the valve stem, even if it has reached the permissible lowest position in use due to wearing of the valve seat, shall not be lower than the top face of the yoke sleeve.
- h) The yoke sleeve of the valve of nominal diameter 100 or more should preferably be so constructed that it is capable of being detached without removing the bonnet from the valve body.
- i) The screw of valve stem shall be of trapezoid.
- j) The length of engagement of the valve stem with the yoke sleeve shall be not less than 1.5 times the valve stem diameter.

- k) The combination of the yoke sleeve and handwheel shall be a suitable fitting which is capable of being stopped with key or with whirl-stop.

1.6.4 Swing check valve The construction and shape of the swing check valve shall be as given in the following:

- a) The valve disc shall be allowed to open up to the position of a stopper equipped on the valve body or bonnet, and be so constructed that it is easily closed by a counter current.
- b) The valve disc may be divided into a valve disc and valve disc bolt. In this case, the valve disc bolt shall be constructed so as not to be loosened.
- c) The connecting part of the valve disc and the arm shall have suitable gap, and shall be so constructed that it may not be loosened during working.
- d) The valve body and arm shall be constructed so as to be capable of rotating smoothly, being connected with a hinge pin. However, other suitable connecting methods may also be used.
- e) The pin hole of the valve body shall be sealed each by screwing-in a plug or other method. However, in the case where the hinge pin has been so constructed that it can be detached easily from one end, the pin hole may have not been penetrated.
- f) The bonnet of the valve should preferably be attached with eyebolts, as required.

1.7 Materials The materials of valves shall be as given in the following:

- a) The material of the valve body and bonnet shall be SCPH2 of **JIS G 5151**. However, for the bonnet, any material equivalent to SCPH2 may be used.
- b) As for the corrosion resistance of the valve disc and disc seat ring, divided into the valve disc and disc seat ring and the valve body and body seat ring, the material equivalent to that of the valve body shall be used.
- c) Respective valve seat faces of the valve disc of solid type or disc seat ring and body seat ring shall be made of metal suitable for application, and the combination listed in Table 1.4 should preferably be used.

Table 1.4 Combination of materials of the valve seat faces

Symbols of combination	Valve seat faces				
	Types of material	Casting	Forging	Welding	Surface hardness (HB min.)
a	13 % Cr steel	SCS1 or SCS2 of JIS G 5121	SUS403, SUS420J1, SUS420J2, SUS410 of JIS G 4303	D410 of JIS Z 3221 or Y410 of JIS Z 3321	250 ⁽¹⁾
	13 % Cr steel				
b ⁽²⁾	13 % Cr steel	SCS1 or SCS2 of JIS G 5121	SUS403, SUS420J1, SUS420J2, SUS410 of JIS G 4303	D410 of JIS Z 3221 or Y410 of JIS Z 3321	250
	Ni-Cu alloy				
c	Co, Cr-W alloy	—	—	DCoCrA of JIS Z 3251	—
	Co, Cr-W alloy				
d ⁽²⁾	Co, Cr-W alloy	—	—	DCoCrA of JIS Z 3251	—
	13 % Cr steel				

Notes (1) In the case of combination of 13 % Cr steel, the difference of the Brinell hardness between the both shall be not less than 50 except for check valve.

(2) The types of material listed in two columns express that the one is for disc seat face and another is for body seat face. Both combination will do.

- d) The valve stem shall be made of SUS403 or SUS410 of **JIS G 4303**.
- e) The bonnet bolts shall be made of SNB7 of **JIS G 4107**. However, in the case where the working temperature of the fluid is not higher than 300 °C, S35C of **JIS G 4051** may be used.
- f) Materials of other parts shall be made under the standard of manufacturer.

1.8 Testing and inspection

1.8.1 Inspection items The inspection items of the valve shall be as follows:

- a) Inspection on construction
- b) Inspection on dimension
- c) Inspection on appearance

- d) Inspection on material
- e) Inspection on pressure resistance of valve body
- f) Inspection on leakage from valve seat
- g) Inspection on marking

1.8.2 Procedure and decision requirement of testing and inspection

- a) Inspections listed in a) to f) of 1.8.1 shall be carried out in accordance with **JIS B 2003**, and the acceptance criteria for them shall also be in accordance with **JIS B 2003**.

Furthermore, the acceptance criteria for inspection on leakage from valve seat shall be in accordance with Table 1.5.

Table 1.5 Leakage from valve seat

Type of valve	Rating	By hydraulic pressure	By pneumatic pressure
Globe valve and angle valve	3	There shall be no leakage.	There shall be no leakage.
	2 ⁽³⁾	The rate of leakage shall not exceed 0.01 mm ³ /s × nominal diameter.	The rate of leakage shall not exceed 0.3 mm ³ /s × nominal diameter at atmospheric pressure.
Gate valve	3	There shall be no leakage.	There shall be no leakage.
	1 ⁽³⁾	The rate of leakage shall not exceed 0.1 mm ³ /s × nominal diameter.	The rate of leakage shall not exceed 30 mm ³ /s × nominal diameter at atmospheric pressure.
Swing check valve	1	The rate of leakage shall not exceed 0.1 mm ³ /s × nominal diameter.	The rate of leakage shall not exceed 30 mm ³ /s × nominal diameter at atmospheric pressure.

Note ⁽³⁾ This is applicable to the case where it is not impediment in use.

Remarks : The rating in the Table shall be in accordance with **JIS B 2003**.

- b) Inspection on marking listed in g) of 1.8.1 shall conform to 1.10.

1.9 Designation The valve shall be designated by the Standard number or symbol indicating the material of valve body, symbol indicating wall thickness⁽⁴⁾, nominal pressure, nominal diameter and type of valve.

Note ⁽⁴⁾ *M* for wall thickness of α and *C* for wall thickness α_1 .

Example : In the case of the nominal pressure 10K, nominal diameter 100A and gate valve

- 1) For wall thickness α :

JIS B 2071-M-10K-100 flanged gate valve or **PH2-M-10K-100** flanged gate valve

- 2) For wall thickness α_1 :

JIS B 2071-C-10K-100 flanged gate valve or **PH2-C-10K-100** flanged gate valve

1.10 Marking

1.10.1 Marking on products

1.10.1.1 Surface of valve body The following information shall be clearly marked on the surface of valve body.

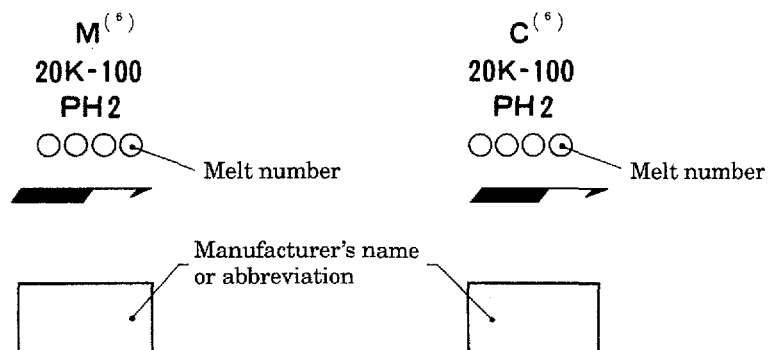
- a) Manufacturer's name or abbreviation
- b) Nominal pressure
- c) Nominal diameter
- d) Symbol⁽⁵⁾ indicating materials of valve body
- e) Arrow mark indicating direction of flow (except gate valve)
- f) Melt number
- g) Symbol⁽⁶⁾ indicating wall thickness

Notes (5) Symbols indicating the materials of valve body and symbols indicating trim materials shall be in accordance with **JIS B 2004**.

(6) Symbol indicating the wall thickness may be marked on the identification plate.

Example : Nominal pressure 20 K,
Nominal diameter 100A
In the case of globe valve
of wall thickness a

Nominal pressure 20 K
Nominal diameter 100A
In the case of globe valve
of wall thickness a_1



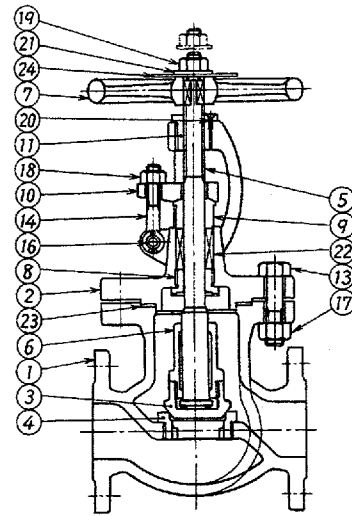
1.10.1.2 Surface of handwheel Marks shall be marked on the surface of handwheel in accordance with **JIS B 2004**.

1.10.1.3 Identification plate On the identification plate, the symbol⁽⁵⁾ indicating the trim materials shall be marked.

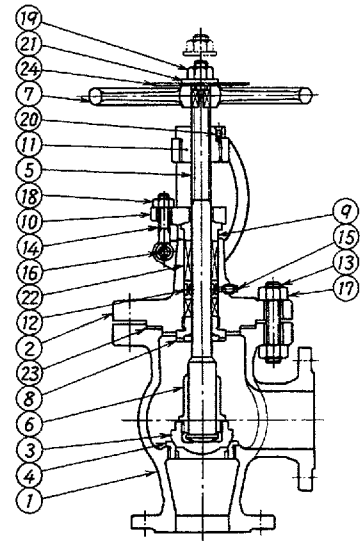
1.10.2 Other marks Marks other than the above shall be as agreed between the parties concerned with delivery. However, in this case, any mark which is liable to be confused with the marking specified in this Section shall be avoided.

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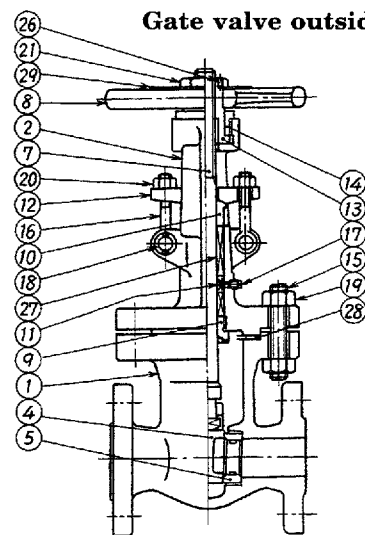
Attached



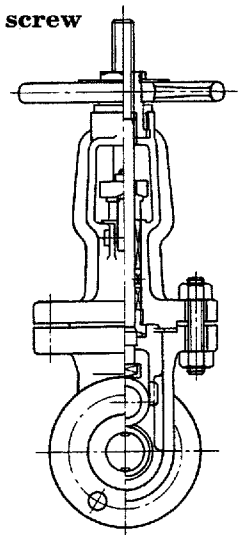
10K Globe valve



20K Angle valve

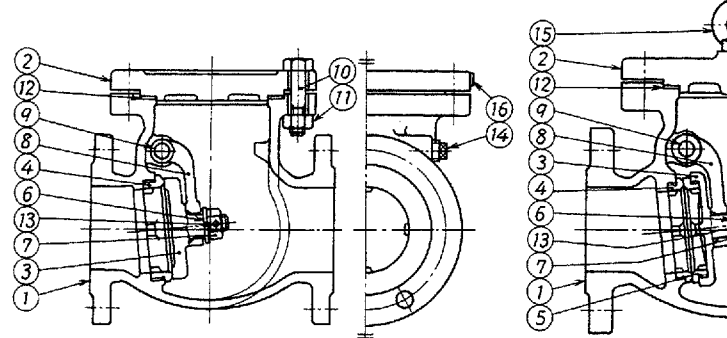


Gate valve outside screw



20K Gate valve

Swing check valve



Swing check valve

Remarks : Figures only show examples of construction

Table 2.1 Classification

Nominal diameter DN	PN10, 16, 20, 25, 40			PN50			PN110			PN150			PN260			PN420		
	Gate valve	Globe valve	Check valve	Gate valve	Globe valve	Check valve	Gate valve	Globe valve	Check valve	Gate valve	Globe valve	Check valve	Gate valve	Globe valve	Check valve	Gate valve	Globe valve	Check valve
10	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
15	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
25	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
32	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
40	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
50	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
65	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
80	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
100	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
125	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
150	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
200	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
250	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
300	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
350	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
400	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
450	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
500	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
600	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
700	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
800	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
900	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
1 000	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Remarks 1 Angle valve is included in globe valve.

2 In ISO Standard, the range of nominal diameter is expressed in the sentence. In this Standard it is arranged into a table for the easier understanding.

2.3 Definitions For the purposes of this Section, the definitions of nominal diameter DN given in **ISO 6708** and nominal pressure PN given in **ISO 7268** apply.

2.4 Pressure and temperature ratings

2.4.1 The pressure and temperature ratings applicable to valves specified in this Section shall be in accordance with those specified in Annex of **JIS B 2238**. Restrictions on temperature and pressure, for example those by non-metallic seals and special trim materials, shall be indicated on the valve identification plate [see **2.8.6 c**].

- Remarks 1 The valve pressure and temperature ratings for PN20 and PN50 through PN420, using **JIS** standard materials in accordance with **2.6.1**, shall follow that of the material group number which shows **JIS** standard materials shown in Annex 4 Table 1.
- 2 The material group number of Annex 5 Table 1 is the same as the material group number of Annex Table D.2 of **JIS B 2238**.

2.4.2 The temperature specified in a pressure and temperature rating is the temperature of the pressure-containing shell of the valve. In general, this is the same as that of the fluid contained. Use of a pressure and temperature rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user.

2.4.3 For temperatures below the lowest temperature specified in the pressure and temperature rating in Annex of **JIS B 2238**, the service pressure shall be no greater than the rating specified for that lowest temperature. The use of valves at lower temperature than the lowest temperature is the responsibility of the user. Consideration should be given to the loss of ductility and impact strength of many materials at low temperature.

2.5 Designing requirements

2.5.1 Wall thickness of valve body

2.5.1.1 Minimum body wall thickness The minimum wall thickness of the body t_m at the time of manufacture shall satisfy the following.

- The minimum wall thickness of body t_m shall be in accordance with Table 2.2 except as indicated in **2.5.1.3** through **2.5.1.5**.
- The requirements for the minimum wall thickness of body shall be applied only to that of measured from the inner fluid immersion line. The minimum wall thickness shall not include liner, lining and cartridge.
- Additional metal thickness needed for assembly stress, closing stress, stress concentrations and shapes other than circular shall be determined by individual manufacturers, since these factors vary widely.

2.5.1.2 Inside diameter For the purpose of determining the wall thickness t_m , the inside diameter d shall be taken in accordance with the following.

- a) The inside diameter d shall be the minimum diameter of the flow passage but not less than 90 % of the basic inside diameter shown in Table 2.3.
- b) For the socket-welding and threaded-end valves, the socket or thread end, screw diameter and associated profile need not be considered in establishing the inside diameter d (see 2.5.2.3 and 2.5.2.4).
- c) For the special case of valves used between high and low pressure sections of a system where an end connection is specified for a thinner pipe wall (or lower nominal pressure flange) on one end than on the other, the inside diameter d shall be based on the end connection with heavier pipe wall (or higher nominal pressure flange).
- d) Localized variations of inside diameter associated with transitions to weld preparations in butt-welding need not be considered. Note, however, limitations of proximity to the body neck in 2.5.1.4. Where linings, liners, or cartridges are used to form the flow passage or portions of the flow passage, the inside diameter d shall not include those thickness.

2.5.1.3 Shape of butt-welding connection The weld preparation in butt-welding valve [see 2.5.2.2 b)] shall not reduce the body wall thickness to less than the values required by 2.5.1.1 within a region closer to the outside surface of the body neck than t_m measured along the run direction. The transition to the weld preparation shall be gradual and the section shall be essentially circular through the entire length of the transition. Sharp discontinuities or abrupt changes in section in areas that infringe into the transition shall be avoided, except that test collars or bands, either welded or integral, are allowed. In no case shall the thickness be less than $0.77 t_m$ at a distance of $1.33 t_m$ from the weld end.

2.5.1.4 Body neck The minimum body wall thickness at the body neck shall satisfy the following.

- a) The body neck shall maintain the minimum wall thickness t_m as required by 2.5.1.1 within the distance of $1.1 \sqrt{d \cdot t_m}$ measured from the outside of the body run along the neck direction, where d is the inside diameter d as defined in 2.5.1.2.
- b) Beyond the distance of $1.1 \sqrt{d \cdot t_m}$ from the outside of the body run, straight circular sections of body necks with inside diameter d' shall be provided with local wall thickness at least equal to t' where t' is determined by interpolation, if necessary, as the value of t_m which would correspond to a value of d equal to $2d'/3$ using the applicable nominal pressure rating.
- c) It will be noted that, for any case where $d' > 1.5d$, the newly determined minimum wall thickness for the body neck will be greater than the basic value t_m . In such cases, this greater wall thickness shall be provided for all of the body neck having a diameter greater than $1.5d$.

2.5.1.5 Local areas Local areas having less than the minimum wall thickness will be acceptable, provided that all of the following limitations are satisfied:

- a) the area of sub-minimum thickness can be enclosed by a circle whose diameter is no greater than $0.35 \sqrt{d_0 \cdot t_0}$, where, $d_0 = d'$ and $t_0 = t'$ for the body neck (see **2.5.1.4**) and $d_0 = d$ (see **2.5.1.2**) and $t_0 = t_m$ (see **2.5.1.1**) for all other local areas;
- b) the measured thickness is no less than $0.75 t_0$;
- c) enclosure circles are separated from each other by an edge-to-edge distance of no less than $1.75 \sqrt{d_0 \cdot t_0}$.

Table 2.2 Minimum body wall thickness (t_m)

Inside diameter (d)	Nominal pressure PN									
	10	16	20	25	40	50	110	150	260	420
	t_m mm									
10	3.0	3.0	3.0	3.0	3.0	3.0	3.3	—	—	—
11	—	—	—	—	—	—	—	3.8	4.6	6.3
13	3.0	3.0	3.0	3.0	3.1	3.1	3.4	4.1	4.8	6.9
14	—	—	—	—	—	—	—	4.1	5.1	7.4
16	—	—	—	—	—	—	—	4.3	5.6	7.9
18	—	—	—	—	—	—	—	4.6	5.8	8.4
19	3.0	3.0	3.1	3.3	3.5	3.8	4.1	5.1	6.1	8.9
22	—	—	—	—	—	—	—	5.6	6.6	9.9
25	4.0	4.0	4.1	4.2	4.6	4.8	4.8	6.4	7.1	11.2
28	—	—	—	—	—	—	—	6.4	7.8	12.7
32	4.5	4.5	4.8	4.8	4.8	4.8	4.8	6.6	8.6	13.5
35	—	—	—	—	—	—	—	7.1	9.6	14.5
38	4.5	4.5	4.8	4.8	4.8	4.8	5.6	7.4	9.9	15.8
47	—	—	—	—	—	—	—	7.9	11.2	19.0
50	5.0	5.5	5.6	5.7	6.1	6.4	6.4	—	—	—
51	—	—	—	—	—	—	—	7.9	11.7	20.1
57	—	—	—	—	—	—	—	8.6	12.7	22.4
64	5.0	5.5	5.6	5.8	6.6	6.4	7.1	9.1	14.2	24.1
70	—	—	—	—	—	—	—	9.9	15.7	26.4
73	—	—	—	—	—	—	—	10.4	16.0	27.7
76	5.0	5.5	5.6	5.8	6.6	7.1	7.9	10.7	16.8	29.0
89	—	—	—	—	—	—	—	11.9	19.0	32.8
92	—	—	—	—	—	—	—	12.2	19.0	34.0
98	—	—	—	—	—	—	—	12.7	20.6	36.1
100	6.0	6.0	6.4	6.6	7.3	7.8	9.6	—	—	—
102	—	—	—	—	—	—	—	13.0	21.1	37.3
111	—	—	—	—	—	—	—	14.2	23.1	40.4
121	—	—	—	—	—	—	—	15.0	24.9	43.7
125	6.3	6.5	7.1	7.2	8.1	9.6	11.2	—	—	—
127	—	—	—	—	—	—	—	16.0	25.9	46.0
136	—	—	—	—	—	—	—	16.8	27.7	49.0
146	—	—	—	—	—	—	—	18.3	29.5	52.3
150	6.5	7.0	7.1	7.5	8.8	9.6	12.7	—	—	—
152	—	—	—	—	—	—	—	18.8	30.7	54.6
178	—	—	—	—	—	—	—	21.1	35.8	63.8
184	—	—	—	—	—	—	—	21.8	36.6	65.8
190	—	—	—	—	—	—	—	22.4	37.6	67.6
200	7.0	8.0	8.1	8.6	10.2	11.2	15.8	23.4	39.4	70.6
203	—	—	—	—	—	—	—	23.6	40.4	71.9
219	—	—	—	—	—	—	—	25.4	42.9	77.0

Remarks 1 The definition of inside diameter d shall comply with 2.5.1.2.

2 The wall thickness can be calculated by the proportional interpolation formula, when the inside diameter lies intermediate of the table.

Table 2.2 (continued)

Inside diameter (<i>d</i>)	Nominal pressure PN									
	10	16	20	25	40	50	110	150	260	
	<i>t_m</i> mm									
222	—	—	—	—	—	—	—	25.6	43.7	
229	—	—	—	—	—	—	—	26.2	44.7	
238	—	—	—	—	—	—	—	26.9	46.5	
241	—	—	—	—	—	—	—	27.7	47.0	
248	—	—	—	—	—	—	—	28.4	48.3	
250	7.5	8.5	8.6	9.3	11.4	12.7	19.0	—	—	
254	—	—	—	—	—	—	—	28.7	49.3	
263	—	—	—	—	—	—	—	30.0	50.8	
276	—	—	—	—	—	—	—	31.5	53.3	
279	—	—	—	—	—	—	—	31.5	53.8	
282	—	—	—	—	—	—	—	31.8	54.6	
289	—	—	—	—	—	—	—	32.8	55.6	
298	—	—	—	—	—	—	—	33.8	57.6	
300	8.5	9.5	9.6	10.4	12.7	14.2	23.1	—	—	
305	—	—	—	—	—	—	—	34.3	58.7	
311	—	—	—	—	—	—	—	35.0	59.9	
325	—	—	—	—	—	—	24.6	—	—	
327	—	—	—	—	—	—	—	36.6	62.7	
330	—	—	—	—	—	—	—	37.1	63.5	
333	—	—	—	—	—	—	—	37.3	64.0	
335	9.0	10.0	10.4	11.3	14.0	15.8	—	—	—	
337	—	—	—	—	—	—	—	37.6	64.5	
343	—	—	—	—	—	—	—	38.4	65.8	
356	—	—	—	—	—	—	—	39.6	68.3	
371	—	—	—	—	—	—	—	41.4	71.4	
375	—	—	—	—	—	—	27.7	41.6	71.6	
378	—	—	—	—	—	—	—	41.9	72.1	
381	—	—	—	—	—	—	—	42.4	73.2	
385	9.6	11.0	11.2	12.7	15.4	17.5	—	—	—	
387	—	—	—	—	—	—	—	42.9	73.9	
400	—	—	—	—	—	—	—	44.4	76.2	
406	—	—	—	—	—	—	—	45.0	77.7	
416	—	—	—	—	—	—	—	46.0	79.2	
419	—	—	—	—	—	—	—	46.2	79.8	
420	—	—	—	—	—	—	31.0	—	—	
430	10.0	11.5	11.9	13.0	16.6	19.0	—	—	—	
432	—	—	—	—	—	—	—	47.2	82.3	
438	—	—	—	—	—	—	—	48.3	83.3	
444	—	—	—	—	—	—	—	48.5	84.6	
448	—	—	—	—	—	—	—	49.3	85.1	

Remarks 1 The definition of inside diameter *d* shall comply with 2.5.1.2.

2 The wall thickness can be calculated by the proportional interpolation formula, when the inside diameter lies intermediate of the table.

Table 2.2 (continued)

Inside diameter (<i>d</i>)	Nominal pressure PN									
	10	16	20	25	40	50	110	150	260	
	<i>t_m</i> mm									
457	—	—	—	—	—	—	—	49.8	86.9	
464	—	—	—	—	—	—	—	51.0	88.1	
465	—	—	—	—	—	—	34.0	—	—	
479	—	—	—	—	—	—	—	52.6	90.9	
483	—	—	—	—	—	—	—	52.6	91.7	
485	10.5	12.5	12.8	14.5	18.3	20.6	—	—	—	
489	—	—	—	—	—	—	—	53.3	92.7	
498	—	—	—	—	—	—	—	54.6	94.5	
508	—	—	—	—	—	—	—	55.1	—	
511	—	—	—	—	—	—	—	55.9	—	
517	—	—	—	—	—	—	—	56.6	—	
527	—	—	—	—	—	—	—	57.6	—	
533	—	—	—	—	—	—	—	57.9	—	
540	—	—	—	—	—	—	—	—	—	
559	—	—	—	—	—	—	—	—	—	
560	—	—	—	—	—	—	40.4	—	—	
575	—	—	—	—	—	—	—	—	—	
578	—	—	—	—	—	—	—	—	—	
584	—	—	—	—	—	—	—	—	—	
585	11.5	14.0	14.4	16.3	21.3	23.9	—	—	—	
591	—	—	—	—	—	—	—	—	—	
603	—	—	—	—	—	—	—	—	—	
610	—	—	—	—	—	—	—	—	—	
616	—	—	—	—	—	—	—	—	—	
625	—	—	—	—	—	—	—	—	—	
635	—	—	—	—	—	—	—	—	—	
641	—	—	—	—	—	—	—	—	—	
648	—	—	—	—	—	—	—	—	—	
660	—	—	—	—	—	—	—	—	—	
667	—	—	—	—	—	—	—	—	—	
670	—	—	—	—	—	—	—	—	—	
685	—	—	—	—	24.3	27.2	—	—	—	
686	—	—	—	—	—	—	—	—	—	
690	12.5	15.5	16.0	18.2	—	—	—	—	—	
692	—	—	—	—	—	—	—	—	—	
695	—	—	—	—	—	—	—	—	—	
711	—	—	—	—	—	—	—	—	—	
718	—	—	—	—	—	—	—	—	—	
737	—	—	—	—	—	—	—	—	—	
743	—	—	—	—	—	—	—	—	—	

Remarks 1 The definition of inside diameter *d* shall comply with 2.5.1.2.

2 The wall thickness can be calculated by the proportional interpolation formula, when the inside diameter lies intermediate of the table.

Table 2.2 (concluded)

Inside diameter (<i>d</i>)	Nominal pressure PN									
	10	16	20	25	40	50				
	<i>t_m</i> mm									
762	—	—	—	—	—	—				
787	—	—	—	—	—	—				
790	—	—	—	—	27.3	30.5				
795	14.0	17.0	17.6	20.1	—	—				
813	—	—	—	—	—	—				
838	—	—	—	—	—	—				
864	—	—	—	—	—	—				
885	—	—	—	—	30.4	33.8				
889	—	—	—	—	—	—				
895	15.5	18.5	19.2	22.0	—	—				
914	—	—	—	—	—	—				
940	—	—	—	—	—	—				
965	—	—	—	—	—	—				
985	—	—	—	—	33.5	37.2				
990	17.0	20.0	20.8	23.9	—	—				
991	—	—	—	—	—	—				

- Remarks 1 The definition of inside diameter *d* shall comply with 2.5.1.2.
- 2 The wall thickness can be calculated by the proportional interpolation formula, when the inside diameter lies intermediate of the table.