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Carbon steel pipes for high  
pressure service

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 3455:2005** is replaced with this Standard.

However, **JIS G 3455:2005** may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until April 19th, 2013.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or the utility model right.





# Carbon steel pipes for high pressure service

## Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 9329-2** published in 1997 with some modifications of the technical contents.

The portions given continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with explanation is given in Annex JB.

## 1 Scope

This Standard specifies the carbon steel pipes (hereafter referred to as “pipes”) used for high pressure service at temperatures 350 °C or lower. This Standard is generally applicable to pipes of outside diameters 10.5 mm (nominal diameter 6A or 1/8B) to 660.4 mm (nominal diameter 650A or 26B).

In addition to the items specified in this text, the purchaser can previously designate special quality requirements upon agreement with the manufacturer, which are shown in Annex JA.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows:

ISO 9329-2:1997 *Seamless steel tubes for pressure purposes—Technical delivery conditions—Part 2: Unalloyed and alloyed steels with specified elevated temperature properties* (MOD)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS G 0321 *Product analysis and its tolerance for wrought steel*

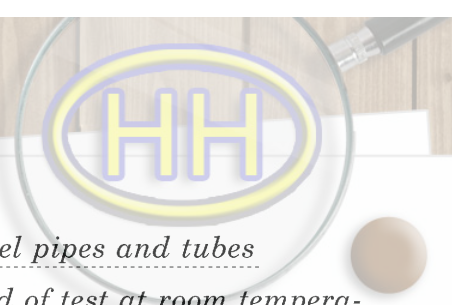
JIS G 0404 *Steel and steel products—General technical delivery requirements*

JIS G 0415 *Steel and steel products—Inspection documents*

NOTE : Corresponding International Standard: ISO 10474 *Steel and steel products—Inspection documents* (IDT)

JIS G 0567 *Method of elevated temperature tensile test for steels and heat-resisting alloys*

JIS G 0582 *Automated ultrasonic examination of steel pipes and tubes*



JIS G 0583 *Automated eddy current examination of steel pipes and tubes*

JIS Z 2241 *Metallic materials—Tensile testing—Method of test at room temperature*

JIS Z 2242 *Method for Charpy pendulum impact test of metallic materials*

JIS Z 8401 *Guide to the rounding of numbers*

### 3 Grade and designation

Pipes are classified into 3 grades and designation of grade, symbol of manufacturing method shall be as given in table 1.

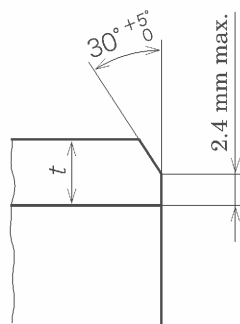
**Table 1 Designation of grade and symbol of manufacturing method**

Designation of grade	Manufacturing method		
	Pipe manufacturing method	Finishing method	Designation
STS370 STS410 STS480	Seamless: S	Hot-finished: H Cold-finished: C	Marking of symbol denoting the manufacturing method shall be in accordance with <b>12 b</b> ).

### 4 Manufacturing method

The manufacturing method of pipes shall be as follows.

- Pipes shall be manufactured from killed steel by the seamless process and shall be finished according to table 1.
- Pipes shall be given the heat treatment as specified in table 2. Other heat treatment than given in table 2 shall be the subject of agreement between the purchaser and the manufacturer.
- The pipe ends shall be finished with plain ends unless otherwise specified. Upon request by the purchaser, pipes may be finished with bevel ends, and the shape, in this case, shall be as agreed between the purchaser and the manufacturer. Pipes not more than 22 mm in wall thickness shall have a shape given in figure 1 unless otherwise specified.



$t$ : wall thickness 22 mm or under

**Figure 1 Shape of bevel end**



**Table 2 Heat treatment**

Designation of grade	Hot-finished seamless steel pipe	Cold-finished seamless steel pipe
STS370 STS410	As manufactured. However, low temperature annealing or normalizing may be applied, as necessary.	Low temperature annealed or normalized
STS480	Low temperature annealed or normalized	

## 5 Chemical composition

Pipes shall be tested in accordance with **10.1** and the obtained heat analysis values shall be as given in table 3. In the case where the purchaser requests a product analysis, the test in **10.1** shall be performed, and the values in table 3 shall be met within the permissible tolerances for product analysis given in table 3 of **JIS G 0321**.

**Table 3 Chemical composition**

Unit: %

Designation of grade	C	Si	Mn	P	S
STS370	0.25 max.	0.10 to 0.35	0.30 to 1.10	0.035 max.	0.035 max.
STS410	0.30 max.	0.10 to 0.35	0.30 to 1.40	0.035 max.	0.035 max.
STS480	0.33 max.	0.10 to 0.35	0.30 to 1.50	0.035 max.	0.035 max.
Other alloy elements than given in this table may be added as required.					

## 6 Mechanical properties

### 6.1 Tensile strength, yield point or proof stress and elongation

Pipes shall be tested in accordance with **10.2.3** and the tensile strength, yield point or proof stress and elongation shall be as given in table 4. When the tensile test is carried out using No. 12 or No. 5 test piece for pipes under 8 mm in wall thickness, the minimum values of elongation given in table 5 shall apply, which are obtained by subtracting 1.5 from the elongation values in table 4 per each 1 mm reduction in thickness and rounding the result to an integer according to Rule A of **JIS Z 8401**.




**Table 4 Mechanical properties**

Designation of grade	Tensile strength  N/mm <sup>2</sup>	Yield point or proof stress  N/mm <sup>2</sup>	Elongation <sup>a)</sup> %			
			No. 11 test piece No. 12 test piece	No. 5 test piece	No. 4 test piece	
			Parallel to the pipe axis	Perpendicular to the pipe axis	Parallel to the pipe axis	Perpendicular to the pipe axis
STS370	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.
STS410	410 min.	245 min.	25 min.	20 min.	24 min.	19 min.
STS480	480 min.	275 min.	25 min.	20 min.	22 min.	17 min.
NOTE : 1 N/mm <sup>2</sup> = 1 MPa						
Note <sup>a)</sup> For pipes of outside diameter under 40 mm, the elongation given in this table shall not apply, however, the test results shall be recorded. The elongation value may be specified upon agreement between the purchaser and the manufacturer.						

**Table 5 Minimum elongation values for No. 12 test piece (parallel to pipe axis) and No. 5 test piece (perpendicular to pipe axis) taken from pipes under 8 mm in wall thickness**

Unit: %

Designation of grade	Test piece	Wall thickness						
		Over 1 mm up to and incl. 2 mm	Over 2 mm up to and incl. 3 mm	Over 3 mm up to and incl. 4 mm	Over 4 mm up to and incl. 5 mm	Over 5 mm up to and incl. 6 mm	Over 6 mm up to and incl. 7 mm	Over 7 mm to and excl. 8 mm
STS370	No. 12 test piece	21	22	24	26	27	28	30
	No. 5 test piece	16	18	19	20	22	24	25
STS410 STS480	No. 12 test piece	16	18	19	20	22	24	25
	No. 5 test piece	11	12	14	16	17	18	20

## 6.2 Flattening resistance

Pipes shall be tested in accordance with **10.2.4** and the test piece shall be free from cracks.

In this case, the distance between the two flat plates shall be calculated in accordance with the following formula.

$$H = \frac{(1+e)t}{e + \frac{t}{D}}$$

where,  $H$ : distance between flat plates (mm)  
 $t$ : wall thickness of pipe (mm)  
 $D$ : outside diameter of pipe (mm)





$e$  : constant defined for each grade of pipe  
STS370: 0.08,  
STS410, STS480: 0.07

### 6.3 Bendability

The purchaser may specify the bend test instead of the flattening test for pipes of which the outside diameter is 50 mm or under. For bendability, the pipes, when tested in accordance with **10.2.5**, shall be free from flaws or cracks. In this case, the bending inside radius shall be not more than 6 times the outside diameter of the pipe, and the bending angle<sup>1)</sup> shall be not less than 90°.

Note <sup>1)</sup> The bending angle is measured from the position of start of bending.

## 7 Hydraulic test characteristics or nondestructive test characteristics

Pipes shall be tested in accordance with **10.3** and the hydraulic test characteristics or the nondestructive test characteristics of the pipes shall be as follows.

### a) Hydraulic test characteristics

The hydraulic test characteristics shall be as follows.

- 1) When the purchaser specifies the test pressure, that pressure shall be taken as the minimum hydraulic test pressure, and the pipe shall withstand it without leakage. If the pressure value specified by the purchaser is greater than the value  $P$  calculated by formula (1) or 20 MPa, the test pressure shall be subject to agreement between the purchaser and the manufacturer.

The purchaser may specify a pressure value lower or higher than the values given in table 6, in which case, the specified value shall be in 0.5 MPa increments if lower than 10 MPa, and in 1 MPa increments if 10 MPa or higher. This applies also to the value calculated by formula (1), i.e. the obtained value shall be rounded to either 0.5 MPa or 1 MPa appropriately.

$$P = \frac{2st}{D} \dots\dots\dots (1)$$

where,  $P$  : test pressure (MPa)

$t$  : wall thickness of pipe (mm)

$D$  : outside diameter of pipe (mm)

$s$  : 60 % of the minimum value of yield point or proof stress given in table 4 (N/mm<sup>2</sup>)

- 2) If the purchaser does not specify a test pressure, the pipe shall be subjected to the minimum hydraulic test pressure given in table 6 and withstand it without leakage.

For pipes having dimensions other than given in table 7, the minimum hydraulic test pressure to be applied shall be determined as follows.

- 2.1) For outside diameter within the range specified in table 7, the smaller value of the applicable outside diameters in this table shall be selected.



- 2.2) For outside diameter selected in **2.1)**, if the wall thickness is within the range of schedule number of that outside diameter, the greater value of the applicable wall thicknesses specified in this table shall be selected.
- 2.3) The test shall be performed by applying the minimum hydraulic test pressure in table 6 corresponding to the schedule number of the outside diameter and wall thickness selected in **2.1)** and **2.2)**.
- 2.4) The minimum hydraulic test pressure to be applied for tubes of dimensions other than given in table 7 which do not satisfy the conditions in **2.1)** and **2.2)** shall be subject to agreement between the purchaser and the manufacturer.
- 2.5) When the minimum hydraulic test pressure of the schedule number selected in **2.2)** or **2.4)** exceeds the value of test pressure  $P$  calculated by formula (1), the test shall be performed by applying the value  $P$  as the minimum hydraulic test pressure, instead of the minimum hydraulic test pressure selected in table 6.

**Table 6 Minimum hydraulic test pressure**

Unit : MPa

Nominal wall thickness	Schedule number Sch						
	40	60	80	100	120	140	160
Minimum hydraulic test pressure	6.0	9.0	12	15	18	20	20

- b) **Nondestructive test characteristics** The nondestructive test characteristics of the pipes, when tested by either the ultrasonic examination or eddy current examination, shall be as follows. In place of these examinations, other nondestructive test specified in the Japanese Industrial Standard may be performed upon agreement between the purchaser and the manufacturer, in which case the judgement criteria shall be at least equal to that applied in the ultrasonic examination or eddy current examination.
- 1) There shall be no signal equivalent to or greater than the signals from the reference standards of the reference sample of working sensitivity division UD specified in **JIS G 0582** or stricter sensitivity division.
  - 2) There shall be no signal equivalent to or greater than the signals from the reference standards of the reference sample of working sensitivity division EY specified in **JIS G 0583** or stricter sensitivity division.

## 8 Dimensions, mass and dimensional tolerances

### 8.1 Dimensions and unit mass

The outside diameter, wall thickness and unit mass of pipes shall be as given in table 7.

**Table 7 Dimensions <sup>a) b)</sup> and unit mass of carbon steel pipes for high pressure service**

Nominal diameter		Out-side diameter mm	Nominal wall thickness													
			Schedule 40		Schedule 60		Schedule 80		Schedule 100		Schedule 120		Schedule 140		Schedule 160	
A	B		Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m	Wall thick-ness mm	Unit mass kg/m
6	1/8	10.5	1.7	0.369	—	—	2.4	0.479	—	—	—	—	—	—	—	—
8	1/4	13.8	2.2	0.629	—	—	3.0	0.799	—	—	—	—	—	—	—	—
10	3/8	17.3	2.3	0.851	—	—	3.2	1.11	—	—	—	—	—	—	—	—
15	1/2	21.7	2.8	1.31	—	—	3.7	1.64	—	—	—	—	—	—	4.7	1.97
20	3/4	27.2	2.9	1.74	—	—	3.9	2.24	—	—	—	—	—	—	5.5	2.94
25	1	34.0	3.4	2.57	—	—	4.5	3.27	—	—	—	—	—	—	6.4	4.36
32	1 1/4	42.7	3.6	3.47	—	—	4.9	4.57	—	—	—	—	—	—	6.4	5.73
40	1 1/2	48.6	3.7	4.10	—	—	5.1	5.47	—	—	—	—	—	—	7.1	7.27
50	2	60.5	3.9	5.44	—	—	5.5	7.46	—	—	—	—	—	—	8.7	11.1
65	2 1/2	76.3	5.2	9.12	—	—	7.0	12.0	—	—	—	—	—	—	9.5	15.6
80	3	89.1	5.5	11.3	—	—	7.6	15.3	—	—	—	—	—	—	11.1	21.4
90	3 1/2	101.6	5.7	13.5	—	—	8.1	18.7	—	—	—	—	—	—	12.7	27.8
100	4	114.3	6.0	16.0	—	—	8.6	22.4	—	—	11.1	28.2	—	—	13.5	33.6
125	5	139.8	6.6	21.7	—	—	9.5	30.5	—	—	12.7	39.8	—	—	15.9	48.6
150	6	165.2	7.1	27.7	—	—	11.0	41.8	—	—	14.3	53.2	—	—	18.2	66.0
200	8	216.3	8.2	42.1	10.3	52.3	12.7	63.8	15.1	74.9	18.2	88.9	20.6	99.4	23.0	110
250	10	267.4	9.3	59.2	12.7	79.8	15.1	93.9	18.2	112	21.4	130	25.4	152	28.6	168
300	12	318.5	10.3	78.3	14.3	107	17.4	129	21.4	157	25.4	184	28.6	204	33.3	234
350	14	355.6	11.1	94.3	15.1	127	19.0	158	23.8	195	27.8	225	31.8	254	35.7	282
400	16	406.4	12.7	123	16.7	160	21.4	203	26.2	246	30.9	286	36.5	333	40.5	365
450	18	457.2	14.3	156	19.0	205	23.8	254	29.4	310	34.9	363	39.7	409	45.2	459
500	20	508.0	15.1	184	20.6	248	26.2	311	32.5	381	38.1	441	44.4	508	50.0	565
550	22	558.8	15.9	213	22.2	294	28.6	374	34.9	451	41.3	527	47.6	600	54.0	672
600	24	609.6	17.5	256	24.6	355	31.0	442	38.9	547	46.0	639	52.4	720	59.5	807
650	26	660.4	18.9	299	26.4	413	34.0	525	41.6	635	49.1	740	56.6	843	64.2	944

NOTE : The unit mass values in this table are calculated from the following formula assuming 1 cm<sup>3</sup> of steel to be 7.85 g and rounded off to three significant figures in accordance with Rule A of **JIS Z 8401**. If exceeding 1 000 kg/m, the value is rounded to an integer value in kg/m.

$$W = 0.024\ 66\ t\ (D - t)$$

where,

$W$  : unit mass of pipe (kg/m)

$t$  : wall thickness of pipe (mm)

$D$  : outside diameter of pipe (mm)

0.024 66 : conversion coefficient for obtaining  $W$

Notes <sup>a)</sup> The designation of pipes shall be based on the nominal diameter and nominal wall thickness (schedule number: Sch). For the nominal diameter, either A or B shall be used, and for identification, the letter A shall be suffixed to the figure of nominal diameter in the case of applying A, and the letter B shall be suffixed in the case of applying B.

<sup>b)</sup> The dimensions other than given in this table shall be the subject of agreement between the purchaser and the manufacturer.





## 8.2 Dimensional tolerances

The tolerances on the outside diameter, wall thickness and wall thickness deviation of pipes shall be as given in table 8.

In the case where the length is specified, the length shall be not less than the specified value.

**Table 8 Tolerances on outside diameter, wall thickness and wall thickness deviation**

Division	Tolerance on outside diameter <sup>a) b)</sup>	Tolerance on wall thickness	Tolerance on wall thickness deviation <sup>c)</sup>
Hot-finished seamless steel pipe	Outside diameter under 50 mm    ±0.5 mm	Wall thickness under 4 mm: ±0.5 mm	20 % or under
	Outside diameter 50 mm or over to and excl. 160 mm    ±1 %		
	Outside diameter 160 mm or over to and excl. 200 mm    ±1.6 mm	Wall thickness 4 mm or over: ±12.5 %	
	Outside diameter 200 mm or over    ±0.8 %		
Cold-finished seamless steel pipe	Outside diameter under 40 mm    ±0.3 mm	Wall thickness under 2 mm: ±0.2 mm	—
	Outside diameter 40 mm or over    ±0.8 %	Wall thickness 2 mm or over: ±10 %	

Notes <sup>a)</sup> For the local repaired part, etc. of the pipe, if the wall thickness thereof can be confirmed to satisfy the wall thickness tolerance in this table, the outside diameter tolerance in this table shall not apply.

<sup>b)</sup> For pipes of outside diameter 350 mm or over, the circumferential length may be applied. When the circumferential length is used in measuring the outside diameter, either the actually measured value of the circumferential length or the outside diameter converted from the measured circumferential length may be used. In either case, the same tolerance ( $\pm 0.5$  %) shall apply. The conversion between the outside diameter ( $D$ ) and the circumferential length ( $l$ ) shall be made by the following formula.

$$D = l/\pi$$

where,  $D$ : outside diameter (mm),  $l$ : circumferential length (mm),  $\pi=3.1416$

<sup>c)</sup> The wall thickness deviation is expressed by the ratio in percentage of the difference between the maximum and minimum wall thicknesses measured on the same cross-section of the pipe to the wall thickness value specified in the order. The wall thickness deviation tolerance does not apply to pipes under 5.6 mm in wall thickness.

## 9 Appearance

The appearance of pipes shall be as follows.

- Pipes shall be practically straight, with both ends normal to the pipe axis.
- The inside and outside surfaces of pipes shall be well-finished and free from defects that are detrimental to practical use.





- c) Pipes may be repaired by grinding or machining, provided that the wall thickness after repairing satisfies the specified tolerance on the wall thickness.
- d) The surface of all repaired parts shall blend smoothly into the contour of the pipe.

## 10 Tests

### 10.1 Chemical analysis

#### 10.1.1 General matters of chemical analysis and sampling method

General matters of chemical analysis and sampling method shall be in accordance with clause 8 of **JIS G 0404**. The sampling method for the product analysis, if a product analysis is requested by the purchaser, shall be in accordance with clause 4 of **JIS G 0321**.

#### 10.1.2 Analytical method

The heat analysis method shall be in accordance with **JIS G 0320**. The product analysis method shall be in accordance with **JIS G 0321**.

### 10.2 Mechanical test

#### 10.2.1 General matters of mechanical test

General matters of mechanical test shall be in accordance with in clause 7 and clause 9 of **JIS G 0404**. The sampling method for mechanical tests shall be in accordance with Class A in 7.6 of **JIS G 0404**.

#### 10.2.2 Sampling method and number of test pieces

For pipes to be supplied as manufactured, one sample shall be taken from a group of 50 pipes or its fraction that are of the same dimensions<sup>2)</sup>, and for pipes to be given heat treatment, one sample shall be drawn from a group of 50 pipes or its fraction that are of the same dimensions and of the same heat treatment<sup>3) 4)</sup>. One test piece shall be taken from each sample thus obtained.

Notes <sup>2)</sup> The “same dimensions” means the same outside diameter and the same wall thickness.

<sup>3)</sup> The “same heat treatment” in the case of using continuous furnace refers to a continuous heat treatment performed under consistent heat treatment condition. Therefore, pipes before and after any stop of continuous furnace do not belong to the same heat treatment.

<sup>4)</sup> In the case of sampling from a group of pipes from the same cast, it may be under the same heat treatment conditions instead of by the same heat treatment.

#### 10.2.3 Tensile test

The tensile test shall be as follows.

- a) **Test piece** The test piece shall be any of No. 11, No. 12 (No. 12A, No. 12B, or No. 12C), No. 4 or No. 5 test piece specified in **JIS Z 2241**, and shall be taken from pipes. For No. 4 test piece, the diameter shall be 14 mm (the gauge length 50 mm).
- b) **Test method** The test method shall be in accordance with **JIS Z 2241**.



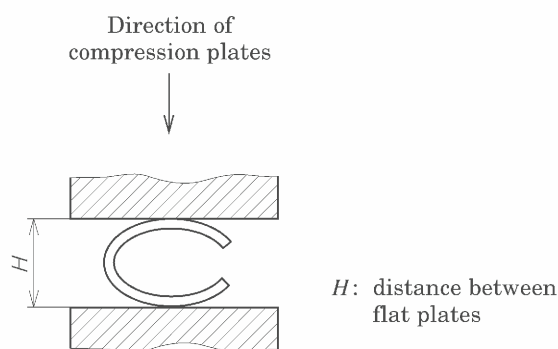
#### 10.2.4 Flattening test

The flattening test shall be as follows.

The flattening test may be omitted unless it is specified by the purchaser<sup>5)</sup>.

Note <sup>5)</sup> This means that the flatness test may be omitted at the discretion of the manufacturer, but only on the precondition that the flatness of the pipe satisfies the specified value.

- a) **Sampling method and number of test pieces** The sampling method and number of test pieces shall be in accordance with **10.2.2**.
- b) **Test piece** A length of 50 mm or over shall be cut off from a sample pipe to be supplied as a test piece. For pipes whose wall thickness is 15 % or over of the outer diameter, a C-shape test piece prepared by removing a part of the circumference of the full-section test piece may be used.
- c) **Test method** The test piece shall be placed between two flat plates at ordinary temperature and flattened by compression until the distance between the flat plates becomes equal to or less than the value specified in **6.2** and then shall be checked for cracks on its wall surface. The C-shape test piece shall be placed as shown in figure 2.



**Figure 2 Flattening test (C-shape test piece)**

#### 10.2.5 Bend test

The bend test piece and the test method shall be as follows.

- a) **Sampling method and number of test pieces** The sampling method and number of test pieces shall be in accordance with **10.2.2**.
- b) **Test piece** An appropriate length shall be cut off from the sample to be supplied as a test piece.
- c) **Test method** The test piece shall be bent around a cylinder at ordinary temperature through a bending angle and with the inside bending radius as specified in **6.3**, and checked for the flaws or cracks on its wall surface.

#### 10.3 Hydraulic test or nondestructive test

The hydraulic test or nondestructive test shall be as follows. Selection between the two tests, if not specified by the purchaser, shall be left to the discretion of the manufacturer.



- a) **Frequency of test** Either the hydraulic test or nondestructive test shall be carried out for each one pipe.
- b) **Test method**
- 1) **Hydraulic test** The pipe shall be held under the minimum hydraulic test pressure specified in **7 a)** for at least 5 s, and then examined to see if it has endured the pressure without leakage.
  - 2) **Nondestructive test** The nondestructive test shall be in accordance with either **JIS G 0582** or **JIS G 0583**. When applying other nondestructive test specified in the Japanese Industrial Standard, the selection of the test method shall be subject to agreement between the purchaser and the manufacturer.

## 11 Inspection and re-inspection

### 11.1 Inspection

The inspection shall be as follows.

- a) General matters of inspection shall be in accordance with **JIS G 0404**.
- b) The chemical composition shall conform to the specification given in clause **5**.
- c) The mechanical properties shall conform to the specification given in clause **6**.
- d) The hydraulic test characteristics or nondestructive test characteristics shall conform to the specification given in clause **7**.
- e) The dimensions, mass and dimensional tolerances shall conform to the specifications given in clause **8**.
- f) The appearance shall conform to the specification given in clause **9**.
- g) In the case where a part of or all of the special quality requirements in Annex JA are applied upon the agreement between the purchaser and the manufacturer, they shall conform to the corresponding requirements.

### 11.2 Re-inspection

Pipes which have failed in mechanical test may be further evaluated for acceptance by conducting a retest specified in **9.8** of **JIS G 0404**.

## 12 Marking

Each pipe having passed the inspection shall be marked with the following items. However, in the case of smaller pipes or when specified by the purchaser, the pipes may be bundled together and marked on each bundle by a suitable means. The order of indication of marking items is not specified. A part of the items may be omitted upon agreement between the purchaser and the manufacturer.

- a) Designation of grade
- b) Symbol indicating the manufacturing method

Symbols indicating the manufacturing method shall be as follows. The dash may be replaced with a blank.





- 1) Hot-finished seamless steel pipes —S—H
- 2) Cold-finished seamless steel pipes —S—C
- c) Dimensions Dimensions shall be marked by “nominal diameter × nominal wall thickness”, or “outside diameter × wall thickness”.  
Example: 50A × Sch80 or 60.5 × 5.5
- d) Manufacturer’s name or its identifying brand
- e) Symbol denoting the special quality requirement: Z (if applicable)

### 13 Report

The manufacturer shall submit the inspection certificate when previously required by the purchaser. In this case, the report shall conform to the requirements of clause **13** in **JIS G 0404**. The type of inspection certificate shall be, unless otherwise specified, standard designation 2.3 or 3.1.B in table 1 of **JIS G 0415**.







## **Annex JA (normative)**

### **Special quality requirements**

#### **JA.1 Scope**

This Annex specifies the special quality requirements to be performed by the manufacturer upon previous agreement between the purchaser and the manufacturer.

#### **JA.2 Yield point or proof stress in tensile test at elevated temperature (Z2)<sup>1)</sup>**

The yield point or proof stress in the tensile test at elevated temperature shall be as follows.

- a) The value of yield point or proof stress and test temperature in the tensile test of pipes at elevated temperature shall be subject to agreement between the purchaser and the manufacturer.
- b) For the test, one sample shall be taken from a group of pipes of the same cast, and one test piece shall be taken therefrom for each test temperature.
- c) The test piece and test method shall be in accordance with **JIS G 0567**.

In the case where taking a test piece of the shape specified in **JIS G 0567** is difficult, the shape of the test piece shall be the subject of agreement between the purchaser and the manufacturer.

Note <sup>1)</sup> In business trading of pipes, the designation of yield point or proof stress in tensile test at elevated temperature can be indicated as Z2.

#### **JA.3 Ultrasonic examination and inspection (Z3)<sup>2)</sup>**

The ultrasonic examination and inspection shall be as follows.

- a) The standard detection sensitivity for the ultrasonic examination shall be division UB or UC as specified in **JIS G 0582**, and there shall be no signals equivalent to or greater than the signals from the reference standards of the reference sample of the said division.
- b) The ultrasonic examination shall be carried out in accordance with **JIS G 0582**.
- c) The ultrasonic examination shall be performed on each pipe, and the requirement in a) shall be satisfied.

Note <sup>2)</sup> In business trading of pipes, the designation of ultrasonic examination can be indicated as Z3.

#### **JA.4 Eddy current examination and inspection (Z4)<sup>3)</sup>**

The eddy current examination and inspection shall be as follows.

- a) The standard detection sensitivity for the test shall be division EU, EV, EW or EX as specified in **JIS G 0583**, and there shall be no signals equivalent to or greater than the signals from the reference standards of the reference sample of the said division.



- b) The eddy current examination shall be carried out in accordance with **JIS G 0583**.
- c) The eddy current examination shall be performed on each pipe, and the requirement in **a)** shall be satisfied.

Note <sup>3)</sup> In business trading of pipes, the designation of eddy current examination can be indicated as Z4.

#### **JA.5 Charpy impact test (Z5) <sup>4)</sup>**

The Charpy impact test shall be as follows.

- a) The absorption energy to be applied in the Charpy impact test of pipe shall be as given in table JA.1. In this case, the test temperature shall be selected from among -10 °C, -20 °C and -30 °C by agreement between the purchaser and the manufacturer.

**Table JA.1 Absorption energy <sup>a)</sup> in Charpy impact test**

Unit : J

Test piece dimensions mm	Absorption energy in Charpy impact test		
	Average value of one set (3 pieces)	Individual values of 2 pieces	Value of each piece
10 × 10	21 min.	21 min.	14 min.
10 × 7.5	18 min.	18 min.	12 min.
10 × 5	14 min.	14 min.	10 min.
NOTE : Individual values of 2 pieces are the two values excluding the minimum value.			
Note <sup>a)</sup> For pipes from which test piece of the size 10 × 5 cannot be taken, the impact test shall not be performed.			

- b) For the test, one sample shall be taken from a group of 100 pipes or its fraction that are of the same heat treatment, and a set (3 pieces) of test pieces shall be taken therefrom.
- c) The test piece shall be a V notch test piece specified in **JIS Z 2242** which is cut from a pipe in the longitudinal direction. However, the width of the test piece may be altered to 7.5 mm or 5 mm according to the dimension of the pipe.
- d) The test method shall be in accordance with **JIS Z 2242**.
- e) The test results of Charpy impact test shall conform to the requirements of **a)**.
- f) **Re-inspection** When the test results fail to satisfy the requirements, a retest may be performed to evaluate the pipes further for acceptance, provided that the average value of the absorption energy already obtained satisfies the value specified in table JA.1 and that either of the following conditions is met.
  - 1) Two of the three values are equal to or higher than the specified average value and only one fails to conform to the “value of each piece” given in table JA.1.
  - 2) Two of the three values satisfy the “value of each piece” given in table JA.1 but fail to conform to the specified average value of a set of pipes (3 pieces)



For a retest, a new set (3 pieces) of test pieces shall be taken from the same lot, and each of the 3 individual tested values shall conform to the “average value of one set” given in table JA.1.

Note <sup>4)</sup> In business trading of pipes, the designation of Charpy impact test can be indicated as Z5.





## Annex JB (informative)

## Comparison table between JIS and corresponding International Standard

JIS G 3455:2012 Carbon steel pipes for high pressure service					ISO 9329-2:1997 Seamless steel tubes for pressure purposes— Technical delivery conditions—Part 2: Unalloyed and alloyed steels with specified elevated temperature properties		
(I) Requirements in JIS		(II) Inter- national Standard number	(III) Requirements in Inter- national Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classifi- cation by clause	Detail of technical deviation	
1 Scope	The carbon steel pipes used for high pressure service at temperatures 350 °C or lower.		1	The carbon steel pipes and alloy steel pipes used for high pressure service.	Alteration	In JIS, only carbon steel pipes are specified.	Alloy steel pipes are specified in other JIS standards; standard structure is different from ISO.
2 Normative references							
3 Grade and designation	Three grades are speci- fied.		4.1	Four carbon steel grades and fourteen alloy steel grades are specified.	Deletion	In JIS, the highest strength grade carbon steel specified in ISO and alloy steel are de- leted.	Highest strength grade of carbon steel is not necessary for applica- tions relevant to JIS products. Also, alloy steel is specified in other JIS standards.



(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
4 Manufacturing method	<p>The following production processes are specified:</p> <ul style="list-style-type: none"> <li>• Pipe manufacturing method</li> <li>• Type of heat treatment</li> <li>• Bevel end</li> </ul>		5.3	Product-making process for tubes is specified.	Identical	—	<p>Heat treatment to be performed on carbon steel specified in <b>JIS</b> are equivalent to those specified in <b>ISO</b>. The specification of the heat treatment temperature range in <b>ISO</b>, which is considered to hinder the quality improvement and advancement in manufacturing techniques, is thus deleted in <b>JIS</b>.</p>
			5.4	Types and conditions of heat treatment for carbon steel and alloy steel are specified.	Deletion	In <b>JIS</b> , the type of heat treatment for carbon steel is specified, and in <b>ISO</b> , the type and conditions of heat treatment for carbon steel and alloy steel are specified.	
			8.2	Tubes can be delivered with bevel ends by agreement between the purchaser and the manufacturer at the time of ordering.	Identical	—	
5 Chemical composition	Chemical composition of three steel grades are specified.		6.1	Chemical composition of four carbon steel grades and fourteen alloy steel grades are specified.	Alteration	In <b>JIS</b> , the specification of the highest strength carbon steel in <b>ISO</b> and of alloy steel are deleted.	The strength required in <b>JIS</b> is different from <b>ISO</b> , and therefore it is not practicable for <b>JIS</b> to apply the same chemical composition as <b>ISO</b> since it determines the strength.

(I) Requirements in <b>JIS</b>		(II) Inter- national Standard number	(III) Requirements in Inter- national Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classifi- cation by clause	Detail of technical deviation	
6.1 Tensile strength, yield point or proof stress and elongation	Tensile strength, yield point or proof stress and elongation at ordi- nary temperature are specified.		6.2.1	Tensile strength, proof stress, elongation, flat- tening resistance, bendability, expanding resistance and impact values are specified.	Deletion	In <b>JIS</b> , the expanding resistance is not speci- fied.	In <b>JIS</b> , the expanding resistance is deleted since it is unnecessary for the applications relevant to <b>JIS</b> prod- ucts, and the impact values are given in Annex.
6.2 Flattening resistance	Flattening resistance is specified.		9.10.3	Either the flattening test, bend test or ring tensile test is to be per- formed.	Deletion	In <b>JIS</b> , it is permitted to apply bendability instead of flattening resistance for pipes of outside diameter 50 mm or under. In <b>ISO</b> , either the flattening test, bend test or ring tensile test, as selected at the discretion of the manufacturer, is to be performed.	Correspondence to <b>ISO</b> can be achieved by sub- stituting the flattening test for bend test and ring tensile test in <b>ISO</b> .
6.3 Bendability	Bendability is specified.		9.10.3	Same as above.	Same as above.	Same as above.	The drift expanding test and ring expanding test are not necessary for the applications rel- evant to <b>JIS</b> products.
			9.10.4	Either the drift expand- ing test or ring expand- ing test is to be per- formed.	Deletion	In <b>JIS</b> , the drift ex- panding test and the ring expanding test are not specified.	

(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
7 Hydraulic test characteristics or non-destructive test characteristics	Either the hydraulic test characteristics or non-destructive test characteristics is to be applied.		9.5	Either the hydraulic test characteristics or non-destructive test characteristics is to be applied.	Alteration	In <b>JIS</b> , the hydraulic test pressure specified is lower than that in <b>ISO</b> . Further, the test pressure may be the value specified by the purchaser.	The hydraulic test pressure can be altered as specified by the purchaser, and therefore no change is made in conventional <b>JIS</b> specification.
8.1 Dimensions and unit mass	Dimensions and mass of pipes are specified.		7.1	The outside diameter, wall thickness and mass values are to be selected from those specified in <b>ISO 4200</b> and <b>ISO 1129</b> .	Alteration	System of dimensional specification is different from <b>ISO</b> .	Changing of the dimensional system may induce confusion in the market, and therefore the conventional system is carried on.
8.2 Dimensional tolerances	The tolerances on outside diameter, wall thickness and wall thickness deviation are specified.		7.3	Tolerances on the outside diameter, wall thickness, length and straightness of tube are specified.	Alteration	In <b>JIS</b> , tolerances on wall thickness deviation are added, while those on the straightness are deleted. <b>JIS</b> gives stricter tolerances for the outside diameter and wall thickness.	Changing of the dimensional tolerances specification may induce confusion in the market, and therefore the conventional system is carried on.
	In the case where the length is specified, the length shall be not less than the specified value.		7.2	The random length and the standard length are specified.	Alteration	In <b>JIS</b> , no concrete tolerance values are given.	Changing of the length tolerance specification may induce confusion in the market, and therefore the conventional system is carried on.
9 Appearance	Appearance is specified.		8.1	Appearance is specified.	Identical	—	



(I) Requirements in <b>JIS</b>		(II) Inter- national Standard number	(III) Requirements in Inter- national Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures	
No. and title of clause	Content		No. of clause	Content	Classifi- cation by clause	Detail of technical deviation		
10.1 Chemical analysis	General matters of chemical analysis and sampling method are specified.		9.3	General matters of chemical analysis and sampling method are specified.	Identical	—		
10.2.2 Sam- pling method and number of test pieces	Tensile test piece and tensile test method are specified.  Flattening test piece and flattening test method are specified.  Bend test piece and bend test method are specified.		9.4	Method of taking test pieces and shape of test pieces are specified.	Alteration	In <b>JIS</b> , one pipe is to be drawn from a group of 50 pipes, and in <b>ISO</b> , one from a group of 100 pipes.		Method of taking test pieces in <b>JIS</b> can sub- stitute for <b>ISO</b> method.
10.2.3 Tensile test			9.10.2	Tensile test is specified.	Alteration	The test piece shape specified in <b>JIS</b> is dif- ferent from that speci- fied in <b>ISO</b> .		
10.2.4 Flat- tening test			9.10.3.3	Bend test is specified.	Identical	—		
10.2.5 Bend test					Alteration	In <b>ISO</b> , the pipe is cut and processed to pre- pare test pieces, while in <b>JIS</b> , the pipe is sup- plied for the test as it is.		
10.3 Hydrau- lic test or non- destructive test	Hydraulic test and non- destructive test meth- ods are specified.		9.5	The hydraulic test or non-destructive test is specified.	Identical	—		



(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
11.1 Inspection	Inspection results are specified.		9.10	The test results are specified alongside the test method requirements.	Deletion	In <b>JIS</b> , the test method requirements and test results are specified separately.	<b>JIS</b> standard structure is different from <b>ISO</b> .
11.2 Re-inspection	Method of re-inspection is specified.		9.12	Method of re-inspection is specified.	Identical	—	
12 Marking	Marking items are specified.		10	Marking items are specified.	Alteration	In <b>JIS</b> , marking of the symbol indicating the manufacturing method, dimensions and symbol denoting the designation of special quality requirement are added. The number of marking items to be indicated is greater in <b>ISO</b> .	Changing of the marking items specification may induce confusion in the market, and therefore the conventional specification is carried on.
13 Report	Details of report are specified.		12	Details of report are specified.	Alteration	Two types of inspection document are specified in <b>JIS</b> , and four types in <b>ISO</b> .	In <b>JIS</b> , the inspection document suitable for the requirements given in <b>JIS</b> should be applied, and therefore no change is made in the conventional <b>JIS</b> specification.

(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
Annex JA Special quality requirements	• Yield point or proof stress in tensile test at elevated temperature		6.2.2	Properties at elevated temperature	Alteration	In <b>JIS</b> , special quality requirements are only to be applied when requested by the purchaser, while in <b>ISO</b> , they are mandatory requirements.	These quality requirements need not be mandatory for applications relevant to <b>JIS</b> products, and therefore remain to be treated as optional requirements.
	• Ultrasonic examination and inspection		9.8	Non-destructive testing	Alteration	Same as above.	Same as above.
	• Eddy current examination and inspection		9.10.5.2	Non-destructive test	Alteration	As an alternative test to the hydraulic test, <b>JIS</b> specifies the eddy current test, and <b>ISO</b> specifies the electromagnetic test.	Each test method has its advantages and disadvantages, and the electromagnetic test is not required for applications relevant to <b>JIS</b> products.
	• Charpy impact test		6.2.1	Impact value is specified.	Alteration	The specified value in <b>JIS</b> is lower than that of <b>ISO</b> .	The level of <b>ISO</b> specification value is not necessary for applications relevant to <b>JIS</b> products.

Overall degree of correspondence between **JIS** and International Standard (**ISO 9329-2:1997**): MOD

NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows:

- Identical: Identical in technical contents.
- Deletion: Deletes the specification item(s) or content(s) of International Standard.
- Alteration: Alters the specification content(s) which are included in International Standard.

NOTE 2 Symbol in column of overall degree of correspondence between **JIS** and International Standard in the above table indicates as follows:

- MOD: Modifies International Standard.



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