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**Carbon steel pipes for high pressure
service**

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Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Symbol of grade	2
4 Manufacturing method	2
5 Chemical composition	3
6 Mechanical properties	3
6.1 Tensile strength, yield point or proof stress, and elongation	3
6.2 Flattening resistance	4
6.3 Bendability	5
7 Hydrostatic test characteristics or nondestructive test characteristics	5
8 Dimensions, unit mass and dimensional tolerances	7
8.1 Dimensions and unit mass	7
8.2 Dimensional tolerances	8
9 Appearance	9
10 Supplementary quality requirements	10
11 Tests	10
11.1 Chemical analysis	10
11.2 Mechanical tests	10
11.3 Hydrostatic test or nondestructive test	11
12 Inspection and reinspection	12
12.1 Inspection	12
12.2 Reinspection	12
13 Marking	12
14 Report	13
Annex JA (normative) Supplementary quality requirements	14
Annex JB (informative) Comparison table between JIS and corresponding International Standard	17

Foreword

This Japanese Industrial Standard has been 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 a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied *mutatis mutandis* pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS G 3455:2016**), which has been technically revised.

However, **JIS G 3455:2016** may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 20 December 2021.

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Carbon steel pipes for high pressure service

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9329-2:1997**, Edition 1, with some modifications of the technical contents.

In addition to the items specified in the main body, the supplementary quality requirements to be applied by agreement between the purchaser and the manufacturer are given in Annex JA. The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations 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 mainly used for machine parts.

NOTE 1 The dimensional range covered by this Standard is generally outside diameter 10.5 mm (nominal diameter 6A or 1/8B) to 660.4 mm (nominal diameter 650A or 26B).

NOTE 2 The International Standards 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)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards 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*

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 *Rounding of numbers*

3 Symbol of grade

Pipes are classified into 3 grades, and the symbols of grade shall be as given in Table 1.

Table 1 Symbols of grade and symbols of manufacturing method

Symbol of grade	Manufacturing method		
	Pipe manufacturing method	Finishing method	Marking
STS370 STS410 STS480	Seamless: S	Hot finished: H Cold finished: C	As given in 13 b).

4 Manufacturing method

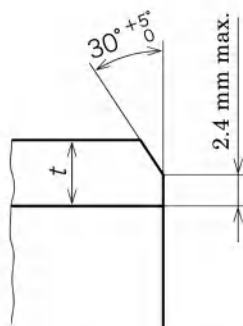
The manufacturing method shall be as follows.

- Pipes shall be manufactured seamlessly from killed steel and then finished according to Table 1. The symbol of manufacturing method shall be as given in Table 1.
- Pipes shall be heat treated in accordance with Table 2. Other heat treatment than given in Table 2 may be performed upon agreement between the purchaser and the manufacturer.

Table 2 Heat treatment

Symbol 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	

- Pipes shall be finished with plain ends, unless otherwise specified. If the purchaser specifies bevel end finishing, the shape of the bevel end shall be as agreed between the purchaser and the manufacturer. The bevel end shape for pipes with a wall thickness 22 mm or under shall be in accordance with Figure 1, unless otherwise specified.



t : wall thickness 22 mm max.

Figure 1 Shape of bevel end

5 Chemical composition

The pipes shall be tested in accordance with 11.1, and the obtained heat analysis values shall conform to Table 3. When the product analysis is requested by the purchaser, the pipes shall be tested in accordance with 11.1, and the obtained product analysis values shall satisfy the requirements in Table 3 within tolerances given in Table 3 of JIS G 0321.

Table 3 Chemical composition

Unit: %

Symbol 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.
Alloy elements not specified in this Table may be added as necessary.					

6 Mechanical properties

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

The pipes shall be tested in accordance with 11.2, and the tensile strength, yield point or proof stress, and elongation shall be as given in Table 4. For pipes with a wall thickness under 8 mm for which the tensile test is performed with Test piece No. 12 or No. 5, the elongation shall satisfy Table 5.

Table 4 Tensile strength, yield point or proof stress, and elongation

Symbol of grade	Tensile strength N/mm ²	Yield point or proof strength N/mm ²	Elongation ^{a)} %			
			Test piece No. 11 Test piece No. 12	Test piece No. 5	Test piece No. 4 ^{b)}	
			Direction parallel to pipe axis	Direction perpendicular to pipe axis	Direction parallel to pipe axis	Direction perpendicular to 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/mm² = 1 MPa

Notes ^{a)} For pipes whose outside diameter is under 40 mm, the elongation values in this Table shall not be applied, but the elongation test results shall be recorded. The elongation may be specified upon agreement between the purchaser and the manufacturer.

^{b)} The tensile direction shall be parallel to the pipe axis. However, where feasible, test pieces may be taken in the direction perpendicular to the pipe axis instead of the direction parallel to the pipe axis.

Table 5 Elongation of pipes with a wall thickness under 8 mm, tested using Test piece No. 12 (direction parallel to pipe axis) and Test piece No. 5 (direction perpendicular to pipe axis)

Unit: %

Symbol 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	Test piece No. 12	21 min.	22 min.	24 min.	26 min.	27 min.	28 min.	30 min.
	Test piece No. 5	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
STS410 STS480	Test piece No. 12	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
	Test piece No. 5	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.

NOTE The elongation values in this table are obtained by subtracting 1.5 % from the elongation value given in Table 4 for each 1 mm decrease of wall thickness from 8 mm, and by rounding the result to an integer according to Rule A of JIS Z 8401.

6.2 Flattening resistance

The pipes shall be tested in accordance with 11.2. When the test piece is flattened until the distance between the platens, H , becomes equal to the value calculated by Formula (1), it shall not generate cracks.

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

where, *H* : distance between platens (mm)
 t : wall thickness of pipe (mm)
 D : outside diameter of pipe (mm)
 e : constant given for each grade of pipe:
 0.08 for STS370;
 0.07 for STS410 and STS480.

NOTE For the flattening test, see **11.2.4**.

6.3 Bendability

The bendability requirement applies where the purchaser specifies a bend test instead of a flattening test for pipes with an outside diameter 50 mm or under. The bendability shall be tested in accordance with **11.2**, and the test piece shall be free from cracks when bent to an angle of 90° with an inside radius six times the pipe outside diameter. The bend angle shall be measured at the starting point of the bend.

7 Hydrostatic test characteristics or nondestructive test characteristics

The pipes shall be tested in accordance with **11.3**, and their hydrostatic test characteristics and nondestructive test characteristics shall be as follows. Which characteristics to be tested shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.

a) **Hydrostatic test characteristics** The hydrostatic test characteristics shall be as follows.

- 1) When a test pressure is not specified by the purchaser and when pipes are subjected to the minimum hydrostatic test pressure given in Table 6, the pipes shall withstand it without leakage.

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

- 1.1) For pipes of outside diameter within the range specified in Table 7, the smaller value of the applicable outside diameters in this Table shall be selected.
- 1.2) When the pipe has the wall thickness within the range of schedule number Sch corresponding to the outside diameter selected in **1.1)**, the greater value of the applicable wall thicknesses specified in this Table shall be selected.
- 1.3) The minimum hydrostatic test pressure shall be selected from Table 6 according to the outside diameter and the schedule number of wall thickness selected in **1.1)** and **1.2)**.
- 1.4) For the pipes which do not satisfy the conditions in **1.1)** and **1.2)** and have dimensions other than those given in Table 7, the minimum hydrostatic test pressure to be applied shall be as agreed between the purchaser and the manufacturer.

- 1.5) When the minimum hydrostatic test pressure of the schedule number selected in 1.2) or 1.4) exceeds the test pressure P obtained by Formula (2), the pressure P shall be applied as the minimum hydrostatic test pressure, instead of the minimum hydrostatic test pressure selected from Table 6.
- 2) When the purchaser specifies a test pressure, the pressure shall be applied as the minimum hydrostatic test pressure, and the pipes shall withstand it without leakage. If the pressure value specified by the purchaser is greater than the test pressure P calculated by Formula (2) or 20 MPa, the test pressure shall be as agreed 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. Likewise, values calculated by Formula (2) shall be rounded off to the nearest 0.5 MPa or 1 MPa, whichever is applicable.

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

where, P : test pressure (MPa)
 t : wall thickness of pipe (mm)
 D : outside diameter of pipe (mm)
 s : 60 % of the specified minimum value of yield point or proof stress given in Table 4 (N/mm²)

Table 6 Minimum hydrostatic test pressure

							Unit: MPa	
Schedule number	Sch	40	60	80	100	120	140	160
Minimum hydrostatic test pressure		6.0	9.0	12	15	18	20	20

- b) **Nondestructive test characteristics** Pipes shall be tested by either the ultrasonic examination or the eddy current examination, and their nondestructive test characteristics shall be as follows. In place of these examinations, other nondestructive tests specified in Japanese Industrial Standards may be carried out 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 the eddy current examination.

NOTE Other nondestructive tests in accordance with **JIS**s include the test specified in **JIS G 0586**.

- 1) For the ultrasonic examination characteristics, the signals from the reference sample containing Category UD reference standard specified in **JIS G 0582** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level. When the pipe to be tested is finished by other methods than cold finishing, the minimum depth of square notch shall be 0.3 mm.

- 2) For the eddy current examination characteristics, the signals from the reference sample containing Category EY reference standard specified in **JIS G 0583** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level.

8 Dimensions, unit 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. Dimensions not specified in Table 7 may be used upon agreement between the purchaser and the manufacturer. In this case, the unit mass shall be calculated by the Formula (3) assuming the mass of steel of 1 cm³ is 7.85 g, and the result shall be rounded off to 3 significant figures according to Rule A of **JIS Z 8401**. The result value exceeding 1 000 kg/m shall be rounded to an integer in the unit of kg/m.

$$W = 0.024\ 66\ t\ (D - t) \dots\dots\dots (3)$$

where, W : unit mass of pipe (kg/m)
 t : wall thickness of pipe (mm)
 D : outside diameter of pipe (mm)

0.024 66 : unit conversion factor for obtaining W

NOTE The unit mass values in Table 7 are the results of the calculation given above.

Table 7 Dimensions^{a)} and unit mass

Nominal diameter		Out-side diam-eter mm	Nominal wall thickness (Schedule number: Sch)													
			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 ^{a)} Pipes are designated by nominal diameter and nominal wall thickness (schedule number: Sch). The nominal diameter, selected from A and B in the Table, shall be indicated by suffixing either the letter A or B, whichever selected, to the numeral of the nominal diameter.

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 pipe length is specified, the minus side tolerance on the specified pipe length shall be 0 mm, and the plus side tolerance is not given.

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

Division	Tolerance on outside diameter ^{a)}	Tolerance on wall thickness	Tolerance on wall thickness deviation ^{c)}
Hot-finished seamless steel pipe	Outside diameter under 50 mm ± 0.5 mm	Wall thickness under 4 mm ± 0.5 mm Wall thickness 4 mm or over ± 12.5 %	20 % or under
	Outside diameter 50 mm or over to and excl. 160 mm ± 1.0 %		
	Outside diameter 160 mm or over to and excl. 200 mm ± 1.6 mm		
	Outside diameter 200 mm or over ^{b)} ± 0.8 %		
Cold-finished seamless steel pipe	Outside diameter under 40 mm ± 0.3 mm	Wall thickness under 2 mm ± 0.2 mm Wall thickness 2 mm or over ± 10 %	—
	Outside diameter 40 mm or over ^{b)} ± 0.8 %		

Notes ^{a)} The tolerances on outside diameter in this Table do not apply to local repaired parts.

^{b)} For pipes of outside diameter 350 mm or over, the outside diameter tolerance may be applied to the circumferential length. When the circumferential length is used in determining the outside diameter, either the actual measured value of the circumferential length or the outside diameter converted from the measured circumferential length shall be used. In both cases, the same value (± 0.5 %) shall be applied as the tolerances. The conversion between the outside diameter (D) and the circumferential length (l) shall be as given in the following formula.

$$D = l/\pi$$

where, D : outside diameter (mm), l : circumferential length (mm), π : 3.141 6

^{c)} 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. This shall not apply to pipes under 5.6 mm in wall thickness.

9 Appearance

The appearance shall be as follows.

- The pipes shall be straight for practical purposes and the both ends shall be at right angles to the pipe axis.
- Both the internal and external surfaces of pipes shall be smoothly finished and free from defects detrimental to use.
- The pipes may be repaired by grinding, machining or other method, provided that the wall thickness after repair is within the specified tolerance on wall thickness.
- The surface of the repaired part shall be smooth along the contour of the pipe.

10 Supplementary quality requirements

The supplementary quality requirements, which can be applied upon agreement between the purchaser and the manufacturer, shall be as given in Annex JA.

11 Tests

11.1 Chemical analysis

11.1.1 General requirements and sampling method

General requirements for chemical analysis and sampling method for heat analysis shall be in accordance with Clause 8 of JIS G 0404. When the product analysis is requested by the purchaser, the sampling method shall be in accordance with Clause 4 of JIS G 0321.

11.1.2 Analytical method

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

11.2 Mechanical tests

11.2.1 General

General requirements for mechanical tests shall be in accordance with Clauses 7 and 9 of JIS G 0404. The sampling method for mechanical tests shall be in accordance with Class A specified in 7.6 of JIS G 0404.

11.2.2 Sampling method and number of test pieces

For pipes to be supplied as manufactured, one sample shall be taken from a group of 50 or its fraction of pipes that are of the same dimensions, and for pipes to which heat treatment is applied, one sample shall be drawn from a group of 50 or its fraction of pipes that are of the same dimensions and from the same heat treatment batch. One test piece shall be taken from each sample thus obtained. "Same dimensions" above means same outside diameter and wall thickness. "Same heat treatment batch" of continuous furnace means a unit of pipes from continuous furnace operation under consistent heat treating conditions, and pipes after any stop of furnace operation are not considered as belonging to the same heat treatment batch. In the case of sampling from a unit of pipes from the same cast, the pipes in the unit may be of the same heat treatment condition, instead of being from the same heat treatment batch.

11.2.3 Tensile test

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

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

11.2.4 Flattening test

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

The flattening test may be omitted unless otherwise specified by the purchaser¹⁾.

Note ¹⁾ The test may be omitted at the discretion of the manufacturer as long as the pipes satisfy the specified flattening resistance.

- a) **Test piece** The length of the test piece shall be 50 mm or longer. For pipes of wall thickness 15 % or over of the outside diameter, C-shaped test piece prepared by cutting out a part of the circumference of a ring-shaped test piece may be used.
- b) **Test method** In the atmosphere at the ordinary temperature (5 °C to 35 °C), place a test piece between two platens, and compress to flatten until the distance between the platens (H) becomes equal to or smaller than the value specified in 6.2. Then examine the test piece for cracks.

The C-shaped test piece shall be placed as shown in Figure 2.

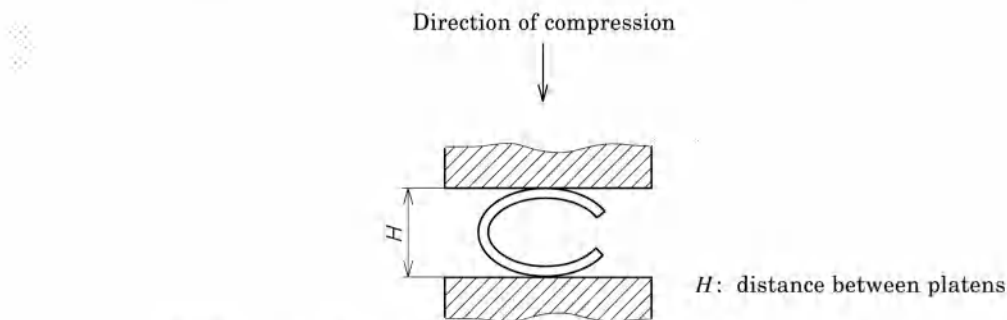


Figure 2 Flattening test (C-shaped test piece)

11.2.5 Bend test

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

- a) **Test piece** The test piece shall be of the proper length for the bend test.
- b) **Test method** In the atmosphere at ordinary temperature (5 °C to 35 °C), bend the test piece around a mandrel to a bend angle not less than the minimum bend angle specified in 6.3 and with the inside radius of curvature not more than the maximum inside radius of curvature specified in 6.3, and examine the test piece for cracks.

11.3 Hydrostatic test or nondestructive test

Either the hydrostatic test or nondestructive test described in the following shall be carried out.

- a) **Frequency of test** Either the hydrostatic test or the nondestructive test shall be carried out on each pipe.
- b) **Test method** The method of the hydrostatic test and nondestructive test shall be as follows.
 - 1) **Hydrostatic test** Hold the pipe under the pressure not less than the minimum hydrostatic test pressure specified in 7 a) for at least 5 s, and examine if the pipe withstands the pressure without leakage.

- 2) **Nondestructive test** The nondestructive test methods shall be as follows. Where other nondestructive tests than shown in the following are carried out in accordance with **JISs** upon agreement between the purchaser and the manufacturer, the test method specified in applicable JISs shall be used.
- 2.1) The ultrasonic examination shall be in accordance with **JIS G 0582**. The test may be carried out by a category of reference standard stricter than Category UD. The alarm level may be set lower than the signals from reference standard at the discretion of the manufacturer.
- 2.2) The eddy current examination shall be in accordance with **JIS G 0583**. The test may be carried out by a category of reference standard stricter than Category EY. The alarm level may be set lower than the signals from reference standard at the discretion of the manufacturer.

12 Inspection and reinspection

12.1 Inspection

The inspection shall be as follows.

- a) The general requirements for inspection shall be as specified in **JIS G 0404**.
- b) The chemical composition shall conform to the requirements specified in Clause 5.
- c) The mechanical properties shall conform to the requirements specified in Clause 6.
- d) The hydrostatic test characteristics or nondestructive test characteristics shall conform to the requirements specified in Clause 7.
- e) Dimensions shall conform to the requirements specified in Clause 8.
- f) The appearance shall conform to the requirements specified in Clause 9.
- g) When the supplementary quality requirements are applied upon the agreement between the purchaser and the manufacturer, the inspection results shall conform to the requirements specified in Clause 10.

12.2 Reinspection

The pipes having failed in the mechanical tests may be subjected to a retest according to 9.8 of **JIS G 0404** for further acceptance judgement.

13 Marking

Each pipe having passed the inspection shall be marked with the following information. When the marking on each pipe is difficult because its outside diameter is small or when so requested by the purchaser, the marking may be given on each bundle of pipes by a suitable means. The order of markings is not specified. Part of the following particulars may be omitted upon agreement between the purchaser and the manufacturer, as far as the product can still be identified.

- a) Symbol of grade
- b) Symbol of manufacturing method

The symbol of manufacturing method shall be as follows. The dash may be replaced with a blank.

- 1) Hot finished seamless steel pipe: —S—H
- 2) Cold finished seamless steel pipe: —S—C
- c) Dimensions The dimensional marking shall consist of the nominal diameter and nominal wall thickness (schedule number), or outside diameter and wall thickness.
Example 50A×Sch80 or 60.5×5.5
- d) Manufacturer's name or identifying brand
- e) Symbol Z to denominate the supplementary quality requirement (if specified)

14 Report

Unless otherwise specified, the manufacturer shall submit an inspection document to the purchaser. The report shall be in accordance with Clause 13 of JIS G 0404. Unless otherwise specified in the order, the type of the inspection document to be submitted shall be in accordance with 5.1 of JIS G 0415.

Where nickel (Ni), chromium (Cr), molybdenum (Mo), vanadium (V), copper (Cu) and/or boron (B) has/have been added intentionally, the content of added element(s) shall be recorded in the inspection document.

Annex JA (normative)

Supplementary quality requirements

JA.1 Yield point or proof stress in tensile test at elevated temperature (Z2)¹⁾

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

- a) The required values of yield point or proof stress and the test temperature in the tensile test of pipes at elevated temperature shall be as agreed between the purchaser and the manufacturer.
- b) Take one sample from a group of pipes from the same cast, and from each sample take a test piece for each test temperature. The sampling direction of test piece shall be as agreed between the purchaser and the manufacturer.
- c) The test piece and the 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 as agreed between the purchaser and the manufacturer.

Note ¹⁾ In transactions of pipes, the purchaser's request for yield point or proof stress in tensile test at elevated temperature may be expressed by giving the symbol Z2.

JA.2 Ultrasonic examination (Z3)²⁾

The ultrasonic examination shall be as follows.

- a) The standard detection sensitivity for the ultrasonic examination shall be Category UB or UC specified in **JIS G 0582**, and there shall be no signals equivalent to or greater than the signals from the reference sample containing the reference standard of the said category. The applicable detection sensitivity category shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.
- b) The ultrasonic examination shall be carried out on each pipe in accordance with **JIS G 0582**.

Note ²⁾ In transactions of pipes, the purchaser's request for ultrasonic examination may be expressed by giving the symbol Z3.

JA.3 Eddy current examination (Z4)³⁾

The eddy current examination shall be as follows.

- a) The standard detection sensitivity for the eddy current examination shall be Category EU, EV, EW or EX specified in **JIS G 0583**, and there shall be no signals equivalent to or greater than the signals from the reference sample containing the reference standard of the said category. The applicable detection sensitivity category shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.

- b) The eddy current examination shall be carried out on each pipe in accordance with **JIS G 0583**.

Note ³⁾ In transactions of pipes, the purchaser's request for eddy current examination may be expressed by giving the symbol Z4.

JA.4 Charpy impact test (Z5) ⁴⁾

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 Absorbed energy in Charpy impact test

Unit: J

Dimension of test piece mm	Absorption energy in Charpy impact test	
	Average of three test pieces	Value of each test piece ^{a)}
10 × 10	21 min.	14 min.
10 × 7.5	18 min.	12 min.
10 × 5	14 min.	10 min.
Note ^{a)} The values of two test pieces among three shall be equal to or higher than the average value of three test pieces in this Table.		

- b) One sample shall be taken from a group of 100 or its fraction of pipes of the same heat treatment batch, and three test pieces shall be taken from each sample.
- c) The test piece shall be a V notch test piece specified in **JIS Z 2242** taken in the direction parallel to the pipe axis. The dimensions of the test piece shall be 10 mm × 10 mm as given in Table JA.1, but may alternatively be 10 mm × 7.5 mm or 10 mm × 5 mm as also given in Table JA.1 depending on the size of the pipe under test. The longitudinal axis of the notch on the test piece shall be perpendicular to the surface of the pipe.

For pipes of a size not big enough for taking 10 mm × 5 mm test piece, the impact test shall not be carried out.

- d) The test method shall be in accordance with **JIS Z 2242**.
- e) 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 of the absorption energy values obtained on three test pieces satisfies the value specified in Table JA.1 and that either of the following conditions is met.
- 1) The values of two test pieces are equal to or higher than the average value of the three test pieces given in Table JA.1, and only one test piece fails to conform to the specified value for each test piece given in Table JA.1.
 - 2) The values of two test pieces satisfy the specified value of each test piece given in Table JA.1 but fail to conform to the average value of the three test pieces given in Table JA.1.

For a retest, a new set of three test pieces shall be taken from the same sample pipe, and when each three value conforms to the specified average value given in Table JA.1, the pipe shall be deemed acceptable.

Note ⁴⁾ In transactions of pipes, the purchaser's request for Charpy impact test may be expressed by giving the symbol Z5.

Annex JB (informative)
Comparison table between JIS and corresponding International Standard

JIS G 3455 : 2020 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 Interna- tional 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	Carbon steel pipes used for high pres- sure service at tem- peratures 350 °C or lower		1	Tubes made of unalloyed and alloyed steel that are intended for pressure purposes where the material is also sub- jected to elevated temperatures	Alteration	Limit the scope to carbon steel pipes.	Alloyed steel pipes are covered in other JISs. JIS standard structure is different from that of ISO.
2 Normative references							
3 Symbol of grade	Three grades of steel pipes		4.1	Four grades of unalloyed steel pipes and 14 grades of alloyed steel pipes	Deletion	Delete unalloyed steel grade of highest strength and alloyed steels.	Highest strength unalloyed steel pipes is not necessary for pur- poses intended in JIS. Alloyed steel pipes are covered in other JISs.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International 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	Classification by clause	Detail of technical deviation	
4 Manufacturing method	The following manufacturing methods: • Pipe manufacturing method • Types of heat treatments • Bevel ends		5.3 5.4 8.2	Product-making process for tubes Types of heat treatments and their conditions for unalloyed and alloyed steel tubes Pipes can be delivered with bevelled ends by agreement between the purchaser and the manufacturer at the time of ordering.	Identical Deletion Identical	— Specify types of heat treatments for carbon steel pipes, while ISO specifies types of heat treatments and their conditions for unalloyed and alloyed steel pipes. —	Types of heat treatments for unalloyed steel pipes are the same as specified in ISO . The heat treatment temperature ranges given in ISO may hinder the quality improvement and advances in manufacturing technology.
5 Chemical composition	Chemical composition requirement for three steel grades.		6.1	Chemical composition requirement for four grades of unalloyed steel and 14 grades of alloyed steel	Deletion/ Alteration	Delete unalloyed steel grade of highest strength and alloyed steels.	JIS is to specify chemical composition that is congruent with JIS 's own strength requirements, which are different from ISO 's.
6.1 Tensile strength, yield point or proof stress, and elongation	Tensile strength, yield point or proof stress and elongation requirements at ordinary temperature		6.2.1	Tensile strength, proof stress, elongation, flattening resistance, bendability, expanding properties and impact properties requirements	Deletion	Delete expanding resistance properties.	Expanding resistance requirement is not necessary for applications intended in JIS . The impact values are specified in the Annex.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International 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	Classification by clause	Detail of technical deviation	
6.2 Flattening property	Flattening resistance requirement		9.10.3	Flattening test, bend test or ring tensile test	Deletion	Permit the purchaser to specify the bend test instead of the flattening test for pipes with an outside diameter 50 mm or under, while ISO permits the manufacturer to select the flattening test, bend test or ring tensile test.	With the use of the flattening test as an alternative test method to the bend test and ring tensile test in ISO , conformance to ISO can be ensured.
6.3 Bendability	Bendability requirement		9.10.3 9.10.4	Same as above. Drift expanding test or ring expanding test	Same as above. Deletion	Same as above. Delete drift expanding test and ring expanding test.	The drift expanding test and ring expanding test are not necessary for applications intended in JIS .
7 Hydrostatic test characteristics or nondestructive test characteristics	Hydrostatic test characteristics or nondestructive test characteristics		9.5	Hydrostatic test characteristics or nondestructive test characteristics	Alteration	Change the hydrostatic test pressure to a lower value. Permit the purchaser to specify the test pressure.	The hydrostatic test pressure can be altered as specified by the purchaser. JIS specification is maintained without change.
8.1 Dimensions and unit mass	Dimensions and unit mass of pipes		7.1	The outside diameters, wall thicknesses and masses to be selected from those in ISO 4200 and ISO 1129	Alteration	The dimensional system differs between JIS and ISO .	Changing the conventional dimensional system used in Japan can bring confusion to the market; JIS specification is maintained without change.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International 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	Classification by clause	Detail of technical deviation	
8.2 Dimensional tolerances	The tolerances on the outside diameter, wall thickness and wall thickness deviation of pipes		7.3	The tolerances on the outside diameter, wall thickness, length and straightness of pipes	Alteration	Add tolerance on wall thickness deviation and delete tolerance on straightness. Change the outside diameter and wall thickness tolerances to more stringent values.	Changing the conventional dimensional tolerances used in Japan can bring confusion to the market; JIS specification is maintained without change.
	In the case where the pipe length is specified, the pipe length shall be equal to or greater than the specified value.		7.2	Random lengths and exact lengths	Alteration	Replace specific length tolerances with JIS 's own general requirement.	Changing the conventional length tolerances used in Japan can bring confusion to the market; JIS specification is maintained without change.
9 Appearance	Appearance requirement		8.1	Appearance requirement	Identical	—	
10 Supplementary quality requirements	Supplementary quality requirements		—	—	Addition	Add requirements that are essential for JIS specification.	The supplementary requirements are contents essential for JIS ; JIS specification is maintained without change.
11.1 Chemical analysis	General requirements for chemical analysis and sampling method		9.3	General requirements for chemical analysis and sampling method	Identical	—	
11.2.2 Sampling method and number of test pieces	Sampling method and number of test pieces		9.4	Sampling method and shapes of test pieces	Alteration	Alter the number of pipes constituting a test unit, 100 in ISO , to 50.	Sampling method in JIS can substitute for ISO method.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International 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	Classification by clause	Detail of technical deviation	
11.2.3 Tensile test	Type of test piece and test method used for tensile test		9.10.2	Tensile test requirements	Alteration	Change the shape of test piece.	The shape of test piece necessary for JIS specification is adopted.
11.2.4 Flattening test	Type of test piece and test method used for flattening test		9.10.3.2	Requirements for flattening test	Addition	Add specification for the omission of test and specific temperature range.	The requirements are necessary for JIS ; JIS specification is maintained without change.
11.2.5 Bend test	Type of test piece and test method used for bend test		9.10.3.3	Bendability test requirements	Addition	Add specific temperature range.	The requirements are necessary for JIS ; JIS specification is maintained without change.
11.3 Hydrostatic test or nondestructive test	Hydrostatic test and nondestructive test requirements		9.5	Leak-tightness test and non-destructive test requirements	Alteration	Change the test conditions to those that are more stringent.	The requirements are necessary for JIS ; JIS specification is maintained without change.
12.1 Inspection	Inspection requirements		9.10	Test methods and results specified within the same sub-clause	Deletion	Delete the test method.	JIS standard structure is different from that of ISO .
12.2 Reinspection	Reinspection requirements		9.12	Reinspection requirements	Identical	—	
13 Marking	Information to be included in the marking		10	Information to be included in the marking	Alteration	Add symbol of manufacturing method, dimensions and symbol to denominate the supplementary quality requirement to the marking. Specify fewer marking items.	Changing the conventional marking items in Japan can bring confusion to the market; JIS specification is maintained without change.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International 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		
14 Report	Report requirements		12	Report requirements	Alteration	The type of inspection document suitable for JIS specification should be adopted; JIS specification is maintained without change.
Annex JA (normative) Supplementary quality requirements	The yield point or proof stress in tensile test at elevated temperature, ultrasonic examination, eddy current examination and Charpy impact test		6.2.2	Properties at elevated temperature	Alteration	The mandatory contents in ISO are not essential requirements in view of applications intended in JIS ; JIS specification is maintained without change.
			9.8	Non-destructive test	Alteration	Same as above.
			9.10.5.2	Non-destructive test	Alteration	Each test method has its advantages and disadvantages, but there is no requirement for electromagnetic test for applications intended in JIS .
			6.2.1	Impact test values	Alteration	ISO specification values are not necessary for applications intended in JIS .

Overall degree of correspondence between JIS and International Standard(s) (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(s). — Addition: Adds the specification item(s) or content(s) which are not included in International Standard(s). — Alteration: Alters the specification content(s) which are included in International Standard(s).
NOTE 2	Symbol in column of overall degree of correspondence between JIS and International Standard(s) in the above table indicates as follows: — MOD: Modifies International Standard(s).

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Errata for **JIS** (English edition) can be downloaded in PDF format at Webdesk (purchase information page) of our website (<https://www.jisa.or.jp/>).

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