

ALLOY STEEL PIPES

ALLOY STEEL PIPES TECHNICAL REQUIREMENTS AND DATA

JIS G 3458:2020

Composition, properties, dimensions, testing, inspection and annexes

HEAT TREATMENT

CHEMICAL COMPOSITION

MECHANICAL PROPERTIES

DIMENSIONS & MASS

INSPECTION & TESTING

Technical reference prepared for product and project requirement review.

Confirm final material, dimensions, testing and documentation before ordering.

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Technical data navigation

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REFERENCE NOTE

Source dimensional values and footnotes are retained. Confirm the applicable material, grade, schedule and project specification before ordering.

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REFERENCE NOTE		
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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 3458:2018**), which has been technically revised.

However, **JIS G 3458:2018** 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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Alloy steel pipes

Introduction

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

Annex JA is unique to **JIS** and not given in the corresponding International Standard. 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 requirements for the alloy steel pipes (hereafter referred to as pipes) mainly used for piping at elevated temperatures.

NOTE 1 This Standard is generally applied to pipes of outside diameter 10.5 mm (nominal diameter 6A or 1/8B) to 660.4 mm (nominal diameter 650A or 26B) (see **9.1**).

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 Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, 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 0201	<i>Glossary of terms used in iron and steel (Heat treatment)</i>
JIS G 0202	<i>Glossary of terms used in iron and steel (Testing)</i>
JIS G 0203	<i>Glossary of terms used in iron and steel (Products and quality)</i>
JIS G 0320	<i>Standard test method for heat analysis of steel products</i>
JIS G 0321	<i>Product analysis and its tolerance for wrought steel</i>
JIS G 0404	<i>Steel and steel products—General technical delivery requirements</i>
JIS G 0415	<i>Steel and steel products—Inspection documents</i>
JIS G 0567	<i>Method of elevated temperature tensile test for steels and heat-resisting alloys</i>

JIS G 0582	<i>Automated ultrasonic examination of steel pipes and tubes</i>
JIS G 0583	<i>Automated eddy current examination of steel pipes and tubes</i>
JIS Z 2241	<i>Metallic materials—Tensile testing—Method of test at room temperature</i>
JIS Z 8401	<i>Rounding of numbers</i>

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS G 0201**, **JIS G 0202** and **JIS G 0203** apply.

4 Symbol of grade

Pipes are classified into 7 grades, and the symbol of grade shall be as given in Table 1.

Table 1 Classification, symbols of grade and symbols for manufacturing method

Classification	Symbol of grade	Symbol for manufacturing method		
		Pipe manufacturing method	Finishing method	Marking of symbol for manufacturing method
Molybdenum steel pipe	STPA12	Seamless: S	Hot finished: H Cold finished: C	As given in 14 b) .
Chromium molybdenum steel pipe	STPA20			
	STPA22			
	STPA23			
	STPA24			
	STPA25			
	STPA26			

5 Manufacturing method

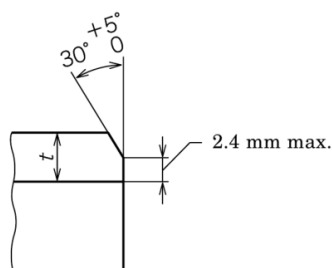
The manufacturing method shall be as follows.

- Pipes shall be manufactured by combination of the pipe manufacturing method and the finishing method which are indicated in Table 1. The symbol for manufacturing method shall be as specified in Table 1.
- Pipes shall be heat treated in accordance with Table 2. Other heat treatment than given in Table 2 may be applied upon agreement between the purchaser and the manufacturer.

Table 2 Heat treatment

Symbol of grade	Heat treatment
STPA12	Low temperature annealing, isothermal annealing, full annealing, normalizing or normalizing followed by tempering
STPA20	Low temperature annealing, isothermal annealing, full annealing or normalizing followed by tempering
STPA22	
STPA23	Isothermal annealing, full annealing or normalizing followed by tempering
STPA24	
STPA25	
STPA26	
The tempering temperature for grades STPA23, STPA24, STPA25 and STPA26 shall be 650 °C or higher.	

- c) 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 shape of bevel end for pipes with a wall thickness 22 mm or under shall be as shown in Figure 1, unless otherwise specified.



Key

r : wall thickness (22 mm max.)

Figure 1 Shape of bevel end

6 Chemical composition

Pipes shall be tested in accordance with **12.1**, and the obtained heat analysis values shall be as given in Table 3. When the product analysis is requested by the purchaser, pipes shall be tested in accordance with **12.1**, and the obtained product analysis values shall satisfy the requirements in Table 3 within tolerances given in Table 4 of **JIS G 0321**.

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Table 3 Chemical composition

Unit: %

Symbol of grade	C	Si	Mn	P	S	Cr	Mo
STPA12	0.10 to 0.20	0.10 to 0.50	0.30 to 0.80	0.035 max.	0.035 max.	a)	0.45 to 0.65
STPA20	0.10 to 0.20	0.10 to 0.50	0.30 to 0.60	0.035 max.	0.035 max.	0.50 to 0.80	0.40 to 0.65
STPA22	0.15 max.	0.50 max.	0.30 to 0.60	0.035 max.	0.035 max.	0.80 to 1.25	0.45 to 0.65
STPA23	0.15 max.	0.50 to 1.00	0.30 to 0.60	0.030 max.	0.030 max.	1.00 to 1.50	0.45 to 0.65
STPA24	0.15 max.	0.50 max.	0.30 to 0.60	0.030 max.	0.030 max.	1.90 to 2.60	0.87 to 1.13
STPA25	0.15 max.	0.50 max.	0.30 to 0.60	0.030 max.	0.030 max.	4.00 to 6.00	0.45 to 0.65
STPA26	0.15 max.	0.25 to 1.00	0.30 to 0.60	0.030 max.	0.030 max.	8.00 to 10.00	0.90 to 1.10
Alloy elements not specified in this Table may be added as necessary.							
Note a) Where necessary, Cr may be added; however, it shall not be added to such a degree that the specified values of other grades are satisfied, making the grades no longer discernible.							

7 Mechanical properties

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

Pipes shall be tested in accordance with 12.2, 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 Test piece 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 stress N/mm ²	Elongation ^{a)} %			
			Tensile test piece and test direction			
			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
STPA12	380 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA20	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA22	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA23	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA24	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA25	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
STPA26	410 min.	205 min.	30 min.	25 min.	24 min.	19 min.
NOTE 1 N/mm ² = 1 MPa						
Note ^{a)} The elongation value in this Table shall not be applied to the pipes under 40 mm in outside diameter. However, the elongation value shall be recorded.						
Note ^{b)} The tensile direction shall be parallel to the pipe axis direction. 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 Test piece No. 12 (parallel to pipe axis) and Test piece No. 5 (perpendicular to pipe axis) taken from pipes under 8 mm in wall thickness

Unit: %

Symbol of grade	Shape of 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
Respective grades	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.

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

7.2 Flattening property

Pipes shall be tested in accordance with **12.2**. 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 0.08

NOTE For the test of flattening resistance, see **12.2.4**.

8 Hydraulic test characteristics or non-destructive test characteristics

Pipes shall be tested in accordance with **12.3**, and their hydraulic test characteristics and non-destructive test characteristics shall conform to the following. 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) **Hydraulic test characteristics** Hydraulic 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 hydraulic test pressure given in Table 6, the pipes shall withstand it without leakage. In this case, the schedule number of the pipes shall be as given in Table 7. For the pipes having dimensions other than those given in Table 7, the minimum hydraulic 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 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 hydraulic 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 hydraulic test pressure to be applied shall be as agreed between the purchaser and the manufacturer.
- 1.5) When the minimum hydraulic test pressure of the schedule number selected in 1.2) exceeds the test pressure P obtained by Formula (2), the pressure P shall be applied as the minimum hydraulic test pressure, instead of the minimum hydraulic test pressure selected from Table 6. In this case, the hydraulic test pressure value shall be rounded off to the nearest 0.5 MPa for values lower than 10 MPa and to the nearest 1 MPa for values 10 MPa or higher.

Table 6 Minimum hydraulic test pressure

Unit: MPa

Nominal thickness	Schedule number: Sch									
	10	20	30	40	60	80	100	120	140	160
Minimum hydraulic test pressure	2.0	3.5	5.0	6.0	9.0	12	15	18	20	20

- 2) When the purchaser specifies test pressure, the pressure shall be applied as the minimum hydraulic test pressure, and the pipes shall withstand it without leakage. If the pressure value specified by the purchaser is greater than the value P calculated by Formula (2) or than 20 MPa, the test pressure to be applied shall be as agreed between the purchaser and the manufacturer.

The specified test pressure shall be rounded off to the nearest 0.5 MPa for values lower than 10 MPa and to the nearest 1 MPa for values 10 MPa or higher. Values calculated by Formula (2) shall be rounded off to the nearest 0.5 MPa or 1 MPa in the same manner.

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

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)

- b) **Non-destructive test characteristics** Pipes shall be tested by either the ultrasonic examination or the eddy current examination, and their non-destructive test characteristics shall be as follows. However, other non-destructive tests specified in Japanese Industrial Standards (JISs) may replace these tests upon agreement between the purchaser and the manufacturer, in which case the judgement criteria shall be at least equal to those for the ultrasonic examination or the eddy current examination.
- 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 the cold-finished method, 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.

9 Dimensions, unit mass and dimensional tolerances

9.1 Outside diameter, wall thickness and unit mass

The outside diameter, wall thickness and unit mass of the pipe shall be in accordance with Table 7. However, 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 following formula 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 a 4-digit integer.

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

where, W : unit mass of pipe (kg/m)
 t : wall thickness of pipe (mm)
 D : outside diameter of pipe (mm)
 0.024 66 : unit conversion factor for obtaining W

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

9.2 Dimensional tolerances

The tolerances on the outside diameter, wall thickness and eccentricity of pipes shall be as given in Table 8. The length of pipes shall be not less than the specified length.

Table 7 Dimensions ^{a)} and unit mass of pipes

Nominal diameter		Outside diameter mm	Nominal wall thickness (Schedule number: Sch)																			
			10		20		30		40		60		80		100		120		140		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	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	—	—	6.4	33.1	7.0	36.1	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	—	—	6.4	41.2	7.8	49.9	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	—	—	6.4	49.3	8.4	64.2	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	6.4	55.1	7.9	67.7	9.5	81.1	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	6.4	63.1	7.9	77.6	9.5	93.0	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	6.4	71.1	7.9	87.5	11.1	122	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	6.4	79.2	9.5	117	12.7	155	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 this Table, shall be indicated by suffixing the letter A or B, whichever selected, to the numeral of the nominal diameter.																			

Table 8 Tolerances on outside diameter, wall thickness and eccentricity

Classification	Tolerance on outside diameter ^{a) b)}		Tolerances on wall thickness	Tolerance on eccentricity ^{c)}
	Outside diameter	Tolerance		
Hot-finished seamless steel pipe	Under 50 mm	± 0.5 mm	Wall thickness under 4 mm: ± 0.5 mm Wall thickness 4 mm or over: ± 12.5 %	20 % max. of wall thickness
	50 mm or over to and excl. 160 mm	± 1 %		
	160 mm or over to and excl. 200 mm	± 1.6 mm		
	200 mm or over	± 0.8 %		
Cold-finished seamless steel pipe	Under 40 mm	± 0.3 mm	Wall thickness under 2 mm: ± 0.2 mm	—
	40 mm or over	± 0.8 %	Wall thickness 2 mm or over: ± 10 %	

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

Note ^{b)} For pipes with an outside diameter of 350 mm or over, the tolerance on outside diameter may be based on 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

Note ^{c)} Eccentricity 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.

10 Appearance

Appearance shall be as follows.

- Pipes shall be straight, and the both ends shall be at right angles to the pipe axis for practical purposes.
- Both the internal and external surfaces of pipes shall be smoothly finished and free from defects detrimental to use.
- Pipes may be repaired by grinding, machining or other methods, provided that the wall thickness of the product after repair is within the specified tolerance on wall thickness. Repair by welding is not permitted.
- The surface of the repaired part shall be smooth along the contour of the pipe.

11 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.

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12 Tests

12.1 Chemical analysis

12.1.1 General requirements for chemical analysis 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.

12.1.2 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.

12.2 Mechanical test

12.2.1 General requirements for mechanical tests

General requirements for mechanical tests shall be in accordance with Clause 7 and Clause 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.

12.2.2 Sampling method and number of test pieces

For the tensile test and flattening test, take one sample from each group of 50 pipes or its fraction of the same dimensions and the same heat treatment batch. From each sample, take one tensile test piece and one flattening test piece. The “same dimensions” means same outside diameter and wall thickness. The “same heat treatment batch” of a continuous furnace means a unit of pipes from continuous furnace operation under consistent heat treating conditions, and pipes which are heat treated 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, “same heat treatment batch” may be replaced by “same heat treatment conditions”.

12.2.3 Tensile test

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

- a) **Test piece and sampling direction** The test piece shall be Test piece No. 11, No. 12A, No. 12B, No. 12C, No. 4 or No. 5 specified in **JIS Z 2241** and shall be taken from the pipe. Test piece No. 4 shall all be of diameter 14 mm (the gauge length 50 mm). The direction of sampling the test piece shall be as given in Table 4. The test piece to be used and the direction of sampling Test piece No. 4 shall be, unless otherwise specified, left to the discretion of the manufacturer.
- b) **Test method** The test method shall be in accordance with **JIS Z 2241**.

12.2.4 Flattening test

The flattening test piece and flattening 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 greater. For pipes of wall thickness 15 % or over of the outside diameter, C-shaped test piece prepared by removing a part of the circumference of a ring-shaped test piece may be used.
- b) **Test method** At 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 reaches not more than the value given by Formula (1) in 7.2. Then examine the test piece for cracks. Place the C-shaped test piece as shown in Figure 2.

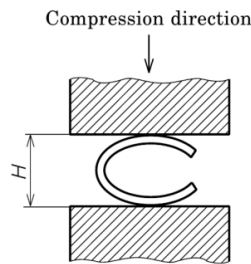


Figure 2 Flattening test (C-shaped test piece)

12.3 Hydraulic test or non-destructive test

The hydraulic test or non-destructive test shall be as follows.

- a) **Test frequency** Either the hydraulic test or non-destructive test shall be performed on each pipe.
- b) **Test method** The method of the hydraulic test or non-destructive test shall be as follows.
 - 1) **Hydraulic test** Hold the pipe under the pressure not less than the minimum hydraulic test pressure specified in 8 a) for at least 5 s, and examine if the pipe withstands the pressure without leakage.
 - 2) **Non-destructive test** The non-destructive test methods shall be as follows. Where other non-destructive 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 performed by a category of reference standard stricter than Category UD reference standard at the discretion of the manufacturer. The alarm level may be set lower (stricter) 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 performed by a category of reference standard stricter than Category EY reference standard at the discretion of the manufacturer. The alarm level may be set lower (stricter) than the signals from reference standard at the discretion of the manufacturer.

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13 Inspection and reinspection

13.1 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 6.
- c) The mechanical properties shall conform to the requirements specified in Clause 7.
- d) The hydraulic test characteristics or non-destructive test characteristics shall conform to the requirements specified in Clause 8.
- e) Dimensions shall conform to the requirements specified in Clause 9.
- f) The appearance shall conform to the requirements specified in Clause 10.
- 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 11.

13.2 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.

14 Marking

Each pipe having passed the inspection shall be marked with the following information. When the marking on each pipe is difficult due to its small diameter 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 for manufacturing method
 - The symbol for 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, expressed by nominal diameter × nominal wall thickness, or outside diameter × wall thickness.
 - Example 50A × Sch40 or 60.5 × 3.9
- d) Manufacturer's name or identifying brand
- e) Symbol Z indicating the supplementary quality requirement (if specified)

15 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.

When alloy elements not specified in Table 3 are intentionally added, or when Cr is added as given in Note ^{a)} to Table 3, the analysis value of the alloy element added shall be reported in the inspection document.

Annex JA (normative)

Supplementary quality requirements

JA.1 Yield point or proof stress in tensile test at elevated temperature (Z2)²⁾

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. From each sample, take one test piece for each test temperature.
- c) The test piece and the test method shall be in accordance with **JIS G 0567**.

When it is difficult to take a test piece in the shape specified in **JIS G 0567** from the pipe, the shape of the test piece shall be as agreed between the purchaser and the manufacturer.

Note ²⁾ In transactions of pipes, the requirements for yield point or proof stress in tensile test at elevated temperature may be marked as Z2.

JA.2 Ultrasonic examination (Z3)³⁾

The ultrasonic examination shall be as follows.

- a) For the standard detection sensitivity for the ultrasonic examination, the signals from the reference sample containing Category UB or UC 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. 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 ³⁾ In transactions of pipes, the requirements for ultrasonic examination may be marked as Z3.

JA.3 Eddy current examination (Z4)⁴⁾

The eddy current examination shall be as follows.

- a) For the standard detection sensitivity for the eddy current examination, the signals from the reference sample containing Category EU, EV, EW or EX 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. The applicable detection sensitivity category shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.

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

Note ⁴⁾ In transactions of pipes, the requirements for eddy current examination may be marked as Z4.

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Annex JB (informative)

Comparison table between JIS and corresponding International Standard

JIS G 3458		ISO 9329-2:1997, (MOD)		
a) No. of clause (JIS)	b) No. of clause (corresponding International Standard)	c) Classification by clause	d) Detail and justification of technical deviation	e) Future measures for the technical deviation
1	1	Deletion	Specify requirements for only alloy steels for piping at elevated temperature.	Requirements for unalloyed steel pipes are specified in other JISs. Difference in standard system.
2				
3	3	Alteration	Normative references are different.	JIS specification is maintained without change.
4	4.1	Deletion	Delete requirements for unalloyed steel pipes.	JIS classifies alloy steels into seven grades. Requirements for unalloyed steel pipes are specified in other JISs.
5	5.4	Deletion	Specify the types of heat treatment for alloy steels, while ISO specifies the types and conditions of heat treatment for unalloyed and alloyed steels.	JIS and ISO specify the same types of heat treatment for alloy steels. The heat treatment temperature ranges given in ISO are deleted in JIS in order to promote the quality improvement and advances in manufacturing technology.
6	6.1	Alteration	Delete the chemical composition requirements for unalloyed steel pipes, and change the elements of alloyed steels.	Due to the difference in the strength required between JIS and ISO, deviation in chemical composition, which determines steel strength, is necessary.
7.1	6.2.1	Alteration	Delete the requirements for bendability, expanding property and impact value.	The strength required is different between JIS and ISO. Requirements for bendability, expanding property and impact value are deleted as they are unnecessary for applications intended in JIS.
7.2	9.10.3	Alteration	ISO requires flattening test, bend test or ring tensile test at the discretion of the manufacturer.	By replacing the bend test and ring tensile test with the flattening test, conformance to ISO can still be ensured.
8	9.5	Alteration	Change hydraulic test pressure values.	Difference in standard systems between JIS and ISO. JIS specification is maintained without change.

a) No. of clause (JIS)	b) No. of clause (corresponding International Standard)	c) Classification by clause	d) Detail and justification of technical deviation	e) Future measures for the technical deviation
9.1	7.1	Alteration	Difference in dimensional systems.	Conventional dimensional system is maintained for the convenience of users.
9.2	7.3	Alteration	Add tolerances on eccentricity. Delete tolerances on straightness. Adopt stricter tolerances on outside diameter and wall thickness.	Conventional dimensional tolerances are maintained for the convenience of users.
	7.2	Alteration	No specific tolerance on pipe length.	
11	—	Addition	Add necessary item for JIS .	The added requirements are commonly practised in business transactions in Japan.
12.2	9.10.2	Alteration	Change the requirements for the shape of tensile test piece, and permit the omission of flattening test.	Sampling method in JIS can substitute for ISO method.
	9.4	Alteration		
	9.10.3.2	Alteration		
12.3	9.5 9.8	Alteration	As an alternative to hydraulic test, JIS specifies ultrasonic examination or eddy current examination, and ISO specifies electromagnetic test or ultrasonic test.	Each test method has advantages and disadvantages; there is no requirement for electromagnetic test for applications intended in JIS .
13.1	9.10	Deletion	Specify test methods and results in separate subclauses.	Difference in standard system between JIS and ISO .
13.2	9.12	Addition	Add a sampling method for retest upon agreement between the purchaser and the manufacturer.	JIS specification is maintained without change.
14	10	Alteration	Some of marking items differ between JIS and ISO .	Conventional making items are maintained for the convenience of users.
15	12	Alteration	Specify 2 types of inspection documents, while ISO specifies 4 types.	The type of inspection document suitable for JIS specification should be adopted; JIS specification is maintained without change.

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a) No. of clause (JIS)	b) No. of clause (corresponding International Standard)	c) Classification by clause	d) Detail and justification of technical deviation	e) Future measures for the technical deviation
Annex JA	6.2.2	Alteration	The requirements for properties at elevated temperature are to be applied upon request from the purchaser in JIS , while those are specification items in ISO .	The specification items in ISO are not essential requirements in view of applications intended in JIS .
	9.8	Alteration	Permit stricter conditions for ultrasonic examination or eddy current examination. ISO specifies requirements for electromagnetic test.	Each test method has its advantages and disadvantages; there is no requirement for electromagnetic test for applications intended in JIS .
	9.10.5.2	Alteration		
	6.2.1	Deletion	Delete specification of impact value.	Specification of impact value is unnecessary for applications intended in JIS .
NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows: — Deletion: Delete the specification item(s) or content(s) of International Standard(s). — Addition: Add the specification item(s) or content(s) which are not included in International Standard(s). — Alteration: Alter the specification content(s) or structure of International Standard(s). NOTE 2 Symbol of overall degree of correspondence between JIS and International Standard(s) in the above table indicates as follows: — MOD: Modify International Standard(s).				

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