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(JISF)

**Carbon steel pipes for high  
temperature service**

ICS 23.040.10; 77.140.75

Reference number : JIS G 3456 : 2004 (E)



## 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)/Japanese Standards Association (JSA) 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 3456 : 1988** is replaced with this Standard.

This revision has been made based on **ISO 9329-2 : 1997 Seamless steel tubes for pressure purposes—Technical delivery conditions—Part 2 : Unalloyed and alloyed steels with specified elevated temperature properties** and **ISO 9330-2 : 1997 Welded steel tubes for pressure purposes—Technical delivery conditions—Part 2 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties** for the purposes of making it easier to compare this Standard with International Standards; to prepare Japanese Industrial Standard conforming with International Standards; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

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, utility model right or application for registration of utility model after opening to the public which have technical properties. 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, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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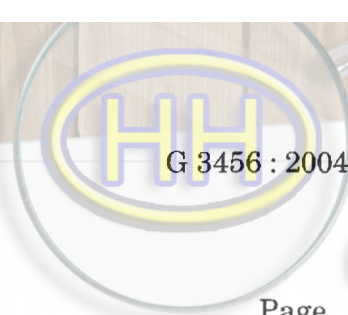
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In the event of any doubts arising as to the contents,  
the original JIS is to be the final authority.

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## Carbon steel pipes for high temperature service

**Introduction** This Japanese Industrial Standard has been prepared based on each first edition of **ISO 9329-2 : 1997** *Seamless steel tubes for pressure purposes—Technical delivery conditions—Part 2 : Unalloyed and alloyed steels with specified elevated temperature properties* and **ISO 9330-2 : 1997** *Welded steel tubes for pressure purposes—Technical delivery conditions—Part 2 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties* but alloyed steel pipes have been specified in other **JIS**, therefore, specifies carbon steel pipes only herein with modifying some technical contents.

Portions sidelined or underlined with dots are the matters modified from the original International Standards. The list of modification with its explanation is given in annex 2 (informative)

**1 Scope** This Standard specifies the carbon steel pipes (hereafter referred to as “pipes”) mainly used for piping at a temperature over 350 °C.

**Remarks 1** When previously agreed upon by the manufacturer, the purchaser may designate one or all of the supplementary quality requirements **1** Yield point or proof stress in elevated temperature test (Z2), **2** Ultrasonic examination, (Z3) or **3** Eddy current examination (Z4) specified in annex 1 (normative) in addition to the items specified in this text.

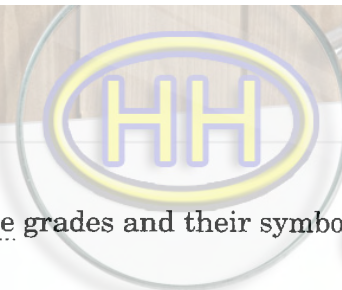
**2** The International Standard corresponding to this Standard is as follows.

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**.

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)

ISO 9330-2 : 1997 *Welded steel tubes for pressure purposes—Technical delivery conditions—Part 2 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties* (MOD)

**2 Normative references** The standards listed in attached table 1 contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) shall be applied.



**3 Grade and symbol** The pipe shall be classified into three grades and their symbols shall be as given in table 1.

**Table 1 Symbol of grade**

Symbol of grade
STPT 370
STPT 410
STPT 480

**4 Method of manufacture** The method of manufacture shall be as follows:

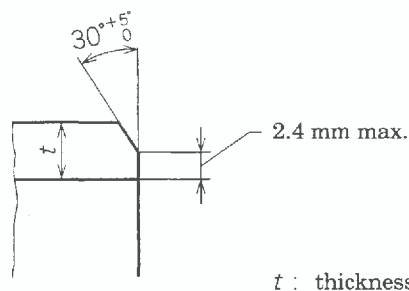
- The pipe shall be manufactured from coarse-grained killed steel by the seamless or electric resistance welding process. However, the pipe of grade STPT 480 shall be manufactured by the seamless process.
- The pipe shall be subjected to the heat treatment specified in table 2. The heat treatment other than specified in table 2 shall be agreed upon by the purchaser and the manufacturer.

**Table 2 Heat treatment**

Symbol of grade	Hot finished seamless steel pipe	Cold finished seamless steel pipe	Hot finished electric resistance welded steel pipe	Electric resistance welded steel pipe other than hot finished
STPT 370 STPT 410	As manufactured. However, low temperature annealing or normalizing may be applied, as necessary.	Low temperature annealed or normalized.	As manufactured. However, low temperature annealing or normalizing may be applied, as necessary.	Low temperature annealed or normalized.
STPT 480			—	—

- When required by the purchaser, the pipe may be furnished with the bevel end<sup>(1)</sup>.

Note <sup>(1)</sup> Unless otherwise specified, the shape of the bevel end shall be as shown in figure 1.



**Figure 1 Shape of bevel end**

**5 Chemical composition** The pipe shall be tested in accordance with 10.1 and the resulting ladle analysis values shall conform to table 3.

**Table 3 Chemical composition**

Unit: %

Symbol of grade	C	Si	Mn	P	S
STPT 370	0.25 max.	0.10 to 0.35	0.30 to 0.90	0.035 max.	0.035 max.
STPT 410	0.30 max.	0.10 to 0.35	0.30 to 1.00	0.035 max.	0.035 max.
STPT 480	0.33 max.	0.10 to 0.35	0.30 to 1.00	0.035 max.	0.035 max.

Remarks : When the product analysis is required by the purchaser, test 10.1, and the values shall be as table 3. However, the tolerances for the above-mentioned values shall conform to attached table 3 and table 2 specified in **JIS G 0321** for seamless steel pipes and electric resistance welded steel pipes, respectively.

## 6 Mechanical properties

**6.1 Tensile strength, yield point or proof stress and elongation** The pipe shall be tested in accordance with 10.2.2 and the resulting tensile strength, yield point or proof stress and elongation of the pipe shall comply with table 4. When the tensile test for pipes under 8 mm in wall thickness is carried out with No. 12 or No. 5 test piece, the minimum value of elongation shall be obtained by subtracting 1.5 % from the values of elongation given in table 4 for each 1 mm decrease in wall thickness, and rounding off the value to an integer in compliance with rule A **JIS Z 8401** and table 5.

**Table 4 Mechanical properties**

Symbol of grade	Tensile strength N/mm <sup>2</sup>	Yield point or proof stress N/mm <sup>2</sup>	Elongation %			
			No. 11 or No. 12 test piece	No. 5 test piece	No. 4 test piece	
					Lengthwise direction	Crosswise direction
STPT 370	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.
STPT 410	410 min.	245 min.	25 min.	20 min.	24 min.	19 min.
STPT 480	480 min.	275 min.	25 min.	20 min.	22 min.	17 min.

Remarks 1 The value of elongation given in table 4 shall not be applied to the pipe whose outside diameter is under 40 mm. However, the value of elongation shall be recorded.

2 When a tensile test piece is taken from the electric resistance welded steel pipe, No. 12 or No. 5 test piece shall be taken from the portion which does not involve welded seam.





**Table 5 Elongation applied to No. 12 (longitudinal) and No. 5 (transverse) test pieces for pipes under 8 mm in wall thickness**

Symbol of grade	Shape of test piece	Elongation for each division of wall thickness %						
		Over 7 mm to and excl. 8 mm	Over 6 mm up to and incl. 7 mm	Over 5 mm up to and incl. 6 mm	Over 4 mm up to and incl. 5 mm	Over 3 mm up to and incl. 4 mm	Over 2 mm up to and incl. 3 mm	Over 1 mm up to and incl. 2 mm
STPT 370	No. 12 test piece	30	28	27	26	24	22	21
	No. 5 test piece	25	24	22	20	19	18	16
STPT 410 STPT 480	No. 12 test piece	25	24	22	20	19	18	16
	No. 5 test piece	20	18	17	16	14	12	11

**6.2 Flattening property** The pipe shall be tested in accordance with 10.2.3 and the pipe shall be free from flaws or cracks on its wall surface. In this case, the distance between the flattening plates shall be calculated from the following formula.

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

where,  $H$  : distance between flattening plates (mm)

$t$  : wall thickness of pipe (mm)

$D$  : outside diameter of pipe (mm)

$e$  : constant which varies depending on the grade of pipe,

0.08 for STPT 370

0.07 for STPT 410 and STPT 480

**6.3 Bendability property** For the pipe whose outside diameter is 50 mm or under, the purchaser may specify the bending test in lieu of the flattening test. The pipe shall be tested in accordance with 10.2.4 and its wall surfaces shall be free from the occurrence of flaws or cracks. In this test the pipe is bent through 90° around an inside radius that is 6 times its outside diameter.

The purchaser may specify the bend test of which the bent angle is 180° and bending inside radius is 4 times the outside diameter the test pipe.

**7 Hydrostatic characteristic or nondestructive characteristic** The pipe shall be tested in accordance with 10.3 and the resulting hydrostatic characteristic or non-destructive characteristic shall conform to either of the following two. The preference shall be in accordance with the designation made by the purchaser or left to the discretion of the manufacturer.

- a) **Hydrostatic characteristic** When the hydrostatic pressure specified by the purchaser or, unless otherwise specified, the values given in attached table 2 is applied, the pipe shall withstand it without leakage. In this case, the purchaser may specify values of pressure lower or higher than those given in attached table 2.

When a hydrostatic pressure test is made in compliance with the designation of the purchaser and the test pressure exceeds either the value  $P$  calculated from the following formula or 20 MPa, the test pressure shall be agreed upon by the purchaser and the manufacturer. The designated hydrostatic test pressure shall be graduated in 0.5 MPa for under 10 MPa, and in 1 MPa for 10 MPa or over.

The value  $P$  in the following formula shall be obtained likewise by rounding off to the nearest 0.5 MPa or 1 MPa.

$$P = \frac{2st}{D}$$

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 specified in table 4 (N/mm<sup>2</sup>)

- b) **Nondestructive characteristic** Either an ultrasonic examination or an eddy current examination shall be made on the pipe, and there shall be no signal equal to or greater than those produced by the artificial defects of the reference test block which is the division UD of the working sensitivity specified in **JIS G 0582** or the division EY of the working sensitivity specified in **JIS G 0583**, respectively.

## 8 Dimensions, mass and dimensional tolerances

**8.1 Dimensions and mass** The outside diameter, wall thickness and mass of the pipe shall be as specified in attached table 3.

**8.2 Dimensional tolerances** The tolerances on outside diameter, wall thickness and deviation in wall thickness of the pipe shall be as specified table 6.

In the case where the pipe length is specified by the purchaser, the tolerances on the pipe length shall be on the plus side.



**Table 6 Tolerances on outside diameter, wall thickness and deviation in wall thickness**

Division	Tolerances on outside diameter	Tolerances on wall thickness	Tolerance on deviation in wall thickness
Hot finished seamless steel pipe	Under 50 mm: $\pm 0.5$ mm	Under 4 mm: $\pm 0.5$ mm 4 mm and over: $\pm 12.5$ %	Up to and incl. 20 % of wall thickness
	50 mm and over to and excl. 160 mm: $\pm 1$ %		
	16 mm and over to and excl. 200 mm: $\pm 1.6$ %		
	200 mm and over: $\pm 0.8$ % However, for pipes 350 mm and over in diameter, the length of circumference may substitute as a basis for the tolerance. In this case, the tolerances shall be $\pm 0.5$ %.		
Cold finished seamless steel pipe and electric resistance welded steel pipe	Under 40 mm: $\pm 0.3$ mm	Under 2 mm: $\pm 0.2$ mm 2 mm and over: $\pm 10$ %	—
	40 mm and over: $\pm 0.8$ % However, for pipes 350 mm and over in diameter, the length of circumference may substitute as a basis for tolerances. In this case, the tolerances shall be $\pm 0.5$ %.		

Remarks 1 The deviation in wall thickness means the ratio of the difference between the maximum and the minimum of the measured thickness of a wall in the same section to the specified wall thickness. This shall not be applied to pipes under 5.6 mm in wall thickness.

- 2 When the length of circumference is used as a basis for the tolerances, either the measured value of the length of circumference itself or the outside diameter derived from the measured value may be used as the criteria. In both cases, the same value  $\pm 0.5$  % shall be applied as the tolerances. The outside diameter ( $D$ ) and the length of circumference ( $l$ ) shall be calculated reversibly from the following formula.

$$l = \pi \times D$$

where,  $\pi = 3.1416$

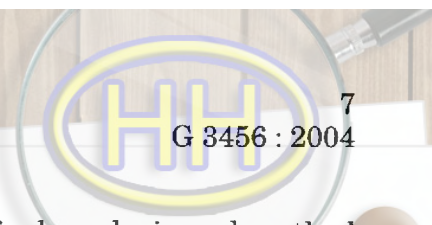
- 3 In the case where compliance with the tolerances on wall thickness in the above table is clearly confirmed in such a local portion as under repairs, the tolerances on the outside diameter in the above table shall not be applied.

## 9 Appearance The appearance shall be as follows:

- The pipe shall be practically straight, and its both ends shall be at right angles to the axes.
- The inside and outside surfaces of the pipe shall be well-finished, and free from defects detrimental to practical use.

## 10 Test

### 10.1 Chemical analysis



**10.1.1 Chemical analysis** General matters about chemical analysis and method of sampling specimens for analysis shall be in accordance with 7.6 and clause 8 in **JIS G 0404**. The number of specimens when the purchaser requested product analysis shall be subject the agreement between the purchaser and the manufacturer.

**10.1.2 Analytical method** The analytical method shall be in accordance with one of the following Standard.

**JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1253, JIS G 1256, JIS G 1257, JIS G 1258**

## **10.2 Mechanical test**

**10.2.1 Sampling method and number of specimens** Sampling method and number of specimens are as follows:

- a) Sampling method and number of specimens of tensile test, flattening test or bend test are as follows: Sample one specimen from each 50 pipes or its fraction with the same dimensions<sup>(2)</sup> of the pipes as manufactured, and from each 50 pipes or its fraction with the same dimensions<sup>(2)</sup> and the simultaneous heat treatment process of the pipes to be heat-treated process, and then, sample one tensile test piece from them. Further, sample one flattening test piece or one bend test piece from pipes with 50 mm or less in outside diameter, and sample one flattening test piece from pipes with over 50 mm in outside diameter.

Note <sup>(2)</sup> The same dimensions mean the same outside diameter and the same thickness.

- b) Hydrostatic test or nondestructive test shall be conducted for every pipe.

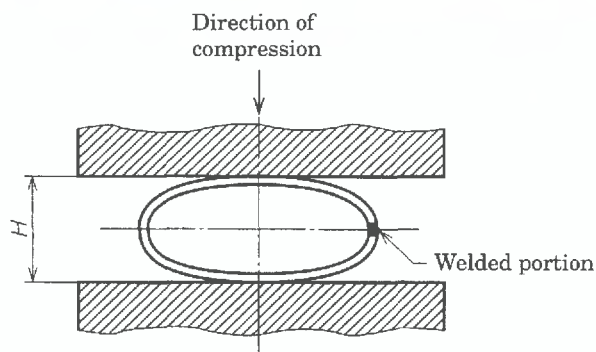
### **10.2.2 Tensile test**

- a) **Test piece** The test specimen shall be No. 11, No. 12 A, No. 12 B, No. 12 C, No. 4 or No. 5 test piece specified in **JIS Z 2201** and shall be cut off from the pipe. However, No. 4 test piece shall be 14 mm in diameter (gauge length: 50 mm).
- b) **Test method** The test method shall be in accordance with **JIS Z 2241**.

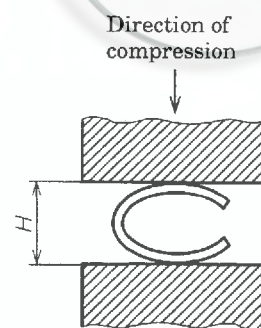
### **10.2.3 Flattening test**

- a) **Test piece** A test piece 50 mm or over in length shall be cut off from the end of a pipe. For the pipe whose wall thickness is 15 % or over of the outside diameter, a C-shape test piece made by removing part of the circumference of a whole test piece may be used.
- b) **Test method** The test piece shall be placed between two flat plates at ordinary temperature and flattened by compression until the distance between the plates comes to the specified value, and checked for the occurrence of flaws or cracks on its wall surface. An electric resistance welded steel pipe shall be placed with the welded portion at right angles to the direction of compression as shown in figure 2, and a C-shape test piece shall be placed as shown in figure 3.





**Figure 2** Flattening test (for whole test piece)



**Figure 3** Flattening test (for C-shape test piece)

#### 10.2.4 Bending test

- Test piece** An appropriate length shall be cut off from the end of a pipe to be made into a test piece.
- Test method** The test piece shall be bent through the angle around a cylinder with an inside radius specified in **6.3** at ordinary temperature, and checked for the occurrence of flaws or cracks on its wall surface. In the case of an electric resistance welded steel pipe, the welded portion shall be placed in the outermost part of the bent portion.

**10.3 Hydrostatic test or nondestructive examination** Either the hydrostatic test or the nondestructive examination shall be made in accordance with any one of the following.

- Carry out either hydrostatic test or nondestructive examination.
- For hydrostatic test, when the pipe is subjected to hydrostatic pressure and kept under the specified pressure, it shall withstand the pressure without leakage.
- The test method of nondestructive examination shall be in accordance with either **JIS G 0582** or **JIS G 0583**.

### 11 Inspection

**11.1 Inspection** The inspection shall be as follows:

- General matters of inspection shall be as specified in **JIS G 0404**.
- Chemical composition shall conform to clause **5**.
- Mechanical property shall conform to clause **6**.
- Hydrostatic or nondestructive characteristic shall conform to clause **7**. In addition, the nondestructive examination may be replaced by appropriate nondestructive examination other than those specified in **10.3 c)** with agreed upon by the purchaser and the manufacturer.
- Dimensions shall conform to clause **8**.
- Appearance shall conform to clause **9**.



- g) When the supplementary quality requirements given in annex 1 are specified by agreement by the purchaser and the manufacturer, the results of inspection shall conform to clauses 1, 2 and 3 of annex 1.

**11.2 Reinspection** Pipes rejected in mechanical test may be retested in accordance with 9.8 of JIS G 0404 for final acceptance.

**12 Marking** Each pipe having passed the inspection shall be marked with the following items. However, in the case of smaller pipes or on a request from the purchaser, pipes may be bundled together and marked for each bundle by suitable means. In either case, the order of arranging the items is not specified. When approved by the purchaser, part of the items may be omitted.

- a) Symbol of grade
- b) Symbol indicating the manufacturing process<sup>(3)</sup>
- c) Dimensions<sup>(4)</sup>
- d) Manufacturer's name or abbreviation
- e) Symbol indicating the supplementary quality requirement, Z

Notes <sup>(3)</sup> The symbol indicating the manufacturing process shall be as follows, provided that the dash may be replaced by a blank.

Hot finished seamless steel pipe: -S-H

Cold finished seamless steel pipe: -S-C

Electric resistance welded steel pipe neither hot finished nor cold finished: -E-G

Hot finished electric resistance welded steel pipe: -E-H

Cold finished electric resistance welded steel pipe: -E-C

- <sup>(4)</sup> The dimensions shall be expressed as follows:

Nominal diameter × nominal wall thickness or outside diameter × wall thickness

Example : 50A × Sch40

**13 Report** The manufacturer shall, as a rule, according to clause 13 of JIS G 0404. However, when the purchaser does not designate at the ordering, inspection document is symbol 2.3 or 3.1.B in table 1 of JIS G 0415.

**Attached Table 1 Normative references**

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>Ultrasonic examination for steel pipes and tubes</i>
JIS G 0583	<i>Eddy current examination of steel pipes and tubes</i>
JIS G 1211	<i>Iron and steel—Methods for determination of carbon content</i>
JIS G 1212	<i>Iron and steel—Methods for determination of silicon content</i>
JIS G 1213	<i>Iron and steel—Methods for determination of manganese content</i>
JIS G 1214	<i>Iron and steel—Methods for determination of phosphorus content</i>
JIS G 1215	<i>Iron and steel—Methods for determination of sulfur content</i>
JIS G 1253	<i>Iron and steel—Method for spark discharge atomic emission spectrometric analysis</i>
JIS G 1256	<i>Iron and steel—Method for X-ray fluorescence spectrometric analysis</i>
JIS G 1257	<i>Iron and steel—Methods for atomic absorption spectrometric analysis</i>
JIS G 1258	<i>Iron and steel—Methods for inductively coupled plasma atomic emission spectrometry</i>
JIS Z 2201	<i>Test pieces for tensile test for metallic materials</i>
JIS Z 2241	<i>Method of tensile test for metallic materials</i>
JIS Z 8401	<i>Guide to the rounding of numbers</i>

**Attached Table 2 Hydrostatic test pressure**

Unit: MPa

Schedule number Sch	10	20	30	40	60	80	100	120	140	160
Hydrostatic test pressure	2.0	3.5	5.0	6.0	9.0	12	15	18	20	20

Remarks : For the pipe whose dimension is not given in attached table 3, the hydrostatic test pressure shall be as specified in the following table depending on the division of the ratio ( $t/D$ ) of the wall thickness to the outside diameter of the pipe.

Unit: MPa

$t/D$ (%)	Over 0.80 up to and incl. 1.60	Over 1.60 up to and incl. 2.40	Over 2.40 up to and incl. 3.20	Over 3.20 up to and incl. 4.00	Over 4.00 up to and incl. 4.80	Over 4.80 up to and incl. 5.60	Over 5.60 up to and incl. 6.30	Over 6.30 up to and incl. 7.10	Over 7.10 up to and incl. 7.90	Over 7.90
Hydrostatic test pressure	2.0	4.0	6.0	8.0	10	12	14	16	18	20

### Attached Table 3 Dimensions and mass of carbon steel pipes for high temperature service

Nominal diam.		Out-side diam. (mm)	Nominal wall thickness																							
			Schedule 10		Schedule 20		Schedule 30		Schedule 40		Schedule 60		Schedule 80		Schedule 100		Schedule 120		Schedule 140		Schedule 160					
			Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m				
A	B		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
6	1/8	10.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
8	1/4	13.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
10	3/8	17.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
15	1/2	21.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
20	3/4	27.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
25	1	34.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
32	1 1/4	42.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
40	1 1/2	48.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
50	2	60.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
65	2 1/2	76.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
80	3	89.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
90	3 1/2	101.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
100	4	114.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
125	5	139.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
150	6	165.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
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	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	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	234				
350	14	355.6	6.4	55.1	6.4	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	282				
400	16	406.4	6.4	63.1	7.9	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	365				
450	18	457.2	6.4	71.1	7.9	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	459				
500	20	508.0	6.4	79.2	9.5	117	12.7	155	155	15.1	184	20.6	248	26.2	311	32.5	381	38.1	441	44.4	508	565				
550	22	558.8	—	—	—	—	—	—	—	15.9	213	22.2	294	28.6	374	34.9	451	41.3	527	47.6	600	672				
600	24	609.6	—	—	—	—	—	—	—	17.5	256	24.6	355	31.0	442	38.9	547	46.0	639	52.4	720	807				
650	26	660.4	—	—	—	—	—	—	—	18.9	299	26.4	413	34.0	525	41.6	635	49.1	740	56.6	843	944				

**Remarks 1** The designation of the pipe shall be based on the nominal diameter and the nominal wall thickness (schedule number: Sch.). However, for the nominal diameter, either A or B shall be used, and the letter A or B shall be suffixed to the figures of nominal diameter for identification.



**Attached Table 3** (concluded)

- 2 Calculate the value of mass from the following formula assuming 1 cm<sup>3</sup> of steel to be 7.85 g and round off the value to 3 significant figures in accordance with **JIS Z 8401**. However, the value over 1 000 kg/m shall be rounded off to an integer of kg/m.

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

where,

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

$t$ : wall thickness of pipe (mm)

$D$ : outside diameter of pipe (mm)

- 3 When dimensions other than those given in the above table are necessary, agreement shall be made by the purchaser and the manufacturer.



**Annex 1 (normative)**  
**Supplementary quality requirements**

The supplementary quality requirements shall apply only when requested by the purchaser, and shall be executed by the manufacturer on the designated items.

**1 Yield point or proof stress in elevated temperature test (Z2)** The yield point or proof stress in elevated temperature test is the following:

- a) The value of yield point or proof stress at elevated temperature test and the testing temperature of the pipe shall be agreed upon by the purchaser and the manufacturer.
- b) The test piece and the test method shall be as specified in **JIS G 0567**.

When it is practically difficult to take the test piece specified in **JIS G 0567**, the shape of the test piece shall be agreed upon by the purchaser and the manufacturer.

- c) The method of sampling the test specimens and the number of test pieces shall be as follows. Take one test specimen for each lot of the same heat charge, and then from one test specimen take one test piece for each lot of the same testing temperature.

**2 Ultrasonic examination (Z3)** The ultrasonic examination is the following:

- a) The criteria of the working sensitivity in the ultrasonic examination shall be the division UB or UC specified in **JIS G 0582**, and there shall be no signal equal to or greater than those produced by the artificial defects of the reference test block.
- b) The test method of the ultrasonic examination shall be as specified in **JIS G 0582**.
- c) The ultrasonic examination shall be performed for each pipe and the results shall conform to the requirements specified in a).

**3 Eddy current examination (Z4)** The eddy current examination is the following.

- a) The criteria of the working sensitivity in the eddy current examination shall be the division EU, EV, EW, or EX specified in **JIS G 0583**, and there shall be no signal equal to or greater than those produced by the artificial defects of the reference test block.
- b) The test method of the eddy current examination shall be as specified in **JIS G 0583**.
- c) The eddy current examination shall be performed for each pipe and the results shall conform to the requirements specified in a).



## Annex 2 (informative)

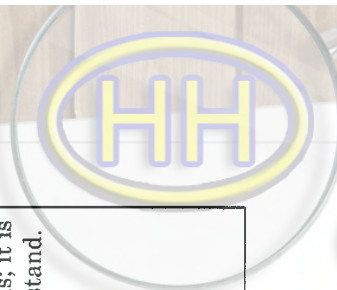
## Comparison table between JIS and corresponding International Standards

JIS G 3456 : 2004 <i>Carbon steel pipes for high temperature service</i>		ISO 9329-2 : 1997 <i>Seamless steel tubes for pressure purposes—Technical delivery conditions—Part 2: Unalloyed and alloyed steels with specified elevated temperature properties</i>		ISO 9330-2 : 1997 <i>Welded steel tubes for pressure purposes—Technical delivery conditions—Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties</i>			
(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 Location of deviation: text, annex Indication method: dotted underlines or continuous sidelines		(V) Justification for the technical deviation and future measures	
	Clause	Content	Clause	Content	Detail of technical deviation		
1 Scope	Specifies carbon steel pipes for piping at over 350 °C.	ISO 9329-2 ISO 9330-2	1	Specifies carbon steel tubes and alloy steel tubes used under elevated temperature and pressure condition.	MOD/ alteration  JIS does not specify by pressure; only specifies by carbon steel.	In JIS, alloy steel pipes have been specified in another JIS; the standard system is different, so it is left as matter now stand. For other differentia, will investigate proposal to ISO when ISO Standard is revised.	
2 Normative references	JIS G 0404, JIS G 0415, JIS G 0567, JIS G 0582, JIS Z 2201, JIS Z 2241 JISs listed in attached table 1 other than above JISs.	ISO 9329-2 ISO 9330-2	2	ISO 404, ISO 10474, ISO 783, ISO 9303, ISO 6892 —	IDT  MOD/ addition	Added JISs are necessary for analysis, and deleted ISO Standards do not refer; all JISs have remained.	





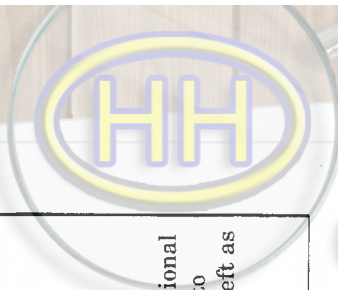
(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: text, annex Indication method: dotted underlines or continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
2 Normative references (concluded)				ISO 377, ISO/R 831, ISO 1129, ISO 2566-1, ISO 3205, ISO 4200, ISO 4948-1, ISO/R 4949, ISO 5252, ISO 5730, ISO 6761, ISO 7438, ISO 8492, ISO 8493, ISO 8495, ISO 8496, ISO 9302, ISO 9305, ISO/TR 9769, ISO 10332	MOD/ deletion	Delete ISO Standards not referred to JIS.	
3 Grade and symbol	Specifies 3 grades.	ISO 9329-2 ISO 9330-2	4.1	Specifies carbon steel and alloy steel; grades are different by individual standards. ISO 9329-2: carbon steel 4 grades, alloy steel 14 grades ISO 9330-2: carbon steel 4 grades, alloy steel 3 grades	MOD/ deletion	JIS does not specify the strongest grade among ISO carbon steels, and JIS specifies only carbon steels.	JIS avoid the need to the strongest carbon steel of ISO. Alloy steels have been specified in another JIS so the Standard is going to be left as matter now stand.



(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
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
4 Method of manufacture a)	By seamless or electric resistance welding.	ISO 9329-2 ISO 9330-2	5.3	Pipe-manufacturing process ISO 9329-2: seamless ISO 9330-2: electric resistance welding or induction welding	MOD/ addition	JIS specifies both seamless and welding, while ISO specifies separately in individual standards.	JIS is standard by use, ISO is by manufacture method; different in standard system. Modification of standard system will give to rise confusion in the market, therefore, it is left as matter now stand.
	Specifies heat treatment.	ISO 9329-2 ISO 9330-2	5.4	Delivery conditions: specifies heat treatment.	MOD/ deletion	JIS specifies heat treatment method of carbon steel, while ISO specifies heat treatment conditions. JIS does not specifies heat treatment for alloy steel.	For heat treatment method, the same in both, but composition system is different, therefore, it cannot be the same heat treatment conditions; it is left as matter now stand.
	Specifies bevel and finishing by request.	ISO 9329-2 ISO 9330-2	8.2	Preparation of ends: can be delivered with bevelled ends by agreement between the purchaser and manufacturer at the ordering.	IDT	—	

(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
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
5 Chemical composition	Specifies 3 grades.	ISO 9329-2 ISO 9330-2	6.1	ISO 9329-2 specifies 4 carbon steel grades and 14 alloy steel grades. ISO 9330-2 specifies 4 carbon steel grades and 3 alloy steel grades.	MOD/alteration	JIS does not specify the strongest carbon steel of ISO, neither alloy steel.	In JIS and ISO, the required strength is different, therefore, chemical composition cannot be the same; it is left as matter now stand.
6.1 Tensile strength, yield point or proof stress and elongation	Specifies tensile strength, proof stress and elongation at ordinary temperature.	ISO 9329-2 ISO 9330-2	6.2.1	At room temperature: tensile strength, proof stress, elongation, flattening property, bendability expanding property and impact value.	MOD/deletion	JIS does not specify impact value and expanding property.	JIS does not need impact value and expanding property, it is left as matter now stand.
6.2 Flattening property	Specifies flattening property.		9.10.3	Specifies testing any one of flattening property, bendability or ring expanding property.	MOD/deletion	JIS permits bendability test in stead of flattening property test for 50 mm or less in outside diameter. In ISO, any one of testings of flattening property, bendability or ring expanding property shall be carried out according to selection of the manufacturer.	JIS corresponds to ISO so that flattening test is substituted for bend test and ring expanding test; it is left as matter now stand.
6.3 Bendability	Specifies bendability.	ISO 9329-2 ISO 9330-2	9.10.4	Specifies either expanding test or ring expanding test.	MOD/deletion	JIS does not specify expanding test and ring expanding test.	JIS does not need expanding test nor ring expanding test in use; it is left as matter now stand.





(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
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation			
7 Hydrostatic characteristic or nondestructive characteristic	Applies either hydrostatic or nondestructive examination.	ISO 9329-2 ISO 9330-2	9.5	Leak-thickness test: applies either hydrostatic leak-thickness test or nondestructive test.	IDT	—		
8.1 Dimensions and mass	Specifies dimensions and mass of pipes.	ISO 9329-2 ISO 9330-2	7.1	Outside diameter, wall thickness and mass: specifies to select from those in ISO 4200 and ISO 1129.	MOD/alteration	Dimension system is different.	Alteration of dimension system will give to rise confusion in the market; it is left as matter now stand.	
8.2 Dimensional tolerances	Specifies tolerance on outside diameter, wall thickness and deviation in wall thickness.	ISO 9329-2 ISO 9330-2	7.3	Tolerances: specifies tolerances of outside diameter, wall thickness, length and straightness.	MOD/alteration	JIS adds tolerances on deviation in wall thickness of seamless pipes. In tolerances on outside diameter and wall thickness, there are cases where JIS is severer or ISO is severer by according to dimensions.	Alteration of dimensional tolerances will give to rise confusion in the market; it is left as matter now stand.	
	When the length of pipes is designated, the length is to be the length designated or longer.	ISO 9329-2 ISO 9330-2	7.2	Lengths: specifies random lengths or exact lengths.	MOD/alteration	JIS does not specify concrete tolerances.	Alteration of dimensional tolerances will give to rise confusion; it is left as matter now stand.	



(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
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
9 Appearance	a) Specifies that the pipe shall be practically straight, and its both ends shall be at right angles to the axes. b) Specifies that the inside and outside surfaces of the pipe shall be well-finished, and free from defects detrimental to practical use.	ISO 9329-2 ISO 9330-2	8.2	Specifies to be square-cut ends or bevelled ends.	IDT	---	
			8.1	Appearance and soundness: specifies finishing of internal and external surfaces and repair of defects.	IDT	---	
10.1 Chemical analysis	Specifies general matters and sampling method of chemical analysis.	ISO 9329-2 ISO 9330-2	9.3	Chemical testing: specifies general matters and sampling method of chemical testing.	IDT		
10.2.1 Sampling method and number of specimens	Specifies sampling of specimen and number of test pieces.		9.4	Testing of mechanical characteristics: specifies sampling method and shape of test pieces.	MOD/alteration	JIS samples 50 pieces unit while ISO 100. Shapes between JIS and ISO are different.	JIS may correspond to ISO in test piece sampling; it is left as it is. Alteration of shape of test pieces affects greatly, and will give to rise confusion in the market, therefore, it is left as matter now stand.

(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
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
10.2.2 Tensile test	Specifies test piece and test method of tensile test.	ISO 9329-2 ISO 9330-2	9.10.2	Tensile test: specifies test method.	IDT	—	JIS may correspond to ISO in test piece sampling; it is left as matter now stand.
10.2.3 Flattening test	Specifies test pieces and method of flattening test.		9.4	Specifies sampling method and shape of test pieces.	MOD/alteration	JIS samples 50 pieces unit while ISO 100.	
10.2.4 Bending test	Specifies test pieces and method of bend test.		9.10.3.2	Flattening test: specifies flattening test method.	IDT	—	
10.3 Hydrostatic test or nondestructive examination	Specifies hydrostatic test or nondestructive examination.		9.10.3.3	Bend test: specifies bend test.	MOD/alteration	ISO manufactures test pieces by cutting and processing the tube, while JIS makes pipe as it is.	
11.1 Inspection	Specifies the results of inspection.	ISO 9329-2 ISO 9330-2	9.5	Leak-thickness test: specifies hydraulic leak-thickness test or nondestructive test.	IDT	—	In JIS, bend test can be replaced with flattening test; it is left as matter now stand.
11.2 Reinspection	Specifies reinspection method.		9.10	Test methods and results: specifies test methods and results as the same time.	MOD/deletion	JIS specifies test methods and results separately.	
			9.12	Retests: specifies retest methods.	IDT	—	Standard systems are different, it is left as matter now stand.



(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
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
12 Marking	Specifies marking items.	ISO 9329-2 ISO 9330-2	10	Marking: specifies marking items.	MOD/alteration	JIS adds markings of symbol and dimensions of manufacturing method, and symbol designating "Supplementary quality requirements". Number of marking items in ISO is greater than those in JIS.	Alteration of marking items will give to rise confusion in the market.
13 Report	Specifies report.	ISO 9329-2 ISO 9330-2	12	Report: specifies report.	MOD/alteration	Inspection document types are 2 in JIS, and ISO 4.	In JIS, inspection documents are adequate for specified items; it is left as matter now stand.
Annex 1 Supplementary quality requirements	• Yield point or proof stress in elevated temperature test  • Ultrasonic examination  • Eddy current examination	ISO 9329-2 ISO 9330-2	6.2.2	At elevated temperature	MOD/alteration	Applies when requested by the purchaser in JIS, and ISO specifies as provisions.	JIS does not need as specified item in use; it is left as matter now stand.
			9.8	Nondestructive test	MOD/alteration	ditto	ditto
			9.10.5.2	Nondestructive test	MOD/alteration	JIS specifies eddy current examination substitute for hydrostatic test and ISO specifies electromagnetic test.	These test methods have both strong and weak points, and, in JIS, the electromagnetic tests are not requested in use, therefore, it is left as matter now stand.

Designated degree of correspondence between **JIS** and International Standards: MOD

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

- IDT: Identical in technical contents.
- MOD/deletion: Deletes specification item(s) or content(s) of International Standards.
- MOD/addition: Adds specification item(s) or content(s) not included in International Standards.
- MOD/alteration: Alters the specification content(s) included in International Standards.

2 Symbol in column of designated degree of correspondence between **JIS** and International Standards in the above table indicates as follows:

- MOD: Modifies International Standards.



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