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**Steel pipes for low temperature service**

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## Foreword

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

Consequently **JIS G 3460:1988** is replaced with this Standard.

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## Steel pipes for low temperature service

**Introduction** This Japanese Industrial Standard has been prepared based on the first editions of **ISO 9329-3** and **ISO 9330-3** published in 1997 with some modifications of the technical contents.

The portions given sidelines are the matters in which the contents of the corresponding International Standards have been modified. A list of modifications with the explanations is given in Annex JB.

**1 Scope** This Standard specifies the steel pipes (hereafter referred to as “pipes”) used for piping at exceptionally low temperatures of freezing point or under.

In addition to the items specified in this text, the supplementary quality requirements which the purchaser can designate with the manufacturer by previous agreement shall be specified in Annex JA.

**NOTE 1** Austenitic stainless steel pipes specified in **JIS G 3459** and **JIS G 3468** can be used for steel pipes for low temperature service.

**NOTE 2** The International Standards corresponding to this Standard and the symbol which denotes the degree of correspondence are as follows:

ISO 9329-3 : 1997 *Seamless steel tubes for pressure purposes— Technical delivery conditions—Part 3 : Unalloyed and alloyed steels with specified low temperature properties*

ISO 9330-3 : 1997 *Welded steel tubes for pressure purposes— Technical delivery conditions—Part 3 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties* (degree of correspondence, total : MOD)

The symbol (MOD), as defined in **ISO/IEC Guide 21**, indicates that the original International Standards have been modified.

**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 methods 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 0582 *Ultrasonic examination for steel pipes and tubes*

JIS G 0583 *Eddy current examination of steel pipes and tubes by encircling coil technique*

JIS Z 2201 *Test pieces for tensile test for metallic materials*

JIS Z 2241 *Method of tensile test for metallic materials*

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

JIS Z 8401 *Guide to the rounding of numbers*

**3 Classifications and symbols** Pipes shall be classified into three classes, and their classes, class symbols and symbols indicating manufacturing methods shall be in accordance with table 1.

**Table 1 Classes, class symbols and symbols indicating manufacturing methods**

Class	Class symbol	Symbol indicating manufacturing method		
		Pipe manufacturing method	Finishing method	Marking
Carbon steel pipe	STPL 380	Seamless : S Electric resistance welded : E	Hot finish : H Cold finish : C Electric resistance welded as it is : G	Marking of the symbol indicating the manufacturing method shall be in accordance with 12 b).
Nickel steel pipe	STPL 450 STPL 690	Seamless : S		

**4 Manufacturing methods** The manufacturing methods shall be as follows.

- Pipes shall be manufactured from fine-grained killed steel by seamless or electric resistance welded for STPL 380 and by seamless for STPL 450 and STPL 690.
- Pipes shall be subjected to the heat treatment specified in table 2. Pipes to be cold finished shall be subjected to the heat treatment specified in table 2 after the cold finishing. The heat treatment other than those specified in table 2 shall be upon the agreement between the purchaser and the manufacturer.

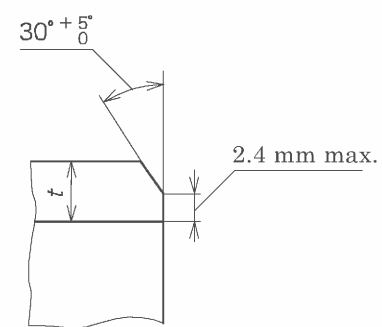
**Table 2 Heat treatment**

Class symbols	Heat treatment
STPL 380	Normalizing, normalizing followed by tempering or quenching followed by tempering
STPL 450	
STPL 690	Normalizing twice followed by tempering or quenching followed by tempering

- Upon request by the purchaser, pipes may be furnished with the bevel end. The shape of the bevel end shall be upon the agreement between the purchaser and the manufacturer. Pipes not more than 22 mm in wall thickness, unless otherwise



specified, shall be as shown in figure 1.



$t$  : wall thickness, 22 mm max.

Figure 1 Shape of bevel end

5 Chemical composition

5.1 Heat analysis Pipes shall be tested in accordance with 10.1 and the heat analysis values shall be in accordance with table 3.

5.2 Product analysis When the product analysis is requested by the purchaser, the tolerance values of the product analysis for table 3 shall be in accordance with table 3 of JIS G 0321 for the seamless steel pipes of STPL 380, table 2 of JIS G 0321 for the electric resistance welded steel pipes, and table 4 of JIS G 0321 for STPL 450 and STPL 690 pipes.

Table 3 Chemical composition

Unit : %						
Class symbols	C	Si	Mn	P	S	Ni
STPL 380 <sup>a)</sup>	0.25 max.	0.35 max.	1.35 max.	0.035 max.	0.035 max.	—
STPL 450	0.18 max.	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.030 max.	3.20 to 3.80
STPL 690	0.13 max.	0.10 to 0.35	0.90 max.	0.030 max.	0.030 max.	8.50 to 9.50

Note <sup>a)</sup> In the case where the impact test is not applied by reason of 6.4 c), STPL 380 pipes shall contain acid soluble aluminium of 0.010 % or more, or alternatively total aluminium of 0.015 % or more, by way of compensation.

6 Mechanical properties

6.1 Tensile strength, yield point or proof stress and elongation Pipes shall be tested in accordance with 10.2.2 and the tensile strength, yield point or proof stress and elongation of pipes obtained shall be in accordance with table 4. When the tensile test is carried out for No. 12 or No. 5 test piece for pipes under 8 mm in wall thickness, the minimum value of elongation shall be in accordance with table 5.

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

Class symbols	Tensile strength N/mm <sup>2</sup>	Yield points or proof stress  N/mm <sup>2</sup>	Elongation <sup>a)</sup> %			
			Test piece for tensile			
			No.11 and No. 12 test pieces	No. 5 test piece	No. 4 test piece	
			Tensile test direction			
			Longitudinal	Transverse	Longitudinal	Transverse
STPL 380	380 min.	205 min.	35 min.	25 min.	30 min.	22 min.
STPL 450	450 min.	245 min.	30 min.	20 min.	24 min.	16 min.
STPL 690	690 min.	520 min.	21 min.	15 min.	16 min.	10 min.

NOTE : 1 N/mm<sup>2</sup> = 1 MPa

Note <sup>a)</sup> The value of elongation given in table 4 shall not be applied to pipes whose outside diameter is under 40 mm, however, the test results shall be recorded. The value of elongation may be ordered upon the agreement by the purchaser and the manufacturer.

**Table 5 Minimum value of elongation for No. 12 test piece (longitudinal) and No. 5 test piece (transverse) for pipes under 8 mm in wall thickness**

Unit : %

Class symbols	Shape of test piece	Division of 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
STPL 380	No. 12 test piece	26	28	29	30	32	34	35
	No. 5 test piece	16	18	19	20	22	24	25
STPL 450	No. 12 test piece	21	22	24	26	27	28	30
	No. 5 test piece	11	12	14	16	17	18	20
STPL 690	No. 12 test piece	12	14	15	16	18	20	21
	No. 5 test piece	6	8	9	10	12	14	15

NOTE : The values in table 5 are obtained by subtracting 1.5 from the values of elongation given in table 4 for each 1 mm decrease from 8 mm in wall thickness, and rounding off to the whole number in accordance with rule A of JIS Z 8401.

**6.2 Flattening** Pipes shall be tested in accordance with 10.2.3 and the test piece shall not generate flaws or cracks. In this case, the distance between the two plates shall be in accordance with the formula (1). For the seamless steel pipes, unless otherwise specified by the purchaser, flattening test may be omitted. For the electric resistance welded steel pipes or the forge welded steel pipes, flattening test may be omitted upon the agreement between the purchaser and the manufacturer.

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

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

$t$  : wall thickness of pipe (mm)

$D$  : outside diameter of pipe (mm)

$e$  : constant, 0.08

**6.3 Bending** For pipes whose outside diameter is not more than 50 mm, the purchaser may specify the bending test instead of the flattening test. In the test of 10.2.4, pipes shall be free from the occurrence of flaws or cracks on its wall surface. In this case, pipes shall be bent through 90° around an inside radius that is 6 times its outside diameter.

**6.4 Absorbed energy** The absorbed energy shall be as follows.

- a) Pipes shall be tested in accordance with 10.2.5 and the absorbed energy of pipes in the Charpy impact test shall be in accordance with table 6. In this case, the testing temperature for STPL 380 pipes shall be  $-45\text{ }^{\circ}\text{C}$ , for STPL 450 pipes shall be  $-100\text{ }^{\circ}\text{C}$ , and for STPL 690 pipes shall be  $-196\text{ }^{\circ}\text{C}$ . In the case where the test is performed at lower temperature than these temperatures, the test may be substituted by the test of this temperature upon the agreement between the purchaser and the manufacturer.
- b) Electric resistance welded steel pipes shall be subjected to the Charpy impact test for the welded parts in addition to the Charpy impact test specified in a). The absorbed energy obtained shall be in accordance with table 6. In this case, the test temperature shall be  $-45\text{ }^{\circ}\text{C}$ . In the case where the test is performed at lower temperature than these temperatures, the test may be substituted by the test of this temperature upon the agreement between the purchaser and the manufacturer.
- c) The Charpy impact test shall not be applied on pipes not affording to provide a test piece  $10\text{ mm} \times 5\text{ mm}$ .

**Table 6 Absorbed energy in Charpy impact test**

Dimensions of test piece mm	Absorbed energy in Charpy impact test J	
	Average value of 3 pieces	Value of each test piece <sup>a)</sup>
10 × 10	21 min.	14 min.
10 × 7.5	18 min.	12 min.
10 × 5	14 min.	10 min.

Note <sup>a)</sup> Two of three values shall be equal to or higher than the average value of three test pieces in table 6.

**7 Hydraulic test characteristics or nondestructive examination characteristics** Pipes shall be tested in accordance with 10.3 and the hydraulic test characteristics or nondestructive examination characteristics shall be as follows. Preference shall be left to the designation by the purchaser, or to the discretion of the manufacturer unless otherwise designated.

- a) **Hydraulic characteristics** When the hydraulic pressure is not designated by the purchaser, the hydraulic test shall be performed at the pressure given in table 7 or table 8 (called “specified pressure”). When the hydraulic pressure is designated by the purchaser, the test shall be performed according to the designated pressure. When the designated pressure exceeds either the pressure  $P$  calculated by the fol-



lowing formula, or 20 MPa, the pressure of the hydraulic test shall be upon the agreement between the purchaser and the manufacturer.

When the test hydraulic pressure is applied, pipes shall withstand it without leakage.

The value of the hydraulic test pressure shall be rounded to the nearest 0.5 MPa for the pressure of under 10 MPa, to the nearest 1 MPa for the pressure of 10 MPa or over.

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

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/mm<sup>2</sup>)

**Table 7 Hydraulic test pressure (for pipes in dimensions of table 9)**

Unit : MPa

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

NOTE : The schedule number given in table 7 refers to the number divided by the ratio of wall thickness to outside diameter of the pipe ( $t/D$ ) and is used as an index of the proof-pressure performance of the steel pipe. In dealings of the steel pipe, when the size of steel pipe is designated, besides the marking of outside diameter (mm) × thickness (mm), the combination of outside diameter and schedule number may be used (The schedule number is used instead of the wall thickness of pipe.). The correspondence of the nominal wall thickness, outside diameter (nominal diameter), and schedule number of pipe are given in table 9.

**Table 8 Hydraulic test pressure (for pipes in dimensions of other than table 9)**

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
Hydraulic test pressure	2.0	4.0	6.0	8.0	10	12	14	16	18	20

- b) **Nondestructive examination characteristics** Pipes shall be examined by either of ultrasonic or eddy current examination, and there shall be no signal at least equal to that from the artificial defects of the reference test piece of working sensitivity division UD of JIS G 0582 or working sensitivity division EY of JIS G 0583. Other nondestructive examinations in place of the ultrasonic or eddy current examination



may be applied upon the agreement between the purchaser and the manufacturer.

## 8 Dimensions, mass and dimensional tolerances

**8.1 Outside diameter, wall thickness, and unit mass** The outside diameter, wall thickness and unit mass of pipes shall be in accordance with table 9.

**8.2 Dimensional tolerances** The tolerance on the outside diameter, wall thickness, and deviation in wall thickness of pipes shall be in accordance with table 10.

In addition, unless otherwise specified, the tolerances of the pipe length shall be on the plus side.



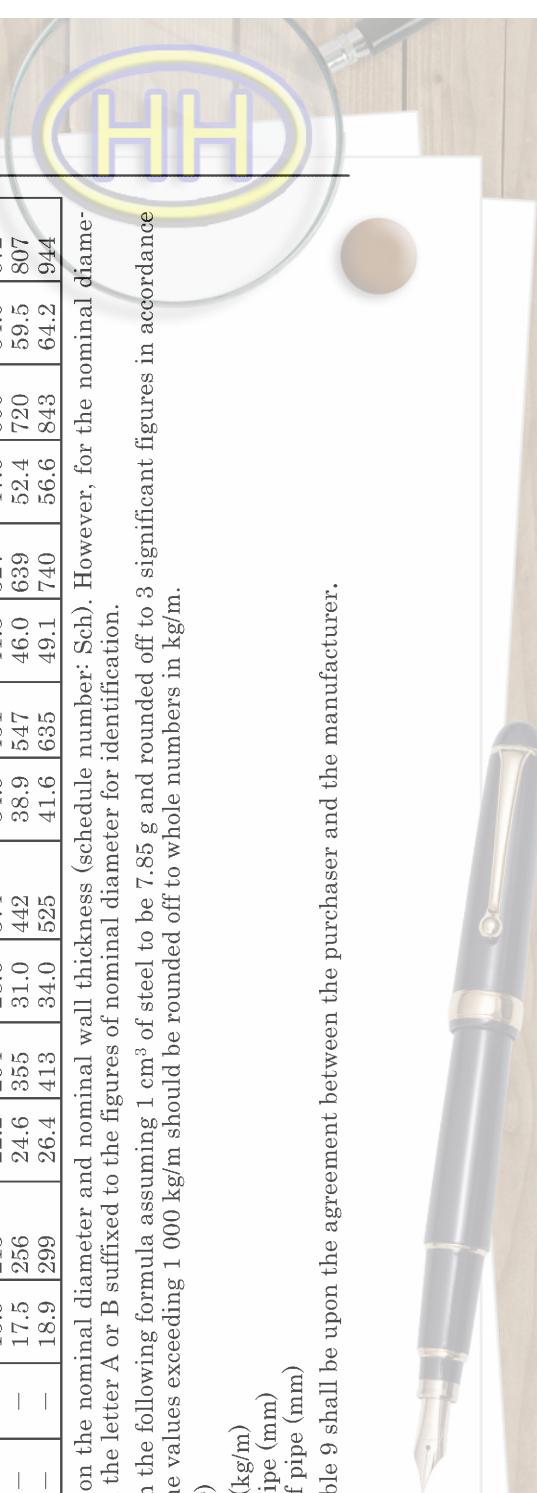


Table 9 Dimensions and unit mass of steel pipes for low temperature service a)

Nominal diameter	outside diameter	Nominal thickness																	
		Schedule 10		Schedule 20		Schedule 30		Schedule 40		Schedule 60		Schedule 80		Schedule 100		Schedule 120		Schedule 140	
A	B	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m	Thick ness mm	Unit mass kg/m
6	1/8	—	—	—	—	—	—	1.7	0.369	—	—	2.4	0.479	—	—	—	—	—	—
8	1/4	—	—	—	—	—	—	2.2	0.629	—	—	3.0	0.799	—	—	—	—	—	—
10	3/8	—	—	—	—	—	—	2.3	0.851	—	—	3.2	1.11	—	—	—	—	—	—
15	1/2	—	—	—	—	—	—	2.8	1.31	—	—	3.7	1.64	—	—	—	—	4.7	1.97
20	3/4	—	—	—	—	—	—	2.9	1.74	—	—	3.9	2.24	—	—	—	—	5.5	2.94
25	1	—	—	—	—	—	—	3.4	2.57	—	—	4.5	3.27	—	—	—	—	6.4	4.36
32	1 1/4	—	—	—	—	—	—	3.6	3.47	—	—	4.9	4.57	—	—	—	—	6.4	5.73
40	1 1/2	—	—	—	—	—	—	3.7	4.10	—	—	5.1	5.47	—	—	—	—	7.1	7.27
50	2	—	—	—	—	—	—	3.9	5.44	—	—	5.5	7.46	—	—	—	—	8.7	11.1
65	2 1/2	—	—	—	—	—	—	5.2	9.12	—	—	7.0	12.0	—	—	—	—	9.5	15.6
80	3	—	—	—	—	—	—	5.5	11.3	—	—	7.6	15.3	—	—	—	—	11.1	21.4
90	3 1/2	—	—	—	—	—	—	5.7	13.5	—	—	8.1	18.7	—	—	—	—	12.7	27.8
100	4	—	—	—	—	—	—	6.0	16.0	—	—	8.6	22.4	—	—	11.1	28.2	13.5	33.6
125	5	—	—	—	—	—	—	6.6	21.7	—	—	9.5	30.5	—	—	12.7	39.8	15.9	48.6
150	6	—	—	—	—	—	—	7.1	27.7	—	—	11.0	41.8	—	—	14.3	53.2	18.2	66.0
200	8	—	—	6.4	33.1	—	—	8.2	42.1	10.3	52.3	12.7	63.8	15.1	74.9	18.2	88.9	20.6	99.4
250	10	—	—	6.4	41.2	—	—	9.3	59.2	12.7	79.8	15.1	93.9	18.2	112	21.4	130	25.4	152
300	12	—	—	6.4	49.3	—	—	10.3	78.3	14.3	107	17.4	129	21.4	157	25.4	184	28.6	204
350	14	6.4	55.1	7.9	67.7	—	—	11.1	94.3	15.1	127	19.0	158	23.8	195	27.8	225	31.8	254
400	16	6.4	63.1	7.9	77.6	—	—	12.7	123	16.7	160	21.4	203	26.2	246	30.9	286	36.5	333
450	18	6.4	71.1	7.9	87.5	—	—	14.3	156	19.0	205	23.8	254	29.4	310	34.9	363	39.7	409
500	20	6.4	79.2	9.5	117	—	—	15.1	184	20.6	248	26.2	311	32.5	381	38.1	441	44.4	508
550	22	—	—	—	—	—	—	15.9	213	22.2	294	28.6	374	34.9	451	41.3	527	47.6	600
600	24	—	—	—	—	—	—	17.5	256	24.6	355	31.0	442	38.9	547	46.0	639	52.4	720
650	26	—	—	—	—	—	—	18.9	299	26.4	413	34.0	525	41.6	635	49.1	740	56.6	843

NOTE 1 The designation of the pipes is based on the nominal diameter and nominal wall thickness (schedule number: Sch). However, for the nominal diameter, either A or B should be used, with the letter A or B suffixed to the figures of nominal diameter for identification.

NOTE 2 The unit mass value is calculated from the following formula assuming 1 cm<sup>3</sup> of steel to be 7.85 g and rounded off to 3 significant figures in accordance with rule A of JIS Z 8401. However, the values exceeding 1 000 kg/m should be rounded off to whole numbers in kg/m.

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

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

$t$  : wall thickness of pipe (mm)

$D$  : outside diameter of pipe (mm)

Note a) Dimensions other than those given in table 9 shall be upon the agreement between the purchaser and the manufacturer.



**Table 10 Tolerances on outside diameter, wall thickness  
and wall thickness deviation**

Division	Tolerance on outside diameter <sup>a), c)</sup>		Tolerance on wall thickness	Tolerance on wall thickness deviation <sup>d)</sup>
	Outside diameter	Tolerance		
Hot-finished seamless steel pipe	Under 50 mm	± 0.5 mm	Under 4 mm : ± 0.5 mm 40 mm or over ± 12.5 %	Not exceeding 20 % 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 % However, for pipes 350 mm or over in diameter, the length of circumference may be used as a basis for tolerance. In this case, the tolerances shall be ±0.5 %. <sup>b)</sup>		
Cold-finished seamless steel pipes and electric resistance welded steel pipe	Up to 40 mm	± 0.3 %	Under 2 mm : ± 0.2 mm 2 mm or over ± 10 %	—
	40 mm or over	± 0.8 % However, for pipes 350 mm or over in diameter, the length of circumference may be used as a basis for tolerance. In this case, the tolerances shall be ±0.5 %. <sup>b)</sup>		

Note<sup>a)</sup> Tolerances on outside diameter of pipes for which quenching followed by tempering applied shall be ±1 % for hot-finished seamless steel pipes whose outside diameter is 50 mm or over and cold-finished seamless steel pipes whose outside diameter is 30mm or over.

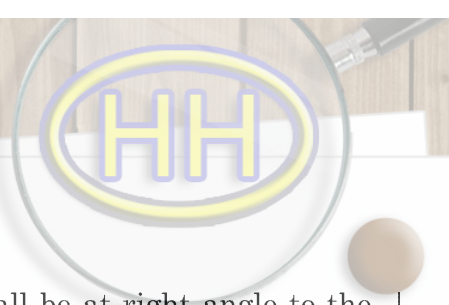
<sup>b)</sup> When the length of circumference is obtained as a basis for the tolerance, either the measured value of the length of circumference itself or the diameter derived from the measured value may be used as the criteria. In both cases, the same value (±0.5 %) of tolerances shall be applied. The outside diameter ( $D$ ) and the length of circumference ( $l$ ) shall be calculated reversibly from the following formula.

$$l = \pi \cdot D$$

$$\text{where, } \pi = 3.141\ 6$$

<sup>c)</sup> In the case where the tolerances on wall thickness are confirmed to meet the specifications in table 10, the tolerances on outside diameter in table 10 shall not be applied to the local part being subjected to repairing, etc.

<sup>d)</sup> The wall thickness deviation means the ratio of the difference between the maximum and the minimum of the wall thickness measured in the same section to the specified wall thickness. The wall thickness deviation shall not be applied to the pipe under 5.6 mm in wall thickness.



## 9 Appearance The appearance shall be as follows.

- a) Pipes shall be practically straight and its both ends shall be at right angle to the axis of pipes.
- b) The outside and inside surfaces of pipes shall be well-finished and free from defects which are detrimental to practical use.
- c) When pipes are repaired, grinding or machining may be applicable, however, the products thickness after repairing shall be within the tolerances of wall thickness.
- d) The surface of repaired parts shall be smooth along the shape of pipes.

## 10 Tests

### 10.1 Chemical analysis

**10.1.1 General matters on chemical analysis and the sampling method of sample** General matters on heat analysis and the sampling method of sample shall be in accordance with clause 8 of JIS G 0404. When the purchaser requests the product analysis, the sampling method shall be in accordance with clause 4 of JIS G 0321.

**10.1.2 Analysis method** The analysis method of heat analysis shall be in accordance with JIS G 0320 and the product analysis shall be in accordance with JIS G 0321.

### 10.2 Mechanical test

**10.2.1 Method of sampling specimens and the number of test pieces** The method of sampling specimens for mechanical test and the number of test pieces shall be as follows.

- a) The method of sampling specimens for the tensile test and flattening test or bending test, and the number of test pieces shall be that one specimen from every 50 pipes and fractions of those of the same dimension<sup>1)</sup> and the simultaneous heat treatment, respectively, shall be sampled; and one test piece for tensile test and one test piece for flattening test from the respective specimen shall be sampled. When designated by the purchaser for pipes not exceeding 50 mm in outside diameter, one test piece shall be sampled for bending test in place of flattening test.

When sampling specimens for the tensile test from the electric resistance welded steel pipes, No. 12 or No. 5 test pieces shall be sampled from portions not including the weld.

- b) The method of sampling specimens for the Charpy impact test, and the number of test pieces shall be that one specimen from every 100 pipes and fractions of those of the same dimension<sup>1)</sup> and the simultaneous heat treatment, respectively, shall be sampled, and then from each specimen take one set (3 pieces) of test pieces. For electric resistance welded steel pipes, another set of test pieces for the Charpy impact test on weld (3 pieces) shall be sampled in addition to the test pieces for the Charpy impact test mentioned above.

Note <sup>1)</sup> The same dimension refers to the same outside diameter and the same wall thickness.

**10.2.2 Tensile test** Tensile test pieces and the tensile test method shall be as follows.

- a) **Test piece and test piece sampling direction** The test piece shall be No. 11, No. 12A, No. 12B, No. 12C, No. 4 or No. 5 test piece specified in **JIS Z 2201** and shall be sampled from pipes. The diameter for No. 4 test piece shall be 14 mm (gauge length 50 mm). The sampling direction of No.4 test piece shall be either of longitudinal or transverse. The manufacturer may designate which direction shall be sampled, unless other wise specified by the purchaser.
- b) **Test method** The test shall be in accordance with **JIS Z 2241**.

**10.2.3 Flattening test** The test piece and test method of flattening test shall be as follows.

- a) **Test piece** A test piece of 50 mm or over in length shall be cut off from the end of pipes. From pipes whose wall thickness is 15 % or over of the outside diameter, a C-shape test piece may be prepared by removing a part of the circumference of the ringed test piece may be used.
- b) **Test method** The test piece shall be placed between two flat plates at ordinary temperatures and flattened by compression until the distance  $H$  between the plates comes to the value of the formula (1) in **6.2**, and examined for the occurrence of flaws or cracks on its wall surface. For the electric resistance welded steel pipes, the weld shall be placed at right angles to the direction of compression as shown in figure 2 and the C-shape test piece shall be placed as shown in figure 3.

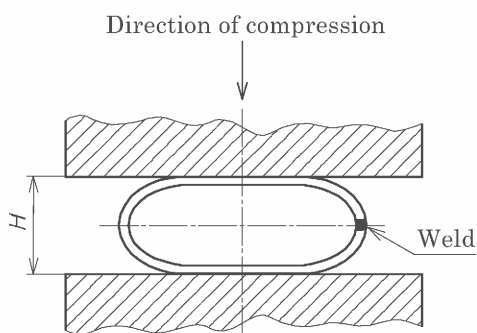


Figure 2 Flattening test  
(ringed test piece)

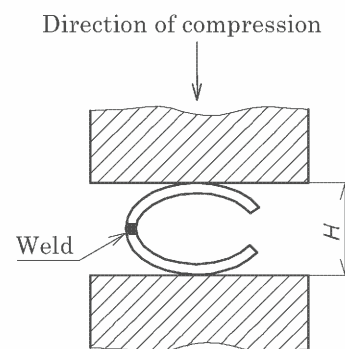


Figure 3 Flattening test  
(C-shape test piece)

**10.2.4 Bending test** The bending test shall be as follows.

- a) **Test piece** The test piece with an appropriate length shall be cut off from the end of pipes.
- b) **Test method** The test piece shall be bent at ordinary temperature through the angle around a cylinder with the inside radius specified in **6.3**, and examined for

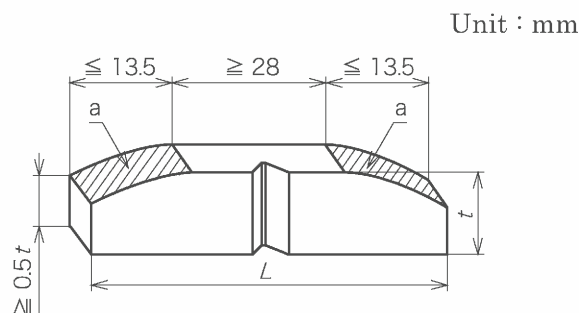


the occurrence of flaws or cracks on its wall surface. For the electric resistance welded steel pipes, the welded part shall be in the outermost part of the bent portion.

**10.2.5 Charpy impact test** The test piece and the test method of the Charpy impact test shall be as follows.

- a) **Test piece and test piece sampling direction** The test piece shall be V notch test piece specified in JIS Z 2242. However, the width of the test piece may be altered to 7.5 mm or 5 mm according to the dimensions of pipes. For the test piece sampling direction, the test piece of the steel product not including the weld of the pipe shall be sampled in longitudinal direction of the pipe and the Charpy impact test piece of the weld of the electric resistance welded steel pipe shall be sampled in transverse direction. Furthermore, as required, the surface finishing method (for example, the length of the non-cut part of the periphery of the pipe shown in informative figure) of the Charpy impact test piece of the weld may be upon the agreement between the purchaser and the manufacturer.

**NOTE :** For the non-cut part of the Charpy impact test piece, the surface finishing is usually performed within the range of dimensions shown in informative figure.



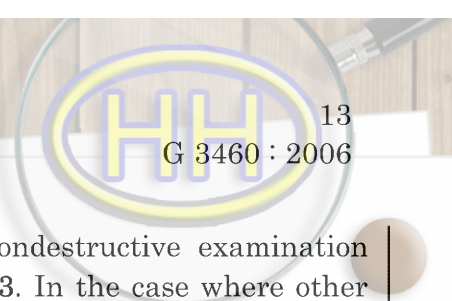
$a$  : Periphery of the pipe remained not being cut  
 $t$  : Width of test piece (10 mm, 7.5 mm, 5 mm)  
 $L$  : Length of test piece (= 55 mm)

**Informative figure Range of non-cut part of Charpy impact test piece**

- b) **Test method** The test method shall be in accordance with the Charpy impact test method in JIS Z 2242.

**10.3 Hydraulic test or nondestructive examination** The frequency of test and the test method of hydraulic test or nondestructive examination shall be as follows.

- a) **Frequency of test** Either of hydraulic test or nondestructive examination shall be performed on each pipe.
- b) **Test method**
- 1) **Hydraulic test** Pipes shall be subjected to water pressure and kept at the designated pressure or at the specified pressure for at least 5 s to see if it withstands the pressure without leakage.



- 2) **Nondestructive examination** The test method of nondestructive examination shall be in accordance with **JIS G 0582** or **JIS G 0583**. In the case where other nondestructive examination is carried out, the test method shall be upon the agreement between the purchaser and the manufacturer.

## 11 Inspections

### 11.1 Inspections Inspections shall be as follows.

- a) General matters for inspection shall be in accordance with **JIS G 0404**.
- b) Chemical composition shall comply with clause 5.
- c) Mechanical properties shall comply with clause 6.
- d) Either the hydraulic test characteristics or the nondestructive examination characteristics shall comply with the clause 7.
- e) Dimensions, mass and dimensional tolerances shall comply with clause 8.
- f) Appearance shall comply with clause 9.
- g) When the supplementary quality requirements given in Annex JA are applied upon the agreement between the purchaser and the manufacturer, the results shall be in accordance with the corresponding requirements in Annex JA.

### 11.2 Reinspections Reinspections shall be as follows.

- a) Pipes failed mechanical tests specified in 10.2.2 to 10.2.4 may be retested in accordance with 9.8 of **JIS G 0404** to determine whether it is acceptable or not.
- b) Pipes failed the test specified in 10.2.5, but satisfied either of the following two conditions as well as the specified limit of the average value of the absorbed energy, a retest may be conducted to determine whether it is acceptable or not.
  - 1) The values of two are equal to or higher than the average value of the three test pieces given in table 6 and only one fails to conform to the value of each test piece given in table 6.
  - 2) The values of two fail the average value of the three test pieces given in table 6, but conform to the value of each test piece given in table 6.

In these cases, retest is performed on one set (3 pieces) of test pieces newly taken from the same lot, and each of the three individual tested values shall conform to the average value of one set given in table 6.



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

- a) Class symbol
- b) Symbol indicating manufacturing method : Symbols indicating manufacturing method shall be as follows. The dash may be omitted.
  - 1) Hot finished seamless steel pipes —S—H
  - 2) Cold finished seamless steel pipes —S—C
  - 3) Electric resistance welded steel pipes —E—G
  - 4) Hot finished electric resistance welded steel pipes —E—H
  - 5) Cold finished electric resistance welded steel pipes —E—C
- c) Dimensions: Dimensions shall be as marked as follows.

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

Example 50 A × Sch 40, or 60.5 × 3.9
- d) Manufacturer's name or its identifying brand
- e) Designation denoting the supplementary quality requirement Z (when designated)

**13 Report** The report shall be in accordance with the requirements in clause 13 of JIS G 0404. When no specification at the time of order, the type of the inspection certificate shall be the symbol 2.3 or 3.1.B in table 1 of JIS G 0415.



## Annex JA (normative)

### Supplementary quality requirements

The supplementary quality requirements shall be applied only when requested by the purchaser, and part of or all designed items shall be carried out by the manufacturer on straight pipes.

**JA.1 Ultrasonic examination (Z3)<sup>1)</sup>** The ultrasonic examination shall be as follows.

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

Note <sup>1)</sup> The ultrasonic examination can also be designated as Z3 on trading of pipes.

**JA.2 Eddy current examination (Z4)<sup>2)</sup>** The eddy current examination shall be as follows.

- a) The criterion of the working sensitivity for the eddy current examination shall comply with the division EU, EV, EW, or EX specified in **JIS G 0583**, and there shall be no signal greater than those produced by the artificial defects of the reference test block.
- b) The test method of the eddy current examination shall be in accordance with **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).

Note <sup>2)</sup> The eddy current examination can also be designated as Z4 on trading of pipes.



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

JIS G 3460 : 2006 Steel pipes for low temperature service		ISO 9329-3 :1997 Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3 : Unalloyed and alloyed steels with specified low temperature properties	
(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard
Clause	Content		Clause Content
1 Scope	<ul style="list-style-type: none"> <li>For piping at low temperatures</li> <li>Low temperatures of freezing point or under</li> <li>Carbon steels, alloyed steels</li> </ul>	ISO 9329-3 ISO 9330-3	<ul style="list-style-type: none"> <li>For piping system</li> <li>For low temperatures</li> <li>Carbon steels, alloyed steels</li> </ul>
2 Normative references			
3 Classifications and symbols	<ul style="list-style-type: none"> <li>3 classes: carbon steels, 3.5 % Ni, 9 % Ni</li> </ul>	ISO 9329-3 ISO 9330-3	<ul style="list-style-type: none"> <li>10 classes: carbon steels (4 classes), Ni alloyed steels (6 classes, welded steel tubes of 4 classes)</li> <li>Heat treatment specification: QT, N</li> </ul>
			Alteration Deletion
			In JIS, classifications which have been conventionally used are adopted.
			1 Since the JIS concerned is different from the corresponding ISO Standards in the standard system (JIS: by use, ISO Standards: by manufacturing method) and the dimensional system, and is referred to in laws and regulations, it was difficult for JIS to conform to ISO Standards. 2 As the measures taken against the above-mentioned, JISs (JIS G 7221, JIS G 7225) which were prepared by translating the corresponding ISO Standards were published. Not only conformity to ISO Standards is intended through the preparation of
			(IV) Classification and details of technical deviation between JIS and the International Standard by clause
			Details of technical deviation
			In JIS, for low temperature heat exchangers. In ISO Standards, for piping system.
			(V) Justification for the technical deviation and future measures

(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	Details of technical deviation	
4 Manufacturing methods	<ul style="list-style-type: none"> <li>Seamless steel pipes</li> <li>Electric resistance welded steel pipes</li> <li>Heat treatment specification: N, NT, NNT, QT</li> </ul>	ISO 9329-3 ISO 9330-3	5 5	<ul style="list-style-type: none"> <li>Seamless steel tubes</li> <li>Electric resistance welded steel tubes</li> </ul>	Addition	In JIS, heat treatment which has been conventionally used is added.	<p>JISs which are identical with ISO Standards, but also promotion of widespread use of products which adopt ISO Standards is intended.</p> <p>3 On the other hand, the JIS concerned is needed as the standard for the specified use apart from the ISO Standard.</p> <p>4 Therefore, the JIS concerned which follows the conventional JIS encouraged stability of market.</p> <p>5 Future subjects:</p> <ul style="list-style-type: none"> <li>Improvement of conformity to ISO Standards shall be encouraged by adopting the specified content of the corresponding ISO Standards (JIS prepared by translation) as much as possible.</li> <li>Improvement of conformity to ISO Standards shall be encouraged by proposing the specified content of the JIS concerned which is not specified in ISO Standards to ISO based on the market request.</li> </ul>
5 Chemical composition	<ul style="list-style-type: none"> <li>3 classes: carbon steels, 3.5 % Ni, 9 % Ni</li> </ul>	ISO 9329-3 ISO 9330-3	6.1 6.1	<ul style="list-style-type: none"> <li>10 classes: carbon steels (4 classes), Ni alloyed steels (6 classes, welded steel tubes of 4 classes)</li> </ul>	Alteration Deletion	In JIS, classifications which have been conventionally used are adopted.	



(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	Details of technical deviation	
6 Mechanical properties	<ul style="list-style-type: none"> <li>• Tensile test</li> <li>• Flattening (bending)</li> <li>• Impact test</li> </ul>	ISO 9329-3 ISO 9330-3	6.2 6.2	<ul style="list-style-type: none"> <li>• Tensile test</li> <li>• Flattening (bending)</li> <li>• Drift expanding</li> <li>• Ring expanding</li> <li>• Impact test</li> </ul>	Alteration Deletion	In JIS, test items and content of specifications which have been conventionally used are adopted.	
7 Hydraulic test characteristics and nondestructive characteristics	<ul style="list-style-type: none"> <li>• Hydraulic test</li> <li>• Nondestructive examination</li> </ul>	ISO 9329-3 ISO 9330-3	9.8 9.8	<ul style="list-style-type: none"> <li>• Hydraulic test</li> <li>• Nondestructive examination</li> </ul>	Alteration Deletion	In JIS, specifications of hydraulic pressure which have been conventionally used are adopted.	
8 Dimensions, mass and dimensional tolerances	<ul style="list-style-type: none"> <li>• Outside diameter, wall thickness, mass</li> <li>• Length</li> <li>• Dimensional tolerances</li> </ul>	ISO 9329-3 ISO 9330-3	7 7	<ul style="list-style-type: none"> <li>• Outside diameters, wall thicknesses, mass: selected from ISO 4200 and ISO 1127</li> <li>• Lengths</li> <li>• Dimensional tolerances</li> </ul>	Alteration Deletion	In JIS, specified values which have been conventionally used are adopted.	
9 Appearance	<ul style="list-style-type: none"> <li>• Appearance and soundness</li> </ul>	ISO 9329-3 ISO 9330-3	8.1 8.1	<ul style="list-style-type: none"> <li>• Appearance and soundness</li> </ul>	Addition	In JIS, the specified contents which have been conventionally used are added.	

(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	Details of technical deviation	
10 Tests	<ul style="list-style-type: none"> <li>• Chemical analysis</li> <li>• Mechanical test</li> <li>• Hydraulic test or non-destructive examination</li> </ul>	ISO 9329-3 ISO 9330-3	9.10 9.10	<ul style="list-style-type: none"> <li>• Chemical analysis</li> <li>• Mechanical test</li> <li>• Hydraulic test or non-destructive examination</li> </ul>	MOD/ alteration	In JIS, test items which have been conventionally used are adopted.	
11 Inspections	Inspections, reinspections	ISO 9329-3 ISO 9330-3	9 9	Inspections, reinspections	Alteration	In JIS, items which have been conventionally used are adopted.	
12 Marking	Marking content	ISO 9329-3 ISO 9330-3	10 10	Marking content	Alteration	In JIS, items which have been conventionally used are adopted.	
13 Report	JIS G 0404, JIS G 0415	ISO 9329-3 ISO 9330-3	9.1 9.1	ISO 0404, ISO 10474	Identical		
Annex JA	Supplementary quality requirements	—	—	—	Addition	In JIS, specified values which have been conventionally used are added.	

Designated degree of correspondence between JIS and International Standards (ISO 9329-3 : 1997, ISO 9330-3: 1997) total : MOD

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

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



— Addition : Adds the specification item(s) and content(s) which are not included in International Standard.

— Alteration : Alters the specifications content(s) which are included in International Standard.

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

— MOD : Modifies International Standard.





Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

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