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service**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied *mutatis mutandis* pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS G 3455:2016**), which has been technically revised.

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

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Carbon steel pipes for high pressure service

Introduction

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

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

1 Scope

This Standard specifies the carbon steel pipes (hereafter referred to as pipes) used for high pressure service at temperatures 350 °C or lower mainly used for machine parts.

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

NOTE 2 The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

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

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

2 Normative references

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

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

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

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

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

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

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

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

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

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

JIS Z 8401 *Rounding of numbers*

3 Symbol of grade

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

Table 1 Symbols of grade and symbols of manufacturing method

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

4 Manufacturing method

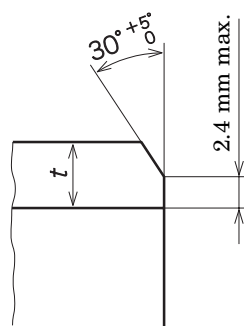
The manufacturing method shall be as follows.

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

Table 2 Heat treatment

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

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



t : wall thickness 22 mm max.

Figure 1 Shape of bevel end

5 Chemical composition

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

Table 3 Chemical composition

Unit: %

Symbol of grade	C	Si	Mn	P	S
STS370	0.25 max.	0.10 to 0.35	0.30 to 1.10	0.035 max.	0.035 max.
STS410	0.30 max.	0.10 to 0.35	0.30 to 1.40	0.035 max.	0.035 max.
STS480	0.33 max.	0.10 to 0.35	0.30 to 1.50	0.035 max.	0.035 max.
Alloy elements not specified in this Table may be added as necessary.					

6 Mechanical properties

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

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

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

Symbol of grade	Tensile strength N/mm ²	Yield point or proof strength N/mm ²	Elongation ^{a)} %			
			Test piece No. 11 Test piece No. 12	Test piece No. 5	Test piece No. 4 ^{b)}	
			Direction parallel to pipe axis	Direction perpendicular to pipe axis	Direction parallel to pipe axis	Direction perpendicular to pipe axis
STS370	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.
STS410	410 min.	245 min.	25 min.	20 min.	24 min.	19 min.
STS480	480 min.	275 min.	25 min.	20 min.	22 min.	17 min.

NOTE 1 N/mm² = 1 MPa

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

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

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

Unit: %

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

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

6.2 Flattening resistance

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

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

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

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

6.3 Bendability

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

7 Hydrostatic test characteristics or nondestructive test characteristics

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

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

- 1) When a test pressure is not specified by the purchaser and when pipes are subjected to the minimum hydrostatic test pressure given in Table 6, the pipes shall withstand it without leakage.
 For pipes having dimensions other than given in Table 7, the minimum hydrostatic test pressure to be applied shall be determined as follows.
 - 1.1) For pipes of outside diameter within the range specified in Table 7, the smaller value of the applicable outside diameters in this Table shall be selected.
 - 1.2) When the pipe has the wall thickness within the range of schedule number Sch corresponding to the outside diameter selected in **1.1**), the greater value of the applicable wall thicknesses specified in this Table shall be selected.
 - 1.3) The minimum hydrostatic test pressure shall be selected from Table 6 according to the outside diameter and the schedule number of wall thickness selected in **1.1**) and **1.2**).
 - 1.4) For the pipes which do not satisfy the conditions in **1.1**) and **1.2**) and have dimensions other than those given in Table 7, the minimum hydrostatic test pressure to be applied shall be as agreed between the purchaser and the manufacturer.