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Arc welded carbon steel pipes

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 3457**:2016), which has been technically revised.

However, **JIS G 3457**: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.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, published patent application or utility model rights. The relevant Minister is not responsible for identifying any of such patent rights, published patent application or utility model rights.

Arc welded carbon steel pipes

1 Scope

This Japanese Industrial Standard specifies requirements for the arc welded carbon steel pipes (hereafter referred to as pipes) used for piping for the steam, water, gas, air, etc. of comparatively low working pressure.

NOTE The dimensional range covered by this Standard is generally outside diameter 355.6 mm (nominal diameter 350A or 14B) to 2 032 mm (nominal diameter 2 000A or 80B) (see **9.1**).

2 Normative references

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

JIS G 0202 *Glossary of terms used in iron and steel (Testing)*

JIS G 0203 *Glossary of terms used in iron and steel (Products and quality)*

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

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

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

JIS G 0584 *Ultrasonic examination for arc welded steel pipes*

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

JIS Z 3121 *Methods of tensile test for butt welded joints*

JIS Z 8401 *Rounding of numbers*

3 Terms and definitions

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

4 Symbol of grade

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

Table 1 Symbols of grade

Symbol of grade
STPY400

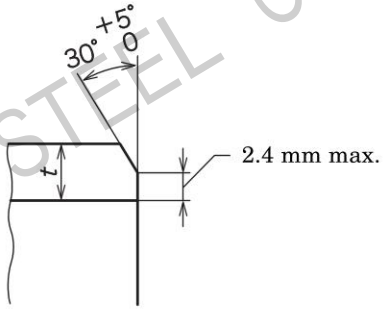
5 Manufacturing method

The manufacturing method of pipes shall be as follows.

a) The pipes shall be manufactured by spiral seam or straight seam welding. In either case, the internal and external surfaces of the pipe shall be automatic submerged arc welded.

b) The pipes shall be supplied either as-welded or as cold-expanded after welding, and shall generally not be heat treated.

c) The pipes shall be furnished 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 as shown in Figure 1, unless otherwise specified.



Key
t: wall thickness (22 mm max.)

Figure 1 Shape of bevel end

6 Chemical composition

The pipes shall be tested in accordance with **11.1**, and the obtained heat analysis values shall conform to Table 2. Alloy elements not specified in this Table may be added as necessary.

Table 2 Chemical composition

Unit: %

Symbol of grade	C	P	S
STPY400	0.25 max.	0.040 max.	0.040 max.

7 Mechanical properties

7.1 Tensile strength, yield point or proof stress, and elongation of base metal

The pipes, or the steel strips or steel plates used for manufacture of the pipes shall be tested in accordance with **11.2**, and the tensile strength, yield point or proof stress and elongation of base metal (parts of pipe excluding the weld, or steel strip or steel plate used for manufacture of the pipe) shall comply with Table 3. When the tensile test is performed on Test piece No. 5 taken from the pipe under 8 mm in wall thickness, the elongation shall be as given in Table 4.

7.2 Tensile strength of weld

The weld of the pipes shall be tested in accordance with **11.2**, and the tensile strength shall be as given in Table 3. For the pipes that are to be cold-expanded, the tensile test of welds may be omitted upon agreement between the purchaser and the manufacturer.

Table 3 Mechanical properties

Symbol of grade	Base metal				Tensile strength of weld
	Tensile strength	Yield point or proof stress	Elongation %		
			Tensile test piece	Tensile test direction	
	N/mm^2	N/mm^2	Test piece No. 5	Direction perpendicular to pipe axis [a)]	N/mm^2
STPY400	400 min.	225 min.	18 min.		400 min.

NOTE 1 N/mm^2 = 1 MPa

Note [a)] A tensile test sample, when taken from the steel strip or steel plate, shall be taken in the direction either parallel to or perpendicular to the rolling direction.

Table 4 Elongation of pipes with a wall thickness under 8 mm, tested using Test piece No. 5 (direction perpendicular to pipe axis)

Unit: %

Wall thickness	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
Elongation	15 min.	16 min.	18 min.

NOTE Elongation in this Table is calculated by subtracting 1.5 % from the elongation value given in Table 3 for each 1 mm decrease in wall thickness from 8 mm, and by rounding the results to the whole number according to Rule A of **JIS Z 8401**.

8 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 conform to the following. Which characteristics to be tested shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.

a) **Hydrostatic test characteristics** The pipes, when subjected to the minimum hydrostatic test pressure of 2.5 MPa, shall withstand the pressure without leakage.

b) **Nondestructive test characteristics** For the ultrasonic examination characteristics, the signals from the reference sample containing Category UY reference standard specified in **JIS G 0584** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level.

9 Dimensions, unit mass and dimensional tolerances

9.1 Dimensions and unit mass

The outside diameter, wall thickness and unit mass of the pipe shall be in accordance with Table 5. Dimensions not specified in Table 5 may be used upon agreement between the purchaser and the manufacturer. In this case, the unit mass shall be calculated by the following formula assuming the mass of steel of 1 cm^3 is 7.85 g, and the result shall be rounded off to 3 significant figures according to Rule A of **JIS Z 8401**. The result value exceeding 1 000 kg/m shall be rounded to a 4-digit integer.

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

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

t : wall thickness of pipe (mm)

D : outside diameter of pipe (mm)

0.024 66 : unit conversion factor for obtaining W

NOTE The unit mass values in Table 5 are the results of the calculation given above.

Table 5 Dimensions [a] and unit mass of pipes

Unit: kg/m

Nominal diameter		Outside diameter	Wall thickness (mm)												
A	B	(mm)	6.0	6.4	7.1	7.9	8.7	9.5	10.3	11.1	11.9	12.7	13.1	15.1	15.9
350	14	355.6	51.7	55.1	61.0	67.7									
400	16	406.4	59.2	63.1	69.9	77.6									
450	18	457.2	66.8	71.1	78.8	87.5									
500	20	508.0	74.3	79.2	87.7	97.4	107	117							
550	22	558.8	81.8	87.2	96.6	107	118	129	139	150	160	171			
600	24	609.6	89.3	95.2	105	117	129	141	152	164	175	187			
650	26	660.4	96.8	103	114	127	140	152	165	178	190	203			
700	28	711.2	104	111	123	137	151	164	178	192	205	219			
750	30	762.0		119	132	147	162	176	191	206	220	235			
800	32	812.8		127	141	157	173	188	204	219	235	251	258	297	312
850	34	863.6				167	183	200	217	233	250	266	275	316	332
900	36	914.4				177	194	212	230	247	265	282	291	335	352
1 000	40	1 016.0				196	216	236	255	275	295	314	324	373	392
1 100	44	1 117.6						260	281	303	324	346	357	411	432
1 200	48	1 219.2						283	307	331	354	378	390	448	472
1 350	54	1 371.6									399	426	439	505	532
1 500	60	1 524.0									444	473	488	562	591
1 600	64	1 625.6											521	600	631
1 800	72	1 828.8											587	675	711
2 000	80	2 032.0												751	791

Note [a] The nominal diameter, selected from A and B in this Table, shall be indicated by suffixing either the letter A or B, whichever selected, to the numeral of the nominal diameter.

9.2 Dimensional tolerances

9.2.1 Tolerances on outside diameter and wall thickness of pipes

The tolerances on the outside diameter and the wall thickness of pipes shall be as given in Table 6. The upper limit value of wall thickness tolerance shall not apply to weld beads.

Table 6 Tolerances on outside diameter and wall thickness

Unit: %

Item		Tolerance
Tolerance on outside diameter [a) b)]		±0.5
Tolerance on wall thickness	Nominal diameter 450A or under	+15 −12.5
	Nominal diameter over 450A	+15 −10

Note [a)] For the determination of tolerances on outside diameter, either the actual measured value of the circumferential length or the outside diameter converted from the measured circumferential length shall be used. The conversion between the outside diameter and the circumferential length shall be as given in the following formula.

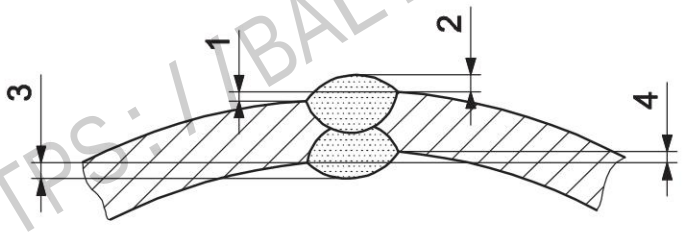
$$D = l/\pi$$

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

Note [b)] The tolerances on outside diameter in this Table shall not apply to local repaired parts.

9.2.2 Weld bead height

The heights of inner and outer weld beads shall be measured from the surface of the adjacent steel pipes. The weld bead height shall be as given in Table 7. For steel strips or steel plates with radial offset of edges, the heights of weld beads shall be measured as shown in Figure 2.



Key
1: outside radial offset
2: height of outer weld bead
3: height of inner weld bead
4: inside radial offset

Figure 2 Weld bead height with radial offset

Table 7 Weld bead height

Unit: mm

Wall thickness	Weld bead height [a)]	
	Inner bead	Outer bead
13.0 or under	3.5 max.	3.5 max.
Over 13.0	3.5 max.	4.5 max.
Note [a)] Weld beads higher than the specified maximum height may be ground at the discretion of the manufacturer so as to satisfy the specified value.		

9.2.3 Pipe length

In general, the length of a pipe shall be 4 000 mm or longer. For the tolerance on length of pipes, the minus side shall be zero, and the plus side is not specified.

10 Appearance

The appearance shall be as follows.

a) The pipe shall be straight and the both ends shall be at right angles to the pipe axis for practical purposes.

b) The internal and external surfaces of the pipe shall be finished smoothly and free from defects detrimental to use. If detrimental defects exist, the surface may be repaired by grinding, machining or welding, provided that the following conditions are satisfied.

1) The surface repairs by grinding, machining or other methods, if conducted, shall be as follows.

— The wall thickness after repair shall be within the specified tolerance on wall thickness.

— The surface of the repaired part shall be smooth along the contour of the pipe.

2) The surface repairs by welding, if conducted, shall be as follows.

— The repair by welding may be given on the base metal of pipes and on the weld.

— The detrimental defects of pipes shall be completely eliminated by chipping, grinding or other suitable methods prior to welding. For the base metal, the depth of the removed part shall be 20 % or less of the nominal thickness of pipes, and the total repaired area of one side (external surface or internal surface) shall be 2 % or less of surface area of one side.

— The repair by welding shall be carried out by the method suitable for the grade of steel material. For the weld, the repair shall be carried out by the method suitable for the characteristics of the weld.

— No undercuts or overlaps shall be made on the edges of the parts repaired by welding. The weld reinforcement shall be above the rolled surface, and shall be removed by chipping, grinding or other methods. The repaired parts shall be in smooth contact with adjacent parts and original weld bead in the case of welds.

— For the heat-treated pipes, heat treatment shall be again given on the pipe itself after the repair by welding.

c) The pipe repaired by welding shall be tested in accordance with **11.3** and shall conform to the requirements specified in Clause **8**.

d) Upon the agreement between the purchaser and the manufacturer, pipes may be coated (e.g. zinc rich painting, epoxy coating, primer coating) on the external surface and/or internal surface.

e) When specified by the purchaser, hanging fixtures may be installed on the pipes, provided that strength and safety are considered. In this case, specification and inspection of the fixtures shall be as agreed between the purchaser and the manufacturer.

11 Tests

11.1 Chemical analysis

11.1.1 General requirements for chemical analysis and sampling method

General requirements for chemical analysis and sampling method for heat analysis shall be in accordance with Clause **8** of **JIS G 0404**.

11.1.2 Analytical method

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

11.2 Mechanical tests

11.2.1 General requirements for mechanical tests

General requirements for mechanical tests shall be in accordance with Clause **7** and Clause **9** of **JIS G 0404**.

11.2.2 Sampling method and number of test pieces

The sampling method and the number of test pieces for the tensile test of base metal and the tensile test of weld shall be as given in Table 8 and Table 9, respectively.

Table 8 Sampling method and number of test pieces (for tensile test of base metal)

When taken from pipe	When taken from steel strip	When taken from steel plate
Take one sample from every 1 200 m length or its fraction of pipes of the same dimensions [a], and take one test piece from each sample.	Take one test piece from each lot of strips from the same cast and of the same thickness. Take two test pieces from lots exceeding 50 t.	Take one test piece from each lot of plates from the same cast, in which the maximum plate thickness is not more than twice the minimum thickness. Take two test pieces from lots exceeding 50 t.
Note [a] "Same dimensions" means the same outside diameter and the same wall thickness.		

Table 9 Sampling method and number of test pieces (for tensile test of weld)

When taken from pipe	When taken from a sample of pipe end welded under the same conditions as the pipe itself
Take one sample from every 1 200 m length or its fraction of pipes of the same dimensions [a], and take one test piece for tensile test of weld from each sample.	Take one sample from each quantity equivalent to 1 200 m length or its fraction of pipes of the same dimensions [a], and take one test piece for tensile test of weld from each sample.
Note [a] "Same dimensions" means the same outside diameter and the same wall thickness.	

11.2.3 Tensile test of base metal

The tensile test of base metal shall be as follows.

a) **Test piece** The tensile test piece shall be Test piece No. 5 specified in **JIS Z 2241**, which has been cut off from the pipe by either of the following methods. The test piece shall be taken from a portion which does not contain a weld.

1) In the case of pipes to be cold-expanded, the test piece shall be taken in the direction perpendicular to the pipe axis after being cold-expanded, and finished into a flat piece.

2) In the case of pipes not to be cold-expanded, the test piece shall be either taken directly from the pipe in the direction perpendicular to the pipe axis and finished into a flat piece, or taken from the steel strip or steel plate used for manufacture of the pipe. A tensile test sample, when taken from the steel strip or steel sheet, shall be taken in the direction either parallel to or perpendicular to the rolling direction.

b) **Test method** The test method shall be in accordance with **JIS Z 2241**.

11.2.4 Tensile test of weld

The tensile test of weld shall be as follows.

a) **Test piece** The test piece for tensile test of weld shall be Test piece No. 1 specified in **JIS Z 3121**, which has been taken from the pipe or from the sample prepared from the pipe end welded under the same conditions as the pipe itself, and shall be finished into a flat piece.

b) **Test method** The test method shall be in accordance with **JIS Z 2241**.

11.3 Hydrostatic test or nondestructive test

The hydrostatic test or nondestructive test shall be carried out for each pipe as follows.

a) **Hydrostatic test** Hold the pipe under the pressure not less than the minimum hydrostatic test pressure specified in **8 a**) for at least 5 s, and examine if the pipe has endured the pressure without leakage.

b) **Nondestructive test** The test method shall be in accordance with **JIS G 0584**. The test may be conducted by a category of reference standard stricter than Category UY at the discretion of the manufacturer. The alarm level may be set lower

(stricter) than the signals from reference standard at the discretion of the manufacturer.

12 Inspection and reinspection

12.1 Inspection

The inspection shall be as follows.

a) The general requirements for inspection shall be as specified in **JIS G 0404**.

b) The chemical composition shall conform to the requirements specified in Clause **6**.

c) The mechanical properties shall conform to the requirements specified in Clause **7**.

d) The hydrostatic test characteristics or nondestructive test characteristics shall conform to the requirements specified in Clause **8**.

e) Dimensions shall conform to the requirements specified in Clause **9**.

f) The appearance shall conform to the requirements specified in Clause **10**.

12.2 Reinspection

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

13 Marking

Each pipe having passed the inspection shall be marked with the following information. The order of markings is not specified. Part of the following particulars may be omitted upon agreement between the purchaser and the manufacturer, as far as the product can still be identified.

a) Symbol of grade

b) Dimensions, expressed by nominal diameter × wall thickness, or outside diameter × wall thickness.

Example 400A × 6.4, or 406.4 × 6.4

c) Name of manufacturer or identifying brand

14 Report

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

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

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