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Carbon steel tubes for machine structure

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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 3445** : 2016), which has been technically revised.

However, **JIS G 3445** : 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 21 February 2022.

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 and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, published patent application or utility model rights.

Carbon steel tubes for machine structure

1 Scope

This Japanese Industrial Standard specifies requirements for carbon steel tubes (hereafter referred to as tubes) used for machinery, automobiles, bicycles, furniture, appliances and other machine parts.

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 3302 *Hot-dip zinc-coated steel sheet and strip*

JIS G 3313 *Electrolytic zinc-coated steel sheet and strip*

JIS G 3314 *Hot-dip aluminium-coated steel sheet and strip*

JIS G 3317 *Hot-dip zinc-5 % aluminium alloy-coated steel sheet and strip*

JIS G 3321 *Hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip*

JIS G 3323 *Hot-dip zinc-aluminium-magnesium alloy-coated steel sheet and strip*

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

JIS Z 8401 *Rounding of numbers*

3 Symbol of grade

The tubes are classified into 22 grades, and the symbol of grade shall be as given in Table 1.

4 Manufacturing method

The manufacturing method shall be as follows.

a) The tubes shall be manufactured by combination of the tube manufacturing method and the finishing method which are indicated in Table 1. The symbol for manufacturing method shall be as specified in Table 1. If required, tubes may be subjected to an appropriate heat treatment.

b) The tubes may be manufactured using coated steel sheet and coated steel strip, if so requested by the purchaser. In this case, the type of coating and coating mass applied should be in accordance with Annex A.

c) The tubes shall be finished with plain ends unless otherwise specified.

d) When manufacturing tubes by electric resistance welding, inner and outer weld beads shall be removed. Inner weld beads may be left unremoved if so agreed between the purchaser and the manufacturer.

Table 1 Symbol of grade and symbol for manufacturing method

Grade		Symbol of grade	Symbol for manufacturing method		
			Tube manufacturing method	Finishing method	Marking
Grade 11	A	STKM11A	Seamless : S Electric resistance welded : E Butt welded : B	Hot finished : H Cold finished : C As electric resistance welded : G	As given in **11 b**).
Grade 12	A	STKM12A			
	B	STKM12B			
	C	STKM12C			
Grade 13	A	STKM13A			
	B	STKM13B			
	C	STKM13C			
Grade 14	A	STKM14A	Seamless : S Electric resistance welded : E	Hot finished : H Cold finished : C As electric resistance welded : G	
	B	STKM14B			
	C	STKM14C			
Grade 15	A	STKM15A			
	C	STKM15C			
Grade 16	A	STKM16A			
	C	STKM16C			
Grade 17	A	STKM17A			
	C	STKM17C			
Grade 18	A	STKM18A			
	B	STKM18B			
	C	STKM18C			
Grade 19	A	STKM19A			
	C	STKM19C			
Grade 20	A	STKM20A			

5 Chemical composition

The tubes shall be subjected to the test of **9.1**, and satisfy the heat analysis values given in Table 2. When the product analysis is requested by the purchaser, the tube shall be tested in accordance with **9.1** and the obtained product analysis values shall satisfy the requirements in Table 2 within tolerances given in Table 3 of **JIS G 0321** for seamless steel tubes, and within those given in Table 2 of **JIS G 0321** for electric resistance welded steel tubes and butt-welded steel tubes.

Table 2 Chemical composition [a)]

Unit: %

Grade		Symbol of grade	C	Si	Mn	P	S	Nb + V
Grade 11	A	STKM11A	0.12 max.	0.35 max.	0.60 max.	0.040 max.	0.040 max.	—
Grade 12	A	STKM12A	0.20 max.	0.35 max.	0.60 max.	0.040 max.	0.040 max.	—
	B	STKM12B						
	C	STKM12C						
Grade 13	A	STKM13A	0.25 max.	0.35 max.	0.30 to 0.90	0.040 max.	0.040 max.	—
	B	STKM13B						
	C	STKM13C						
Grade 14	A	STKM14A	0.30 max.	0.35 max.	0.30 to 1.00	0.040 max.	0.040 max.	—
	B	STKM14B						
	C	STKM14C						
Grade 15 [b)]	A	STKM15A	0.25 to 0.35	0.35 max.	0.30 to 1.00	0.040 max.	0.040 max.	—
	C	STKM15C						
Grade 16	A	STKM16A	0.35 to 0.45	0.40 max.	0.40 to 1.00	0.040 max.	0.040 max.	—
	C	STKM16C						
Grade 17	A	STKM17A	0.45 to 0.55	0.40 max.	0.40 to 1.00	0.040 max.	0.040 max.	—
	C	STKM17C						
Grade 18	A	STKM18A	0.18 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	—
	B	STKM18B						
	C	STKM18C						
Grade 19	A	STKM19A	0.25 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	—
	C	STKM19C						
Grade 20	A	STKM20A	0.25 max.	0.55 max.	1.60 max.	0.040 max.	0.040 max.	0.15 max.

Notes [a)] Alloy elements not included in this table and elements indicated with "—" may be added as necessary.

[b)] For electric resistance welded steel tubes of this grade, the lower limit of C content may be changed by agreement between the purchaser and the manufacturer.

6 Mechanical properties

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

The tubes shall be tested in accordance with **9.2**, and the obtained tensile strength, yield point or proof stress, and elongation shall satisfy the requirements specified in Table 3. However, when the tensile test is performed on Test piece No. 5 or No. 12 taken from the tube under 8 mm in wall thickness, the elongation shall be in accordance with Table 4.

6.2 Flattening resistance

The tube shall be tested in accordance with **9.2**, and the test piece shall be free from cracks when flattened until the distance between the plates *H* reaches the value given in Table 3.

NOTE For the flattening test, see **9.2.4**.

6.3 Bendability

The bendability requirement applies where the purchaser specifies a bend test instead of a flattening test for tubes of outside diameter 50 mm or under. The bendability shall be tested in accordance with **9.2**, and the test piece shall be free from cracks when bent to an angle given in Table 3 with an inside radius given in Table 3.

Table 3 Mechanical properties

Grade		Symbol of grade	Tensile strength N/mm²	Yield point or proof stress N/mm²	Elongation [a) b)] %				Flattening resistance	Bendability	
					Test piece No. 11 Test piece No. 12	Test piece No. 5	Test piece No. 4 [c)]		Distance between flat plates (H) [d)]	Bending angle [e)]	Inside radius
					Direction parallel to tube axis	Direction perpendicular to tube axis	Direction parallel to tube axis	Direction perpendicular to tube axis			
Grade 11	A	STKM11A	290 min.	—	35 min.	30 min.	33 min.	28 min.	$\frac{1}{2}D$	180°	4 D
Grade 12	A	STKM12A	340 min.	175 min.	35 min.	30 min.	33 min.	28 min.	$\frac{2}{3}D$	90°	6 D
	B	STKM12B	390 min.	275 min.	25 min.	20 min.	23 min.	18 min.	$\frac{2}{3}D$	90°	6 D
	C	STKM12C	470 min.	355 min.	20 min.	15 min.	18 min.	14 min.	—	—	—
Grade 13	A	STKM13A	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.	$\frac{2}{3}D$	90°	6 D
	B	STKM13B	440 min.	305 min.	20 min.	15 min.	18 min.	14 min.	$\frac{3}{4}D$	90°	6 D
	C	STKM13C	510 min.	380 min.	15 min.	10 min.	14 min.	9 min.	—	—	—
Grade 14	A	STKM14A	410 min.	245 min.	25 min.	20 min.	23 min.	18 min.	$\frac{3}{4}D$	90°	6 D
	B	STKM14B	500 min.	355 min.	15 min.	10 min.	14 min.	9 min.	$\frac{7}{8}D$	90°	8 D
	C	STKM14C	550 min.	410 min.	15 min.	10 min.	14 min.	9 min.	—	—	—
Grade 15	A	STKM15A	470 min.	275 min.	22 min.	17 min.	20 min.	16 min.	$\frac{3}{4}D$	90°	6 D
	C	STKM15C	580 min.	430 min.	12 min.	7 min.	11 min.	6 min.	—	—	—
Grade 16	A	STKM16A	510 min.	325 min.	20 min.	15 min.	18 min.	14 min.	$\frac{7}{8}D$	90°	8 D
	C	STKM16C	620 min.	460 min.	12 min.	7 min.	11 min.	6 min.	—	—	—
Grade 17	A	STKM17A	550 min.	345 min.	20 min.	15 min.	18 min.	14 min.	$\frac{7}{8}D$	90°	8 D
	C	STKM17C	650 min.	480 min.	10 min.	5 min.	9 min.	4 min.	—	—	—
Grade 18	A	STKM18A	440 min.	275 min.	25 min.	20 min.	23 min.	18 min.	$\frac{7}{8}D$	90°	6 D
	B	STKM18B	490 min.	315 min.	23 min.	18 min.	21 min.	17 min.	$\frac{7}{8}D$	90°	8 D
	C	STKM18C	510 min.	380 min.	15 min.	10 min.	14 min.	9 min.	—	—	—
Grade 19	A	STKM19A	490 min.	315 min.	23 min.	18 min.	21 min.	17 min.	$\frac{7}{8}D$	90°	6 D
	C	STKM19C	550 min.	410 min.	15 min.	10 min.	14 min.	9 min.	—	—	—
Grade 20	A	STKM20A	540 min.	390 min.	23 min.	18 min.	21 min.	17 min.	$\frac{7}{8}D$	90°	6 D

Table 3 (concluded)

NOTE 1	In this table, *D* stands for the outside diameter of tube.
NOTE 2	1 N/mm^2 = 1 MPa
Notes [a]	For tubes whose outside diameter is 40 mm or under, the elongation values in this table shall not be applied, but the elongation test results shall be recorded. The value of elongation may be specified upon agreement between the purchaser and the manufacturer.
[b]	For tubes not subjected to heat treatment after being cold finished, the elongation value in this table shall not be applied, but the elongation test results shall be recorded. The value of elongation may be specified upon agreement between the purchaser and the manufacturer.
[c]	The tensile direction shall be equal to the direction parallel to tube axis. Where feasible, test pieces may be taken in the direction perpendicular to the tube axis instead of the direction parallel to the tube axis.
[d]	The minimum value of the distance between plates (*H*) for flattening test shall be five times the tube wall thickness. For the tubes having outside diameter not more than five times the wall thickness, the distance between plates (*H*) shall be as agreed between the purchaser and the manufacturer.
[e]	The bending angle shall be measured from the starting point of the bend.

Table 4 Elongation of tubes with a wall thickness under 8 mm, tested using Test pieces No. 5 (direction perpendicular to tube axis) and No. 12 (direction parallel to tube axis)

Unit: %

Grade		Symbol of grade	Test piece	Wall thickness							
				1 mm or under	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
Grade 11	A	STKM11A	Test piece No. 5	20 min.	21 min.	22 min.	24 min.	26 min.	27 min.	28 min.	30 min.
			Test piece No. 12	24 min.	26 min.	28 min.	29 min.	30 min.	32 min.	34 min.	35 min.
Grade 12	A	STKM12A	Test piece No. 5	20 min.	21 min.	22 min.	24 min.	26 min.	27 min.	28 min.	30 min.
			Test piece No. 12	24 min.	26 min.	28 min.	29 min.	30 min.	32 min.	34 min.	35 min.
	B	STKM12B	Test piece No. 5	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
			Test piece No. 12	14 min.	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
	C	STKM12C	Test piece No. 5	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
			Test piece No. 12	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.

Table 4 (continued)

Unit: %

Grade		Symbol of grade	Test piece	Wall thickness							
				1 mm or under	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
Grade 13	A	STKM13A	Test piece No. 5	14 min.	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
			Test piece No. 12	20 min.	21 min.	22 min.	24 min.	26 min.	27 min.	28 min.	30 min.
	B	STKM13B	Test piece No. 5	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
			Test piece No. 12	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
	C	STKM13C	Test piece No. 5	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
			Test piece No. 12	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
Grade 14	A	STKM14A	Test piece No. 5	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
			Test piece No. 12	14 min.	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
	B	STKM14B	Test piece No. 5	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
			Test piece No. 12	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
	C	STKM14C	Test piece No. 5	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
			Test piece No. 12	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
Grade 15	A	STKM15A	Test piece No. 5	6 min.	8 min.	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.
			Test piece No. 12	12 min.	13 min.	14 min.	16 min.	18 min.	19 min.	20 min.	22 min.
	C	STKM15C	Test piece No. 5	—	—	—	1 min.	2 min.	4 min.	6 min.	7 min.
			Test piece No. 12	2 min.	3 min.	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.
Grade 16	A	STKM16A	Test piece No. 5	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
			Test piece No. 12	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
	C	STKM16C	Test piece No. 5	—	—	—	1 min.	2 min.	4 min.	6 min.	7 min.
			Test piece No. 12	2 min.	3 min.	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.

Table 4 (concluded)

Unit: %

Grade		Symbol of grade	Test piece	Wall thickness							
				1 mm or under	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
Grade 17	A	STKM17A	Test piece No. 5	4 min.	6 min.	8 or over	9 min.	10 min.	12 min.	14 min.	15 min.
			Test piece No. 12	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
	C	STKM17C	Test piece No. 5	—	—	—	—	—	2 min.	4 min.	5 min.
			Test piece No. 12	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
Grade 18	A	STKM18A	Test piece No. 5	10 min.	11 min.	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.
			Test piece No. 12	14 min.	16 min.	18 min.	19 min.	20 min.	22 min.	24 min.	25 min.
	B	STKM18B	Test piece No. 5	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.	16 min.	18 min.
			Test piece No. 12	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.	22 min.	23 min.
	C	STKM18C	Test piece No. 5	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
			Test piece No. 12	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
Grade 19	A	STKM19A	Test piece No. 5	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.	16 min.	18 min.
			Test piece No. 12	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.	22 min.	23 min.
	C	STKM19C	Test piece No. 5	—	1 min.	2 min.	4 min.	6 min.	7 min.	8 min.	10 min.
			Test piece No. 12	4 min.	6 min.	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.
Grade 20	A	STKM20A	Test piece No. 5	8 min.	9 min.	10 min.	12 min.	14 min.	15 min.	16 min.	18 min.
			Test piece No. 12	12 min.	14 min.	16 min.	17 min.	18 min.	20 min.	22 min.	23 min.

NOTE The elongation values in this table are given by deducting 1.5, for every 1 mm decrease in wall thickness from 8 mm, from the values given in Table 3 and rounding the results to the whole number according to Rule A in **JIS Z 8401**.

7 Dimensions and dimensional tolerances

7.1 Dimensions

The dimensions shall be as agreed between the purchaser and the manufacturer.

7.2 Dimensional tolerances

The dimensional tolerances shall be as follows.

a) The tolerances on the outside diameter and the wall thickness of tubes shall be as given in Table 5 and Table 6, respectively. For hot finished seamless steel tubes, Class 1 given in Tables 5 and 6 shall be applied. For other tubes, the category to be applied shall be determined according to the agreement between the purchaser and the manufacturer.

The tolerance on outside diameter and wall thickness for tubes manufactured from coated steel sheet or coated steel strip shall be as given in Tables 5 and 6. The plus tolerance shall apply to the outside diameter and wall thickness including the coating layer, and the minus tolerance shall apply to the outside diameter and wall thickness values reduced by the equivalent or actually measured coating thickness.

Equivalent coating thickness shall be as specified in **JIS G 3302** in the case of hot-dip zinc coating, as specified in **JIS G 3313** in the case of electrolytic zinc coating, as specified in **JIS G 3314** in the case of hot-dip aluminium coating, as specified in **JIS G 3317** in the case of hot-dip zinc-5 % aluminium alloy coating, as specified in **JIS G 3321** in the case of hot-dip 55 % aluminium-zinc alloy coating and as specified in **JIS G 3323** in the case of hot-dip zinc-aluminium-magnesium alloy coating.

b) The tolerance on tube length shall be $^{+50}_{0}$ mm. If other tolerance than this is to be applied, it shall be subjected to the agreement between the purchaser and the manufacturer.

Table 5 Tolerances on outside diameter [a)]

Category	Outside diameter	Tolerances on outside diameter
Class 1	Under 50 mm	±0.5 mm
	50 mm or over	±1.0 %
Class 2	Under 50 mm	±0.25 mm
	50 mm or over	±0.50 %
Class 3	Under 25 mm	±0.12 mm
	25 mm or over to and excl. 40 mm	±0.15 mm
	40 mm or over to and excl. 50 mm	±0.18 mm
	50 mm or over to and excl. 60 mm	±0.20 mm
	60 mm or over to and excl. 70 mm	±0.23 mm
	70 mm or over to and excl. 80 mm	±0.25 mm
	80 mm or over to and excl. 90 mm	±0.30 mm
	90 mm or over to and excl. 100 mm	±0.40 mm
	100 mm or over	±0.50 %
Note [a)]	For local repaired parts, the tolerances on outside diameter in this table shall not apply.	

Table 6 Tolerances on wall thickness

Category	Wall thickness	Tolerances on wall thickness
Class 1	Under 4 mm	+0.6 mm –0.5 mm
	4 mm or over	+15 % –12.5 %
Class 2	Under 3 mm	±0.3 mm
	3 mm or over	±10 %
Class 3	Under 2 mm	±0.15 mm
	2 mm or over	±8 %

c) For tolerance on wall thickness of the weld of the tube, either of the following shall apply.

1) The same wall thickness tolerance as the tubes (base metal). Wall thickness tolerance of other categories than that applied to base metal may be applied upon agreement between the purchaser and the manufacturer.

2) For tubes with inner weld beads left unremoved by agreement, the upper limit specified in Table 7.

Table 7 Upper limit of wall thickness of weld (for tubes with inner weld beads left unremoved)

Wall thickness of base metal	Upper limit of wall thickness
2.38 mm or under	Twice the wall thickness of base metal
Over 2.38 mm	Wall thickness of base metal + 2.38 mm

8 Appearance

The appearance shall be as follows.

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

b) Both internal and external surfaces of tubes shall be finished smoothly and free from defects detrimental to use.

c) The tubes may be repaired by grinding, machining or other method, provided that the wall thickness after repair is within the specified tolerance on wall thickness.

d) The surface of the repaired part shall be smooth along the contour of the tube.

e) The surface finishing of tubes and coating, when especially requested, shall be as agreed between the purchaser and the manufacturer.

9 Tests

9.1 Chemical analysis

9.1.1 General requirements and sampling method

General requirements for chemical analysis and sampling method for heat analysis shall be in accordance with Clause 8 of **JIS G 0404**. When the product analysis is requested by the purchaser, the sampling method shall be in accordance with Clause 4 of **JIS G 0321**.

9.1.2 Analytical method

The heat analysis method shall be in accordance with **JIS G 0320**. The product analysis method shall be in accordance with **JIS G 0321**.

9.2 Mechanical tests

9.2.1 General

General requirements for mechanical tests shall be in accordance with Clauses 7 and 9 of **JIS G 0404**. However, the sampling method for mechanical tests shall be in accordance with Class A in 7.6 of **JIS G 0404**.

The mechanical tests for tubes manufactured from coated steel sheets or coated steel strip shall be performed on tubes with the coating applied.

9.2.2 Sampling method and number of test pieces

The sampling method and the number of test pieces shall be as given in Table 8.

Table 8 Sampling method and number of test pieces

Outside diameter	Sampling method	Number of test pieces
65 mm or under	Take one sample from each 2 000 m and its fraction of tubes of the same dimensions [a] and the same heat treatment batch [b] [c].	The number of test pieces to be taken from the sample is as follows. The test piece to be applied shall be in accordance with **9.2.3**, **9.2.4** and **9.2.5**. Tensile test piece : one Flattening test piece : one Bend test piece : one
Over 65 mm up to and incl. 100 mm	Take one sample from each 1 000 m and its fraction of tubes of the same dimensions [a] and the same heat treatment batch [b] [c].	
Over 100 mm up to and incl. 200 mm	Take one sample from each 500 m and its fraction of tubes of the same dimensions [a] and the same heat treatment batch [b] [c].	
Over 200 mm	Take one sample from each 250 m and its fraction of tubes of the same dimensions [a] and the same heat treatment batch [b] [c].	

Notes
[a] "Same dimensions" refer to the same outside diameter and the same wall thickness.
[b] Applicable to heat-treated tubes. The "same heat treatment batch" in the case of using continuous furnace refers to a unit of tubes from continuous furnace operation under the same heat treatment conditions, and tubes which are heat treated after any stop of furnace operation do not belong to the same heat treatment batch.
[c] In the case of sampling from a unit of tubes from the same cast, the tubes in the unit may be of the same heat treatment condition, instead of being from the same heat treatment batch.

9.2.3 Tensile test

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

a) **Test piece** Test pieces shall be either Test piece No. 11, No. 12 (No. 12A, No. 12B or No. 12C), No. 4 or No. 5 specified in **JIS Z 2241**. Test piece No. 4 shall be of diameter 14 mm (gauge length 50 mm). Test piece No. 12 or No. 5 for the tensile test of electric resistance welded steel tube and butt-welded steel tube shall be taken from a portion not containing the weld.

For tubes manufactured from coated steel sheet or coated steel strip, the wall thickness value used for calculation of the yield point or proof stress, and tensile strength shall be one of the following.

— Actually measured wall thickness after removal of coating

— Actually measured wall thickness including the coating layer, from which the

equivalent coating thickness has been deducted

— Actually measured wall thickness including the coating layer, from which the coating thickness obtained through conversion of the actually measured coating mass has been deducted

b) **Test method** The test method shall be as specified in **JIS Z 2241**.

9.2.4 Flattening test

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

The flattening test of seamless steel tubes may be omitted unless otherwise specified by the purchaser [1)].

Note [1)] It means that although the test may be omitted according to the judgement of the manufacturer, the tubes shall satisfy the specified flattening resistance.

a) **Test piece** The length of the test piece shall be 50 mm or greater. For tubes of wall thickness 15 % or over of the outside diameter, C-shaped test piece prepared by removing a part of the circumference of a ring-shaped test piece may be used. The part to be removed shall be as shown in Figure 2.

b) **Test method** Place the test piece at ordinary temperature (5 °C to 35 °C) between two flat plates and compress to flatten until the distance between the plates H becomes equal to or smaller than the value specified in Table 3, then examine for cracks on the test piece. For testing the electric resistance welded steel tube and butt-welded steel tube, place the test piece, as shown in Figure 1, such that the line connecting the centre of the tube and the weld is perpendicular to the direction of compression. In the case of C-shaped test piece, see Figure 2.

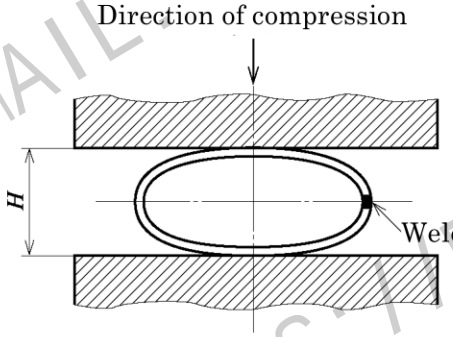

Figure 1 Flattening test (using ring-shaped test piece)

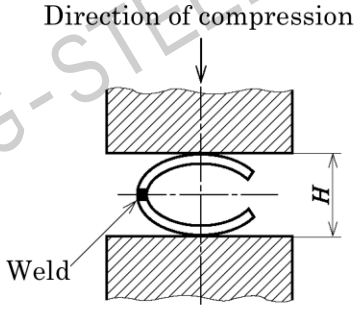

Figure 2 Flattening test (using C-shaped test piece)

9.2.5 Bend test

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

a) **Test piece** The test piece shall be of the proper length for the bend test.

b) **Test method** Bend the test piece around a cylinder at ordinary temperature (5 °C

to 35 °C) at a bending angle not less than the minimum bending angle specified in Table 3, and with an inside radius not more than the maximum inside radius specified in Table 3, and examine the test piece for cracks. For testing the electric resistance welded steel tube and butt-welded steel tube, place the test piece such that the weld is 90 °C from the outermost position of the bend.

NOTE In addition to the tests specified in this Standard, a hydrostatic test, non-destructive test at the weld and other tests are in some cases carried out upon agreement between the purchaser and the manufacturer. In this case, the test item, sampling method, test method, acceptance criteria, or any other test requirements shall be previously agreed between the purchaser and the manufacturer.

10 Inspection and reinspection

10.1 Inspection

The inspection shall be as follows.

a) General requirements for inspection shall be in accordance with **JIS G 0404**.

b) Chemical composition shall conform to the requirements of Clause **5**.

c) Mechanical properties shall conform to the requirements of Clause **6**.

d) Dimensions shall conform to the requirements of Clause **7**.

e) Appearance shall conform to the requirements of Clause **8**.

10.2 Reinspection

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

11 Marking

Each tube having passed the inspection shall be marked with the following information. When the marking on tube is difficult because its outside diameter is small or when so requested by the purchaser, the marking may be given on each bundle of tubes by a suitable means. In this case, the order of marking is not specified. Any information among the following not essential for identification of the product may be omitted upon agreement between the purchaser and the manufacturer.

a) Symbol of grade

b) Symbol for manufacturing method

The symbol for manufacturing method shall be as follows. A dash may be replaced with a blank.

1) Hot finished seamless steel tube : –S–H

2) Cold finished seamless steel tube : –S–C

3) As electric resistance welded steel tube : –E–G

4) Hot-finished electric resistance welded steel tube : –E–H

5) Cold-finished electric resistance welded steel tube : –E–C

6) Butt-welded steel tubes –B

c) Dimensions The outside diameter and wall thickness shall be marked.

d) Manufacturer's name or abbreviation

e) Symbol indicating the type of coating (in the case of using coated steel sheet or coated steel strip). This symbol shall be as agreed between the purchaser and the manufacturer.

f) Symbol W, which indicates that different wall thickness tolerances have been applied to the weld and the base metal (as agreed between the purchaser and the manufacturer). The dash before W may be replaced with a blank.

Example For as electric resistance welded steel tube manufactured from coated steel plate, wall thickness tolerance different from that applied to base metal has been applied to the weld upon agreement between the purchaser and the manufacturer.
STKM11A–E–G– (symbol of coating type : PZ) –W

12 Report

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

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

Annex A (normative)

Type of coating and coating mass for tubes manufactured from coated steel sheet or coated steel strip

A.1 Type of coating and coating mass

The type of coating and coating mass applied should be as follows.

a) The types of coating that can be applied are: hot-dip zinc coating, electrolytic zinc coating, hot-dip aluminium coating, hot-dip zinc-5 % aluminium alloy coating, hot-dip 55 % aluminium-zinc alloy coating or hot-dip zinc-aluminium-magnesium alloy coating. Upon agreement between the purchaser and the manufacturer, other types of coating than these may be applied [see **c**)]. When applying equivalent thickness coating, the coating mass as specified in **JIS G 3302**, **JIS G 3313**, **JIS G 3314**, **JIS G 3317**, **JIS G 3321** and **JIS G 3323** is applied.

b) In the case of applying hot-dip zinc coating and hot-dip 55 % aluminium-zinc alloy coating, the coating mass may be different between the front and rear surfaces of the steel sheet or steel strip (differential thickness coating). In this case, the following conditions should be satisfied.

1) The coating mass on the outer surface of the tube for hot-dip zinc coating should meet the minimum triple-spot average value [1)] and minimum single-spot value [1)] of 30 g/m^2 and 26 g/m^2, respectively, and for hot-dip 55 % aluminium-zinc alloy coating, 35 g/m^2 and 30 g/m^2, respectively.

Note [1)] See **5.3.2** of **JIS G 3302**.

2) The coating mass on the inner surface of the tube for both hot-dip zinc coating and hot-dip 55 % aluminium-zinc alloy coating should meet the minimum triple-spot average value and minimum single-spot value of 30 g/m^2 and 26 g/m^2, respectively.

c) Upon agreement between the purchaser and the manufacturer, other type of hot-dip coating or electrolytic coating than stated in **a**) may be applied. In this case, the following conditions should be satisfied.

1) For hot-dip coating, the total coating mass of both surfaces should meet the minimum triple-spot average value and minimum single-spot value of 60 g/m^2 and 51 g/m^2, respectively.

2) For electrolytic coating, the coating mass on one surface should meet the minimum value of 8.5 g/m^2 in the case of equal thickness coating and 8 g/m^2 in the case of differential thickness coating.

Errata for **JIS** (English edition) can be downloaded in PDF format at Webdesk (purchase information page) of our website (https://www.jsa.or.jp/).

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