JIS G3444 Carbon steel tubes for general structural purposes

1. Scope

This Japanese Industrial Standard specifies the carbon steel tubes (hereafter referred to as "tubes") used for civil engineering, architecture, steel towers, scaffoldings, struts, piles for suppression of landslide ([1]) and other structures.

Note ([1]) The tubes used for piles for suppression of landslide are limited to seamless steel tubes and welded steel tubes of under 318.5 mm in outside diameter.

Remarks

1. This Standard shall not apply to the foundation piles of the welded steel tube of 318.5 mm or larger in outside diameter and piles for suppression of landslide.

2. Grades and symbols

Tubes shall be classified into 5 grades, and their symbols shall be as given in Table 1.

Table 1 Grades and symbols

Symbol of Class	former symbol
STK 290	STK 30
STK 400	STK 41
STK 500	STK 51
STK 490	STK 50
STK 540	STK 55

World Standard Comparative Table

KS		ASTM		JIS		DIN		BS	
NUMBER	GRADE	NUMBER	GRADE	NUMBER	GRADE	NUMBER	GRADE	NUMBER	GRADE
D 3566	SPS 290(new) SPS 30 (old)	A500	Gr A	G-3444	STK290 (STK30)	-	-	6323	HFW2
	SPS 400(new) SPS 41 (old)	A252 A500 A501	Gr 2 Gr A -		STK400 (STK41)	-	-	6323	HFW4 RAW4 HFS4
	SPS 500(new) SPS 51 (old)	A500	Gr C		STK500 (STK51)	-	-	-	-

	SPS 490(new) SPS 50 (old)	-	-		STK490 (STK50)	-	-	6323	HFW5 HFS5 SAW5
	SPS 540(new) SPS 55 (old)	A500	Gr C		STK540 (STK55)	-	-	-	-
						17120 17121 17123 17124	UST37-2 ST37-2 STE255 STE255		
						17120 17123 17124	RST37-2 STE285 STE285		
						17120 17121 17123 17124	ST37-3 ST37-3 STE355 STE355		
						17120 17121 17123 17124	ST44-2 ST44-2 STE460 STE460		
						17120 17121 17123 17124	ST44-3 ST44-3 TSTE255 TSTE255		
						17120 17121 17123 17124	ST52-3 ST52-3 TSTE285 TSTE285		
						17123 17124	TSTE355 TSTE355		

						17123 17124	TSTE460 TSTE460		

3. Chemical Composition

The tube shall be tested in accordance with 8.1 and the cast analysis values shall conform to Table 2.

Table 2 Chemical Composition

Unit:%

Symbol of grade	C	Si	Mn	P	S
STK 290	-	-	-	0.050 max.	0.050 max.
STK 400	0.25 max.	-	-	0.040 max.	0.040 max.
STK 500	0.24 max.	0.35 max.	0.30~1.30	0.040 max.	0.040 max.
STK 490	0.18 max.	0.55 max.	1.50 max.	0.040 捞窍	0.040 max.
STK 540	0.23 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.

Remark

1. Alloying elements other than those in the above table may be added, if necessary.
2. For the tube of grade SPS 540 exceeding 12.5 mm in wall thickness, the chemical composition may be agreed upon by the purchaser and manufacturer.
3. When the purchaser requires product analysis for the tube made of killed steel, the tolerances for the values given in the above table shall be as specified in Table 1. (Tolerance on product analysis) in JIS G0321.

4. Mechanical properties

The tube shall be tested in accordance with 8.2, 8.3 and 8.4 and the resulting tensile strength, yield point or proof stress, elongation, bendability, flattening and tensile strength in welded zone shall conform to Table 2.

In the case of bendability or flattening test, the tube shall be free from flaws or cracks on its wall surface.

Further, the tensile test for the electric resistance welded and arc welded steel tube exceeding 350 mm in outside diameter may be substituted by the tensile test made on the steel coil or plate, unless expansion forming process is applied.

Table .3 Mechanical properties

Mechanical properties	Tensile strength N/Π	Yield point or proof stress N/Π	Elongation %		Bendability ()		Flattening	Tensile strength in welded zone N/Π
			No. 11 and No.12 test pieces	No. 5 test piece	Bend angle	Inside radius (D: outside diameter of tube)	Distance between flattening plates(H) (D: outside diameter of tube)	

Method of manufacture		Seamless, butt-welding, electric resistance welding and arc welding process				Seamless, butt-welding electric resistance welding process		Seamless butt-welding. electric resistance welding process	Arc welding process
Method of manufacture	Outside diameter	Full range	Full range	Over 40 mm		50 mm or under		Full range	Over 350 mm
STK 290		290 min.	-	30 min.	25 min.	90Σ	6D	2/3D	290 min.
STK400		400 min.	235 min.	23 min.	18 min.	90Σ	6D	2/3D	400 min.
STK 500		500 min.	355 min.	15 min.	10 min.	90Σ	6D	7/8D	500 min.
STK 490		490 min.	315 min.	23 min.	18 min.	90Σ	6D	7/8D	490 min.
STK 540		540 min.	390 min.	20 min.	16 min.	90Σ	6D	7/8D	540 min.

Note ([1]) The bend test, instead of the flattening test, shall be applied to the tube 50 mm or under in outside diameter only when specified by the purchaser.

Remark

1. When the tensile test for the tube under 8 mm in wall thickness is performed using No.12 or No.5 test piece, the minimum elongation value shall be determined by reducing 1.5 % per 1 mm decrease in wall thickness from the values in Table 3 and rounding off the value obtained to an integer in accordance with JIS Z 8401.
2. The elongation values for the tube 40 mm or under in outside diameter, if particularly required, shall be agreed upon by the purchaser and manufacturer.
3. No. 12 or No. 5 test piece for the tensile test to be sampled from a butt-welded, electric resistance welded or arc welded steel tube shall be taken from a portion without seams.

5. Dimensions, mass and tolerances on dimensions

5.1 Dimensions and mass

Unless otherwise specified, the outside diameter, wall thickness and mass of the tube shall be as given in Attached Table 1.

Attached Table 1. Dimensions and mass of carbon steel tubes for general structural purposes

Outside diameter mm	Thickness mm	Unit mass kg/m	Informative reference			
			Cross-sectional area P	Geometrical moment of inertia H^4	Modulus of section Ж	Radius of gyration of area H
21.7	2.0	0.972	1.238	0.607	0.560	0.700
27.2	2.0 2.3	1.24 1.41	1.583 1.799	1.26 1.41	0.930 1.03	0.890 0.880
34.0	2.3	1.80	2.291	2.89	1.70	1.12

42.7	2.3	2.29	2.919	5.97	2.80	1.43
	2.5	2.49	3.157	6.40	3.00	1.42
	2.8	2.76	3.510	7.02	3.29	1.41
48.6	2.3	2.63	3.345	8.99	3.70	1.64
	2.5	2.84	3.621	9.65	3.97	1.63
	2.8	3.16	4.029	10.6	4.36	1.62
	3.2	3.58	4.564	11.8	4.86`	1.61
60.5	2.3	3.30	4.205	17.8	5.90	2.06
	3.2	4.52	5.760	23.7	7.84	2.03
	4.0	5.57	7.100	28.5	9.41	2.00
76.3	2.8	5.08	6.465	43.7	11.5	2.60
	3.2	5.77	7.349	49.2	12.9	2.59
	4.0	7.13	9.085	59.5	15.6	2.56
89.1	2.8	5.96	7.591	70.7	15.9	3.05
	3.2	6.78	8.636	79.8	17.9	3.04
	4.0	8.39	10.69	97.0	21.8	3.01
101.6	3.2	7.76	9.892	120	23.6	3.48
	4.0	9.63	12.26	146	28.8	3.45
	5.0	11.9	15.17	177	34.9	3.42
114.3	3.2	8.77	11.17	172	30.2	3.93
	3.6	9.83	12.52	192	33.6	3.92
	4.5	12.2	15.52	234	41.0	3.89
	5.6	15.0	19.12	283	49.6	3.85
139.8	3.6	12.1	15.40	357	51.1	4.82
	4.0	13.4	17.07	394	56.3	4.80
	4.5	15.0	19.13	438	62.7	4.79
	6.0	19.8	25.22	566	80.9	4.74
165.2	4.5	17.8	22.72	734	88.9	5.68
	5.0	19.8	25.16	808	97.8	5.67
	6.0	23.6	30.01	952	115	5.63

	7.0	27.3	34.79	109】10	132	5.60
190.7	4.5	20.7	26.32	114】10	120	6.59
	5.0	22.9	29.17	126】10	132	6.57
	6.0	27.3	34.82	149】10	156	6.53
	7.0	31.7	40.40	171】10	179	6.50
216.3	4.5	23.5	29.94	168】10	155	7.49
	6.0	31.1	39.61	219】10	203	7.44
	7.0	36.1	46.03	252】10	233	7.40
	8.0	41.1	52.35	284】10	263	7.37
267.4	6.0	38.7	49.27	421】10	315	9.24
	7.0	45.0	57.27	486】10	363	9.21
	8.0	51.2	65.19	549】10	411	9.18
	9.0	57.4	73.06	611】10	457	9.14
318.5	6.0	46.2	58.91	719】10	452	11.1
	7.0	53.8	68.50	831】10	552	11.0
	8.0	61.3	78.04	941】10	591	11.0
	9.0	68.7	87.51	105】10^2	659	10.9
355.6	6.3	54.3	69.13	105】10^2	593	12.4
	8.0	68.6	87.36	132】10^2	742	12.3
	9.0	76.9	98.00	147】10^2	828	12.3
	12.0	102	129.5	191】10^2	108】10	12.2
406.4	9.0	88.2	112.4	222】10^2	109】10	14.1
	12.0	117	148.7	289】10^2	142】10	14.0
	16.0	154	196.2	374】10^2	184】10	13.8
	19.0	182	231.2	435】10^2	214】10	13.7
457.2	9.0	99.5	126.7	318】10^2	140】10	15.8
	12.0	132	167.8	416】10^2	182】10	15.7
	16.0	174	221.8	540】10^2	236】10	15.6
	19.0	205	261.6	629】10^2	275】10	15.5
500	9.0	109	138.8	418】10^2	167】10	17.4

	12.0	144	184.0	548】10^2	219】10	17.3
	14.0	168	213.8	632】10^2	253】10	17.2
508.0	9.0	111	141.1	439】10^2	173】10	17.6
	12.0	147	187.0	575】10^2	226】10	17.5
	14.0	171	217.3	663】10^2	261】10	17.5
	16.0	194	247.3	749】10^2	295】10	17.4
	19.0	229	291.9	874】10^2	344】10	17.3
	22.0	264	335.9	994】10^2	391】10	17.2
558.8	9.0	122	155.5	588】10^2	210】10	19.4
	12.0	162	206.1	771】10^2	276】10	19.3
	16.0	214	272.8	101】10^3	360】10	19.2
	19.0	253	322.2	118】10^3	421】10	19.1
	22.0	291	371.0	134】10^3	479】10	19.0
600	9.0	131	167.1	730】10^2	243】10	20.9
	12.0	174	221.7	958】10^2	320】10	20.8
	14.0	202	257.7	111】10^3	369】10	20.7
	16.0	230	293.6	125】10^3	418】10	
609.6	9.0	133	169.8	766】10^2	251】10	
	12.0	177	225.3	101】10^3	330】10	21.2
	14.0	206	262.0	116】10^3	381】10	21.1
	16.0	234	298.4	132】10^3	432】10	21.1
	19.0	277	352.5	154】10^3	505】10	
	22.0	319	406.1	176】10^3	576】10	

5.2 Tolerances on dimensions Tolerances on dimensions shall be as follows

(1) The tolerances on outside diameter and wall thickness fo the tube shall be as specified in Table 4 and 5, respectively. In this case, unless otherwise specified, Class 1 shall be applied.

Table 4 Tolerances on outside diameter

Classification	Tolerances
Class 1	Under 50mm 【0.5mm 50mm or over 【1%

Class 2	Under 50mm 【0.25mm 50mm or over 【0.5%

Remarks

1. The tolerances on the outside diameter of hot finished seamless steel tubes shall follows Class 1.

2. The tolerances on the outside diameter of electric resistance welded and arc welded steel tubes exceeding 350 mm in outside diameter shall follows Class 1 in Table 4, and the tolerances thereof at tube ends shall be within 【0.5 %.

3. The outside diameter of tubes exceeding 350 mm in outside diameter maybe determined by the length of circumference.

Table 5 Tolerances on wall thickness

Classification	Tolerances	
	Seamless steel tube	Other than seamless steel tube
Class 1	Under 4mm +0.6mm -0.5mm 4mm or over +15% -12.5%	Under 4mm +0.6mm -0.5mm 4mm or over +15% Under 12mm -12.5% 12mm or over +15% -1.5mm
Class 2	Under 3mm 【0.3% 3mm or over 【10%	Under 3mm 【0.3% 3mm or over 【10% Under 12mm 【10% 12mm or over +10% -1.2mm

Remarks

1. The tolerances on wall thickness of hot finished seamless steel tubes shall follow Class 1.

2. The tolerance on wall thickness of tubes exceeding 1016.0 mm in outside diameter may be agreed upon between the purchaser and the manufacturer.

6. Appearance

The appearance shall be as follows

(1) The tube shall be practically straight, and both ends shall be at a right angle to the axis of the tube.

(2) The tube shall be free from defects which are detrimental to practical use.

(3) When particularly required by the purchaser, the surface finishing and plating of the tube shall be agreed upon by the purchaser and the manufacturer.

7. Method of manufacture

The manufacturing method shall be as follows:

(1) The tube shall be manufactured by seamless process, electric resistance welding, butt-welding or are-welding (spiral seam and straight seam) process.

(2) The tube shall, as a rule, be as-manufactured without heat treatment.

8. Test

8.1 Chemical analysis

8.1.1 Chemical analysis

General requirements on chemical analysis and the methods of sampling specimens for analysis shall be in accordance with 3. (Chemical composition in JIS G 0303)

8.1.2 Analysis method

The analysis methods shall be in accordance with any one of the following standards:

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1253, JIS G 1256, JIS G 1257.

8.2 Tensile test

8.2.1 Test piece

The test piece shall be as follows:

(1) The test piece shall be No. 11, No. 12A, No. 12B, No. 12C or No. 5 test piece specified in JIS Z 2201, and cut off from the tube. No. 5 test piece may be used on request by the purchaser, or for the tube 200 mm or over in outside diameter, and it shall be cut from a tube in a transverse direction to be made into a flat piece. However, the electric resistance welded and arc welded steel tubes exceeding 350 mm in outside diameter shall be in accordance with (2) and (3).

(2) For an electric resistance welded and arc welded steel tube over 350 mm in outside diameter, the test piece shall be No. 5 test specified in JIS Z 2201 and the sampling method shall be either one of the following.

(a) For the tube made by expansion forming process, a test piece shall be cut off from the tube itself.

(b) For the tube not by expansion forming process, a test piece shall be cut off from the tube itself, steel coil or plate as the material of tube.

(3) In the case of the tensile test piece for the welded zone of the arc welded steel tube, a test specimen shall be cut either from the tube itself or from the part of tube end that is welded under the same conditions as the tube itself to be flattened. Afterward, the test piece taken from this specimen shall be finished into No. 1 test piece specified in JIS Z 3121.

8.2.2 Test method The test method shall be in accordance with JIS Z 2241. For a welded zone, its tensile strength shall be examined.

8.3 Bend test

8.3.1Test piece

A test piece of appropriate length shall be cut off from the end of a tube.

8.3.2 Test method

The test piece shall be bent at ordinary temperature through 90 x around a cylinder of an inside radius specified in Table 2. and checked for the existence of flaws or cracks on the surface of the tubular test piece.

For electric resistance welded steel tubes and butt-welded steel tubes, the welded zone shall be placed in the outermost part of bent portion.

8.4 Flattening test

8.4.1 Test piece

A test piece 50 mm or over in length shall be cut off from the end of a tube.

8.4.2 Test method

The test piece shall be placed at ordinary temperature between two flat plates and flattened by compression until the distance between the plates reaches the specified value, and then examined for the existence of flaws or cracks on the surface of tubular test piece. In the case of electric resistance welded and but-welded steel tubes, however, the welded zone shall be placed at right angles to the direction of compression as shown in Fig 1.

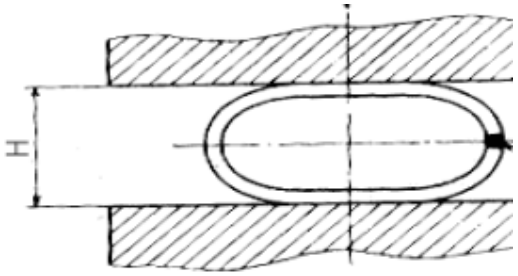

Fig. 1.

9. Inspection

9.1 Inspection

The inspection shall be carried out as follows:

(1) The general requirements for inspection shall be as specified in JIS G 0303.

(2) The chemical composition shall conform to the requirements specified in 4.

(3) The mechanical propertied shall conform to the requirements specified in 5. However, the flattening test and the tensile test in welded zone can be omitted when approved by the purchaser.

(4) The dimensions shall conform to the requirements specified in 6.

(5) The purchaser can specify hydrostatic test, nondestructive test in welded zone, etc. in addition to the inspection items specified in (2) to (5).

Table 6. Method of sampling test specimens and number of test pieces.

Division of outside diameter	Method of sampling test specimens and number of test piece
Under 100 mm	Take one test specimen from each 5000 m or its fraction of tubes of the same dimensions, and then prepare from it one tensile test piece or one bending test piece.
Over 100 mm up to and incl. 200 mm	Take one test specimen from each 2500 m or its fraction of tubes of the same dimensions, and then prepare from it one tensile test piece and one flattening test piece.

Over 200 mm up to and incl. 350 mm	Take one test specimen from each 1250 m or its fraction of tubes of the same dimensions, and then prepare from it one tensile test piece and one flattening test piece.
Over 350 mm	1. In the case of sampling from the tube Take one test specimen from each 1250 m or its fraction of tubes of the same dimensions, and then prepare from it one tensile test piece and one for tensile test in welded zone or one flattening test piece. 2. In the case of sampling for tensile test from the steel strips or plates in coil The method of sampling specimens for tensile test from steel strips or plates in coil shall be in accordance with Group A in JIS G 0303. As to the number of tensile test pieces, for steel plates, take one test piece from each lot of plates of the maximum thickness within twice the minimum thickness and at the same time belonging to the same heat, and take two test pieces from each lot exceeding 50 t. For steel strips, take one test piece from each lot of the same heat and thickness and take two from each lot exceeding 50 t.

9.2 Reinspection

The tube may be determined for acceptance or not by carrying out the retest as specified in 4.4 (Retest) of JIS G 0303.

10.Marking

Each tube having passed the inspection shall be marked with the following items. The arrangement of items is not specified. However, smaller tubes and those especially specified by the purchaser may be bundled together to be marked for each bundle by suitable means.

(1) Symbol of grade

(2) Symbol which denotes method of manufacture ([2])

(3) Dimensions

(4) Manufacturer's name or its identifying brand

Note ([2]) The symbol which denotes the method of manufacture shall be as follows,

However, the dash may be replaced by a blank.

Hot finished seamless steel tube: -S-H

Cold finished seamless steel tube: -S-C

Electric resistance welded steel tube other than hot finished or cold finished steel tube: -E-G

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

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

Butt-welded steel tube: -B

Arc-welded steel tube: -A

11. Report

The manufacturer shall submit a test report when previously requested by the purchaser.

JIS Number and Corresponding Foreign Standards

JIS			ASTM			BS			NF			Index Number
Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	
G3444	STK290	C	A252	Gr1	C				A49-642	TS30.0	C	C016
	(STK30)		A5000	Gr A	C				A49-643	TS30.0	C	
									A49-643	TS30a	C	
									A49-644	TS30.0	C	
									A49-645	TS30.0	C	
									"	TS30E	C	
									"	TS30ES	C	
	STK400	C	A252	Gr2	C	6232	SAW	C	A49-643	TS37a	C	
	(STK41)		A500	Gr B	C							
			A501	-	C							
	STK500	C				6323	SAW	C				
	(STK50)											
	STK490	C							A49-643	TS47a	C	
	(STK50)											
	STK540	C										
	(STK55)											