

JIS

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

④ JIS G 3444 : 2004
(JISF)



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Carbon steel tubes for general structural purposes

ICS 23.040.10; 77.140.75

Reference number : JIS G 3444 : 2004 (E)

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 3444 : 1994** is replaced with this Standard.

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Date of Establishment: 1961-02-01

Date of Revision: 2004-08-20

Date of Public Notice in Official Gazette: 2004-08-20

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Iron and Steel

JIS G 3444:2004, First English edition published in 2005-02

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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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: 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.

Information 1 The foundation piles for structures and piles for suppression of landslide are also specified in **JIS A 5525**.

2 Piles for suppression of landslide of centrifugally cast steel tubes are specified in **JIS G 5201**.

2 Normative references The standards listed in attached table 1 contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) shall be applied.

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

Table 1 Symbol of grade

Symbol of grade
STK 290
STK 400
STK 500
STK 490
STK 540

4 Manufacturing method The manufacturing method shall be as follows:

- Tubes are manufactured without seams or by electric resistance welding, forge welding or arc welding (spiral seam or straight seam).
- Tubes shall be as manufactured and generally not processed by heat treatment.

5 Chemical composition

5.1 Cast analysis A tube shall be tested in accordance with 9.1 and the cast analysis 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 to 1.30	0.040 max.	0.040 max.
STK 490	0.18 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.
STK 540	0.23 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.

- Remarks 1 If necessary, alloying elements other than those in the above table may be added.
- 2 For the tube of grade STK 540 exceeding 12.5 mm in wall thickness, the chemical composition may be agreed upon between the manufacturer and the purchaser.

5.2 Product analysis The product analysis of tubes shall be killed steel. When the product analysis is requested by the purchaser, the tube shall be tested in accordance with 9.1 and for the value, the variation tolerance value in attached table 2 of JIS G 0321 is applied to the value in table 2.

6 Mechanical properties The tube shall be tested in accordance with 9.2, 9.3 and 9.4, and the resulting tensile strength, yield point or proof stress, elongation, bendability, flattening and tensile strength in weld zone shall conform to table 3. However, the bendability and flattening are applied to seamless steel tubes, electric resistance welded tubes or butt welded-steel tubes, and the tensile strength in weld zone is applied to arc welded steel tubes.

When the tensile test for the tube of 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 value in table 3 and rounding off the result to the whole number in accordance with rule A in JIS Z 8401 as given in table 4.

In the case of bendability or flattening test, the tube shall be free from flaws or cracks on the wall of tube. 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 4 The minimum value of elongation in the case of No. 12 test piece (longitudinal direction) and No. 5 test piece (transverse direction) of tubes under 8 mm in wall thickness

Unit: %

Symbol of grade	The shape of test piece	Division of thickness							
		Over 7 mm to and excl. 8 mm	Over 6 mm up to and incl. 7 mm	Over 5 mm up to and incl. 6 mm	Over 4 mm up to and incl. 5 mm	Over 3 mm up to and incl. 4 mm	Over 2 mm up to and incl. 3 mm	Over 1 mm up to and incl. 2 mm	1 mm or under
STK 290	No. 12 test piece	30	28	27	26	24	22	21	20
	No. 5 test piece	25	24	22	20	19	18	16	14
STK 400	No. 12 test piece	23	22	20	18	17	16	14	12
	No. 5 test piece	18	16	15	14	12	10	9	8
STK 500	No. 12 test piece	15	14	12	10	9	8	6	4
	No. 5 test piece	10	8	7	6	4	2	1	—
STK 490	No. 12 test piece	23	22	20	18	17	16	14	12
	No. 5 test piece	18	16	15	14	12	10	9	8
STK 540	No. 12 test piece	20	18	17	16	14	12	11	10
	No. 5 test piece	16	14	13	12	10	8	7	6

7 Dimensions, mass and tolerance on dimensions

7.1 Outside diameter, thickness and mass The outside diameter, thickness and mass of tubes shall, unless otherwise specified, conform to attached table 2.

7.2 Tolerances on outside diameter and thickness The tolerances on the outside diameter and thickness of tubes shall respectively conform to table 5 and table 6.

Table 5 Tolerances on outside diameter

Classification	Outside diameter	Tolerance on outside diameter	Classification of application
Class 1	Under 50 mm 50 mm or over	± 0.5 mm ± 1 %	Hot finished seamless steel tube or when not especially specified.
Class 2	Under 50 mm 50 mm or over	± 0.25 mm ± 0.5 %	When especially specified. However, hot finished seamless steel tube is rejected.

Remarks 1 The tolerance on the outside diameter of electric resistance welded and arc welded steel tubes exceeding 350 mm in outside diameter shall follow class 1 in table 5 and tolerances of the outside diameter at the end part of the tube shall be ± 5 %.

2 The method for measuring the outside diameter of tubes exceeding 350 mm in outside diameter may be determined by the circumferential length.

Table 3 Mechanical properties

Mechanical properties	Tensile strength N/mm ²	Yield point or proof stress N/mm ²	Elongation %		Bendability ⁽²⁾		Flattening	Tensile strength in weld zone N/mm ²
			No. 11 and No. 12 test pieces	No. 5 test piece	Bend angle	Inside radius (<i>D</i> is outside diameter of tube)	Distance between flattening plates (<i>H</i>) (<i>D</i> is outside diameter of tube)	
			Longitudinal direction	Transverse direction				
Applied outside diameter	All outside diameter	All outside diameter	Over 40 mm		50 mm or under		All outside diameter ⁽²⁾	Over 350 mm
STK 290	290 min.	—	30 min.	25 min.	90°	6 <i>D</i>	$\frac{2}{3} D$	290 min.
STK 400	400 min.	235 min.	23 min.	18 min.	90°	6 <i>D</i>	$\frac{2}{3} D$	400 min.
STK 500	500 min.	355 min.	15 min.	10 min.	90°	8 <i>D</i>	$\frac{7}{8} D$	500 min.
STK 490	490 min.	315 min.	23 min.	18 min.	90°	6 <i>D</i>	$\frac{7}{8} D$	490 min.
STK 540	540 min.	390 min.	20 min.	16 min.	90°	6 <i>D</i>	$\frac{7}{8} D$	540 min.

Note (2) The bendability is applied only when specified by the purchaser and may substitute for the flattening property of tubes 50 mm or under in inside diameter.

Remarks 1 The elongation of tubes 40 mm or under in outside diameter, when especially required, shall conform to the agreement between the manufacturer and the purchaser.

2 1 N/mm² = 1 MPa

Table 6 Tolerances on wall thickness

Classi- fication	For seamless steel tube		For other than seamless steel tube		Classification of application
	Thickness	Tolerance on wall thickness	Thickness	Tolerance on wall thickness	
Class 1	Under 4 mm	+0.6 mm -0.5 mm	Under 4 mm	+0.6 mm -0.5 mm	Hot finished seam- less steel tube or when especially not specified.
	4 mm or over	+15 % -12.5 %	4 mm or over to and excl. 12 mm	+15 % -12.5 %	
			12 mm or over	+15 % -1.5 mm	
Class 2	Under 3 mm	±0.3 mm	Under 3 mm	±0.3 mm	When especially specified, hot finished seamless steel tube is rejected.
	3 mm or over	±10 %	3 mm or over to and excl. 12 mm	±10 %	
			12 mm or over	+10 % -1.2 mm	

Remarks : The tolerance on wall thickness of tube exceeding 1 016.0 mm in outside diameter may be as agreed upon between the manufacturer and the purchaser.

7.3 Length The length and tolerance of tube shall conform to the agreement between the manufacturer and the purchaser. Unless otherwise specified, the length of tube shall be the specified length or over.

8 Appearance The appearance shall be as follows:

- The tube shall be practically straight and its both ends shall be at right angle to the axis of the tube.
- The tube shall be free from defects which are differential to practical use.
- When particularly required by the purchaser, the surface finishing and plating of the tube shall be agreed upon between the manufacturer and the purchaser.

9 Tests

9.1 Chemical analysis The chemical analysis shall be as follows:

- General matter on chemical analysis** The chemical composition of tube shall be generally obtained by the cast analysis, and general matter on the analysis test shall conform to clause 8 of JIS G 0404.
- Sampling of analytical sample** Sampling of the analytical sample shall be as follows:
 - Cast analysis** Sampling of cast analytical sample shall conform to clause 8 of JIS G 0404.
 - Product analysis** The sampling of a product analysis sample when the sample is killed steel and the product analysis is requested by the purchaser, shall conform to clause 4 of JIS G 0321.

c) **Analysis method** The analysis method shall conform to **JIS G 0320**.

9.2 Tensile test

9.2.1 Test piece The test piece shall be as follows:

- a) The test piece shall be No. 11, No. 12 A, No. 12 B, No. 12 C 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 off from a tube in a traverse 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 conform to b) and c).
- b) For an electric resistance welded and arc welded steel tube over 350 mm in outside diameter, the test piece shall be No. 5 test piece specified in **JIS Z 2201** and the sampling method shall be either one of the following:
 - 1) For the tube made by expansion forming process, a test piece shall be cut off from the tube itself.
 - 2) 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.
- c) In the case of the tensile test piece for the weld zone of the arc welded steel tube, a test specimen shall be cut either from the tube itself or the part of tube end that is welded under the same condition as the tube itself to be flattened. Afterward, the test piece taken from the specimen shall be finished into No. 1 test piece specified in **JIS Z 3121**.
- d) When a tensile test piece is sampled from butt-welded-steel tube, electric resistance welded steel tube and arc welded steel tube, No. 12 test piece or No. 5 test piece shall be sampled from a part not containing the seam.

9.2.2 Test method The test method shall conform to **JIS Z 2241**. For a weld zone, tensile strength is examined.

9.2.3 Number of test pieces The sampling of a test specimen and the number of test pieces shall be as given in table 7.

9.3 Bend test The bend test shall be as follows:

- a) **Test piece** A test piece of an appropriate length shall be cut off from the end of a tube.
- b) **Test method** The test piece shall be bent at ordinary temperature through 90° around a cylinder of an inside radius specified in table 3, 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 weld zone shall be placed in the outmost part of the bent portion.
- c) **Number of test pieces** The sampling method of a test specimen and the number of test pieces shall be as given in table 7.

9.4 Flattening test The flattening test shall be as follows:

- a) **Test piece** A test piece 50 mm or over in length shall be cut off from the end of a tube.
- b) **Test method** The test piece shall be placed at an ordinary temperature between two flat plates and flattened by compression until the distance between the plates reaches the value specified in table 3, and then examined for the existence of flaws or cracks on the surface of a tubular test piece. In the case of electric resistance welded and butt-welded steel tubes, however, the weld zone shall be placed at right angles to the direction of compression as shown in figure 1.
- c) **Number of test pieces** The sampling method of a test specimen and the number of test pieces shall be as given in table 7.

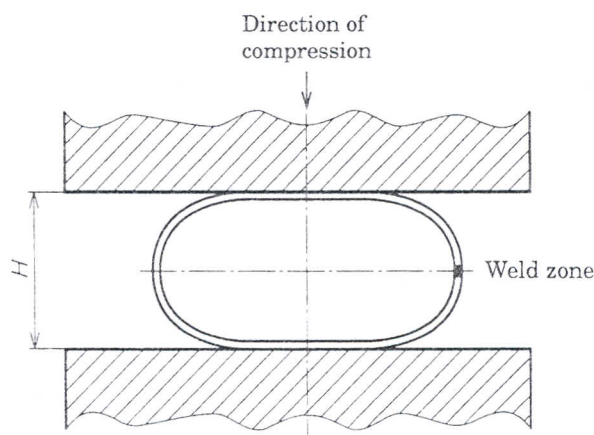


Figure 1 Flattening test

Table 7 Method of sampling test specimen and number of test pieces

Division of outside diameter	Method of sampling test specimens and number of test pieces
Under 100 mm	Take one test specimen from each 5 000 m or its fraction of tubes of the same dimensions, and then prepare from it one tensile test piece and either one flattening test piece or one bending test piece.
Over 100 mm up to and incl. 200 mm	Take one test specimen from each 2 500 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 1 250 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 a test specimen from the tube Take one test specimen from each 1 250 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 weld 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 in coil shall be in accordance with A in JIS G 0404. 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. 3) In the case of sampling tensile test piece for weld zone from the specimen welded under the same conditions as the tube itself. Take one test specimen from each 1 250 m or its fraction of tubes with the same dimensions, and then prepare one tensile test piece for weld zone from it.

10 Inspections

10.1 Inspection The inspection shall be carried out as follows:

- a) General matters for inspection shall be as specified in **JIS G 0404**.
- b) Chemical components shall conform to requirements specified in clause 5.
- c) Mechanical properties shall conform to requirements specified in clause 6. However, the flattening test and the tensile test in weld zone may be omitted when approved by the purchaser.
- d) Dimensions shall conform to requirements specified in clause 7.
- e) Appearance shall conform to requirements specified in clause 8.
- f) The purchaser may specify a hydrostatic test, the nondestructive test in a weld zone and the like in addition to the inspection items in b) to e).

In this case, the test items, sampling method, test method and their acceptance criteria shall previously be agreed upon between the manufacturer and the purchaser.

10.2 Reinspection The tube not accepted in the mechanical test, shall be determined for acceptance or not by carrying out the retest as specified in **9.8** of **JIS G 0404**.

11 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.

When approved by the purchaser, part of the items may be omitted.

- a) Symbol of grade
- b) Symbol which denotes method of manufacture⁽³⁾
- c) Dimensions
- d) Manufacturer's name or identifying brand

Note (3) 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

12 Report The report shall conform to clause **13** of **JIS G 0404**. When previously requested by the purchaser, the manufacturer shall submit the inspection document on which test results to be known are mentioned to the purchaser in accordance with **JIS G 0415**. The class of the inspection document, when especially not specified, shall conform to the symbol 2.3 (delivery inspection report) or 3.1 B (inspection certificate 3.1 B) of table 1 (summary table of inspection document).

Attached Table 1 Normative references

- 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 Z 2201 *Test pieces for tensile test for metallic materials*
JIS Z 2241 *Method of tensile test for metallic materials*
JIS Z 3121 *Methods of tensile test for butt welded joints*
JIS Z 8401 *Guide to the rounding of numbers*

Related standards:

- JIS A 5525 *Steel pipe piles*
JIS G 5201 *Centrifugally cast steel pipes for welded structure*

**Attached Table 2 Dimensions and mass of carbon steel tubes for
general structural purposes**

Outside diameter mm	Thickness mm	Unit mass kg/m	Informative			
			Cross-sectional area cm ²	Geometrical moment of inertia cm ⁴	Modulus of section cm ³	Radius of gyration of area cm
21.7	2.0	0.972	1.238	0.607	0.560	0.700
27.2	2.0	1.24	1.583	1.26	0.930	0.890
	2.3	1.41	1.799	1.41	1.03	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	2.48	3.157	6.40	3.00	1.42
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	2.58
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
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
	3.5	9.56	12.18	187	32.7	3.92
	4.5	12.2	15.52	234	41.0	3.89
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
	7.1	27.7	35.26	110×10	134	5.60
190.7	4.5	20.7	26.32	114×10	120	6.59
	5.3	24.2	30.87	133×10	139	6.56
	6.0	27.3	34.82	149×10	156	6.53
	7.0	31.7	40.40	171×10	179	6.50
	8.2	36.9	47.01	196×10	206	6.46
216.3	4.5	23.5	29.94	168×10	155	7.49
	5.8	30.1	38.36	213×10	197	7.45
	6.0	31.1	39.64	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
	8.2	42.1	53.61	291×10	269	7.36

Attached Table 2 (continued)

Outside diameter mm	Thickness mm	Unit mass kg/m	Informative			
			Cross-sectional area cm ²	Geometrical moment of inertia cm ⁴	Modulus of section cm ³	Radius of gyration of area cm
267.4	6.0	38.7	49.27	421×10	315	9.24
	6.6	42.4	54.08	460×10	344	9.22
	7.0	45.0	57.26	486×10	363	9.21
	8.0	51.2	65.19	549×10	411	9.18
	9.0	57.3	73.06	611×10	457	9.14
	9.3	59.2	75.41	629×10	470	9.13
318.5	6.0	46.2	58.91	719×10	452	11.1
	6.9	53.0	67.55	820×10	515	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
	10.3	78.3	99.73	119×10^2	744	10.9
355.6	6.4	55.1	70.21	107×10^2	602	12.3
	7.9	67.7	86.29	130×10^2	734	12.3
	9.0	76.9	98.00	147×10^2	828	12.3
	9.5	81.1	103.3	155×10^2	871	12.2
	12.0	102	129.5	191×10^2	108×10	12.2
	12.7	107	136.8	201×10^2	113×10	12.1
406.4	7.9	77.6	98.90	196×10^2	967	14.1
	9.0	88.2	112.4	222×10^2	109×10	14.1
	9.5	93.0	118.5	233×10^2	115×10	14.0
	12.0	117	148.7	289×10^2	142×10	14.0
	12.7	123	157.1	305×10^2	150×10	13.9
	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
	9.5	105	133.6	335×10^2	147×10	15.8
	12.0	132	167.8	416×10^2	182×10	15.7
	12.7	139	177.3	438×10^2	192×10	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	7.9	97.4	124.1	388×10^2	153×10	17.7
	9.0	111	141.1	439×10^2	173×10	17.6
	9.5	117	148.8	462×10^2	182×10	17.6
	12.0	147	187.0	575×10^2	227×10	17.5
	12.7	155	197.6	606×10^2	239×10	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

Attached Table 2 (concluded)

Outside diameter mm	Thickness mm	Unit mass kg/m	Informative			
			Cross-sectional area cm ²	Geometrical moment of inertia cm ⁴	Modulus of section cm ³	Radius of gyration of area cm
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	20.7
609.6	9.0	133	169.8	766×10^2	251×10	21.2
	9.5	141	179.1	806×10^2	265×10	21.2
	12.0	177	225.3	101×10^3	330×10	21.1
	12.7	187	238.2	106×10^3	348×10	21.1
	14.0	206	262.0	116×10^3	381×10	21.1
	16.0	234	298.4	132×10^3	431×10	21.0
	19.0	277	352.5	154×10^3	505×10	20.9
	22.0	319	406.1	176×10^3	576×10	20.8
700	9.0	153	195.4	117×10^3	333×10	24.4
	12.0	204	259.4	154×10^3	439×10	24.3
	14.0	237	301.7	178×10^3	507×10	24.3
	16.0	270	343.8	201×10^3	575×10	24.2
711.2	9.0	156	198.5	122×10^3	344×10	24.8
	12.0	207	263.6	161×10^3	453×10	24.7
	14.0	241	306.6	186×10^3	524×10	24.7
	16.0	274	349.4	211×10^3	594×10	24.6
	19.0	324	413.2	248×10^3	696×10	24.5
	22.0	374	476.3	283×10^3	796×10	24.4
812.8	9.0	178	227.3	184×10^3	452×10	28.4
	12.0	237	301.9	242×10^3	596×10	28.3
	14.0	276	351.3	280×10^3	690×10	28.2
	16.0	314	400.5	318×10^3	782×10	28.2
	19.0	372	473.8	373×10^3	919×10	28.1
	22.0	429	546.6	428×10^3	105×10^2	28.0
914.4	12.0	267	340.2	348×10^3	758×10	31.9
	14.0	311	396.0	401×10^3	878×10	31.8
	16.0	354	451.6	456×10^3	997×10	31.8
	19.0	420	534.5	536×10^3	117×10^2	31.7
	22.0	484	616.5	614×10^3	134×10^2	31.5
1016.0	12.0	297	378.5	477×10^3	939×10	35.5
	14.0	346	440.7	553×10^3	109×10^2	35.4
	16.0	395	502.7	628×10^3	124×10^2	35.4
	19.0	467	595.1	740×10^3	146×10^2	35.2
	22.0	539	687.0	849×10^3	167×10^2	35.2

Remarks : Mass listed above shall be calculated from the following formula assuming that the mass of steel of 1 cm³ is 7.85 g and rounding off the result to three significant digits in accordance with rule A of **JIS Z 8401**. However, the value exceeding 1 000 kg/m shall be rounded off to the whole number in kg/m.

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

where, W : unit mass of the tube (kg/m)
 t : wall thickness of the tube (mm)
 D : outside diameter of the tube (mm)