

JIS G3445 Carbon steel tubes for machine structural purposes

1. Scope

This Japanese Industrial Standard specifies the carbon steel tubes, hereinafter referred to as the "tubes", used for machinery, automobiles, bicycles, furniture, appliances and other machine parts.

Remark

1. The units and numerical values given in {} in this Standard are based on the International System of Units (SI) and are appended for informative reference.
2. Further, the traditional units accompanied by numerical values in this Standard shall be converted to the SI units and numerical values on January 1. 1991.

2. Grade and Designation

The grade and designation of the tube shall be as given in Table 1.

The subclassification letter symbols A, B and C are used to indicate distinction of method of manufacturing the tube, cold working process, heat treatment, etc.

Table 1. Grade and Designation

Grade		Designation
Grade 11	A	STKM 11A
Grade 12	A	STKM 12A
	B	STKM 12B
	C	STKM 12C
Grade 13	A	STKM 13A
	B	STKM 13B
	C	STKM 13C
Grade 14	A	STKM 14A
	B	STKM 14B
	C	STKM 14C
Grade 15	A	STKM 15A
	C	STKM 15C
Grade 16	A	STKM 16A

	C	STKM 16C
Grade 17	A	STKM 17A
	C	STKM 17C
Grade 18	A	STKM 18A
	B	STKM 18B
	C	STKM 18C
Grade 19	A	STKM 19A
	C	STKM 19C
Grade 20	A	STKM 20A

World Standard Comparative Table

KS			ASTM		JIS		BS	
NUBER	GRADE		NUBER	GRADE	NUBER	GRADE	NUBER	GRADE
D 3517	Grade 11 A	STKM 11 A	A513	MT1010	G-3445	STKM11A	-	-
			A519	MT1010				
	Grade 12A	STKM 12 A	A513	MT1015		STKM12A	980	CDS-3
			A519	MT1015				
	Grade 12 B	STKM 12 B	-	-		STKM12B	-	-
	Grade 12C	STKM 12C	A512	MT1015		STKM12C	-	-
			A513					
	Grade 13 A	STKM 13 A	A512	MT 1025		STKM13A	-	-
			A513	MTX1025				
			A519	MT 1025				
	Grade13B	STKM 13 B	-	-		STKM13B	980	CDS-4
	Grade13 C	STKM 13 C	-	-		STKM13C	-	-
Grade14 A	STKM 14 A		A513	MT1030		STKM14A	1717	CDS-103
			A519	MT1030				

	Grade14 B	STKM 14 B	-	-		STKM14B	-	-
	Grade14 C	STKM 14 C	-	-		STKM14C	-	-
	Grade15 A	STKM 15 A	A513	MT1033		STKM15A	1717	CDS-105
	Grade15 C	STKM 15 C	-	-		STKM15C	-	-
	Grade16 A	STKM 16 A	A519	MT1040		STKM16A	980	CDS-5
	Grade16 C	STKM 16 C	-	-		STKM16C	-	-
	Grade17 A	STKM 17 A	A519	MT1050		STKM17A	980 1717	CDS-7 CDS-107
	Grade17 C	STKM 17 C	-	-		STKM17B	-	-
	Grade18 A	STKM 18 A	A519	MT1524		STKM18A	980	CDS-9
	Grade18 B	STKM 18 B	-	-		STKM18B	-	-
	Grade18 C	STKM 18 C	-	-		STKM18C	-	-
	Grade19 A	STKM 19 A	-	-		-	-	-
	Grade19 C	STKM 19 C	-	-		-	-	-
	Grade20 A	STKM 20 A	-	-		-	-	-
-	-	-	A512	MT1008	-	-	-	-
-	-	-	A512	MTX1020	-	-	-	-
-	-	-	A519	MTX1020	-	-	-	-
-	-	-	A512	MTX1015	-	-	-	-
-	-	-	A519	MTX1015	-	-	-	-
-	-	-	A512	MT1008	-	-	-	-
-	-	-	A513	MT1008	-	-	-	-
-	-	-	A519	MT1008	-	-	-	-
-	-	-	A512	MT1010	-	-	-	-
-	-	-	A513	MT1010	-	-	-	-
-	-	-	A512	MT1012	-	-	-	-
-	-	-	A513	MT1012	-	-	-	-

			A519	MT1012				
-	-	-	A512	MT1015	-	-	-	-
			A512	MT1016				
-	-	-	A513	MT1016	-	-	-	-
			A519	MT1016				
			A512	MT1018				
-	-	-	A513	MT1018	-	-	-	-
			A519	MT1018				
			A512	MT1019				
-	-	-	A513	MT1019	-	-	-	-
			A519	MT1019				
			A512	MT1021				
-	-	-	A513	MT1021	-	-	-	-
			A519	MT1021				
			A512	MT1026				
-	-	-	A513	MT1026	-	-	-	-
			A519	MT1026				
			A512	MT1035				
-	-	-	A513	MT1035	-	-	-	-
			A519	MT1035				
-	-	-	A512	MT1100	-	-	-	-
			A512	MT1115				
-	-	-	A512	MT1117	-	-	-	-
			A513	MT1017				
-	-	-	A519	MT1017	-	-	-	-
			A513	MT1022				
-	-	-	A519	MT1022	-	-	-	-
			A513	MT1023				

			A519	MT1023				
-	-	-	A513	MT1024	-	-	-	-
			A519	MT1024				
-	-	-	A513	MT1050	-	-	-	-
			A519	MT1050				
-	-	-	A513	MT1060	-	-	-	-
-	-	-	A513	MT1340	-	-	-	-
-	-	-	A513	MT1524	-	-	-	-
			A519	MT1524				
-	-	-	A513	MT4118	-	-	-	-
-	-	-	A513	MT4130	-	-	-	-
-	-	-	A513	MT4140	-	-	-	-
-	-	-	A513	MT5130	-	-	-	-
-	-	-	A513	MT8620	-	-	-	-
-	-	-	A513	MT8630	-	-	-	-
-	-	-	A519	MT1524	-	-	-	-
-	-	-	A519	MT1541	-	-	-	-

3. Method of Manufacture

3.1 The tubes of Grades 11, 12 and 13 shall be manufactured by seamless process, electric resistance welding process, or butt welding process, and those of other grades shall be manufactured by seamless process or electric resistance welding process.

3.2 The tube shall be as manufactured or as cold-finished condition, or they shall be subjected to appropriate heat treatment.

4. Chemical Composition

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

Table 2. Chemical Composition

Grade	Designation	Unit %
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			C	Si	Mn	P	S	Nb or V
Grade 11	A	STKM 11A	0.12 max.	0.35 max.	0.60 max.	0.040 max.	0.040 max.	-
Grade 12	A	STKM 12A	0.20 max.	0.35 max.	0.60 max.	0.040 max.	0.040 max.	-
	B	STKM 12B						
	C	STKM 12C						
Grade 13	A	STKM 13A	0.25 max.	0.35 max.	0.30~0.90	0.040 max.	0.040 max.	-
	B	STKM 13B						
	C	STKM 13C						
Grade 14	A	STKM 14A	0.30 max.	0.35 max.	0.30~1.00	0.040 max.	0.040 max.	-
	B	STKM 14B						
	C	STKM 14C						
Grade 15	A	STKM 15A	0.25~0.35	0.35 max.	0.30~1.00	0.040 max.	0.040 max.	-
	C	STKM 15C						
Grade 16	A	STKM 16A	0.35~0.45	0.40 max.	0.40~1.00	0.040 max.	0.040 max.	-
	C	STKM 16C						
Grade 17	A	STKM 17A	0.45~0.55	0.40 max.	0.40~1.00	0.040 max.	0.040 max.	-
	C	STKM 17C						
Grade 18	A	STKM 18A	0.18 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	-
	B	STKM 18B						
	C	STKM 18C						
Grade 19	A	STKM 19A	0.25 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	-
	C	STKM 19C						
Grade 20	A	STKM 20A	0.25 max.	0.55 max.	1.60 max.	0.040 max.	0.040 max.	0.15 max.

Remarks

1. When the purchaser requires product analysis for the tubes made of killed steel, the tolerances for the values given above shall be as specified in Table 2 in JIS G 0321 for

seamless steel tubes and in Table 1 for electric resistance welded or butt welded steel tubes.

2. For the tubes of Grade 15 made by electric resistance welding process, the lower limit of carbon content may be altered by agreement between the parties concerned.

3. For the tubes of Grade 20, Nb in combination with V may be added. In this case, the maximum content of Nb + V shall be 0.15 %.

5. Mechanical Properties

5.1 Tensile Strength, Yield Point or Proof Stress, and Elongation

The tube shall be tested in accordance with 8.2 and the resulting tensile strength, yield point or proof stress, and elongation shall comply with Table 3

5.2 Bending Strength or Flattening Strength

The tube shall be tested in accordance with 8.3 or 8.4 and shall be free from flaws or cracks on their wall surfaces.

The bending test, however, shall be applied to the tubes 50 mm or under in outside diameter in lieu of flattening test when especially specified by the purchaser.

Grade		Designation	Tensile strength N/Π {kgf/Π}	Yield point or proof N/Π {kgf/Π}	Elongation %		Flattening strength	Bending strength	
					No. 4, No. 11 No. 12 test pieces Longitudinal direction	No. 4, No. 5 test pieces Transverse direction		Distance between flat plates (H) (D is outside dia. of the tube)	Inside radius (D is outside dia. of the tube)
11	A	STKM11A	290{30} min.	-	35 min.	30 min.	1/2 D	180	4 D
12	A	STKM12A	340{35} min.	175{18} min.	35 min.	30 min.	2/3 D	90	6 D
	B	STKM12B	390{40} min.	275{28} min.	25 min.	20 min.	2/3 D	90	6 D
	C	STKM12C	470{48} min.	355{36} min.	20 min.	15 min.	-	-	-
13	A	STKM13A	370{38} min..	215{22} min.	30 min.	25 min.	2/3 D	90	6 D
	B	STKM13B	440{45} min..	305{31} min.	20 min.	15 min.	3/4 D	90	6 D
	C	STKM13C	510{52} min..	380{39} min.	15 min.	10 min.	-	-	-
14	A	STKM14A	410{42} min..	245{25} min.	25 min.	20 min.	3/4 D	90	6 D
	B	STKM14B	500{51} min.	355{36} min.	15 min.	10 min.	7/8 D	90	8 D

	C	STKM14C	550{56} min..	410{42} min.	15 min.	10 min.	-	-	-
15	A	STKM15A	470{48} min..	275{28} min.	22 min.	17 min.	3/4 D	90	6 D
	C	STKM15C	580{59} min..	430{44} min.	12 min.	7 min.	-	-	-
16	A	STKM16A	510{52} min..	325{33} min.	20 min.	15 min.	7/8 D	90	8 D
	C	STKM16C	620{63} min..	460{47} min.	12 min.	7 min.	-	-	-
17	A	STKM17A	550{56} min..	345{35} min.	20 min.	15 min.	7/8 D	90	8 D
	C	STKM17C	650{66} min..	480{49} min.	10 min.	5 min.	-	-	-
18	A	STKM18A	440{45} min..	275{28} min.	25 min.	20 min.	7/8 D	90	6 D
	B	STKM18B	490{50} min..	315{32} min.	23 min.	18 min.	7/8 D	90	8 D
	C	STKM18C	510{52} min.	380{39} min.	15 min.	10 min.	-	-	-
19	A	STKM19A	490{50} min.	315{32} min.	23 min.	18 min.	7/8 D	90	6 D
	C	STKM19C	550{56} min.	410{42} min.	15 min.	10 min.	-	-	-
20	A	STKM20A	540{55} min.	390{40} min.	23 min.	18 min.	7/8 D	90	6 D

Remarks

- When the tensile test is carried out on No. 12 or No. 5 test piece for the tube under 8 mm in wall thickness, the minimum value of elongation shall be calculated by subtracting 1.5 % from the values of elongation given in Table 3 for each 1 mm decrease in wall thickness and rounding off to an integer in accordance with JIS Z 0 8401. Examples of calculation are given in Reference Table.
- The values of elongation in Table 3 shall not be applied to the these 40 mm or smaller in outside diameter. However, it may be agreed upon by the purchaser and the manufacturer. when especially required.
- For electric resistance welded steel tubes and butt-welded steel tubes, the tensile test pieces shall be No. 12 or No. 5 and they shall be taken from a portion not involving welded seams.
- For the flattening test, the minimum distance between the flat plates (H) shall be 5 times the plate thickness

6. Appearance

- The tubes shall be practically straight. and the two ends shall be at right angles to the axis of the tube.
- The tubes shall be free from defects detrimental to practical use.

6.3 The surface finish of the tubes, when especially specified shall be agreed upon by the purchaser and the manufacturer.

7. Dimensional Tolerances

7.1 The tolerances on outside diameter and wall thickness for the tubes shall be as given in Table 4 and Table 5, respectively .

Table 4. Tolerances on Outside Diameter

Division	Tolerances on outside diameter
No. 1	Under 50mm 【 0.5mm
	50mm or over 【 1%
No. 2	Under 50mm 【 0.25mm
	50mm or over 【 0.5%
No. 3	Under 25mm 【 0.12mm
	25mm or over to and excl. 40mm 【 0.15mm
	40mm or over to and excl. 50mm 【 0.18mm
	50mm or over to and excl. 60mm 【 0.20mm
	60mm or over to and excl. 70mm 【 0.23mm
	70mm or over to and excl. 80mm 【 0.25mm
	80mm or over to and excl. 90mm 【 0.30mm
	90mm or over to and excl.100mm 【 0.40mm
	100mm or over 【 0.50%

Remarks

- 1.For hot finished seamless steel tube, the outside diameter tolerances No. 1 shall be applied.
- 2.The tolerances on outside diameter of quenched and tempered tubes shall be as agreed upon by the purchaser and the manufacturer.

Table 5. Tolerances on Wall Thickness

Division	Tolerances on wall thickness
No. 1	Under 4mm +0.6mm -0.5mm
	4mm or over +15% -12.5%
No. 2	Under 3mm 【 0.3mm

No. 3	3mm or over	【 10%】
	Under 2mm	【 0.15mm】
	2mm or over	【 8%】

Remarks

For hot finished seamless steel tubes the tolerances NO. 1 shall be applied.

7.2 The tolerances on the tube length shall be in the range of 0 to + 50 mm. However, when tolerances outside this range are especially required, agreement shall be made between the purchaser and the manufacturer.

8. Test**8.1 Chemical Analysis****8.1.1 Chemical analysis**

The general requirements for chemical analysis and method of sampling specimens for analysis shall be in accordance with the 3. in JIS G 0303

8.1.2 Analytical Method

The analytical method shall be in accordance with one of the following Standards.

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215,

JIS G 1221, JIS G 1237, JIS G 1243, JIS G 1256, JIS G 1257.

8.2 Tensile Test**8.2.1 Test Piece**

The test piece shall be No. 11, No. 12 A, No. 12 B, No. 12 C, No. 4 or No. 5 test piece specified in JIS Z 2201 and shall be cut off from the tube. The gauge length for No. 4 test piece, however, shall be 50 mm

8.2.2 Test Method

The test method shall be in accordance with JIS Z 2241.

8.3 Bending Test**8.3.1 Test Piece**

A suitable length of a tube shall be cut off from one end of the tube to be made into a test piece.

8.3.2 Test Method

The test piece shall be bent, at ordinary temperature around a cylinder with the bend angle and inside radius specified in Table 3 and checked for the occurrence of flaws or cracks.

In the case of electric resistance welded steel tubes and butt-welded steel tubes, the weld shall be placed in the outermost part of the bent portion

8.4 Flattening Test

8.4.1 Test Piece

A test piece 50mm or over in length shall be cut off from one end of a tube. For the tube of wall thickness 15 % or over of its outside diameter, a test piece made into C-shape by removing part of the circumference of a full-section test piece may be used.

8.4.2 Test Method

The test piece shall be placed between two flat plates, flattened by compression at ordinary temperature until the distance between the plates comes to the specified in Table 3, and checked for the tance welded steel tubes and butt-welded steel tubes, the weld shall be placed at right angles to the direction of compression as shown in Fig. 1. Further, a C-shape test piece shall be placed as shown in Fig. 2.

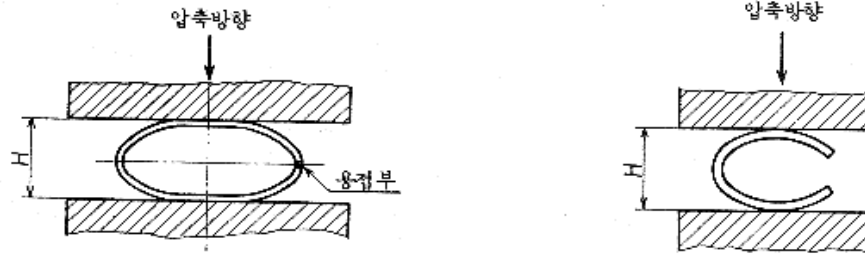


Fig 1. Flattening Test (for Full-section Test Piece)

Fig 2. Flattening Test (for C-shape Test Piece)

9. Inspection

9.1 Inspection

The general requirements for inspection shall be in accordance with JIS G 0303.

9.2 The chemical composition, mechanical properties, dimensions and appearance shall conform to the requirements specified in 3., 4., 5. and 6. the bending test and the flattening test, however, may be omitted when approved by the purchaser.

9.3 The purchaser may specify a flaring test, hydrostatic test, etc., in addition to those specified in 9.2 In this case, the test items, sampling method and acceptance criteria shall be previously agreed upon by the manufacturer.

9.4 The number of specimens for product analysis shall be as agreed upon by the purchaser and the manufacturer.

9.5 The method of sampling specimens and the number of test pieces for tensile test, bending test and flattening test shall be as given in Table 6.

Table 6. Method of Sampling Specimens and Number of Test Pieces.

Grade	Designation	Division of outside diameter	Method of sampling specimens and number of test pieces
A and B of 11 to 20	STKM 11A	100 mm or under	Take one specimen from each 1000 m or its fraction of the tubes of the same dimensions. From the specimen, take one flattening or bend test piece for the tubes 50 mm or under in outside diameter, and one flattening test piece for the tubes over 50 mm in outside diameter, in addition to each one tensile test piece in either case.
	STKM 12A		
	STKM 12B		
	STKM 13A		
	STKM 13B	Over 100 mm up to and incl. 200 mm	Take one specimen from each 500 m or its fraction of the tubes of the same dimensions. From the specimen, take one tensile test piece and one flattening test piece.
	STKM 14A		
	STKM 14B	Over 200 mm	Take one specimen from each 250 m or its fraction of the tubes of the same dimensions. From the specimen, take one tensile test piece and one flattening test piece.
	STKM 15A		
	STKM 16A		
	STKM 17A		
	STKM 18A		
	STKM 18B		
	STKM 19A		
	STKM 20A		
C of 12 to 19	STKM 12C	100 mm or under	Take one specimen from each 1000 m or its fraction of the tubes of the same dimensions. From the specimen, take one tensile test piece.
	STKM 13C		
	STKM 14C	Over 100 mm up to and incl. 200 mm	Take one specimen from each 500 m or its fraction of the tubes of the same dimensions. From the specimen, take one tensile test piece.
	STKM 15C		
	STKM 16C	Over 200 mm	Take one specimen from each 250 m or its fraction of the tubes of the same dimensions. From the specimen, take one tensile test piece.
	STKM 17C		
	STKM 18C		
	STKM 19C		

10. Reinspection

The tube may be retested in accordance with 4.4 in JIS G 0303.

11. Marking

Each tube having passed the inspection shall be legibly marked with the following items, the order of arranging the items is not specified.

However, for smaller tubes or on a request from the purchaser, tubes may be bundled together and marked for each bundle by suitable means.

(1) Designation of grade

(2) Letter symbol indicating the manufacturing process⁽¹⁾

Note (1)

The letter symbol indicating the manufacturing process shall be as follows.

However, the sign 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 -E-G

than hot finished or cold finished ones

Hot finished electric resistance welded steel tube -E-H

Cold finished electric resistance welded steel tube -B

Cold finished butt-welded steel tube -B-C

12. Report

The manufacturer shall, as a rule, submit to the purchaser a report on the test results, manufacturing process, ordered dimensions, quantity and work lot number traceable to the history of manufacture, etc. Reference Table

Calculated Examples of Elongation Applied to No. 5 Test piece (Transverse Direction) and No. 12 Test Piece (Longitudinal Direction) for Tubes under 8 mm in Wall Thickness

Grade		Designation	Type of test piece	Elongation for each division of wall 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
Grade 11	A	STKM 11A	No. 5	30	28	27	26	24	22	21	20
			No. 12	35	34	32	30	29	28	26	24
Grade 12	A	STKM 12A	No. 5	30	28	27	26	24	22	21	20
			No. 12	35	34	32	30	29	28	26	24

	B	STKM 12B	No. 5	20	18	17	16	14	12	11	10
			No. 12	25	24	22	20	19	18	16	14
	C	STKM 12C	No. 5	15	14	12	10	9	8	6	4
			No. 12	20	18	17	16	14	12	11	10
Grade 13	A	STKM 13A	No. 5	25	24	22	20	19	18	16	14
			No. 12	30	28	27	26	24	22	21	20
	B	STKM 13B	No. 5	15	14	12	10	9	8	6	4
			No. 12	20	18	17	16	14	12	11	10
	C	STKM 13C	No. 5	10	8	7	6	4	2	1	-
			No. 12	15	14	12	10	9	8	6	4
Grade 14	A	STKM 14A	No. 5	20	18	17	16	14	12	11	10
			No. 12	25	24	22	20	19	18	16	14
	B	STKM 14B	No. 5	10	8	7	6	4	2	1	-
			No. 12	15	14	12	10	9	8	6	4
	C	STKM 14C	No. 5	10	8	7	6	4	2	1	-
			No. 12	15	14	12	10	9	8	6	4
Grade 15	A	STKM 15A	No. 5	17	16	14	12	11	10	8	6
			No. 12	22	20	19	18	16	14	13	12
	C	STKM 15C	No. 5	7	6	4	2	1	-	-	-
			No. 12	12	10	9	8	6	4	3	2
Grade 16	A	STKM16A	No. 5	15	14	12	10	9	8	6	4
			No. 12	20	18	17	16	14	12	11	10
	C	STKM 16C	No. 5	7	6	4	2	1	-	-	-
			No. 12	12	10	9	8	6	4	3	2

Grade 17	A	STKM 17A	No. 5	15	14	12	10	9	8	6	4
			No. 12	20	18	17	16	14	12	11	10
	C	STKM 17C	No. 5	5	4	2	-	-	-	-	-
			No. 12	10	8	7	6	4	2	1	-
Grade 18	A	STKM 18A	No. 5	20	18	17	16	14	12	11	10
			No. 12	25	24	22	20	19	18	16	14
	B	STKM 18B	No. 5	18	16	15	14	12	10	9	8
			No. 12	23	22	20	18	17	16	14	12
	C	STKM 18C	No. 5	10	8	7	6	4	2	1	-
			No. 12	15	14	12	10	9	8	6	4
Grade 19	A	STKM 19A	No. 5	18	16	15	14	12	10	9	8
			No. 12	23	22	20	18	17	16	14	12
	C	STKM 19C	No. 5	10	8	7	6	4	2	1	-
			No. 12	15	14	12	10	9	8	6	4
Grade 20	A	STKM 20A	No. 5	18	16	15	14	12	10	9	8
			No. 12	23	22	20	18	17	16	14	12

Remark

The symbol "-" indicates a case where elongation is not specified.