JIS G3474 High Tensile Strength Steel Tubes for Tower Structural Purposes

1. Scope

This Japanese Industrial Standard specifies high tensile strength steel tubes (hereafter referred to as "tubes") used principally for transmission steel tower.

Remarks

1. The purchaser may specify the special quality requirements specified in Annex in addition to the items specified in this text in the case or STKT 590 by preliminary agreement between the purchaser and manufacturer.

2. The standards cited in this Standard are given in Attached Table 2.

2. Classification and symbol

The tubes shall be categorized into two classes, and their symbols shall be as given in Table 1.

Table 1 Classification and symbol

Classification and symbol	(Reference) Traditional symbol	Remarks
STKT 540	STKT 55	-
STKT 590	STKT 60	killed, thickness 25mm max.

World standard Comparative Table

	KS		JIS
Grade number	D 3780		G 3474
Designation of Grade	Traditional symbol	Symbol	-
	STKT 55	STKT 540	STKT 540
	STKT 60	STKT 590	STKT 590

3. Method of manufacture

The manufacturing method of the tubes shall be as follows:

(1) The tubes shall be manufactured by electric resistance welding or electric are welding(straight seam).

(2) The tubes shall be supplied as-manufactured conditions and, as a rule, shall not be heat-treated.

4. Chemical composition

The tubes shall be subjected to the test of 9.1, and the cast analysis value thereof shall be as given in Table 1.

Table 1 Chemical composition

Unit: %

Symbol	C	Si	Mn	P	S	Nb+V
STKT 540	0.23 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	-
STKT 590	0.12 max.	0.40 max.	2.00 max.	0.030 max.	0.030 max.	0.15 max.

Remarks

1. Alloy elements other than those given in Table 1 may be added, if necessary.
2. The tubes of STKT 590 shall be of fine grain killed steel up to and including 25mm in wall thickness.

5. Mechanical properties

5.2 Tensile strength, yield point or proof stress, elongation, flattening property, and tensile strength for welded zone The tubes shall be subjected to the tests of 9.2 and 9.3 and the tensile strength, yield point or proof stress, elongation, flattening property, and the tensile strength, for welded zone shall be as given in Table2. For the flattening property, the wall of the tubes shall be free from flaws and cracks.

6. Carbon equivalent

The carbon equivalent for the tubes shall be 0.40 % or less. The carbon equivalent shall be calculated from the following formula by using the cast analysis values given in 9.1.

Carbon equivalent (%) = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

7. Dimensions, mass and dimensional tolerances

The dimensions, mass and dimensional tolerances shall be as follows:

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

Dimensions and mass of high tensile strength steel tubes for tower structural purpose

Outside diameter mm	Wall thickness mm	Unit mass kg/m	Informative reference			
			Sectional area P	Moment of inertia of area H^4	Section modulus ЭК	Radius of duration of area H
139.8	3.5	11.8	14.99	348	49.8	4.82
139.8	4.5	15.0	19.13	438	62.7	4.79
165.2	4.5	17.8	22.72	734	88.9	5.68
165.2	5.5	21.7	27.59	881	107	5.65
190.7	5.3	24.2	30.87	133] 10	139	6.56
190.7	5.5	25.1	32.00	137] 10	144	6.55
190.7	6.0	27.3	34.82	149] 10	156	6.53

216.3	5.8	30.1	38.36	213] 10	197	7.45
216.3	6.0	31.1	39.64	219] 10	203	7.44
216.3	7.0	36.1	46.03	252] 10	233	7.40
216.3	8.2	42.1	53.61	291] 10	269	7.36
267.4	6.0	38.7	49.27	421] 10	315	9.24
267.4	7.0	45.0	57.27	486] 10	363	9.21
267.4	9.0	57.4	73.06	611] 10	457	9.14
318.5	6.9	53.0	67.55	820] 10	515	11.0
318.5	8.0	61.3	78.04	941] 10	591	11.0
318.5	9.0	68.7	87.51	105] 10^2	659	10.9
355.6	7.9	67.7	86.29	130] 10^2	734	12.3
355.6	9.0	76.9	98.00	147] 10^2	828	12.3
355.6	10.0	85.2	108.6	162] 10^2	912	12.2
406.4	9.0	88.2	112.4	222] 10^2	109] 10	14.1
406.4	10.0	97.8	124.5	245] 10^2	120] 10	14.0
406.4	12.0	117	148.7	289] 10^2	142] 10	14.0
457.2	12.0	132	167.8	416] 10^2	182] 10	15.7
508.0	12.0	147	187.0	575] 10^2	227] 10	17.5
558.8	12.0	162	206.1	771] 10^2	276] 10	19.3
558.8	14.0	188	239.6	890] 10^2	318] 10	19.3
609.6	14.0	206	262.0	119] 10^3	381] 10	21.1
609.6	16.0	234	298.4	132] 10^3	431] 10	21.0
660.4	16.0	254	323.9	168] 10^3	509] 10	22.8
660.4	18.0	285	363.3	188] 10^3	568] 10	22.7
711.2	18.0	308	392.0	236] 10^3	663] 10	24.5
762.0	18.0	330	420.7	291] 10^3	765] 10	26.3

812.8	18.0	353	449.4	355] 10^3	874] 10	28.1
812.8	20.0	391	498.1	392] 10^3	964] 10	28.0
863.6	18.0	375	478.2	428] 10^3	990] 10	29.9
863.6	20.0	416	530.1	472] 10^3	109] 10^2	29.8
914.4	18.0	398	506.9	509] 10^3	111] 10^2	31.7
914.4	20.0	441	562.0	562] 10^3	123] 10^2	31.6
914.4	22.0	484	616.8	614] 10^3	134] 10^2	31.6
965.2	20.0	466	593.9	664] 10^3	137] 10^2	33.4
965.2	22.0	512	651.9	725] 10^3	150] 10^2	33.4
965.2	24.0	557	709.6	786] 10^3	163] 10^2	33.3
1016.0	20.0	491	625.8	776] 10^3	153] 10^2	35.2
1016.0	24.0	587	748.0	921] 10^3	181] 10^2	35.1
1066.8	20.0	516	657.7	901] 10^3	169] 10^2	37.0
1066.8	22.0	567	722.1	986] 10^3	185] 10^2	36.9
1066.8	24.0	617	786.3	107] 10^4	200] 10^2	36.9
1117.6	22.0	594	757.2	114] 10^4	203] 10^2	38.7
1117.6	24.0	647	824.6	123] 10^4	221] 10^2	38.7

Remarks: A numerical value of mass shall be calculated from the following formula by taking steel of 1 cm^3 as 7.85 g and shall be rounded off to three significant figures in accordance with JIS Z 8401. However, if exceeds 1000 kg/m, the result shall be rounded off to an integer in kg/m.

$$W = 0.02466t(D-t)$$

Where W: unit mass of tube kg/m

t: thickness of tube mm

D: outside diameter of tube mm

(2) The dimensional tolerances shall be as follows:

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

(b) The tolerances on lengths for the tubes shall be not less than the specific length, unless otherwise specified.

Table 5 Tolerances on outside diameter

Discrimination of outside diameter	Tolerance on outside diameter

Up to 50mm	【0.5mm
50mm and over	【1%

Remarks

1. The tolerances on outside diameter at the end of the tube of electric resistance welded steel tube and electric arc welded steel tube 350mm in outside diameter shall be within 【0.5%.

2. The outside diameter of the tubes exceeding 350mm in outside diameter may be determined by the length of circumference.

Table 6 Tolerances on wall thickness

Discrimination of thickness	Tolerance on wall thickness
Up to 4mm	+0.6mm -0.5mm
4mm and over, up to 12mm	+15% -12.5%
12mm and over	+15% -1.5mm

Remarks

The tolerances on wall thickness for the tubes exceeding 1016.0mm in outside diameter may be agreed upon between the purchaser and supplier.

8. Appearance

The appearance of the tubes shall be as follows:

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

(2) The tubes shall be free from defects that are detrimental to practical use.

(3) When especially required, the surface finish of the tubes shall be agreed upon between the purchaser and manufacturer.

9. Test

9.1 Chemical analysis

9.1.1 General requirements for chemical analysis and sampling method of specimen The chemical composition of the tubes shall be determined by cast analysis and the general requirements for chemical analysis and sampling method of specimen for analysis shall be in accordance with 3. (Chemical composition) of JIS G 0303.

9.1.2 Analytical methods The method for chemical analysis shall be in accordance with any one of the following methods

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1216, JIS G 1217, JIS G 1218, JIS G 1221, JIS G 1223, JIS G 1227, JIS G 1237, JIS G 1253, JIS G 1256, JIS G 1257

9.2 Tensile test.

9.2.1 The piece

The tensile test piece shall be any one of No.11, No. 12A, No.12B, No.12C or No. test piece specified in JIS Z 2201 to be cut off from the tubes. However, for the tubes over 350mm in outside diameter, it shall be as follows:

(1) The test piece shall be NO. 5 test piece specified in JIS Z 2201. With this respect, for the tubes made by expansion forming process, the test piece shall be taken from the tube itself, while for the tubes not by expansion forming process, the test piece shall be taken from the tube itself or sheet-in-coil or plate used for manufacturing the tubes.

(2) In the case of tensile test piece for the welded zone of arc welded steel tube, the test piece shall be NO. 1 test piece specified in JIS Z 3121, and it is made from a specimen which is cut either from the tube itself or from a part of a tube end that is welded under the same conditions as the tube itself.

9.2.2 Test method

The test method shall be in accordance with JIS Z 2241. For the welded zone, tensile strength shall be investigated

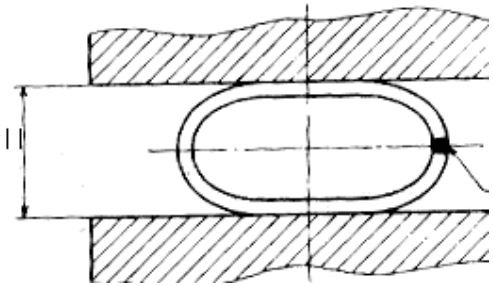
9.3 Flattening test

9.3.1 Test piece

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

9.3.2 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. However, the welded zone shall be placed at right angles to the direction of compression as shown in Fig.



Fig

9.4 Impact test

9.4.1 Test piece The test piece shall be No. 4 test piece specified in JIS Z 2202, and shall be taken longitudinally at a position of 90 X from the welded zone of the tube. However, for tubes exceeding 350mm in outside diameter, the test piece may be taken from steel sheet-in-coil or plate used for manufacturing the tubes excepting the case where the tube is produced by expanding forming process.

Further, the width of the test piece may be 7.5mm or 5mm according to the dimensions of the tube.

9.4.2 Test method The test method shall be in accordance with Charpy impact test specified in JIS Z 2242.

10. Inspection

10.1 Inspection The inspection shall be carried out as follows:

(1) 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 properties shall conform to the requirements specified in 5, provided that the flatting test and tensile test for welded zone may be omitted on approval by the purchaser.

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

(5) The dimensions shall conform to the requirements specified in 7.

(6) The appearance shall conform to the requirements specified in 8.

(7) When the special quality requirements given in Annex are specified by agreement between the purchaser and supplier, the result of inspection shall conform to the relevant requirements specified in Z 12.

(8) The purchaser may specify a hydrostatic test, nondestructive testing for welded portion, etc. in addition to the inspection item specified in (2) to (7). in this case, for testing items, sampling method of specimen, test method and acceptance criteria thereon, the purchaser shall previously be agree upon with the manufacturer.

Table 7 Sampling method of specimen and number of test pieces

Discrimination of outside diameter	Sampling method of specimen and number of test pieces
Up to and incl. 100mm	Take one specimen from each 5000m or its fraction of tubes of the same dimensions, and then take from it one tensile test piece and one flattening test piece.
Over 100mm, up to and incl. 200mm	Take one specimen from each 2500m or its fraction of tubes of the same dimensions, and then take from ti one tensile test piece and one flattening test piece.
Over 200mm, up to and incl. 350mm	Take one specimen from each 1250m or its fraction of the tubes of the same dimensions, and then take from it one tensile test piece and one flattening test piece.
Over 350mm	1.In the case of sampling of specimen from the tubes Take one specimen from each 1250m or its fraction of tubes of the same dimensions, and then take from it one tensile test piece and either one tensile test piece for welded zone or one flattening test piece. 2.In the case of sampling of specimen from the steel sheet-in-coil or plate The method of sampling of the specimen for tensile test from steel sheet-in-coil or plate shall be in accordance with group A of JIS G 0303. As to the number of tensile test pieces, for steel plates, take one tensile test piece from each lot of steel plates which belong to the same heat and of which the maximum thickness is within two times the minimum thickness. However, take two tensile test pieces when the lot exceeds 50t. For steel sheet-in-coil, take one tensile test piece from each lot which belong to the same heat and same thickness. However, take two tensile test piece when the lot exceeds 50t. 3.In the case of sampling of tensile test piece for welded zone from the specimen welded under the same conditions as the tube itself Take one specimen from each 1250m or every equivalent amount of the tubes of the same dimension or its fraction, and then take from it one tensile test piece for welded zone.

10.2 Reinspection

The tubes may be subjected to a retest in accordance with 4.4 (Retest) in JIS G 0303 to determine whether it is finally acceptable or not.

11. Making

The tubes which have passed the inspection shall be marked on each tube with the following items provided that the order of arranging the peculiarities is not specified. However, in the case of either smaller tubes or on request by the purchaser, the tubes may be bundled together and marked for every bundle by suitable means.

Further, when approved by the purchaser, a part of the items may be omitted.

(1) Symbol of class

(2) Symbol indicating method of manufacture([1])

(3) Dimensions

(4) Manufacturer's name or identifying brand

(5) Symbol Z denoting the special quality requirement

Note([1]) The symbol indicating the method of manufacture shall be as follows, provided that the dash may be replaces by a blank.

Electric resistance welded steel tube: -E-G

Electric arc welded steel tube: -A

12. Report

When preliminarily requested by the purchaser, the manufacturer shall submit the test results report

Annex Special quality requirements

This special quality requirements shall apply when required by the purchaser.

Z12 Sensivity of crack by hot-dipped zinc-coating The equivalent on sensitivity of crack by hot-dipped zinc-coating and cast analysis value of boron shall be as follows:

(1) The special quality requirements shall apply to the tubes of STKT 590 which are got-dipped zinc-coated after welding.

(2) Annex Table 1. Equivalent on sensitivity of crack by hot-dipped zinc-coating and cast analysis value of boron

Discrimination of thickness	Equivalent on sensitivity of crack by hot-dipped zinc-coating	Cast analysis value of boron
22mm or less	0.44 % max.	0.0002 % max.
Over 22mm	Agreement between the purchaser and supplier	Agreement between the purchaser and supplier

(3) The cast analysis value shall be as given in 9.1 (Chemical analysis) in the text.

Equivalent on sensitivity of crack by hot-dipped zinc-coating(%) = C+Si/27+Mn/12+V/3+Nb/2.5+Ti/5+Cr/6+Mo/9+9B

(4) The equivalent on sensitivity of crack by hot-dipped zinc-coating shall be calculated from the following formula by using the cast analysis value of (2)