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# JIS G3473 Carbon Steel Tubes Cylinder Barrels

## 1. Scope

This Japanese Industrial Standard specifies the carbon steel tubes, hereinafter referred to as the "tubes", used for manufacturing cylinder barrels of pistion type hydraulic cylinders and pneumatic cylinders whose internal surfaces and furnished by cutting or honing

## Remarks

1. With a previous agreement of the manufacturer, the purchaser may designate the special quality requirements Z 3 specified in Appendix, in addition to those specified in this text.

2. 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.

Further, the traditional units accompanied by numerical values in this Standard shall be converted to the SI units and numerical values on Jan. 1, 1991.

# 2. Grade and Designation

The tubes shall be classified into 7 grades, and their designations shall be as given in Table 1.

Table 1 Designation of Grade					
Designation of Grade	(Reference) Traditional symbol				
STC 370	STC 38				
STC 440	STC 45				
STC 510 A	STC 52 A				
STC 510 B	STC 52 B				
STC 540	STC 55				
STC 590 A	STC 60 A				
STC 590 B	STC 60 B				

#### World Standard Comferens Table

	KS	JIS	ASTM	BS			DIN
Grade number	D 3618	G 3473	A 519	5242/1	5242/3	1717	2391
Designation of Grade	STC 370	STC 370	-	HP 1	HP 1	-	St 35
	STC 440	STC 440	-	HP 4	HP 4	-	-
	STC 510A	STC 510A	-	HP 2	HP 2	-	-
	STC 510B	STC 510B	-	-	-	-	-
	STC 540	STC 540	-	-	-	-	-
	STC 590A	STC 590A	-	HP 5	HP 5	-	-
	STC 590B	STC 590B	-	-	-	-	-

			MT 1010	Gr 1020	c	:1
			MT 1015	Gr 1021	c	2
			MTX1015	Gr 1022	c	:3
			MT 1020	Gr 1025	c	:4
			MTX1020	Gr 1026	c	:5
			Gr 1008	Gr 1030	c	:FS
	-	-	Gr 1010	Gr 1035	E	RW
			Gr 1012	Gr 1040	c	EW
			Gr 1015	Gr 1045		
			Gr 1016	Gr 1050		
			Gr 1017	Gr 1518		
			Gr 1018	Gr 1524		
			Gr 1019	Gr1541		

#### 3. 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

Unit:

Designation of grade	С	Si	Mn	Р	S	Nb or V
STC 370	0.25 max.	0.35 max.	0.30~0.90	0.040 max.	0.040 max.	-
STC 440	0.25 max.	0.35 max.	0.30~0.90	0.040 max.	0.040 max.	-
STC 510 A	0.25 max.	0.35 max.	0.30~0.90	0.040 max.	0.040 max.	-
STC 510 B	0.25 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	-
STC 540	0.25 max.	0.55 max.	1.60 max.	0.040 max.	0.040 max.	0.15 max.
STC 590 A	0.25 max.	0.35 max.	0.30~0.90	0.040 max.	0.040 max.	-
STC 590 B	0.25 max.	0.55 max.	1.50 max.	0.040 max.	0.040 max.	-

#### Remarks

1. When the tube is made of killed steel and also product analysis is required by the purchaser, the tolerances for the values given above shall conform to Table 2 specified in JIS

G 0321 for seamless steel tubes and Table 1 for electric resistance welded steel tubes.

2. For the tubes of STC 55, Nb in combination with V may be added. In this case the maximum value of Nb + V shall be 0.15%

The tubes 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.

	Tensile strength	Yield point or proof stress	Elongation %					
Designation of grade	N/mm²	N/mm²	No.11 test piece					
	{kgf/㎜}}	{kgf/mm²}	No.12 test piece Longitudinal direction					
STC 370	370{38} min.	251{22} min.	30 min.					
STC 440	440{45} min.	305{31} min.	10 min.					
STC 510 A	510{52} min.	380{39} min.	10 min.					
STC 510 B	510{52} min.	380{39} min.	15 min.					
STC 540	540{55} min.	390{40} min.	20 min.					
STC 590 A	590{60} min.	490{50} min.	10 min.					
STC 590 B	590{60} min.	490{50} min.	15 min.					

Table 3 Mechanical Properties

#### Remarks

1. When the tube under 8mm in thickness is subjected to tensile test by using No.12 test piece, the minimum value of elongation shall be calculated by subtracting 1.5% from the value of elongation given in Table 3 for each decrease of 1mm and rounding off the result to a whole number according to JIS Z 8401. Examples of calculation are shown in Reference Table 1.

2. When a tensile test piece is to be taken from the electric resistance steel tube, a No12 test piece shall be taken from a seamless portion.

#### 5. Dimension, Mass and Dimensional Tolerances

5.1 Dimensions and Mass

(1) Pertaining to the dimensions for hot-finished seamless steel tube, the purchaser shall specify the outside diameter and wall thickness.

(2) Pertaining to the dimensions for cold-finished seamless steel tube, the purchaser shall specify the outside diameter and wall thickness for the tubes used for cutting, and the inside diameter and wall thickness for those for honing. Concerning the dimensions of cold-finished electric resistance welded steel tube, the purchaser shall specify the inside diameter and wall thickness. The preferred inside diameter shall be as given in Table 4.

#### Table 4 Preferred Inside Diameter for Cold Finished Steel Tube for Honing

I Init.

								Unit.
32.0	40.0	50.0	60.0*	63.0	65.0*	70.0*	80.0	90.0*
100.0	110.0*	125.0	140.0	150.0	160.0	180.0	200.0	

#### honing pipe weight or dimer

Number	1D】0D	(T)	(kg/m)	(kg/P)	Number	1D] 0D	(T)	(kg/m)	(kg/P)
1	15】21	3	1.33	416	35	100】127	13.5	37.8	280

mm

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2	20】26	3	1.7	313	36	105】118	6.5	17.87	120
3	25】33	4	2.46	332	37	110】127	8.5	24.85	150
4	30】40	5	4.32	346	38	110】130	10	29.6	189
5	35】45	5	4.93	297	39	110】135	12.5	37.8	235
6	40】50	5	5.55	260	40	115】127	6	17.9	108
7	45】55	5	6.17	231	41	120】132	6	18.6	104
8	50】57	3.5	4.62	145	42	120】140	10	32.1	173
9	50】60	5	6.78	208	43	125】134	4.5	14.4	74
10	55】67	6	9.02	227	44	125】137	6	19.4	100
11	60】70	5	8.01	173	45	125】145	10	33.3	166
12	60】80	10	17.3	346	46	125】150	12.5	42.4	208
13	63】71	4	6.61	132	47	130】140	5	16.65	80
14	63】73	5	8.38	165	48	130】153	11.5	40.1	184
15	63】76 <sup>3</sup>	6.65	11.1	215	49	140】150	5	17.9	74
16	65】76 <sup>3</sup>	5.65	9.84	181	50	140】153	6.5	23.5	96
17	70】80	5	9.25	148	51	140】160	10	37	148
18	70】86	8	15.4	237	52	140】165	12.5	47	186
19	70】90	10	19.7	297	53	150】163	6.5	25.1	90
20	75】85	5	9.8	138	54	150】168	9	35.3	124
21	75】88	6.5	13.06	180	55	160】170	5	20.3	65
22	80】87	3.5	7.2	91	56	160】174	7	28.8	91
23	80】88	4		104	57	160】180	10	41.9	130
24	80】90	5	10.5	130	58	160】187	13.5	57.7	176
25	80】95	7.5	16.2	195	59	180】193	6.5	298.9	75
26	80】101.6	10.8	24.2	280	60	180】202	11	51.8	127
27	80】114	17	40.6	442	61	180】216 <sup>3</sup>	18.15	88.7	210
28	85] 101	8	10.1	203	62	200] 216 <sup>3</sup>	8.15	41.8	84
29	90】100	5	11.7	115	63	200] 223	11.5	59.8	118

30	90】110	10	24.6	231	64	200】241 <sup>8</sup>	20.9	113.8	217
31	90】114	12	31.2	277	65	250】267 <sup>4</sup>	8.7	55.5	105
32	100】110	5	12.9	104	66	250】273	11.5	74.1	112
33	100】114	7	18.5	145	67	300】318 <sup>5</sup>	9.25	70.5	64
34	100】120	10	27.1	208	-	-	-	-	-

Remark

The figures for inside diameters without n\*n indicate the dimensions specified in JIS B 8354 or JIS B 8377.

(3) Calculate the unit mass of the tube per 1m length from the following formula assuming 1 cm of steel to be 7.85g and rounding off the result to 3 significant figures in accordance with JIS Z 8401.

When the outside diameter is specified:  $W = 0.02466 t (D_{\Sigma}-t)$ 

When the inside diameter is specified:  $W = 0.02466 t (D_l+t)$ 

Where W: unit mass of the tube kg/m

t: wall thickness of the tube mm

 $D_{\Sigma}$ : outside diameter of the tube mm

D<sub>i</sub>: inside diameter of the tube mm

5.2 Dimensional Tolerances

(1) When the outside diameter is specified, the tolerances shall be as specified Table 5.

Table 5 Tolerances on (	Outside Diameter
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Category	Tolerance on outside diameter		
	Up to 50mm 【0.5mm		
Hot-finished seamless steel tube	50mm and over, 【1.0%, however, the maximum		
	125mm and over 【0.8%		
Cold finished accompany staal tube	Up to 50mm 【0.25mm		
Cold-finished seamless steel tube	50mm and over 【0.5%		

(2) Where the inside diameter is specified, the tolerances shall be as specified in Table 6. However, tolerances on the inside diameter other than those given in this table may be agreed upon by the purchaser and the manufacturer, if necessary.

Table 6 Tolerances on Inside Diameter

Category	Nominal inside diameter	Tolerances on inside diameter		
outegory		Upper limit	Lower limit	

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	Up to and incl. 50mm		
Cold finished seamless steel tube Cole	Over 50mm up to and incl. 80mm	-0.10	
finished electric resistance welded steel	Over 120mm up to and incl. 160mm	-0.10 -0.	
	Over 160mm up to and incl. 180mm		
	Over 180mm up to and incl. 200mm		

# 6. Appearance.

6.1 Both ends of the tube shall be at right angles to the axis of the tube.

6.2 The inside and outside surfaces of the tube shall be well-finished and free from defects detrimental to practical use.

#### 7. Method of Manufacture

The process of manufacture and heat treatment of the tube shall be as specified in Table 8 may be agreed upon by the purchaser and the manufacturer.

Designation of grade	Process of manufacture	Heat treatment	Application	
STC 370	Hot finishing seamless process	As manufactured	Cutting	
STC 440	Cold finishing electric resistance welding	As cold drawn or stress relieving	Honing	
STC 510A	Cold finishing seamless process	As cold drawn or stress relieving	Cutting and honing	
	Cold finishing electric resistance welding	As cold drawn or stress relieving	Honing	
STC 510	Cold finishing seamless process	Stress relieving	Cutting and honing	
	Cold finishing electric resistance welding	Stress relieving	Honing	
STC 540	Hot finishing seamless process	As manufactured	Cutting	
STC 590A	Cold finishing seamless process	As cold drawn or stress relieving	Cutting and honing	
STC 590B	Cold finishing seamless process	Stress relieving	Cutting and honing	

 Table 8 Processes of Manufacture and Heat Treatment

#### Remarks

1. The tubes specified "as manufactured" may be subjected to an appropriate heat treatment at the discretion of the manufacturer.

2. The term "stress relieving" used in this Standard includes such a heat treatment as a combination of cold working and heat treatment to obtain the desired mechanical property.

8. Test

8.1 Chemical Analysis

8.1.1 Chemical Analysis

General matters of chemical analysis and method of sampling specimens for analysis shall be in accordance with 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 1253

JIS G 1256

JIS G 1257

JIS G 1214

JIS G 1215

JIS G 1211

JIS G 1212

JIS G 1213

JIS G 1221

JIS G 1237

8.2 Tensile Test

8.2.1 Test Piece

The test specimen shall be No.11, No.12 A, No.12 B or No.12 C test piece specified in JIS Z 2201 and shall be cut off form the pipe.

8.2.2 Test Method

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

9. Inspection

9.1 Inspection

The inspection shall be as follows.

(1) General matters of inspection shall be specified in JIS G 0303.

(2) The test results of chemical analysis, mechanical properties, dimensions and appearance shall conform to the requirements specified in 3., 4., 5. and 6.

Further, when the special quality requirement given in Appendix are specified by agreement between the purchaser and the manufacturer, the results of inspection shall conform

to the requirements specified in Z 3.

(3) The number of specimens for product analysis shall be agreed upon between the purchaser and the manufacturer.

(4) The method of sampling specimens for tensile test shall be as follows: Take one specimen from each length of 500m (250m for tubes over 200mm in outside diameter) or its fraction of the tubes of the same dimensions, and then from this specimen take one tensile test piece.

9.2 Reinspection

The tube is entitled to a retest specified in 4.4 in JIS

10.Marking

Each tube having passed the inspection shall be marked with the following items. However, in the case of either smaller tubes or a request from the purchaser, the tubes may be bundled together and mark for each bundle by a suitable means. In either case, the order of arranging the item is not specified.

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

(1) Letter symbol of grade

(2) Letter symbol indicating the manufacturing process (<sup>1</sup>)

(3) Dimensions (<sup>2</sup>)

(4) Manufacturer's name or its abbreviation

(5) Letter symbol indicating the special quality requirement, Z

Note (<sup>1</sup>) The letter symbol indication the manufacturing process shall be as follows. However, the dash may be replaced by a bland.

Hot finished seamless steel tube: -S-H

Cold finished seamless steel tube: -S-C

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

Note (<sup>2</sup>) The dimensions of the tube shall be expressed by outside (or inside) diameter, wall thickness and length in this order and also in mm. When the outside diameter is specified, the letter symbol "ID" shall be placed before the figures that express the outside diameter and inside diameter, respectively.

#### 11. Report

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

Designation of grade	Elongation relation to wall thickness %							
	Over 7mm up to 8mm	Over 6mm up to and incl. 7mm	Over 5mm up to and incl. 6mm	Over 4mm up to and incl. 5mm	Over 3mm up to and incl. 4mm			
STC 370	30	28	27	26	24			
STC 440	10	8	7	6	4			
STC 510 A	10	8	7	6	4			
STC 510 B	15	14	12	10	9			
STC 540	20	18	17	16	14			
STC 590 A	10	8	7	6	4			
STC 590 B	15	14	12	10	9			

Reference Table 2 Calculation Examples of Values of Elongation Applied to No.12 Test Piece for Tubes under 8mm in Wall Thickness

Appendix. Special Quality Requirement

The special quality requirement shall apply only when requested by the purchaser, and shall be executed by the manufacturer.

Z3 Ultrasonic

(1) The criteria of the working sensitivity in the ultrasonic examination shall be Division UC specified in JIS G 0582 for hot finished steel tubes, and Division UB specified in JIS G 0582 for cold finished seamless steel tubes and cold finished electric resistance welded steel tubes, and in any case there shall be no signal equal to or greater than those produced by the artificial defects of the reference test block.

(2) The test method of the ultrasonic examination shall be as specified in JIS G 0582.

(3) The ultrasonic examination shall be applied for each tube, and the results shall conform to the requirements of (1).

## JIS Number and Corresponding Foreign Standards

วเร		BS		DIN		ISO						
Standard Number	Grade	Туре	Standard Number	Grade	Туре	Standard Number	Grade	Туре	Standard Number	Grade	Туре	Index Number
G3473	STD370	С	5242/1	HP1	С	2391	St35		2937	TS4	С	C022
	(STC38)		5242/3	HP1	С							
	STC440	С	5242/1	HP4	С							
	(STC45)		5242/3	HP4	С							
	STC510A	С	5242/1	HP2	С							
	(STC52A)		5242/3	HP2	С							
	STC510B	С										
	(STC52B)											
	STC510B	С										
	(STC55)											
	STC590A	с	5242/1	HP5	С							
	(STC60A)		5242/3	HP5	С							
	STC590B	С										
	(STC60B)											