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JIS H 3300 : 2006

(JCBA/JSA)

Copper and copper alloy seamless pipes and tubes

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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 Japan Copper and Brass Association (JCBA)/Japanese Standards Association (JSA) 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 H 3300** : 1997 is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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Copper and copper alloy seamless pipes and tubes

1 Scope This Japanese Industrial Standard specifies the wrought copper and copper alloy seamless pipes and tubes having a round section (hereafter referred to as "tubes").

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 8265 *Construction of pressure vessel—General principles*

JIS B 8266 *Alternative standard for construction of pressure vessels*

JIS H 0321 *General rules for inspection of non-ferrous metal materials*

JIS H 0501 *Methods for estimating average grain size of wrought copper and copper alloys*

JIS H 0502 *Method of eddy current testing for copper and copper alloy pipes and tubes*

JIS H 0505 *Measuring methods for electrical resistivity and conductivity of non-ferrous materials*

JIS H 1051 *Methods for determination of copper in copper and copper alloys*

JIS H 1052 *Methods for determination of tin in copper and copper alloys*

JIS H 1053 *Methods for determination of lead in copper and copper alloys*

JIS H 1054 *Methods for determination of iron in copper and copper alloys*

JIS H 1055 *Methods for determination of manganese in copper and copper alloys*

JIS H 1056 *Methods for determination of nickel in copper and copper alloys*

JIS H 1057 *Methods for determination of aluminium in copper and copper alloys*

JIS H 1058 *Methods for determination of phosphorus in copper and copper alloys*

JIS H 1059 *Methods for determination of arsenic in copper and copper alloys*

JIS H 1061 *Methods for determination of silicon in copper and copper alloys*

JIS H 1062 *Methods for determination of zinc in copper and copper alloys*

JIS H 1292 *Method for X-ray fluorescence spectrometric analysis of copper alloys*

JIS K 8085 *Ammonia solution*

JIS S 3200-1 *Equipment for water supply service—Test methods of hydrostatic pressure*

JIS S 3200-7 *Equipment for water supply service—Test methods of effect to water quality*

JIS Z 2201 *Test pieces for tensile test for metallic materials*

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JIS Z 2241 *Method of tensile test for metallic materials*

JIS Z 2245 *Rockwell hardness test—Test method*

3 Grade, class and designation The grade, class and their designations of tubes shall be as given in table 1.

Remarks : The designation to express the temper grade shall be suffixed to the designation given in table 1.

Table 1 Grade, class and their designations of tubes

Grade	Class	Designation	Informative	
Alloy No.			Name	Specific character and examples of use
C 1020	Common grade	C 1020 T(1)	Oxygen free copper	Having excellent electric and heat conductivity, workability, drawability and good weldability, corrosion and weathering resistance. Free from hydrogen embrittlement when heated at elevated temperature in reducing atmosphere. Applicable to heat exchanger, electrical and chemical industries, etc.
	Special grade	C 1020 TS(1)		
C 1100	Common grade	C 1100 T(1)	Tough pitch copper	Having excellent electric and heat conductivity, and drawability, corrosion and weathering resistance. Applicable to electrical parts, etc.
	Special grade	C 1100 TS(1)		
C 1201	Common grade	C 1201 T	Phosphorus deoxidized copper	Having good flaring and bending properties, drawability, weldability, corrosion and weathering resistance and heat conductivity. C 1220 has a property to be free from hydrogen embrittlement when heated at elevated temperature in reducing atmosphere. C 1201 has better electric conductivity than C 1220. Applicable to heat exchanger, chemical industry, gas pipe, etc. C 1220 may be also used for water supply and hot water supply.
	Special grade	C 1201 TS		
C 1220	Common grade	C 1220 T		
	Special grade	C 1220 TS		
C 2200	Common grade	C 2200 T	Red brass	Having fine gloss, good flaring and bending properties, drawability and weathering resistance. Applicable to cosmetics case, water supply and drain pipe, joint, etc.
	Special grade	C 2200 TS		
C 2300	Common grade	C 2300 T		
	Special grade	C 2300 TS		
C 2600	Common grade	C 2600 T	Brass	Having good flaring and bending properties, drawability and suitable for plating. Applicable to heat exchanger, curtain rod, sanitary tube, parts for various apparatuses and machinery, antenna rod, etc. C 2800 has high strength. Applicable to sugar plant, ship use, parts for various apparatuses and machinery, etc.
	Special grade	C 2600 TS		
C 2700	Common grade	C 2700 T		
	Special grade	C 2700 TS		
C 2800	Common grade	C 2800 T		
	Special grade	C 2800 TS		

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Table 1 (concluded)

Grade	Class	Designation	Informative	
Alloy No.			Name	Specific character and examples of use
C 4430	Common grade	C 4430 T	Brass for condenser	Having good corrosion resistance, especially, C 6870, C 6871 and C 6872 have good corrosion resistance in sea water. Applicable to condenser for steam and nuclear power plant, condenser for ship, heater and water supply, distillater, oil cooler, heat exchanger for desalinator or the like.
	Special grade	C 4430 TS		
C 6870	Common grade	C 6870 T		
	Special grade	C 6870 TS		
C 6871	Common grade	C 6871 T		
	Special grade	C 6871 TS		
C 6872	Common grade	C 6872 T		
	Special grade	C 6872 TS		
C 7060	Common grade	C 7060 T	Cupronickel for condenser	Having good corrosion resistance, especially, good corrosion resistance in sea water, and suitable for higher temperature service. Applicable to condenser for ship, heater and water supply, chemical industry, desalinator, etc.
	Special grade	C 7060 TS		
C 7100	Common grade	C 7100 T		
	Special grade	C 7100 TS		
C 7150	Common grade	C 7150 T		
	Special grade	C 7150 TS		
C 7164	Common grade	C 7164 T		
	Special grade	C 7164 TS		

Note (1) For electric conduction use, the letter "C" shall be suffixed to the designation given in table 1.

4 Quality

4.1 Appearance Tubes shall have accurate shapes, workmanlike finish, shall be even on the surface and free from defects(2) that are detrimental to practical use.

Note (2) The defects detrimental to practical use shall be as agreed upon between the purchaser and the supplier.

4.2 Chemical composition The chemical composition of tubes, when tested in accordance with **6.1**, shall be as given in table 2.

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Table 2 Chemical composition of tubes

Alloy No.	Chemical composition (mass %)											
	Cu	Pb	Fe	Sn	Zn	Al	As	Mn	Ni	P	Si	Cu +Fe +Mn +Ni
C 1020	99.96 min.	—	—	—	—	—	—	—	—	—	—	—
C 1100	99.90 min.	—	—	—	—	—	—	—	—	—	—	—
C 1201	99.90 min.	—	—	—	—	—	—	—	—	0.004 or over to and excl. 0.015	—	—
C 1220	99.90 min.	—	—	—	—	—	—	—	—	0.015 to 0.040	—	—
C 2200	89.0 to 91.0	0.05 max.	0.05 max.	—	Residual	—	—	—	—	—	—	—
C 2300	84.0 to 86.0	0.05 max.	0.05 max.	—	Residual	—	—	—	—	—	—	—
C 2600	68.5 to 71.5	0.05 max.	0.05 max.	—	Residual	—	—	—	—	—	—	—
C 2700	63.0 to 67.0	0.05 max.	0.05 max.	—	Residual	—	—	—	—	—	—	—
C 2800	59.0 to 63.0	0.10 max.	0.07 max.	—	Residual	—	—	—	—	—	—	—
C 4430	70.0 to 73.0	0.05 max.	0.05 max.	0.9 to 1.2	Residual	—	0.02 to 0.06	—	—	—	—	—
C 6870	76.0 to 79.0	0.05 max.	0.05 max.	—	Residual	1.8 to 2.5	0.02 to 0.06	—	—	—	—	—
C 6871	76.0 to 79.0	0.05 max.	0.05 max.	—	Residual	1.8 to 2.5	0.02 to 0.06	—	—	—	0.20 to 0.50	—
C 6872	76.0 to 79.0	0.05 max.	0.05 max.	—	Residual	1.8 to 2.5	0.02 to 0.06	—	0.20 to 1.0	—	—	—
C 7060	—	0.05 max.	1.0 to 1.8	—	0.50 max.	—	—	0.20 to 1.0	9.0 to 11.0	—	—	99.5 min.
C 7100	—	0.05 max.	0.50 to 1.0	—	0.50 max.	—	—	0.20 to 1.0	19.0 to 23.0	—	—	99.5 min.
C 7150	—	0.05 max.	0.40 to 1.0	—	0.50 max.	—	—	0.20 to 1.0	29.0 to 33.0	—	—	99.5 min.
C 7164	—	0.05 max.	1.7 to 2.3	—	0.50 max.	—	—	1.5 to 2.5	29.0 to 32.0	—	—	99.5 min.

4.3 Test items of mechanical and physical properties The test items of mechanical (tensile strength, elongation, hardness) and physical properties of tubes shall be as given in tables 3 and 4.

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Table 3 Test items of mechanical and physical properties of tubes (excluding pressure vessels)

Alloy No.	Temper grade	Designation	Outside diameter mm	Test items indicating mechanical and physical properties										
				Tensile strength	Elongation	Hardness	Grain size	Flaring	Flattening	Nondestructive examination characteristics	Electric conductivity	Hydrogen embrittlement	Season crack	Leaching performance
C 1020	O	C 1020 T-O	50 or under	○	○	△	△	○	—	△	△	○	—	—
		C 1020 TS-O	Over 50 up to and incl. 100	○	○	△	△	○	—	—	△	○	—	—
	OL	C 1020 T-OL	50 or under	○	○	△	△	○	—	△	△	○	—	—
		C 1020 TS-OL	Over 50 up to and incl. 100	○	○	△	△	○	—	—	△	○	—	—
	½H	C 1020 T-½H	50 or under	○	—	△	—	—	—	△	△	○	—	—
		C 1020 TS-½H	Over 50 up to and incl. 100	○	—	△	—	—	—	—	△	○	—	—
	H	C 1020 T-H	50 or under	○	—	△	—	—	—	△	△	○	—	—
		C 1020 TS-H	Over 50 up to and incl. 100	○	—	△	—	—	—	—	△	○	—	—
C 1100	O	C 1100 T-O	50 or under	○	○	△	—	○	—	△	△	—	—	—
		C 1100 TS-O	Over 50 up to and incl. 100	○	○	△	—	○	—	—	△	—	—	—
			Over 100	○	○	△	—	—	○	—	△	—	—	—
	½H	C 1100 T-½H	50 or under	○	—	△	—	—	—	△	△	—	—	—
		C 1100 TS-½H	Over 50 up to and incl. 100	○	—	△	—	—	—	—	△	—	—	—
	H	C 1100 T-H	50 or under	○	—	△	—	—	—	△	△	—	—	—
		C 1100 TS-H	Over 50 up to and incl. 100	○	—	△	—	—	—	—	△	—	—	—
C 1201 C 1220	O	C 1201 T-O C 1201 TS-O C 1220 T-O C 1220 TS-O	50 or under	○	○	△	△	○	—	△(3)	—	△(4)	—	△(5)
			Over 50 up to and incl. 100	○	○	△	△	○	—	△(3)	—	△(4)	—	△(5)
			Over 100	○	○	△	△	—	○	△(3)	—	△(4)	—	△(5)
	OL	C 1201 T-OL C 1201 TS-OL C 1220 T-OL C 1220 TS-OL	50 or under	○	○	△	△	○	—	△(3)	—	△(4)	—	△(5)
			Over 50 up to and incl. 100	○	○	△	△	○	—	△(3)	—	△(4)	—	△(5)
			Over 100	○	○	△	△	—	○	△(3)	—	△(4)	—	△(5)
	½H	C 1201 T-½H C 1201 TS-½H C 1220 T-½H C 1220 TS-½H	50 or under	○	—	△	—	—	—	△(3)	—	△(4)	—	△(5)
			Over 50 up to and incl. 100	○	—	△	—	—	—	△(3)	—	△(4)	—	△(5)
	H	C 1201 T-H C 1201 TS-H C 1220 T-H C 1220 TS-H	50 or under	○	—	△	—	—	—	△(3)	—	△(4)	—	△(5)
			Over 50 up to and incl. 100	○	—	△	—	—	—	△(3)	—	△(4)	—	△(5)

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Table 3 (continued)

Alloy No.	Temper grade	Designation	Outside diameter mm	Test items indicating mechanical and physical properties											
				Tensile strength	Elongation	Hardness	Grain size	Flaring	Flattening	Nondestructive examination characteristics	Electric conductivity	Hydrogen embrittlement	Season crack	Leaching performance
C 2200 C 2300	O	C 2200 T-O C 2200 TS-O C 2300 T-O C 2300 TS-O	50 or under	○	○	△	△	○	—	△	—	—	—	—
			Over 50 up to and incl. 100	○	○	△	△	○	—	—	—	—	—	—
			Over 100	○	○	△	△	—	○	—	—	—	—	—
	OL	C 2200 T-OL C 2200 TS-OL C 2300 T-OL C 2300 TS-OL	50 or under	○	○	△	△	○	—	△	—	—	—	—
			Over 50 up to and incl. 100	○	○	△	△	○	—	—	—	—	—	—
			Over 100	○	○	△	△	—	○	—	—	—	—	—
	½H	C 2200 T-½H C 2200 TS-½H C 2300 T-½H C 2300 TS-½H	50 or under	○	○	△	—	—	—	△	—	—	—	—
			Over 50	○	○	△	—	—	—	—	—	—	—	—
	H	C 2200 T-H C 2200 TS-H C 2300 T-H C 2300 TS-H	50 or under	○	—	△	—	—	—	△	—	—	—	—
			Over 50	○	—	△	—	—	—	—	—	—	—	—
C 2600 C 2700	O	C 2600 T-O C 2600 TS-O C 2700 T-O C 2700 TS-O	50 or under	○	○	△	△	○	—	△	—	—	□	—
			Over 50 up to and incl. 100	○	○	△	△	○	—	—	—	—	□	—
			Over 100	○	○	△	△	—	○	—	—	—	□	—
	OL	C 2600 T-OL C 2600 TS-OL C 2700 T-OL C 2700 TS-OL	50 or under	○	○	△	△	○	—	△	—	—	□	—
			Over 50 up to and incl. 100	○	○	△	△	○	—	—	—	—	□	—
			Over 100	○	○	△	△	—	○	—	—	—	□	—
	½H	C 2600 T-½H C 2600 TS-½H C 2700 T-½H C 2700 TS-½H	50 or under	○	○	△	—	—	—	△	—	—	□	—
			Over 50	○	○	△	—	—	—	—	—	—	□	—
	H	C 2600 T-H C 2600 TS-H C 2700 T-H C 2700 TS-H	50 or under	○	—	△	—	—	—	△	—	—	□	—
			Over 50	○	—	△	—	—	—	—	—	—	□	—

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Table 3 (concluded)

Alloy No.	Temper grade	Designation	Outside diameter mm	Test items indicating mechanical and physical properties										
				Tensile strength	Elongation	Hardness	Grain size	Flaring	Flattening	Nondestructive examination characteristics	Electric conductivity	Hydrogen embrittlement	Season crack	Leaching performance
C 2800	O	C 2800 T-O C 2800 TS-O	50 or under	○	○	–	–	○	–	△	–	–	□	–
			Over 50 up to and incl. 100	○	○	–	–	○	–	–	–	–	□	–
			Over 100	○	○	–	–	–	○	–	–	–	□	–
	OL	C 2800 T-OL C 2800 TS-OL	50 or under	○	○	△	–	○	–	△	–	–	□	–
			Over 50 up to and incl. 100	○	○	△	–	○	–	–	–	–	□	–
			Over 100	○	○	△	–	–	○	–	–	–	□	–
	½H	C 2800 T-½H C 2800 TS-½H	50 or under	○	○	△	–	–	–	△	–	–	□	–
			Over 50	○	○	△	–	–	–	–	–	–	□	–
	H	C 2800 T-H C 2800 TS-H	50 or under	○	–	–	–	–	–	△	–	–	□	–
			Over 50	○	–	–	–	–	–	–	–	–	□	–
C 4430 C 6870 C 6871 C 6872	O	C 4430 T-O C 4430 TS-O C 6870 T-O C 6870 TS-O C 6871 T-O C 6871 TS-O C 6872 T-O C 6872 TS-O	50 or under	○	○	–	△	○	○	○	–	–	□	–
			Over 50 up to and incl. 100	○	○	–	△	○	○	–	–	–	□	–
			Over 100	○	○	–	△	–	○	–	–	–	□	–
C 7060 C 7100 C 7150 C 7164	O	C 7060 T-O C 7060 TS-O C 7100 T-O C 7100 TS-O C 7150 T-O C 7150 TS-O C 7164 T-O C 7164 TS-O	50 or under	○	○	–	△	○	○	○	–	–	–	–
			Over 50 up to and incl. 100	○	○	–	△	○	○	–	–	–	–	–
			Over 100	○	○	–	△	–	○	–	–	–	–	–

Notes (3) When C 1220 tube is used for water supply as requested by the purchaser, a hydrostatic test in **6.8** shall be executed as a type inspection.

(4) Not applicable to tubes of C 1220.

(5) When C 1220 is used as pipes for water supply as requested by the purchaser, a leaching performance test in **6.13** shall be executed as a type inspection.

Remarks : ○ mark indicates mandatory test items, △ mark indicates those to be applied upon request of the purchaser. □ mark indicates standard test items which may be omitted upon agreement between the purchaser and the supplier.

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Table 4 Test items of mechanical and physical properties of alloy tubes for pressure container

Alloy No.	Temper grade	Designation	Outside diameter mm	Test items indicating mechanical and physical properties							
				Tensile strength	Proof stress (6)	Elongation	Grain size	Flaring	Flattening	Nondestructive examination characteristics	Season crack
C 2800	O	C 2800 T-O C 2800 TS-O	50 or under	○	○	○	—	○	—	○	□
			Over 50 up to and incl. 100	○	○	○	—	○	—	—	□
			Over 100	○	○	○	—	—	○	—	□
C 4430	O	C 4430 T-O C 4430 TS-O	50 or under	○	○	○	△	○	○	○	□
			Over 50 up to and incl. 100	○	○	○	△	○	○	—	□
			Over 100	○	○	○	△	—	○	—	□
C 7060	O	C 7060 T-O C 7060 TS-O	50 or under	○	○	○	△	○	○	○	—
			Over 50 up to and incl. 100	○	○	○	△	○	○	—	—
			Over 100	○	○	○	△	—	○	—	—
C 7150	O	C 7150 T-O C 7150 TS-O	50 or under	○	○	○	△	○	○	○	—
			Over 50 up to and incl. 100	○	○	○	△	○	○	—	—
			Over 100	○	○	○	△	—	○	—	—

Note (6) The proof test is limited to alloys to which **JIS B 8265** and **JIS B 8266** (see **4.4.2**) are applied.

Remarks : ○ mark indicates mandatory test items, △ mark indicates those to be applied upon request of the purchaser. □ mark indicates standard test items which may be omitted upon agreement between the purchaser and the supplier.

4.4 Mechanical properties

4.4.1 Mechanical properties of tubes The mechanical properties (tensile strength, elongation and Rockwell hardness) of tubes, when tested in accordance with **6.2** and **6.3**, shall be as given in table 5. When the hardness test is applied, however, the tests for tensile strength and elongation may not be applied.

The mechanical properties of tubes having a dimension exceeding the range of the specified dimensions shall be as agreed upon between the purchaser and the supplier.

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Table 5 Mechanical properties of tubes

Alloy No.	Temper grade	Designation	Tensile test				Hardness test			
			Outside diameter mm	Wall thickness mm	Tensile strength N/mm²	Elongation %	Wall thickness mm	Rockwell hardness(7)		
								HR30T	HR15T	HRF
C 1020	O	C 1020 T-O C 1020 TS-O	4 or over up to and incl. 100	0.25 or over up to and incl. 30	205 min.	40 min.	0.6 min.	—	60 max.	50 max.
	OL	C 1020 T-OL C 1020 TS-OL	4 or over up to and incl. 100	0.25 or over up to and incl. 30	205 min.	40 min.	0.6 min.	—	65 max.	55 max.
	½H	C 1020 T-½H C 1020 TS-½H	4 or over up to and incl. 100	0.25 or over up to and incl. 25	245 to 325	—	—	30 to 60	—	—
	H	C 1020 T-H C 1020 TS-H	25 or under	0.25 or over up to and incl. 3	315 min.	—	—	55 min.	—	—
			Over 25 up to and incl. 50	0.9 or over up to and incl. 4				—	—	—
			Over 50 up to and incl. 100	1.5 or over up to and incl. 6				—	—	—
C 1100	O	C 1100 T-O C 1100 TS-O	5 or over up to and incl. 250	0.5 or over up to and incl. 30	205 min.	40 min.	—	—	—	—
	½H	C 1100 T-½H C 1100 TS-½H	5 or over up to and incl. 250	0.5 or over up to and incl. 25	245 to 325	—	—	30 to 60	—	—
	H	C 1100 T-H C 1100 TS-H	5 or over up to and incl. 100	0.5 or over up to and incl. 6	275 min.	—	—	—	—	80 min.
				Over 6 up to and incl. 10	265 min.	—	—	—	—	75 min.

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Table 5 (continued)

Alloy No.	Temper grade	Designation	Tensile test				Hardness test			
			Outside diameter mm	Wall thickness mm	Tensile strength N/mm²	Elongation %	Wall thickness mm	Rockwell hardness(7)		
								HR30T	HR15T	HRF
C 1201 C 1220	O	C 1201 T-O C 1201 TS-O C 1220 T-O C 1220 TS-O	4 or over up to and incl. 250	0.25 or over up to and incl. 30	205 min.	40 min.	0.6 min.	—	60 max.	50 max.
	OL	C 1201 T-OL C 1201 TS-OL C 1220 T-OL C 1220 TS-OL	4 or over up to and incl. 250	0.25 or over up to and incl. 30	205 min.	40 min.	0.6 min.	—	65 max.	55 max.
	½H	C 1201 T-½H C 1201 TS-½H C 1220 T-½H C 1220 TS-½H	4 or over up to and incl. 250	0.25 or over up to and incl. 25	245 to 325	—	—	30 to 60	—	—
	H	C 1201 T-H C 1201 TS-H C 1220 T-H C 1220 TS-H	25 or under	0.25 or over up to and incl. 3	315 min.	—	—	55 min.	—	—
			Over 25 up to and incl. 50	0.9 or over up to and incl. 4				—	—	—
			Over 50 up to and incl. 100	1.5 or over up to and incl. 6				—	—	—
			Over 100 up to and incl. 200	2 or over up to and incl. 6	275 min.	—	—	—	—	—
			Over 200 up to and incl. 350	3 or over up to and incl. 8	255 min.	—	—	—	—	—
C 2200	O	C 2200 T-O C 2200 TS-O	10 or over up to and incl. 150	0.5 or over up to and incl. 15	225 min.	35 min.	1.1 or under	30 max.	—	—
							Over 1.1	—	—	70 max.
	OL	C 2200 T-OL C 2200 TS-OL	10 or over up to and incl. 150	0.5 or over up to and incl. 15	225 min.	35 min.	1.1 or under	37 max.	—	—
							Over 1.1	—	—	78 max.
	½H	C 2200 T-½H C 2200 TS-½H	10 or over up to and incl. 150	0.5 or over up to and incl. 6	275 min.	15 min.	—	38 max.	—	—

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Table 5 (continued)

Alloy No.	Temper grade	Designation	Tensile test				Hardness test			
			Outside diameter mm	Wall thickness mm	Tensile strength N/mm²	Elongation %	Wall thickness mm	Rockwell hardness(7)		
								HR30T	HR15T	HRF
C 2200	H	C 2200 T-H C 2200 TS-H	10 or over up to and incl. 100	0.5 or over up to and incl. 6	365 min.	—	Over 0.5 up to and incl. 6	55 min.	—	—
C 2300	O	C 2300 T-O C 2300 TS-O	10 or over up to and incl. 150	0.5 or over up to and incl. 15	275 min.	35 min.	1.1 or under	36 max.	—	—
							Over 1.1	—	—	75 max.
	OL	C 2300 T-OL C 2300 TS-OL	10 or over up to and incl. 150	0.5 or over up to and incl. 15	275 min.	35 min.	1.1 or under	39 max.	—	—
							Over 1.1	—	—	85 max.
	½H	C 2300 T-½H C 2300 TS-½H	10 or over up to and incl. 150	0.5 or over up to and incl. 6	305 min.	20 min.	—	43 min.	—	—
	H	C 2300 T-H C 2300 TS-H	10 or over up to and incl. 100	0.5 or over up to and incl. 6	390 min.	—	Over 0.5 up to and incl. 6	65 min.	—	—
C 2600	O	C 2600 T-O C 2600 TS-O	4 or over up to and incl. 250	0.3 or over up to and incl. 15	275 min.	45 min.	0.8 or under	40 max.	—	—
							Over 0.8	—	—	80 max.
	OL	C 2600 T-OL C 2600 TS-OL	4 or over up to and incl. 250	0.3 or over up to and incl. 15	275 min.	45 min.	0.8 or under	60 max.	—	—
							Over 0.8	—	—	90 max.
	½H	C 2600 T-½H C 2600 TS-½H	4 or over up to and incl. 100	0.3 or over up to and incl. 6	375 min.	20 min.	—	53 min.	—	—
			Over 100 up to and incl. 250	2 or over up to and incl. 10	355 min.					
	H	C 2600 T-H C 2600 TS-H	4 or over up to and incl. 100	0.3 or over up to and incl. 6	450 min.	—	Over 0.5 up to and incl. 6	70 min.	—	—
			Over 100 up to and incl. 250	2 or over up to and incl. 10	390 min.					

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Table 5 (continued)

Alloy No.	Temper grade	Designation	Tensile test				Hardness test			
			Outside diameter mm	Wall thickness mm	Tensile strength N/mm²	Elongation %	Wall thickness mm	Rockwell hardness(7)		
								HR30T	HR15T	HRF
C 2700	O	C 2700 T-O C 2700 TS-O	4 or over up to and incl. 250	0.3 or over up to and incl. 15	295 min.	40 min.	0.8 or under	40 max.	—	—
							Over 0.8	—	—	80 max.
	OL	C 2700 T-OL C 2700 TS-OL	4 or over up to and incl. 250	0.3 or over up to and incl. 15	295 min.	40 min.	0.8 or under	60 max.	—	—
							Over 0.8	—	—	90 max.
	½H	C 2700 T-½H C 2700 TS-½H	4 or over up to and incl. 100	0.3 or over up to and incl. 6	375 min.	20 min.	—	53 max.	—	—
			Over 100 up to and incl. 250	2 or over up to and incl. 10	355 min.					
	H	C 2700 T-H C 2700 TS-H	4 or over up to and incl. 100	0.3 or over up to and incl. 6	450 min.	—	Over 0.5 up to and incl. 6	70 max.	—	—
			Over 100 up to and incl. 250	2 or over up to and incl. 10	390 min.					
C 2800	O	C 2800 T-O C 2800 TS-O	10 or over up to and incl. 250	1 or over up to and incl. 15	315 min.	35 min.	—	—	—	—
	OL	C 2800 T-OL C 2800 TS-OL	10 or over up to and incl. 250	1 or over up to and incl. 15	315 min.	35 min.	0.8 or under	60 max.	—	—
							Over 0.8	—	—	90 max.
	½H	C 2800 T-½H C 2800 TS-½H	10 or over up to and incl. 250	1 or over up to and incl. 6	375 min.	15 min.	—	55 min.	—	—
	H	C 2800 T-H C 2800 TS-H	10 or over up to and incl. 100	1 or over up to and incl. 6	450 min.	—	—	—	—	—

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Table 5 (concluded)

Alloy No.	Temper grade	Designation	Tensile test				Hardness test			
			Outside diameter mm	Wall thickness mm	Tensile strength N/mm²	Elongation %	Wall thickness mm	Rockwell hardness(7)		
								HR30T	HR15T	HRF
C 4430	O	C 4430 T-O C 4430 TS-O	5 or over up to and incl. 250	0.8 or over up to and incl. 10	315 min.	30 min.	—	—	—	—
C 6870 C 6871 C 6872	O	C 6870 T-O C 6870 TS-O C 6871 T-O C 6871 TS-O C 6872 T-O C 6872 TS-O	5 or over up to and incl. 50	0.8 or over up to and incl. 10	375 min.	40 min.	—	—	—	—
			Over 50 up to and incl. 250	0.8 or over up to and incl. 10	355 min.	40 min.				
C 7060	O	C 7060 T-O C 7060 TS-O	5 or over up to and incl. 250	0.8 or over up to and incl. 5	275 min.	30 min.	—	—	—	—
C 7100	O	C 7100 T-O C 7100 TS-O	5 or over up to and incl. 50	0.8 or over up to and incl. 5	315 min.	30 min.	—	—	—	—
C 7150	O	C 7150 T-O C 7150 TS-O	5 or over up to and incl. 250	0.8 or over up to and incl. 5	365 min.	30 min.	—	—	—	—
C 7164	O	C 7164 T-O C 7164 TS-O	5 or over up to and incl. 50	0.8 or over up to and incl. 5	430 min.	30 min.	—	—	—	—

Note (7) For those alloys for which the hardness is doubly specified, either one of the hardness tests shall be selected on an agreement between the purchaser and the supplier.

Remarks : 1 N/mm² = 1 MPa

4.4.2 Proof stress The proof stress of alloy tubes for pressure containers shall be as given in table 6.

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Table 6 Proof stress of alloy tubes for pressure vessels

Unit: N/mm^2

Alloy No.	Temper grade	Designation	0.2 % proof stress (40 °C)
C 2800	O	C 2800 T-O C 2800 TS-O	125 or over
C 4430	O	C 4430 T-O C 4430 TS-O	103 or over
C 7060	O	C 7060 T-O C 7060 TS-O	103 or over
C 7150	O	C 7150 T-O C 7150 TS-O	125 or over

Remarks : 1 N/mm^2 = 1 MPa

4.5 Grain size The grain size of tubes shall be as given in table 7.

Remarks : When applying the grain size in table 7, the mechanical properties in table 5 need not be applied.

Table 7 Grain size of tubes

Unit: mm

Alloy No.	Temper grade	Designation	Grain size
C 1020 C 1201 C 1220	O	C 1020 T-O, C 1020 TS-O C 1201 T-O, C 1201 TS-O C 1220 T-O, C 1220 TS-O	0.025 to 0.060
	OL	C 1020 T-OL, C 1020 TS-OL C 1201 T-OL, C 1201 TS-OL C 1220 T-OL, C 1220 TS-OL	0.040 max.
C 2200 C 2300 C 2600 C 2700	O	C 2200 T-O, C 2200 TS-O C 2300 T-O, C 2300 TS-O C 2600 T-O, C 2600 TS-O C 2700 T-O, C 2700 TS-O	0.025 to 0.060
	OL	C 2200 T-OL, C 2200 TS-OL C 2300 T-OL, C 2300 TS-OL C 2600 T-OL, C 2600 TS-OL C 2700 T-OL, C 2700 TS-OL	α (8) to 0.035
C 4430 C 6870 C 6871 C 6872 C 7060 C 7100 C 7150 C 7164	O	C 4430 T-O, C 4430 TS-O C 6870 T-O, C 6870 TS-O C 6871 T-O, C 6871 TS-O C 6872 T-O, C 6872 TS-O C 7060 T-O, C 7060 TS-O C 7100 T-O, C 7100 TS-O C 7150 T-O, C 7150 TS-O C 7164 T-O, C 7164 TS-O	0.010 to 0.045

Note (8) "α" means the minimum grain size of the thoroughly recrystallized α phase grain.

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4.6 Flareability For temper grade O and OL, tubes shall be free from cracks on the surface when the flaring test is conducted as specified in **6.5**.

4.7 Flattenability For temper grade O and OL, tubes shall be free from cracks on the surface when the flattening test is conducted in accordance with **6.6**.

4.8 Nondestructive test characteristics Tubes, when subjected to the eddy current test of **6.7**, shall be free from detrimental defects. Instead of the eddy current test, the hydrostatic test of **6.8** or the pneumatic test of **6.9** may be applied as agreed upon between the purchaser and the manufacturer. Tubes shall be free from leakage when subjected the hydrostatic test of **6.8** or the pneumatic test of **6.9**.

4.9 Electric conductivity The electric conductivity of tubes, when tested in accordance with **6.10**, shall be as given in table 8.

Table 8 Electric conductivity of tubes

Alloy No.	Temper grade	Designation	Wall thickness mm	Electric conductivity (20 °C) %IACS
C 1020 C 1100	O	C 1020 T-O, C 1020 T-OL C 1020 TS-O, C 1020 TS-OL	2 or under	100 min.
	OL	C 1100 T-O, C 1100 T-OL C 1100 TS-O, C 1100 TS-OL	Over 2	100 min.
	½H	C 1020 T-½H C 1020 TS-½H	2 or under	97 min.
		C 1100 T-½H C 1100 TS-½H	Over 2	98 min.
	H	C 1020 T-H C 1020 TS-H C 1100 T-H C 1100 TS-H	2 or under	96 min.
			Over 2	97 min.

4.10 Hydrogen embrittlement When the hydrogen embrittlement test specified in **6.11** is carried out, tubes of C 1020, C 1201 shall not have many blowholes or open grain structures characteristic of hydrogen embrittlement at the vicinity of grain boundaries.

4.11 Season cracking When the season cracking test specified in **6.12** is carried out for tubes of C 2600, C 2700, C 2800, C 4430, C 6870, C 6871 and C 6872, tubes shall be free from cracking on the surface. This test, however, may be omitted by agreement with the purchaser.

4.12 Leaching performance C 1220 tubes used as water supply piping, when subjected to the leaching performance test by **6.13**, shall be accepted by the criterion of the leaching performance as specified in table 9.

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Table 9 Leaching performance of C 1220 tubes used as water supply piping

Alloy No.	Standard item	Unit	Criterion value	Test temperature
C 1220	Turbidity (9)	Degree	2 or under	Ordinary temperature
	Chromaticity (9)	Degree	5 or under	
	Odour		Free from abnormality	
	Taste		Free from abnormality	
	Eluted amount of copper	mg/L	1.0 or under	

Note (9) The loss values of the turbidity and chromaticity of the leaching performance are obtained from differences from those in a blank test.

5 Dimensions and tolerances

5.1 Dimensions specification To specify the dimensions for tubes, any two out of outside diameter, inside diameter or wall thickness as well as length shall be indicated. Out of the three dimensions, the one not specified shall be calculated as required according to the formula: Outside diameter = inside diameter + wall thickness × 2.

5.2 Standard dimension The standard dimensions for tubes shall be as given in table 10.

Information : The standard dimensions for tubes other than copper alloy tubes for ordinary piping and water supply shall be shown in Annex for reference.

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Table 10 Standard dimensions and mean outside diameter tolerance of copper tubes for ordinary piping and water supply

Nominal diameter [10]		Standard outside diameter mm	Mean outside diameter tolerance [11] mm	Wall thickness mm		
(A)	(B)			Type K [12]	Type L [12]	Type M [12]
8	1/4	9.52	±0.03	0.89	0.76	—
10	3/8	12.70	±0.03	1.24	0.89	0.64
15	1/2	15.88	±0.03	1.24	1.02	0.71
—	5/8	19.05	±0.03	1.24	1.07	—
20	3/4	22.22	±0.03	1.65	1.14	0.81
25	1	28.58	±0.04	1.65	1.27	0.89
32	1 1/4	34.92	±0.04	1.65	1.40	1.07
40	1 1/2	41.28	±0.05	1.83	1.52	1.24
50	2	53.98	±0.05	2.11	1.78	1.47
65	2 1/2	66.68	±0.05	—	2.03	1.65
80	3	79.38	±0.05	—	2.29	1.83
100	4	104.78	±0.05	—	2.79	2.41
125	5	130.18	±0.08	—	3.18	2.77
150	6	155.58	±0.08	—	3.56	3.10

Notes [10] For the nominal diameter, either (A) or (B) shall be used. However, as occasion demands, the letter A for the (A) series and the letter B for the (B) series shall be suffixed to each digit expressing the nominal diameter to identify.

[11] The term "mean outside diameter tolerance" is defined as the allowable limit on the difference between the mean value of maximum and minimum diameters measured at arbitrary cross section of the tube and the standard outside diameter.

[12] Type K tubes are mainly used for piping service of medicine, and Type M tubes are mainly used for water supply, feed water, hot water supply, cool or warm water and town gas transmission. Type L tubes are used for both of the said applications.

Remarks : The most typical standard values for the standard outside diameters are shown in the table.

5.3 Dimensional tolerances The tolerances on dimensions of tubes shall be as follows:

a) **Diameter tolerance** The tolerances on diameter for tubes shall be as given in table 11. For copper alloy tubes for ordinary piping and water supply of temper grade other than O or OL, the mean outside diameter tolerance specified in table 10 shall be applied. For copper alloy tubes for heat exchanger, table 12 shall be applied.

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Table 11 Tolerances on average diameter(13) of tubes

Outside diameter or inside diameter	Alloy No.			
	C 1020 • C 1100 • C 1201 • C 1220 • C 2200 • C 2300 • C 2600 • C 2700 • C 2800		C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164	
	Class		Class	
	Common grade	Special grade	Common grade	Special grade
4 or over up to and incl. 15	±0.08	±0.05	—	—
Over 15 up to and incl. 25	±0.09	±0.06	—	—
Over 25 up to and incl. 50	±0.12	±0.08	—	—
Over 50 up to and incl. 75	±0.15	±0.10	±0.15	±0.10
Over 75 up to and incl. 100	±0.20	±0.13	±0.20	±0.13
Over 100 up to and incl. 125	±0.27	±0.15	±0.27	±0.15
Over 125 up to and incl. 150	±0.35	±0.18	±0.35	±0.18
Over 150 up to and incl. 200	±0.50	—	±0.50	—
Over 200 up to and incl. 250	±0.65	—	±0.65	—
Over 250 up to and incl. 350	±0.40 %	—	±0.40 %	—

Note (13) The term "average diameter" is defined as the mean value either obtained from the maximum and minimum outside diameters or obtained from the maximum and minimum inside diameters measured at arbitrary cross section of the tube.

Remarks 1 When the tolerance is specified for only either plus or minus side, the value in the table shall be doubled.

2 The tolerance for tubes having a dimension exceeding the range of specified dimensions shall be as agreed upon between the purchaser and the supplier.

Table 12 Tolerances on diameter of copper alloy tubes for heat exchanger

(Alloy No. C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164)

Unit: mm

Outside diameter	Class		
	Common grade	Special grade	
		1.1 or under in thickness	Over 1.1 in thickness
5 or over up to and incl. 10	0 −1.5 %	0 −0.10	0 −0.10
Over 10 up to and incl. 20		0 −0.20	0 −0.17
Over 20 up to and incl. 30		0 −0.30	0 −0.22
Over 30 up to and incl. 50		0 −0.40	0 −0.30

Remarks : The tolerances for copper alloy tubes for heat exchanger having a dimension exceeding the range of specified dimensions shall be as agreed upon between the purchaser and the supplier.

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b) **Thickness tolerance** The tolerances on wall thickness of tubes shall be as follows:

1) For tubes excepting the alloy tubes for heat exchanger (C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164), tables 13 and 14 shall apply. When the inside diameter is specified, tables 13 and 14 shall be so applied that the outside diameter equals the inside diameter plus twice the wall thickness.

2) For the alloy tubes for heat exchanger (C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164), the tolerance on wall thickness shall be ±10 %.

Table 13 Tolerances on wall thickness (Common grade)

Unit: mm

Outside diameter	Wall thickness									
	0.25 or over up to and incl. 0.4	Over 0.4 up to and incl. 0.6	Over 0.6 up to and incl. 0.8	Over 0.8 up to and incl. 1.4	Over 1.4 up to and incl. 2	Over 2 up to and incl. 3	Over 3 up to and incl. 4	Over 4 up to and incl. 5.5	Over 5.5 up to and incl. 7	Over 7
4 or over up to and incl. 15	±0.06	±0.07	±0.10	±0.13	±0.15	±0.18				
Over 15 up to and incl. 25	±0.07	±0.08	±0.10	±0.15	±0.18	±0.20	±0.30	±0.40	±0.45	
Over 25 up to and incl. 50		±0.09	±0.11	±0.15	±0.18	±0.20	±0.30	±0.40	±0.45	±8 %
Over 50 up to and incl. 100			±0.15	±0.18	±0.22	±0.25	±0.30	±0.40	±0.45	±8 %
Over 100 up to and incl. 175				±0.22	±0.25	±0.30	±0.35	±0.42	±0.45	±9 %
Over 175 up to and incl. 250					±0.30	±0.35	±0.40	±0.45	±0.50	±9 %

Remarks 1 When the tolerance is specified for only either plus or minus side, the value in the table shall be doubled.

2 The tolerances for tubes having dimensions exceeding the range of the specified dimensions shall be as agreed upon between the purchaser and the supplier.

Table 14 Tolerances on wall thickness (Special grade)

Unit: mm

Outside diameter	Wall thickness						
	0.25 or over up to and incl. 0.4	Over 0.4 up to and incl. 0.6	Over 0.6 up to and incl. 0.8	Over 0.8 up to and incl. 1.4	Over 1.4 up to and incl. 2	Over 2 up to and incl. 3	Over 3 up to and incl. 4
4 or over up to and incl. 15	±0.03	±0.05	±0.06	±0.08	±0.09	±0.10	
Over 15 up to and incl. 25	±0.04	±0.05	±0.06	±0.09	±0.10	±0.13	±0.15
Over 25 up to and incl. 50		±0.06	±0.08	±0.09	±0.10	±0.13	±0.18
Over 50 up to and incl. 100			±0.10	±0.13	±0.15	±0.18	±0.20

Remarks 1 When the tolerance is specified for only either plus or minus side, the value in the table shall be doubled.

2 For the applicable tolerances for tubes having a dimension exceeding the range of specified dimensions, table 13 shall be applied.

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c) **Tolerance on out-of-roundness** The tolerances on out-of-roundness(14) for tubes shall be as given in table 15. However, the out-of-roundness shall not be applied to tubes of temper grade O and OL, tubes in coil form, alloy tubes for heat-exchangers, and tubes under 0.4 mm in wall thickness.

Note (14) The term "out-of-roundness" is defined as the proportion of the specified outside diameter to the difference between the longest and shortest diameter measured at arbitrary cross section of the tube.

Remarks : When either only the outside diameter or the wall thickness is specified, the ratio of wall thickness to outside diameter shall be calculated from the value of the wall thickness or outside diameter, whichever is unspecified, which is obtained by the formula: Outside diameter = inside diameter + wall thickness × 2.

Table 15 Tolerances on out-of-roundness of tubes

Wall thickness/ outside diameter	Class	
	Common grade	Special grade
0.01 or over up to and incl. 0.03	3 % max. of outside diameter	1.5 % max. of outside diameter
Over 0.03 up to and incl. 0.05	2 % max. of outside diameter	1.0 % max. of outside diameter
Over 0.05 up to and incl. 0.10	1.5 % max.(15) of outside diameter	0.8 % max.(16) of outside diameter
Over 0.10	1.5 % max.(15) of outside diameter	0.7 % max.(16) of outside diameter

Notes (15) When the resultant value is 0.1 mm or under, the tolerance shall be 0.1 mm.

(16) When the resultant value is 0.05 mm or under, the tolerance shall be 0.05 mm.

Remarks : The tolerance for the tube of which the ratio of wall thickness to outside diameter is outside the specified range shall be as agreed upon between the purchaser and the supplier.

d) **Length tolerance** The length tolerances for tubes shall be as given in table 16. For copper alloy tubes for heat exchangers and tubes in coil form, the tolerances in table 17 and table 18, respectively, shall apply.

The length tolerances for straight tubes having a dimension exceeding the range of specified dimensions shall be as agreed upon between the purchaser and the supplier.

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Table 16 Length tolerances for straight tubes

(Alloy No. C 1020 · C 1100 · C 1201 · C 1220 · C 2200 · C 2300 · C 2600 · C 2700 · C 2800)

Unit: mm

Length	Outside diameter		
	25 or under	Over 25 up to and incl. 100	Over 100
600 or under	+2 0	+3 0	+3 0
Over 600 up to and incl. 1 800	+3 0	+3 0	+6 0
Over 1 800 up to and incl. 4 200	+6 0	+6 0	+6 0
Over 4 200 up to and incl. 9 000	+10 0	+10 0	+10 0

Table 17 Length tolerances for copper alloy straight tubes for heat exchanger

(Alloy No. C 4430 · C 6870 · C 6871 · C 6872 · C 7060 · C 7100 · C 7150 · C 7164)

Unit: mm

Length	Tolerance
9 000 or under	+5 0
Over 9 000 up to and incl. 18 000	+10 0
Over 18 000 up to and incl. 30 000	+15 0

Table 18 Length tolerances for tubes in coil form

Unit: mm

Length	Outside diameter
	50 or under
15 000 or under	+300 0
Over 15 000 up to and incl. 30 000	+600 0
Over 30 000	+3 % 0

5.4 Maximum permissible value of bend of straight tubes The maximum permissible value of bend for tubes[17] shall be as given in table 19. However, the maximum permissible value of bend shall be applied to straight tubes with an outside diameter 6 mm or over up to and including 90 mm, and shall not be applied to those of temper grade O and OL.

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The maximum permissible value for tubes having a dimension exceeding the range of specified dimensions shall be as agreed upon between the purchaser and the supplier.

Note (17) The term "bend" is the depth of the arc for the full length as shown in figure 1.

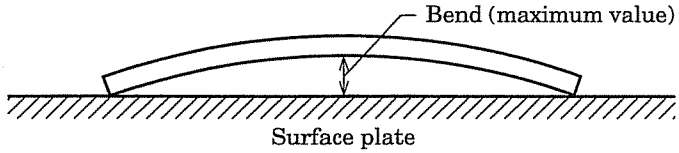

Figure 1 Bend of tube

Table 19 Maximum permissible value on bend

Unit: mm

Length	Maximum value (18)
1 000 or over up to and incl. 2 000	5
Over 2 000 up to and incl. 2 500	8
Over 2 500 up to and incl. 3 000	12

Note (18) The maximum permissible value of bend for the tube with a length over 3 000 mm shall be 12 mm or under in any 3 000 mm in length instead of full length.

6 Test

6.1 Chemical analysis The analytical method of chemical composition shall conform to any one of the following standards. **JIS H 1292** may also be applied if the elements or determination range of the chemical composition to be determined are covered in the said standard.

JIS H 1051 · JIS H 1052 · JIS H 1053 · JIS H 1054 · JIS H 1055 · JIS H 1056 · JIS H 1057 · JIS H 1058 · JIS H 1059 · JIS H 1061 · JIS H 1062

6.2 Tensile test The tensile test shall conform to **JIS Z 2241**. The test piece, in this case, shall be No. 11 test piece specified in **JIS Z 2201**.

In case No. 11 test piece can not be taken, either No. 12 or No. 14C test piece shall be substituted. Further, the sectional area of the test piece is calculated by either a method of measuring direct dimensions or a method of obtaining the sectional area from the weight of the test piece.

6.3 Hardness test The hardness test shall be conducted on the inside surface of tubes in accordance with **JIS Z 2245**.

6.4 Grain size test The grain size test shall be conducted on the tube section parallel to the tube axis in accordance with **JIS H 0501**.

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6.5 Flaring test The flaring test shall be conducted by thrusting a conical wedge having a vertical angle of 60° into any one end of the test piece taken from one end of a tube with an adequate length until its outside diameter extends to the ratio as given in table 20.

Table 20 Flaring ratio

Alloy No.	Outside diameter, wall thickness	
	20 mm or under in outside diameter, and also over 0.5 mm in wall thickness	Over 20 mm up to and incl. 100 mm in outside diameter, or 0.5 mm or under in wall thickness
C 1020 • C 1100 • C 1201 • C 1220	1.4	1.3
C 2200 • C 2300 • C 2600 • C 2700 • C 2800	1.2	1.15
C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164	1.25	

6.6 Flattening test The flattening test shall be conducted by placing the test piece taken from one end of a tube with a length approximately 100 mm as given in figure 2, and pinching it between two flat plates and flattening it until the distance between the plates becomes equal to 3 times the wall thickness of the tube.

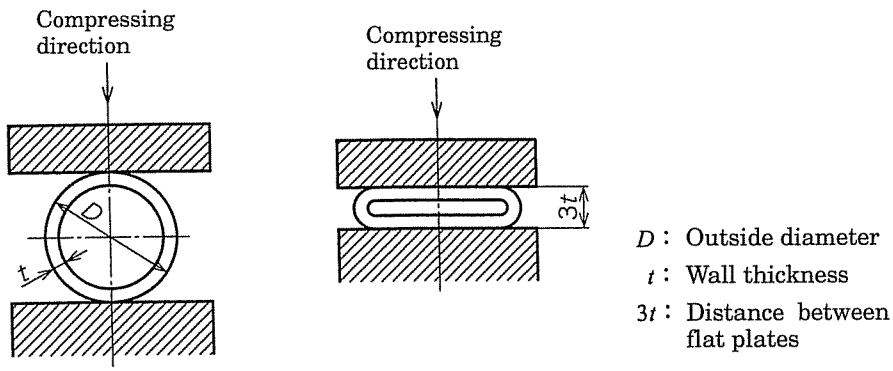

Figure 2 Flattening test

6.7 Eddy current test The eddy current test shall conform to **JIS H 0502**. This test may be conducted on a test piece before annealed. In this case, the size of reference defects (diameter of drill hole) shall be as given in table 21.

The diameter of drill hole for tubes exceeding the range of specified dimensions shall be as agreed upon between the purchaser and the supplier.

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Table 21 Size of reference defects (Diameter of drill hole)

Unit: mm

Diameter	Alloy No.				
	C 1020 • C 1100 • C 1201 • C 1220		C 2200 • C 2300 • C 2600 • C 2700 • C 2800	C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164	
	Application		Application	Application	
	Other than heat exchanger	Heat exchanger	All	Other than heat exchanger	Heat exchanger
4 or over up to and incl. 10	0.9	0.6	0.7	0.7	0.6
Over 10 up to and incl. 20	1.0	0.6	0.8	0.8	0.6
Over 20 up to and incl. 25	1.1	0.8	0.9	0.9	0.8
Over 25 up to and incl. 30	1.1	0.9	0.9	0.9	0.9
Over 30 up to and incl. 40	1.3	1.1	1.1	1.1	1.1
Over 40 up to and incl. 45	1.5	1.2	1.3	1.3	1.2
Over 45 up to and incl. 50	1.5	1.3	1.3	1.3	1.3

6.8 Hydrostatic test In the hydrostatic test, pressures computed by the following formula shall be applied. Unless specially specified, this pressure P does not need to exceed 6.85 MPa.

Further, the method specified in **JIS S 3200-1** is applied to C 1220 tubes used for water supply piping.

$$P = \frac{2S \times t}{D - 0.8t}$$

where, P : test hydrostatic pressure (MPa)

S : allowable stress of material as given in table 22 (N/mm²)

t : wall thickness of tube (mm)

D : outer diameter of tube (mm)

Table 22 Allowable stress of materials

Unit: N/mm²

Alloy No.	Value of S
C 1020 • C 1100 • C 1201 • C 1220	41
C 2200 • C 2300 • C 2600 • C 2700 • C 2800 • C 4430 • C 6870 • C 6871 • C 6872 • C 7060 • C 7100 • C 7150 • C 7164	48

Remarks : 1 N/mm² = 1 MPa

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6.9 Pneumatic test The pneumatic test shall be conducted in water by using an air pressure of 0.4 MPa min. for 5 s or more.

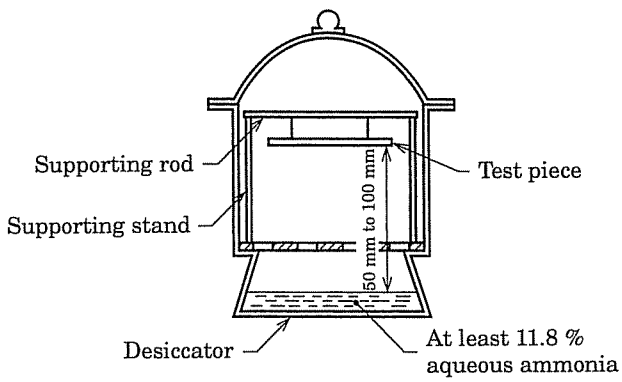
6.10 Electric conductivity test The electric conductivity test shall conform to **JIS H 0505**.

6.11 Hydrogen embrittlement test The hydrogen embrittlement test shall be conducted by heating the test piece in a hydrogen gas current at 850 °C ± 25 °C for 30 min followed by polishing and etching, and then examining the crystal grain boundary by means of a microscope of 75 magnifications to 200 magnifications.

6.12 Season cracking test The season cracking test shall be conducted conforming to the following procedure of ammonia test method.

a) The test piece with a length not less than 75 mm cut from a tube shall be degreased and dried, and placed in the desiccator containing aqueous ammonia specified in **JIS K 8085** which has been diluted by equal amount of pure water to 11.8 % min. mass concentration, with the test piece being 50 mm to 100 mm below the liquid surface. After keeping it in this ammonia atmosphere for 2 h (see informative figure 1), the test piece shall be removed from the desiccator.

b) This test piece shall be rinsed with 10 % sulfuric acid solution and polished on the surface and visually examined for cracks. For tubes of temper grade O and OL, the test piece may be flattened until one diameter becomes 50 % to 60 % of original outside diameter (3 times the wall thickness for the tube with an outside diameter not more than 6 times the wall thickness).



Informative Figure 1 Ammonia test method

6.13 Leaching performance test The leaching performance test of C 1220 tubes used for water supply piping shall be carried out by the method specified in **JIS S 3200-7**.

7 Inspection The inspection shall be carried out as follows:

a) General requirements shall comply with **JIS H 0321**.

b) Tubes shall be inspected on appearance and dimensions in addition to the tests conforming to the requirements of clause **6**, and their results shall comply with the specifications of clauses **4** and **5**.

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c) One representative tube for the tensile test, hardness test, grain size test, flaring test, flattening test, electric conductivity test, hydrogen embrittlement test and season crack test shall be taken at random from each lot normally consisting of 100 tubes (if the mass of 100 tubes is less than 2 000 kg, the unit shall be 2 000 kg in mass) or the fraction, of the same grade, class, and temper grade rolled to the same sectional dimensions. And the test piece shall be made from the tube mentioned above.

d) Eddy current test, hydrostatic test or pneumatic test shall be conducted on the tube taken at random from a lot consisting of tubes of the same grade, class, and temper grade rolled to the same sectional dimensions. The number of tubes to be tested shall be 0.2 % of the whole quantity in the lot. However, those tests shall be conducted on all the tubes in the lot for C 4430, C 6870, C 6871, C 6872, C 7060, C 7100, C 7150 and C 7164.

Those tests may be applied to the tubes in as-worked condition prior to the final heat treatment.

e) When the product belongs to the same lot as already tested, the result of electric conductivity test carried out by the manufacturer may be considered as the representative value for the lot.

f) The hydrostatic test and the leaching performance test of C 1220 tubes used for water supply piping are executed as a type inspection (19).

Note (19) The type inspection is an inspection for judging whether or not all the quality items indicated in the quality design of the product are satisfied (not a delivery inspection).

8 Marking Tubes shall be marked with the following items on each package, on each bundle, on each coil, or on each tube by a suitable means such as labelling.

a) Reference to this Standard, grade, class, temper grade or their designation

Example : **JIS H 3300** C 2200 TS-OL

b) Dimensions

c) Manufacturing number

d) Manufacturer's name or its identifying brand

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Annex (informative)
Standard dimensions of copper and copper alloy seamless pipes and tubes

This Annex is to supplement the matters related to the text and not to constitute the provisions of this Standard.

Introduction This Annex consists of tables of standard dimensions of tubes which have been withdrawn from the text and replaced in this Annex (informative).

1 Definition "Standard dimensions" are those which are widely accepted in the market.

2 Standard dimensions of tubes The standard dimensions of tubes are shown in Annex table 1 and Annex table 2.

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Annex Table 1 Standard dimensions for tubes

(Alloy No. C 1020 · C 1100 · C 1201 · C 1220 · C 2200 · C 2300 · C 2600 · C 2700 · C 2800)

Unit: mm

Outside diameter	Wall thickness																				
	0.25	0.30	0.35	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2	2.5	3	3.5	4	4.5	5	6	8	10
4	—	—	—	—	—	—	—	—	—	—											
5	—	—	—	—	—	○	—	—	—	—											
6	○	○	○	○	○	○	○	○	○	—											
6.35	○	○	○	○	○	○	○	○	○	—											
8	○	○	○	○	○	○	○	○	○	○	○	—									
9.52	○	○	○	○	○	○	○	○	○	○	○	—									
10	—	—	—	○	○	○	○	○	○	○	○	—									
12	—	—	—	○	○	○	○	○	○	○	○	—									
12.7				○	○	○	○	○	○	○	○	—									
14					—	○	○	○	○	○	—	—									
15					—	○	○	○	○	○	○	—									
15.9					○	○	○	○	○	○	○	—									
16					○	○	○	○	○	○	—	—	—								
18						—	—	○	○	○	—	—	—								
19.1						○	○	○	○	○	○	○	—								
20						—	—	—	○	○	—	—	—								
22						—	—	○	○	○	○	—	—								
22.2						—	○	○	○	○	○	—	—	—							
25						—	—	—	○	○	—	○	—	—							
25.4						○	○	○	○	○	○	○	—	—							
28						—	—	—	○	○	—	—	—	—							
31.8						○	○	○	○	○	○	—	—	—							
32						—	—	○	○	○	—	—	—	—							
35						—	—	—	○	—	—	—	—	—							
38.1						○	○	○	○	○	—	—	—	—							
40								—	—	—	—	—	—	—	—	—					
45									—	—	—	○	—	—	—	—					
50									—	—	—	○	—	—	—	—	—	—			
50.8									—	—	—	○	—	—	—	—	—	—			
75												—	—	—	—	—	—	—	—	—	—
100															—	—	—	—	—	—	—
125														—	—	—	—	—	—	—	—
150																—	—	—	—	—	—
200																		—	—	—	—
250																		—	—	—	—

Remarks : Bold-face lines show the range of manufacture, and ○ mark shows the standard dimensions.

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Annex Table 2 Standard dimensions of alloy tubes for heat exchanger

(Alloy No. C 4430 · C 6870 · C 6871 · C 6872 · C 7060 · C 7100 · C 7150 · C 7164)

Unit: mm

Outside diameter	Wall thickness																				
	0.50	0.70	0.80	0.90	1.00	1.20	1.24	1.40	1.47	1.50	1.60	1.65	1.80	2.00	2.11	2.41	2.50	2.77	2.80	3.00	3.50	4.50
6.35	○	–	–	–	–	–	–	–	–	–												
8.00	○	○	○	–	○	–	–	–	–	–	–	–										
9.52	○	–	○	–	–	–	–	–	–	–	–	–	–	–								
10.00	–	○	○	○	○	○	–	–	–	–	○	–	–	–	–	–	–					
11.00	–	–	–	–	○	–	–	–	–	○	–	–	–	–	–	–	–					
12.00	○	–	○	○	○	○	–	–	–	○	○	–	–	○	–	–	○	–	○	○		
12.70	–	–	–	–	○	–	○	○	–	○	–	–	–	–	–	–	–	–	–	–		
14.00		–	○	–	○	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
15.00		–	○	–	–	–	–	–	–	○	○	–	○	○	–	–	–	–	–	–	–	
15.88		○	–	–	–	○	○	–	–	–	–	○	–	–	–	–	–	–	–	–	–	
16.00		○	○	○	○	○	–	–	–	○	○	○	–	○	–	–	–	–	–	○	–	–
19.00		–	○	○	○	○	○	–	–	○	○	○	–	–	○	–	–	–	–	–	–	○
19.05		–	–	–	○	–	○	–	○	–	–	○	–	–	○	○	–	–	–	–	–	–
20.00		–	–	–	○	–	–	–	–	○	○	–	○	○	○	–	–	–	–	–	–	–
22.00		–	–	–	–	○	○	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
22.22		–	–	–	○	○	○	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23.00		–	–	–	○	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
25.00		–	–	–	○	–	–	–	–	○	–	–	–	○	–	–	–	–	–	–	–	–
25.40		○	–	–	–	○	○	–	–	–	○	–	–	–	○	○	–	○	–	–	–	–
30.00					–	–	–	–	–	○	–	–	–	○	–	–	–	–	–	–	–	–
38.00					–	–	–	–	–	○	–	–	–	○	–	–	–	–	–	–	–	–
38.10					–	○	○	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44.50						–	–	–	–	○	–	–	–	○	–	–	○	–	–	○	○	–

Remarks : Bold-face lines show the range of manufacture, and ○ mark shows the standard dimensions.

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