ASTM B135 / ASME SB135

Standard Specification for Seamless Brass Tube

This specification covers seamless round and rectangular including square copper alloy tube in straight lengths.

A. Chemical Composition :-

1. The material shall conform to the chemical requirements specified in Table 1.

Table 1

Copper Alloy UNS No.	Copper	Lead	Arsenic	Tin	Iron, max	Zinc
C22000	89.0–91.0	0.05max	...	...	0.05	remainder
C23000	84.0–86.0	0.05max	...	...	0.05	remainder
C26000	68.5–71.5	0.07max	...	...	0.05	remainder
C27000	63.0–68.5	0.09max	...	...	0.07	remainder
C27200	62.0–65.0	0.07max	...	...	0.07	remainder
C27400	61.0–64.0	0.09max	...	...	0.05	remainder
C28000	59.0–63.0	0.09max	...	...	0.07	remainder
C33000	65.0–68.0	0.25[A]-0.7	...	...	0.07	remainder
C33200	65.0–68.0	1.5–2.5	...	...	0.07	remainder
C37000	59.0–62.0	0.9–1.4	...	...	0.15	remainder
C44300	70.0–73.0	0.07max	0.02–0.06	0.9–1.2	0.06	remainder

[A] *In the case of Copper Alloy UNS No. C33000 on tube sizes greater than 5 in. in outside diameter, or distance between outside parallel surfaces, the lead content shall be 0.7 % maximum, no minimum is specified.*

2. When all the elements in Table 1 are analyzed, their sum shall be as shown in the following table:

Copper Alloy UNS	Copper Plus Named Elements, % min
C22000	99.8
C23000	99.8
C26000	99.7
C27000	99.7
C27200	99.7
C27400	99.7
C28000	99.7
C33000	99.6
C33200	99.6
C37000	99.6

C44300	99.6

B. Temper :-

1. Drawn Tempers, H—The tempers of drawn tube shall be designated as light-drawn (H55), drawn (H58), and hard-drawn (H80) (see Table 2).
2. Annealed Tempers, O—The tempers of annealed tube shall be designated as light anneal (O50) and soft anneal (O60) (Table 3).

C. Mechanical Properties :-

1. Drawn Temper—Tube shall conform to the mechanical properties prescribed in Table 2.
2. Annealed Temper—Tube shall conform to the grain size and Rockwell hardness limits prescribed in Table 3.

Table 2

Copper Alloy UNS No.	Temper Designation[A]		Outside Diameter, in. or Major Distance Between Outside Parallel Surfaces, in.	Wall Thickness, in	Tensile Strength ksi[B]	Rockwell Hardness[C] 30T
	Standard	Former				
C22000	H58	drawn (general purpose)	all	all	40 min	38 min
C22000	H80	hard drawn[D]	up to 1, incl	0.020 to 0.120, incl	52 min	55 min
C22000	H80	hard drawn[D]	over 1 to 2, incl	0.035 to 0.180, incl	52 min	55 min
C22000	H80	hard drawn[D]	over 2 to 4, incl	0.060 to 0.250, incl	52 min	55 min
C23000	H55	light drawn[D]	all	all	44–58	43–75
C23000	H58	drawn (general purpose)	all	all	44 min	43 min
C23000	H80	hard drawn[D]	up to 1, incl	0.020 to 0.120, incl	57 min	65 min
C23000	H80	hard drawn[D]	over 1 to 2, incl	0.035 to 0.180, incl	57 min	65 min
C23000	H80	hard drawn[D]	over 2 to 4, incl	0.0605 to 0.250, incl	57 min	65 min
C26000, C27000, C27200, C27400, C33000, and C33200	H58	drawn (general purpose)	all	all	54 min	53 min
C26000, C27000, C27200, C27400, C33000, and C33200	H80	hard drawn[D]	up to 1, incl	0.020 to 0.120, incl	66 min	70 min
C26000, C27000, C27200, C27400, C33000, and C33200	H80	hard drawn[D]	over 1 to 2, incl	0.035 to 0.180, incl	66 min	70 min
C26000, C27000, C27200, C27400, C33000, and C33200	H80	hard drawn[D]	over 2 to 4, incl	0.060 to 0.250, incl	66 min	70 min
C28000 and C37000	H58	drawn (general purpose)	all	all	54 min	55 min
C44300	H58	drawn (general purpose)	all	all	54 min	53 min
C44300	H80	hard drawn[D]	all	all	66 min	70 min

[A] *Standard designations defined in Classification B601.*

[B] *ksi = 1 000 psi.*

[C] *Rockwell hardness values shall apply only to tubes having a wall thickness of 0.012 in. or over and to round tubes having an inside diameter of 5/16 in. or over and to rectangular including square tubes having an inside major distance between parallel surfaces of 3/16 in. or over. Rockwell hardness shall be made on the inside surface of the tube. When suitable equipment is not*

available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the manufacturer and the purchaser.

[D] *Light-drawn and hard-drawn tempers are available in round-tube only.*

Table 3

Copper Alloy UNS No.	Temper Designation[A]		Wall Thickness, in.	Rockwell Hardness[B]		Average Grain Size, mm	
	Standard	Former		Scale	Max	Min	Max
C22000	O60	soft anneal	up to 0.045, incl	30T	30	0.025	0.06
C22000	O60	soft anneal	over 0.045	F	70	0.025	0.06
C22000	O50	light anneal	up to 0.045, incl	30T	37	[C]	0.035
C22000	O50	light anneal	over 0.045	F	78	[C]	0.035
C23000	O60	soft anneal	up to 0.045, incl	30T	36	0.025	0.06
C23000	O60	soft anneal	over 0.045	F	75	0.025	0.06
C23000	O50	light anneal	up to 0.045, incl	30T	39	[C]	0.035
C23000	O50	light anneal	over 0.045	F	85	[C]	0.035
C26000, C33000, and C33200	O60	soft anneal	up to 0.030, incl	30T	40	0.025	0.06
C26000, C33000, and C33200	O60	soft anneal	over 0.030	F	80	0.025	0.06
C26000, C28000, C33000, C332000, and C37000	O50	light anneal	up to 0.030, incl	30T	60	[C]	0.035
C26000, C28000, C33000, C332000, and C37000	O50	light anneal	over 0.030	F	90	[C]	0.035
C27000, C27200, and C27400	O60	soft anneal	up to 0.030, incl	30T	40	0.025	0.06
C27000, C27200, and C27400	O60	soft anneal	over 0.030	F	80	0.025	0.06
C27000, C27200, and C27400	O50	light anneal	up to 0.030, incl	30T	60	[C]	0.035
C27000, C27200, and C27400	O50	light anneal	over 0.030	F	90	[C]	0.035
C44300	O60	soft anneal	up to 0.030, incl	30T	40	0.025	0.06
C44300	O60	soft anneal	over 0.030	F	80	0.025	0.06
C44300	O50	light anneal	up to 0.030, incl	30T	60	[C]	0.035
C44300	O50	light anneal	over 0.030	F	90	[C]	0.035

[A] *Standard designations defined in Classification B601.*

[B] *Rockwell hardness values shall apply only to tubes having a wall thickness of 0.015 in. or over and to round tubes having an inside diameter of 5/16 in. or over and to rectangular including square tubes having an inside major distance between parallel surfaces of 3/16 in. or over. For all other tube no Rockwell hardness values shall apply. Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the manufacturer and the purchaser.*

[C] *Although no minimum grain size is specified, the product must nevertheless have a fully recrystallized grain structure.*

D. <u>Expansion Test for Round Tube :-</u>

1. Tube ordered in the annealed (O) condition, selected for test, shall be capable of withstanding in accordance with Test Method B153 an expansion of the outside diameter in the following amount:

Outside Diameter, in.	Expansion of Outside Diameter, %
3⁄4 and under	20
Over 3⁄4	15

2. As an alternative to the expansion test for tube over 4 in. in diameter in the annealed condition, a 4 in. in length shall be cut from the end of one of the lengths for a flattening test.

E. Mercurous Nitrate Test :-

1. When specifically required, test specimens 6 in. in length of both annealed and drawn tempers shall withstand, after proper cleaning, an immersion for 30 min without cracking in the standard mercurous nitrate solution prescribed in Test Method B154.

F. Non-destructive Testing :-

1. Eddy-current testing is the standard non-destructive test, and all tubes of appropriate size shall be eddy-current tested in accordance with point F.3.
2. Tubes that are not of a size suitable for eddy-current test capabilities shall be tested by the hydrostatic test, or by the pneumatic test.
3. Eddy-Current Test—
    i. Each tube up to 3⁄8 in. in outside diameter shall be subjected to an eddy-current test. Testing shall follow the procedure of Practice E243, except the determination of "end effect" is not required.
    ii. The purchaser shall have the option to specify either a hydrostatic test or the pneumatic test.
4. Hydrostatic Test—
    i. When specified, the tube shall stand, without showing evidence of leakage an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 7000 psi, determined by the following equation for thin hollow cylinders under tension:

$$P = 2St/(D-0.8t) \quad \text{.....(1)}$$

where: P = hydrostatic pressure, psi;
t = wall thickness of the material, in.;
D = outside diameter of the material, in.; and
S = allowable stress of the material.

5. Pneumatic Test—
    i. When specified, the tube shall be subjected to an internal air pressure of 60 psig minimum for 5 s without showing evidence of leakage.

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