

AERONAUTICAL MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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Revised

TOLERANCES Copper and Copper Alloy Seamless Tubing

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1. PURPOSE: To publish established manufacturing tolerances.
2. APPLICATION: Tolerances shown herein apply, unless otherwise agreed between purchaser and vendor. These tolerances apply to all conditions unless otherwise noted.
3. DIAMETER:

TABLE I

Nominal O.D. Inches	Tolerance Applies to	Mean Diameter Tolerance, Inch, Plus and Minus	
		Non-Refractory	Refractory
1/8 and under:			
Coils	I.D.	0.004	
Straight Lengths	I.D.	0.002	0.003
Straight Lengths	O.D.	0.002	0.0025
Over 1/8 to 5/8, incl.	I.D. or O.D.	0.002	0.0025
Over 5/8 to 1, incl.	I.D. or O.D.	0.0025	0.003
Over 1 to 2, incl.	I.D. or O.D.	0.003	0.004
Over 2 to 3, incl.	I.D. or O.D.	0.004	0.005
Over 3 to 4, incl.	I.D. or O.D.	0.005	0.006
Over 4 to 5, incl.	I.D. or O.D.	0.006	0.008
Over 5 to 6, incl.	I.D. or O.D.	0.007	0.009
Over 6 to 8, incl.	I.D. or O.D.	0.008	0.010
Over 8 to 10, incl.	I.D. or O.D.	0.010	0.013

If so specified in the purchase order, tolerances shall apply to either inside or outside diameter, but not to both inside and outside diameter of the same lot of tubing.

4. WALL THICKNESS:

TABLE II

Wall Thickness Inch	Tolerance, Inch, Plus and Minus						
	O.D. Ranges, Inches						
	1/32 to 1/8 incl.	Over 1/8 to 5/8 incl.	Over 5/8 to 1 incl.	Over 1 to 2 incl.	Over 2 to 4 incl.	Over 4 to 7 incl.	Over 7 to 10 incl.
NON-REFRACTORY							
Under 0.018	0.002	0.001	0.0015	0.002			
0.018 to 0.025, excl.	0.003	0.002	0.002	0.0025			
0.025 to 0.035, excl.	0.003	0.0025	0.0025	0.003	0.004		
0.035 to 0.058, excl.	0.003	0.003	0.0035	0.0035	0.005	0.007	
0.058 to 0.083, excl.		0.0035	0.004	0.004	0.006	0.008	0.010
0.083 to 0.120, excl.		0.004	0.005	0.005	0.007	0.009	0.011

4. WALL THICKNESS: (cont'd)

TABLE II (cont'd)

Wall Thickness Inch	Tolerance, Inch, Plus and Minus						
	O.D. Ranges, Inches						
	1/32 to 1/8 incl.	Over 1/8 to 5/8 incl.	Over 5/8 to 1 incl.	Over 1 to 2 incl.	Over 2 to 4 incl.	Over 4 to 7 incl.	Over 7 to 10 incl.
NON-REFRACTORY							
0.120 to 0.165, excl.		0.005	0.006	0.006	0.008	0.010	0.012
0.165 to 0.220, excl.		0.007	0.0075	0.008	0.010	0.012	0.014
0.220 to 0.284, excl.			0.009	0.010	0.012	0.014	0.016
0.284 to 0.380, excl.			0.011	0.012	0.014	0.016	0.018
0.380 and over				5%	5%	6%	6%
REFRACTORY							
Under 0.018	0.0025	0.0015	0.002	0.0025			
0.018 to 0.025, excl.	0.004	0.0025	0.0025	0.003			
0.025 to 0.035, excl.	0.004	0.003	0.003	0.004	0.005		
0.035 to 0.058, excl.	0.004	0.004	0.0045	0.0045	0.0065	0.009	
0.058 to 0.083, excl.		0.0045	0.005	0.005	0.0075	0.010	0.013
0.083 to 0.120, excl.		0.005	0.0065	0.0065	0.009	0.011	0.014
0.120 to 0.165, excl.		0.007	0.007	0.0075	0.010	0.013	0.015
0.165 to 0.220, excl.			0.009	0.010	0.013	0.015	0.018
0.220 to 0.284, excl.			0.012	0.013	0.015	0.018	0.020
0.284 to 0.380, excl.				0.015	0.018	0.020	0.023
				6%	6%	8%	8%

If tubing is ordered with tolerances all plus or all minus, double the above values shall be permitted.

5. LENGTH:

TABLE III

O.D. Inches	Tolerance, Inch Plus Only						
	Straight Lengths					Coils	
	Over 6 in To 6 in incl.	Over 2 to 2 ft incl.	Over 6 to 6 ft incl.	Over 6 to 14 ft incl.	Over 14 ft	Over 50 ft incl.	Over 50 ft
To 1, incl.	1/32	1/16	3/32	1/4	1/2	12	24
Over 1 to 2, incl.	1/16	3/32	1/8	1/4	1/2	12	24
Over 2 to 4, incl.	1/16	3/32	1/8	1/4	1/2		
Over 4		1/8	1/4	1/4	1/2		

6. STRAIGHTNESS: Tubing in straight lengths and with O.D. of 1/4 to 3-1/2 inches, incl. shall be of such straightness that the maximum curvature (depth of arc) shall not exceed 0.50 inch in any 10 feet of length or 0.05 inch x length in feet for other lengths.

7. FLATNESS: None.

8. SPECIAL TOLERANCES: (a) Out-of-Roundness of Unannealed Tubing in Straight Lengths.- Shall not exceed 1% of the specified diameter.

(b) Out-of-Roundness of Annealed Tubing in Straight Lengths or Coils.- No tolerance is established.

9. CLASSIFICATION:

Classification of Copper and Alloys as to Refractoriness

Non-Refractory

Copper

Brass Copper-zinc alloys containing a minimum of 60% copper

Leaded Brass Copper-zinc-lead alloys containing a minimum of 60% copper

Copper-Zinc (Containing a minimum of 63% copper and only one of the
Copper-Zinc-Lead following elements in not more than the indicated amount;
Other Copper Base (aluminum, 0.5%; beryllium, 0.2%; cadmium, 0.5%; chromium, 0.3%;
Alloys (iron, 0.5%; manganese, 2.5%; nickel, 5.0%; tin, 0.8%;
(silicon, 1.0%.

Silicon Bronze Type B (A.S.T.M.)

Age-Hardenable All such alloys from the following group when drawn to
Alloys finished dimensions from the soft condition: copper-cobalt;
copper-iron-phosphorus; copper-nickel-phosphorus; copper-
manganese-phosphorus; copper-zirconium.

Refractory

Aluminum Brass and Bronze Containing over 0.5% aluminum

Beryllium Alloy Containing over 0.2% beryllium

Cadmium Bronze Containing over 0.5% cadmium

Cupro-Nickel and Nickel Silver Containing over 5.0% nickel

Manganese Bronze Types A and B (A.S.T.M.)

Naval Brass Containing less than 63% copper and 0.5% to
1.0% tin, with or without lead

Silicon Bronze Types A, C and D (A.S.T.M.)

Phosphor Bronze (Tin Bronze) Types A, B1, C and D (A.S.T.M.)