AERONAUTICAL MATERIAL SPECIFICATIONS

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TOLERANCES
Aluminum Alloy Drawn Tubing

1. PURPOSE: To publish established manufacturing tolerances.

2. APPLICATION: Tolerances shown herein shall apply, unless otherwise agreed upon by purchaser and vendor. The term "excl" is used to apply only to the higher figure of the specified range.

3. DIAMETER, WIDTH, OR DEPTH:

Ø 3.1 Round:

TABLE I

Nominal OD or ID Inches (See Note 1)	Tolerance, Inch, Plus and Minus (See Note 12)		
		Diameter at Any Point (Ovality) (See Note 4)	
	Mean Diameter (See Note 3)	Non-Heat Treated Alloys (See Note 5)	Heat Treated Alloys (See Note 5)
0.500 and under	0.003	0.003	0.006
Over 0.500 to 1.000, incl	0.004	0.004	0.008
Over 1.000 to 2.000, incl	0.005	0.005	0.010
Over 2.000 to 3.000, incl	0.006	0.006	0.012
Over 3.000 to 5.000, incl	0.008	0.008	0.016
Over 5.000 to 6.000, incl	0.010	0.010	0.020
Over 6.000 to 8.000, incl	0.015	0.015	0.030
Over 8.000 to 10.000, incl	0.020	0.020	0.040
Over 10.000 to 12.000, incl	0.025	0.025	0.050

3.2 Square, Rectangular, Hexagonal, and Octagonal:

TABLE I CONT.

Nominal Width or Depth Inches (See Note 1)	Tolerance, Inch, Plus and Minus (See Note 12)		
	At Corners	Not at Corners (See Note 4)	
	Square and Rectangular	Square, Hexagonal, and Octagonal	Rectangular
0.500 and under	0.003	0.006	The tolerance for the width is the value in the preceding column for a dimension equal to the depth, and conversely, but in no case less than that for its own dimension at the corners (See Note 6)
Over 0.500 to 1.000, incl	0.004	0.008	
Over 1.000 to 2.000, incl	0.005	0.010	
Over 2.000 to 3.000, incl	0.006	0.012	
Over 3.000 to 5.000, incl	0.008	0.016	
Over 5.000 to 6.000, incl	0.010	0.020	
Over 6.000 to 8.000, incl	0.015	0.030	
Over 8.000 to 10.000, incl	0.020	0.040	
Over 10.000 to 12.000, incl	0.025	0.050	

3.3 Streamline, Oval, and Elliptical:

TABLE I CONT.

Nominal Equivalent Round Diameter Inches (See Notes 1 and 7)	Tolerance, Inch (See Note 12)			
	Major Axis		Minor Axis	
	Plus	Minus	Plus	Minus
2.500 and under	0.040	0.025	0.025	0.015
Over 2.500 to 4.250, incl	0.050	0.035	0.035	0.025
Over 4.250 to 6.000, incl	0.070	0.050	0.055	0.040
Over 6.000 to 8.000, incl	0.100	0.085	0.080	0.060
Over 8.000 to 10.000, incl	0.160	0.140	0.115	0.085

Ø 4. WALL THICKNESS:

TABLE II

Nominal Wall Thickness Inch (See Notes 1 and 2)	Mean Wall Thickness (See Note 8)	Tolerance, Inch, Plus and Minus (See Note 12)	
		Wall Thickness at any Point From Nominal Wall Thickness (Eccentricity)	
		Round, Non-Heat Treatable (See Note 13)	Round, Heat Treatable; All Tubing Other than Round; and All Coiled Tubing
0.010 to 0.035, incl	0.002	0.002	
Over 0.035 to 0.049, incl	0.003	0.003	
Over 0.049 to 0.083, incl	0.004	0.004	± 10% of nominal wall thickness ± 0.003 in. min
Over 0.083 to 0.120, incl	0.005	0.006	
Over 0.120 to 0.203, incl	0.006	0.008	
Over 0.203 to 0.300, incl	0.008	0.012	
Over 0.300 to 0.375, incl	0.015	0.020	
Over 0.375 to 0.500, incl	0.020	0.030	

5. LENGTH:

5.1 Straight Tubing:

TABLE III

Nominal OD, Width, Major Axis or Depth (Whichever is Greater) Inches	Tolerance, Inch, Plus Only Length Ranges, Feet			
	12 and under	Over 12 to 30, incl	Over 30 to 50, incl	Over 50
Under 0.250	1/4	3/8	1/2	-
0.250 to 3.000, excl	1/8	1/4	3/8	1
3.000 to 8.000, excl	3/16	5/16	7/16	1
8.000 and over	1/4	3/8	1/2	1

5.2 Coiled Tubing:

TABLE III CONT.

Nominal OD, Width or Depth (Whichever is Greater) Inches	Tolerance, %, Plus and Minus Except as Indicated			
	Length Ranges, Feet			
	100 and Under	Over 100 to 250, excl	250 to 500, excl	500 and over
Under 1.250	+5, -0	10	15	20

6. STRAIGHTNESS:

6.1 Straight Tubing:

TABLE IV

Nominal OD, Width, or Depth (Whichever is Greater) Inches	Tolerance, Inches (See Notes 9 and 10)	
	In Each Foot of Length	In Total Length (L) of Piece
Under 0.375	0.500	0.500L (See Note 11)
0.375 to 6.000, excl	0.010	0.010L
6.000 and over	0.020	0.020L

Ø 7. FLATNESS:

Ø 7.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE V

Nominal Width, Depth, or Distance Between Parallel Sides Inches	Tolerance, Inch (See Note 4)
0.500 and under	0.003
Over 0.500 to 1.000, incl	0.004
Over 1.000 to 2.000, incl	0.005
Over 2.000 to 3.000, incl	0.006
Over 3.000 to 5.000, incl	0.008
Over 5.000 to 6.000, incl	0.010
Over 6.000 to 8.000, incl	0.015
Over 8.000 to 10.000, incl	0.020
Over 10.000 to 12.000, incl	0.025

Ø 8. TWIST:

Ø 8.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE VI

Nominal Width or Depth (Whichever is Greater) Inches	Tolerance, Degrees (See Note 9) In Each Foot of Length	Tolerance, Degrees (See Note 9) In Total Length (L) of Piece
Under 1.500	1	L
1.500 to 3.000, excl	1/2	L/2; 5 max
3.000 and over	1/4	L/4; 3 max

Ø 9. CORNER RADII:

Ø 9.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE VII

Nominal Radius, Inches	Tolerance (See Note 12)
Sharp Corners	± 1/64 in.
Under 0.188	± 1/64 in.
0.188 and over	± 10%

Ø 10. ANGULARITY:

10.1 Tubing Other Than Round: The allowable deviation from nominal angle is ± 2 Ø degrees.

11. SQUARENESS OF CUT ENDS: Ends shall not deviate from square by more than Ø 1 degree.

Note 1. When OD, ID, and wall thickness (or their equivalent dimensions in other than round tubing) are all specified, standard tolerances are applicable to any two of these dimensions, but not all three.

Note 2. When the dimensions specified are outside and inside, rather than wall thickness itself, the allowable deviation at any point is ± 10% of the mean wall thickness but not less than ± 0.003 inch.

Note 3. Mean diameter is the average of two diameter measurements taken at right angles to each other at any point along the length.

Note 4. Not applicable to annealed (-O temper) tubing, coiled tubing, or tubing Ø having wall thickness less than 0.020 in. or less than 2-1/2% of the OD or equivalent round diameter (see Note 7).

Note 5. For the - T8 tempers of 6063, the tolerances under non-heat treated Ø alloys apply.

Note 6. Example: The width tolerance of a 1 in. x 3 in. rectangular tubing is ± 0.008 in. and the depth tolerance is ± 0.012 inch.

Note 7. The equivalent round diameter is the diameter of a circle having a circumference equal to the perimeter of the shape.