

AERONAUTICAL MATERIAL SPECIFICATIONS

AMS 2203D

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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:

∅ 3.1 Round:

TABLE I

| Nominal OD or ID Inches (See Note 1) | Mean Diameter (See Note 3) | Tolerance, Inch, Plus and Minus (See Note 12) | |
|--|-------------------------------|---|--|
| | | Diameter at Any Point (Ovality) (See Note 4) | |
| | | 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 | |

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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 |
| Over 0.083 to 0.120, incl | 0.005 | 0.006 | + 0.003 in. min |
| 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 |

∅ 7. FLATNESS:

∅ 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 |

∅ 8. TWIST:

∅ 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 | 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.

Ø Note 4. Not applicable to annealed (-0 temper) tubing, coiled tubing, or tubing having wall thickness less than 0.020 in. or less than 2-1/2% of the OD or equivalent round diameter (see Note 7).

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

