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AEROSPACE MATERIAL SPECIFICATION

MAM 2203

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Revised

# TOLERANCES, METRIC
## Aluminum Alloy Drawn Tubing

1. SCOPE: This specification covers established metric manufacturing tolerances applicable to aluminum alloy drawn tubing ordered to metric dimensions. These tolerances apply to all conditions, unless otherwise noted. The term "excl" applies only to the higher figure of the specified range.

2. DIAMETER, WIDTH, OR DEPTH:

2.1 Round:

TABLE I

| Specified OD or ID Millimetres (See Note 1) | Tolerance, Millimetres, Plus and Minus (See Note 2) | | | |
|---|---|---|---|---|
| | | Diameter at Any Point (Ovality) (See Note 3) | | |
| | Mean Diameter (See Note 4) | Non-Annealed and Non-Heat Treated Tube | Heat Treated Tube (See Note 5) | Annealed Tube |
| Up to 12.50, incl | 0.08 | 0.08 | 0.16 | 0.48 |
| Over 12.50 to 25.00, incl | 0.10 | 0.10 | 0.20 | 0.60 |
| Over 25.00 to 50.00, incl | 0.13 | 0.13 | 0.25 | 0.75 |
| Over 50.00 to 80.00, incl | 0.15 | 0.15 | 0.30 | 0.90 |
| Over 80.00 to 130.00, incl | 0.20 | 0.20 | 0.41 | 1.20 |
| Over 130.00 to 150.00, incl | 0.25 | 0.25 | 0.50 | 1.50 |
| Over 150.00 to 200.00, incl | 0.38 | 0.38 | 0.76 | 2.25 |
| Over 200.00 to 250.00, incl | 0.50 | 0.50 | 1.00 | 3.00 |
| Over 250.00 to 300.00, incl | 0.64 | 0.64 | 1.25 | 3.75 |

2.2 Square, Rectangular, Hexagonal, and Octagonal:

TABLE II

| Specified Width or Depth Millimetres (See Note 1) | Tolerance, Millimetres, Plus and Minus (See Note 2) | | |
|---|---|---|---|
| | At Corners | Not at Corners (See Notes 3 and 9) | |
| | Square and Rectangular | Square, Hexagonal, and Octagonal | Rectangular |
| Up to 12.50, incl | 0.08 | 0.16 | 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 12.50 to 25.00, incl | 0.10 | 0.20 | |
| Over 25.00 to 50.00, incl | 0.13 | 0.25 | |
| Over 50.00 to 80.00, incl | 0.15 | 0.30 | |
| Over 80.00 to 130.00, incl | 0.20 | 0.40 | |
| Over 130.00 to 150.00, incl | 0.25 | 0.50 | |
| Over 150.00 to 200.00, incl | 0.38 | 0.75 | |
| Over 200.00 to 250.00, incl | 0.50 | 1.00 | |
| Over 250.00 to 300.00, incl | 0.64 | 1.25 | |

2.3 Streamline, Oval, and Elliptical: The equivalent round diameter is the diameter of a circle having a circumference equal to the perimeter of the tube.

TABLE III

| Equivalent Round Diameter Millimetres (See Note 1) | Tolerance, Millimetres | | | |
|---|---|---|---|---|
| | Major Axis | | Minor Axis | |
| | Plus | Minus | Plus | Minus |
| Up to 70.00, incl | 1.00 | 0.64 | 0.64 | 0.38 |
| Over 70.00 to 110.00, incl | 1.25 | 0.90 | 0.90 | 0.64 |
| Over 110.00 to 150.00, incl | 1.80 | 1.25 | 1.40 | 1.00 |
| Over 150.00 to 200.00, incl | 2.55 | 2.15 | 2.05 | 1.60 |
| Over 200.00 to 250.00, incl | 4.05 | 3.55 | 2.90 | 2.15 |

3. WALL THICKNESS: 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 ±0.08 millimetre.

TABLE IV

| Specified Wall Thickness Millimetres (See Note 1) | Tolerance, Millimetres, Plus and Minus (See Note 2) | | |
|---|---|---|---|
| | Mean Wall Thickness from Specified Wall Thickness (See Note 7) | Wall Thickness at any Point From Specified Wall Thickness (Eccentricity) | |
| | | Round, Non-Heat Treatable (See Note 8) | Round, Heat Treatable; All Tubing Other Than Round; and All Coiled Tubing |
| Over 0.23 to 0.80, incl | 0.05 | 0.05 | |
| Over 0.80 to 1.20, incl | 0.08 | 0.08 | |
| Over 1.20 to 2.00, incl | 0.10 | 0.10 | 10% of specified wall thickness; 0.08 mm, min |
| Over 2.00 to 3.20, incl | 0.13 | 0.15 | |
| Over 3.20 to 5.00, incl | 0.15 | 0.20 | |
| Over 5.00 to 8.00, incl | 0.20 | 0.30 | |
| Over 8.00 to 10.00, incl | 0.38 | 0.50 | |
| Over 10.00 to 12.50, incl | 0.50 | 0.75 | |

4. LENGTH:

4.1 Straight Tubing:

TABLE V

| Specified OD, Width, or Major Axis Millimetres | Tolerance, Millimetres, Plus Only | | | |
|---|---|---|---|---|
| | Length Ranges, Millimetres | | | |
| | Up to 5000, incl | Over 5,000 to 10,000, incl | Over 10,000 to 15,000, incl | Over 15,000 |
| Up to 6.30, incl | 7 | 10 | 13 | -- |
| Over 6.30 to 70.00, incl | 4 | 7 | 10 | 25 |
| Over 70.00 to 200.00, incl | 6 | 9 | 11 | 25 |
| Over 200.00 | 7 | 10 | 13 | 25 |

4.2 Coiled Tubing:

TABLE VI

| Specified OD or Width Millimetres | Tolerance, %, Plus and Minus Except as Indicated — Length Ranges, Millimetres | | | |
|---|---|---|---|---|
| | Up to 30,000, incl | Over 30,000 to 75,000, incl | Over 75,000 to 150,000, incl | Over 150,000 |
| Up to 35.00, incl | -0, +5 | 10 | 15 | 20 |

5. STRAIGHTNESS:

5.1 Straight Tubing:

TABLE VII

| Specified OD or Width Millimetres | Tolerance, Millimetres per metre (See Notes 9 and 10) In total length or in any 300 mm or longer chord segment of total length |
|---|---|
| Up to 9.50, excl | 42 |
| 9.50 to 150.00, excl | 1 |
| 150.00 and over | 2 |

6. FLATNESS:

6.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE VIII

| Specified Width, Depth or Distance Between Parallel Sides Millimetres | Tolerance, Millimetres (See Note 12) |
|---|---|
| Up to 12.50, incl | 0.08 |
| Over 12.50 to 25.00, incl | 0.10 |
| Over 25.00 to 50.00, incl | 0.13 |
| Over 50.00 to 80.00, incl | 0.15 |
| Over 80.00 to 130.00, incl | 0.20 |
| Over 130.00 to 150.00, incl | 0.25 |
| Over 150.00 to 200.00, incl | 0.38 |
| Over 200.00 to 250.00, incl | 0.50 |
| Over 250.00 to 300.00, incl | 0.64 |

7. TWIST:

7.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE IX

| Specified Width Millimetres | Tolerance, Degrees, (See Notes 9 and 10) In total length or in any 300 mm or longer chord segment of total length |
|---|---|
| Up to 40.00, incl | 3/m; 7 max |
| Over 40.00 to 80.00, incl | 1.5/m; 5 max |
| Over 80.00 | 1/m; 3 max |

8. INSIDE AND OUTSIDE RADII:

8.1 Square, Rectangular, Hexagonal, and Octagonal:

TABLE X

| Specified Radius Millimetres (See Note 11) | Tolerance |
|---|---|
| Sharp Corners | +0.5 mm |
| Over 0.50 to 5.00, incl | ±0.5 mm |
| Over 5.00 | ±10% |

9. ANGULARITY:

9.1 Square, Rectangular, Hexagonal, and Octagonal: The allowable deviation from specified angle is ±2 degrees.

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

11. SURFACE ROUGHNESS (See Note 9): Depth of surface roughness imperfections shall not exceed 10% of the specified (or nominal) wall thickness or 0.13 mm, whichever is smaller.

12. DENTS: Depths of dents shall not exceed twice the applicable ovality tolerance of Table I for the particular tubing size being measured, except for tubing having a wall thickness less than 2-1/2% of the OD in which case the following multipliers apply:

| | | | |
|---|---|---|---|
| 1/2% | to 1%, | excl | 5.0 x tolerance |
| 1% | to 1-1/2%, | excl | 4.0 x tolerance |
| 1-1/2% | to 2%, | excl | 3.0 x tolerance |
| 2% | to 2-1/2%, | excl | 2.5 x tolerance |