

# AEROSPACE MATERIAL SPECIFICATION

**SAE** MAM-2253

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## TOLERANCES, METRIC Carbon and Alloy Steel Tubing

1. **SCOPE:** This specification covers established metric manufacturing tolerances applicable to carbon and alloy steel tubing ordered to metric dimensions. These tolerances apply to all conditions unless otherwise noted. The term "excl" is used to apply only to the higher figure of the specified range.

2. **DIAMETER:**

2.1 **Aircraft Type, Seamless; Cold Finished:**

**TABLE I**

Specified OD Millimetres	OD Tolerance, Millimetre, Plus and Minus	
	Annealed, Normalized, or Stress Relieved	Quenched and Tempered
Up to 12.5, incl	0.12	0.25
Over 12.5 to 37.5, incl	0.12	0.35
Over 37.5 to 75.0, incl	0.25	0.75
Over 75.0 to 150.0, incl	0.35	1.15
Over 150.0	0.50	1.50

2.1.1 Tubes with wall thickness less than 3% of the nominal OD will be allowed an ovality tolerance over and under equal to 0.5% of the nominal OD in addition to the tolerance indicated in Table I, but the mean OD shall be within the individual measurement tolerances specified in Table I.

2.1.1 When specified on the purchase order, the tolerance for the OD shall apply to the ID instead, but not to both ID and OD of the same lot of tubing.

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2.2 Aircraft Type, Welded; Annealed, Normalized, or Stress Relieved:

TABLE II

Specified OD Millimetres	Specified Wall Thickness Millimetre	OD Tolerance, Millimetre	
		Diameter Plus and Minus	Ovality
Up to 12.5, incl	All	0.08	0.10
Over 12.5 to 15.5, incl	All	0.10	0.10
Over 15.5 to 25.0, incl	0.70 to 1.60, excl	0.10	0.12
Over 15.5 to 25.0, incl	1.60 to 3.00, incl	0.10	0.10
Over 25.0 to 34.5, incl	0.70 to 3.00, incl	0.12	0.20
Over 34.5 to 50.0, incl	0.70 to 1.60, excl	0.15	0.20
Over 34.5 to 50.0, incl	1.60 to 3.35, incl	0.12	0.15
Over 50.0 to 62.5, incl	All	0.18	0.25
Over 62.5 to 75.0, incl	0.85 to 2.10, excl	0.25	0.50
Over 62.5 to 75.0, incl	2.10 to 3.35, incl	0.25	0.38
Over 75.0 to 87.5, incl	1.00 to 2.35, excl	0.30	0.50
Over 75.0 to 87.5, incl	2.35 to 3.35, incl	0.25	0.50
Over 87.5 to 100.0, incl	1.00 to 2.35, excl	0.40	0.62
Over 87.5 to 100.0, incl	2.35 to 3.35, incl	0.30	0.50
Over 100.0 to 125.0, incl	1.25 to 2.35, excl	0.55	0.80
Over 100.0 to 125.0, incl	2.35 to 3.35, incl	0.40	0.80

2.2.1 When specified on the purchase order, the tolerance for OD shall apply to the ID instead, but not to both ID and OD of the same lot of tubing.

2.2.2 Ovality is the difference between the maximum and minimum diameters of any one section of the tube.

2.3 Mechanical Type, Seamless; Cold Finished, As Finished or Stress Relieved:

TABLE III

Specified OD Millimetres	Specified Wall Thickness Millimetres	OD Tolerance, Millimetres	
		Plus	Minus
4.70 to 12.5, excl	All	0.10	0
12.5 to 37.5, excl	All	0.12(2.3.1)	0(2.3.1)
37.5 to 87.5, excl	All	0.25(2.3.1)	0(2.3.1)
87.5 to 135.0, excl	All	0.38(2.3.1)	0(2.3.1)
135.0 to 200.0, excl	Under 5% of OD	0.75(2.3.1)	0.75(2.3.1)
135.0 to 200.0, excl	5 - 7.5%, incl, of OD	0.50	0.50
135.0 to 200.0, excl	Over 7.5% of OD	0.75	0
200.0 to 270.0, incl	Under 5% of OD	1.12(2.3.1)	1.12(2.3.1)
200.0 to 270.0, incl	5 - 7.5%, incl, of OD	0.88	0.88
200.0 to 270.0, incl	Over 7.5% of OD	1.12	0

- 2.3.1 Tubes with wall thickness less than 3% of the nominal OD will be allowed an ovality tolerance over and under equal to 0.5% of the nominal OD in addition to the tolerance indicated in Table III, but the average OD shall be within the individual measurement tolerances specified in Table III.

2.4 Mechanical Type, Seamless; Hot Finished:

TABLE IV

Specified OD Millimetres	Specified Wall Thickness Millimetres	OD Tolerance, Millimetres, Plus and Minus	
		As Finished, Annealed, or Normalized	Quenched and Tempered
37.5 to 75.0, excl	Over 2.35	0.55	0.75
75.0 to 80.0, excl	Over 2.35	0.75	1.15
80.0 to 135.0, excl	3% of OD or more	0.75	1.15
135.0 to 200.0, excl	3% of OD or more	1.15	1.50
200.0 to 270.0, incl	3 to 5%, excl, of OD	1.55	1.85
200.0 to 270.0, incl	5% of OD or more	1.15	1.50

2.5 Mechanical Type, Seamless; Cold Finished, Annealed, Normalized, or Quenched and Tempered:

TABLE V

Specified OD Millimetres	Specified Wall Thickness	OD Tolerance, Millimetres Plus and Minus
4.65 to 12.5, incl	All	0.25
Over 12.5 to 37.5, incl	3% of OD or more	0.38
Over 37.5 to 87.5, incl	3% of OD or more	0.75
Over 87.5 to 135.0, incl	3% of OD or more	1.15
Over 135.0 to 200.0, incl	3% of OD or more	1.50
Over 200.0 to 270.0, incl	3 to 5%, excl, of OD	1.85
Over 200.0 to 270.0, incl	5% of OD or more	1.50

3. WALL THICKNESS:

3.1 Aircraft Type, Cold Finished:

- 3.1.1 Wall thickness of tubes 12.5 mm and over in nominal ID shall not vary more than  $\pm 10\%$ .
- 3.1.2 Wall thickness of tubes under 12.5 mm in nominal ID shall not vary more than  $\pm 15\%$ .

3.2 Aircraft Type, Welded:

TABLE VI

Specified Wall Thickness Millimetres	Tolerance, Millimetre, Minus Only (3.2.1) Outside Diameter Ranges, Millimetres			
	9.40 to 22.00, incl	Over 22.00 to 50.0, incl	Over 50.0 to 75.0, incl	Over 75.0 to 100.0, incl
Up to 0.70, incl	0.10	0.10	--	--
Over 0.70 to 0.85, incl	0.10	0.10	0.12	--
Over 0.85 to 1.25, incl	0.10	0.12	0.15	--
Over 1.25 to 1.65, incl	0.10	0.15	0.15	0.15
Over 1.65 to 2.10, incl	0.10	0.15	0.15	0.15
Over 2.10 to 2.75, incl	--	0.15	0.15	0.15
Over 2.75 to 3.00, incl	--	0.15	0.20	0.20
Over 3.00 to 3.35, incl	--	0.15	0.20	0.20

- 3.2.1 Tolerances are exclusive of the inside welding flash which shall not exceed the wall thickness of the tubing, but in any case shall not exceed 2.35 millimetres.

3.3 Mechanical Type, Cold Finished:

- 3.3.1 Wall thickness of all tubes, except those sizes in 3.3.2 and 3.3.3, shall not vary more than  $\pm 10\%$ .

- 3.3.2 Wall thickness may vary  $\pm 12.5\%$  for the following sizes:

- 3.3.2.1 Under 135 mm nominal OD with a wall thickness over 25% of the nominal OD.

- 3.3.2.2 135 to 200 mm nominal OD, excl, with a wall thickness over 30 millimetres.

- 3.3.2.3 200 mm and over in nominal OD and weighing over 135 kg per metre.

- 3.3.3 For tubes under 12.5 mm nominal ID (or under 15.5 mm in nominal ID when wall thickness is more than 20% of OD), the wall thickness may vary  $\pm 15\%$ .

3.4 Mechanical Type, Seamless, Hot Finished:

TABLE VII

Specified Wall Thickness (T) Millimetres	Tolerance, Millimetre Plus and Minus
Up to 2.75, incl	0.165T
Over 2.75 to 4.30, incl	0.15T
Over 4.30 to 5.10, incl	0.14T
Over 5.10	0.125T