SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE MAM 2223C

Issued JUL 1982
Reaffirmed OCT 1999
Noncurrent MAR 2003

Superseding MAM 2223B

Tolerances, Metric
Copper and Copper Alloy Seamless Tubing

NONCURRENCY NOTICE

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of March, 2003. It is recommended, therefore, that this specification not be specified for new designs.

AMS 2223 covers the same requirements.

"NONCURRENT" refers to those materials which have been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these as standard materials for future use in new designs.

"NONCURRENT" specifications are available from SAE.

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1. SCOPE:

This specification covers established metric manufacturing tolerances applicable to copper and copper alloy seamless tubing ordered to metric (SI) dimensions. These tolerances apply to all conditions, unless otherwise noted. The term "exclusive" is used to apply only to the higher figure of a specified range.

1.1 AMS 2223 is the inch/pound version of this MAM.

2. DIAMETER:

See Table 1 and 2.1.

TABLE 1 - Average Diameter Tolerance

Specified Diameter mm	Average Diameter Tolerance mm, Plus and Minus
Up to 3, incl	0.05
Over 3 to 16, incl	0.05
Over 16 to 25, incl	0.06
Over 25 to 50, incl	0.08
Over 50 to 75, incl	0.10
Over 75 to 100, incl	0.125
Over 100 to 125, incl	0.15
Over 125 to 150, incl	0.18
Over 150 to 200, incl	0.20
Over 200 to 250, incl	0.25

2.1 Applicable to inside or outside diameter. Table 1 is applicable to both refractory and non-refractory alloys.

2.2 Out-of roundness (difference between the major and minor diameters at any one cross-section) of unannealed tubing in straight lengths shall be not greater than specified in Table 2; if the tolerance is expressed as a percentage of a specified dimension, the tolerance so calculated shall be rounded to the nearest 0.025 millimeter to obtain the permissible tolerance.

TABLE 2 - Roundness Tolerance

Ratio of Specified Wall Thickness to Specified Diameter	Roundness Tolerance % of Specified Diameter
0.01 to 0.03, incl	1.5
Over 0.03 to 0.05, incl	1.0
Over 0.05 to 0.10, incl	0.8; 0.05 mm, min
Over 0.10	0.7; 0.05 mm, min

3. WALL THICKNESS:

When the tolerance is expressed as a percentage of a dimension, the tolerance so calculated shall be rounded to the nearest 0.025 millimeter to obtain the permissible tolerance.

3.1 Round; Non-Refractory:

See Table 3.

3.1.1 When round tube is ordered by outside and inside diameter, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in the table by more than 50%.

3.1.2 Percent of specified wall expressed to the nearest 0.025 millimeter.

3.2 Round, Refractory:

See Table 4.

4. LENGTH:

See Table 5.

TABLE 3 - Wall Tolerance, Millimeter, Plus and Minus, Non-Refractory Rounds

Outside Diameter, mm (See 3.1.1) Wall Thickness, mm	Outside Diameter, mm (See 3.1.1) 0.80 to 3.0, incl	Outside Diameter, mm (See 3.1.1) Over 3.0 to 16, incl	Outside Diameter, mm (See 3.1.1) Over 16 to 25, incl	Outside Diameter, mm (See 3.1.1) Over 25 to 50, incl	Outside Diameter, mm (See 3.1.1) Over 50 to 100, incl	Outside Diameter, mm (See 3.1.1) Over 100 to 180, incl	Outside Diameter, mm (See 3.1.1) Over 180 to 250, incl
Up to 0.40, incl	0.05	0.03	0.04	0.05	---	---	---
Over 0.40 to 0.60, incl	0.08	0.05	0.05	0.06	---	---	---
Over 0.60 to 0.90, incl	0.08	0.06	0.06	0.08	0.10	---	---
Over 0.90 to 1.5, incl	0.08	0.08	0.09	0.09	0.12	0.20	---
Over 1.5 to 2.0, incl	---	0.09	0.10	0.10	0.15	0.20	0.25
Over 2.0 to 3.0, incl	---	0.10	0.12	0.12	0.20	0.20	0.28
Over 3.0 to 4.0, incl	---	0.12	0.15	0.15	0.20	0.25	0.30
Over 4.0 to 5.5, incl	---	0.20	0.20	0.20	0.25	0.30	0.35
Over 5.5 to 7.0, incl	---	---	0.25	0.25	0.30	0.35	0.45
Over 7.0 to 10, incl	---	---	0.30	5% (3.1.2)	5% (3.1.2)	6% (3.1.2)	6% (3.1.2)
Over 10	---	---	---	5% (3.1.2)	5% (3.1.2)	6% (3.1.2)	6% (3.1.2)

TABLE 4 - Wall Tolerance, Refractory Rounds

Specified Wall Thickness mm	Wall Tolerance, mm, Plus and Minus OD Ranges, mm 0.80 to 3.0, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm Over 3.0 to 16, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm Over 16 to 25, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm Over 25 to 50, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm, Over 50 to 100, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm, Over 100 to 180, incl	Wall Tolerance, mm, Plus and Minus OD Ranges, mm, Over 180 to 250, incl
Up to 0.40, incl	0.06	0.04	0.05	0.06	---	---	---
0.40 to 0.60, incl	0.10	0.06	0.06	0.08	---	---	---
0.60 to 0.90, incl	0.10	0.08	0.08	0.10	0.13	---	---
0.90 to 1.5, incl	0.10	0.10	0.11	0.11	0.16	0.23	---
1.5 to 2.0, incl	---	0.11	0.13	0.13	0.19	0.25	0.33
2.0 to 3.0, incl	---	0.13	0.16	0.16	0.23	0.28	0.35
3.0 to 4.0, incl	---	0.18	0.18	0.19	0.25	0.33	0.38
4.0 to 5.5, incl	---	---	0.23	0.25	0.33	0.38	0.45
5.5 to 7.0, incl	---	---	0.30	0.33	0.38	0.45	0.50
7.0 to 10, incl	---	---	---	0.38	0.45	0.50	0.58
Over 10	---	---	---	6%	6%	8%	8%

TABLE 5 - Length Tolerances

Specified Diameter mm	Length Tolerance, mm, Plus Only Straight Lengths 150 mm and Under	Length Tolerance, mm, Plus Only Straight Lengths Over 150 to 600 mm, incl	Length Tolerance, mm, Plus Only Straight Lengths Over 600 to 2000 mm, incl	Length Tolerance, mm, Plus Only Straight Lengths Over 2000 to 4000 mm, incl	Length Tolerance, mm, Plus Only Straight Lengths Over 4000 mm	Length Tolerance, mm, Plus Only Coils 15,000 mm and Under	Length Tolerance, mm, Plus Only Coils Over 15,000 to 30,000 mm, incl
Up to 25, incl	0.80	1.5	2.5	6.0	12	300	600
Over 25 to 50, incl	1.5	2.5	3.0	6.0	12	300	600
Over 50 to 100, incl	1.6	2.4	3.1	6.0	12	--	--
Over 100	--	3.0	6.0	6.0	12	--	--

5. STRAIGHTNESS (UNANNEALED STRAIGHT TUBING 6.0 TO 100 MM OD):

See Table 6.

TABLE 6 - Straightness, Maximum Curvature

Length mm	Max Curvature (Depth of Arc) mm
Over 1000 to 2000, incl	5.0
Over 2000 to 2500, incl	8.0
Over 2500 to 3000, incl	12
Over 3000	12 in any 3000 mm of total length