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400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

MAM 2221

Issued 7-1-82
Revised

TOLERANCES, METRIC
Copper and Copper Alloy Bars and Rods

1. SCOPE: This specification covers established metric manufacturing tolerances applicable to bars and rods of copper and copper alloys 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 a specified range.

1.1 If the tolerance is expressed as a percentage of a nominal dimension, the tolerance so calculated shall be rounded to the nearest 0.02 mm to obtain the permissible tolerance.

2. DIAMETER OR THICKNESS:

2.1 Cold Finished:

2.1.1 Rods; Rounds, Hexagons, and Octagons:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tolerance, Millimetre, Plus and Minus			
	Non-Refractory		Refractory	
	Round	Hexagonal Octagonal	Round	Hexagonal Octagonal
Up to 3.75, incl	0.032	0.062	0.05	--
Over 3.75 to 12.50, incl	0.038	0.08	0.05	0.10
Over 12.50 to 25.00, incl	0.05	0.10	0.08	0.12
Over 25.00 to 50.00, incl	0.062	0.12	0.10	0.15
Over 50.00	0.15%	0.30%	0.20%	0.40%

2.1.2 Bars; Squares and Rectangles:

2.1.2.1 Copper:

TABLE II

Nominal Thickness Millimetres	Thickness Tolerance Millimetre, Plus and Minus Width Ranges, Millimetres					
	Up to 12.50, incl	Over 12.50 to 31.25, incl	Over 31.25 to 50.0, incl	Over 50.0 to 100.0, incl	Over 100.0 to 200.0, incl	Over 200.0 to 300.0, incl
Over 4.70 to 12.50, incl	0.08	0.08	0.09	0.10	0.11	0.14
Over 12.50 to 25.00, incl	--	0.10	0.10	0.011	0.12	0.15
Over 25.00 to 50.00, incl	--	0.11	0.11	0.12	0.15	--
Over 50.00 to 100.00, incl	--	--	--	0.30%	--	--

2.1.2.2 Non-Refractory Alloys:

TABLE III

Nominal Thickness Millimetres	Thickness Tolerance Millimetre, Plus and Minus Width Ranges, Millimetres					
	Up to 12.50, incl	Over 12.50 to 31.25, incl	Over 31.25 to 50.0, incl	Over 50.0 to 100.0, incl	Over 100.0 to 200.0, incl	Over 200.0 to 300.0, incl
Over 4.70 to 12.50, incl	0.08	0.10	0.11	0.11	0.15	0.20
Over 12.50 to 25.00, incl	--	0.11	0.12	0.12	0.18	0.22
Over 25.00 to 50.00, incl	--	0.12	0.12	0.15	0.20	--
Over 50.00 to 100.00, incl	--	--	--	0.30%	--	--

2.1.2.3 Refractory Alloys:

TABLE IV

Nominal Thickness Millimetres	Thickness Tolerance Millimetre, Plus and Minus Width Ranges, Millimetres					
	Up to 12.50, incl	Over 12.50 to 31.25, incl	Over 31.25 to 50.0, incl	Over 50.0 to 100.0, incl	Over 100.0 to 200.0, incl	Over 200.0 to 300.0, incl
Over 4.70 to 12.50, incl	0.12	0.12	0.15	0.18	0.22	0.30
Over 12.50 to 25.00, incl	--	0.15	0.18	0.20	0.25	0.32
Over 25.00 to 50.00, incl	--	0.15	0.18	0.22	0.28	--
Over 50.00 to 100.00, incl	--	--	--	0.50%	--	--

2.2 Extruded Round, Hexagonal, Octagonal, Square, and Rectangular Shapes:

TABLE V

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tolerance, Millimetres, Plus and Minus	
	Non Refractory	Refractory
Up to 25.00, incl	0.25	0.50
Over 25.00 to 50.00, incl	0.38	0.75
Over 50.00 to 75.00, incl	0.62	1.25
Over 75.00 to 87.50, incl	0.88	1.75
Over 87.50 to 100.00, incl	1.50	3.00

2.3 Hot Finished Rounds:

TABLE VI

Nominal Diameter Millimetres	Tolerance, Millimetres	
	plus	minus
6.25	0.50	0.25
Over 6.25 to 18.75, incl	0.38	0.38
Over 18.75 to 31.25, incl	0.50	0.50
Over 31.25 to 37.50, incl	0.75	0.75
Over 37.50 to 75.00, incl	1.56	1.56
Over 75.00	3.12	3.12

3. WIDTH:

3.1 Rectangles, Not Including Squares:

TABLE VII

Nominal Width Millimetres	Tolerance, Millimetre, Plus and Minus	
	Copper and Non-Refractory	Refractory
Over 4.70 to 12.50, incl	0.09	0.12
Over 12.50 to 31.25, incl	0.12	0.18
Over 31.25 to 50.00, incl	0.20	0.25
Over 50.00 to 100.00, incl	0.30	0.38
Over 100.00 to 300.00, incl	0.30%	0.50%

4. LENGTH: Cold finished bars and rods shall not vary from the length ordered by more than -0, +9.5 mm when specific lengths are ordered or by more than -0, +25 mm when stock lengths are ordered. No length tolerances are established for extruded or hot rolled rod.

5. STRAIGHTNESS:

5.1 Cold Finished Rods; Hexagons, Octagons:

TABLE VIII

Length Millimetres	Maximum Curvature (Depth of Arc) Millimetres
Up to 600, excl	0.8
600 to 1500, excl	0.8 in any 600 mm of total length
1500 to 3000, excl	3.2 in any 1500 mm of total length
3000 and Over	12.5 in any 3000 mm of total length

5.2 Bars; Squares and Rectangles: When supplied in straight lengths, in rolls, or on bucks, shall be of such straightness that the maximum edgewide curvature (depth of arc) shall be not greater than 12.5 mm in any 1800 mm or 2.0 mm x length in 300 mm for shorter lengths.

6. FLATNESS: None specified.

7. SPECIAL TOLERANCES:

7.1 If tolerances specified herein are plus and minus and if all plus or all minus are desired, use the sum of the plus and minus values specified, neglecting the signs.

7.2 If tolerances specified herein are all plus and if all minus are desired, use the same values specified.