

# AEROSPACE MATERIAL SPECIFICATIONS

## AMS 2221C

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

485 Lexington Ave., New York, N.Y. 10017

Issued 7-1-45

Revised 2-15-65

### TOLERANCES Copper and Copper Alloy Rods and Bars

1. **PURPOSE:** To publish established manufacturing tolerances.
2. **APPLICATION:** Tolerances shown herein apply, unless otherwise agreed upon by purchaser and vendor. These tolerances apply to all conditions, unless otherwise noted.
3. **DIAMETER OR THICKNESS:**
  - 3.1 **Cold Finished:**
    - 3.1.1 **Rods; Rounds, Hexagons, and Octagons:**

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**TABLE I**

Nominal Diameter or Distance Between Parallel Sides Inches	Tolerance, Inch, Plus and Minus (See Note 1)			
	Non-refractory		Refractory	
	Round	Hexagonal Octagonal	Round	Hexagonal Octagonal
Up to 0.150, incl	0.0013	0.0025	0.002	--
Over 0.150 to 0.500, incl	0.0015	0.003	0.002	0.004
Over 0.500 to 1.00, incl	0.002	0.004	0.003	0.005
Over 1.00 to 2.00, incl	0.0025	0.005	0.004	0.006
Over 2.00	0.15%	0.30%	0.20%	0.40%

- 3.1.2 **Bars; Squares and Rectangles:**

- 3.1.2.1 **Copper:**

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**TABLE II**

**Thickness Tolerance, Inch, Plus and Minus (See Note 1)**  
**Width Ranges, Inches**

Nominal Thickness Inches	Width Ranges, Inches					
	Up to 0.500 incl	Over 0.500 to 1.250 incl	Over 1.250 to 2.00 incl	Over 2.00 to 4.00 incl	Over 4.00 to 8.00 incl	Over 8.00 to 12.00 incl
Over 0.188 to 0.500, incl	0.003	0.003	0.0035	0.004	0.0045	0.0055
Over 0.500 to 1.00, incl	--	0.004	0.004	0.0045	0.005	0.006
Over 1.00 to 2.00, incl	--	0.0045	0.0045	0.005	0.006	--
Over 2.00 to 4.00, incl	--	--	--	0.30%	--	--

3.1.2.2 Non-Refractory Alloys:

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TABLE III

Thickness Tolerance, Inch, Plus and Minus (See Note 1)  
Width Ranges, Inches

Nominal Thickness Inches	Width Ranges, Inches					
	Up to 0.500 incl	Over 0.500 to 1.250 incl	Over 1.250 to 2.00 incl	Over 2.00 to 4.00 incl	Over 4.00 to 8.00 incl	Over 8.00 to 12.00 incl
Over 0.188 to 0.500, incl	0.0035	0.004	0.0045	0.0045	0.006	0.008
Over 0.500 to 1.00, incl	--	0.0045	0.005	0.005	0.007	0.009
Over 1.00 to 2.00, incl	--	0.005	0.005	0.006	0.008	--
Over 2.00 to 4.00, incl	--	--	--	0.30%	--	--

3.1.2.3 Refractory Alloys:

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TABLE IV

Thickness Tolerance, Inch, Plus and Minus (See Note 1)  
Width Ranges, Inches

Nominal Thickness Inches	Width Ranges, Inches					
	Up to 0.500 incl	Over 0.500 to 1.250 incl	Over 1.250 to 2.00 incl	Over 2.00 to 4.00 incl	Over 4.00 to 8.00 incl	Over 8.00 to 12.00 incl
Over 0.188 to 0.500, incl	0.005	0.005	0.006	0.007	0.009	0.012
Over 0.500 to 1.00, incl	--	0.006	0.007	0.008	0.010	0.013
Over 1.00 to 2.00, incl	--	0.006	0.007	0.009	0.011	--
Over 2.00 to 4.00, incl	--	--	--	0.50%	--	--

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

TABLE V

Nominal Diameter or Distance Between Parallel Sides Inches	<u>Tolerance, Inch, Plus and Minus</u>	
	Non-refractory	Refractory
Up to 1.00, incl	0.010	0.020
Over 1.00 to 2.00, incl	0.015	0.030
Over 2.00 to 3.00, incl	0.025	0.050
Over 3.00 to 3.50, incl	0.035	0.070
Over 3.50 to 4.00, incl	0.060	0.120

3.3 Hot Finished Rounds:

TABLE VI

Nominal Diameter Inches	Tolerance, Inch	
	plus	minus
0.250 only	0.020	0.010
Over 0.250 to 0.750, incl	0.015	0.015
Over 0.750 to 1.25, incl	0.020	0.020
Over 1.25 to 1.50, incl	0.030	0.030
Over 1.50 to 3.00, incl	0.0625	0.0625
Over 3.00	0.125	0.125

4. WIDTH:

4.1 Rectangles, Not Including Squares:

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TABLE VII

Nominal Width Inches	Tolerance, Inch, Plus and Minus (See Note 1)	
	Copper and Non-Refractory	Refractory
Over 0.188 to 0.500, incl	0.0035	0.005
Over 0.500 to 1.25, incl	0.005	0.007
Over 1.25 to 2.00, incl	0.008	0.010
Over 2.00 to 4.00, incl	0.012	0.015
Over 4.00 to 12.00, incl	0.30%	0.50%

5. LENGTH: Cold finished rods and bars shall not vary from the ordered length by more than -0, +0.375 in. when specific lengths are ordered or by more than -0, +1.0 in. when stock lengths are ordered. No length tolerances are established for extruded and hot rolled rod.

6. STRAIGHTNESS:

6.1 Cold Finished Rods; Hexagons, Octagons:

TABLE VIII

Length Feet	Maximum Curvature (Depth of Arc)
	Inch
Up to 2, excl	1/32
2 to 5, excl	1/32 in any 2 ft of total length
5 to 10, excl	1/8 in any 5 ft of total length
10 and over	1/2 in any 10 ft of total length

6.2 Bars; Squares and Rectangles: When furnished in straight lengths, in rolls, or on bucks, shall be such straightness that the maximum edgewise curvature (depth or arc) shall be not greater than 0.50 in. in any 6 ft of length, or 0.083 in. x length in feet for shorter lengths.

∅ 7. FLATNESS: No requirements for AMS.

8. SPECIAL TOLERANCES:

8.1 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.