



## 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://www.sae.org).

AMS 2221 Tolerances, Copper and Copper Alloy Bars and Rods  
AMS 2750 Pyrometry

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM B 249 General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes  
ASTM B 249M General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes (Metric)  
ASTM E 3 Preparation of Metallographic Specimens  
ASTM E 8 Tension Testing of Metallic Materials  
ASTM E 8M Tension Testing of Metallic Materials (Metric)  
ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials  
ASTM E 112 Determining the Average Grain Size  
ASTM E 478 Chemical Analysis of Copper Alloys

## 3. TECHNICAL REQUIREMENTS:

## 3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element (3.1.1)	min	max
Beryllium	1.80	2.00
Cobalt + Nickel	0.20	--
Cobalt + Nickel + Iron	--	0.6
Aluminum	--	0.20
Silicon	--	0.20
Copper (3.1.2)	remainder	
Sum of named elements (3.1.3)	99.5	--

- 3.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and purchaser.

3.1.2 Copper may be reported as “remainder”, or as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.

3.1.3 When all elements in the table are analyzed, the sum shall be 99.5% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition:

Hot reduced or hot and cold reduced, solution and precipitation heat treated; TF00 temper (See 8.2).

3.3 Heat Treatment:

Product shall be heat treated as follows; pyrometry shall be in accordance with AMS 2750:

3.3.1 Solution: Heat within the range 1400 to 1475 °F (760 to 802 °C), hold at heat for 30 to 60 minutes, and water quench.

3.3.2 Precipitation: Heat to 600 to 675 °F (316 to 357 °C), hold at heat for not less than 3 hours, and cool in still air.

3.4 Properties:

The product shall conform to the following requirements (See 8.3):

3.4.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	165 ksi (1138 MPa)
Yield Strength at 0.2% Offset	140 ksi ( 965 MPa)
Elongation in 2 Inches (50.8 mm)	
Nominal Diameter or Least	
Distance Between Parallel Sides	
3 Inches (76 mm) and Under	4%
Over 3 Inches (76 mm)	3%

3.4.2 Hardness: Bars and rods 0.188 inch (4.78 mm) and over in nominal diameter or least distance between parallel sides shall have hardness of 36 to 45 HRC, or equivalent (See 8.4), determined in accordance with ASTM E 18.

3.4.3 Average Grain Size: The product shall have average grain size not coarser than shown in Table 3, determined in accordance with ASTM E 112.

TABLE 3 - Maximum Average Grain Size

Nominal Diameter or Least Distant Between Parallel Sides Inches	Diameter or Least Distant Between Parallel Sides Millimeters	Maximum Average Grain Size Millimeter
Up to 1.000, excl	Up to 25.40, excl	0.050
1.000 to 1.500, excl	25.40 to 38.10, excl	0.075
1.500 to 2.000, excl	38.10 to 50.80, excl	0.100
2.000 to 3.000, excl	50.80 to 76.20, excl	0.125

3.4.4 Microstructure: Product shall contain not more than 6% beta phase constituent, determined at 100X magnification on specimens prepared in accordance with ASTM E 3.

### 3.5 Quality:

Product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

### 3.6 Tolerances:

Shall conform to AMS 2221 as applicable to refractory alloys.

## 4. QUALITY ASSURANCE PROVISIONS:

### 4.1 Responsibility for Inspection:

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

### 4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

### 4.3 Sampling and Testing:

Shall be in accordance with ASTM B 249 or ASTM B 249M and the following; a lot shall be all product with the same form, from the same heat, processed at one time through all steps of manufacture.

4.3.1 One or more chemical analysis samples from each heat shall be analyzed in accordance with 3.1.