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## Standard Specification for General Requirements for Wrought Copper and Copper- Alloy Plate, Sheet, Strip, and Rolled Bar (Metric)<sup>1</sup>

This standard is issued under the fixed designation B248M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope\*

1.1 This specification establishes the general requirements common to several wrought product specifications. Unless otherwise specified in the purchase order or in an individual specification, these general requirements shall apply to copper and copper-alloy plate, sheet, strip, and rolled bar supplied under each of the following product specifications issued by ASTM: B36/B36M, B96/B96M, B103/B103M, B121/B121M, B122/B122M, B152/B152M, B169/B169M, B194, B422, B465, B534, B591, B592, B694, B740, B747, and ~~B768~~, and B888.<sup>2</sup>

1.2 *Units*—This specification is the companion specification to inch-pound Specification B248.

### 2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

#### 2.2 ASTM Standards:<sup>3</sup>

B36/B36M Specification for Brass Plate, Sheet, Strip, and Rolled Bar

B96/B96M Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels

B103/B103M Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar

B121/B121M Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar

B122/B122M Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar

B152/B152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar

B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar

B193 Test Method for Resistivity of Electrical Conductor Materials

B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

B248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

B422 Specification for Copper-Aluminum-Silicon-Cobalt Alloy, Copper-Nickel-Silicon-Magnesium Alloy, Copper-Nickel-Silicon Alloy, Copper-Nickel-Aluminum-Magnesium Alloy, and Copper-Nickel-Tin Alloy Sheet and Strip

B465 Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar

B534 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

B591 Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar

B592 Specification for Copper-Zinc-Aluminum-Cobalt Alloy, Copper-Zinc-Tin-Iron Alloy Plate, Sheet, Strip, and Rolled Bar

B694 Specification for Copper, Copper-Alloy, Copper-Clad Bronze (CCB), Copper-Clad Stainless Steel (CCS), and Copper-Clad Alloy Steel (CAS) Sheet and Strip for Electrical Cable Shielding

B740 Specification for Copper-Nickel-Tin Spinodal Alloy Strip

B747 Specification for Copper-Zirconium Alloy Sheet and Strip

B768 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Strip and Sheet

B846 Terminology for Copper and Copper Alloys

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

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<sup>2</sup> The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix “C” and a suffix “00.” The suffix can be used to accommodate composition variations of the base alloy.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard.

[B888 Specification for Copper Alloy Strip for Use in Manufacture of Electrical Connectors or Spring Contacts](#)  
[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)—~~Metrie~~  
[E18 Test Methods for Rockwell Hardness of Metallic Materials](#)  
[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)  
[E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials](#)  
[E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry](#)  
[E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes](#)  
[E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\)](#)  
[E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys](#)  
[E106 Test Methods for Chemical Analysis of Copper-Beryllium Alloys](#)  
[E112 Test Methods for Determining Average Grain Size](#)  
[E118 Test Methods for Chemical Analysis of Copper-Chromium Alloys](#)  
[E121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys](#)  
[E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition](#)  
[E478 Test Methods for Chemical Analysis of Copper Alloys](#)  
[E527 Practice for Numbering Metals and Alloys in the Unified Numbering System \(UNS\)](#)

### 3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology B846.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *coil, n*—a length of the product wound into a series of connected turns. The unqualified term “coil” as applied to “flat product” usually refers to a coil in which the product is spirally wound, with the successive layers on top of one another. (Sometimes called a “roll.”)

3.2.2 *lengths, mill, n*—straight lengths, including ends, that can be conveniently manufactured in the mills. Full length pieces are usually 2400, 3000, or 3600 mm and subject to established length tolerances.

3.2.2.1 *lengths, stock, n*—straight lengths that are mill cut and stored in advance of orders. They are usually 2400, 3000, or 3600 mm and subject to established length tolerances.

3.2.3 *rolled bar, n*—a rolled flat product over 5 mm thick and up to and including 300 mm wide, with sheared, sawed, or machined edges, in straight lengths or coils (rolls).

### 4. Materials and Manufacture

4.1 *Materials*—The:

4.1.1 The material of manufacture shall be a cast bar, cake, slab of such purity and soundness as to be suitable for processing into the products to the product specification listed in Section 1.

4.1.2 When specified in the contract or purchase order that the heat identification or traceability is required, the purchaser shall specify the details desired.

4.2 *Manufacture:*

4.2.1 The product shall be manufactured by such hot ~~working or working~~, cold working and annealing process as to produce a uniform wrought structure in the finished product.

4.2.2 The product shall be hot or cold worked to the finished size and subsequently ~~annealed~~, annealed when required, to meet the temper properties specified.

4.3 *Edges*—The edges shall be slit, shared, sawed, or rolled edges, as specified. Slit edges shall be furnished unless otherwise specified in the contract or purchase order. See 5.6 for edge descriptions and corresponding tables for tolerances.

### 5. Dimensions, Mass, and Permissible Variations

5.1 *General*—For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimension may be cause for rejection.

NOTE 1—Blank spaces in the tolerance tables indicate either that the material is not available or that no tolerances have been established.

5.2 *Thickness*—The standard method of specifying thickness shall be in decimal fractions of a millimetre. For material 0.50 mm and under in thickness, it is recommended that the nominal thicknesses be stated not closer than the nearest 0.01 mm. A list of preferred thicknesses is shown in Appendix X1. The thickness tolerances shall be those shown in Tables 1-3 for the product specification indicated:

5.2.1 Table 1—Thickness tolerances applicable to Specifications B36/B36M, B103/B103M, B121/B121M, B152/B152M, B465, B591, B592, ~~and~~, B747, and B888.

5.2.2 Table 2—Thickness tolerances applicable to Specifications B96/B96M, B122/B122M, B169/B169M, B194, B422, B534, B740, and B768.

5.2.3 Table 3—Special thickness tolerances applicable to Copper Alloy UNS No. C72500 when ordered to Specification B122/B122M, and to Specifications B194, B534, B740, and B768 as noted in the table.

**TABLE 1 Thickness Tolerances**

(Applicable to Specifications B36/B36M, B103/B103M, B121/B121M, B152/B152M, B465, B591, B592, and B747 and B888)

Thickness, mm		Thickness Tolerances, Plus and Minus, mm						
Over	Through	Strip			Sheet			
		Up to 200 mm, incl, in Width	Over 200 mm to 300 mm, incl, in Width	Over 300 mm to 600 mm, incl, in Width	Over 600 mm to 700 mm, incl, in Width	Over 700 mm to 900 mm, incl, in Width	Over 900 mm to 1200 mm, incl, in Width	Over 1200 mm to 1600 mm, incl, in Width
	0.10	0.007	0.015	...	...	...	...	...
0.10	0.20	0.01	0.02	0.03	...	...	...	...
0.20	0.30	0.015	0.025	0.035	...	...	...	...
0.30	0.40	0.02	0.03	0.045	0.06	0.08	0.09	0.10
0.40	0.50	0.025	0.035	0.05	0.06	0.08	0.09	0.11
0.50	0.60	0.03	0.04	0.05	0.08	0.09	0.10	0.12
0.60	0.70	0.035	0.05	0.06	0.08	0.09	0.10	0.12
0.70	1.0	0.045	0.05	0.06	0.09	0.10	0.12	0.15
1.0	1.3	0.05	0.06	0.07	0.10	0.12	0.15	0.17
1.3	2.0	0.06	0.07	0.08	0.12	0.15	0.17	0.20
2.0	3.5	0.07	0.08	0.10	0.15	0.17	0.20	0.25
3.5	5.0	0.08	0.10	0.11	.17	0.20	0.25	0.30
Rolled Bar				Plate				
5.0	8.0	0.10	0.11	0.12	0.22	0.25	0.30	0.35
8.0	13.0	0.11	0.12	0.15	0.30	0.35	0.40	0.45
13.0	20.0	0.13	0.17	0.22	0.40	0.45	0.50	0.60
20.0	30.0	0.17	0.22	0.27	0.45	0.55	0.60	0.75
30.0	40.0	0.55	0.55	0.55	0.55	0.65	0.75	0.90
40.0	60.0	0.65	0.65	0.65	0.65	0.75	0.90	1.1

**TABLE 2 Thickness Tolerances**

(Applicable to Specifications B96/B96M, B122/B122M, B169/B169M, B194, B422, B534, B740, and B768)

Thickness, mm		Thickness Tolerances, Plus and Minus, mm						
Over	Through	Strip			Sheet			
		Up to 200 mm, incl, in Width	Over 200 mm to 300 mm, incl, in Width	Over 300 mm to 600 mm, incl, in Width	Over 600 mm to 700 mm, incl, in Width	Over 700 mm to 900 mm, incl, in Width	Over 900 mm to 1200 mm, incl, in Width	Over 1200 mm to 1600 mm, incl, in Width
	0.10	0.01	0.02	...	...	...	...	...
0.10	0.20	0.015	0.025	0.035	...	...	...	...
0.20	0.30	0.02	0.03	0.05	...	...	...	...
0.30	0.40	0.025	0.035	0.06	...	...	...	...
0.40	0.50	0.03	0.05	0.06	...	...	...	...
0.50	0.60	0.035	0.06	0.07	...	...	...	...
0.60	0.70	0.05	0.06	0.07	0.10	0.13	0.15	0.18
0.70	1.0	0.06	0.07	0.08	0.13	0.15	0.18	0.20
1.0	1.3	0.07	0.08	0.10	0.15	0.18	0.20	0.25
1.3	2.0	0.08	0.10	0.11	0.18	0.20	0.25	0.30
2.0	3.5	0.10	0.11	0.12	0.20	0.25	0.30	0.35
3.5	5.0	0.11	0.13	0.15	0.25	0.30	0.35	0.40
Rolled Bar				Plate				
5.0	8.0	0.13	0.15	0.18	0.30	0.35	0.40	0.45
8.0	13.0	0.15	0.18	0.20	0.40	0.45	0.50	0.60
13.0	20.0	0.20	0.25	0.30	0.50	0.55	0.60	0.75
20.0	30.0	0.30	0.40	0.50	0.60	0.65	0.75	0.95
30.0	40.0	0.70	0.70	0.70	0.70	0.80	0.95	1.2
40.0	60.0	0.85	0.85	0.85	0.85	0.95	1.1	1.4

5.3 *Width*—The width tolerances shall be those shown in Tables 4-6 depending on the type of edge required (see 5.3.1, 5.3.2, and 5.3.3):

5.3.1 *Table 4*—Width tolerances for slit metal and slit metal with rolled edges.

5.3.2 *Table 5*—Width tolerances for square-sheared metal.

5.3.3 *Table 6*—Width tolerances for sawed metal.

5.4 *Length*—The material shall be furnished in coils or straight lengths of plate, sheet, strip, or rolled bar as specified. The length tolerances for straight lengths shall be those shown in Tables 7-10 depending on the method of cutting required (see 5.4.1-5.4.4). When ends are permitted, the length and quantity of the ends shall be in accordance with the schedule in Table 8.

5.4.1 *Table 7*—Length tolerances for straight lengths.

5.4.2 *Table 8*—Schedule of minimum length and maximum weight of ends for lengths with ends. —Schedule of minimum

**TABLE 3 Special Thickness Tolerances**

Thickness, mm	Tolerances Applicable to Copper Alloy UNS No. C72500, Specifications B122/B122M and B740-Tolerances, Plus and Minus, <sup>A</sup> mm for Strip 200 mm and Under in Width	Tolerances Applicable to Specifications B194, B534, B740, and B768 Tolerances, Plus and Minus, <sup>A</sup> mm for Strip 100 mm and Under in Width
	0.10 and under	0.005
Over 0.10 to 0.16, incl	0.008	0.008
Over 0.16 to 0.22, incl	0.010	0.013
Over 0.22 to 0.35, incl	0.013	0.015
Over 0.35 to 0.45, incl	0.018	0.018
Over 0.45 to 0.55, incl	0.020	0.020
Over 0.55 to 0.60, incl	0.025	0.025
Over 0.65 to 0.80, incl	0.033	0.025
Over 0.80 to 1.2, incl	0.038	...

<sup>A</sup> If tolerances are specified as all plus or all minus, double the values given.

**TABLE 4 Width Tolerances for Slit Metal and Slit Metal with Rolled Edges**  
 (Applicable to all specifications listed in 1.1)

Width, mm	Width Tolerances, <sup>A</sup> Plus and Minus, mm			
	For Thicknesses 0.102 to 0.80 mm, incl	For Thicknesses Over 0.80 to 3.2 mm, incl	For Thicknesses Over 3.2 to 5.0 mm, incl	For Thicknesses Over 5.0 to 12.0 mm, incl
50.8 and under	0.13	0.25	0.30	0.38
Over 50.8 to 200, incl	0.20	0.33	0.38	0.38
Over 200 to 600, incl	0.40	0.40	0.40	0.79
Over 600 to 1270, incl	0.79	0.79	0.79	1.19

<sup>A</sup> If tolerances are specified as all plus or all minus, double the values given.

**TABLE 5 Width Tolerances for Square-Sheared Metal**  
 (Applicable to all specifications listed in 1.1)

NOTE 1—All lengths up to 3.05 m, inclusive.

Width, mm	Width Tolerances, <sup>A</sup> Plus and Minus, mm		
	1.59 mm and Under in Thickness	Over 1.5 mm to 3.5 mm, incl, in Thickness	Over 3.5 mm in Thickness
500 and under	0.79	1.2	1.6
Over 500 to 900, incl	1.2	1.2	1.6
Over 900 to 3000, incl	1.6	1.6	1.6

<sup>A</sup> If tolerances are specified as all plus or all minus, double the values given.

**TABLE 6 Width Tolerances for Sawed Metal**  
 (Applicable to all specifications listed in 1.1)

Width, mm	Width Tolerances, <sup>A</sup> Plus and Minus, mm		
	For Lengths Up to 3000 mm, incl		For Length Over 3000 mm
	For Thicknesses Up to 38 mm, incl	For Thicknesses Over 38.1 mm	All Thicknesses
Up to 300, incl	0.79	1.6	1.6
Over 300 to 3000, incl	1.6	1.6	1.6

<sup>A</sup> If tolerances are specified as all plus or all minus, double the values given.

length and maximum weight of ends for mill lengths, specific lengths with ends, and stock lengths with ends.

5.4.3 *Table 9*—Length tolerances for square-sheared metal.—Length tolerances for square-sheared metal in all widths 3000 mm and under.

5.4.4 *Table 10*—Length tolerances for sawed metal.

5.5 *Straightness*—The straightness tolerances which are the maximum edgewise curvature (depth of arc) in any 1800-mm portion of the total length, shall be those shown in Tables 11-13 depending on the type of edge required.

5.5.1 *Table 11*—Straightness tolerances for metal as slit, or as slit and straightened, or as slit and edge-rolled, or metal with drawn edges.

**TABLE 7 Length Tolerances for Straight Lengths**  
(Applicable to all specifications listed in 1.1 except B694)

NOTE 1—The following length tolerances are all plus; if all minus tolerances are desired, use the same values; if tolerances are desired plus and minus, halve the values given.

Length, mm	Length Tolerances, mm
Specific lengths, mill lengths, multiple lengths, and specific lengths with ends	
3000 and under	6.4
Over 3000 to 6000, incl	13
Stock lengths and stock lengths with ends	
	25 <sup>A</sup>

<sup>A</sup> As stock lengths are cut and placed in stock in advance of orders, departure from this tolerance is not practicable.

**TABLE 8 Schedule of Minimum Length and Maximum Weight of Ends for Mill Lengths, Specific Lengths with Ends, and Stock Lengths with Ends**  
(Applicable to all specifications listed in 1.1 except B694)

Nominal Length, mm	1.3 mm and Under in Thickness		Over 1.3 to 3.2 mm, incl, in Thickness		Over 3.2 to 6.5 mm, incl, in Thickness	
	Minimum Length of Shortest Piece, mm	Maximum Permissible Weight of Ends, % of Lot Weight	Minimum Length of Shortest Piece, mm	Maximum Permissible Weight of Ends, % of Lot Weight	Minimum Length of Shortest Piece, mm	Maximum Permissible Weight of Ends, % of Lot Weight
1800 to 2400, incl	1200	20	1200	25	900	30
2400 to 3000, incl	1800	25	1500	30	1200	35
3000 to 4300, incl	2000	30	1800	35	1500	40

**TABLE 9 Length Tolerances for Square-Sheared Metal in All Widths 3000 mm and Under**  
(Applicable to all specifications listed in 1.1 except B694)

Length, mm	Length Tolerance, <sup>A</sup> Plus and Minus, mm		
	For Thicknesses Up to 1.6 mm, incl	For Thicknesses Over 1.6 to 3.2 mm, incl	For Thicknesses Over 3.2 mm
508 and under	0.8	1.2	1.6
Over 508 to 914, incl	1.2	1.2	1.6
Over 914 to 3048, incl	1.6	1.6	1.6

<sup>A</sup> If tolerances are specified as all plus or all minus, double the values given.

**TABLE 10 Length Tolerances for Sawed Metal**  
(Applicable to all specifications listed in 1.1 except B694)

NOTE 1—The following tolerances are all plus; if all minus tolerances are desired, use the same values; if tolerances are desired plus and minus, halve the values given.

Width, mm	Length Tolerance, mm
Up to 3000, incl	64

5.5.2 *Table 12*—Straightness tolerances for square-sheared metal.

5.5.3 *Table 13*—Straightness tolerances for sawed metal.

5.6 *Edges*—When rolled edges are required, they may be produced by either rolling or drawing to one of the following specified edge contours:

5.6.1 *Square Edges (Square Corners)*—Edges shall have commercially-squared corners with a permissible maximum radius as prescribed in Table 14.

5.6.2 *Rounded Corners*—Edges shall have rounded corners as shown in Fig. 1 with a radius as prescribed in Table 15.

5.6.3 *Rounded Edges*—Edges shall be rounded as shown in Fig. 2 with a radius as prescribed in Table 16.

5.6.4 *Full-Rounded Edges*—Edges shall be full-rounded as shown in Fig. 3 with a radius as prescribed in Table 17.

5.7 *Weight Tolerances for Hot-Rolled Material:*

5.7.1 *Table 18*—Lot weight tolerances for hot-rolled sheet and plate applicable to Specifications B36/B36M, B96/B96M (Copper Alloy UNS No. C65500), B103/B103M, B122/B122M, B152/B152M, and B591.

**TABLE 11 Straightness Tolerances for Slit Metal or Slit Metal  
Either Straightened or Edge-Rolled**  
(Applicable to all specifications listed in 1.1)

Maximum Edgewise Curvature (Depth of Arc) in any 1800-mm Portion of the Total Length			
Width, mm	Straightness Tolerance, mm		
	As Slit Only		As Slit and Either Straightened or Edge Rolled
	Shipped in Rolls	Shipped Flat	
Over 6 to 10, incl	51	38	13
Over 10 to 12, incl	38	25	13
Over 12 to 25, incl	25	19	13
Over 25 to 50, incl	16	16	9.5
Over 50 to 100, incl	13	13	9.5
Over 100	9.5	9.5	9.5

**TABLE 12 Straightness Tolerances for Square-Sheared Metal**  
(Applicable to all specifications listed in 1.1)  
(Not applicable to metal over 3000 mm in length)

Maximum Edgewise Curvature (Depth of Arc) in any 1800-mm Portion of the Total Length		
Thickness, mm	Straightness Tolerances, mm	
	Up to 250 mm, incl, in Width	Over 250 mm in Width
	3.2 and under	1.6
Over 3.2 to 5.0, incl	3.2	1.2
Over 5.0	3.2	1.6

**TABLE 13 Straightness Tolerances for Sawed Metal**  
(Applicable to all specifications listed in 1.1)  
(Not applicable to metal over 3600 mm in length)

Maximum Edgewise Curvature (Depth of Arc) in Any 2000-mm Portion of the Total Length	
Width, mm	Straightness Tolerances, mm
80 and under	1.6
Over 80	1.2

**TABLE 14 Tolerances for Radius of Commercially Square Corners of Rolled or Drawn Edges with Square Corners**  
(Applicable to all specifications listed in 1.1 except B694)

Thickness, mm	Permissible Radius of Corners, max, mm
0.8 to 1.6, incl	0.25
Over 1.6 to 4.8, incl	0.40
Over 4.8 to 25, incl	0.8

5.7.2 The weight of each lot of five or more plates or sheets of the same type and the same specified dimensions, when ordered to thickness, shall not vary from the theoretical by more than the amount prescribed in Table 18 for the product specification indicated. The weight of any individual plate or sheet may vary from the nominal by not more than one third in excess of the tolerances prescribed in Table 18 for the product specification indicated. The tolerances for lots of less than five plates or sheets shall be governed by the tolerances for individual plates or sheets.

5.7.3 For the purpose of calculation, the densities of the materials covered by these specifications are listed in Appendix X2.

## 6. Workmanship, Finish, and Appearance

6.1 The material product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable. A superficial film of residual light lubricant is normally present and is acceptable unless otherwise specified.

## 7. Sampling

7.1 *Sampling*—The lot size, portion size, and selection of sample pieces shall be as follows: