



Designation: B 248 – 01<sup>ε1</sup>

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

This standard is issued under the fixed designation B 248; 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.*

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<sup>ε1</sup> NOTE—Referenced Documents were editorially corrected in November 2003.

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### 1. Scope\*

1.1 This specification covers a group of 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: B 36/B 36M, B 96/B 96M, B 103/B 103M, B 121/B 121M, B 122/B 122M, B 152/B 152M, B 169/B 169M, B 194, B 291, B 422,

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<sup>1</sup> This specification is under the jurisdiction of the 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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**\*A Summary of Changes section appears at the end of this standard.**

B 465, B 534, B 591, B 592, B 694, B 740, B 747, and B 768.<sup>2</sup>

NOTE 1—A complete metric companion to Specification B 248 has been developed—B 248M; therefore no metric equivalents are presented in this specification.

## 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:

B 36/B 36M Specification for Brass Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 96/B 96M Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels<sup>3</sup>

B 103/B 103M Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 121/B 121M Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 122/B 122M Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 152/B 152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar<sup>3</sup>

B 169/B 169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar<sup>3</sup>

B 193 Test Method for Resistivity of Electrical Conductor Materials<sup>4</sup>

B 194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 291 Specification for Copper-Zinc-Manganese Alloy (Manganese Brass) Sheet and Strip<sup>5</sup>

B 422 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<sup>3</sup>

B 465 Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 534 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 591 Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 592 Specification for Copper-Zinc-Aluminum-Cobalt Alloy, Copper-Zinc-Tin-Iron Alloy Plate, Sheet, Strip, and Rolled Bar<sup>3</sup>

B 694 Specification for Copper, Copper-Alloy, and Copper-Clad Stainless Steel (CCS) and Copper-Clad Alloy Steel (CAS) Sheet and Strip for Electrical Cable Shielding<sup>3</sup>

B 740 Specification for Copper-Nickel-Tin Spinodal Alloy Strip<sup>3</sup>

B 747 Specification for Copper-Zirconium Alloy Sheet and Strip<sup>3</sup>

B 768 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Strip and Sheet<sup>3</sup>

E 8 Test Methods for Tension Testing of Metallic Materials<sup>6</sup>

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials<sup>6</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>7</sup>

E 50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials<sup>8</sup>

E 53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry<sup>8</sup>

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes<sup>8</sup>

~~E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition<sup>8</sup>~~

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)<sup>8</sup>

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys<sup>8</sup>

E 106 Test Methods for Chemical Analysis of Copper-Beryllium Alloys<sup>8</sup>

E 112 Test Methods for Determining the Average Grain Size<sup>6</sup>

E 118 Test Methods for Chemical Analysis of Copper-Chromium Alloys<sup>8</sup>

E 121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys<sup>8</sup>

E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition<sup>8</sup>

E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>9</sup>

<sup>2</sup> The UNS system for copper and copper alloys (see Practice E 527) 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> *Annual Book of ASTM Standards*, Vol 02.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 02.03.

<sup>5</sup> Discontinued. See 1992 *Annual Book of ASTM Standards*, Vol 03.05.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>9</sup> *Annual Book of ASTM Standards*, Vol 03.06.

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>10</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *blank*—a piece of flat product intended for subsequent fabrication by forming, bending, cupping, drawing, hot pressing, and so forth.

3.1.2 *coil*—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”.)

3.1.2.1 *level or traverse wound*—a coil in which the turns are positioned into layers parallel to the axis of the coil such that successive turns in a given layer are next to one another.

3.1.2.2 *level or traverse wound on a reel or spool*—a coil in which the turns are positioned into layers on a reel or spool parallel to the axis of the reel or spool such that successive turns in a given layer are next to one another.

3.1.3 *lengths*—straight pieces of the product.

3.1.3.1 *ends*—straight pieces, shorter than the nominal length, left over after cutting the product into mill lengths, stock lengths, or specific lengths. They are subject to minimum length and maximum weight requirements.

3.1.3.2 *mill*—straight lengths, including ends, that can be conveniently manufactured in the mills. Full-length pieces are usually 8, 10, or 12 ft and subject to established length tolerances.

3.1.3.3 *multiple*—straight lengths of integral multiples of a base length, with suitable allowance for cutting if and as specified.

3.1.3.4 *specific*—straight lengths that are uniform in length, as specified, and subject to established length tolerances.

3.1.3.5 *specific with ends*—specific lengths, including ends.

3.1.3.6 *stock*—straight lengths that are mill cut and stored in advance of orders. They are usually 8, 10, or 12 ft and subject to established length tolerances.

3.1.3.7 *stock with ends*—stock lengths, including ends.

3.1.4 *plate*—a wrought flat product over 0.188 in. thick and over 12 in. wide, in straight lengths or coils (rolls).

3.1.5 *reel or spool*—a cylindrical device that has a rim at each end and an axial hole for a shaft or spindle, and on which the product is wound to facilitate handling and shipping.

3.1.6 *rolled bar*—a rolled flat product over 0.188 in. thick and up to and including 12 in. wide, with sheared, sawed, or machined edges, in straight lengths or coils (rolls).

3.1.7 *sheet*—a rolled flat product up to and including 0.188 in. thick and over 24 in. wide, in straight lengths or coils (rolls).

3.1.8 *strip*—a rolled flat product, other than flat wire, up to and including 0.188 in. thick, in straight lengths, coils (rolls) or traverse wound on reels or spools:

3.1.8.1 *with slit, or sheared edges in widths up to 24 in. inclusive.*

3.1.8.2 *with finished drawn or rolled edges, in widths over 1¼ to 12 in. inclusive.*

### 4. Materials and Manufacture

4.1 *Materials*—The material shall be of such quality and purity that the finished product shall have the properties and characteristics prescribed in the applicable product specification listed in Section 1.

4.2 *Manufacture*—The material shall be produced by either hot- or cold-working operations. It shall be finished, unless otherwise specified, by such hot working, cold working, annealing, or heat treatment as may be necessary to meet the properties specified.

4.3 *Edges*—The edges shall be slit, sheared, sawed, or rolled edges, as specified. Slit edges shall be furnished unless otherwise specified or agreed between purchaser and supplier or manufacturer. See 5.6 for edge descriptions and tolerances.

### 5. Dimensions, Weights, 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 2—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 an inch. For material 0.021 in. and under in thickness, it is recommended that the nominal thicknesses be stated not closer than the nearest half-thousandth. (For example, specify 0.006 or 0.0065 in., but not 0.0063 in.) For material over 0.021 in. in thickness, it is recommended that the nominal thicknesses be stated not closer than the nearest thousandth. (For example, specify 0.128 or 0.129 in., but not 0.1285 in.) 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 B 36/B 36M, B 121/B 121M, B 152/B 152M, B 291, B 465, B 591 (Copper Alloy UNS No. C41100), B 592, and B 747.

<sup>10</sup> Annual Book of ASTM Standards, Vol 01.01.

**TABLE 1 Thickness Tolerances**

(Applicable to Specifications B 36/B 36M, B 121/B 121M, B 152/B 152M, B 291, B 465, B 591 (Copper Alloy UNS No. C41100), B 592, and B 747)

Thickness, in.	Thickness Tolerances, plus and minus, <sup>A</sup> in.								
	Strip					Sheet			
	8 in. and Under in Width	Over 8 to 12 in., incl, in Width	Over 12 to 14 in., incl, in Width	Over 14 to 20 in., incl, in Width	Over 20 to 24 in., incl, in Width	Over 24 to 28 in., incl, in Width	Over 28 to 36 in., incl, in Width	Over 36 to 48 in., incl, in Width	Over 48 to 60 in., incl, in Width
0.004 and under	0.0003	0.0006	0.0006	...	...	...	...	...	...
Over 0.004 to 0.006, incl	0.0004	0.0008	0.0008	0.0013	...	...	...	...	...
Over 0.006 to 0.009, incl	0.0006	0.0010	0.0010	0.0015	...	...	...	...	...
Over 0.009 to 0.013, incl	0.0008	0.0013	0.0013	0.0018	0.0025	0.0025	0.003	0.0035	0.004
Over 0.013 to 0.017, incl	0.0010	0.0015	0.0015	0.002	0.0025	0.0025	0.003	0.0035	0.0045
Over 0.017 to 0.021, incl	0.0013	0.0018	0.0018	0.002	0.003	0.003	0.0035	0.004	0.005
Over 0.021 to 0.026, incl	0.0015	0.002	0.002	0.0025	0.003	0.003	0.0035	0.004	0.005
Over 0.026 to 0.037, incl	0.002	0.002	0.002	0.0025	0.0035	0.0035	0.004	0.005	0.006
Over 0.037 to 0.050, incl	0.002	0.0025	0.0025	0.003	0.004	0.004	0.005	0.006	0.007
Over 0.050 to 0.073, incl	0.0025	0.003	0.003	0.0035	0.005	0.005	0.006	0.007	0.008
Over 0.073 to 0.130, incl	0.003	0.0035	0.0035	0.004	0.006	0.006	0.007	0.008	0.010
Over 0.130 to 0.188, incl	0.0035	0.004	0.004	0.0045	0.007	0.007	0.008	0.010	0.012
Rolled Bar									
Over 0.188 to 0.205, incl	0.0035	0.004	0.004	0.0045	0.007	0.007	0.008	0.010	0.012
Over 0.205 to 0.300, incl	0.004	0.0045	0.0045	0.005	0.009	0.009	0.010	0.012	0.014
Over 0.300 to 0.500, incl	0.0045	0.005	0.005	0.006	0.012	0.012	0.013	0.015	0.018
Over 0.500 to 0.750, incl	0.0055	0.007	0.007	0.009	0.015	0.015	0.017	0.019	0.023
Over 0.750 to 1.00, incl	0.007	0.009	0.009	0.011	0.018	0.018	0.021	0.024	0.029
Over 1.00 to 1.50, incl	0.022	0.022	0.022	0.022	0.022	0.022	0.025	0.029	0.036
Over 1.50 to 2.00, incl	0.026	0.026	0.026	0.026	0.026	0.026	0.030	0.036	0.044
Plate									

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

**TABLE 2 Thickness Tolerances**

(Applicable to Specifications B 96/B 96M, B 103/B 103M, B 122/B 122M, B 169/B 169M, B 194, B 422, B 534, B 591, B 740 (except Copper Alloy UNS No. C41100), and B 768)

Thickness, in.	Thickness Tolerances, Plus and Minus, <sup>A</sup> in.								
	Strip					Sheet			
	8 in. and Under in Width	Over 8 to 12 in., incl, in Width	Over 12 to 14 in., incl, in Width	Over 14 to 20 in., incl, in Width	Over 20 to 24 in., incl, in Width	Over 24 to 28 in., incl, in Width	Over 28 to 36 in., incl, in Width	Over 36 to 48 in., incl, in Width	Over 48 to 60 in., incl, in Width
0.004 and under	0.0004	0.0008	0.0008	...	...	...	...	...	...
Over 0.004 to 0.006, incl	0.0006	0.0010	0.0010	0.0015	...	...	...	...	...
Over 0.006 to 0.009, incl	0.0008	0.0013	0.0013	0.002	...	...	...	...	...
Over 0.009 to 0.013, incl	0.0010	0.0015	0.0015	0.0025	...	...	...	...	...
Over 0.013 to 0.017, incl	0.0013	0.002	0.002	0.0025	...	...	...	...	...
Over 0.017 to 0.021, incl	0.0015	0.0025	0.0025	0.003	...	...	...	...	...
Over 0.021 to 0.026, incl	0.002	0.0025	0.0025	0.003	0.004	0.004	0.005	0.006	0.007
Over 0.026 to 0.037, incl	0.0025	0.003	0.003	0.0035	0.005	0.005	0.006	0.007	0.008
Over 0.037 to 0.050, incl	0.003	0.0035	0.0035	0.004	0.006	0.006	0.007	0.008	0.010
Over 0.050 to 0.073, incl	0.0035	0.004	0.004	0.0045	0.007	0.007	0.008	0.010	0.012
Over 0.073 to 0.130, incl	0.004	0.0045	0.0045	0.005	0.008	0.008	0.010	0.012	0.014
Over 0.130 to 0.188, incl	0.0045	0.005	0.005	0.006	0.010	0.010	0.012	0.014	0.016
Rolled Bar									
Over 0.188 to 0.205, incl	0.0045	0.005	0.005	0.006	0.010	0.010	0.012	0.014	0.016
Over 0.205 to 0.300, incl	0.005	0.006	0.006	0.007	0.012	0.012	0.014	0.016	0.018
Over 0.300 to 0.500, incl	0.006	0.007	0.007	0.008	0.015	0.015	0.017	0.019	0.023
Over 0.500 to 0.750, incl	0.008	0.010	0.010	0.012	0.019	0.019	0.021	0.024	0.029
Over 0.750 to 1.00, incl	0.010	0.012	0.012	0.015	0.023	0.023	0.026	0.030	0.037
Over 1.00 to 1.50, incl	0.028	0.028	0.028	0.028	0.028	0.028	0.032	0.037	0.045
Over 1.50 to 2.00, incl	0.033	0.033	0.033	0.033	0.033	0.033	0.038	0.045	0.055
Plate									

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

5.2.2 Table 2—Thickness tolerances applicable to Specifications B 96/B 96M, B 103/B 103M, B 122/B 122M, B 169/B 169M, B 194, B 422, B 534, B 591, B 740, and B 768 (except Copper Alloy UNS No. C41100).

5.2.3 Table 3—Special thickness tolerances applicable to Copper Alloy UNS No. C72500 when ordered to Specification B 122/B 122M, and to Specifications B 194, B 534, B 740, and B 768 as noted in the table.

5.3 Width—The width tolerances shall be those shown in Tables 4-6, depending on the type of edge required (see 5.3.15.3.25.3.3):

**TABLE 3 Special Thickness Tolerances**

Thickness, in.	Tolerances Applicable to Copper Alloy UNS No. C72500, Specification B 122/B 122M and B 740	Tolerances Applicable to Specifications B 194, B 534, and B 768
	Tolerances, Plus and Minus, <sup>4</sup> in., for Strip 8 in. and Under in Width	Tolerances, Plus and Minus, <sup>4</sup> in., for Strip 4 in. and Under in Width
0.004 and under	0.0002	0.0002
Over 0.004 to 0.006, incl	0.0003	0.0003
Over 0.006 to 0.009, incl	0.0004	0.0005
Over 0.009 to 0.013, incl	0.0005	0.0006
Over 0.013 to 0.017, incl	0.0007	0.0007
Over 0.017 to 0.021, incl	0.0008	0.0008
Over 0.021 to 0.026, incl	0.0010	0.0010
Over 0.026 to 0.032, incl	0.0013	0.0010
Over 0.032 to 0.050, incl	0.0015	...

<sup>4</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 2.2)

Width, in.	Width Tolerances, <sup>4</sup> Plus and Minus, in.			
	For	For	For	For
	Thicknesses 0.004 to 0.032 in.	Thicknesses Over 0.032 to 0.125 in.	Thicknesses Over 0.125 to 0.188 in.	Thicknesses Over 0.188 to 0.500 in.
2 and under	0.005	0.010	0.012	0.015
Over 2 to 8, incl	0.008	0.013	0.015	0.015
Over 8 to 24, incl	1/64	1/64	1/64	1/32
Over 24 to 40, incl	1/32	1/32	1/32	3/64

<sup>4</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 2.2)

NOTE—All lengths up to 120 in., incl.

Width, in.	Width Tolerances, <sup>4</sup> Plus and Minus, in.		
	1/16 in. and Under in Thickness	Over 1/16 to 1/8 in., incl, in Thickness	Over 1/8 in. in Thickness
	20 and under	1/32	3/64
Over 20 to 36, incl	3/64	3/64	1/16
Over 36 to 120, incl	1/16	1/16	1/16

<sup>4</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 2.2)

Width, in.	Width Tolerances, <sup>4</sup> Plus and Minus, in.		
	For Lengths Up to 10 ft, incl		For Lengths Over 10 ft.
	For Thicknesses Up to 1 1/2 in., incl	For Thicknesses Over 1 1/2 in.	All Thicknesses
Up to 12, incl	1/32	1/16	1/16
Over 12 to 120, incl	1/16	1/16	1/16

<sup>4</sup>If tolerances are specified as all plus or all minus, double the values given.

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 7-9, depending on the method of cutting required (see 5.4.1-5.4.3). 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.

**TABLE 7 Length Tolerances for Straight Lengths**  
(Applicable to all specifications listed in 2.2 except B 694)

NOTE—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 ft.	Length Tolerances in.
Specific lengths, mill lengths, multiple lengths, and specific lengths with ends 10 and under	¼
Over 10 to 20, incl	½
Stock lengths and stock lengths with ends	1 <sup>A</sup>

<sup>A</sup>As stock lengths are cut and placed in stock in advance of orders, departure from the 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 2.2 except B 694)

Nominal Length, ft	0.050 in. and Under in Thickness		Over 0.050 to 0.125 in., incl, in Thickness		Over 0.125 to 0.250 in., incl, in Thickness	
	Minimum Length of Shortest Piece, ft	Maximum Permissible Weight of Ends, % of Lot Weight	Minimum Length of Shortest Piece, ft	Maximum Permissible Weight of Ends, % of Lot Weight	Minimum Length of Shortest Piece, ft	Maximum Permissible Weight of Ends, % of Lot Weight
6 to 8, incl	4	20	4	25	3	30
8 to 10, incl	6	25	5	30	4	35
10 to 14, incl	7	30	6	35	5	40

**TABLE 9 Length Tolerances for Square-Sheared Metal in All Widths 120 in. (3.05 m) and Under**

(Applicable to all specifications listed in 2.2 except B 694)

Length, in.	Length Tolerance, <sup>A</sup> Plus and Minus, in.		
	For Thicknesses Up to ¼ in., incl	For Thicknesses Over ¼ to ½ in., incl	For Thicknesses Over ½ in.
20 and under	⅓ <sub>2</sub>	⅜ <sub>4</sub>	⅛ <sub>6</sub>
Over 20 to 36, incl	⅜ <sub>4</sub>	⅜ <sub>4</sub>	⅛ <sub>6</sub>
Over 36 to 120, incl	⅛ <sub>6</sub>	⅛ <sub>6</sub>	⅛ <sub>6</sub>

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

5.4.3 Table 9—Length tolerances for square-sheared metal.

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 72-in. 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.

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 square corners with essentially 90° angles and with a maximum corner 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.

**TABLE 10 Length Tolerances for Sawed Metal**  
(Applicable to all specifications listed in 2.2 except B 694)

NOTE—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, in.	Length Tolerance, in.
Up to 120, incl	¼

**TABLE 11 Straightness Tolerances for Slit Metal or Slit Metal  
Either Straightened or Edge-Rolled**  
(Applicable to all specifications listed in 2.2)

Maximum Edgewise Curvature (Depth of Arc) in any 72-in. Portion of the Total Length			
Width, in.	Straightness Tolerance, in.		
	As Slit Only		As Slit and Either Straightened or Edge Rolled
	Shipped in Rolls	Shipped Flat	Shipped Flat, in Rolls, or on Bucks
Over ¼ to ⅜, incl	2	1½	½
Over ⅜ to ½, incl	1½	1	½
Over ½ to 1, incl	1	¾	½
Over 1 to 2, incl	⅝	⅝	⅜
Over 2 to 4, incl	½	½	⅜
Over 4	⅜	⅜	⅜

**TABLE 12 Straightness Tolerances for Square-Sheared Metal**  
(Applicable to all specifications listed in 2.2)  
(Not applicable to metal over 120 in. in length)

Maximum Edgewise Curvature (Depth of Arc) in any 72-in. Portion of the Total Length		
Thickness, in.	Straightness Tolerances, in.	
	Up to 10 in., incl, in Width	Over 10 in., in Width
⅛ and under	1/16	1/32
Over ⅛ to 3/16, incl	1/8	3/64
Over 3/16	1/8	1/16

**TABLE 13 Straightness Tolerances for Sawed Metal**  
(Applicable to all specifications listed in 2.2)  
(Not applicable to metal over 144 in. in length)

Maximum Edgewise Curvature (Depth of Arc) in any 72-in. Portion of the Total Length	
Width, in.	Straightness Tolerances, in.
3 and under	1/16
Over 3	3/64

**TABLE 14 Tolerances for Radius of Commercially Square  
Corners of Rolled or Drawn Edges with Square Corners**  
(Applicable to all specifications listed in 2.2 except B 694)

Thickness, in.	Permissible Radius of Corners, max, in.
0.032 to 0.064, incl	0.010
Over 0.064 to 0.188, incl	0.016
Over 0.188 to 1, incl	1/32

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:*

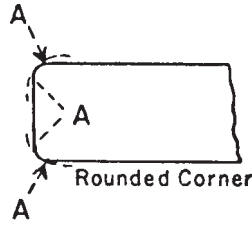
5.7.1 Table 18—Lot weight tolerances for hot-rolled sheet and plate applicable to Specifications B 96/B 96M (Copper Alloy UNS Nos. C65500 and C65800) and B 152/B 152M.

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 shall be free of defects, but blemishes of a nature that do not interfere with normal commercial operations are



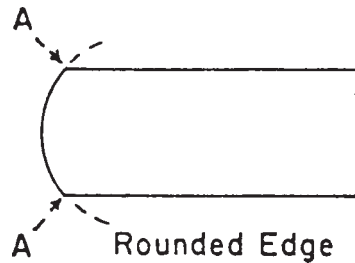
NOTE—The arc of the rounded corner shall not necessarily be tangent at points “A,” but the product shall be commercially free from sharp, rough, or projecting edges.

FIG. 1 Rounded Corners

**TABLE 15 Tolerances for Radius on Corners of Rolled or Drawn Edges with Rounded Corners**  
(Applicable to all specifications listed in 2.2 except B 694)

Thickness, in.	Radius of Corners, in.	
	Min	Max
Up to 0.125, incl <sup>A</sup>	...	...
Over 0.125 to 0.188, incl	0.016	0.048
Over 0.188 to 1, incl	0.031	0.094
Over 1 to 2, incl	0.063	0.188

<sup>A</sup>Not available.



NOTE—The arc of the rounded edge shall be substantially symmetrical with the axis of the product. The corners “A” will usually be sharp but shall not have rough or projecting edges.

FIG. 2 Rounded Edge

**TABLE 16 Tolerances for Radius of Rolled or Drawn Rounded Edges**  
(Applicable to all specifications listed in 2.2 except B 694)

Thickness, in.	Radius of Edges <sup>A</sup>	
	Min	Max
Up to 0.188, incl	$\frac{3}{4} t$	$1\frac{3}{4} t$
Over 0.188	$1 t$	$1\frac{1}{2} t$

<sup>A</sup>The  $t$  refers to the measured thickness of the test specimen.

acceptable. It shall be well cleaned and free of dirt. A superficial film of residual light lubricant is normally present and is acceptable unless otherwise specified.

6.2 The surface finish and appearance shall be the normal commercial quality for the alloy, thickness, and temper ordered. When application information is provided with purchase order, the surface shall be that commercially producible for the application. Superficial films of discoloration, or lubricants, or tarnish inhibitors are permissible unless otherwise specified.

## 7. Sampling

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

7.1.1 *Lot Size*—An inspection lot shall be 10 000 lb or less material of the same mill form, alloy, temper, and nominal dimensions, subject to inspection at one time or shall be the product of one cast bar from a single melt charge, whose weight shall not exceed 25 000 lb that has been continuously processed and subject to inspection at one time.

7.1.2 *Portion Size*—A portion shall be four or more pieces selected as to be representative of each lot. If the lot consists of less than four pieces, representative samples shall be taken from each piece.





**Full Rounded Edge**

NOTE—The arc of the rounded edge shall not necessarily be tangent at points “A” but shall be substantially symmetrical with the axis of the product, and the product shall be commercially free from sharp, rough, or projecting edges.

**FIG. 3 Full Rounded Edge**

**TABLE 17 Tolerances for Radius of Rolled or Drawn Full-Rounded Edges**

(Applicable to all specifications listed in 2.2 except B 694)

Thickness, in.	Radius of Edges <sup>A</sup>	
	Min	Max
All thicknesses	$\frac{1}{2} t$	$\frac{3}{4} t$

<sup>A</sup>The *t* refers to the thickness of the test specimen.

**TABLE 18 Lot Weight Tolerances for Hot-Rolled Sheet and Plate**

(Applicable to Specifications B 36/B 36M, B 96/B 96M (Copper Alloy UNS Nos. C65500 and C65800), B 103/B 103M, B 122/B 122M, B 152/B 152M, and B 591)

Thickness, in.	Weight Tolerances, Plus and Minus, Percentage of Theoretical Weight				
	48 in. and Under in Width	Over 48 to 60 in., incl. in Width	Over 60 to 72 in., incl. in Width	Over 72 to 90 in., incl. in Width	Over 90 to 110 in., incl. in Width
$\frac{1}{8}$ and under	8	9.5	11	12.5	14
Over $\frac{1}{8}$ to $\frac{3}{16}$ , incl	6.5	8	9.5	11	12.5
Over $\frac{3}{16}$ to $\frac{1}{4}$ , incl	6	7.5	8.5	9	10
Over $\frac{1}{4}$ to $\frac{5}{16}$ , incl	5.5	7	8	8.5	9
Over $\frac{5}{16}$ to $\frac{3}{8}$ , incl	5	6	7	7.5	8
Over $\frac{3}{8}$ to $\frac{7}{16}$ , incl	4.5	5	6	7	7.5
Over $\frac{7}{16}$ to $\frac{1}{2}$ , incl	4	4.5	5.5	6	6.5
Over $\frac{1}{2}$ to $\frac{5}{8}$ , incl	3.5	4.5	5	5.5	6
Over $\frac{5}{8}$ to $\frac{3}{4}$ , incl	3	4	4.5	5	5.5
Over $\frac{3}{4}$ to 1, incl	2.75	3.5	4	4.5	5
Over 1 to $1\frac{1}{2}$ , incl	2.5	3	3.5	4	4.5
Over $1\frac{1}{2}$ to 2, incl	2.25	2.75	3.25	3.75	4.25

7.1.2.1 *Chemical Analysis*—The sample for chemical analysis shall be taken in accordance with Practice E 255 for product in its final form. Unless otherwise required by the purchaser, at the time the order is placed, the manufacturer shall have the option of determining conformance to chemical composition by analyzing samples taken at the time the castings are poured or samples taken from the semifinished product if heat identity can be maintained throughout all operations. If the manufacturer determines the chemical composition during manufacture, he shall not be required to sample and analyze the finished product. The minimum weight of the composite sample in accordance with Practice E 255 that is to be divided into three equal parts shall be as follows:

ASTM Designation	Weight of Sample, min, g
B 36/B 36M, B 96/B 96M, B 121/B 121M, B 122/B 122M, B 152/B 152M, B 169/B 169M, B 194, B 291, B 422, B 465, B 534, B 591, B 592, and B 740	150
B 103/B 103M	225

7.1.2.2 *Samples for All Other Tests* —Samples for all other tests shall be taken from the sample portion in 7.1.2 and be of a convenient size to accommodate the test and comply with the requirements of the appropriate ASTM Product Standards and Test Methods.

**8. Number of Tests and Retests**

8.1 *Chemical Requirements:*

8.1.1 When samples are taken at the time the castings are poured, at least one sample shall be analyzed for each group of castings poured simultaneously from the same source of molten metal.

8.1.2 When samples are taken from the semifinished or finished product, at least one sample representative of the product of each cast bar from a single melt charge continuously processed with heat identity maintained shall be analyzed.

8.1.3 When samples are taken from the semifinished or finished product and heat identity has not been maintained, a single sample representative of each 10 000 lb lot, or fraction thereof, shall be analyzed. When the product piece is greater than 10 000 lb, one sample to be representative of the product piece shall be analyzed.

8.2 *Mechanical and Electrical Requirements and Grain Size*—Unless otherwise provided in the product specification, test specimens shall be taken from two of the sample pieces selected in accordance with 7.1.2. The required tests shall be made on each of the specimens so selected. In the case of copper alloy Specifications B 194, B 534, and B 740 two specimens shall be taken from each of two sample pieces selected in accordance with 7.1.2. One specimen from each sample piece shall be tested without further treatment, and the other specimen shall be tested after precipitation hardening. In the case of the requirements in Table 4, Mill Hardened Tempers, in Specifications B 194 and B 740, only two specimens need to be taken and tested, because the product is in the precipitation hardened temper as supplied. The reported value shall be the arithmetic average of the readings. In the case of hardness, three readings shall be taken and averaged for each sample.

8.3 *Retests:*

8.3.1 If the chemical analysis of the specimens prepared from samples selected in accordance with 7.1.2 fails to conform to the specified limits, analysis shall be made on a new composite sample prepared from the pieces selected in accordance with 7.1.2.

8.3.2 If one of the two tests made to determine any of the mechanical or physical properties fails to meet a specified limit, this test shall be repeated on the remaining pieces, maximum of two, selected in accordance with 7.1.2, and the results of both of these tests shall comply with the specified requirements.

8.3.3 If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

8.3.4 If the percentage of elongation of any tension test specimen is less than that specified and any part of the fracture is outside the middle two thirds of the gage length or in a punched or scribed mark within the reduced section, a retest shall be allowed.

8.3.5 If a bend test specimen fails because of conditions of bending more severe than required by the specification, a retest shall be permitted, either on a duplicate specimen or on a remaining portion of the failed specimen.

8.3.6 After removal of defective specimens and correction of test methods, only one retest cycle is permitted. If after the retest the material fails to meet the requirements of this specification, it shall be rejected.

## 9. Specimen Preparation

9.1 *Chemical Analysis*—A composite sample of the semifinished or finished product shall be prepared in accordance with Practice E 255, or as described in 7.1.2.1.

9.2 Specimens shall be prepared in accordance with the method prescribed in 10.3 for all other tests. Full cross-section specimens shall be used whenever possible. Samples shall be representative of the condition of the material, and particular specimen preparation techniques shall be stated in the specific product specification.

## 10. Test Methods

10.1 The test method used for routine chemical analysis for specification compliance and preparation of certifications and test reports, when required, shall be at the discretion of the reporting laboratory.

10.1.1 Commonly accepted technique for routine chemical analysis of copper and copper alloys include, but are not limited to, X-ray fluorescence spectroscopy, atomic absorption spectrophotometry, argon plasma spectroscopy, and emission spectroscopy.

10.2 In case of disagreement concerning chemical composition, an applicable test method for chemical analysis may be found in Test Methods E 53, E 54, E 62, E 75, E 106, E 118, E 121, or E 478.

10.2.1 The specific test method(s) to be used will be stated in the particular product specification.

10.2.2 In case of disagreement concerning sulfur content, the test method described in the Annex shall be used.

10.3 The following test methods shall be used for determining the mechanical and physical properties required in the specifications listed in Section 1:

Tension	E 8
Grain size	E 112
Rockwell hardness	E 18
Electrical resistivity	B 193

10.3.1 The testing procedure used for a particular property is dependent upon alloy, temper, and configuration of the product. The manufacturer shall have the option of selecting the most representative procedure unless a specific procedure is specified at the time the contract is placed.

## 11. Significance of Numerical Limits

11.1 For the purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Practice E 29.

Property	Rounded Unit for Observed or Calculated Value
----------	--

Chemical composition	nearest unit in the last
Hardness	right-hand signifi-
Electrical resistivity	cant digit used in express-
Electrical conductivity	ing the limiting value
Tensile strength	nearest ksi (5 MPa)
Yield strength	nearest ksi (5 MPa)
Elongation:	nearest 1 %
Grain size:	
Under 0.060 mm	nearest multiple of 0.005 mm
0.060 mm and over	nearest 0.01 mm

## 12. Inspection

12.1 The manufacturer or supplier shall inspect and make tests necessary to verify that the product furnished conforms to the requirements specified.

12.2 Source inspection of the material by the purchaser may be agreed upon between the manufacturer or supplier and the purchaser as part of the purchase contract. In this case, the nature of the facilities needed to satisfy the inspector representing the purchaser that the product is being furnished in accordance with this specification shall be included in the agreement. All tests and the inspection shall be conducted so as not to interfere unnecessarily with the operation of the works.

12.3 The manufacturer or supplier and the purchaser, by mutual agreement, may accomplish the final inspection simultaneously.

## 13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the manufacturer or supplier may make claim for a rehearing.

## 14. Certification

14.1 When specified in the purchase order or contract, a manufacturer's certificate of compliance shall be furnished to the purchaser stating that each lot has been sampled, tested, and inspected in accordance with this specification and that the requirements have been met.

## 15. Mill Test Report

15.1 When specified in the purchase order or contract, the manufacturer or supplier shall furnish to the purchaser a manufacturer's test report showing the results of the required tests.

## 16. Packaging and Package Marking

16.1 The material shall be separated by size, composition, and temper and prepared for shipment in such a manner as to ensure acceptance by common carrier for transportation and to afford protection from the normal hazards of transportation.

16.2 Each shipping unit shall be legibly marked with the purchase order number, metal or alloy designation, temper, size, shape, gross and net weight, and name of supplier. The specification number shall be shown when specified.

16.3 *Product Identification*—For *ASME Boiler and Pressure Vessel Code* applications, the name or trademark of the manufacturer and the manufacturer's lot identification number shall be legibly stamped or stenciled on each finishing plate and sheet in two places not less than 12 in. from the edge. If the plate and sheet are too small to locate the markings as such, the marking may be placed near the center of the plate and sheet. In the case of butt straps, the markings may be placed 12 in. from the end. The plate number and type shall be legibly stamped on each plate and on each test specimen.

## 17. Keywords

17.1 general requirements, plate; general requirements, sheet; general requirements, strip; general requirements, rolled bar; general requirements, wrought copper and copper alloys

## SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order, for agencies of the U.S. government.

### S1. Referenced Documents

S1.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

S1.1.1 *Federal Standards*:<sup>11</sup>

Fed. Std. No. 102 Preservation, Packaging and Packing Levels

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

Fed. Std. No. 185 Identification Marking of Copper and Copper-Base Alloy Mill Products

S1.1.2 *Military Standard*:<sup>11</sup>

MIL-STD-129 Marking for Shipment and Storage

S1.1.3 *Military Specification*:<sup>11</sup>

MIL-C-3993 Packaging of Copper and Copper-Base Alloy Mill Products

### S2. Quality Assurance

S2.1 *Responsibility for Inspection*:

S2.1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections or tests set forth when such inspections and tests are deemed necessary to assure that the material conforms to prescribed requirements.

### S3. Identification Marking

S3.1 All material shall be properly marked for identification in accordance with Fed. Std. No. 185 except that the ASTM specification number and the alloy number shall be used.

### S4. Preparation for Delivery

S4.1 *Preservation, Packaging, Packing*:

S4.1.1 *Military Agencies*—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, Level A or C, packed, Level A, B, or C, as specified in the contract or purchase order, in accordance with the requirements of MIL-C-3993.

S4.1.2 *Civil Agencies*—The requirements of Fed. Std. No. 102 shall be referenced for definitions of the various levels of packaging protection.

S4.2 *Marking*:

S4.2.1 *Military Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with MIL-STD-129.

S4.2.2 *Civil Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

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<sup>11</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

**(Mandatory Information)****A1. TEST METHOD FOR SULFUR BY COMBUSTION AND INFRARED DETECTOR****A1.1 Scope**

A1.1.1 This test method covers the determination of sulfur in electrolytic cathode copper.

A1.1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

**A1.2 Summary of Test Method**

A1.2.1 The sulfur is converted to sulfur dioxide (SO<sub>2</sub>) by combustion in a stream of oxygen and the SO<sub>2</sub> is measured by infrared absorption.

A1.2.2 This test method is written for use with commercial analyzers equipped to carry out the above operations automatically.

**A1.3 Interferences**

A1.3.1 The elements ordinarily present do not interfere.

**A1.4 Apparatus**

A1.4.1 *Combustion and Analyzing Instrumentation*, capable of making the required measurements.

**A1.5 Reagents and Materials**

A1.5.1 *Reagents:*

A1.5.1.1 *Accelerator*—Use the accelerator recommended by the instrument manufacturer which, for copper, should be sulfur and tin free.

A1.5.1.2 *Oxygen*—Ultra high purity, 99.95 % min. Other grades of oxygen may be used if sulfur free, or the oxygen may be purified as described in Practices E 50.

A1.5.2 *Materials:*

A1.5.2.1 *Crucibles*—Use crucibles recommended by the manufacturer, or equivalent.

A1.5.2.2 *Crucible Tongs*—Use tongs capable of handling recommended crucibles.

**A1.6 Hazards**

A1.6.1 For precautions to be observed in the use of certain reagents in this test method, refer to Practice E 50.

A1.6.2 Use care when handling hot crucibles and operating the furnace to avoid burns and electrical shock.

**A1.7 Preparation of Apparatus**

A1.7.1 Assemble and test the apparatus according to the manufacturer's instructions.

**A1.8 Sample Preparation**

A1.8.1 The sample should be uniform in size but not finer than 40 mesh.

**A1.9 Calibration**

A1.9.1 *Calibration Reference Materials*—Select a minimum of two reference materials with sulfur content near the mid point and high limit.

A1.9.2 *Instrument Calibration*—Calibrate according to the manufacturer's instructions.

**A1.10 Procedure**

A1.10.1 Stabilize the furnace and analyzer according to the manufacturer's instruction.

A1.10.2 Transfer the weight of sample recommended by the manufacturer into a crucible and add the same amount of accelerator used in the calibration. Proceed as directed by the manufacturer's instructions.

**A1.11 Calculation**

A1.11.1 Since most commercially available instruments calculate percent concentrations directly, including corrections for blank and sample weight, calculations by the analyst are not required.

A1.11.2 If the analyzer does not compensate for blank and sample weight values, use the following equation:

$$\text{Sulfur, \%} = \frac{(A - B) \times C}{D}$$

where:

- A* = Digital voltmeter (DVM) reading for specimen,
- B* = DVM reading for blank,
- C* = weight compensator setting, and
- D* = specimen weight, g.

#### **A1.12 Precision and Bias**

A1.12.1 *Precision*—The precision of this test method is dependent upon sample preparation care and preciseness of calibration.

A1.12.2 *Bias*—The accuracy of this test method is dependent to a large extent upon the accuracy of the methods used to determine the sulfur concentration in the calibration standards as well as their homogeneity.

## **APPENDIXES**

(Nonmandatory Information)

### **X1. PREFERRED THICKNESSES FOR UNCOATED WROUGHT COPPER AND COPPER ALLOY PLATE, SHEET, STRIP AND ROLLED BAR, UNDER 0.250 IN.**

X1.1 It is recommended that wherever possible material purchased to these specifications be ordered in thicknesses listed as follows:

in.	in.	in.	in.
0.004	0.014	0.040	0.112
0.005	0.016	0.045	0.125
0.006	0.018	0.050	0.140
0.007	0.020	0.056	0.160
0.008	0.022	0.063	0.180
0.009	0.025	0.071	0.200
0.010	0.028	0.080	0.224
0.011	0.032	0.090	
0.012	0.036	0.100	

## X2. STANDARD DENSITIES

X2.1 For purposes of calculating weights, cross sections, and so forth, the densities of the copper alloys covered by the specifications listed in the Scope Section shall be taken as follows:

ASTM Designation	Material	Copper Alloy UNS No.	Density, lb/in. <sup>3</sup>		
B 36/B 36M	copper-zinc alloy (brass)	C21000	0.320		
		C22000	0.318		
		C23000	0.316		
		C24000	0.313		
		C26000	0.308		
		C26800	0.306		
		C27200	0.305		
B 96/B 96M	copper-silicon alloy	C65100	0.316		
		C65500	0.308		
		C65800	0.308		
B 103/B 103M	copper-tin alloy (phosphor bronze)	C51000	0.320		
		C51100	0.320		
		C52100	0.318		
		C52400	0.317		
		C53200	0.323		
		C53400	0.322		
		C54400	0.320		
B 121/B 121M	copper-zinc-lead alloy (leaded brass)	C33500	0.306		
		C34000	0.306		
		C34200	0.307		
		C35000	0.305		
		C35300	0.306		
		C35340	0.306		
		C35600	0.307		
B 122/B 122M	copper-nickel-zinc alloy (nickel silver and copper-nickel alloy)	C70600	0.323		
		C71000	0.323		
		C71500	0.323		
		C72200	0.323		
		C72500	0.321		
		C73500	0.319		
		C74000	0.314		
		C74500	0.313		
		C75200	0.316		
		C76200	0.310		
		C77000	0.314		
		B 152/B 152M	Copper UNS Nos. C10100, C10200, C10300, C10400, C10500, C10700, C10800, C12000, C12200, C12300, C14530, C11000, C11300, C11400, C11600, C12500, C14200	...	0.323
				...	0.322
B 169/B 169M	copper-aluminum alloy (aluminum bronze)	C60600	0.295		
		C61000	0.281		
		C61300	0.285		
		C61400	0.285		

B 194	copper-beryllium alloy	C17000	0.297		
		C17200	0.297		
B 291	copper-zinc-manganese alloy	C66700	0.308		
B 422	copper-nickel-silicon	C63800	0.299		
		C70250	0.318		
		C70260	0.320		
		C72400	0.311		
		C19200	0.320		
		C19400	0.322		
		C19500	0.322		
B 465	copper-iron alloy	C19600	0.320		
		C19700	0.319		
		C17500	0.316		
		C17510	0.317		
B 534	copper-cobalt-beryllium alloy	C17510	0.317		
B 591	copper-nickel-beryllium alloy copper-zinc-tin alloys	C40500	0.319		
		C40800	0.320		
		C41100	0.318		
		C41300	0.318		
		C41500	0.318		
		C42200	0.318		
		C42500	0.316		
		C43000	0.316		
		C43400	0.316		
		B 592	copper-zinc-aluminum-cobalt alloy copper-aluminum-nickel alloy	C68800	0.296
				C69000	0.296
B 740	copper-nickel-tin alloys			C72700	0.321
		C72900	0.323		
		C72650	0.320		

## SUMMARY OF CHANGES

This section identifies the principal changes to this specification that have been incorporated since the 1998 issue as follows.

(I) Table 1—Section 11 was revised.

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