



Designation: B 248 – 01

Standard Specification for General Requirements for Wrought Copper and Copper- Alloy Plate, Sheet, Strip, and Rolled Bar¹

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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

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, B 465, B 534, B 591, B 592, B 694, B 740, B 747, and B 768.²

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 Bar³
- B 96/B 96M Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels³
- B 103/B 103M Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar³
- B 121/B 121M Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar³
- 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 Bar³

- B 152/B 152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar³
- B 169/B 169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar³
- B 193 Test Method for Resistivity of Electrical Conductor Materials⁴
- B 194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar³
- B 291 Specification for Copper-Zinc-Manganese Alloy (Manganese Brass) Sheet and Strip⁵
- 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 Strip³
- B 465 Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar³
- B 534 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar³
- B 591 Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar³
- B 592 Specification for Copper-Zinc-Aluminum-Cobalt Alloy, Copper-Zinc-Tin-Iron Alloy Plate, Sheet, Strip, and Rolled Bar³
- 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 Shielding³
- B 740 Specification for Copper-Nickel-Tin Spinodal Alloy Strip³
- B 747 Specification for Copper-Zirconium Alloy Sheet and Strip³
- B 768 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Strip and Sheet³
- E 8 Test Methods for Tension Testing of Metallic Materials⁶
- E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁶
- E 29 Practice for Using Significant Digits in Test Data to

¹ 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.

Current edition approved May 10, 2001. Published September 2001. Originally published as B 248 – 51 T. Last previous edition B 248 – 98.

² 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.

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ *Annual Book of ASTM Standards*, Vol 02.03.

⁵ Discontinued. See 1992 *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.01.

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

- Determine Conformance with Specifications⁷
- E 50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials⁸
 - E 53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry⁸
 - E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes⁸
 - E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁸
 - E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)⁸
 - E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys⁸
 - E 106 Test Methods for Chemical Analysis of Copper-Beryllium Alloys⁸
 - E 112 Test Methods for Determining the Average Grain Size⁶
 - E 118 Test Methods for Chemical Analysis of Copper-Chromium Alloys⁸
 - E 121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys⁸
 - E 478 Test Methods for Chemical Analysis of Copper Alloys⁹
 - E 527 Practice for Numbering Metals and Alloys (UNS)¹⁰

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

⁷ Annual Book of ASTM Standards, Vol 14.02.

⁸ Annual Book of ASTM Standards, Vol 03.05.

⁹ Annual Book of ASTM Standards, Vol 03.06.

¹⁰ Annual Book of ASTM Standards, Vol 01.01.

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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.

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):

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.

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.

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

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, ^A 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 | | | | | Plate | | | | |
| 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 | |

^AWhen tolerances are specified as all plus or all minus, double the values given.

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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, ^A 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 | | | | | Plate | | | | | | | | |
|--|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|-------------------------|-------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|-------------------------|-------------------------|
| | Over 0.188 to 0.205, incl | Over 0.205 to 0.300, incl | Over 0.300 to 0.500, incl | Over 0.500 to 0.750, incl | Over 0.750 to 1.00, incl | Over 1.00 to 1.50, incl | Over 1.50 to 2.00, incl | Over 0.188 to 0.205, incl | Over 0.205 to 0.300, incl | Over 0.300 to 0.500, incl | Over 0.500 to 0.750, incl | Over 0.750 to 1.00, incl | Over 1.00 to 1.50, incl | Over 1.50 to 2.00, incl |
| | 0.0045 | 0.005 | 0.005 | 0.006 | 0.010 | 0.010 | 0.010 | 0.012 | 0.014 | 0.016 | 0.016 | 0.018 | 0.023 | 0.029 |
| | 0.005 | 0.006 | 0.006 | 0.007 | 0.012 | 0.012 | 0.012 | 0.014 | 0.016 | 0.018 | 0.023 | 0.030 | 0.037 | 0.045 |
| | 0.006 | 0.007 | 0.007 | 0.008 | 0.015 | 0.015 | 0.017 | 0.019 | 0.021 | 0.024 | 0.029 | 0.037 | 0.045 | 0.055 |
| | 0.008 | 0.010 | 0.010 | 0.012 | 0.019 | 0.019 | 0.021 | 0.024 | 0.026 | 0.030 | 0.037 | 0.045 | 0.055 | 0.065 |
| | 0.010 | 0.012 | 0.012 | 0.015 | 0.023 | 0.023 | 0.026 | 0.030 | 0.033 | 0.037 | 0.045 | 0.055 | 0.065 | 0.075 |
| | 0.028 | 0.028 | 0.028 | 0.028 | 0.028 | 0.028 | 0.032 | 0.037 | 0.045 | 0.055 | 0.065 | 0.075 | 0.085 | 0.100 |
| | 0.033 | 0.033 | 0.033 | 0.033 | 0.033 | 0.033 | 0.038 | 0.045 | 0.055 | 0.065 | 0.075 | 0.085 | 0.100 | 0.110 |

^AWhen tolerances are specified as all plus or all minus, double the values given.

TABLE 3 Special Thickness Tolerances

| Thickness, in. | Tolerances Applicable to Copper Alloy UNS No. C72500, Specification B 122/B 122M and B 740 Tolerances, Plus and Minus, ^A in., for Strip 8 in. and Under in Width | Tolerances Applicable to Specifications B 194, B 534, and B 768 Tolerances, Plus and Minus, ^A in., for Strip 4 in. and Under in Width |
|---------------------------|---|--|
| | 0.004 and under | 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 | ... |

^AIf 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, ^A Plus and Minus, in. | | | |
|---------------------|--|---|---|---|
| | For Thicknesses 0.004 to 0.032 in. | | For Thicknesses Over 0.032 to 0.125 in. | |
| | For Thicknesses 0.004 to 0.032 in. | For Thicknesses Over 0.032 to 0.125 in. | For Thicknesses Over 0.125 to 0.188 in. | For 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 |

^AIf tolerances are specified as all plus or all minus, double the values given.

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

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, ^A 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 | 1/16 |
| Over 20 to 36, incl | 3/64 | 3/64 | 1/16 |
| Over 36 to 120, incl | 1/16 | 1/16 | 1/16 |

^AIf 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, ^A 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 |

^AIf tolerances are specified as all plus or all minus, double the values given.

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

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 ^A |

^AAs stock lengths are cut and placed in stock in advance of orders, departure from the tolerance is not practicable.

are 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.

7.1.2.1 *Chemical Analysis*—The sample for chemical analysis shall be taken in accordance with Practice E 55 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 55 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

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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, ^A Plus and Minus, in. | | |
|----------------------|--|--|------------------------------|
| | For Thicknesses Up to 1/16 in., incl | For Thicknesses Over 1/16 to 1/8 in., incl | For Thicknesses Over 1/8 in. |
| 20 and under | 1/32 | 3/64 | 1/16 |
| Over 20 to 36, incl | 3/64 | 3/64 | 1/16 |
| Over 36 to 120, incl | 1/16 | 1/16 | 1/16 |

^AIf 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 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 | 1/4 |

TABLE 11 Straightness Tolerances for Slit Metal or Slit Metal Either Straightened or Edge-Rolled

(Applicable to all specifications listed in 2.2)

| Width, in. | Straightness Tolerance, in. | | |
|-----------------------|---|--|-------------------------------------|
| | Maximum Edgewise Curvature (Depth of Arc) in any 72-in. Portion of the Total Length | | |
| | As Slit Only | As Slit and Either Straightened or Edge Rolled | |
| | Shipped in Rolls | Shipped Flat | Shipped Flat, in Rolls, or on Bucks |
| Over 1/4 to 3/8, incl | 2 | 1 1/2 | 1/2 |
| Over 3/8 to 1/2, incl | 1 1/2 | 1 | 1/2 |
| Over 1/2 to 1, incl | 1 | 3/4 | 1/2 |
| Over 1 to 2, incl | 5/8 | 5/8 | 3/8 |
| Over 2 to 4, incl | 1/2 | 1/2 | 3/8 |
| Over 4 | 3/8 | 3/8 | 3/8 |

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 semi-finished or finished product shall be prepared in accordance with Practice E 55, or as described in 7.1.2.1.

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)

| Thickness, in. | Straightness Tolerances, in. | |
|------------------------|------------------------------|-----------------------|
| | Up to 10 in., incl, in Width | Over 10 in., in Width |
| 1/8 and under | 1/16 | 1/32 |
| Over 1/8 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)

| Width, in. | Straightness Tolerances, in. | |
|-------------|---|--|
| | Maximum Edgewise Curvature (Depth of Arc) in any 72-in. Portion of the Total Length | |
| 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 |

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.