



Designation: B 100 – 03a

## Standard Specification for Wrought Copper-Alloy Bearing and Expansion Plates and Sheets for Bridge and Other Structural Use<sup>1</sup>

This standard is issued under the fixed designation B 100; 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.

### 1. Scope\*

1.1 This specification establishes the requirements for wrought copper-alloy bearing plate and bearing sheets for application in bridges and other structures. Specifically, the plates and sheets are to be used for fixed or expansion bearings where the motion is slow and intermittent with pressures not exceeding 3 ksi (20 MPa).

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

### 2. Referenced Documents

#### 2.1 *ASTM Standards:*

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

- B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet Strip, and Rolled Bar<sup>2</sup>
- B 846 Terminology for Copper and Copper Alloys<sup>2</sup>
- E 8 Test Methods for Tension Testing of Metallic Materials<sup>3</sup>
- E 9 Compression Testing of Metallic Materials at Room Temperature<sup>3</sup>
- E 10 Test Method for Brinell Hardness of Metallic Materials<sup>3</sup>
- E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials<sup>3</sup>
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>4</sup>
- E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes<sup>5</sup>
- E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric)<sup>6</sup>
- E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition<sup>6</sup>
- E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>6</sup>

### 3. General Requirements

3.1 The following sections of Specification B 248 constitute a part of this specification:

- 3.1.1 Terminology,
- 3.1.2 Workmanship, Finish, and Appearance,
- 3.1.3 Sampling,
- 3.1.4 Number of Tests and Retests,
- 3.1.5 Specimen Preparation,
- 3.1.6 Test Methods,
- 3.1.7 Significance of Numerical Limits,
- 3.1.8 Inspection,
- 3.1.9 Rejection and Rehearing,
- 3.1.10 Certification,
- 3.1.11 Test Reports,
- 3.1.12 Packaging and Package Marking, and
- 3.1.13 Supplementary Requirements.

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 appears in this specification, it contains additional requirements that supplement those appearing in Specification B 248.

### 4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

### 5. Ordering Information

5.1 Orders for product to this specification should include the following information:

- 5.1.1 ASTM specification designation and year of issue,
- 5.1.2 Copper Alloy UNS No. designation (for example, C51000),
- 5.1.3 Dimensions: length, width, thickness (Section 11 and Table 1),
- 5.1.4 Quantity or weight for each size,
- 5.1.5 Temper (Section 7, 8),

5.1.6 When product produced of Copper Alloy UNS No. C61300 is to be used in applications requiring welding (Table 2, footnote A), and

5.1.7 When product is purchased for agencies of the U.S. government (Section 10).

5.2 The following options are available under this specification and should be specified in the contract or purchase order when required:

- 5.2.1 Heat identification or traceability (Section 6.1.2),
- 5.2.2 Certification (Specification B 248), and
- 5.2.3 Test Report (Specification B 248).

### 6. Material and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture shall be cast bar, slab, cake, billets, and so forth of Copper Alloy UNS No. C51000, C51100, C61300, C61400, or C65500 of such purity and soundness as to be suitable for processing into the products prescribed herein.

<sup>2</sup> Annual Book of ASTM Standards, Vol 02.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 14.02.

<sup>5</sup> Discontinued; See 2001 Annual Book of ASTM Standards, Vol 03.05.

<sup>6</sup> Annual Book of ASTM Standards, Vol 03.05.

**TABLE 1 Thickness and Weight Tolerances**

Ordered Weight lb/ft <sup>2</sup> (kg/m <sup>2</sup> ) <sup>A</sup>	Weight Tolerance,%		Ordered Thickness, in. (mm)	Thickness Tolerance, %	
	Over	Under		Over	Under
Plates and Sheets 20 in. (508 mm) and Under in Width					
5.0 to 7.5 (24.4 to 36.6), excl	4.5	3.5	Under 1/8 (3.18)	9	0
7.5 to 10.0 (36.6 to 48.8), excl	4	3	1/8 to 3/16 (3.18 to 4.76), excl	8	0
10.0 to 12.5 (48.8 to 61.0), excl	4	2.5	3/16 to 1/4 (4.76 to 6.35), excl	7	0
12.5 to 15.0 (61.0 to 73.2), excl	3.5	2.5	1/4 to 5/16 (6.35 to 7.94), excl	6	0
15.0 to 17.5 (73.2 to 85.4), excl	2.5	2.5	5/16 to 3/8 (7.94 to 9.52), excl	5	0
17.5 to 20.0 (85.4 to 97.6), excl	2.5	2.0	3/8 to 7/16 (9.52 to 11.1), excl	4.5	0
20 (97.6) or over	2.5	2.0	7/16 to 1/2 (11.1 to 12.7), excl	4 <sup>B</sup>	0
			1/2 to 5/8 (12.7 to 15.9), excl	3.5 <sup>B</sup>	0
			5/8 to 3/4 (15.9 to 19.0), excl	3 <sup>B</sup>	0
			3/4 to 1 (19.0 to 25.4), excl	2.5 <sup>B</sup>	0
			1 (25.4) or over	2.5 <sup>B</sup>	0
Plates and Sheets Over 20 in. (508 mm) in Width					
All weights	5.0	5.0	All thicknesses	10.0	0

<sup>A</sup> For purposes of calculating weights, cross section, etc., the density of rolled phosphor bronze (Copper Alloy UNS Nos. C51000 and C51100) shall be taken as 0.320 lb/in.<sup>3</sup>(8.86 g/cm<sup>3</sup>) and the density of rolled copper silicon alloy (Copper Alloy UNS No. C65500) as 0.308 lb/in.<sup>3</sup> (8.53 g/cm<sup>3</sup>).

<sup>B</sup> These "Over" thickness tolerances apply to plates and sheets 10 in. (254 mm) and under in width. For plates and sheets over 10 to 20 in. (254 to 508 mm), incl. in width the "Over" thickness tolerances shall be as follows:

Ordered Thickness, in. (mm).....	Thickness Tolerance, Over, %
7/16 to 5/8 (11.1 to 15.9), excl.....	4.5
5/8 to 3/4 (15.9 to 19.0), excl.....	4.0
3/4 (19.0) or over.....	3.5

**TABLE 2 Chemical Requirements**

Element	Composition %				
	C51000	C51100	C61300	C61400	C65500
Copper (incl Silver)	remainder	remainder	remainder	remainder	remainder
Phosphorus	0.03–0.35	0.03–0.35	0.015 max.	0.015 max.	...
Tin	4.2–5.8	3.5–4.9	0.20–0.50	...	...
Silicon	...	...	0.10 max.	...	2.8–3.8
Aluminum	...	...	6.0–7.5	6.0–8.0	...
Iron	0.10 max.	0.10 max.	2.0–3.0	1.5–3.5	0.8 max.
Manganese	...	...	0.20 max.	1.0 max.	0.5–1.3
Zinc, max.	0.30	0.30	0.10	0.20	1.5 max.
Lead, max.	0.05	0.05	0.01	0.01	0.05
Nickel, max.	...	...	0.15	...	0.6
Nickel, max.	...	...	0.15 <sup>A</sup>	...	0.6 <sup>A</sup>
Other named elements	...	...	A	...	...
Other named elements	...	...	B	...	...

<sup>A</sup> Ni value includes Co.

<sup>B</sup> When the product is for subsequent welding applications and is so specified by the purchaser, chromium, cadmium, zirconium, and zinc shall each be 0.05 % max.

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

### 6.2 Manufacture:

6.2.1 The product shall be manufactured by hot or cold working and annealing processes as deemed necessary in order to produce a uniform wrought structure in the finished product.

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

## 7. Chemical Composition

7.1 The material shall conform to the chemical requirements prescribed in Table 2 for the Copper Alloy UNS No. designation specified in the contract or purchase order.

7.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be established and determination required by agreement between the manufacturer or supplier and the purchaser.

7.3 Copper, given as the remainder, may be taken as the difference between the sum of results of all elements analyzed and 100 %.

7.4 When all elements listed in Table 2 for the specified Copper Alloy UNS No. designation are determined, the sum of results shall be 99.5 % min except for C61300 which shall be 99.8 %.

## 8. Temper

8.1 The temper of product furnished to this specification, and as defined in Practice B 601, shall be as follows:

UNS Alloy No.  
 C51000  
 C51100  
 C65500  
 C61300  
 C61400

Temper  
 H03 (¾ hard)  
 H03 (¾ hard)  
 H01 (¼ hard)  
 M20 (as hot rolled) or 061 (annealed)  
 M20 (as hot rolled) or 061 (annealed)

## 9. Mechanical Property Requirements

9.1 Product in final form shall conform to the requirements of Table 3.

9.1.1 Product in plate form less than ¾ in. (20 mm) in thickness and product in sheet form shall conform to the tensile requirements when tested in accordance with Test Method E 8.

9.1.2 Product in plate form ¾ in. (20 mm) or over in thickness shall conform to either tensile or compression requirements when tested in accordance with Test Method E 8 or Test Method E 9 respectively.

9.1.2.1 In case of dispute, Test Method E 8 shall govern.

9.1.3 The properties of product over 18 in. (460 mm) in width and over ¾ in. (20 mm) in thickness shall be subject to agreement between the manufacturer and the purchaser.

## 10. Purchases for U.S. Governmental Agencies

10.1 When identified in the contract or purchase order, product purchased for agencies of the U.S. government shall conform to the requirements stipulated in the Supplemental Requirements section of Specification B 248.

## 11. Dimensions, Mass and Permissible Variations

11.1 For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimensions may be cause for rejection.

11.2 The thickness of the plates and sheets may be specified by weight per square foot (metre) or in common or decimal fractions of an inch (millimetre). The plates and sheets shall conform to the requirements prescribed in Table 1 as to tolerances in weight and thickness.

11.3 Length tolerances for square sheared metal in all widths 120 in. (3048 mm) and under shall be ± 1/16 in. (1.56 mm). When tolerances are specified as all plus or all minus, double the values given.

11.4 Length tolerances for sawed metal for all widths up to and including 120 in. (3048 mm) shall be ± 1/4 in. (6.35 mm). When tolerances are specified as all plus or all minus, double the values given.

11.5 Width tolerances for square sheared metal or sawed metal for widths up to and including 120 in. (3048 mm) for all thicknesses shall be ± 1/16 in. (1.56 mm). When tolerances are specified as all plus or all minus, double the values given.

## 12. Sampling

12.1 *Other Tests:*

12.1.1 Samples used for the preparation of tensile test specimen shall be taken so that the longitudinal axis of such specimen is parallel to the direction of rolling.

## 13. Number of Tests and Retests

13.1 *Tests:*

13.1.1 *Chemical Analysis*—Chemical composition shall be determined as the average of at least two replicate determinations of each specified element.

13.1.2 *Other Tests*—Tensile, compression and hardness test results shall be reported as the average of results obtained from at least two sample portions selected and each specimen must meet the requirements of this specification.

13.2 *Retests:*

13.2.1 When requested by the manufacturer or supplier, a retest shall be permitted should test results obtained by the purchaser fail to conform with specification requirements.

**TABLE 3 Mechanical Requirements**

Tension	
Tensile strength, min, ksi <sup>A</sup> (MPa <sup>B</sup> )	60 (415)
Elongation in 2 in. (50.8 mm), min, %	10
Compression	
Yield strength (0.1 % offset) min, ksi <sup>A</sup> (MPa <sup>B</sup> )	25 (170)
Permanent set under 100 ksi <sup>A</sup> (690 MPa <sup>B</sup> )%	6–20
Hardness	
Plates ¼ in. (6.35 mm) and over in thickness, Brinell, min	130 HB
Plates under ¼ in. (6.35 mm) in thickness, Rockwell, min	75 HRB

<sup>A</sup> ksi = 1000 psi.

<sup>B</sup> See Appendix.

13.2.2 Retesting shall be as directed in the product specification for the initial test(s), except that the number of test specimens shall be twice that normally required for the test.

13.2.3 Test results for all specimens shall conform to the product specification requirements in retest and failure to conform shall be cause for lot rejection.

## 14. Specimen Preparation

### 14.1 Chemical Composition:

14.1.1 Preparation of the test specimen for chemical analysis shall be the responsibility of the reporting laboratory.

14.1.2 In case of dispute, the sample preparation shall be in accordance with Practice E 255.

### 14.2 Tensile:

14.2.1 The test specimens shall be prepared in accordance with Test Method E 8, Figs. 7 or 8. The longitudinal axis of the specimen shall be parallel to the direction of rolling.

### 14.3 Compression:

14.3.1 The specimen shall be 1 in.<sup>2</sup> (645 mm<sup>2</sup>) in cross-sectional area and the height shall be the thickness of the plate from which the sample is taken.

### 14.4 Hardness:

14.4.1 The test specimen shall be of a size and shape to permit testing by available test equipment and shall be taken to permit testing in a plane parallel or perpendicular to the direction of deformation given to the product.

14.4.2 The surface of the test specimen shall be sufficiently smooth and even to permit the accurate determination of hardness.

14.4.3 The test specimen shall be free from scale and foreign matter and care shall be taken to avoid any change in condition, for example, heating or cold working.

## 15. Test Methods

### 15.1 Chemical Analysis:

15.1.1 Chemical composition shall be determined, in case of disagreement, by the following appropriate method:

Element	Test Method
Aluminum	E 478
Copper	E 478
Iron (0.003 to 1.25 %)	E 478
Iron (1.0 to 5.0 %)	E 54
Lead	E 478 (AA)
Manganese	E 62
Nickel	E 478 (Photometric)
Phosphorus	E 62
Silicon	E 54 (Sulfuric acid)
Tin	E 478
Zinc	E 478 (AA)

15.1.2 Test method(s) for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and the purchaser.

15.2 The product furnished shall conform to the mechanical property requirements enumerated in this specification when tested in accordance with the following appropriate method:

Test	Test Method
Tensile	E 8
Compression	E 9
Rockwell Hardness	E 18
Brinell Hardness	E 10

15.2.1 Tensile requirements shall be determined from full size specimens when practical. Whenever results are obtained from full size and machined specimens and they differ, the results of the full size specimen shall be used.

15.2.1.1 Although a considerable range of testing speed is permitted, the rate of stressing to yield strength should not exceed 100 ksi/min (690 MPa/min). Above the yield strength, the movement per minute of the testing machine head under load should not exceed 0.5 in./in. (0.5 mm/mm) of gage length (or distance between grips for full section specimens).

15.2.1.2 Elongation shall be determined as specified in the first two subsections of the section "Elongation" of Test Method E 8.

15.2.2 Yield strength for compression requirements shall be determined by successive application and releases of the load until 0.1 % offset is determined.

## 16. Rejection and Rehearing

16.1 *Rejection*—Refer to Specification B 248.

### 16.2 Rehearing:

16.2.1 When notified of product rejection, the manufacturer, or supplier, may make claim for a retest to be conducted by the manufacturer, or supplier, and the purchaser.

16.2.2 Samples of the rejected product shall be taken in accordance with the product specification and tested by both parties following the test method(s) specified in the product specification, or alternatively, upon agreement of both parties, an independent

laboratory may be selected to perform the testing following the specified test methods.

## 17. Keywords

17.1 bearing plates; bearing sheets; bridges; copper-alloy plates; copper-alloy sheets; expansion bearing plates; expansion bearing sheets; structures; UNS No. C51000; UNS No. C51100; UNS No. C61300; UNS No. C61400; UNS No. C65500

## APPENDIX

### (Nonmandatory Information)

#### X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ( $N = \text{kg}\cdot\text{m}/\text{s}^2$ ). The derived SI unit for pressure or stress is the newton per square metre ( $\text{N}/\text{m}^2$ ), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since  $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$  the metric equivalents are expressed as megapascal (MPa), which is the same as  $\text{MN}/\text{m}^2$  and  $\text{N}/\text{mm}^2$ .

#### SUMMARY OF CHANGES

Committee B05 has identified the location of selected change to this standard since the last issue (B 100 – 9703) that may impact the use of this standard (approved ~~Apr. 10,~~ Oct. 1, 2003).

(1) Added footnote “Ni value includes Co.” to Table 2, Chemical Requirements.

Committee B05 has identified the location of selected change to this standard since the last issue (B 100 – 97) that may impact the use of this standard (approved Apr. 10, 2003).

(1) Corrected typographical error in Table 3, Chemical Requirements, for phosphorous in Alloys C61400 and C61300 to correct UNS value of 0.015 %.

(2) Added Sections 3 and 4 and renumbered remaining sections.

(3) Clarified footnote “A” of Table 3 to reflect CDA UNS limits.

(4) Adjusted informational SI values in sections 11.3, 11.4, 11.5, and 15.2.1.1 to reflect the same accuracy as the inch-pound units.

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