



# Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction<sup>1</sup>

This standard is issued under the fixed designation B 101; 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 establishes the requirements for lead-coated copper sheet and strip in flat lengths (or in coils) in ounce-weight thicknesses for roofing, flashing, gutters, downspouts, and for the general sheet metalwork in building construction. The lead coating is applied by hot dipping.

1.2 Materials made to this specification are not intended for electrical applications.

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

NOTE 1—A companion specification for copper sheet and strip for building construction is Specification B 370.

1.4 The following hazard caveat pertains to the test method portion, Section 17, of this specification. *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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

B 370 Specification for Copper Sheet and Strip for Building Construction

B 601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B 846 Terminology for Copper and Copper Alloys

E 8 Test Methods for Tension Testing of Metallic Materials

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 37 Test Methods for Chemical Analysis of Pig Lead

E 46 Test Methods for Chemical Analysis of Lead- and Tin-Base Solders<sup>3</sup>

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)

E 112 Test Methods for Determining Average Grain Size

E 478 Test Methods for Chemical Analysis of Copper Alloys

## 3. Terminology

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

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *coil*—a length of the product wound into a series of connected turns.

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

3.2.2 *lead-coated copper sheet (for building construction)*, *n*—a rolled flat product over 24 in. (610 mm) in width and of ounce-weight thickness from 8 oz (227 g) to 48 oz (1361 g).

3.2.3 *lead-coated strip (for building construction)*, *n*—a rolled flat product up to and including 24 in. (610 mm) in width and of ounce-weight thickness from 8 oz (227 g) to 48 oz (1361 g).

3.2.4 *lengths, mill, n*—straight lengths, including ends, that are conveniently manufactured in the mills.

3.2.4.1 *Discussion*—Full length pieces are usually 8, 10, or 12 ft (2.44, 3.05, or 3.66 m) and subject to established length tolerances.

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

3.2.6 *ounce-weight*—the weight of uncoated copper sheet or strip expressed in ounces per square foot.

<sup>3</sup> Discontinued

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

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.7 *thickness, ounce-weight, n*—the metal thickness that corresponds to the ounce weight.

#### 4. General Requirements

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

- 4.1.1 Significance of numerical limits,
- 4.1.2 Inspection,
- 4.1.3 Rejection and rehearing,
- 4.1.4 Certification,
- 4.1.5 Mill test reports, and
- 4.1.6 Packaging and package marking.

4.2 In addition, when a section with a title identical to that referenced in **4.1**, above, appears in this specification, it contains additional requirements that supplement those appearing in Specification **B 248**.

#### 5. Ordering Information

5.1 Include the following information when placing orders for product under this specification, as applicable:

- 5.1.1 ASTM designation and year of issue.
- 5.1.2 Temper (Section **8** and **Table 1**),
- 5.1.3 How furnished: flat lengths or in coils,
- 5.1.4 Quantity: total weight or sheets of each size,
- 5.1.5 Ounce-weight or ounce-weight thickness of the uncoated copper sheet or strip (**Table 2**),
- 5.1.6 Dimensions: width and length (Section **12**),
- 5.1.7 Certification, where required (see **5.1.4**),
- 5.1.8 Mill test report, where required (see **5.1.5**), and
- 5.1.9 If the material being purchased is intended for use by agencies of the U.S. government, refer to Section **11**.
- 5.1.10 Other variations in coating or texture shall be furnished by agreement in writing between the purchaser and the manufacturer or supplier.

#### 6. Materials and Manufacture

6.1 *Materials:*

6.1.1 The lead coating shall conform to the chemical requirements of **Table 3**.

6.1.2 The copper sheet or strip to be lead coated shall be manufactured by any process that provides a finished product that conforms to the requirements of Specification **B 370**.

6.2 *Manufacture:*

6.2.1 The lead coating shall be applied to the copper sheet or strip by hot dipping in a bath of molten lead.

6.2.2 Unless otherwise specified, the lead coating shall be applied to the copper sheet or strip after slitting and cutting to the specified length.

**TABLE 2 Sheet Weights**

| Nominal Weights and Thickness of Bare Copper Sheets |                                                | Minimum Weight of Lead-Coated Copper Sheet |
|-----------------------------------------------------|------------------------------------------------|--------------------------------------------|
| Ounce-Weight, oz/ft <sup>2</sup>                    | Ounce-Weight Thickness <sup>A</sup> , in. (mm) | oz/ft <sup>2</sup> (g/m <sup>2</sup> )     |
| 24                                                  | 0.0323 (0.820)                                 | 25.0 (7625)                                |
| 20                                                  | 0.0270 (0.686)                                 | 21.2 (6466)                                |
| 16                                                  | 0.0216 (0.549)                                 | 17.3 (5276)                                |
| 12                                                  | 0.0162 (0.411)                                 | 13.2 (4026)                                |

<sup>A</sup>Based upon a density of 0.322 lb/in.<sup>3</sup> (8.91 g/cm<sup>3</sup>).

**TABLE 3 Chemical Requirements for Lead Used to Coat Copper Sheet**

| Element               | Composition, % (Maximum unless shown as range or remainder) |
|-----------------------|-------------------------------------------------------------|
| Silver                | 0.02                                                        |
| Copper                | 0.08                                                        |
| Arsenic plus antimony | 0.10                                                        |
| Zinc                  | 0.005                                                       |
| Iron                  | 0.01                                                        |
| Bismuth               | 0.08                                                        |
| Lead                  | remainder                                                   |
| Tin                   | 3.0-4.0                                                     |
| Phosphorus            | 0.03                                                        |

#### 7. Chemical Composition

7.1 The copper sheet or strip shall have a minimum copper, including silver, content of 99.5 %.

7.2 Any copper that complies with **7.1** shall be acceptable.

7.3 If limits for unnamed elements are required, they shall be established and analysis required by agreement between manufacturer or supplier and purchaser.

7.4 The lead coating shall conform to the chemical requirements of **Table 3**.

#### 8. Temper

8.1 Uncoated copper sheet and strip covered by this specification is commercially available in the following tempers, as defined by Classification **B 601**: O60 (soft annealed); H00 (eight hard, cold-rolled); and H01 (quarter hard), cold-rolled high yield) (see **Table 1**).

#### 9. Physical Property Requirements

9.1 Although no minimum grain size is specified for soft-temper material, it shall be fully recrystallized.

#### 10. Mechanical Property Requirements

10.1 *Tensile Strength Requirements:*

**TABLE 1 Mechanical Properties of Uncoated Sheet**

| Temper Designation |                          | Tensile Strength, ksi <sup>A</sup> (MPa) |          | Yield Strength, at<br>0.5 % Extension<br>Under Load, min,<br>ksi (MPa) | Approximate Rockwell Hardness <sup>B</sup><br>(for Information Only) |     |                  |     |
|--------------------|--------------------------|------------------------------------------|----------|------------------------------------------------------------------------|----------------------------------------------------------------------|-----|------------------|-----|
| Standard           | Former                   | Min                                      | Max      |                                                                        | F Scale                                                              |     | Superficial 30 T |     |
|                    |                          |                                          |          |                                                                        | Min                                                                  | Max | Min              | Max |
| O60                | soft                     | 30 (210)                                 | 38 (265) | ...                                                                    | ...                                                                  | 65  | ...              | 31  |
| H00                | cold-rolled              | 32 (225)                                 | 40 (280) | 20 (140)                                                               | 54                                                                   | 82  | 15               | 49  |
| H01                | cold-rolled (high yield) | 34 (240)                                 | 42 (295) | 28 (195)                                                               | 60                                                                   | 84  | 18               | 51  |

<sup>A</sup> ksi = 100 psi.

<sup>B</sup> Rockwell hardness values apply as follows: The F scale applies to metal 0.020 in. (0.508 mm) and over in thickness; the superficial 30T scale applies to metal 0.012 in. (0.305 mm) to 0.020 in. (0.508 mm) in thickness.

10.1.1 The uncoated product furnished under this specification shall conform to the tensile requirements prescribed in **Table 1** when tested in accordance with Test Methods **E 8**. Tension test specimens shall be taken so that the longitudinal axis of such specimens is parallel to the direction of rolling.

#### 10.2 Rockwell Hardness:

10.2.1 The approximate Rockwell hardness values given in **Table 1** are for general information and assistance in testing and shall not be used as a basis for product rejection.

NOTE 2—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper and tensile strength.

### 11. Purchases for the U.S. Government

11.1 When specified in the contractor purchase order, product purchased for an agency of the U.S. government shall conform to the special government requirements specified in the Supplementary Requirements section of Specification **B 248**.

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

12.1 *Weight*—The weight of the lead-coated sheet and strip copper shall conform to the minimum requirements of **Table 2**.

12.2 *Width*—The tolerances for width of sheets shall be as shown in **Table 4**.

12.3 *Length*—Sheets ordered to exact lengths shall be permitted to have a variation of +¼ in. (+6.5 mm) in length.

12.4 *Straightness*—The tolerances on straightness or edge-wise curvature (depth of arc) in any 72-in. (2-m) portion of the total length shall be as specified in **Table 5** for slit metal and **Table 6** for square-sheared metal.

### 13. Workmanship, Finish and Appearance

#### 13.1 Lead Coating:

13.1.1 The lead coating shall cover both surfaces, edges, and ends.

13.1.2 The coating shall be smooth and free from pinholes, voids, or unwetted areas, but blemishes of a nature that do not interfere with the intended application are acceptable.

13.1.3 The weight of the lead coating shall conform to the requirements of **Table 7**.

### 14. Sampling

14.1 Refer to Specification **B 248** for chemical and mechanical properties.

#### 14.2 Weight of Coating Tests:

14.2.1 *Method A*—Test ten sheets selected at random.

14.2.2 *Methods B and C*—Test four representative samples cut from the diagonal of one sheet selected at random.

### 15. Number of Tests and Retests

#### 15.1 Tests:

**TABLE 4 Width Tolerances**

| Width, in. (mm)             | Tolerances, in. (mm) |
|-----------------------------|----------------------|
| 5 (125) and under           | +0.025 (0.6) – 0     |
| Over 5 – 14 (125–355), incl | +0.050 (1.2) – 0     |
| Over 14 (355)               | +0.125 (3.2) – 0     |

**TABLE 5 Straightness Tolerances for Slit Metal**

| Width, in. (mm)                 | Straightness Tolerance, in. (mm) |
|---------------------------------|----------------------------------|
| Over 4 to 24 (102 to 610), incl | ½ (13)                           |

**TABLE 6 Straightness Tolerances for Square-Sheared Metal**

NOTE 1—Maximum edgewise curvature (depth of arc) in any 72-in. (1.83-m) portion of the total length (not applicable to metal over 120 in. (3.05 m) in length).

|                 | Straightness Tolerances, in. (mm)    |                               |
|-----------------|--------------------------------------|-------------------------------|
|                 | Up to 10 in. (254 mm) incl. in Width | Over 10 in. (254 mm) in Width |
| All thicknesses | ⅛ (1.6)                              | ⅜ (9.5)                       |

**TABLE 7 Weight of Lead Coating, lb (kg)<sup>A</sup>**

| Min      | Max      |
|----------|----------|
| 12 (5.4) | 15 (6.8) |

<sup>A</sup> The weight of coating specified is the total weight of lead applied to two sides of 100 ft<sup>2</sup> (9.3 m<sup>2</sup>) of copper sheet, approximately one half of the coating to be on each side of the sheet.

15.1.1 Refer to the section of Specification **B 248** for chemical and mechanical tests.

15.1.2 A test on each specimen taken in **14.2.1** or **14.2.2**, as applicable, shall be made for the determination of lead.

#### 15.2 Retests:

15.2.1 When a specimen fails to meet the requirements of a test, one retest shall be made under the conditions of the original test.

15.2.2 All specimens must conform to test requirements when retested or the material may be rejected.

### 16. Specimen Preparation

16.1 Refer to Specification **B 248** for the chemical and mechanical property test specimen preparation.

#### 16.2 Weight of Coating Tests:

16.2.1 Refer to **17.4.1** of this specification for Method A.

16.2.2 Refer to **17.4.2** of this specification for Method B.

16.2.3 Refer to **17.4.3** of this specification for Method C.

### 17. Test Methods

#### 17.1 Chemical Analysis:

17.1.1 In case of disagreement, determine the composition using the following methods:

| Element     | Range, %        | Test Method   |
|-------------|-----------------|---------------|
| Copper      | 99.0 min        | <b>E 478</b>  |
|             | 0.001 to 0.1    | <b>E 37</b>   |
| Lead        | 95.0 to 100     | by difference |
|             | 0.001 to 0.02   | <b>E 37</b>   |
| Tin         | 1 to 4          | <b>E 46</b>   |
|             | 0.001 to 0.03   | <b>E 37</b>   |
| Silver      | 0.0005 to 0.02  | <b>E 37</b>   |
| Arsenic     | 0.001 to 0.03   | <b>E 37</b>   |
| Antimony    | 0.001 to 0.005  | <b>E 37</b>   |
| Zinc        | 0.0005 to 0.005 | <b>E 37</b>   |
| Iron        | 0.002 to 0.2    | <b>E 37</b>   |
| Bismuth     | 0.001 to 0.03   | <b>E 62</b>   |
| Phosphorous |                 |               |

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



17.2 *Grain Recrystallization*—Recrystallization shall be determined in accordance with Test Methods E 112.

17.3 *Mechanical Requirements:*

17.3.1 *Tensile Strength*—Tensile strength shall be determined in accordance with Test Methods E 8.

17.3.2 *Yield Strength*—Yield strength shall be determined at 0.5 % extension-underload of Test Methods E 8.

17.3.3 Test results are not seriously affected by variations in speed or testing. A considerable range of testing speed is permitted; however, the rate of stressing to the yield strength should not exceed 100 ksi/min. Above the yield strength, the movement per minute of the testing machine head under load should not exceed 0.5 in./in. of gage length (or distance between grips for full-section specimens).

17.4 *Weight of Coating Test*—When testing is specified, the determination of the lead coating shall be made in accordance with one of the three following methods:

17.4.1 *Method A*—Select at random ten sheets from those being coated. Weigh these ten sheets before and after coating and calculate the weight of the coating from the difference in weight on the basis of the ordered size.

17.4.2 *Method B*—Select at random one sheet from the lead-coated sheets furnished. Cut four representative samples 2¼ by 2¼ in. (60 by 60 mm) from each sheet, uniformly spaced along a diagonal, the end samples being taken not less than 1 in. (25 mm) from the edge. Weigh and then completely dissolve the four samples of sheet obtained. Determine the copper by electrolytic assay in accordance with Test Method E 478. Calculate the weight of the lead coating as the difference between the total weight of the samples and the weight of copper found.

17.4.3 *Method C*—Select at random one sheet from the lead-coated sheets furnished. Cut four representative samples 2¼ by 2¼ in. (60 by 60 mm) from the sheet, uniformly spaced along a diagonal, the end samples being taken not less than 1 in. (25 mm) from the edge. After removing the burrs, clean each sample and rinse with alcohol and ether. Obtain the weight of the specimens and the weight of the coating from

measurements taken of the specific gravity or density of these samples as determined by the usual method of weighing in air and in water.

17.4.4 Calculations are as follows:

$$\text{Weight of lead coating, lb/100 ft}^2 = (29.1 - 259/D)W \quad (1)$$

$$\text{Weight of bare copper sheet, oz/ft}^2 = (41.5/D - 3.66)W \quad (2)$$

where:

$W$  = weight of the sample in air, g;

$D$  = density of the sample =  $(W \times D_t)/(W - M)$ ;

$D_t$  = density of water at room temperature; and

$M$  = weight of the sample in water, g.

NOTE 3—To convert lb/100 ft<sup>2</sup> to kg/m<sup>2</sup>, multiply by 0.0488. To convert oz/ft<sup>2</sup> to kg/m<sup>2</sup>, multiply by 0.305.

17.4.5 In case of dispute, the weight of the coating shall be determined by Method B.

## 18. Significance of Numerical Limits

18.1 For the purpose of determining compliance with the specified limits for requirements of the properties listed in the following table and for dimensional tolerances, 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 Right-Hand Significant Digit Used in Expressing the Limiting Value |
| Hardness                                          | Digit Used in Expressing the Limiting Value                                                 |
| Tensile Strength                                  | Nearest ksi                                                                                 |
| Yield Strength                                    |                                                                                             |
| Grain Size                                        |                                                                                             |
| Under 0.060 mm                                    | Nearest multiple of 0.005 mm                                                                |
| 0.060 mm and over                                 | Nearest 0.01 mm                                                                             |
| Coating Weight in accordance with 100 square feet | Nearest Pound                                                                               |

## 19. Keywords

19.1 building construction; downspouts; flashing; lead-coated copper sheet and strip; roofing; sheet metal-sheet strip in flat lengths/coils for building construction

## SUPPLEMENTARY REQUIREMENTS

Refer to the section on Supplementary Requirements in Specification B 248.



## 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 that, 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 megapascals (MPa), which is the same as  $\text{MN}/\text{m}^2$  and  $\text{M}/\text{mm}^2$ .

## SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B 101 – 02) that may impact the use of this standard. (Approved Oct. 1, 2007)

- (1) Minor editing to conform to the B05 Electronic Template and *Outline of Form*.
- (2) Minimum weights in **Table 2** increased to reflect tighter current tolerances in **B 370**.
- (3) In **Table 3** “max” adjusted to reflect that tin % is a range and lead % is a remainder.

- (4) Word “uniformly” has been deleted as sheet must be fully covered with lead coating but the vagueness of the term “uniformly” has caused confusion in the past. The weight of the coating must conform to sections **13.1.3** and **17.4**.
- (5) Added Section **18** on Significance of Numeric Limits.

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