



Designation: B 101 – 96

# 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 reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

## 1. Scope

1.1 This specification establishes the requirements for lead-coated rolled 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 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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

### 2.2 ASTM Standards:

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip and Rolled Bar<sup>2</sup>

B 370 Specification for Copper Sheet and Strip for Building Construction<sup>2</sup>

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast<sup>2</sup>

E 37 Test Methods for Chemical Analysis of Pig Lead<sup>3</sup>

<sup>1</sup> This specification is under the jurisdiction of Committee B-5 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> Annual Book of ASTM Standards, Vol 02.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.05.

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

E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>3</sup>

## 3. Terminology

### 3.1 Definitions:

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

3.1.1.1 *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”.)

3.1.2 *lead-coated copper sheet (for building construction)*—a rolled flat product over 24 in. (610 mm) in width and of ounce-weight thickness from 8 (226.7) to 48 oz (1361 g), furnished in flat lengths of not over 10 ft (3.1 m).

3.1.3 *lead-coated strip (for building construction)*—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).

3.1.3.1 *Discussion*—Strip shall be furnished in flat lengths of not over 10 ft (3.1 m) or in rolls of one single continuous length of not less than 25 ft (7.6 m) wound into a cylindrical spiral.

3.1.4 *lengths*—straight pieces of the product.

3.1.4.1 *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.

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

3.1.4.3 *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.

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

3.1.4.5 *lengths, stock*—straight lengths that are mill cut and stored in advance of orders.

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

3.1.5 *ounce-weight*—the weight of uncoated copper sheet or

strip expressed in ounces per square foot.

3.1.6 *ounce-weight thickness*—the metal thickness that corresponds to the ounce weight.

**4. Ordering Information**

4.1 Orders for material under this specification shall include the following information:

- 4.1.1 Temper (Section 7 and Table 1),
- 4.1.2 How furnished: flat lengths or in coils (see 3.1.5 and 3.1.6),
- 4.1.3 Quantity: total weight or number of sheets of each size,
- 4.1.4 Ounce-weight or ounce-weight thickness of the uncoated copper sheet or strip (Table 2),
- 4.1.5 Dimensions: width and length (Section 9),
- 4.1.6 Certification, where required (Section 19),
- 4.1.7 Mill test report, where required (Section 20), and
- 4.1.8 ASTM designation and date of issue.

4.2 If the material being purchased is intended for use by agencies of the U.S. Government refer to 5.3.

**5. Materials and Manufacture**

5.1 *Materials:*

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

5.1.2 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.

5.2 *Manufacture:*

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

5.2.2 Unless otherwise specified, the lead coating shall be applied to the copper sheet or strip after slitting and cutting to the specified length. The coating shall be commercially acceptable in terms of thickness uniformity, freedom from pinholes, voids or unwetted areas.

5.2.3 The weight of the lead coating shall conform to the requirements of Table 2 except as may be specified in 5.2.4.

5.2.4 Other variations in coating or texture shall be furnished by agreement in writing between the purchaser and the manufacturer or supplier.

5.3 Materials purchased for agencies of the U.S. Government shall conform to the Supplementary Requirements of Specification B 248.

**6. Chemical Composition**

6.1 The copper sheet or strip shall have a minimum copper (including silver) content of 99.9 %.

**TABLE 2 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.

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

Element	Composition, max, %
Silver	0.020
Copper	0.08
Arsenic plus antimony	0.005 <sup>A</sup>
Zinc	0.002 <sup>A</sup>
Iron	0.002
Bismuth	0.050
Lead	remainder
Tin	4.0
Phosphorus	0.03

<sup>A</sup> Provision for 4 % of tin makes necessary provision for possible higher amounts of these elements than generally required for pig lead.

6.1.1 Any copper that complies with 6.1 shall be acceptable.

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

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

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

**7. Physical Properties**

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

**8. Mechanical Properties**

8.1 The materials shall conform to the requirements specified in Table 1 for the tempers listed.

8.2 *Tensile Strength*—The tension test shall be the standard test for all tempers, and acceptance or rejection shall depend on the tensile requirements specified in Table 1. Tension test specimens shall be taken so that the longitudinal axis of such specimens is parallel to the direction of rolling.

8.3 *Rockwell Hardness*—Since Rockwell hardness tests offer a quick and convenient method of checking the conformity of the material to the requirements for tensile strength, approximate Rockwell hardness values are given in Table 1 for general information and assistance in testing, but the values shall not

**TABLE 1 Mechanical Properties**

Temper Designation		Tensile Strength, ksi <sup>A</sup> (MPa)		Yield Strength, at 0.5 % Extension Under Load, min, ksi (MPa)	Approximate Rockwell Hardness <sup>B</sup> (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.

be used as a basis for rejection.

**9. Dimensions, Mass, and Permissible Variations**

9.1 *Weight*—The weight of the lead-coated sheet and strip copper shall conform to the minimum requirements of Table 4.

9.2 *Width*—The tolerances for width of sheets shall be as shown in Table 5.

9.3 *Length*—Sheets ordered to exact lengths shall be permitted to have a variation of +1/4 in. (+6.5 mm) in length.

9.4 *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 6 for slit metal and Table 7 for square-sheared metal.

**10. Workmanship, Finish and Appearance**

10.1 Refer to the section on Workmanship, Finish and Appearance in Specification B 248.

**11. General Requirements**

11.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 248, unless specifically stated otherwise in this specification.

**12. Sampling**

12.1 Refer to Specification B 248 for chemical and mechanical properties.

12.2 *Weight of Coating Tests:*

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

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

**13. Number of Tests and Retests**

13.1 *Tests:*

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

13.1.2 A test on each specimen taken in 12.2.1 or 12.2.2, as applicable, shall be made for the determination of lead.

13.2 *Retests:*

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

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

**14. Specimen Preparation**

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

**TABLE 4 Sheet Weights**

Nominal Weights and Thickness of Bare Copper Sheets		Minimum Weight of Lead-Coated Copper Sheet
Ounce-Weight, oz/ft <sup>2</sup> (g/m <sup>2</sup> )	Ounce-Weight Thickness, in. (mm)	oz/ft <sup>2</sup> (g/m <sup>2</sup> )
24 (7320)	0.0323 (0.820)	25.0 (7630)
20 (6100)	0.0270 (0.686)	21.2 (6470)
16 (4880)	0.0216 (0.549)	17.2 (5250)
12 (3660)	0.0162 (0.411)	13.3 (4060)

**TABLE 5 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 6 Straightness Tolerances for Slit Metal**

Width, in. (mm)	Straightness Tolerance, in. (mm)
Over 4 to 24 (102 to 610), incl	1/2(13)

**TABLE 7 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	1/16 (1.6)	1/32(0.8)

14.2 *Weight of Coating Tests:*

14.2.1 Refer to 15.3.1 of this specification for Method A.

14.2.2 Refer to 15.3.2 of this specification for Method B.

14.2.3 Refer to 15.3.3 of this specification for Method C.

**15. Test Methods**

15.1 Refer to the section of Specification B 248 for mechanical and physical property tests.

15.2 Chemical composition, in case of dispute, shall be determined as follows:

Element	Range, %	Test Method
Copper	99.0 min	E 478
	0.001 to 0.1	E 37
	95.0 to 100	By Difference
Lead	0.001 to 0.02	E 37
		E 46
Silver	0.001 to 0.03	E 37
		E 37
Arsenic	0.0005 to 0.02	E 37
Antimony	0.001 to 0.03	E 37
Zinc	0.001 to 0.005	E 37
Iron	0.0005 to 0.005	E 37
Bismuth	0.002 to 0.2	E 37

15.3 *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:

15.3.1 *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.

15.3.2 *Method B*—Select one sheet at random from the lead-coated sheets furnished. Cut four representative samples 2 1/4 by 2 1/4 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.

15.3.3 *Method C*—Select one sheet at random 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.

15.3.4 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 2—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.

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

## 16. Significance of Numerical Limits

16.1 Refer to the section on Significance of Numerical Limits in B 248.

## 17. Inspection

17.1 Refer to the section on Inspection in Specification B 248.

## 18. Rejection and Rehearing

18.1 Refer to the section on Rejection and Rehearing in Specification B 248.

## 19. Certification

19.1 Refer to the section on Certification in Specification B 248.

## 20. Mill Test Report

20.1 Refer to the section on Mill Test Report in Specification B 248.

## 21. Packaging and Package Marking

21.1 Refer to the section on Packaging and Package Marking in Specification B 248.

## 22. Keywords

22.1 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.

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