



Standard Specification for Copper Alloy Strip for Flexible Metal Hose¹

This standard is issued under the fixed designation B508; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification establishes the requirements for annealed copper-alloy strip for the manufacture of flexible metal hose produced from Copper Alloy UNS Nos. C41100 and C50500.

1.1.1 The nominal compositions are as follows:

Copper Alloy UNS No.	Copper	Zinc	Tin
C41100	91.0	8.5	0.5
C50500	98.7	...	1.3

1.2 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. Grain size is given in SI units.

1.3 The following precautionary statement pertains only to the test method portion, Section 13, 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*:²

[B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast](#)

[B846 Terminology for Copper and Copper Alloys](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

[E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\) \(Withdrawn 2010\)](#)³

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

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² 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 The last approved version of this historical standard is referenced on www.astm.org.

[E112 Test Methods for Determining Average Grain Size](#)
[E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition](#)
[E478 Test Methods for Chemical Analysis of Copper Alloys](#)

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms related to copper and copper alloys, refer to Terminology [B846](#).

4. Ordering Information

4.1 Include the following choices when placing orders for product under this specification, as applicable:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper Alloy UNS designation (see Section 1 and [Table 1](#)),

4.1.3 Temper (see [7.1](#) and [Table 2](#)),

4.1.4 Quantity, number of pieces or total weight of each alloy and size, and

4.1.5 *Dimensions*—Thickness and width; and length, if applicable (see [8.2](#) and [8.3](#)).

4.1.6 *How furnished*—Coils (inside and outside diameters), pounds per inch of width; stock or specific lengths, with or without ends;

4.1.7 *Packing*—Type of pallet, skid, or box: interleaving, banding, maximum weight, and so forth;

4.2 The following options are available but may not be included unless specified at the time of placing of the order when required:

4.2.1 Heat identification and traceability details;

4.2.2 Certification;

4.2.3 Mill Test Report;

4.2.4 Special surface condition requirements, if any (see [9.3](#)).

5. Materials and Manufacture

5.1 *Material*:

5.1.1 The material of manufacture shall be cast bar, slab, cake, billet, or so forth of Copper Alloy UNS No. C41100 or C50500 of such purity and soundness as to be suitable for processing into the products prescribed herein.

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

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

NOTE 1—Because of the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify specific casting analysis with a specific quantity of finished material.

5.2 Manufacture:

5.2.1 The product shall be manufactured by such hot-working, cold-working, and annealing processes as to produce a uniform wrought structure in the finished product.

5.2.2 The product shall be hot- or cold-worked to the finished size and subsequently annealed, if required, to meet the temper properties specified.

5.2.3 *Edges*—Slit edges shall be furnished unless otherwise specified in the contract or purchase order.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements in [Table 1](#) for the alloy specified in the ordering information.

6.2 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and purchaser, limits may be established and analysis required for unnamed elements.

6.3 For alloys in which zinc is listed as “remainder,” either copper or zinc may be taken as the difference of all other elements determined and 100 %.

6.4 When all elements in [Table 1](#) are determined, the sum of results for Copper Alloy UNS C41100 shall be 99.7 % minimum and 99.5 % minimum for Copper Alloy UNS C50500.

7. Grain Size of Annealed Tempers

7.1 The average grain size of each of two samples of annealed material, as determined on a longitudinal cross section, shall be within the limit prescribed of the four nominal grain sizes listed in [Table 2](#) when tested in accordance with ASTM Standard Test Method [E112](#).

7.2 In the case of thin-gage material 0.010 in. (0.25 mm) and under, there shall exist no less than six grains per stock thickness, averaged for five locations one thickness apart.

8. Dimensions, Mass, and Permissible Variations

8.1 *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.

8.2 *Thickness*—The standard method of specifying thickness shall be in decimal fractions of an inch. For material 0.021 in. (0.533 mm) and under in thickness, it is recommended that the nominal thickness be stated not closer than the nearest 0.0005 in. (0.013 mm). For example, specify 0.006 or 0.0065 in. (0.152 or 0.165 mm), but not 0.0063 in. (0.160 mm). For material over 0.021 (0.533 mm) in thickness, it is recommended that the nominal thickness be stated not closer than the nearest 0.001 in. (0.025 mm). For example, specify 0.128 or 0.129 in. (3.25 or 3.28 mm) but not 0.1285 in. (3.26 mm). A list

of preferred thickness is shown in [Appendix XI](#). The thickness tolerances shall be those shown in [Table 3](#).

8.3 *Width*—The width tolerances shall be those shown in [Table 4](#).

8.4 *Straightness*—The straightness tolerances shall be those shown in [Table 5](#).

9. Workmanship, Finish, and Appearance

9.1 The product shall be uniform in quality and soundness and free of internal and external defects. However, surface blemishes that do not interfere with the intended application are acceptable.

9.2 The product shall be well cleaned and free of dirt.

9.3 A superficial film or residual light lubricant shall be permissible, unless otherwise specified in the contract or purchase order.

10. Sampling

10.1 The lot size, portion size, and selection of pieces shall be as follows:

10.1.1 *Lot Size*—10 000 lb, (4550 kg), or less material of the same mill form, alloy, temper, and thickness, subject to inspection at one time.

10.1.2 *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.

10.2 *Chemical Analysis*—A sample for chemical analysis shall be taken and prepared in accordance with Practice [E255](#).

10.2.1 Instead of sampling in accordance with Practice [E255](#), the manufacturer shall have the option of determining conformance to chemical composition as follows: Conformance shall be determined by the manufacturer by analyzing samples taken at the time the castings are poured or samples taken from the semifinished product. If the manufacturer determined the chemical composition of the material during the course of manufacture, he shall not be required to sample and analyze the finished product. The number of samples taken for determination of chemical composition shall be as follows:

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

10.2.1.2 When samples are taken from the semifinished product, a sample shall be taken to represent each 10 000 lb (4550 kg) or fraction thereof, except that not more than one sample shall be required per piece.

10.3 *Grain Size*—Samples for grain size shall be taken from material in the finished condition. A sample shall be taken to represent each 10 000 lb (4550 kg) or fraction thereof, except that not more than one sample shall be required per piece.

11. Number of Tests and Retests

11.1 *Tests*:

11.1.1 Chemical composition shall be determined in accordance with the element mean of the results from at least two replicate analyses of the sample(s).

11.1.2 *Other Tests*—For other tests, test specimens shall be taken from two of the sample pieces selected in accordance with 10.1.2. The required tests shall be made on each of the specimens so selected.

11.2 Retests:

11.2.1 When requested by the manufacturer or supplier, a retest shall be permitted when the results of tests obtained by the purchaser fail to conform to the requirements of the product specification.

11.2.2 The retest 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.

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

12. Specimen Preparation

12.1 *Chemical Analysis*—Prepare a composite sample of the semifinished or finished product in accordance with Practice E255, or as described in 10.2. Preparation of the analytical specimen shall be the responsibility of the reporting laboratory.

12.2 Prepare specimens in accordance with the method prescribed in 13.2 for other tests. Use full cross-section specimens whenever possible. Samples shall be representative of the condition of the material, and state particular specimen preparation techniques in the specific product specification.

13. Test Methods

13.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer and purchaser. The following table is a list of published methods, some of which may no longer be viable, which along with others not listed, may be used subject to agreement.

Element	ASTM Test Method
Copper	E478
Tin	E478 (Photometric & Titrimetric)
Phosphorus	E62
Iron	E478
Lead	E478 (AA)
Zinc	E478 (AA & Titrimetric)

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

13.2 *Other Test*—The product furnished shall conform with the grain size requirements found in Table 2 when tested in accordance with the following test method:

Test	ASTM Test Method
Grain size	E112 (Heyn Intercept)

14. Significance of Numerical Limits

14.1 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Practice E29:

Property	% Rounded Unit for Observed or Calculated Value
Chemical composition	nearest unit in the last right hand place of figures of the specified limit
Grain size	nearest multiple of 0.005 mm

15. Inspection

15.1 The manufacturer, or supplier, shall inspect and make the tests necessary to verify the furnished product conforms to specification requirements.

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

15.3 When mutually agreed upon, the manufacturer, or supplier, and the purchaser may accomplish the final inspection simultaneously.

16. Rejection and Rehearing

16.1 Rejection:

16.1.1 Product that fails to conform to the specification requirements when inspected or tested by the purchaser, or purchaser's agent, are subject to rejection.

16.1.2 Rejection shall be reported to the manufacturer, or supplier, promptly. In addition, a written notification of rejection shall follow.

16.1.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer, or supplier, shall have the option to make claim for a rehearing.

16.2 *Rehearing*—As a result of product rejection, the manufacturer, or supplier, shall have the option to make claim for a retest to be conducted by the manufacturer, or supplier, and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and subjected to test by both parties using the test method(s) specified in the product specification, or alternately, upon agreement of both parties, an independent laboratory may be selected for the test(s) using the test method(s) specified in the product specification.

17. Certification

17.1 When specified in the contract or purchase order, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met.

18. Test Report

18.1 When specified in the contract or purchase order, a report of test results shall be furnished.

19. Packaging and Package Marking

19.1 *Packaging*—The product shall be separated by size, composition, and temper, and prepared for shipment in such a

manner as to ensure acceptance by common carrier for transportation and to afford protection from the normal hazards of transportation.

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

20. Keywords

20.1 copper alloy strip; flexible metal hose

TABLE 1 Chemical Requirements

Element	Composition, %	
	Copper Alloy UNS Nos.	
	C41100	C50500
Copper	89.0–92.0	remainder
Tin	0.30–0.7	1.0–1.7
Phosphorus	...	0.03–0.35
Iron, max	0.05	0.10
Lead, max	0.09	0.05
Zinc	remainder	0.30 max

TABLE 2 Grain Size Requirements

Temps Standard Designation ^A	Grain Size, mm		
	Nominal	Minimum	Maximum
OS050	0.050	0.035	0.090
OS035	0.035	0.025	0.050
OS025	0.025	0.015	0.035
OS015	0.015	^B	0.025

^A Standard designations defined in Classification B601.

^B Although no minimum grain size is required, this material must be fully recrystallized.

TABLE 3 Thickness Tolerances

Thickness, in. (mm)	Thickness Tolerances, plus and minus, ^A in.					
	Copper Alloy UNS No. C41100			Copper Alloy UNS No. C50500		
	8 in. and under in Width in. (mm)	Over 8 to 14 in., incl in Width in. (mm)	Over 14 to 20 in., incl in Width in. (mm)	8 in. and under in Width in. (mm)	Over 8 to 14 in., incl in Width in. (mm)	Over 14 to 20 in., incl in Width in. (mm)
0.004 (0.102) and under	0.0003 (0.008)	0.0006 (0.015)	...	0.0004 (0.010)	0.0008 (0.020)	...
Over 0.004 to 0.006 (0.102 to 0.152), incl	0.0004 (0.010)	0.0008 (0.020)	0.0013 (0.033)	0.0006 (0.015)	0.0010 (0.025)	0.0015 (0.038)
Over 0.006 to 0.009 (0.152 to 0.229), incl	0.0006 (0.015)	0.0010 (0.035)	0.0015 (0.038)	0.0008 (0.020)	0.0013 (0.033)	0.002 (0.051)
Over 0.009 to 0.013 (0.229 to 0.330), incl	0.0008 (0.020)	0.0013 (0.033)	0.0018 (0.046)	0.0010 (0.025)	0.0015 (0.038)	0.0025 (0.064)
Over 0.013 to 0.017 (0.330 to 0.432), incl	0.0010 (0.028)	0.0015 (0.038)	0.002 (0.051)	0.0013 (0.033)	0.002 (0.051)	0.0025 (0.064)
Over 0.017 to 0.021 (0.432 to 0.533), incl	0.0013 (0.033)	0.0018 (0.046)	0.002 (0.051)	0.0015 (0.038)	0.0025 (0.064)	0.003 (0.076)
Over 0.021 to 0.026 (0.533 to 0.660), incl	0.0015 (0.038)	0.002 (0.051)	0.0025 (0.064)	0.002 (0.051)	0.0025 (0.064)	0.003 (0.076)
Over 0.026 to 0.037 (0.660 to 0.940), incl	0.002 (0.051)	0.002 (0.051)	0.0025 (0.064)	0.0025 (0.064)	0.003 (0.076)	0.0035 (0.089)
Over 0.037 to 0.050 (0.940 to 1.270), incl	0.002 (0.051)	0.0025 (0.064)	0.003 (0.076)	0.003 (0.076)	0.0035 (0.089)	0.004 (0.102)
Over 0.050 to 0.073 (1.270 to 1.854), incl	0.0025 (0.064)	0.003 (0.076)	0.0035 (0.084)	0.0035 (0.089)	0.004 (0.102)	0.0045 (0.114)
Over 0.073 to 0.130 (1.854 to 3.302), incl	0.003 (0.076)	0.0035 (0.089)	0.004 (0.102)	0.004 (0.102)	0.0045 (0.114)	0.005 (0.127)
Over 0.130 to 0.188 (3.302 to 4.775), incl	0.0035 (0.089)	0.004 (0.102)	0.0045 (0.114)	0.0045 (0.114)	0.005 (0.127)	0.006 (0.152)

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

TABLE 4 Width Tolerances

Width, in. (mm)	Width Tolerances, ^A plus and minus, in. (mm)		
	For Thicknesses 0.004 (0.102 mm) to 0.032 in. (0.813 mm), incl	For Thicknesses Over 0.032 (0.813 mm) to 0.125 in. (3.18 mm), incl	For Thicknesses Over 0.125 (3.18 mm) to 0.188 in. (4.78 mm), incl
2 (50.8) under	0.005 (0.13)	0.010 (0.25)	0.012 (0.30)
Over 2 to 8 (50.8 to 203), incl	0.008 (0.20)	0.013 (0.33)	0.015 (0.38)
Over 8 to 20 (203 to 508), incl	1/64 (0.40)	1/64 (0.40)	1/64 (0.40)

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

TABLE 5 Straightness Tolerances for Silt Metal

NOTE 1—Maximum edgewise curvature (depth of arc) in any 72 in. (1.82 m) portion of the total length.

Width, in. (mm)	Straightness Tolerance, in. (mm)
Over 1/4 to 3/8 (6.35 to 9.53) incl	2 (51)
Over 3/8 to 1/2 (9.53 to 12.7) incl	1 1/2 (38)
Over 1/2 to 1 (12.7 to 25.4) incl	1 (25)
Over 1 to 2 (25.4 to 50.8) incl	5/8 (16)
Over 2 to 4 (50.8 to 102) incl	1/2 (13)
Over 4 (102)	3/8 (9.5)

APPENDIXES

(Nonmandatory Information)

X1. PREFERRED THICKNESS

X1.1 It is recommended that wherever possible, material purchased to this specification be ordered in thicknesses as listed in [Table X1.1](#).

TABLE X1.1 Preferred Thicknesses

NOTE 1—All values in inches (millimetres).

0.004 (0.102)	0.020 (0.508)	0.080 (2.03)
0.005 (0.127)	0.022 (0.559)	0.090 (2.29)
0.006 (0.152)	0.025 (0.635)	0.100 (2.54)
0.007 (0.178)	0.028 (0.711)	0.112 (2.84)
0.008 (0.203)	0.032 (0.813)	0.125 (3.18)
0.009 (0.229)	0.036 (0.914)	0.140 (3.56)
0.010 (0.254)	0.040 (1.02)	0.160 (4.06)
0.011 (0.279)	0.045 (1.14)	0.180 (4.57)
0.012 (0.305)	0.050 (1.27)	0.200 (5.08)
0.014 (0.356)	0.056 (1.42)	0.224 (6.29)
0.016 (0.406)	0.063 (1.60)	...
0.018 (0.457)	0.071 (1.80)	...

X2. STANDARD WEIGHT

X2.1 For information purposes, for estimating weights, cross sections, and so forth, the density of Copper Alloy UNS Nos. C41100 and C50500 are included in **Table X2.1**.

TABLE X2.1 Standard Weight

Copper Alloy UNS No.	Density, lb/in. ³ (g/cm)
C41100	0.318 (8.80)
C50500	0.321 (8.89)

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the B508 – 08 issue as follows:

(1) Editorial changes throughout to conform to Guide B950.

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