



Designation: **B591–15 B591 – 20**

Standard Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar¹

This standard is issued under the fixed designation B591; 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 ~~covers~~establishes the requirements for specified copper-zinc-tin alloys and copper-zinc-tin-iron-nickel alloys plate, sheet, strip, and rolled bar. The alloys and nominal compositions are as follows:

Copper Alloy UNS No.	Copper, %	Tin, %	Zinc, %	Phos., %%%	Iron, %	Nickel, %
C40500	95	1	4			
C40810	95.5	2.0	2.2	0.03	0.1	0.15
C40850	95.5	3.0	1.3	0.1	0.1	0.1
C40860	94.8	2.0	3	0.03	0.03	0.1
C41100	91	0.5	8.5			
C41300	91	1	8			
C41500	91	2	7			
C42200	87	1	12			
C42500	88	2	10			
C42520	89.8	2.0	8	0.1	0.1	0.1
C43000	85	2	13			
C43400	85	0.7	14.3			

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 which are provided for information only and are not considered standard.

1.2.1 *Exception*—Average grain size in Table 3 is stated in SI units.

1.3 The following safety hazard caveat pertains only to the test method(s) described in this specification:

1.3.1 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents in the current issue of the *Annual Book of ASTM Standards* form a part of this specification to the extent referenced herein:

2.1 *ASTM Standards*:²

B248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

¹ 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.

Current edition approved Feb. 15, 2015 April 1, 2020. Published March 2015 April 2020. Originally approved in 1973. Last previous edition approved in 2009 2015 as B591–09 B591–15. DOI: 10.1520/B0591-15-10.1520/B0591-20.

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.

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

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

E112 Test Methods for Determining Average Grain Size

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification **B248** constitute a part of this specification:

3.1.1 ~~Terminology—Definitions;~~ Terminology—Definitions;

3.1.2 ~~Workmanship, Finish, and Appearance;~~ Appearance;

3.1.3 ~~Sampling;~~ Sampling;

3.1.4 ~~Number of Tests and Retests;~~ Retests;

3.1.5 ~~Specimen Preparation;~~ Preparation;

3.1.6 ~~Test Methods—except for chemical analysis;~~ analysis;

3.1.7 ~~Significance of Numerical Limits;~~ Limits;

3.1.8 ~~Inspection;~~ Inspection;

3.1.9 ~~Rejection and Rehearing;~~ Rehearing;

3.1.10 ~~Certification;~~ Certification;

3.1.11 ~~Test Reports (Mill);~~ (Mill);

3.1.12 ~~Packaging and Package Marking;~~ Marking; and

3.1.13 ~~Supplementary Requirements.~~

3.2 In addition, when a section with a title identical to that referenced in 3.1 appears in this specification, it contains additional requirements, which supplement those appearing in Specification **B248**.

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

5. Ordering Information

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

5.1.1 ~~ASTM designation and year of issue (for example, B591—XX);~~ —XX);

5.1.2 ~~Copper [Alloy] UNS No. Designation (for example, C42500);~~ C42500);

5.1.3 ~~Temper (see Section 8);~~ ;

5.1.4 ~~Dimensions, that is, thickness, width, length, and so forth (see Section 12);~~ ;

5.1.5 ~~Form: plate, sheet, strip, or rolled bar;~~ bar;

5.1.6 ~~How furnished: coils, specific or stock lengths, with or without ends;~~ ends;

5.1.7 ~~Quantity: total weight each form, temper, and size;~~ size; and

5.1.8 ~~Intended application.~~

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

5.2.1 ~~Type of edge: slit, sheared, sawed, square corners, round corners, rounded edges, or full rounded edges;~~ edges;

5.2.2 ~~Width and straightness tolerances (see Section 12);~~ ;

5.2.3 ~~Heat Identification or traceability details (see 6.1.2);~~ ;

5.2.4 ~~Certification;~~ Certification; and

5.2.5 ~~Mill Test Report.~~

5.2.6 If product is purchased for agencies of the U.S. Government, see Section **11** of this specification and the Supplementary Requirements section of Specification **B248** for additional requirements, if specified.

6. Materials and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture shall be a form (cast bar, cake, or slab) of Copper Alloy UNS No. C40500, C40810, C40850, C40860, C41100, C41300, C41500, C42200, C42500, C42520, C43000, or C43400 of such purity and soundness as to be suitable for processing into products prescribed herein.

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

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

6.2 *Manufacture:*

³ The last approved version of this historical standard is referenced on www.astm.org.

6.2.1 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.

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

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

7. Chemical Composition

7.1 The material shall conform to the chemical compositional requirements specified in **Table 1** for the copper alloy UNS No. designation specified in the ordering information.

7.1.1 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.

7.2 For alloys in which zinc is listed as “remainder,” either copper or zinc may be taken as the difference between the sum of the results for all elements determined and 100 %. When all elements in **Table 1** are determined, the sum of the results shall be 99.7 % min.

8. Temper

8.1 The standard tempers for products described in this specification are given in **Table 2** and **Table 3**.

8.1.1 *Hot Rolled Temper (M20)*—*Hot Rolled Temper (M20)*.

8.1.2 *Cold Rolled Tempers H01 to H10*—Special tempers not listed in this specification are subject to agreement between the manufacturer and the purchaser.

8.1.3 *Annealed Tempers OS015 to OS035*—Special tempers not listed in this specification are subject to agreement between the manufacturer and the purchaser.

8.1.4 Temper designations are defined in Classification **B601**.

9. Grain Size for Annealed Tempers

9.1 Grain size shall be the standard requirement for all products in the annealed tempers.

9.2 Acceptance or rejection based upon grain size shall depend only on the average grain size of test specimen taken from each of two sampling portions and each specimen shall be within the limits prescribed in **Table 3** when determined in accordance with Test Methods **E112**.

9.3 Grain size shall be determined on a plane parallel to the flat surfaces of the product.

10. Mechanical Property Requirements

10.1 *Tensile Strength Requirements of Rolled Tempers*:

10.1.1 Product furnished under this specification shall conform to the tensile requirements prescribed in **Table 2** for the temper and UNS Alloy Number specified in the ordering information when tested in accordance with Test Methods **E8/E8M**.

10.1.2 Test specimens shall be taken so that the longitudinal axis is parallel to the direction of rolling.

10.1.3 Acceptance or rejection based upon mechanical properties shall depend only on tensile strength.

10.2 *Rockwell Hardness*—The approximate Rockwell values given in **Table 2** and **Table 4** are for general information and assistance in testing and shall not be used as a basis for rejection.

10.2.1 When performed, the hardness values shall be determined using Test Methods **E18**.

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

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, % max (Unless Shown as a Range)						
	Copper	Tin	Lead	Iron	Phosphorus	Nickel	Zinc
C40500	94.0-96.0	0.7-1.3	0.05	0.05	...	...	remainder
C40810	94.5-96.5	1.8-2.2	0.05	0.08-0.12	0.028-0.04	0.11-0.20	remainder
C40850	94.5-96.5	2.6-4.0	0.05	0.05-0.20	0.01-0.20	0.05-0.20	remainder
C40860	94.0-96.0	1.7-2.3	0.05	0.01-0.05	0.02-0.04	0.05-0.20	remainder
C41100	89.0-92.0	0.30-0.7	0.09	0.05	...	...	remainder
C41300	89.0-93.0	0.7-1.3	0.09	0.05	...	...	remainder
C41500	89.0-93.0	1.5-2.2	0.09	0.05	...	...	remainder
C42200	86.0-89.0	0.8-1.4	0.05	0.05	0.35	...	remainder
C42500	87.0-90.0	1.5-3.0	0.05	0.05	0.35	...	remainder
C42520	88.0-91.0	1.5-3.0	0.05	0.05-0.20	0.01-0.20	0.05-0.20	remainder
C43000	84.0-87.0	1.7-2.7	0.09	0.05	...	...	remainder
C43400	84.0-87.0	0.40-1.0	0.05	0.05	...	...	remainder