Designation: B 591 – 08

Standard Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar[1]

This standard is issued under the fixed designation B 591; 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 Department of Defense.

1. Scope*

1.1 This specification covers the requirements for specified copper-zinc-tin alloys and copper-zinc-tin-iron-nickel alloys in the form of plate, sheet, strip, and rolled bar. The alloys and nominal compositions are as follows:

Copper Alloy UNS No.[2]	Copper, %	Tin, %	Zinc, %	Phos., %%	Iron, %	Nickel, %
C40500	95	1	4			
C40810	95.5	2.0	2.22	0.03	0.1	0.15
C40850	95.5	3.0	1.27	0.1	0.1	0.1
C40860	94.8	2.0	3.04	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	7.97	0.1	0.1	0.1
C43000	85	2	13			
C43400	85	0.7	14.3			

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.

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:

2.2 *ASTM Standards:* [3]

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

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 18 Test Methods for Rockwell Hardness of Metallic Materials

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

E 76 Test Methods for Chemical Analysis of Nickel-Copper Alloys[4]

E 112 Test Methods for Determining Average Grain Size

E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition

E 478 Test Methods for Chemical Analysis of Copper Alloys

E 527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. General Requirements

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

3.1.1 Terminology—Definitions,
3.1.2 Materials and Manufacturing,
3.1.3 Workmanship, Finish, and Appearance,
3.1.4 Sampling—except for chemical analysis,
3.1.5 Number of Tests and Retests,
3.1.6 Specimen Preparation,
3.1.7 Test Methods—except for chemical analysis,
3.1.8 Significance of Numerical Limits,
3.1.9 Inspection,
3.1.10 Rejection and Rehearing,
3.1.11 Certification,
3.1.12 Test Reports (Mill),
3.1.13 Packaging and Package Marking, and
3.1.14 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 B 248.

[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.

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[2] New designations established in accordance with Practice E 527. In the new UNS system the designations for copper alloys are simply expansions of the present standard designations by a prefix "C" and a suffix "00."

[3] 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.

[4] Withdrawn.

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

4. Terminology

4.1 *Definitions*—For standard terms related to copper and copper alloys, refer to Terminology B 846.

5. Ordering Information

5.1 Contracts or purchase orders for product under this specification should include the following information:

5.1.1 ASTM designation and year of issue (for example, B 591 – XX);

5.1.2 Copper Alloy UNS No. Designation (for example, 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, that is, plate, sheet, strip, or rolled bar;

5.1.6 How furnished, that is, rolls, specific or stock lengths, with or without ends;

5.1.7 Quantity, that is, total weight each form, temper, and size; and

5.1.8 When material is purchased for agencies of the U.S. Government the requirements of Section 11 shall apply.

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 Type of edge, that is, slit, sheared, sawed, square corners, round corners, rounded edges, or full rounded edges, and

5.2.2 Width and straightness tolerances (see Section 12).

6. Materials and Manufacture

6.1 *Material*:

6.1.1 The material of manufacture shall be Copper Alloy UNS No. C40500, C41100, C41300, C41500, C42200, C42000, C43300, C43400, C40810, C40850, C40860, or C42520 as specified in the ordering information.

6.1.2 In the event that heat identification or traceability is required, the purchaser shall specify the details required.

NOTE 1—Because of 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*:

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 in the ordering information.

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 possible presence of other unnamed elements. Limits may be established and analysis required for unnamed elements by agreement between manufacturer or supplier and the purchaser.

7.2 Zinc, given as the "Remainder," is the difference between the sum of the results for all elements determined and 100 %.

7.2.1 Copper may be determined by difference; however, when so determined, the results must conform to the requirements of Table 1.

7.3 When all elements specified in Table 1 for the designated alloy are determined, the sum of results shall equal at least 99.7 %.

8. Temper

8.1 *As Hot Rolled (M20) Material*—This standard temper of sheet and plate produced by hot rolling, where applicable, is shown in Table 2. (See Table 3 for SI equivalents.)

8.2 *H (Rolled Material)*—The standard tempers of rolled materials are as designated in Table 2 with the prefix "H." Special tempers not listed in this specification are subject to agreement between the manufacturer and the purchaser.

8.3 *Annealed Material*—The standard tempers of annealed material are as designated in Table 4 in the column entitled "Nominal Grain Size." Special tempers not listed in this specification are subject to agreement between the manufacturer and the purchaser.

8.4 Temper designations are defined in Classification B 601.

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

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

TABLE 2 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Rolled Tempers

NOTE 1—Plate is generally available in only the as hot-rolled (M20) temper. Required properties for other tempers shall be agreed upon between the manufacturer and the purchaser at the time of placing the order.

NOTE 2—See Table 3 for SI unit equivalents.

Temper Designation		Tensile Strength, ksi[A]		Approximate Rockwell Hardness			
				B-Scale		Superficial 30T	
Standard	Former	Min	Max	0.020 to 0.036 in. (0.51 to 0.91 mm), incl	Over 0.036 in. (0.91 mm)	0.012 to 0.028 in. (0.30 to 0.71 mm), incl	Over 0.028 in. (0.711 mm)
				Copper Alloy UNS No. C40500			
M20	As hot-rolled	35	50	. . .	. . .	. . .	. . .
H01	Quarter hard	41	53	30-54	34-62	36-56	38-58
H02	Half hard	46	58	50-66	52-69	49-60	51-62
H03	Three-quarter hard	52	64	60-72	62-74	56-66	58-68
H04	Hard	58	70	66-76	68-78	60-68	62-70
H06	Extra hard	63	75	71-78	72-80	65-71	66-73
H08	Spring	68	80	75-81	76-83	67-72	68-74
H10	Extra spring	73	84	78-83	79-85	69-73	70-75
				Copper Alloy UNS No. C40810			
H02	Half hard	57	73	65-80	66-81	60-70	62-72
H04	Hard	76	88	78-89	80-90	67-74	69-75
H06	Extra hard	90	100	82-90	83-92	69-75	70-76
H08	Spring	94	102	85-92	86-94	71-77	72-78
				Copper Alloy UNS No. C40850			
H02	Half hard	57	73	65-80	67-81	60-69	62-72
H04	Hard	76	89	78-88	80-90	67-74	69-75
H06	Extra hard	90	100	82-91	83-93	69-75	70-76
H08	Spring	94	106	85-92	87-94	72-77	73-78
				Copper Alloy UNS No. C40860			
H02	Half hard	56	72	64-80	65-80	60-70	61-72
H04	Hard	74	87	77-89	79-90	66-74	68-75
H06	Extra hard	88	98	81-90	82-91	68-75	69-76
H08	Spring	92	105	84-92	85-94	70-77	71-78
				Copper Alloy UNS No. C41100			
M20	As hot-rolled	34	50	. . .	. . .	. . .	. . .
H01	Quarter hard	42	54	32-60	34-63	37-57	38-64
H02	Half hard	49	60	51-68	52-70	50-62	51-67
H03	Three-quarter hard	55	66	62-75	63-77	58-66	59-70
H04	Hard	61	72	68-79	69-81	62-70	64-71
H06	Extra hard	67	78	74-82	76-84	66-73	67-72
H08	Spring	73	83	78-84	77-86	69-74	70-73
H10	Extra spring	78	. . .	80 and over	80 and over	70 and over	71 and over
				Copper Alloy UNS No. C41300			
M20	As hot-rolled	37	50	. . .	. . .	. . .	. . .
H01	Quarter hard	45	55	34-62	35-64	40-58	39-60
H02	Half hard	50	62	52-70	53-72	51-63	51-64
H03	Three-quarter hard	58	68	64-77	66-78	59-68	60-69
H04	Hard	65	75	71-80	72-81	63-70	64-70
H06	Extra hard	70	82	77-83	78-84	67-71	68-72
H08	Spring	76	86	81-86	82-87	70-73	70-74
H10	Extra spring	81	. . .	85 and over	86 and over	72 and over	73 and over
				Copper Alloy UNS No. C41500			
M20	As hot rolled	38	50	. . .	. . .	. . .	. . .
H01	Quarter hard	46	56	48-73	49-75	48-65	49-67
H02	Half hard	53	63	68-78	70-80	62-68	63-70
H03	Three-quarter hard	57	68	73-80	75-82	65-70	66-71
H04	Hard	64	75	78-85	79-87	69-72	69-74
H06	Extra hard	70	82	81-87	82-90	70-73	70-75
H08	Spring	78	89	86-92	87-93	73-76	73-77
H10	Extra spring	85	. . .	89 and over	90 and over	74 and over	75 and over
				Copper Alloy UNS No. C42200			
M20	As hot-rolled	40	53	. . .	. . .	. . .	. . .
H01	Quarter hard	47	57	42-68	44-70	43-62	46-65
H02	Half hard	54	65	64-74	66-76	58-68	61-70
H03	Three-quarter hard	60	72	71-80	73-82	64-69	66-71
H04	Hard	67	79	76-83	78-85	67-71	69-73
H06	Extra hard	75	85	80-85	82-87	69-73	70-74