Designation: B 465 – 04

Standard Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar[1]

This standard is issued under the fixed designation B 465; 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 establishes Copper Alloy UNS Nos. C19200, C19210, C19400, C19500, C19700, and C19720 plate, sheet, strip, and rolled bar.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

B 193 Test Method for Resistivity of Electrical Conductor Materials

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 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes[3]

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

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys

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

E 112 Test Methods for Determining Average Grain Size

E 478 Test Methods for Chemical Analysis of Copper Alloys

E 527 Practice for Numbering Metals and Alloys (UNS)

3. General Requirements

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

3.1.1 Terminology,
3.1.2 Materials and Manufacture,
3.1.3 Workmanship, Finish, and Appearance,
3.1.4 Sampling,
3.1.5 Number of Tests and Retests,
3.1.6 Specimen Preparation,
3.1.7 Test Methods (except 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.

4. Terminology

4.1 *Definitions*—For definitions of 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 465–XX),

5.1.2 Copper Alloy UNS No. designation (for example, C19200),

5.1.3 Temper (Section 8),

5.1.4 *Dimensions*—Thickness, width, length, and so forth (Section 13),

5.1.5 *Form*—Plate, sheet, strip, or rolled bar,

5.1.6 *How Furnished*—Coils (rolls), specific lengths or stock lengths, with or without ends,

5.1.7 *Quantity*—total weight each form, temper, and size, and

5.1.8 When material is purchased for agencies of the U.S. government (Section 12).

5.2 The following options are available under this specification and should be specified in the contract or purchase order when required:

[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] 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] Withdrawn.

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

5.2.1 *Type of Edge*—Slit, sheared, sawed, square corners, round corners, rounded edges, or full rounded edges,

5.2.2 Width and straightness tolerances (appropriate table in Specification B 248),

5.2.3 Heat identification or traceability details,

5.2.4 Certification, and

5.2.5 Mill test report.

6. Materials and Manufacture

6.1 *Material*:

6.1.1 The material of manufacture shall be a cast bar, cake, slab, and so forth of Copper Alloy UNS No. C19200, C 19210, C19400, C19500, C19700, or C19720 as specified in the ordering information, and of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.1.2 In the event 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 practical to identify a specific casting analysis with a specific quantity of finished product.

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.

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 requirements prescribed 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. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser.

7.2 Copper, when specified as the remainder, may be taken as the difference between the sum of results for specified elements and 100 %.

7.3 When all elements listed in Table 1 for the designated alloy are determined, the sum of results shall be 99.8 % minimum.

8. Temper

8.1 As defined in Classification B 601, products shall be produced in tempers O60 (soft annealed), O61 (annealed), O50 (light annealed), O82 (annealed to temper - ½ hard), H01 (¼ hard), H02 (½ hard), H03 (¾ hard), H04 (hard), H06 (extra hard), HR02 (½ hard), HR04 (hard), H08 (spring), H10 (extra spring), and H14 (super spring).

NOTE 2—The purchaser should confer with the manufacturer or supplier for the availability of product in a specific alloy, temper, and form, since all tempers are subject to manufacturing limitations.

NOTE 3—Properties of special tempers not listed in this specification are subject to agreement between the manufacturer and purchaser.

9. Grain Size for Annealed Tempers

9.1 *Grain Size*—No grain size requirements have been established for tempers O50, O60, and O61; however, the product material shall be fully recrystallized when examined in accordance with Test Methods E 112.

10. Physical Property Requirements

10.1 *Electrical Resistivity Requirement*:

10.1.1 The product furnished shall conform to the requirements of Table 2 for the Copper UNS No. designation and temper specified in the ordering information when determined in accordance with Test Method B 193.

10.1.1.1 Products produced in temper O60 from Copper Alloy UNS No. C19400 are not required to conform with the resistivity requirement of Table 2.

11. Mechanical Property Requirements

11.1 *Tensile Requirements*:

11.1.1 The product furnished shall conform to the requirements prescribed in Table 3 for the Copper Alloy UNS No. designation and temper specified in the ordering information when subjected to test in accordance with Test Methods E 8.

11.1.1.1 Refer to Table X1.1, Appendix X1 for SI equivalents for tensile strength.

11.2 *Rockwell Hardness*—The approximate Rockwell values given in Table 3 are for general information and assistance in testing and shall not be used as a basis for rejection.

NOTE 4—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper and tensile strength.

TABLE 1 Chemical Requirements

Element	Composition, %					
	Copper Alloy UNS No.					
	C19200	C19210	C19400	C19500	C19700	C19720
Copper	98.5 min	remainder	97.0 min	96.0 min	remainder	remainder
Iron	0.8 to 1.2	0.05 to 0.15	2.1 to 2.6	1.0 to 2.0	0.30–1.2	0.05–0.50
Phosphorus	0.01 to 0.04	0.025 to 0.04	0.015 to 0.15	0.01 to 0.35	0.10–0.40	0.05–0.15
Zinc	0.20 max	. . .	0.05 to 0.20	0.20 max	0.20 max	0.20 max
Lead, max	0.03	. . .	0.03	0.02	0.05	0.05 max
Tin	. . .	. . .	. . .	0.10 to 1.0	0.20 max	0.20 max
Cobalt	. . .	. . .	. . .	0.3 to 1.3	0.05 max	. . .
Aluminum	. . .	. . .	. . .	0.02 max	. . .	. . .
Magnesium	. . .	. . .	. . .	. . .	0.01–0.20	0.06–0.20
Nickel, max	. . .	. . .	. . .	. . .	0.05	0.10 max
Manganese, max	. . .	. . .	. . .	. . .	0.05	0.05 max

TABLE 2 Electrical Resistivity Requirements and Equivalent Conductivity

Tempers	Copper Alloy UNS No.	Resistivity at 20°C (68°F) Ω g/m^2	Equivalent Conductivity at 20°C (68°F), % IACS
O50, O60[A], O61, and O62	C19200	0.235 81 max	65 min
	C19210	0.170 31 max	90 min
	C19400	0.383 26 – 0.204 37	40 – 75
	C19500	0.305 65 max	50 min
	C19700	0.191 60 max	80 min
H01, H02, H03, H04, H06, H08, H10, and H14	C19200	0.255 47 max	60 min
	C19210	0.180 33 max	85 min
	C19400	0.255 47 max	60 min
	C19500	0.340 62 max	45 min
	C19700	0.199 06 max	77 min
	C19720	0.199 06 max	77 min

[A] O60 temper of Copper Alloy UNS No. C19400 is not required to conform with the resistivity requirement of this table.

12. Purchases for U.S. Government Agencies

12.1 When identified in the contract or purchase order, as product purchased for agencies of the U.S. Government, it shall conform to the special government requirements stipulated in the Supplemental Requirements given in Specification B 248.

13. Dimensions, Mass, and Permissible Variations

13.1 The product furnished under this specification shall conform to the following tables in the Dimensions, Mass, and Permissible Variations section of Specification B 248:

13.1.1 *Thickness*:

13.1.1.1 *Tolerances*—Table 1.

13.1.2 *Width*:

13.1.2.1 *Tolerances for Slit Metal and Slit Metal with Rolled Edges*—Table 2.

13.1.2.2 *Tolerances for Square-Sheared Metal*—Table 5.

13.1.2.3 *Tolerances for Sawed Metal*—Table 6.

13.1.3 *Length*:

13.1.3.1 *Tolerances for Straight Lengths*—Table 7.

13.1.3.2 *Schedule of Minimum Lengths with Ends*—Table 8.

13.1.3.3 *Tolerances for Squared Sheared Metal*—Table 9.

13.1.3.4 *Tolerances for Sawed Metal*—Table 10.

13.1.4 *Straightness*:

13.1.4.1 *Tolerance for Slit Metal or Slit Metal Either Straightened or Edge Rolled*—Table 11.

13.1.4.2 *Tolerances for Squared Sheared Metal*—Table 12.

13.1.4.3 *Tolerances for Sawed Metal*—Table 13.

13.1.5 *Edges*:

13.1.5.1 *Tolerances for Radius of Square Edges*—Table 14.

13.1.5.2 *Tolerances for Radius of Round Corners*—Table 15.

13.1.5.3 *Tolerances for Radius of Round Edges*—Table 16.

13.1.5.4 *Tolerances for Radius of Full Rounded Edges*—Table 17.

14. Test Methods

14.1 *Chemical Analysis*:

14.1.1 Chemical composition shall be determined, in case of disagreement, by the following appropriate method:

Element	Test Method
Aluminum	E 478
Copper	E 478
Cobalt	E 75
Iron	E 76
Lead	E 478 (AA)
Manganese	E 62
Nickel	E 478 (Photometric)
Phosphorus	E 62
Tin	E 478 (Photometric)
Zinc	E 478 (AA)

14.1.1.1 Since no recognized test method is known to be published, the determination of magnesium shall be subject to agreement between the manufacturer or supplier and the purchaser.

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

14.2 Test methods for all other properties are given in Specification B 248.

15. Keywords

15.1 copper-iron alloy plate; copper-iron alloy rolled bar; copper-iron alloy sheet; copper-iron alloy strip; UNS No. C19200; UNS No. C19210; UNS No. C19400; UNS No. C19500; UNS No. C19700; UNS No. C19720

TABLE 3 Mechanical Requirements

Temper Designation (B 601)		Tensile Strength, ksi[A]	Approximate Rockwell Hardness			
			B Scale		Superficial 30T	
Designation	Name		0.020 in. (0.508 mm) to 0.036 in. (0.914 mm) Incl	Over 0.036 in. (0.914 mm)	0.012 in. (0.305 mm) to 0.028 in. (0.711 mm) Incl	Over 0.028 in. (0.711 mm)
		Copper Alloy UNS No. C19200				
O61	annealed	40–50	. . .	. . .	. . .	. . .
H01	¼ hard	45–55	. . .	. . .	. . .	. . .
H02	½ hard	52–62	53–69	. . .	53–66	. . .
H04	hard	60–70	68–74	. . .	66–71	. . .
H06	extra hard	67–74	71–75	. . .	69–73	. . .
H08	spring	70–78	73–76	. . .	69–74	. . .
H10	extra spring	74–80	73–76	. . .	69–74	. . .
		Copper Alloy UNS No. C19210				
O61	annealed	27–42	. . .	. . .	. . .	. . .
H01	¼ hard	43–53	. . .	. . .	. . .	50 max
H02	½ hard	47–60	. . .	. . .	. . .	35–60
H03	¾ hard	52–62	. . .	. . .	. . .	52–67
H04	hard	56–66	. . .	. . .	. . .	54–69
H06	extra hard	60–70	. . .	. . .	. . .	56–71
H08	spring	64–74	. . .	. . .	. . .	58–73
H10	extra spring	66 min	. . .	. . .	. . .	60–75
		Copper Alloy UNS No. C19400				
O60	soft anneal	40–50	. . .	. . .	. . .	. . .
O50	light anneal	45–55	. . .	. . .	. . .	. . .
O82	annealed to temper—½ hard	53–63	. . .	. . .	. . .	. . .
H02	½ hard	53–63	49–69	57–70	52–63	51–66
H04	hard	60–70	67–73	68–76	61–68	64–69
H06	extra hard	67–73	72–75	75–77	67–69	68–69
H08	spring	70–76	73–78	76–79	68–69	69–72
H10	extra spring	73–80	75–79	77–80	69–70	69–72
H14	super spring	80 min	. . .	. . .	70 min	. . .
		Copper Alloy UNS No. 19500				
O60	soft anneal	50–60	. . .	. . .	. . .	. . .
H01	¼ hard	60–72	63–79	. . .	61–71	. . .
H02	½ hard	68–78	76–81	. . .	69–73	. . .
H03	¾ hard	75–85	80–83	. . .	72–74	. . .
H04	hard	82–90	82–85	. . .	73–75	. . .
H08	spring	88–97	84–87	. . .	74–77	. . .
		Copper Alloy UNS No. C19700				
O60	soft anneal	43–53	. . .	. . .	. . .	. . .
H02	½ hard	53–63	62–71	. . .	62–68	. . .
H04	hard	60–70	66–73	. . .	65–70	. . .
H06	extra hard	67–73	70–75	. . .	68–71	. . .
H08	spring	70–76	71–77	. . .	69–72	. . .
H10	extra spring	73–80	72–78	. . .	70–74	. . .
		Copper Alloy UNS No. C19720				
HR02	½ hard	56–63	65–71	. . .	62–68	. . .
HR04	hard	60–70	66–73	. . .	65–70	. . .

[A] The tensile strength conversions to SI units are given in Table X1.1 (ksi = 1000 psi).

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 which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

TABLE X1.1 SI Equivalents for Tensile Strength

ksi	MPa
40	275
43	295
45	310
47	325
50	345
52	360
53	365
55	380
57	395
60	415
62	425
63	435
67	460
70	485
73	505
74	510
76	525
80	550

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B 465 – 03) that may impact the use of this standard. (Approved May 1, 2004.)

(*1*) Added Alloy C19720 to the Scope, to paragraph 6.1.1, and to Keywords.
(*2*) Added tempers to paragraph 8.1.
(*3*) Added chemistry of Alloy C19720.
(*4*) Added electrical resistivity to Table 2and mechanical properties to Table 3 for Alloy C19720.

Committee B05 has identified the location of selected changes to this standard since the last issue (B 465 – 00$^{\epsilon 1}$) that may impact the use of this standard. (Approved Oct. 1, 2003.)

(*1*) Added Copper Alloy UNS No. C19210 to 1.1.
(*2*) Switched order of Sections 3 and 4 (General Requirements and Terminology).
(*3*) Added Copper Alloy UNS No. C19210 to 6.1.1.
(*4*) Added reference to Appendix X1 in 11.1.1.1.
(*5*) Added alloy numbers to Section 15.
(*6*) Added Copper Alloy UNS No. C19210 to Table 1.
(*7*) Revised Table 2 to include Copper Alloy UNS No. C19210; reformatted to include conductivity equivalents; removed rolled and rewound temper designations.
(*8*) Added mechanical requirements for Copper Alloy UNS No. C19210 to Table 3.
(*9*) Moved former Table 4 to be Table X1.1 in the Appendix.
(*10*) Removed Section X2, Conductivity Equivalents (including Table X2.1).