



Designation: **B465—16 B465 – 20**

Standard Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar¹

This standard is issued under the fixed designation B465; 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 copper-iron alloy plate, sheet, strip, and rolled bar for Copper [Alloy] UNS Nos. C19200, C19210, C19400, C19500, C19700, and C19720.

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 units that are provided for information only and are not considered standard.

1.3 *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 ASTM Standards:²

- B193 Test Method for Resistivity of Electrical Conductor Materials
- 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
- E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)³
- E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)³
- E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)³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

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

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

- 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
- 3.1.13 Packaging and Package Marking
- 3.1.14 Supplementary Requirements.

3.2 In addition, when a section with a title identical to that referenced in 3.1, above, 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~~; issue;
- 5.1.2 Copper [Alloy] UNS No. ~~designation~~; designation;
- 5.1.3 Temper (Section 8); ;;
- 5.1.4 *Dimensions*—Thickness, width, length, and edges (Section 12); ;;
- 5.1.5 *How Furnished*—Straight lengths or ~~coils~~; coils;
- 5.1.6 *Quantity*—total weight or total length or number of pieces of each ~~size~~; size; and
- 5.1.7 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 Heat identification or traceability details,
- 5.2.2 Certification,

5.2.3 Test Report,

5.2.4 Type of edge (slit, sheared, sawed, square corners, round corners, rounded edges, or full-rounded edges),

5.2.5 Width and straightness tolerances (appropriate tables in Specification **B248**), and

5.2.6 If product is purchased for agencies of the U.S. Government (see the Supplemental section of Specification **B248** for additional requirements, if specified).

6. Materials and Manufacture

6.1 Materials:

6.1.1 The material of manufacture shall be a form (cast bar, cake, slab, et cetera), of Copper Alloy UNS No. C19200, C19210, C19400, C19500, C19700, or C19720 of such purity and soundness as to be suitable for processing into the products prescribed herein.

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

NOTE 1—Due to 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 material.

6.2 Manufacture:

6.2.1 The product shall be manufactured by such ~~hot-working, cold-working,~~ 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-hot or cold-worked~~ cold worked to the finished ~~size,~~ size and subsequently annealed, when required, to meet the temper properties specified.

6.3 Edges:

6.3.1 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 composition requirements in **Table 1** for the Copper [alloy] UNS No. designation specified in the ordering information.

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	0.8–1.2	0.05–0.15	2.1–2.6	1.0–2.0	0.30–1.2	0.05–0.50
Phosphorus	0.01–0.04	0.025–0.04	0.015–0.15	0.01–0.35	0.10–0.40	0.05–0.15
Zinc	0.20 max	...	0.05–0.20	0.20 max	0.20 max	0.20 max
Lead, max	0.03	...	0.03	0.02	0.05	0.05
Tin	...	...	...	0.10–1.0	0.20 max	0.20 max
Cobalt	...	...	...	0.30–1.3	0.05 max	...
Aluminum	...	...	...	0.02 max	...	...
Magnesium	...	...	...	...	0.01–0.20	0.06–0.20
Nickel, max	...	...	...	...	0.05	0.10 ^A
Manganese, max	...	...	...	...	0.05	0.05

^A Includes cobalt.

7.2 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.

7.3 For alloys in which copper is listed as “remainder,” copper is the difference between the sum of results of all elements determined and 100 %.

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8. Temper

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

8.1.1 Cold-rolled tempers H01 to H14.

8.1.2 Annealed tempers O50, O60, O61, or O82.

8.1.3 Cold-worked and stress-relieved tempers HR02 to HR06.

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 **E112**.

10. Physical Property Requirements

10.1 *Electrical Resistivity Requirement:*

10.1.1 The product furnished shall conform to the electrical mass resistivity requirement prescribed in **Table 2** when tested in accordance with Test Method **B193**.

10.1.2 Products produced in temper O60 from Copper Alloy UNS No. C19400 are not required to conform to the electrical mass resistivity requirements of **Table 2**.

TABLE 2 Electrical Resistivity Requirements and Equivalent Conductivity

Tempers	Copper Alloy UNS No.	Resistivity at 20°C (68°F) g/m ²	Equivalent Conductivity at 20°C (68°F), % IACS
Tempers	Copper Alloy UNS No.	Resistivity at 20 °C (68 °F) g/m ²	Equivalent Conductivity at 20 °C (68 °F), % IACS
O50, O60 ^A , O61, and O82	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, H14, HR02, HR04, and HR06	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.

TABLE 3 Mechanical Requirements

Temper Designation (B601)		Tensile Strength, ksi [MPa] ⁴	Approximate Rockwell Hardness			
			B Scale		Superficial 30T	
			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)
Code	Name					
Copper Alloy UNS No. C19200						
O61	annealed	40–50 [275–345]	...	...	...	...
H01	¼ hard	45–55 [310–380]	...	...	...	...
H02	½ hard	52–62 [360–425]	53–69	...	53–66	...
H04	hard	60–70 [415–485]	68–74	...	66–71	...
H06	extra hard	67–74 [460–510]	71–75	...	69–73	...
H08	spring	70–78 [485–540]	73–76	...	69–74	...
H10	extra spring	74–80 [510–550]	73–76	...	69–74	...
Copper Alloy UNS No. C19210						
O61	annealed	27–42 [185–290]	...	...	...	...
H01	¼ hard	43–53 [295–365]	...	...	...	50 max
H02	½ hard	47–60 [325–415]	...	...	...	35–60
H03	¾ hard	52–62 [360–425]	...	...	...	52–67
H04	hard	56–66 [385–455]	...	...	...	54–69
H06	extra hard	60–70 [415–485]	...	...	...	56–71
H08	spring	64–74 [440–510]	...	...	...	58–73
H10	extra spring	66 min [445 min]	...	...	...	60–75
Copper Alloy UNS No. C19400						
O60	soft anneal	40–50 [275–345]	...	...	...	...
O50	light anneal	45–55 [310–380]	...	...	...	...
O82	annealed to temper—½ hard	53–63 [365–435]	...	...	...	...
H02	½ hard	53–63 [365–435]	49–69	57–70	52–63	51–66
H04	hard	60–70 [415–485]	67–73	68–76	61–68	64–69
H06	extra hard	67–73 [460–505]	72–75	75–77	67–69	68–69
H08	spring	70–76 [485–525]	73–78	76–79	68–69	69–72
H10	extra spring	73–80 [505–550]	75–79	77–80	69–70	69–72
H14	super spring	80 min [550 min]	...	...	70 min	...
Copper Alloy UNS No. 19500						
O60	soft anneal	50–60 [345–415]	...	...	...	...
H01	¼ hard	60–72 [415–495]	63–79	...	61–71	...
H02	½ hard	68–78 [470–540]	76–81	...	69–73	...
H03	¾ hard	75–85 [515–585]	80–83	...	72–74	...
H04	hard	82–90 [565–620]	82–85	...	73–75	...
H08	spring	88–97 [605–670]	84–87	...	74–77	...
Copper Alloy UNS No. C19700						
O60	soft anneal	43–53 [295–365]	...	...	...	...
H02	½ hard	53–63 [365–435]	62–71	...	62–68	...
H04	hard	60–70 [415–485]	66–73	...	65–70	...
H06	extra hard	67–73 [460–505]	70–75	...	68–71	...
H08	spring	70–76 [485–525]	71–77	...	69–72	...
H10	extra spring	73–80 [505–550]	72–78	...	70–74	...
Copper Alloy UNS No. C19720						
HR02	½ hard	53–63 [365–435]	65–71	...	62–68	...
HR04	hard	60–70 [415–485]	66–73	...	65–70	...
HR06	extra hard	67–73 [460–505]	70–78	...	65–75	...

⁴ See Appendix X1.

11. Mechanical Property Requirements

11.1 Tensile Strength Requirements:

11.1.1 Product furnished under this specification shall conform to the tensile requirements prescribed in **Table 3** when tested in accordance with Test Methods **E8/E8M**.

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

11.2 Rockwell Hardness Requirement:

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