Designation: B 422 – 0~~3~~4

Standard Specification for Copper-Aluminum-Silicon-Cobalt Alloy, Copper-Nickel-Silicon-Magnesium Alloy, Copper-Nickel-Silicon Alloy, Copper-Nickel-Aluminum-Magnesium Alloy, and Copper-Nickel-Tin Alloy Sheet and Strip[1]

This standard is issued under the fixed designation B 422; 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] 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 ~~Oct.~~ May 1, 200~~3~~4. Published ~~November 2003.~~ May 2004. Originally approved 1965. Last previous edition approved in ~~1999~~ 2003 as B 422 – ~~99~~03.

1. Scope*

1.1 This specification establishes the requirements for[2] Copper Alloy UNS Nos. C19010, C19020, C19025, C63800, C70250, and C70260 (Note 1) Sheet and Strip.

NOTE 1—This document contains some patented alloys. Alternatives such as beryllium coppers and spinodal alloys are available for similar applications.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in SI units represent mathematical conversions, which are provided for information only and are not considered standard.

1.3 *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 The following documents of the issue in effect on date of material purchase 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 846 Terminology for Copper and Copper Alloys

E 527 Practice for Numbering Metals and Alloys (UNS)

3. General Requirements

3.1 Material furnished to this specification shall be in accordance with the applicable requirements of the current edition of 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 Orders for material under this specification should include the following information:

5.1.1 Quantity (of each size),

5.1.2 Alloy: Copper Alloy UNS No. (Section 1),

5.1.3 Form of material (sheet or strip),

5.1.4 Temper (see 7.1),

5.1.5 Dimensions (thickness, width, length (if applicable),

5.1.6 How furnished (rolls, specific lengths with or without ends, stock lengths with or without ends),

5.1.7 Type of edge, if required (slit, sheared, sawed, square corners, rounded corners, rounded edges, or full-rounded edges (see 10.6),

5.1.8 Type of width and straightness tolerances, if required (slit-metal tolerances, square sheared-metal tolerances, sawed-metal tolerances, straightened or edge-rolled-metal tolerances) (Section 10), and

5.1.9 ASTM specification number and year of issue.

5.2 In addition, when material is purchased for agencies of the U.S. Government, it shall conform to the Supplementary Requirements as defined in Specification B 248 when specified in the contract or purchase order.

6. Chemical Composition

6.1 The materials shall conform to the compositions prescribed in Table 1.

6.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be established by agreement between manufacturer or supplier and purchaser.

6.3 Copper may be taken as the difference between the sum of all the elements analyzed and 100 %. When all the elements in Table 1 for Alloys C 19010, C63800, C70250, and C70260 are analyzed, their sum shall be 99.5 % min. When all the elements in Table 1 for Alloy C19025 are analyzed, their sum shall be 99.7 % min. When all the elements in Table 1 for Alloy C19020 are analyzed, their sum shall be 99.8 % min.

7. Temper

7.1 Tempers available under this specification are as designated in Tables 2 ~~6.~~ 7.

---

[2] The UNS system for copper and copper alloys (see Practice E 527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

[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.

TABLE 1 Chemical Requirements Composition %

Element	C19010	C19020	C19025	C63800	C70250	C70260
~~Nickel~~	~~0.8–1.8~~		~~0.80–1.20~~	~~0.20 max.~~	~~2.2–4.2[A]~~	~~1.0–3.0[A]~~
Nickel	0.8–1.8	0.50–3.0	0.80–1.20	0.20 max.	2.2–4.2[A]	1.0–3.0[A]
~~Silicon~~	~~0.15–0.35~~		~~...~~	~~1.5–2.1~~	~~0.25–1.2~~	~~0.20–0.7~~
Silicon	0.15–0.35	...	...	1.5–2.1	0.25–1.2	0.20–0.7
~~Lead, max.~~	~~...~~		~~...~~	~~0.05~~	~~0.05~~	~~...~~
Lead, max.	...	...	...	0.05	0.05	...
~~Iron, max.~~	~~...~~		~~...~~	~~0.20~~	~~0.20~~	~~...~~
Iron, max.	...	...	...	0.20	0.20	...
~~Zinc, max.~~	~~...~~	~~...~~		~~0.8~~	~~1.0~~	~~...~~
Zinc, max.	...	...	0.20	0.8	1.0	...
~~Aluminum~~	~~...~~		~~...~~	~~2.5–3.1~~	~~...~~	~~...~~
Aluminum	...	...	...	2.5–3.1	...	...
~~Copper~~	~~remainder~~		~~remainder~~	~~remainder~~	~~remainder~~	~~remainder~~
Copper	remainder	remainder	remainder	remainder	remainder	remainder
~~Cobalt~~	~~...~~		~~...~~	~~0.25–0.55~~	~~...~~	~~...~~
Cobalt	...	...	...	0.25–0.55	...	...
~~Manganese, max.~~	~~...~~		~~...~~	~~0.10~~	~~0.10~~	~~...~~
Manganese, max.	...	...	...	0.10	0.10	...
~~Magnesium~~	~~...~~		~~...~~	~~...~~	~~0.05–0.30~~	~~...~~
Magnesium	...	...	...	...	0.05–0.30	...
~~Tin~~	~~...~~		~~0.70–1.10~~	~~...~~	~~...~~	~~...~~
Tin	...	0.30–0.9	0.70–1.10	...	...	...
Phosphorus	0.01–0.05	0.01–0.20	0.03–0.07	...	...	0.010 max.

[A] Including cobalt.

TABLE 2 Tensile Property Requirements and Approximate Hardness Values for Copper Alloy UNS No. C63800

Temper		Tensile Strength		Elongation in 2 in. (50.8 mm), %	Approximate Rockwell Hardness[A]	
Designation	Name	ksi[B]	MPa[C]		Rockwell B	Superficial 30T
O60	soft anneal	78 max	540 max	37 min	...	...
O61	annealed	77–87	530–600	27–40	...	70–78
H01	¼ hard	90–102	620–705	...	92–96	76–80
H02	½ hard	100–112	690–775	...	95–98	79–81
H03	¾ hard	105–117	720–810	...	97–99	80–82
H04	hard	114–126	785–870	...	98–100	81–83
H06	extra hard	118–130	815–900	...	99–101	81–83
H08	spring	123–134	845–925	...	99–101	82–84
H10	extra spring	130 min	900 min	...	100 min	83 min

[A] Hardness values shown apply only to direct determination, not converted values. They are for information only.
[B] ksi = 1000 psi.
[C] See Appendix X1.

TABLE 3 Yield Requirements for Copper Alloy UNS No. C70250

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM00	65–90	450–620
TM02	83–110	585–760
TM03	95–120	655–825
TR02	80 min	550 min
TH03	65–85	450–585

[A] ksi = 1000 psi.
[B] See Appendix X1.

8. Mechanical Properties

8.1 Copper Alloy UNS No. C63800 is a dispersion-strengthened alloy which does not require heat treatment. The annealed and rolled tempers shall conform to the tensile property requirements prescribed in Table 2.

8.2 Copper Alloy UNS No. C70250 is supplied in a mill-hardened, or cold-worked and precipitation heat-treated, or precipitation heat-treated or spinodal heat-treated, 1/2 Hd and stress-relieved tempers. The 0.2 % offset yield strength shall be the standard tests for these tempers and shall conform to the requirements specified in Table 3.

8.2.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.3 Copper Alloy UNS No. C70260 is supplied in a mill-hardened temper. The 0.2 % offset yield strength shall be the standard test for the mill-hardened tempers TM00, TM02, TM03, and TM04 and shall conform to the requirements specified in Table 4. The tensile strength shall be the standard test for the mill-hardened temper TM01 and shall conform to the requirements specified in Table 4.

TABLE 4 Tensile and Yield Requirements for Copper Alloy UNS No. C70260

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM00	65–85	450–585
TM02	90–100	620–690
TM03	95–115	653–790
TM04	100–120	687–825
	Tensile Strength	
Temper Designation	ksi[A]	MPa[B]
TM01	90–105	620–720

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 5 Tensile Requirements for Copper Alloy UNS No. C19025

Designation	Tensile Strength		Elongation in 2 in.
	ksi[A]	MPa[B]	(50.8 mm) %
HR02	63–76	435–525	9–25
HR04	72–83	495–570	5–14
HR06	78 min	540 min	4–12

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 6 Yield Requirements for Copper Alloy UNS No. C19010

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM03	50–65	340–450
TM04	60–75	410–515
TM06	64–79	440–545
TM08	74–89	510–610
H01	40–55	275–380
H02	54–69	370–475
H03	62–77	410–530
H04	66–81	435–555
H06	72–87	460–600
H08	78–93	520–640
H10	85–100	585–685

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 7 Tensile Requirements for Copper Alloy UNS No. C19020

Designation	Tensile Strength		Elongation in 2 in. (50.8 mm), %
	ksi	MPa	
HR02	58-70	400-485	5 min
HR04	65-74	450-510	3 min
HR06	71-80	490-550	3 min
HR08	77 min	530 min	2 min

8.3.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.4 Copper Alloy UNS Nos. C19020 and C19025 ~~is~~ are supplied in cold-worked, stress-relieved temper. These tempers shall conform to the tensile strength and elongation requirements in Table 5. The 0.2 % offset yield strength shall be the standard test for the mill-hardened tempers and shall conform to the requirements specified in Table 7 and Table 5, respectively.

8.4.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.5 Copper Alloy UNS No. C19010 is supplied in either precipitation heat-treated (TM03 to TM08) tempers, or mill-hardened (H01 to H10) tempers. The 0.2 % offset yield strength shall be the standard test for the precipitation heat-treated and mill-hardened tempers and shall conform to the requirements specified in Table 6.

8.5.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

9. Electrical Properties

9.1 The electrical resistivity of Copper Alloys UNS Nos. C19010, C19025, C63800, C70250, and C70260 are listed in Table ~~7~~ 8 for information only.

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances shall be as prescribed in the current edition of Specification B 248, with particular reference to Section 5 and the following tables of that specification:

10.2 *Thickness:* See 5.2, Table 2.

10.3 *Width:*

10.3.1 *Slit Metal and Slit Metal with Rolled Edges*—See 5.3, Table 4.

10.3.2 *Square-Sheared Metal*—See 5.3, Table 5.

10.3.3 *Sawed Metal*— See 5.3, Table 6.

10.4 *Length:*

10.4.1 *Specific and Stock Lengths With and Without Ends*—See 5.4, Table 7.

10.4.2 *Schedule of Lengths (Specific and Stock) With Ends*—See 5.4, Table 8.

10.4.3 *Length Tolerances for Square-Metal* —See 5.4, Table 9.

10.4.4 *Length Tolerances for Sawed Metal*—See 5.4, Table 10.

10.5 *Straightness:*

10.5.1 *Slit Metal or Slit Metal Either Straightened or Edge-Rolled*—See 5.5, Table 11.

10.5.2 *Square-Sheared Metal*—See 5.5, Table 12.

10.5.3 *Sawed Metal*— See 5.5, Table 13.

10.6 *Edges*—See 5.6:

10.6.1 *Square Edges*— See 5.6.1, Table 14.

10.6.2 *Rounded Corners*— See 5.6.2, Table 15.

10.6.3 *Rounded Edges*— See 5.6.3, Table 16.

10.6.4 *Full-Rounded Edges*—See 5.6.4, Table 17.

11. Keywords

11.1 copper-aluminum-silicon-cobalt alloy; copper-nickel-aluminum magnesium alloy; copper-nickel-silicon alloy; copper nickel-silicon-magnesium alloy; copper-nickel-tin alloy; sheet; strip; UNS No. C19010; UNS No. C19020; UNS No. C19025; UNS No. C63800; UNS No. C70250; UNS No. C70260

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

TABLE ~~7~~ 8 Electrical Resistivity and Conductivity Equivalent

Copper Alloy UNS No.	Temper	Electrical Resistivity at 20°C (68°F), $\Omega \cdot g/m^2$	Equivalent Conductivity at 20°C (68°F), % IACS
C63800		1.5328	10
C70250	TR02, TM00, TM02	0.3832	40
C70250	TM03	0.4258	36
C70260	TM00, TM02, TM03, TM04	0.3832	40
C70260	TM01	0.3066	50
C19025	HR02, HR04, HR06	0.3832	40
C70250	TH03	0.3066	50
C19010	H08, H10	0.3193	48
C19010	TM03, TM04, TM06, TM08, H03, H04, H06	0.3066	50
C19010	H01, H02	0.2787	55 min
C19020	HR02, HR04, HR06, HR08	0.3066	50

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.

SUMMARY OF CHANGES

Committee ~~B05.01~~ B05 has identified the location of selected changes to this standard since the last issue (B 422 – ~~99~~03) that may impact the use of this standard. (Approved ~~Oct.~~ May 1, 200~~3~~4.)

(*1*) Added UNS No. C19020 to the Scope, chemistry to Table 1, and included Table 7 for this alloy.
(*2*) Revised Table 8 to include UNS No. C19020.
(*3*) Changed paragraph 8.4 to include UNS No. C19020.
(*4*) Added zinc specification to UNS No. C19025 in Table 1.

Committee B05 has identified the location of selected changes to this standard since the last issue (B 422 – 99) that may impact the use of this standard. (Approved Oct. 1, 2003.)

(*1*) Added UNS No. C19010 to 1.1.
(*2*) Moved General Requirements section to be Section 3.
(*3*) Added Section 4, Terminology. Subsequent sections and section references were renumbered accordingly.
(*4*) Added UNS No. C19010 to 6.3.
(*5*) Added 8.5 and 8.5.1 for Mechanical Properties of UNS No. C19010.
(*6*) Added UNS No. C19010 to 9.1 and changed the order of alloys to agree with other sections.
(*7*) Added alloy numbers to Section 11.
(*8*) Added UNS No. C19010 to Table 1.
(*9*) Changed Table 3 title to Yield Requirements for Copper Alloy UNS No. C70250.
(*10*) Changed Table 4 title to Yield Requirements for Copper Alloy UNS No. C70260, added tempers of TM01, TM03, and TM04.
(*11*) Added Table 6, Yield Requirements for Copper Alloy UNS No. C19010.
(*12*) Renumbered Table ~~7,~~ 8, changed title to Electrical Resistivity Requirements and Conductivity Equivalent, added TM01, TM03, and TM04 requirements for Copper Alloy UNS No. C70260, added tempers for Copper Alloy UNS No. C19010.