



Designation: B206/B206M – 12 (Reapproved 2017)

Standard Specification for Copper-Nickel-Zinc (Nickel Silver) Wire and Copper-Nickel Alloy Wire ¹

This standard is issued under the fixed designation B206/B206M; 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 wire in round, hexagonal, octagonal, rectangular, and square form of UNS Alloy Nos. C71000, C74500, C75200, C75700, C76400, C77000, and C79200.

1.2 This specification is general in that the product is used in many applications where the requirements are too particular to be specified by standard test results.

1.2.1 For particular or critical applications it is advisable for the purchaser to submit samples or drawings to the manufacturer to secure an adjustment of anneal or temper to suit the application for which the product is intended.

1.3 The following information is intended to assist the purchaser in the application of this specification:

1.3.1 For most general applications—UNS Alloy Nos. C71000, C74500, C75200, and C75700.

1.3.2 For hard or spring tempers—UNS Alloy Nos. C76400 and C77000.

1.3.3 For ease of machining—UNS Alloy No. C79200.

1.4 *Units*—Values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.5 *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.*

¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rod, Bar, Wire, Shapes and Forgings.

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2. Referenced Documents

2.1 *ASTM Standards*:²

B250/B250M Specification for General Requirements for Wrought Copper Alloy Wire

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

B846 Terminology for Copper and Copper Alloys

B950 Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

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 **B250/B250M** constitute 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,
- 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 Supplemental Requirements.

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 appears in this specification, it

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

contains additional requirements that supplement those which appear in Specification **B250/B250M**.

4. Terminology

4.1 For the definition of general 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 products under this specification, as applicable:

- 5.1.1 ASTM designation and year of issue,
- 5.1.2 Copper Alloy UNS No. (Section 1),
- 5.1.3 Temper designation (Section 8),
- 5.1.4 Quantity—Total weight or length or number of pieces of each temper, form, or alloy.
- 5.1.5 Dimensions—Diameter, distance between parallel surfaces,
- 5.1.6 How furnished—specific lengths, coils, reels, and so forth, 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 (Specification **B250/B250M**), and
- 5.2.3 Mill Test Reports (Specification **B250/B250M**).
- 5.2.4 If product is purchased for agencies of the U.S. Government (Specification **B250/B250M**).

6. Material and Manufacture

6.1 *Material*—The material shall be made from cast or wrought billets, logs or rods of Copper Alloy UNS Nos. C71000, C74500, C75200, C75700, C76400, C77000, or C79200, and shall be of such soundness and structure as to enable them to be processed into the desired product.

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

6.2 *Manufacture*—The product shall be manufactured by such hot-working, cold-working, straightening, coiling or reeling and annealing processing needed to produce a uniform wrought structure and obtain the finish properties specified in the purchase order or contract.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in **Table 1** for the Copper Alloy UNS No.

specified in the ordering information:

7.1.1 These composition limits do not preclude the presence of other elements. When required, limits may be established and analysis required for unnamed elements by agreement between the supplier and the purchaser.

7.2 For UNS No. C71000, in which copper is listed as the remainder, the copper content may be determined as the difference between the sum of results for all elements analyzed and 100 %.

7.3 For those copper alloys in which zinc is specified as the remainder, either copper or zinc may be taken as the difference between the sum of all elements analyzed and 100 %. When copper is so determined, that difference value shall conform to the requirements given in **Table 1**.

7.4 When all elements listed in **Table 1** for the Copper Alloy UNS No. prescribed in the ordering information are determined, the sum of results shall be 99.5 % minimum.

8. Temper

8.1 Tempers, as defined in Classification **B601**, available to this specification are as prescribed in **Table 2**, **Table 3**, and **Table 4** in the various alloys and sizes listed.

8.2 Hexagonal, octagonal, rectangular, and square wire are normally furnished in H01 (quarter-hard) temper.

8.3 UNS Alloy Nos. C76400 and C77000 are normally furnished in the H04 (hard), H08 (spring), or H14 (extra spring) tempers.

9. Grain Size for Annealed Wire

9.1 Product furnished in the OS (annealed) condition shall conform to the requirements specified in **Table 4** for the temper and Copper Alloy UNS No. designated in the ordering information, when tested in accordance with Test Methods **E112**.

9.1.1 Grain size shall be the standard requirement for product ordered in the OS (annealed) condition and acceptance or rejection based upon grain size shall depend upon the average grain size test results obtained.

10. Mechanical Property Requirements

10.1 *Tensile Strength Requirements:*

10.1.1 Round wire 0.020 through 0.250 in. [0.50 through 6.0 mm] in diameter of the Copper Alloy UNS No. specified in the ordering information shall conform to the requirements of **Table 2** or **Table 3** for the prescribed H (cold-worked) temper ordered.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, %					
	Copper	Nickel (incl cobalt)	Lead	Iron, max	Manganese, max	Zinc
C71000	remainder	19.0-23.0	0.05 max	1.0	1.0	1.0 max
C74500	63.5-66.5	9.0-11.0	0.05 max	0.25	0.50	remainder
C75200	63.0-66.5	16.5-19.5	0.05 max	0.25	0.50	remainder
C75700	63.5-66.5	11.0-13.0	0.05 max	0.25	0.50	remainder
C76400	58.5-61.5	16.5-19.5	0.05 max	0.25	0.50	remainder
C77000	53.5-56.5	16.5-19.5	0.05 max	0.25	0.50	remainder
C79200	59.0-66.5	11.0-13.0	0.8-1.4	0.25	0.50	remainder

TABLE 2 Mechanical Requirements for Round Wire 0.020 to 0.250 in., Inclusive, in Diameter

Temper Designation		Tensile Strength, ksi				
		Copper Alloy UNS No.				
Code	Temper Name	C71000	C74500 and C75700	C75200	C76400 and C77000	C79200
H01	quarter-hard	55	73	68	74	70
		72	88	84	93	90
H02	half-hard	67	88	83	92	90
		83	103	97	110	110
H04	hard	77	108	99	112	104
		92	123	111	128	124
H08	spring					
0.020 to 0.0253 in., incl		90 min	130 min	...	130 min	...
Over 0.0253 to 0.0625 in., incl		88 min	125 min	...	125 min	...
Over 0.0625 to 0.125 in., incl		85 min	120 min	...	120 min	...
Over 0.125 to 0.250 in., incl		83 min	112 min	...	120 min	...
H14	super spring					
0.020 to 0.040 in.		100	...	...	...	...
		115	...	...	...	...

TABLE 3 Mechanical Requirements for Round Wire 0.50 to 6.0 mm, Inclusive, in Diameter

Temper Designation		Tensile Strength, MPa				
		Copper Alloy UNS No.				
Code	Temper Name	C71000	C74500 and C75700	C75200	C76400 and C77000	C79200
H01	quarter-hard	380	505	470	510	485
		495	605	580	640	620
H02	half-hard	460	605	570	635	620
		570	710	670	760	760
H04	hard	530	745	685	770	715
		635	850	765	885	855
H08	spring					
Over 0.50 to 0.65 mm, incl		620 min	895 min	...	895 min	...
Over 0.65 to 1.60 mm, incl		605 min	860 min	...	860 min	...
Over 1.60 to 3.0 mm, incl		585 min	825 min	...	825 min	...
Over 3.0 to 6.0 mm, incl		570 min	770 min	...	830 min	...
H14	super spring					
0.50 to 1.0 mm, incl		690	...	...	...	...
		795	...	...	...	...

TABLE 4 Grain Size Requirements for Annealed Wire

Copper Alloy UNS No.	Temper	Grain Size, mm		
		Nominal	Minimum	Maximum
C71000	OS015	0.015	...	0.030
C71000	OS035	0.035	0.025	0.050
C74500, C75200, C75700, C76400, C77000, and C79200	OS015	0.015	...	0.030
C74500, C75200, C75700, C76400, C77000, and C79200	OS035	0.035	0.025	0.050
C74500, C75200, C75700, C76400, and C77000	OS070	0.070	0.050	0.100

10.1.1.1 Tensile strength shall be the standard temper test for round wire in the size range noted above when ordered in the H (cold-worked) condition. Acceptance or rejection based upon mechanical properties shall depend upon the tensile test results obtained when tested in accordance with Test Methods **E8/E8M**.

10.1.2 Requirements for round wire in sizes smaller than 0.020 in. [0.50 mm] or larger than 0.250 in. [6.0 mm] shall be by agreement between the supplier and the purchaser.

10.1.3 Requirements for wire other than round shall be by agreement between the supplier and the purchaser.

11. Performance Requirements

11.1 Bending Requirements:

11.1.1 Wire of tempers H04 (hard), H08 (spring), and H14 (extra spring) in sizes up to 0.250 in. [6 mm] inclusive, shall withstand being bent cold through an angle of 120° on a radius equal to the diameter or distance between parallel surfaces of the wire, without developing cracks or other flaws visible to the unaided eye.

12. Dimensions, Mass and Permissible Variations

12.1 Refer to the appropriate paragraphs in Specification **B250/B250M** with particular reference to the following tables:

12.1.1 Diameter or Distance Between Parallel Surfaces—**Table 2**,

12.1.2 Thickness, Table 4,

12.1.3 Width, Table 6,

12.1.4 Length, Tables 7 and 8, and

12.1.5 Straightness, Table 9.

13. Test Methods

13.1 Chemical Analysis:

13.1.1 In cases of disagreement test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser.

13.1.2 The following table is a list of published test methods, some of which are considered by ASTM as no longer viable. These and others not listed may be used subject to agreement.

Element	Test Method
Copper	E478
Nickel and Cobalt	E478 (Gravimetric)
Lead	E478 (AA)
Iron	E478
Manganese	E62
Zinc (1 % max)	E478 (AA)
Zinc (>1 %)	E478 (Titrimetric)

13.1.3 Test Method(s) to be followed for the determination of elements required by contractual or purchase order agreement shall be as agreed upon between the supplier and the purchaser.

14. Keywords

14.1 copper-alloy wire; copper-nickel wire; general purpose wire; high strength wire; nickel silver wire; non-electrical wire; UNS No. C71000 wire; UNS No. C74500 wire; UNS No. C75200 wire; UNS No. C76400 wire; UNS No. C77000 wire; UNS No. C79200 wire

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification since the 2007 issue as follows:

(1) Minor editing to conform to Standard Guide B950 for Editorial Procedures.

(2) Made a few changes in the Metric Tensile Strengths to conform to Rational (within 5 MPa) rounding.

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