



Designation: B 206/B206M – 97

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Copper-Nickel-Zinc (Nickel Silver) Wire and Copper-Nickel Alloy Wire¹

This standard is issued under the fixed designation B 206/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 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 The values stated in inch-pound units or SI units are to be regarded separately as standard. Within the test, SI units are shown in brackets. The values in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

B 250 Specification for General Requirements for Wrought Copper-Alloy Wire²

B 250M Specification for General Requirements for Wrought Copper-Alloy Wire [Metric]²

B 601 Practice for Temper Designations for Copper and Copper Alloy-Wrought and Cast²

E 8 Test Methods for Tension Testing of Metallic Materials³

¹ This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rod, Bar, Wire, Shapes and Forgings.

Current edition approved Feb. 10, 1997. Published April 1997. Originally published as B 206 – 46T. Last previous edition B 206 – 93.

² Annual Book of ASTM Standards, Vol 02.01.

³ Annual Book of ASTM Standards, Vol 03.01.

E 8M Test Methods for Tension Testing of Metallic Materials [Metric]³

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁴

E 112 Test Methods for Determining Average Grain Size³

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

3. Terminology

3.1 For the definition of general terms related to copper and copper alloys, refer to Terminology B 846.

3.2 *Description of Terms Specific to This Specification:*

3.2.1 *unaided eye*—permits the use of corrective optical lenses necessary to obtain normal vision.

4. Ordering Information

4.1 Contracts or purchase orders for product to this specification should include the following information:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper Alloy UNS No. (Section 1),

4.1.3 Temper designation (Section 7),

4.1.4 Quantity—Total weight or length or number of pieces of each temper, form, or alloy.

4.1.5 Dimensions—Diameter, distance between parallel faces,

4.1.6 How furnished—specific lengths, coils, reels, etc., and

4.1.7 When product is purchased for agencies of the U.S. Government (B 250 or B250M).

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

4.2.1 Heat identification or traceability details,

4.2.2 Certification (B 250 or B250M), and

4.2.3 Mill Test Reports (B 250 or B250M).

5. Material and Manufacture

5.1 Material:

5.1.1 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

⁴ Annual Book of ASTM Standards, Vol 03.05.

be processed into the desired product.

5.2 Manufacture:

5.2.1 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.

6. Chemical Composition

6.1 The material composition shall conform to the requirements of Table 1 for the Copper Alloy UNS No. specified in the ordering information:

6.1.1 These compositional 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.

6.2 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 %.

6.3 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.

6.4 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.

7. Temper

7.1 Tempers, as defined in Practice B 601, available to this specification are as prescribed in Table 2, Table 3 and Table 4 in the various alloys and sizes listed.

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

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

8. Mechanical Property Requirements

8.1 Tensile Requirements:

8.1.1 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.

8.1.1.1 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 E 8 or E 8M.

8.1.2 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.

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

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 E 112.

9.1.1 Grain size shall be the standard temper test 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. Performance Requirements

10.1 Bending Requirements:

10.1.1 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.

11. Dimensions, Mass and Permissible Variations

11.1 Refer to the appropriate paragraphs in Specification B 250 or B 250M with particular reference to the following tables:

- 11.1.1 Diameter or Distance Between Parallel Surfaces—Table 2,
- 11.1.2 Thickness,
 - 11.1.2.1 B 250v—Table 4,
 - 11.1.2.2 B 250M—Table 3,
- 11.1.3 Width,
 - 11.1.3.1 B 250—Table 6,
 - 11.1.3.2 B 250M—Table 4,
- 11.1.4 Length,
 - 11.1.4.1 B 250—Tables 7 and 8,
 - 11.1.4.2 B 250M—Tables 5 and 6,
- 11.1.5 Straightness,
 - 11.1.5.1 B 250—Table 9, and
 - 11.1.5.2 B 250M—Table 7.

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

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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.				
Standard	Former	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 0.020 to 0.0253 in., incl Over 0.0253 to 0.0625 in., incl Over 0.0625 to 0.125 in., incl Over 0.125 to 0.250 in., incl	spring	90 min	130 min	...	130 min	...
		88 min	125 min	...	125 min	...
		85 min	120 min	...	120 min	...
		83 min	112 min	...	120 min	...
H14 0.020 to 0.040 in.	super spring	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.				
Standard	Former	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	740	685	770	715
		635	850	765	885	850
H08 Over 0.50 to 0.65 mm, incl Over 0.65 to 1.60 mm, incl Over 1.60 to 3.0 mm, incl Over 3.0 to 6.0 mm, incl	spring	620 min	900 min	...	900 min	...
		605 min	860 min	...	860 min	...
		585 min	830 min	...	830 min	...
		570 min	770 min	...	830 min	...
H14 0.50 to 1.0 mm, incl	super spring	690
		790

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

12. Test Methods

12.1 Chemical Analysis:

12.1.1 Material composition shall, in case of dispute, be determined as follows:

Element	Test Method
Copper	E 478
Nickel and Cobalt	E 478 (Gravimetric)
Lead	E 478 (AA)
Iron	E 478
Manganese	E 62
Zinc (1 % max)	E 478 (AA)

Zinc (>1 %)

E 478 (Titrimetric)

12.1.2 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.

13. General Requirements

13.1 The following sections of Specification B 250 or B 250M constitute a part of this specification:

- 13.1.1 Terminology,
- 13.1.2 Materials and Manufacture,
- 13.1.3 Workmanship, Finish and Appearance,
- 13.1.4 Sampling
- 13.1.5 Number of Tests and Retests,
- 13.1.6 Specimen Preparation,
- 13.1.7 Test Methods,
- 13.1.8 Significance of Numerical Limits,
- 13.1.9 Inspection,
- 13.1.10 Rejection and Rehearing,
- 13.1.11 Certification,
- 13.1.12 Test Reports (Mill),
- 13.1.13 Packaging and Package Marking, and
- 13.1.14 Supplemental Requirements.

13.2 In addition, when a section with a title identical to one

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of those referenced in 13.1 appears in this specification, it contains additional requirements that supplement those which appear in Specification B 250 or B 250M.

wire; high strength wire; nickel silver wire; non-electrical wire; UNS C71000 wire; UNS C74500 wire; UNS C75200 wire; UNS C76400 wire; UNS C77000 wire; UNS C79200 wire

14. Keywords

14.1 copper-alloy wire; copper-nickel wire; general purpose

SUPPLEMENTARY REQUIREMENTS

This section identifies the principal changes to this specification since the 1993 issue as follows.

1. Combined customary inch-lb and metric unit specifications into a single document and revised the scope accordingly.
2. Added items to the Referenced Documents section.
3. Completely changed the General Requirements section.
4. Added Terminology, Ordering Information and Material and Manufacture sections.
5. Changed wording to clarify the Chemical Composition section.
6. Other general revisions were made to conform to the ASTM Form and Style and B5 Outline of Form guidelines.

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