Designation: B151/B151M – 13

Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar[1]

This standard is issued under the fixed designation B151/B151M; 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.

1. Scope*

1.1 This specification establishes the requirements for copper-nickel-zinc and copper-nickel rod and bar for general application produced from Copper Alloy UNS Nos. C70600, C70620, C71500, C71520, C74500, C75200, C75700, C76400, C77000, and C79200.

1.1.1 Copper Alloys UNS Nos. C70620 and C71520 are for product intended for welding applications.

1.1.2 *Units*—The values stated in either inch-pound 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.

NOTE 1—Requirements for copper-nickel-zinc alloy wire appear in Specification B206/B206M.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B206/B206M Specification for Copper-Nickel-Zinc (Nickel Silver) Wire and Copper-Nickel Alloy Wire

B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

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

E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)[3]

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B249/B249M constitute a part of this specification:

3.1.1 Terminology,
3.1.2 Material 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 Report,
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, above, appears in this specification, it contains additional requirements which supplement those appearing in Specifications B249/B249M.

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 (for example, B151/B151M – XX),

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

5.1.3 Temper (Section 8 and Tables 2-6),

[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] 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**

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, % max (unless shown as range or min)								
	Copper, Incl Silver	Nickel, Incl Cobalt	Lead	Iron	Manganese	Zinc	Phosphorous	Sulfur	Carbon
C70600	remainder	9.0-11.0	0.05	1.0-1.8	1.0	1.0	. . .	. . .	. . .
C70620	86.5 min	9.0-11.0	0.02	1.0-1.8	1.0	0.50	0.02	0.02	0.05
C71500	remainder	29.0-33.0	0.05	0.40-1.0	1.0	1.0	. . .	. . .	. . .
C71520	65.0 min	29.0-33.0	0.02	0.40-1.0	1.0	0.50	0.02	0.02	0.05
C74500	63.5-66.5	9.0-11.0	0.05	0.25	0.50	remainder	. . .	. . .	. . .
C75200	63.0-66.5	16.5-19.5	0.05	0.25	0.50	remainder	. . .	. . .	. . .
C75700	63.5-66.5	11.0-13.0	0.05	0.25	0.50	remainder	. . .	. . .	. . .
C76400	58.5-61.5	16.5-19.5	0.05	0.25	0.50	remainder	. . .	. . .	. . .
C77000	53.5-56.5	16.5-19.5	0.05	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 Grain Size Requirements for OS (Annealed) Temper Rod and Bar

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

TABLE 3 Tensile Requirements for Copper-Nickel-Zinc Alloy Rod and Bar (Inch-Pound Units)

NOTE 1—SI values are stated in Table 4.

Temper Designation	Diameter or Distance Between Parallel Surfaces, in.	Tensile Strength, ksi			
		Copper Alloy UNS Nos. C75200 and C79200		Copper Alloy UNS Nos. C74500, C75700, C76400, and C77000	
		Min	Max	Min	Max
	Rod: round				
H01	0.02 to 0.50, incl	60	80	75	95
	Rod: round, hexagonal, octagonal				
H04	0.02 to 0.25, incl	80	100	90	110
	Over 0.25 to 0.50, incl	70	90	80	100
	Over 0.50 to 1.0, incl	65	85	75	95
	Over 1.0	60	80	70	90
H04	Bar: square, rectangular				
	all sizes	68	88	75	95

TABLE 4 Tensile Requirements for Copper-Nickel-Zinc Alloy Rod and Bar [SI Units]

NOTE 1—Inch-Pound values are stated in Table 3.

Temper Designation	Diameter or Distance Between Parallel Surfaces, mm	Tensile Strength, MPa			
		Copper Alloy UNS Nos C75200 and C79200		Copper Alloy UNS Nos C74500, C75700, C76400 and C77000	
		Min	Max	Min	Max
	Rod: round				
H01	0.5 to 10, incl	415	550	515	655
	Rod: round, hexagonal octagonal				
H04	0.5 to 6.5 incl	550	690	620	760
	Over 6.5 to 10, incl	485	620	550	690
	Over 10 to 25, incl	450	590	515	655
	Over 25	415	550	485	620
H04	Bar: square, rectangular				
	all sizes	470	605	515	650

5.1.4 Form: cross section such as round, hexagonal, square, and so forth (Section 12),

5.1.5 Diameter or distance between parallel surfaces, length (Section 12),

5.1.6 Weight: total for each form, size, and temper, 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 (Section 4.1 of Specification B249/B249M),

5.2.2 Certification (Section 15 of Specification B249/B249M),

5.2.3 Test report (Section 16 of Specification B249/B249M), and

5.2.4 When material is purchased for agencies of the U.S. Government (Section 11).

6. Materials and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture as specified in the contract or purchase order, shall be of one of Copper Alloy UNS Nos. C70600, C70620, C71500, C71520, C74500, C75200, C75700, C76400, C77000, or C79200.

7. Chemical Composition

7.1 The product shall conform to the chemical composition requirements 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. By agreement between the manufacturer and the purchaser, limits may be established and analysis required for unnamed elements.

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

7.3 For alloys in which zinc is listed as “remainder,” either copper or zinc may be taken as the difference between the sum of all elements determined and 100 %.

TABLE 5 Tensile Requirements for Copper-Nickel Alloy Rod and Bar (Inch-Pound Units)

NOTE 1—SI values are stated in Table 6.

Temper Designation	Diameter or Distance Between Parallel Surfaces, in.		Tensile Strength, min, ksi	Yield Strength at 0.5 % Extension Under Load, min, ksi	Elongation in 4× Diameter or Thickness of Specimen, min, %[A]
	Copper Alloy UNS Nos. C70600 and C70620				
O60, M30	round, hexagonal, and octagonal rods and square bars	all sizes	38	15	30
H04	round, hexagonal, and octagonal rods and square bars	up to ⅜, incl	60	38	10
		over ⅜ to 1, incl	50	30	15
		over 1 to 3, incl	40	15	30
		over 3 to 5, incl	38	15	20
O60	rectangular bars and shapes	all sizes	38	15	30
		For Thicknesses			
H04	rectangular bars	up to ⅜, incl	55	30	10
		over ⅜ to ½ incl	50	28	12
		over ½ to 3	40	17	20
H04	shapes	all sizes	(As agreed upon between the manufacturer or supplier and the purchaser)		
	Copper Alloy UNS Nos. C71500 and C71520				
O60, M30	round, hexagonal, and octagonal rods and square bars	up to ½, incl	52	18	30
		over ½ to 1, incl	48	18	30
		over 1	45	18	30
H01	round, hexagonal, and octagonal rods and square bars	up to ½, incl	65	50	10
		over ½ to 1, incl	60	45	15
		over 1 to 3, incl	55	35	20
		over 3 to 5, incl	45	18	20
H04		up to ½, incl	80	60	8
		over ½ to 1, incl	75	58	10
		over 1 to 2, incl	70	55	10
O60	rectangular bars and shapes	all sizes	45	15	30
		For Thicknesses			
H04	rectangular bars	up to ½, incl	75	55	7
		over ½ to 1, incl	70	50	10
H04	shapes	all sizes	(As agreed upon between the manufacturer or supplier and the purchaser)		

[A] In any case, a minimum gage length of 1 in. shall be used.

7.4 When all elements listed in Table 1 for a specified alloy are determined, the sum of results shall be 99.5 % minimum.

8. Temper

8.1 The standard tempers for products described in this specification and as defined in Classification B601 are: O60, OS015, OS035, OS070, M30, H01, and H04 as given in Tables 2-6.

NOTE 2—The purchaser should confer with the manufacturer or supplier concerning the availability of a specific form and temper.

8.2 Other tempers, and tempers for other products including shapes, shall be subject to agreement between the manufacturer and the purchaser.

9. Grain Size of Annealed Tempers

9.1 Grain size shall be the standard requirement for all product in the annealed tempers.

9.1.1 Product in the OS temper shall conform to the grain size requirement prescribed in Table 2 for the specified copper alloy and temper.

9.1.2 Grain size shall be the basis for acceptance or rejection for OS temper product produced from Copper Alloy UNS Nos. C74500, C75200, C75700, C76400, C77000, and C79200.

10. Mechanical Property Requirements

10.1 *Tensile Strength Requirement:*

10.1.1 Product of Copper-Nickel-Zinc Alloys UNS Nos. C74500, C75200, C75700, C76400, C77000, and C79200 in Tempers H01 and H04 furnished under this specification shall conform to the tensile requirements prescribed in Tables 3 and 4 for the specified shape and size. The tensile strength shall be the basis of acceptance or rejection for product in these tempers.

10.1.2 Product of Copper-Nickel Alloys UNS Nos. C70600, C70620, C71500, and C71520 in Tempers H01, H04, M30, and O60 furnished under this specification shall conform to the tensile requirements prescribed in Tables 5 and 6 for the specified shape and size. The tensile properties shall be the basis of acceptance or rejection for all tempers.

11. Purchases for U.S. Government Agencies

11.1 When specified in the contract or purchase order, product purchased for agencies of the U.S. Government shall conform to the special government regulations specified in the Supplementary Requirements section of Specification B249/B249M.

12. Dimensions, Mass, and Permissible Variations

12.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B249/B249M with particular reference to the following tables and related paragraphs:

12.1.1 *Diameter or Distance Between Parallel Surfaces:*

TABLE 6 Tensile Requirements for Copper-Nickel Alloy Rod and Bar [SI Units]

NOTE 1—Inch-pound values are stated in Table 5.

Temper Designation	Diameter or Distance Between Parallel Surfaces, mm		Tensile Strength, min, MPa	Yield Strength at 0.5 % Extension Under Load, min, MPa	Elongation in 4× Diameter or Thickness of Specimen, min, %[A]
	Copper Alloy UNS Nos. C70600 and C70620				
O60, M30	round, hexagonal, and octagonal rods and square bars	all sizes	260	105	30
H04	round, hexagonal, and octagonal rods and square bars	up to 9.5, incl	415	260	10
		over 9.5 to 25, incl	345	205	15
		over 25 to 80, incl	275	105	30
		over 80 to 125, incl	260	105	20
O60	rectangular bars and shapes	all sizes	260	105	30
		For Thicknesses			
H04	rectangular bars	up to 9.5, incl	380	205	10
		over 9.5 to 12, incl	345	195	12
		over 12 to 80, incl	275	115	20
H04	shapes	all sizes	(As agreed upon between the manufacturer or supplier and the purchaser)		
	Copper Alloy UNS Nos. C71500 and C71520				
O60, M30	round, hexagonal, and octagonal rods and square bars	up to 12, incl	360	125	30
		over 12 to 25, incl	330	125	30
		over 25	310	125	30
H01	round, hexagonal, and octagonal rods and square bars	up to 12, incl	450	345	10
		over 12 to 25, incl	415	310	15
		over 25 to 80, incl	380	240	20
		over 80 to 125, incl	310	125	20
H04		up to 12, incl	550	415	8
		over 12 to 25, incl	515	400	10
		over 25 to 50, incl	485	380	10
O60	rectangular bars and shapes	all sizes	310	105	30
		For Thicknesses			
H04	rectangular bars	up to 12, incl	515	380	7
		over 12 to 25, incl	485	345	10
H04	shapes	all sizes	(As agreed upon between the manufacturer or supplier and the purchaser)		

[A] In any case, a minimum gage length of 25 mm shall be used.

12.1.1.1 Rod: round/hexagonal, octagonal—cold-drawn rod, Table 2.

12.1.1.2 Bar: rectangular and square—thickness, width, Tables 9 and 11.

12.1.2 Length—length tolerances, schedule of length, Tables 13 and 15.

12.1.3 Straightness tolerances for rod, bar, and shapes, Table 16.

12.1.4 Edge contours—see identically titled section.

13. Test Methods

13.1 The test method(s) used for quality control or production control, or both, for the determination of conformance with product property requirements are discretionary.

13.1.1 The test method(s) used to obtain data for the preparation of certification or test report, or both, shall be made available to the purchaser on request.

13.2 *Chemical Analysis*—In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. 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	Range, %	Method
Copper	53–90	E478
Iron	0.02–8	E75
Lead	0.05–1.5	E478 (AA)
Manganese	0.05–1.0	E75
Nickel	8–34	E478 (Gravimetric)
Zinc	0–1.0	E478 (AA)
Zinc	2–40	E478 (Titrimetric)
Sulfur	0-0.1	E478 (AA)
Phosphorus	0-1.0	E478 (AA)
Carbon	0.01-1.0	E76

14. Keywords

14.1 copper alloy bar; copper alloy rod; copper-nickel alloy bar; copper-nickel alloy rod; copper-nickel-zinc alloy bar; copper-nickel-zinc alloy rod; cupronickel bar; cupronickel rod; nickel silver bar; nickel silver rod; UNS C70600 bar; UNS C71500 bar; UNS C74500 bar; UNS C75200 bar; UNS C75700 bar; UNS C76400 bar; UNS C77000 bar; UNS C79200 bar; UNS C70600 rod; UNS C71500 rod; UNS C74500 rod; UNS C75200 rod; UNS C75700 rod; UNS C76400 rod; UNS C77000 rod; UNS C79200 rod ; UNS C70620; UNS C71520

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the 2011 issue as follows:

(1) General editorial modifications were incorporated in accordance with Guide B950.

(2) P and S limits were removed from C70600 as they appeared to have been an earlier error.