



Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar¹

This standard is issued under the fixed designation B 151/B 151M; 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 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 The values stated in either inch-pound or SI units are to be regarded separately as standard. 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 B 206/B 206M.

2. Referenced Documents

2.1 ASTM Standards:

B 206/B 206M Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) Wire and Copper-Nickel Alloy Wire²

B 249 Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings²

B 249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings [Metric]²

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast²

B 846 Terminology for Copper and Copper Alloys²

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys³

E 76 Test Methods for Chemical Analysis of Nickel-Copper Alloys³

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 Annual Book of ASTM Standards, Vol 02.01.

³ Annual Book of ASTM Standards, Vol 03.05.

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

3. General Requirements

3.1 The following sections of Specifications B 249 or B 249M are 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 Specimen Preparation,

3.1.6 Test Methods,

3.1.7 Inspection,

3.1.8 Certification,

3.1.9 Report, and

3.1.10 Packaging and Package Marking.

3.2 In addition, when a section with a title identical to that referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specifications B 249 or B 249M.

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

5. Ordering Information

5.1 Include the following information in the contract or purchase order:

5.1.1 ASTM designation and year of issue (for example, B 151/B 151M – XX),

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

5.1.3 Temper (Section 8 and Tables 2, 3, and 4),

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

5.2 The following options are available and should be specified in the contract or purchase order when required:

⁴ Annual Book of ASTM Standards, Vol 03.06.

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

- 5.2.1 Heat identification or traceability detail,
- 5.2.2 Certification, and
- 5.2.3 Test report.

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 No. C70600, C70620, C71500, C71520, C74500, C75200, C75700, C76400, C77000, or C79200.

7. Chemical Composition

7.1 The product shall conform to the chemical compositional requirements prescribed in Table 1 for the Copper Alloy UNS No. designation specified in the contract or purchase order.

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

7.2 For copper alloys in which zinc or copper is specified as the remainder, zinc or copper may be taken as the difference between the sum of results for all elements determined and 100 %.

7.3 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 available under this specification and as defined in Practice B 601 are: O60, OS035, OS070, H01, and H04 are given in Tables 2-4.

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:*

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.

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

| Temper Designation | Diameter or Distance Between Parallel Surfaces, in. [mm] | Tensile Strength, ksi [MPa] ^A | | | |
|--------------------|--|--|-----------|--|-----------|
| | | Copper Alloy UNS Nos. C75200 and C79200 | | Copper Alloy UNS Nos. C74500, C75700, C76400, and C77000 | |
| | | Min | Max | Min | Max |
| H01 | Rod: round | 60 [415] | 80 [550] | 75 [515] | 95 [655] |
| | 0.02 to 0.50 [0.5 to 10], incl | | | | |
| H04 | Rod: round, hexagonal, octagonal | 80 [550] | 100 [690] | 90 [620] | 110 [760] |
| | 0.02 to 0.25 [0.5 to 6.5], incl | | | | |
| | Over 0.25 to 0.50 [6.5 to 10], incl | 70 [485] | 90 [620] | 80 [550] | 100 [690] |
| | Over 0.50 to 1.0 [10 to 25], incl | 65 [450] | 85 [590] | 75 [515] | 95 [655] |
| H04 | Bar: square, rectangular all sizes | 60 [415] | 80 [550] | 70 [485] | 90 [620] |
| | Over 1.0 [25] | 68 [470] | 88 [605] | 75 [515] | 95 [650] |

10. Mechanical Property Requirements

10.1 *Tensile Requirement:*

10.1.1 Copper-Nickel-Zinc Alloys UNS Nos. C74500, C75200, C75700, C76400, C77000, and C79200 in Tempers H01 and H04 shall conform to the requirement prescribed in Table 3 for the specified shape and size and the tensile strength shall be the basis of acceptance or rejection for product in these tempers.

10.1.2 Copper-Nickel Alloys UNS Nos. C70600, C70620, C71500, and C71520 in Tempers H01, H04, and O60 shall conform to the requirement prescribed in Table 4 for the specified shape and size, and the tensile properties shall be the basis of acceptance or rejection for all tempers.

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 | 0.02 | 0.02 | ... |
| 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 | 63.5-66.5 | 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 4 Tensile Requirements for Copper-Nickel Alloy Rod and Bar

| Temper Designation | Diameter or Distance Between Parallel Surfaces, in. [mm] | | Tensile Strength, min, ksi [MPa] | Yield Strength at 0.5 % Extension Under Load, min, ksi [MPa] | Elongation in 4× Diameter or Thickness of Specimen, min, % ^A |
|---|--|-----------------------|---|--|---|
| Copper Alloy UNS Nos. C70600 and C70620 | | | | | |
| O60 | round, hexagonal, and octagonal rods and square bars | all sizes | 38 [260] | 15 [105] | 30 |
| H04 | round, hexagonal, and octagonal rods and square bars | up to 3/8, incl | 60 [415] | 38 [260] | 10 |
| | | over 3/8 to 1, incl | 50 [345] | 30 [205] | 15 |
| | | over 1 to 3 | 40 [275] | 15 [105] | 30 |
| O60 | rectangular bars and shapes | all sizes | 38 [260] | 15 [105] | 30 |
| For Thicknesses | | | | | |
| H04 | rectangular bars | up to 3/8, incl | 55 [380] | 30 [205] | 10 |
| | | over 3/8 to 1/2, incl | 50 [345] | 28 [195] | 12 |
| | | over 1/2 to 3 | 40 [275] | 17 [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 | round, hexagonal, and octagonal rods and square bars | up to 1/2, incl | 52 [360] | 18 [125] | 30 |
| | | over 1/2 to 1, incl | 48 [330] | 18 [125] | 30 |
| | | over 1 | 45 [310] | 18 [125] | 30 |
| H01 | round, hexagonal, and octagonal rods and square bars | up to 1/2, incl | 65 [450] | 50 [345] | 10 |
| | | over 1/2 to 1, incl | 60 [415] | 45 [310] | 15 |
| | | over 1 to 3, incl | 55 [380] | 35 [240] | 20 |
| H04 | | up to 1/2, incl | 80 [550] | 60 [415] | 8 |
| | | over 1/2 to 1, incl | 75 [515] | 58 [400] | 10 |
| | | over 1 to 2, incl | 70 [485] | 55 [380] | 10 |
| O60 | rectangular bars and shapes | all sizes | 45 [310] | 15 [105] | 30 |
| For Thicknesses | | | | | |
| H04 | rectangular bars | up to 1/2, incl | 75 [515] | 55 [380] | 7 |
| | | over 1/2 to 1, incl | 70 [485] | 50 [345] | 10 |
| H04 | shapes | all sizes | (As agreed upon between the manufacturer or supplier and the purchaser) | | |

^AIn any case, a minimum gage length of 1 in. [25.4 mm] shall be used.

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 Supplemental Requirements section of Specifications B 249 or B 249M.

12. Dimensions, Mass, and Permissible Variations

12.1 The following titled sections and tables in Specifications B 249 or B 249M are a part of this specification:

12.1.1 Diameter or Distance Between Parallel Surfaces:

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

12.1.1.2 Bar: rectangular and square—thickness, width.

12.1.2 Length—length tolerances, schedule of length.

12.1.3 Straightness tolerances for rod, bar, and shapes.

12.1.4 Edge contours—see identically titled clause.

13. Number of Tests and Retests

13.1 Tests:

13.1.1 Chemical Analysis:

13.1.1.1 Chemical composition shall be determined as the per element mean of results from at least two replicate determinations of the sample(s) and the results of each replication shall conform to compositional requirements.

13.1.2 Other Tests:

13.1.2.1 Grain size and tensile properties shall be determined from specimens prepared from each of two sample pieces selected for tests and each specimen shall conform to test requirement(s).

13.2 Retests:

13.2.1 When requested by the manufacturer or supplier, a retest may be permitted when test results obtained by the purchaser fail to conform with the product specification requirement(s).

13.2.2 Retesting shall be as directed in the product specification for the initial test except for the number of test specimens, which shall be twice that normally required for the test. Test results for all specimens shall conform to the product specification requirement(s) in retest and failure to comply shall be cause for lot rejection.

14. Test Methods

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

14.1.1 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.

14.2 Chemical Analysis—Chemical composition shall be

determined, in case of disagreement, as follows:

| Element | Range, % | Method |
|------------|----------|---------------------|
| Copper | 53–90 | E 478 |
| Iron | 0.02–8 | E 75 |
| Lead | 0.05–1.5 | E 478 (AA) |
| Manganese | 0.05–1.0 | E 75 |
| Nickel | 8–34 | E 478 (Gravimetric) |
| Zinc | 0–1.0 | E 478 (AA) |
| Zinc | 2–40 | E 478 (Titrimetric) |
| Sulfur | 0-0.1 | E 478 (AA) |
| Phosphorus | 0-1.0 | E 478 (AA) |
| Carbon | 0.01-1.0 | E 76 |

15. Rejection and Rehearing

15.1 Rejection:

15.1.1 Product that fails to conform to the requirements of this product specification is subject to rejection.

15.1.2 Rejection shall be reported to the manufacturer or supplier, promptly and in writing.

15.1.3 In case of disagreement or dissatisfaction with the results of the test upon which rejection was based, the manufacturer or supplier may take claim for a rehearing.

15.2 Rehearing:

15.2.1 As a result of product rejection, the manufacturer or supplier may make claim to the purchaser for retest to be conducted by the manufacturer or supplier and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and tested by both parties as directed in the product specification, or, alternatively, upon agreement between both parties, an independent laboratory may be selected for the tests using the test methods prescribed in this product specification.

16. Keywords

16.1 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 location of selected changes to this standard since the B 151 – 94 issue that may impact its use.

(1) Table 1, Chemical Requirements, was updated and Alloys UNS No. C70620 and C71520 were added.

(2) Specifications B 151 and B 151M were combined and B 151M withdrawn concurrently.

(3) Section 4, Terminology, was added.

(4) General editorial modifications were incorporated to meet current form and style guidelines.

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