



Designation: **B466/B466M – 14 B466/B466M – 18**

Standard Specification for Seamless Copper-Nickel Pipe and Tube¹

This standard is issued under the fixed designation B466/B466M; 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 seamless copper-nickel pipe and tube in straight lengths, suitable for general engineering purposes. The alloys involved are copper alloys UNS Nos. C70400, C70600, C70620, C71000, C71500, C71520, and C72200.

1.1.1 Copper alloys UNS Nos. C70620 and C71520 are intended for product that will be subsequently welded.

1.2 *Units*—Values stated in either SI units or inch-pound 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 specification.

1.3 The following safety hazard caveat pertains only to the test methods described in this specification:

1.3.1 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[B153 Test Method for Expansion \(Pin Test\) of Copper and Copper-Alloy Pipe and Tubing](#)

[B251/B251M Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube \(Metric\)](#)
[B0251-B0251M](#)

~~[B251M Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube \(Metric\) \(Withdrawn 2017\)](#)~~³

[B846 Terminology for Copper and Copper Alloys](#)

~~[B950 Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys](#)~~

[B968/B968M Test Method for Flattening of Copper and Copper-Alloy Pipe and Tube](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E18 Test Methods for Rockwell Hardness of Metallic Materials](#)

[E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes \(Withdrawn 2002\)](#)³

[E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\) \(Withdrawn 2010\)](#)³

[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

[E118 Test Methods for Chemical Analysis of Copper-Chromium Alloys \(Withdrawn 2010\)](#)³

[E243 Practice for Electromagnetic \(Eddy Current\) Examination of Copper and Copper-Alloy Tubes](#)

[E478 Test Methods for Chemical Analysis of Copper Alloys](#)

¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.04 on Pipe and Tube.

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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



2.2 Other Standard:⁴

[ASME Boiler and Pressure Vessel Code](#)

3. General Requirements

3.1 The following sections of Specification ~~B251~~[B251/B251M](#) or ~~B251M~~ constitute a part of this specification:

- 3.1.1 Terminology,
- 3.1.2 Materials and Manufacture,
- 3.1.3 Dimensions, Mass, and Permissible Variations,
- 3.1.4 Workmanship, Finish, and Appearance,
- 3.1.5 Sampling,
- 3.1.6 Number of Tests and Retests,
- 3.1.7 Test Specimens,
- 3.1.8 Test Methods,
- 3.1.9 Significance of Numerical Limits,
- 3.1.10 Inspection,
- 3.1.11 Rejection and Rehearing,
- 3.1.12 Certification,
- 3.1.13 Packing and Package Marking, and
- 3.1.14 Mill Test Report.

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 Specification ~~B251~~[B251/B251M](#) or ~~B251M~~.

4. Terminology

4.1 *Definitions*—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,
- 5.1.2 Copper Alloy UNS No. (Scope section),
- 5.1.3 Temper (Temper section),
- 5.1.4 Dimensions; diameter or distance between parallel surfaces, wall thickness, or size (see also [Table X1.1](#)).
- 5.1.5 Total length, total weight, or number of pieces of each, and
- 5.1.6 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 When tension tests are required for large diameter tube (Mechanical Property Requirements section),
- 5.2.2 Hydrostatic Test (Nondestructive Test Requirements section),
 - 5.2.2.1 If the product needs to be subjected to a pressure gage reading over 1000 psi [7 MPa].
- 5.2.3 Pneumatic Test (Nondestructive Test Requirements section),
- 5.2.4 Heat identification or traceability requirements, or both,
- 5.2.5 Certification (Specification ~~B251~~[B251/B251M](#) or ~~B251M~~),
- 5.2.6 Mill test report (Specification ~~B251~~[B251/B251M](#) or ~~B251M~~),
- 5.2.7 When product is ordered for ASME Boiler & Pressure Vessel Code Application,
- 5.2.8 When the product in alloys C71000 or C72200 is to be subsequently welded ([Table 1](#), Footnote A), and
- 5.2.9 When product is purchased for an agency of the U.S. Government (Purchases for U.S. Government section).

6. Materials and Manufacture

6.1 *Materials*—The material of manufacture shall be cast billets of copper alloys UNS Nos. C70400, C70600, C70620, C71000, C71500, C71520, and C72200 of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.2 *Manufacture*—The product shall be manufactured by such hot extrusion or piercing and subsequent cold working and annealing as to produce a uniform, seamless wrought structure in the finished product.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in [Table 1](#) for the copper alloy UNS No. designation specified in the ordering information.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.



TABLE 1 Chemical Requirements

| Copper Alloy UNS Nos. | Composition, % | | | | | | | | | |
|--------------------------|-----------------------|-----------------------|-------------------|-------------|------------------|--------------|----------------|--------------------|-------------|-------------------------|
| | Copper incl Silver | Nickel incl Cobalt | Lead, max | Iron | Zinc, max | Manganese | Sulfur, max | Phosphorus, max | Chromium | Other Named Elements |
| C70400 | remainder | 4.8 to 6.2 | 0.05 | –1.3 to 1.7 | 1.0 | –0.30 to 0.8 | 0.02 | 0.02 | ... | ... |
| C70400 | remainder | 4.8 to 6.2 | 0.05 | 1.3 to 1.7 | 1.0 | 0.30 to 0.8 | 0.02 | 0.02 | ... | ... |
| C70600 | remainder | –9.0 to 11.0 | 0.05 | –1.0 to 1.8 | 1.0 | 1.0 max | ... | ... | ... | ... |
| C70600 | remainder | 9.0 to 11.0 | 0.05 | 1.0 to 1.8 | 1.0 | 1.0 max | ... | ... | ... | ... |
| C70620 | 86.5 min | 9.0 to 11.0 | 0.02 | 1.0 to 1.8 | 0.50 | 1.0 max | 0.02 | 0.02 | ... | Carbon 0.05 max |
| C71000 | remainder | 19.0 to 23.0 | 0.05 ^A | –0.5 to 1.0 | 1.0 ^A | 1.0 max | 0.02 | 0.02 | ... | ... |
| C71000 | remainder | 19.0 to 23.0 | 0.05 ^A | 0.5 to 1.0 | 1.0 ^A | 1.0 max | 0.02 | 0.02 | ... | ... |
| C71500 | remainder | 29.0 to 33.0 | 0.05 | 0.40 to 1.0 | 1.0 | 1.0 max | ... | ... | ... | ... |
| C71520 | 65.0 min | 29.0 to 33.0 | 0.02 | 0.40 to 1.0 | 0.50 | 1.0 max | 0.02 | 0.02 | ... | Carbon 0.05 max |
| C72200 | remainder | 15.0 to 18.0 | 0.05 ^A | 0.50 to 1.0 | 1.0 ^A | 1.0 max | 0.02 | 0.02 | 0.30 to 0.7 | max ^{A,B} |

^A When the product is for subsequent welding applications, and so specified by the purchaser, zinc shall be 0.50 % max, lead 0.02 % max, and carbon 0.05 % max.

^B Silicon 0.03 max, titanium 0.03 max.

7.2 These composition limits do not preclude the presence of other elements. By agreements between the manufacturer and purchaser, limits may be established and analysis required for unnamed elements.

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

7.2.2 When all elements in Table 1 are determined, the sum of results shall be as shown below:

| Copper Alloy UNS No. | Copper Plus Named Elements, % min |
|----------------------|--------------------------------------|
| C70400 | 99.5 |
| C70600 & C70620 | 99.5 |
| C71000 | 99.5 |
| C71500 & C71520 | 99.5 |
| C72200 | 99.8 |

8. Temper

8.1 The standard tempers for products described in this specification are given in Table 2.

8.1.1 *Annealed Temper*—O60 (soft anneal).

8.1.2 *Drawn Tempers*—H55 (light drawn), H80 (hard drawn), or HE80 (hard drawn and end annealed).

NOTE 1—The H55 (light drawn) temper is used only when product of some stiffness yet capable of being bent is needed. The H80 (hard drawn) temper is used only when there is a need for material as strong as commercially feasible.

TABLE 2 Mechanical Requirements

| Temper Code | Temper Name | Copper Alloy UNS Nos. | Tensile Strength, min | | Yield Strength, ^A min | | Rockwell ^B Hardness 30 T |
|-------------|--------------------------|--------------------------|--------------------------|-----|-------------------------------------|-----|---|
| | | | ksi | MPa | ksi | MPa | |
| O60 | Soft anneal ^C | C70400 | 37 | 255 | 12 | 85 | 45 max |
| | | C70600 & C70620 | 38 | 260 | 13 | 90 | 45 max |
| | | C71000 | 45 | 310 | 16 | 110 | 48 max |
| | | C71500 & C71520 | 52 | 360 | 18 | 125 | 51 max |
| | | C72200 | 40 | 275 | 14 | 95 | 45 max |
| H55 | Light drawn | C70400 | 40 | 275 | 30 | 205 | 41 to 65 |
| | | C70600 & C70620 | 45 | 310 | 35 | 240 | 45 to 70 |
| | | C72200 | 48 | 330 | 42 | 290 | 55 to 70 |
| H80 | Hard drawn | C70400 | 45 | 310 | 35 | 240 | 60 min |
| | | C70600 & C70620 | 50 | 345 | 40 | 275 | 63 min |
| | | C71000 | 55 | 380 | 43 | 295 | 67 min |
| | | C71500 & C71520 | 70 | 485 | 45 | 310 | 70 min |
| | | C72200 | 55 | 380 | 44 | 305 | 67 min |

^A At 0.5 % extension under load.

^B Rockwell hardness values shall apply only to tube or pipe having a wall thickness of 0.020 in. [0.5 mm] or over and an outside diameter of 5/16 in. [8 mm] or over. For all other tube no Rockwell hardness values shall apply. Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values may be specified subject to agreement between the manufacturer and the purchaser.

^C Although no minimum grain size is specified, the product must nevertheless have fully recrystallized grain structure.