



Designation: B111/B111M – 24

Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock¹

This standard is issued under the fixed designation B111/B111M; 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 specification² covers the requirements for seamless tube and ferrule stock of copper and various copper alloys up to 3 1/8 in. [80 mm] inclusive, in diameter, for use in surface condensers, evaporators, and heat exchangers. The following coppers and copper alloys are specified:³

Copper or Copper Alloy UNS No.	Previously Used Designation	Description
C10100	OFE	Oxygen-free electronic
C10200	OF ^A	Oxygen-free without residual deoxidants
C10300	...	Oxygen-free, extra low phosphorus
C10800	...	Oxygen-free, low phosphorus
C12000	DLP ^A	Phosphorized, low residual phosphorus
C12200	DHP ^A	Phosphorized, high residual phosphorus
C14200	DPA ^A	Phosphorized, arsenical
C15630	...	Nickel Phosphorus
C19200	...	Phosphorized, 1 % iron
C23000	...	Red Brass
C28000	...	Muntz Metal
C44300	...	Admiralty Metals, B, C, and D
C44400	...	...
C44500	...	...
C60800	...	Aluminum Bronze
C61300	...	...
C61400	...	Aluminum Bronze, D
C68700	...	Aluminum Brass, B
C70400	...	95-5 Copper-Nickel
C70600	...	90-10 Copper-Nickel
C70620	...	90-10 Copper-Nickel—Welding Grade
C71000	...	80-20 Copper-Nickel
C71500	...	70-30 Copper-Nickel
C71520	...	70-30 Copper-Nickel—Welding Grade

Copper or Copper Alloy UNS No.	Previously Used Designation	Description
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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 ASME Boiler and Pressure Vessel Code applications, see related Specification SB-111 in Section II of the Code.

³ The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix “C” and a suffix “00.” The suffix can be used to accommodate composition variations of the base alloy.

C71640	...	Copper-nickel-iron-manganese
C72200	...	...

^A Designations listed in Classification B224.

1.2 *Units*—The values stated in either inch-pound units 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 non-conformance with the standard.

1.3 The following safety hazards caveat pertains only to the test method(s) portion in Section 17 of this specification. *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. (Warning—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Caution when handling mercury and mercury containing products. See the applicable product Safety Data Sheet (SDS) for additional information. Users should be aware that selling mercury or mercury containing products, or both, into your state or country may be prohibited by law.*

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*:⁴
B153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing

⁴ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

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

B154 Test Method for Mercurous Nitrate Test for Copper Alloys
B170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes
B224 Classification of Coppers
B846 Terminology for Copper and Copper Alloys
B858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in 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
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry (Withdrawn 2022)⁵
E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)⁵
E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁵
E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)⁵
E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)⁵
E112 Test Methods for Determining Average Grain Size
E118 Test Methods for Chemical Analysis of Copper-Chromium Alloys (Withdrawn 2010)⁵
E243 Practice for Electromagnetic (Eddy Current) Examination of Copper and Copper-Alloy Tubes
E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition
E478 Test Methods for Chemical Analysis of Copper Alloys
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms relating to copper and copper alloys, refer to Terminology **B846**.

4. Ordering Information

4.1 Include the following specified choices when placing orders for product under this specification, as applicable:

- 4.1.1 ASTM Designation and year of issue;
- 4.1.2 Copper or Copper Alloy UNS No. Designation (see **Table 1**);
- 4.1.3 Temper (Section 7);
- 4.1.4 Dimensions, outside diameter, and wall thickness, whether minimum or nominal (Section 12);
- 4.1.5 How furnished (tube or ferrule stock);
- 4.1.6 Quantity—Total weight or total length or number of pieces of each size; and

4.1.7 Intended application.

4.2 The following options are available and, when required, shall be specified at the time of placing the order:

4.2.1 Tension test in accordance with ASME Boiler and Pressure Vessel Code (see Section 9).

4.2.2 Hydrostatic or pneumatic test as an alternative to eddy current test (Section 11).

4.2.3 If the cut ends of the tubes do not need to be deburred (Section 13).

4.2.4 If the product is to be subsequently welded (**Table 1**, footnotes G and H).

4.2.5 Residual Stress Test—Ammonia vapor test or mercurous nitrate test (Section 10).

4.2.6 For ammonia vapor test, risk level (pH value) if other than 10.

4.2.7 Heat identification or traceability details.

4.2.8 Certification (Section 21).

4.2.9 Test report (Section 22).

4.2.10 If a subsequent thermal treatment after straightening is required (Section 7).

4.2.11 If product is purchased for agencies of the U.S. Government (see Supplementary Requirements section of this specification for additional requirements, when specified).

5. Materials and Manufacture

5.1 Materials:

5.1.1 The material of manufacture shall be a form of such purity and soundness as to be suitable for processing into the products prescribed herein.

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

NOTE 1—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify a specific casting analysis with a specific quantity of finished material.

5.2 Manufacture:

5.2.1 The product shall be manufactured by such hot-working, cold-working, annealing, straightening, trimming, and other processes as to produce a uniform seamless tube in the finished product.

5.2.2 The product shall be hot- or cold-worked to the finished size, and subsequently annealed, when required, to meet the temper properties specified.

6. Chemical Composition

6.1 The product shall conform to the chemical composition requirements in **Table 1** for the copper or Copper Alloy UNS No. specified in the ordering information.

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

6.2.1 *Copper Alloy UNS No. C19200*—Copper is the difference between the sum results of all the elements determined and 100 %. When all the elements in **Table 1** are determined, their sum shall be 99.8 % minimum.

6.2.2 For alloys in which copper is listed as “remainder,” copper is the difference between the sum results of all the

⁵ The last approved version of this historical standard is referenced on www.astm.org.