



Designation: **B643 – 12 (Reapproved 2016) B643 – 18**

Standard Specification for Copper-Beryllium Alloy Seamless Tube¹

This standard is issued under the fixed designation B643; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification establishes requirements for copper-beryllium alloy seamless tube in straight lengths. Copper Alloy UNS C17200 will be the alloy furnished whenever Specification B643 is specified.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

1.4 *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.*

1.5 *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 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:²

B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

B251 Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric) B0251_B0251M

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B846 Terminology for Copper and Copper Alloys

E3 Guide for Preparation of Metallographic Specimens

E8/E8M Test Methods for Tension Testing of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E112 Test Methods for Determining Average Grain Size

E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. Terminology

3.1 *Definitions*—For terms relating to copper and copper alloys, refer to Terminology **B846**.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *stock, n*—straight lengths that are mill cut and stored in advance of orders. They are usually 8, 10, 12, or 20 ft (2.44, 3.05, 3.66, or 6.10 m) and subject to established length tolerances.

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.

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

4. General Requirements

- 4.1 The following sections of Specification **B251** constitute a part of this specification:
- 4.1.1 Workmanship, Finish and Appearance,
 - 4.1.2 Significance of Numerical limits,
 - 4.1.3 Inspection,
 - 4.1.4 Rejection and Rehearing,
 - 4.1.5 Certification,
 - 4.1.6 Mill Test Report, and
 - 4.1.7 Packaging and Package Marking.

5. Ordering Information

- 5.1 Include the following information 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. designation (see **1.1**),
 - 5.1.3 Temper (see Section **8**),
 - 5.1.4 Dimensions, specify O.D./I.D., O.D./wall, or I.D./wall and include length if applicable,
 - 5.1.5 How furnished, stock lengths with or without ends, specific lengths with or without ends,
 - 5.1.6 Quantity: total weight or number or pieces,
 - 5.1.7 Special tests or exceptions, if any,
 - 5.1.8 Hardness tests, if required,
 - 5.1.9 Special tests such as tension test or grain size, if required,
 - 5.1.10 Special marking or packaging, if required,
 - 5.1.11 Inspection, if required (see Specification **B251**),
 - 5.1.12 Certification, if required (see Specification **B251**), and
 - 5.1.13 Mill test report, if required (see Specification **B251**).

5.2 If the product is purchased for agencies of the U.S. Government (see Supplementary Requirements section of Specification **B251**, for additional requirements, if specified).

6. Materials and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture shall be billets, cast bars or tube of Copper Alloy UNS No. C17200, of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.1.2 The tube shall have heat traceable identity.

6.2 *Manufacture:*

6.2.1 The product shall be manufactured by such hot working, cold working, annealing, or precipitation heat treatment, or both, as to produce a uniform wrought structure in the finished product.

7. Chemical Composition

7.1 The material shall conform to the chemical requirements in **Table 1** for the copper alloy UNS No. C17200 specified in this ordering information.

7.2 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.

7.3 For alloys in which copper is listed as “remainder,” copper is the difference between the sum of results of all elements determined and 100 %. When all elements in **Table 1** are determined, the sum of the results shall be 99.5 % minimum.

TABLE 1 Chemical Requirements

| Element | Composition, % |
|-----------------------------|-----------------------------|
| | Copper Alloy UNS No. C17200 |
| Beryllium | 1.80–2.00 |
| Additive elements: | |
| Nickel + cobalt, min | 0.20 |
| Nickel + cobalt + iron, max | 0.6 |
| Aluminum, max | 0.20 |
| Silicon, max | 0.20 |
| Copper | remainder |

8. Temper

8.1 The standard tempers for products described in this specification are given in [Table 2](#) and [Table 3](#).

8.1.1 Solution heat-treated TB00 (A).

8.1.2 Heat Treated and Cold Worked to hard temper TD04 (H).

8.1.3 Precipitation Hardened TF00 (AT).

8.1.4 Hard and Precipitation Heat Treated TH04 (HT).

8.2 Tempers available under this specification are defined in Classification [B601](#).

9. Precipitation Heat Treatment

9.1 When material is purchased in the TB00(A) or the TD04(H) tempers, the precipitation heat treatment is performed by the purchaser.

9.2 When testing for conformance to the TF00(AT) and the TH04(HT) property requirements shown in [Table 3](#) for products supplied in the TB00(A) and TD04(H) tempers, the appropriate test specimens shall be heat treated for times and temperatures within those stated in [Table 4](#). The times and temperatures used by the manufacturer to qualify the material will be stated on the mill test report. The use of other times and temperatures, within the allowable ranges, shown in [Table 4](#), may produce properties other than those stated on the mill test report. This will not be cause for rejection.

9.3 This material may be heat-treated at other times and temperature for specific applications. These special combinations of properties, such as increased ductility, dimensional accuracy, endurance life, may be obtained by special precipitation-hardening heat treatments. The mechanical requirements of [Table 3](#) do not apply to such special heat treatments. Specific test requirements as needed shall be agreed upon between the manufacturer, or supplier, and the purchaser of the end product.

9.4 TF00 (AT) and TH04 (HT) tempers are standard mill-hardened products that have been precipitation heat-treated and tested by the manufacturer. An appropriate time and temperature has been used to produce properties within the specification limits shown in [Table 3](#). [Table 4](#) does not apply. Further, thermal treatments of these tempers is not normally required.

10. Physical Property Requirements

10.1 Microstructure and Grain Size

10.1.1 The product in the precipitation heat-treated condition shall have a microstructure with a minimum of second phase (beta) constituents.

10.1.2 Grain size, if required, shall be agreed upon between the purchaser and the manufacturer or the supplier and shall be determined in accordance with Test Methods [E112](#).

11. Mechanical Property Requirements

11.1 *Rockwell Hardness Requirement:*

11.1.1 Product furnished under this specification shall conform to the Rockwell hardness requirements in [Table 2](#) and [Table 3](#), when tested in accordance with Test Methods [E18](#).

11.1.2 Acceptance or rejection based on mechanical properties shall depend only on Rockwell hardness.

11.1.3 Where agreement on Rockwell hardness tests cannot be reached, the tensile strength requirements of [Table 2](#) and [Table 3](#) shall be the basis for acceptance or rejection.

11.2 *Tension Strength Requirements:*

11.2.1 When specified in the contract or purchase order, product furnished under this specification shall conform to the tensile strength requirements in [Table 2](#) and [Table 3](#), when tested in accordance with Test Methods [E8/E8M](#).

11.2.2 Only when specified in the contract or purchase order, acceptance or rejection based upon mechanical properties shall depend only on tensile strength.

12. Dimensions, Mass and Permissible Variations

12.1 *General:*

12.1.1 The standard method of specifying wall thickness shall be in decimal fractions of an inch.

TABLE 2 Mechanical Property Requirements Before Precipitation Heat Treatment

| Temper Designation ^A | | Diameter Distance Between Cross-Sectional Parallel Surfaces, in. (mm) | Rockwell Hardness, ^B B Scale | Tensile Strength ^C | |
|---------------------------------|---------------------------|---|---|-------------------------------|-----------|
| Standard | Former | | | ksi ^D | (MPa) |
| TB00 | Solution-heat treated (A) | ¾ (19.1) and over | 45–85 | 60–85 | (410–570) |
| TD04 | Hard (H) | ¾ (19.1) and over | 88–103 | 85–115 | (590–800) |

^A Standard designations defined in Classification [B601](#).

^B Hardness values shown apply only to direct determinations, not converted values.

^C Hardness is the normal commercial acceptance criterion. Mechanical properties apply only when specifically required.

^D ksi = 1000 psi.