



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

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

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](#)

[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.

4. General Requirements

4.1 The following sections of Specification [B251](#) constitute a part of this specification:

4.1.1 Workmanship, Finish and Appearance,

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

- 4.1.2 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.

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).

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

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.

TABLE 3 Tensile Strength and Hardness Requirements After Precipitation Heat Treatment^A

Temper Designation ^B		Diameter or Distance Between Cross-Sectional Parallel Surfaces, in. (mm)	Rockwell Hardness, C, min	Tensile Strength ^C		Yield Strength (min) (0.2 % Offset)		Elongation (min) in 4 × D
Standard	Former			ksi ^D	(MPa)	ksi	(MPa)	
TF00	AT	¾ (15.9) and over	36	165–190 ^E	(1140–1310)	130	(900)	3 %
TH04	HT	¾ (15.9) to 1 (25.4) incl	38	180–215 ^E	(1240–1480)	155	(1070)	4 %
		Over 1 (25.4) to 2 (50.8) incl	37	175–215 ^E	(1210–1480)	150	(1040)	4 %
		Over 2 (50.8) to 3½ (88.9) incl	37	175–215 ^E	(1210–1480)	140	(970)	4 %

^A These values apply to mill products. See 9.3 for exceptions in end products.

^B Standard designations defined in Classification B601.

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

^D ksi = 1000 psi.

^E The upper limits in the tensile strength column are for design guidance only.

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.

**TABLE 4 Standard Precipitation Heat-Treatment Time for
Acceptance Tests**

Temper Designation		Diameter	Time at 600 to 675°F (316 to 357°C), h
Standard	Former		
TF00	Solution-heat treated (A)	all sizes	3–4
TH04	Hard (H)	all sizes	2–3