



Standard Specification for Copper-Beryllium Seamless Tube (UNS Nos. C17500 and C17510)¹

This standard is issued under the fixed designation B937; 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.

1. Scope*

1.1 This specification establishes the requirements for copper-beryllium alloy seamless tube in straight lengths. Copper-cobalt-beryllium alloy UNS No. C17500 and copper-nickel-beryllium alloy UNS No. C17510 will be the alloys furnished whenever this specification is specified.

1.2 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 method(s) described in 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 and health practices and to 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

B193 Test Method for Resistivity of Electrical Conductor Materials

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

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.

E8/E8M Test Methods for Tension Testing of Metallic Materials

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

E1004 Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method

3. General Requirements

3.1 The following sections of Specification **B251** (as noted) constitute a part of this specification:

3.1.1 Terminology,

3.1.2 Test Specimens,

3.1.3 Significance of Numerical Limits,

3.1.4 Inspection,

3.1.5 Rejection and Rehearing,

3.1.6 Certification,

3.1.7 Packaging and Package Marking, and

3.1.8 Mill Test Report.

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

4.2 Definitions of Terms Specific to This Standard:

4.2.1 *average diameter (for round tubes only), n*—the average of the maximum and minimum outside diameters, or maximum and minimum inside diameters, whichever is applicable, as determined at any one cross section of the tube.

4.2.2 *lengths, n*—straight pieces of the product

4.2.2.1 *ends, n*—straight pieces, shorter than the nominal length, left over after cutting the product into mill lengths, stock lengths, or specific lengths. They are subject to minimum length and maximum weight requirements.

4.2.2.2 *specific, adj*—straight lengths that are uniform in length, as specified, and subject to established length tolerances.

4.2.2.3 *specific with ends, adj*—specific lengths, including ends.

4.2.2.4 *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.

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

4.2.2.5 *stock with ends, adj*—stock lengths, including ends.

4.2.3 *tube, n*—a hollow product of round or any other cross section having a continuous periphery.

4.2.3.1 *tube, seamless, adj*—a tube produced with a continuous periphery in all stages of the operations.

5. Ordering Information

5.1 Include the following information in orders for product under this specification, as applicable:

- 5.1.1 ASTM designation and year of issue,
- 5.1.2 Copper Alloy UNS designation (1.1),
- 5.1.3 Temper (see Section 8),
- 5.1.4 Quantity, pounds or number of pieces,
- 5.1.5 Dimensions, including length if applicable. For tube or pipe specify either OD/ID, OD/wall, or ID/wall,
- 5.1.6 How furnished: stock lengths with or without ends, specific lengths with or without ends,
- 5.1.7 When product is purchased for ASME Boiler and Pressure Vessel Code Application, and
- 5.1.8 When product is purchased for agencies of the U.S. government,
- 5.1.9 Special tests or exceptions, if any,
- 5.1.10 Tensile strength test, if required,
- 5.1.11 Special marking or packaging, if required,
- 5.1.12 Inspection, if required (see Specification B251),
- 5.1.13 Certification (see Specification B251),
- 5.1.14 Mill test report, if required (see Specification B251).

5.2 When material is purchased for agencies of the U.S. government, the material shall conform to the Supplementary Requirements as defined in the current issue of Specification B251.

6. Materials and Manufacture

6.1 *Materials:*

6.1.1 The material of manufacture shall be UNS Alloy No. C17500 or C17510, cast and worked into tubular form, and 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 a combination of hot working or cold working, or both; annealing; or

TABLE 1 Chemical Composition

Element	Concentration, %	
	Copper Alloy UNS No. C17500	Copper Alloy UNS No. C17510
Beryllium	0.4-0.7	0.2-0.6
Cobalt	2.4-2.7	0.3 max
Nickel	...	1.4-2.2
Iron, max	0.10	0.10
Aluminum, max	0.20	0.20
Silicon, max	0.20	0.20
Copper	Remainder	Remainder

precipitation heat treatment, or both, as to produce a uniform wrought structure in the finished product, to meet the temper specified.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in Table 1 for the copper alloy designated in the 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 results shall be 99.5 % min.

8. Temper

8.1 Tempers, as described in Classification B601, available under this specification are: TB00 (solution treated (A)), TF00 (precipitation hardened (AT)), TD04 (solution heat-treated and cold worked: hard (H)), and TH04 (hard and precipitation heat-treated (HT)). These products meet property requirements in Table 2.

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.

TABLE 2 Tensile Strength and Rockwell Hardness Requirements^A

Temper Designation		As Supplied				
Standard	Former	Tensile Strength ksi ^B (MPa ^C)	Yield Strength ksi (MPa) min	Rockwell Hardness, B Scale	Elongation min, %	Electrical Conductivity IACS min, %
TB00	A	35-55 (240-380)		50 max		20
TD04	H	65-80 (450-550)		60-80		20
After Precipitation Heat Treatment						
TF00	AT	100-130 (690-895) ^D	80 (550)	92-100	10	45
TH04	HT	110-140 (760-965) ^D		95-102		48

^A These values apply to mill products. See Section 11 for exceptions in end products.

^B ksi = 1000 psi.

^C See Appendix.

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

9.2 Conformance to the TF00 (AT) and TH04 (HT) specification limits shown in Table 2, for products supplied in the TB00 (A) or the TD04 (H) tempers, shall be determined by testing specimens heat-treated at a uniform temperature of 850 to 900°F for the times shown in Table 3.

9.3 End products may be heat-treated at other times and temperatures for specific applications. These special combinations of properties such as increased ductility, dimensional accuracy, and endurance strength may be obtained by special precipitation-hardening heat treatments. The mechanical requirements of Table 2 do not apply to such special heat treatment. Specific test requirements as needed shall be agreed upon between the manufacturer or the supplier and the purchaser of the end product.

9.4 TF00 (AT) and TH04 (HT) tempers as standard mill-hardened products has 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 2. Table 3 does not apply. Further thermal treatment of these tempers is not normally required.

10. Physical Property Requirements

10.1 *Electrical Conductivity*—Product furnished to this specification shall conform to the electrical conductivity requirement given in Table 2 for the applicable temper, when tested in accordance with Test Method E1004 or by converting from resistivity measured in accordance with Test Method B193.

11. Mechanical Property Requirements

11.1 Mechanical property requirements are specified in Table 2.

11.2 *Rockwell Hardness*—Acceptance or rejection based on mechanical properties shall depend only on Rockwell hardness.

11.2.1 The referee product rejection criteria shall be tensile results, when tested in accordance with Test Methods E8/E8M.

11.3 *Tension Test*—The tension test will be used for qualification of all material when specifically required by the purchaser, as in some government requirements.

12. Number of Tests and Retests

12.1 *Retests*:

12.1.1 Refer to Specification B251 with the following additional requirements:

12.1.2 Material that fails to conform to the requirements of this specification due to inadequate heat-treatment may be

heat-treated subsequently and submitted for test. Only two such subsequent treatments shall be permitted.

13. Purchases for the U.S. Government

13.1 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 Specification B251.

14. Dimensions, Mass, and Permissible Variation

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

14.1.1 For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified values for any dimension may be cause for rejection.

14.1.2 Tolerances on a given tube may be specified with respect to any two, but not all three, of the following: outside diameter, inside diameter, wall thickness

NOTE 1—Blank spaces in the tolerance tables indicate either that the material is not generally available or no tolerances have been established.

14.2 *Wall-Thickness Tolerances*—Wall-thickness tolerances shall be in accordance with Table 4 and Table 5.

14.3 *Diameter Tolerances*—Diameter Tolerances shall be in accordance with Table 6.

14.4 *Length Tolerances*—Length tolerances shall be in accordance with Table 7

14.5 *Squareness*—For tube in straight lengths, the departure from squareness of the end shall not exceed the following:

Diameter, in. (mm)	Specified Outside
	Tolerance, in./in. (mm/mm)
3/4 (19.1) and over	0.062

14.6 Straightness—Refer to Table 7 of Specification B251.

15. Workmanship, Finish, and Appearance

15.1 The product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.

16. Sampling

16.1 Refer to sampling section in Specification B251.

16.2 *Sampling*—Sample pieces shall be taken from a heat and lot of material processed simultaneously in the same equipment, as follows:

16.2.1 *Heat*—A heat shall be the result of castings poured simultaneously from the same source of molten metal

16.2.2 *Lot*—The lot shall be a heat, or fraction thereof.

TABLE 3 Precipitation Heat-Treatment Time for Acceptance Tests

Temper Designation		Copper Alloy UNS No. 17500 at 850°F (454°C) to 900°F (482°C), h	Copper Alloy UNS No. C17510 at 850°F (454°C) ^A to 900°F (482°C) ^A , h
Standard	Former		
TB00	A	3	3
TD04	H	2	2

^A Specific temperature used must conform with supplier's certification within ±10°F.

TABLE 4 Wall-Thickness Tolerances—TB00 (A) and TF00 (AT) Tempers^A

NOTE 1—*Maximum Deviation of Any Point*—The following tolerances are plus and minus: if tolerances all plus or all minus are desired double the values given.

Wall Thickness, in. (mm)	Outside Diameter, in. (mm)			
	5/8 to 1 (15.9 to 25.4)	Over 1 to 2 (25.4 to 50.8)	Over 2 to 4 (50.8 to 102)	Over 4 (102)
Over 0.125 (3.2) to 0.250 (6.5) incl	±0.014 (0.36)	±0.017 (0.43)	±0.020 (0.51)	±0.030 (0.76)
Over 0.250 (6.5) to 0.500 (12.7) incl	±0.017 (0.43)	±0.023 (0.58)	±0.032 (0.81)	±0.053 (1.35)
Over 0.500 (12.7) to 1.000 (25.4) incl	...	±0.030 (0.76)	±0.053 (1.35)	±0.083 (2.11)
Over 1.000 (25.4)	±0.068 (1.73)	±0.098 (2.49)

^A When tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in this table more than 50 %.

TABLE 5 Wall-Thickness Tolerances—TD04 (H) and TH04 (HT) Tempers^A

NOTE 1—*Maximum Deviation of Any Point*—The following tolerances are plus and minus: if tolerances all plus or all minus are desired double the values given.

Wall Thickness, in. (mm)	Outside Diameter, in. (mm)				
	Over 3/8 to 1 (15.9 to 25.4) Incl	Over 1 to 2 (25.4 to 50.8) Incl	Over 2 to 4 (50.8 to 102) Incl	Over 4 to 7 (102 to 173) Incl	Over 7 to 12 (173 to 305) Incl
Over 0.034 (0.864), to 0.057 (1.45) incl	0.0045 (0.11)	0.0045 (0.11)	0.0065 (0.17)	0.009 (0.23)	...
Over 0.057 (1.45) to 0.082 (2.08) incl	0.005 (.13)	0.005 (.13)	0.0075 (0.19)	0.010 (.25)	0.013 (0.33)
Over 0.082 (2.08) to 0.119 (3.02) incl	0.0065 (0.17)	0.0065 (0.17)	0.009 (0.23)	0.011 (0.28)	0.014 (0.36)
Over 0.119 (3.02) to 0.164 (4.17) incl	0.007 (0.18)	0.0075 (0.19)	0.010 (0.25)	0.013 (0.33)	0.015 (0.38)
Over 0.164 (4.17) to 0.219 (5.56) incl	0.009 (0.23)	0.010 (0.25)	0.012 (0.30)	0.015 (0.38)	0.018 (0.46)
Over 0.219 (5.56) to 0.283 (7.19) incl	0.012 (0.30)	0.013 (0.33)	0.015 (0.38)	0.018 (0.46)	0.020 (0.51)
Over 0.283 (7.19) to 0.379 (9.62) incl	0.014 (0.36)	0.015 (0.38)	0.018 (0.46)	6% ^B _B	6% ^B _B
Over 0.379 (9.62)	...	6% ^B	6% ^B	6% ^B _B	6% ^B _B

^A When tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in this table more than 50 %.

^B Percent of the specified wall thickness expressed to the nearest 0.001 in. (0.025 mm).

TABLE 6 Average Diameter Tolerances^A

Specified Diameter, in. (mm)	Tolerance, Plus and Minus, in. (mm) ^B	
	Cold-Worked Tube	Hot-Worked Tube
Over 1/2 (12.7) to 3/4 (19.1), incl	0.003 (0.08)	0.020 (0.51)
Over 3/4 (19.1) to 1 (25.4), incl	0.006 (0.15)	0.020 (0.51)
Over 1 (25.4) to 2 (50.8), incl	0.008 (0.20)	0.030 (0.76)
Over 2 (50.8) to 3 (76.2), incl	0.010 (0.25)	0.040 (1.02)
Over 3 (76.2) to 4 (102), incl	0.012 (0.30)	0.050 (1.27)
Over 4 (102) to 5 (127), incl	0.016 (0.41)	0.060 (1.52)
Over 5 (127) to 6 (152), incl	0.018 (0.46)	0.060 (1.52)
Over 6 (152) to 8 (203), incl	0.020 (0.51)	0.060 (1.52)
Over 8 (203) to 12 (305), incl	0.030 (0.76)	0.060 (1.52)

^A When tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in this table more than 50 %.

^B Tolerance applies to inside or outside diameter.

17. Specimen Preparation

17.1 *Chemical Analysis*—Sample preparation shall be in accordance with Practice E255.

17.1.1 Analytical specimen preparation shall be the responsibility of the reporting laboratory.

17.2 *Tension Tests*—Sample preparation shall be in accordance with Specification B251.

17.3 *Rockwell Hardness*—The test specimens shall be of a size and shape to permit testing by the available test equipment and shall permit testing in a plane parallel to the direction of deformation given to the product.

17.3.1 The surface of the test specimens shall be sufficiently smooth and even to permit the accurate determination of hardness.

17.3.2 Each specimen shall be free of scale and foreign matter and care shall be taken to avoid change in condition, that is, heating or cold working

18. Test Methods

18.1 *Chemical Analyses*—The chemical composition shall, in cases of disagreement, be determined in accordance with the applicable method in Annex A1 of Specification B194.

18.2 *Tension Tests*—Tension tests, when required, shall be made according to Test Methods E8/E8M.

19. Test Report

19.1 When specified in the contract or purchase order, a report of test results shall be furnished.

20. Keywords

20.1 beryllium copper tube; UNS No. C17500; UNS No. C17510

TABLE 7 Length Tolerances—All Tempers^A

Length	Tolerances, in. (mm)		Applicable Only to Full-Length Pieces	
	Outside Diameters		Outside Diameters	Outside Diameters
	Up to 1 in. (25.4 mm)		Over 1 in. (25.4 mm)	Over 4 in. (102 mm)
	incl		incl	
Specific lengths:				
Up to 6 in. (152 mm), incl	1/32 (0.79)		1/16 (1.6)	1/8 (3.2)
Over 6 in. (152 mm) to 2 ft (610 mm), incl	1/16 (1.6)		3/32 (2.4)	1/4 (6.4)
Over 2 ft (610 mm) to 6 ft (1.83 m), incl	3/32 (2.4)		1/8 (3.2)	1/4 (6.4)
Over 6 ft (1.83 m) to 14 ft (4.27 m), incl	1/4 (6.4)		1/4 (6.4)	1/2 (13)
Over 14 ft (4.27 m)	1/2 (13)		1/2 (13)	1 (25)
Specific lengths with ends	1 (25)		1 (25)	1 ^A (25)
Stock lengths with or without ends	1 ^A (25)		1 ^A (25)	

^A As stock lengths are cut and placed in stock in advance of orders, departure from this tolerance is not practicable.

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the Newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = \text{kg}\cdot\text{m}/\text{s}^2$). The derived SI unit for pressure or

stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$ the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2 .

SUMMARY OF CHANGES

- (1) Sections 2, 3, 5, 9.2, 11, 19, and Tables 2 and 3 were revised.
- (2) New Section 12 was added.
- (3) 9.5 was deleted.

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