



Designation: B 315 – 99

Standard Specification for Seamless Copper Alloy Pipe and Tube¹

This standard is issued under the fixed designation B 315; 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 Department of Defense.

1. Scope *

1.1 This specification² establishes the requirements for seamless, copper alloy pipe and tube in nominal pipe sizes, both regular and extra strong, and seamless tube in straight lengths for general engineering purposes. Pipe and tube are produced in the copper alloy UNS Numbers: C61300, C61400, C63020, C65100, and C65500.

NOTE 1—Inquiry should be made of the manufacturer or supplier concerning the availability of product in a specific alloy.

1.2 The values stated in inch-pound units are the standard. The SI values given in parentheses are for information only.

1.3 The following pertains only to the test method described in 9.1.2 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- B 846 Terminology for Copper and Copper Alloys³
- E 8 Test Methods of Tension Testing of Metallic Materials⁴
- E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵
- E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes⁶
- E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁶

¹ This specification is under the jurisdiction of ASTM Committee B-5 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 SB315 in Section II of that Code.

³ Annual Book of ASTM Standards, Vol 02.01.

⁴ Annual Book of ASTM Standards, Vol 03.01.

⁵ Annual Book of ASTM Standards, Vol 14.02.

⁶ Annual Book of ASTM Standards, Vol 03.05.

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes⁷

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition⁶

E 478 Test Methods for Chemical Analysis of Copper Alloys⁸

3. Terminology

3.1 For definitions of terms related to copper and copper alloys refer to Terminology B 846.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *specially cleaned*—sufficiently free of oxides as to exhibit the golden color associated with the alloy.

4. Ordering Information

4.1 Orders for product under this specification shall include the following information:

4.1.1 ASTM Designation and year of issue (for example B 315 – XX),

4.1.2 Alloy (Section 6, Table 1),

4.1.3 Temper (Section 7),

4.1.4 Pipe size regular (Table 3),

4.1.5 Pipe size, extra-strong (Table 3),

4.1.6 Tube diameter (Table 9),

4.1.7 Tube wall thickness (Table 6, Table 7, or Table 8),

4.1.8 Length (Table 10 or Table 11),

4.1.9 Total length of each size,

4.1.10 Whether the product is to be subsequently welded (see Table 1 and Footnote B),

4.1.11 Finish (11.2 and 11.3), and

4.1.12 When copper alloy UNS No. C63020 is ordered under this specification, tube diameter, wall thickness, length, sizes, and tolerances shall be a part of the purchase order as agreed upon between the supplier and the purchaser.

4.2 When product is to be subjected to welding or brazing, the purchase order or contract shall specify product to be “specially cleaned.”

⁷ Annual Book of ASTM Standards, Vol 03.03.

⁸ Annual Book of ASTM Standards, Vol 03.06.

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



TABLE 1 Chemical Requirements

Copper Alloy UNS No.	C61300 ^A	C61400	C63020 ^B	C65100	C65500
	Composition, % Max (Unless Shown as a Range or Minimum)				
Copper ^C	remainder	remainder	74.5 min	remainder	remainder
Lead	0.01	0.01	0.03	0.05	0.05
Iron	2.0–3.0	1.5–3.5	4.0–5.5	0.8	0.8
Zinc	0.10	0.20	0.30	1.5	1.5
Aluminum	6.0–7.5	6.0–8.0	10.1–16.0	...	...
Manganese	0.20	1.0	1.5	0.7	0.50–1.3
Silicon	0.10	...	...	0.8–2.0	2.8–3.8
Tin	0.20–0.50	...	0.25	...	...
Nickel (including cobalt)	0.15	...	4.2–6.0	...	0.6
Phosphorus	0.015	0.015	...	...	...

^AWhen the product is for subsequent welding applications and is so specified by the purchaser, chromium shall be 0.05 % max, cadmium 0.05 % max, zinc 0.05 % max, and zirconium 0.05 % max.

^BChromium shall be 0.05 max and cobalt 0.20 max.

^CIncluding silver.

4.3 The following options are available under this specification and must be specified in the contract or purchase order when required:

- 4.3.1 Heat identification or traceability (12.1.3.4),
- 4.3.2 Certification (Section 19), and
- 4.3.3 Test Report (Section 20).

5. Materials and Manufacture

5.1 Material:

5.1.1 The material of manufacture shall be a cast billet, bar, tube, or so forth of copper alloy UNS No. C61300, C61400, C63020, C65100, or C65500 and of such purity and soundness as to be suitable for processing in to the products prescribed herein.

5.1.2 In the event heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 2—Because of 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 produced by hot-working or cold-working operations, or both. Unless otherwise specified, the product shall be finished by such cold working and annealing or heat treatment as necessary to meet the properties specified.

5.2.2 Copper alloy UNS No. C63020 tube shall be quench hardened and tempered (TQ30) as follows:

5.2.2.1 Heat to 1550 to 1650°F (843 to 899°C) for 2-h minimum and quench in water. Then, temper at 900 to 1000°F (482 to 538°C) for 2-h minimum and air cool to room temperature.

6. Chemical Composition

6.1 The material shall conform to the compositional requirements as listed in Table 1 for the alloy specified in the contract or purchase order

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

6.2.1 When the copper concentration is specified as the remainder, the percentage of copper may be calculated as the difference between the sum of all the elements determined and 100 %.

6.2.1.1 When all the elements listed for an alloy in Table 1 are determined, the sum of the determined elements for the alloy shall be as shown in the following table:

Copper Alloy UNS No.	Copper Plus Named Elements, % min
C61300	99.8
C61400	99.5
C63020	99.5
C65100	99.5
C65500	99.5

7. Temper

7.1 The standard tempers for products described in this specification are listed as follows and in Table 2:

7.1.1 Alloys C61300 and C61400 are supplied in tempers M30 (hot-extruded), O30 (hot-extruded and annealed), and O61 (annealed).

7.1.2 Alloy C63020 is supplied in temper TQ30 (quench hardened and tempered).

7.1.3 Alloy C65100 is supplied in tempers O30 (extruded and annealed), O61 (annealed), and H50 (extruded and cold worked).

7.1.4 Alloy C65500 is supplied in tempers O30 (extruded and annealed) and O61 (annealed).

8. Mechanical Property Requirements

8.1 Tensile, Yield, and Elongation:

8.1.1 Product furnished under this specification shall conform to the tensile, yield, and elongation requirements prescribed in Table 2, for the alloy specified in the ordering information, when tested in accordance with Test Methods E 8.

8.1.1.1 Only tensile, yield, or elongation test results shall be a basis for rejection based upon mechanical properties.

8.2 Rockwell Hardness:

8.2.1 Product furnished from Alloy C63020 in TQ30 temper shall have a minimum hardness of 26 on the Rockwell C scale when tested in accordance with Test Methods E 18.



TABLE 2 Tensile Requirements

Copper Alloy UNS No.	C61300 and C61400	C63020	C65100		C65500
Temper Designation	M30 (Extruded) or O61 (Annealed)	TQ30 (Quench-Hardened and Tempered)	O30 (Extruded and Annealed) or O61 (Annealed)	H50 (Extruded and Cold-Worked)	O30 (Extruded and Annealed) and O61 (Annealed)
Tensile Strength, min, ksi ^A (Mpa) ^B	65 (447)	130 (896)	40 (275)	50 (345)	50 (345)
Yield Strength at 0.5 % extension under load, ksi ^A (Mpa) ^B	28 (193) min	89 (621) ^C	10 (69) min	40 (275) min	15 to 29 (103 to 200)
Elongation in 2 in. or 50 mm, min %	30	6	35	7	35

^Aksi = 1000 psi.^BSee Appendix.^CYield strength at 0.2 % offset, min, ksi^A (Mpa)^B.

8.2.1.1 Rockwell hardness test results shall not be a basis for product rejection.

9. Other Requirements

9.1 Nondestructive Testing:

9.1.1 Unless otherwise agreed upon between the supplier and the purchaser, the pipe or tube shall be tested for defects either in the final drawn, annealed, or specified temper or in the drawn temper before the final anneal. Unless otherwise specified, the manufacturer shall have the option of testing the pipe or tube by one of the following tests:

9.1.2 *Electromagnetic Examination (Eddy Current)*—Each tube or pipe in nominal sizes from 1/8 in. (3.2 mm) up to and including 2 1/2 in. (63.5 mm), regular and extra-strong, shall be subjected to an eddy-current test. Tests shall follow the procedures of Practice E 243 except for the determination of “end effect.” The pipe or tube shall be passed through an eddy-current testing unit adjusted to detect an artificial defect of a size and shape defined as follows:

NOTE 3—End effect is that length of the pipe or tube that travels through the coil until the testing unit has stabilized and is able to detect flaws. The magnitude of the spike generated when an end passes through the test coils is such that it disrupts testing momentarily.

9.1.2.1 *Artificial Defects*—Round bottom-notch standards with a profile as defined in Practice E 243, rounded to the nearest 0.001 in. (0.025 mm) shall be 10 % of the specified wall thickness. Notch-depth tolerances shall be ± 0.0005 in. (0.013 mm). Alternatively, when a manufacturer uses speed-insensitive equipment that can select a maximum unbalance signal, a maximum unbalance signal of 0.3 % shall be used.

9.1.2.2 *Retesting*—Pipes or tubes that do not activate the signaling device of the eddy-current tester shall be considered as conforming to the requirements of this test. Lengths with discontinuities, indicated by the testing unit, at the option of the manufacturer, may be reexamined or retested to determine whether the discontinuity is cause for rejection. Signals that are found to have been caused by soil, moisture, or minor mechanical damage shall not be cause for rejection, provided the pipe or tube dimensions are still within the prescribed limits and the pipe or tube is suitable for its intended application.

9.1.3 *Pressure Tests*—Each pipe or tube selected in accordance with 13.3 shall withstand the pressure test of either 9.1.3.1 or 9.1.3.2.

9.1.3.1 *Hydrostatic Test*—Each pipe or tube shall withstand, without showing evidence of leakage, an internal hydrostatic

pressure sufficient to subject the material to a fiber stress of 7000 psi (48 mPa). The pipe or tube need not be tested at a hydrostatic pressure of over 1000 psi (6.9 MPa) unless so specified. At the option of the manufacturer, annealed pipe with wall thickness up to 0.083 in. (2.11 mm), inclusive, may be tested in the drawn condition, before annealing. Fiber stress shall be determined by the following equation for thin, hollow cylinders under tension:

$$P = 2St/(D - 0.8t) \quad (1)$$

where:

P = hydrostatic pressure, psi (MPa);

t = thickness of pipe or tube wall, in. (mm);

D = outside diameter of the pipe or tube, in. (mm); and

S = allowable fiber stress of the material, psi (MPa).

9.1.3.2 *Pneumatic Test*—Each pipe or tube shall be pressurized to a minimum of 60 psi (415 kPa), air for 5 s, without showing evidence of leakage. The test method used shall permit easy visual detection of any leakage, such as by submerging the tube under water or by pressure differential method.

10. Dimensions, Mass, and Permissible Variations

10.1 General:

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

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

10.1.3 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 4—Blank spaces in the tolerance tables indicate either that the product is not generally available or that no tolerances have been established.

10.2 *Dimensions*—Dimensions and theoretical weights of nominal pipe sizes shall be in accordance with Table 3.

10.3 *Wall Thickness Tolerances*—Wall thickness tolerances for pipe shall be in accordance with Tables 4 and 5. Wall thickness tolerances for tube shall be in accordance with Tables 6-8.

10.4 *Diameter Tolerances*—Diameter tolerances for pipe and tube shall be as follows:

10.4.1 *Diameter Tolerances for Pipe*—