



Designation: B315 – 19

Standard Specification for Seamless Copper Alloy Pipe and Tube¹

This standard is issued under the fixed designation B315; 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.

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.

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

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:³

[B36/B36M Specification for Brass Plate, Sheet, Strip, and Rolled Bar](#)

[B96/B96M Specification for Copper-Silicon Alloy Plate,](#)

[Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels](#)

[B121/B121M Specification for Lead Brass Plate, Sheet, Strip, and Rolled Bar](#)

[B122/B122M Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy \(Nickel Silver\), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar](#)

[B152/B152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar](#)

[B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar](#)

[B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar](#)

[B422/B422M Specification for Copper-Aluminum-Silicon-Cobalt Alloy, Copper-Nickel-Silicon-Magnesium Alloy, Copper-Nickel-Silicon Alloy, Copper-Nickel-Aluminum-Magnesium Alloy, and Copper-Nickel-Tin Alloy Sheet and Strip](#)

[B465 Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar](#)

[B534 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar](#)

[B591 Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar](#)

[B592 Specification for Copper-Zinc-Aluminum-Cobalt Alloy, Copper-Zinc-Tin-Iron Alloy Plate, Sheet, Strip, and Rolled Bar](#)

[B740 Specification for Copper-Nickel-Tin Spinodal Alloy Strip](#)

[B747 Specification for Copper-Zirconium Alloy Sheet and Strip](#)

[B768 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Strip and Sheet](#)

[B846 Terminology for Copper and Copper Alloys](#)

[B888/B888M Specification for Copper Alloy Strip for Use in Manufacture of Electrical Connectors or Spring Contacts](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E18 Test Methods for Rockwell Hardness of Metallic Materials](#)

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 SB315 in Section II of that Code.

³ 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

- [E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)
- [E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes \(Withdrawn 2002\)⁴](#)
- [E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\) \(Withdrawn 2010\)⁴](#)
- [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](#)
- 2.2 *ASME Standard*:⁵
- [ASME Boiler and Pressure Vessel Code](#)

4.1.4.6 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.

4.1.5 Quantity or total length of each size,

4.1.6 Finish (11.2 and 11.3),

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

4.1.7 Intended application.

4.2 The following options are available but may not be included unless specified at the time of order placement when required:

4.2.1 Heat identification or traceability details (5.1.2),

4.2.2 Certification (Section 19),

4.2.3 Test Report (Section 20),

4.2.4 If product is ordered for ASME Boiler and Pressure Vessel Code Application (see Section 19), and

4.2.5 If the product specification number must be marked on the shipping unit (21.2).

5. Materials and Manufacture

5.1 Materials:

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 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 hot working, cold working, and annealing processes as to produce a uniform wrought structure in the finished product.

5.2.2 The product shall be finished by such cold worked to the finished size, and subsequently annealed or heat treatment, when required, to meet the temper properties specified.

3. Terminology

3.1 For definitions of terms related to copper and copper alloys refer to Terminology B846.

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

4.1.1 ASTM Designation and year of issue (for example B315 – XX),

4.1.2 Copper [Alloy] UNS No. (Section 6, Table 1),

4.1.2.1 Whether the product of copper alloy C61300 is to be subsequently welded (see Table 1 and Footnote A),

4.1.3 Temper (Section 7),

4.1.4 *Dimensions, Diameter, and Wall Thickness*:

4.1.4.1 Pipe size, regular (Table 3);

4.1.4.2 Pipe size, extra-strong (Table 3);

4.1.4.3 Tube diameter (Table 9);

4.1.4.4 Tube wall thickness (Table 6, Table 7, or Table 8);

4.1.4.5 Length (Table 10 or Table 11);

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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	10.0–11.0	...	...
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	...	...	...

^A When 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.

^B Chromium shall be 0.05 max and cobalt 0.20 max.

^C Including silver.

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

5.2.3.1 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 chemical composition requirements in **Table 1** for the Copper [Alloy] UNS No. Designation specified in the ordering information.

6.1.1 Results of analysis on a product (check) sample shall conform to the composition requirements within the permitted analytical variance specified in **Table 1**.

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 For alloys in which copper is listed as “remainder,” copper is the difference between the sum of results of all 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) 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 Strength Requirements:

8.1.1 Product furnished under this specification shall conform to the tensile, yield, and elongation requirements prescribed in **Table 2**, when tested in accordance with Test Methods **E8/E8M**.

8.1.1.1 Acceptance or rejection based on mechanical properties shall depend only upon tensile, yield, or elongation test results.

8.2 Rockwell Hardness Requirement:

8.2.1 Product furnished from Alloy C63020 in TQ30 temper should have a minimum hardness of 26 on the Rockwell C scale when tested in accordance with Test Methods **E18**.

8.2.1.1 The approximate Rockwell hardness values given are for general information and assistance in testing and shall not be used as a basis for product rejection. The test is optional.

NOTE 2—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper, tensile strength and grain size.

9. Nondestructive Test

9.1 Nondestructive Testing:

9.1.1 The tubes shall be tested in the drawn tempers or as drawn before the final annealed temper unless otherwise agreed upon between the manufacturer and the purchaser.

9.1.2 Electromagnetic (Eddy-Current Test):

9.1.2.1 Each tube up to and including 3 1/8 in. (79 mm) in outside diameter shall be subjected to test.

9.1.2.2 When tested in accordance with Practice **E243**, tubes which do not actuate the signaling device of the testing unit shall be considered as conforming to the requirements of the test.

9.1.2.3 *Artificial Defects*—Round bottom-notch standards with a profile as defined in Practice **E243**, 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.

9.1.3 *Pressure Tests*—Each pipe or tube selected in accordance with **13.1.3** shall withstand the pressure test of either **9.1.3.1** or **9.1.3.2**.

TABLE 2 Tensile Requirements

Copper Alloy UNS No. Temper Designation	C61300 and C61400		C63020	C65100		C65500
	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 (450)	130 (895)	40 (275)	50 (345)	50 (345)	
Yield Strength at 0.5 % extension under load, ksi ^A (MPa) ^B	28 (195) min	89 (615) ^C	10 (70) min	40 (275) min	15 to 29 (105 to 200)	
Elongation in 2 in. or 50 mm, min %	30	6	35	7	35	

^A ksi = 1000 psi.

^B See Appendix.

^C Yield strength at 0.2 % offset, min, ksi^A (MPa).^B

9.1.3.1 *Hydrostatic Pressure Test*—When specified in the contract or purchase order, each tube shall be capable of withstanding an internal hydrostatic pressure sufficient to produce a fiber stress of 7000 psi (48 MPa) without leakage. The tube need not be subjected to a pressure gauge reading over 1000 psi (6.9 MPa) unless specifically stipulated in the contract or purchase order. 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 Pressure Test*—When specified in the contract or purchase order, each tube shall be capable of withstanding an internal air pressure of 60 psi (400 kPa), minimum for 5 s without leakage.

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 3—Spaces that contain an ellipsis (...) 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**.

TABLE 3 Dimensions and Weights of Copper Alloy Pipe, Standard Pipe Sizes

Nominal or Standard Pipe Size, in.	Dimension, in. (mm)			Cross-Sectional Area of Bore, in. ² (cm ²)	Theoretical Weight, lb/ft (kg/m)		
	Outside Diameter	Inside Diameter	Wall Thickness		Copper Alloy UNS No.		
					C61300 and C61400	C65500	C65100
Regular							
1/8	0.405 (10.3)	0.269 (6.83)	0.068 (1.73)	0.057 (0.367)	0.246 (0.366)	0.266 (0.395)	0.273 (0.406)
1/4	0.540 (13.7)	0.364 (9.25)	0.088 (2.24)	0.104 (0.670)	0.427 (0.634)	0.462 (0.686)	0.474 (0.704)
3/8	0.675 (17.1)	0.493 (12.5)	0.091 (2.31)	0.191 (1.23)	0.571 (0.849)	0.617 (0.917)	0.633 (0.941)
1/2	0.840 (21.3)	0.622 (15.8)	0.109 (2.77)	0.304 (1.96)	0.856 (1.27)	0.925 (1.37)	0.949 (1.41)
3/4	1.050 (26.7)	0.824 (20.9)	0.113 (2.87)	0.533 (3.44)	1.14 (1.69)	1.23 (1.83)	1.26 (1.88)
1	1.315 (33.4)	1.049 (26.6)	0.133 (3.38)	0.864 (3.57)	1.69 (2.51)	1.83 (2.72)	1.87 (2.79)
1 1/4	1.660 (42.2)	1.380 (35.1)	0.140 (3.56)	1.496 (9.66)	2.29 (3.40)	2.47 (3.68)	2.53 (3.77)
1 1/2	1.900 (48.3)	1.610 (40.9)	0.145 (3.68)	2.036 (13.1)	2.74 (4.07)	2.95 (4.40)	3.03 (4.51)
2	2.375 (60.3)	2.067 (52.5)	0.154 (3.91)	3.356 (21.7)	3.67 (5.45)	3.97 (5.91)	4.07 (6.06)
2 1/2	2.875 (73.0)	2.469 (62.7)	0.203 (5.16)	4.788 (30.9)	5.83 (8.66)	6.30 (9.37)	6.46 (9.61)
3	3.500 (88.9)	3.068 (77.9)	0.216 (5.49)	7.393 (47.7)	7.62 (11.3)	8.24 (12.3)	8.45 (12.6)
3 1/2	4.000 (102)†	3.548 (90.1)	0.226 (5.74)	9.887 (63.8)	9.16 (13.6)	9.90 (14.7)	10.2 (15.1)
4	4.500 (114)	4.026 (102)	0.237 (6.02)	12.730 (82.1)	10.9 (16.2)	11.7 (17.5)	12.0 (17.9)
5	5.562 (141)	5.046 (128)	0.258 (6.55)	19.998 (129)	14.7 (21.8)	15.9 (23.6)	16.3 (24.3)
6	6.625 (168)	6.065 (154)	0.280 (7.11)	28.890 (186)	19.1 (28.4)	20.6 (30.7)	21.2 (31.5)
8	8.625 (219)	7.981 (203)	0.322 (8.18)	50.030 (323)	28.7 (42.7)	31.0 (46.2)	31.9 (47.4)
10	10.750 (273)	10.020 (255)	0.365 (9.27)	78.8 (508)	40.8 (90.1)	44.1 (65.6)	45.2 (67.3)
12	12.750 (324)	12.000 (305)	0.375 (9.52)	113.0 (729)	49.9 (74.1)	53.9 (80.2)	55.3 (82.3)
Extra Strong							
1/8	0.405 (10.3)	0.215 (5.46)	0.095 (2.41)	0.036 (0.232)	0.316 (0.470)	0.342 (0.508)	0.351 (0.522)
1/4	0.540 (13.7)	0.302 (7.67)	0.119 (3.02)	0.072 (0.464)	0.538 (0.799)	0.582 (0.865)	0.597 (0.887)
3/8	0.675 (17.1)	0.423 (10.7)	0.126 (3.20)	0.141 (0.909)	0.743 (1.10)	0.803 (1.19)	0.824 (1.22)
1/2	0.840 (21.3)	0.546 (13.9)	0.147 (3.73)	0.234 (1.51)	1.10 (1.63)	1.183 (1.76)	1.214 (1.80)
3/4	1.050 (26.7)	0.742 (18.8)	0.154 (3.91)	0.432 (2.79)	1.48 (2.20)	1.60 (2.39)	1.65 (2.45)
1	1.315 (33.4)	0.957 (24.3)	0.179 (4.55)	0.719 (4.64)	2.19 (3.25)	2.36 (3.52)	2.42 (3.61)
1 1/4	1.660 (42.2)	1.278 (32.5)	0.191 (4.85)	1.283 (8.28)	3.01 (4.47)	3.26 (4.85)	3.34 (4.97)
1 1/2	1.900 (48.3)	1.500 (38.1)	0.200 (5.08)	1.767 (11.4)	3.65 (5.42)	3.95 (5.88)	4.05 (6.03)
2	2.375 (60.3)	1.939 (49.3)	0.218 (5.54)	2.953 (19.1)	5.05 (7.50)	5.46 (8.12)	5.60 (8.34)
2 1/2	2.875 (73.0)	2.323 (59.0)	0.276 (7.01)	4.238 (27.3)	7.71 (11.4)	8.33 (12.4)	8.55 (12.7)
3	3.500 (88.9)	2.900 (73.7)	0.300 (7.62)	6.605 (42.6)	10.3 (15.3)	11.1 (16.6)	11.4 (17.0)
3 1/2	4.000 (102)	3.364 (85.5)	0.318 (8.08)	8.888 (57.3)	12.6 (18.7)	13.6 (20.2)	13.9 (20.8)
4	4.500 (114)	3.826 (97.2)	0.337 (8.56)	11.497 (74.)	15.1 (22.4)	16.3 (24.2)	16.7 (24.9)
5	5.562 (141)	4.812 (122)	0.375 (9.53)	18.186 (117)	20.9 (31.1)	22.6 (33.6)	23.2 (34.5)
6	6.625 (168)	5.761 (146)	0.432 (10.9)	26.067 (168)	28.7 (42.6)	31.1 (46.2)	31.9 (47.4)
8	8.625 (219)	7.625 (194)	0.500 (12.7)	45.664 (295)	43.6 (64.8)	47.2 (70.2)	48.4 (72.0)
10	10.750 (273)	9.750 (248)	0.500 (12.7)	74.7 (482)	55.1 (81.9)	59.5 (88.5)	61.1 (90.9)

TABLE 4 Dimensional Limits for Standard Pipe Sizes
Copper Alloy UNS No. C61300 and C61400

Nominal or Standard Pipe Size	Outside Diameter, in. (mm)	Min	Max	Regular			Extra Strong		
				Wall Thickness, in. (mm)	Min	Max	Wall Thickness, in. (mm)	Min	Max
1/8	0.405 (10.3)	0.374 (9.50)	0.421 (10.7)	0.068 (1.73)	0.061 (1.55)	0.075 (1.91)	0.095 (2.41)	0.086 (2.18)	0.105 (2.67)
1/4	0.540 (13.7)	0.509 (12.9)	0.556 (14.1)	0.088 (2.24)	0.079 (2.01)	0.097 (2.46)	0.119 (3.02)	0.107 (2.72)	0.131 (3.33)
3/8	0.675 (17.1)	0.644 (16.4)	0.691 (17.6)	0.091 (2.31)	0.082 (2.08)	0.100 (2.54)	0.126 (3.20)	0.113 (2.87)	0.139 (3.53)
1/2	0.840 (21.3)	0.809 (20.5)	0.856 (21.7)	0.109 (2.77)	0.098 (2.49)	0.120 (3.05)	0.147 (3.73)	0.132 (3.35)	0.162 (4.11)
3/4	1.050 (26.7)	1.019 (25.9)	1.066 (27.1)	0.113 (2.87)	0.102 (2.59)	0.124 (3.15)	0.154 (3.91)	0.139 (3.53)	0.169 (4.29)
1	1.315 (33.4)	1.284 (32.6)	1.331 (33.8)	0.133 (3.38)	0.120 (3.05)	0.146 (3.71)	0.179 (4.55)	0.161 (4.09)	0.197 (5.00)
1 1/4	1.660 (42.2)	1.629 (41.4)	1.676 (42.6)	0.140 (3.56)	0.126 (3.20)	0.154 (3.91)	0.191 (4.85)	0.172 (4.37)	0.210 (5.33)
1 1/2	1.900 (48.3)	1.869 (47.5)	1.916 (48.7)	0.145 (3.68)	0.131 (3.33)	0.160 (4.06)	0.200 (5.08)	0.180 (4.57)	0.220 (5.59)
2	2.375 (60.3)	2.351 (59.7)	2.399 (60.9)	0.154 (3.91)	0.139 (3.53)	0.169 (4.29)	0.218 (5.54)	0.196 (4.98)	0.240 (6.10)
2 1/2	2.875 (73.0)	2.846 (72.3)	2.904 (73.8)	0.203 (5.16)	0.183 (4.65)	0.223 (5.66)	0.276 (7.01)	0.248 (6.30)	0.304 (7.72)
3	3.500 (88.9)	3.465 (88.0)	3.535 (89.8)	0.216 (5.49)	0.194 (4.93)	0.238 (6.05)	0.300 (7.62)	0.270 (6.86)	0.330 (8.38)
3 1/2	4.000 (102)	3.960 (101)	4.040 (103)	0.226 (5.74)	0.203 (5.16)	0.249 (6.32)	0.318 (8.08)	0.286 (7.26)	0.350 (8.89)
4	4.500 (114)	4.455 (113)	4.545 (115)	0.237 (6.02)	0.213 (5.41)	0.261 (6.63)	0.337 (8.56)	0.303 (7.70)	0.371 (9.42)
5	5.562 (141)	5.506 (140)	5.618 (143)	0.258 (6.55)	0.232 (5.89)	0.284 (7.21)	0.375 (9.53)	0.338 (8.59)	0.413 (10.5)
6	6.625 (168)	6.559 (167)	6.691 (170)	0.280 (7.11)	0.252 (6.40)	0.308 (7.82)	0.432 (11.0)	0.389 (9.88)	0.475 (12.1)
8	8.625 (219)	8.539 (217)	8.711 (221)	0.322 (8.18)	0.290 (7.37)	0.354 (8.99)	0.500 (12.7)	0.450 (11.4)	0.550 (14.0)
10	10.750 (273)	10.643 (270)	10.858 (276)	0.365 (9.27)	0.329 (8.36)	0.402 (10.2)	0.500 (12.7)	0.450 (11.4)	0.550 (14.0)
12	12.750 (324)	12.623 (321)	12.878 (327)	0.375 (9.53)	0.338 (8.59)	0.413 (10.5)	...	...	...

TABLE 5 Dimensional Limits for Standard Pipe Sizes
Copper Alloy UNS No. C65100 and C65500

Nominal or Standard Pipe Size	Outside Diameter, in. (mm)	Min	Max	Regular			Extra Strong		
				Wall Thickness, in. (mm)	Min	Max	Wall Thickness, in. (mm)	Min	Max
1/8	0.405 (10.3)	0.374 (9.50)	0.421 (10.7)	0.068 (1.73)	0.065 (1.65)	0.083 (2.11)	0.095 (2.41)	0.090 (2.29)	0.123 (3.12)
1/4	0.540 (13.7)	0.509 (12.9)	0.556 (14.1)	0.088 (2.24)	0.084 (2.13)	0.102 (2.59)	0.119 (3.02)	0.107 (2.72)	0.144 (3.66)
3/8	0.675 (17.1)	0.644 (16.4)	0.691 (17.6)	0.091 (2.31)	0.086 (2.18)	0.103 (2.62)	0.126 (3.20)	0.120 (3.05)	0.146 (3.71)
1/2	0.840 (21.3)	0.809 (20.5)	0.856 (21.7)	0.109 (2.77)	0.104 (2.64)	0.122 (3.10)	0.147 (3.73)	0.140 (3.56)	0.166 (4.22)
3/4	1.050 (26.7)	1.019 (25.9)	1.066 (27.1)	0.113 (2.87)	0.107 (2.72)	0.124 (3.15)	0.154 (3.91)	0.146 (3.71)	0.171 (4.34)
1	1.315 (33.4)	1.284 (32.6)	1.331 (33.8)	0.133 (3.38)	0.126 (3.20)	0.145 (3.68)	0.179 (4.55)	0.170 (4.32)	0.196 (4.98)
1 1/4	1.660 (42.2)	1.629 (41.4)	1.676 (42.6)	0.140 (3.56)	0.133 (3.38)	0.151 (3.84)	0.191 (4.85)	0.181 (4.60)	0.207 (5.26)
1 1/2	1.900 (48.3)	1.869 (47.5)	1.916 (48.7)	0.145 (3.68)	0.138 (3.51)	0.156 (3.96)	0.200 (5.08)	0.190 (4.83)	0.216 (5.49)
2	2.375 (60.3)	2.351 (59.7)	2.399 (60.9)	0.154 (3.91)	0.146 (3.71)	0.164 (4.17)	0.218 (5.54)	0.207 (5.26)	0.233 (5.92)
2 1/2	2.875 (73.0)	2.846 (72.3)	2.904 (73.8)	0.203 (5.16)	0.193 (4.90)	0.217 (5.51)	0.276 (7.01)	0.262 (6.65)	0.295 (7.49)
3	3.500 (88.9)	3.465 (88.0)	3.535 (89.8)	0.216 (5.49)	0.205 (5.21)	0.230 (5.84)	0.300 (7.62)	0.285 (7.24)	0.321 (8.15)
3 1/2	4.000 (102)	3.960 (101)	4.040 (103)	0.226 (5.74)	0.215 (5.46)	0.240 (6.10)	0.318 (8.08)	0.302 (7.67)	0.340 (8.64)
4	4.500 (114)	4.455 (113)	4.545 (115)	0.237 (6.02)	0.225 (5.72)	0.252 (6.40)	0.337 (8.56)	0.320 (8.13)	0.360 (9.14)
5	5.562 (141)	5.506 (140)	5.618 (143)	0.258 (6.55)	0.245 (6.22)	0.275 (6.99)	0.375 (9.53)	0.356 (9.04)	0.400 (10.2)
6	6.625 (168)	6.559 (167)	6.691 (170)	0.280 (7.11)	0.266 (6.76)	0.298 (7.57)	0.432 (11.0)	0.410 (10.4)	0.461 (11.7)
8	8.625 (219)	8.539 (217)	8.711 (221)	0.322 (8.18)	0.299 (7.59)	0.349 (8.86)	0.500 (12.7)	0.465 (11.8)	0.554 (13.8)
10	10.750 (273)	10.643 (270)	10.858 (276)	0.365 (9.27)	0.336 (8.53)	0.400 (10.2)	0.500 (12.7)	0.460 (11.7)	0.548 (13.9)
12	12.750 (324)	12.623 (321)	12.878 (327)	0.375 (9.53)	0.345 (8.76)	0.410 (10.4)	...	...	...

TABLE 6 Wall Thickness Tolerances for Copper Alloy UNS No. C61300 and C61400 Tube (Not Applicable to Pipe)

NOTE 1—Maximum deviation at 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 5/8 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 0.024 (0.610) to 0.034 (0.864), incl.	0.003(0.076)	0.004(0.10)	0.004(0.10)
Over 0.034 (0.864) to 0.057 (1.45), incl.	0.0045(0.11)	0.005(0.13)	0.006(0.15)
Over 0.057 (1.45) to 0.082 (2.08), incl.	0.005(0.13)	0.006(0.15)	0.008(0.20)
Over 0.082 (2.08) to 0.119 (3.02), incl.	0.007(0.18)	0.008(0.20)	0.009(0.23)
Over 0.119 (3.02) to 0.164 (4.17), incl.	0.009(0.23)	0.010(0.25)	0.012(0.30)

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

10.4.1 Diameter Tolerances for Pipe:

Nominal Pipe Size, in. (mm)	Diameter Tolerance, in. (mm)
1 1/2 (38.1) and under	+0.016 -0.031 (+0.40 -0.79)
Over 1 1/2 (38.1)	±1 % of specified diameter

10.4.2 The dimensional limits of nominal pipe sizes are shown in Tables 4 and 5.

10.4.3 Diameter tolerances for tube shall be in accordance with Table 9.

TABLE 7 Wall Thickness Tolerances for Copper Alloy UNS No. C65500 Tube (Not Applicable to Pipe)

NOTE 1—Maximum deviation at 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, ^A in. (mm)						
	1/32 to 1/8 (0.792 to 3.18), incl.	Over 1/8 to 5/8 (3.18 to 15.9), incl.	Over 5/8 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 10 (173 to 251), incl.
Up to 0.017 (0.432), incl.	0.0025 (0.064)	0.0015 (0.038)	0.002 (0.051)	0.0025 (0.064)	...	...	...
Over 0.017 (0.432) to 0.024 (0.610), incl.	0.004 (0.10)	0.0025 (0.064)	0.0025 (0.064)	0.003 (0.076)	...	...	...
Over 0.024 (0.610) to 0.034 (0.864), incl.	0.004 (0.10)	0.003 (0.076)	0.003 (0.076)	0.004 (0.10)	0.005 (0.13)	...	...
Over 0.034 (0.864) to 0.057 (1.45), incl.	0.004 (0.10)	0.001 (0.10)	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.	...	0.0045 (0.11)	0.005 (0.13)	0.005 (0.13)	0.0075 (0.19)	0.010 (0.25)	0.013 (0.33)
Over 0.082 (2.08) to 0.119 (3.02), incl.	...	0.005 (0.13)	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)	0.007 (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)	6 ^B	6 ^B	8 ^B	8 ^B
Over 0.379 (9.62)	...	...	...	6 ^B	6 ^B	8 ^B	8 ^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 by more than 50 %.

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

TABLE 8 Wall Thickness Tolerances for Copper Alloy UNS No. C65100 Tube (Not Applicable to Pipe)

NOTE 1—Maximum deviation at 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, ^A in. (mm)						
	1/32 to 1/8 (0.792 to 3.18), incl.	Over 1/8 to 5/8 (3.18 to 15.9), incl.	Over 5/8 to 1 (15.9 to 25.4), incl.	Over 1 (25.4) to 2 (50.8), incl.	Over 2 (50.8) to 4 (102), incl.	Over 4 (102) to 7 (213), incl.	Over 7 (213) to 10 (254), incl.
Up to 0.017 (0.432), incl.	0.002 (0.051)	0.001 (0.025)	0.0015 (0.038)	0.002 (0.051)	...	...	...
Over 0.017 (0.432) to 0.024 (0.610), incl.	0.003 (0.076)	0.002 (0.051)	0.002 (0.051)	0.0025 (0.064)	...	...	...
Over 0.024 (0.610) to 0.034 (0.864), incl.	0.003 (0.076)	0.0025 (0.064)	0.0025 (0.064)	0.003 (0.076)	0.004 (0.10)	...	...
Over 0.034 (0.864) to 0.057 (1.45), incl.	0.003 (0.076)	0.003 (0.076)	0.0035 (0.089)	0.0035 (0.089)	0.005 (0.13)	0.007 (0.18)	...
Over 0.057 (1.45) to 0.082 (2.08), incl.	...	0.0035 (0.089)	0.004 (0.10)	0.004 (0.10)	0.006 (0.15)	0.008 (0.20)	0.010 (0.26)
Over 0.082 (2.08) to 0.119 (3.02), incl.	...	0.004 (0.10)	0.005 (0.13)	0.005 (0.13)	0.007 (0.18)	0.009 (0.23)	0.011 (0.28)
Over 0.119 (3.02) to 0.164 (4.17), incl.	...	0.005 (0.13)	0.006 (0.15)	0.006 (0.15)	0.008 (0.20)	0.010 (0.25)	0.012 (0.30)
Over 0.164 (4.17) to 0.219 (5.56), incl.	...	0.007 (0.18)	0.0075 (0.19)	0.008 (0.20)	0.010 (0.25)	0.012 (0.30)	0.014 (0.36)
Over 0.219 (5.56) to 0.283 (7.19), incl.	...	...	0.009 (0.23)	0.010 (0.25)	0.012 (0.30)	0.014 (0.36)	0.016 (0.44)
Over 0.283 (7.19) to 0.379 (9.62), incl.	...	...	0.012 (0.30)	5 ^B	5 ^B	6 ^B	6 ^B
Over 0.379 (9.62), incl.	...	...	...	5 ^B	5 ^B	6 ^B	6 ^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 by more than 50 %.

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

10.5 Length Tolerances:

10.5.1 Length tolerances shall be in accordance with Table 10.

10.5.2 Schedule of Tube Lengths—Specific and stock lengths with ends shall be in accordance with Table 11.

10.6 Squareness of Cut—For pipe and tube in straight lengths, the departure from squareness of the end of any pipe or tube shall not exceed the following:

10.6.1 Pipe:

Outside Diameter	Tolerance
Up to 5/8 in. (15.9 mm), incl.	0.010 in. (0.25 mm)
Over 5/8 in. (15.9 mm)	0.016 in./in. (0.016 mm/mm) of diameter

10.6.2 Tube:

Outside Diameter	Tolerance
Up to 5/8 in. (15.9 mm), incl.	0.010 in. (0.25 mm)
Over 5/8 in. (15.9 mm)	0.016 in./in. (0.016 mm/mm) of diameter

TABLE 9 Average Diameter Tolerances for Tube (Not Applicable to Pipe)

Copper Alloy UNS No.	Tolerance, ±in. (mm) ^A			
	Specified Diameter, in. (mm)	C61300 and C61400	C65100	C65500
Up to 1/8 (3.18), incl.	...	0.002 (0.051) ^B	0.003 (0.076) ^B	0.003 (0.076) ^B
Up to 1/8 (3.18), incl.	...	0.002 (0.051) ^C	0.0025 (0.064) ^C	0.0025 (0.064) ^C
Over 1/8 (3.18) to 5/8 (15.9), incl.	0.004 (0.10)	0.002 (0.051)	0.0025 (0.064)	0.0025 (0.064)
Over 5/8 (15.9) to 1 (25.4), incl.	0.005 (0.13)	0.0025 (0.064)	0.003 (0.076)	0.003 (0.076)
Over 1 (25.4) to 2 (50.8), incl.	0.006 (0.15)	0.003 (0.076)	0.004 (0.10)	0.004 (0.10)
Over 2 (50.8) to 3 (76.2), incl.	0.007 (0.18)	0.004 (0.10)	0.005 (0.13)	0.005 (0.13)
Over 3 (76.2) to 4 (102), incl.	...	0.005 (0.13)	0.006 (0.15)	0.006 (0.15)
Over 4 (102) to 5 (127), incl.	...	0.006 (0.15)	0.008 (0.20)	0.008 (0.20)
Over 5 (127) to 6 (152), incl.	...	0.007 (0.18)	0.009 (0.23)	0.009 (0.23)
Over 6 (152) to 8 (203), incl.	...	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)
Over 8 (203) to 10 (254), incl.	...	0.010 (0.25)	0.013 (0.33)	0.013 (0.33)

^A Tolerance applies to inside or outside diameters, except as noted.

^B On inside diameter.

^C On outside diameter.