



Designation: B75/B75M – 19

Standard Specification for Seamless Copper Tube¹

This standard is issued under the fixed designation B75/B75M; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification² establishes the requirements for seamless round, rectangular, and square copper tube suitable for general engineering applications.

1.1.1 Tubes made from any of the following Copper UNS No. designations shall be supplied unless otherwise specified in the contract or purchase order:

| Copper UNS No. | Type of Copper |
|----------------|---|
| C10100 | Oxygen-free electronic |
| C10200 | Oxygen-free without residual deoxidants |
| C10300 | Oxygen-free, extra low phosphorus |
| C10800 | Oxygen-free, low phosphorus |
| C12000 | Phosphorus deoxidized, low residual phosphorus |
| C12200 | Phosphorus deoxidized, high residual phosphorus |

1.2 *Units*—The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.3 The following safety hazard caveat pertains only to the test methods 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.*

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.

Current edition approved April 1, 2019. Published May 2019. Originally published as B75 – 28T. Last previous edition approved in 2011 as B75/B75M–11. DOI: 10.1520/B0075_B0075M–19.

² For ASME Boiler and Pressure Vessel Code applications, refer to related Specification SB-75 in Section II of that Code.

2. Referenced Documents

2.1 ASTM Standards:³

B153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing

B170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes

B193 Test Method for Resistivity of Electrical Conductor Materials

B251/B251M Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube

B577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper

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

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁴

E112 Test Methods for Determining Average Grain Size

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

2.2 ASME Standard:⁵

ASME Boiler and Pressure Vessel Code

3. General Requirements

3.1 The following sections of Specification **B251/B251M** are a part of this specification.

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.

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.

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

- 3.1.1 Terminology, General;
- 3.1.2 Material and Manufacture;
- 3.1.3 Workmanship, Finish, and Appearance;
- 3.1.4 Significance of Numerical Limits;
- 3.1.5 Inspection;
- 3.1.6 Rejection and Rehearing;
- 3.1.7 Certification;
- 3.1.8 Mill Test Reports;
- 3.1.9 Packaging and Package Marking; and
- 3.1.10 Supplementary Requirements.

3.2 In addition, when a section with an identical title to those referenced in section 3.1 appears in this specification, and is in conflict with the section appearing in Specification B251/B251M, the section in this specification shall prevail.

4. Terminology

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

5. Ordering Information

5.1 Include the following specific choices when placing orders for product under this specification, as applicable.

- 5.1.1 ASTM designation and year of issue (for example, B75 – 02);
- 5.1.2 Copper UNS No. (for example, C10100);
- 5.1.3 Temper (Section 8);
- 5.1.4 Dimensions; diameter or distance between parallel surfaces, and wall thickness (Section 17);
- 5.1.5 How furnished; coils or straight lengths;
- 5.1.6 Number of pieces or footage; each size and type;
- 5.1.7 Total weight.

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

- 5.2.1 Electrical mass resistivity test,
- 5.2.2 Hydrogen embrittlement test,
- 5.2.3 Hydrostatic test for pressures less than or equal to 1000 psi (21.2.8),
- 5.2.4 Hydrostatic test for pressures over 1000 psi (21.2.8.1),
- 5.2.5 Pneumatic test,
- 5.2.6 Certification,
- 5.2.7 Mill test report,
- 5.2.8 Expansion test,
- 5.2.9 When product is purchased for ASME Boiler and Pressure Vessel Code application,
- 5.2.10 When product is purchased for agencies of the U.S. Government.

6. Material and Manufacture

6.1 *Material*—The material of manufacture shall be billets, bars, or tube of Copper UNS No. C10100, C10200, C10300, C10800, C12000, or C12200, and shall be of such soundness as to be suitable for processing into the tubular products described.

6.2 *Manufacture:*

6.2.1 The tube shall be manufactured by such hot- and cold-working processes as to produce a uniform wrought structure in the finished product. It shall be cold drawn to the finished size and wall thickness.

6.2.2 When cold-drawn temper is required, the final drawing operation shall be such as to meet the specified temper. When annealed temper is required, the tube shall be annealed subsequent to the final cold draw.

7. Chemical Composition

7.1 The material shall conform to the requirements in Table 1 for the specified Copper UNS No. designation.

7.1.1 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer or supplier and the purchaser, limits may be established and analysis required for unnamed elements.

8. Temper

8.1 The requirements and size availability of tube in the cold-drawn tempers H55, H58, and H80, as defined in Classification B601, are specified in Table 2 or Table 3.

8.1.1 Rectangular, including square, tube shall normally be supplied only in H58 temper. When requested by the manufacturer or supplier, and upon agreement with the purchaser, tube may be supplied in H55 temper.

8.1.1.1 For any combination of diameter and wall thickness not listed under H80 temper, the requirements specified for H58 temper shall apply.

8.2 The requirements and size availability of tube in the annealed tempers O50, O60, and O62 as defined in Classification B601, are specified in Table 2 or Table 3.

NOTE 1—The purchaser shall confer with the manufacturer or supplier for the availability of product in a specific temper.

NOTE 2—Refer to Appendix X1 for recommended applications based on temper.

9. Grain Size Requirements

9.1 Tube in the annealed temper shall conform to the grain size specified in Table 2 or Table 3.

TABLE 1 Chemical Requirements

| Element | Composition, % | | | | | |
|--------------------------|---------------------|---------------------|-------------|-------------|-------------|-------------|
| | Copper UNS No. | | | | | |
| | C10100 ^A | C10200 ^B | C10300 | C10800 | C12000 | C12200 |
| Copper, min | 99.99 | 99.95 | ... | ... | 99.90 | 99.9 |
| Copper + phosphorus, min | ... | ... | 99.95 | 99.95 | ... | ... |
| Phosphorus | ... | ... | 0.001–0.005 | 0.005–0.012 | 0.004–0.012 | 0.015–0.040 |

^A Refer to Table 1, Chemical Requirements, Grade 1, of Specification B170 for impurity limits for Copper UNS No. C10100.

^B Refer to Table 1, Chemical Requirements, Grade 2, of Specification B170 for impurity limits for Copper UNS No. C10200.

TABLE 2 Mechanical Property Requirements of Drawn-Temper and Annealed-Temper Tube (inch-pound values)

| Temper Designation | | Outside Diameter, or Major Distance Between Outside Parallel Surfaces, in. | Wall Thickness, in. | Rockwell Hardness ^A | | Average Grain Size, mm | Tensile Strength, ksi ^B | Yield Strength, ^C min., ksi ^B |
|--------------------|--------------------------|--|----------------------------------|------------------------------------|------------------|------------------------|------------------------------------|---|
| Code | Name | | | Scale | Hardness | | | |
| H55 | light-drawn ^D | all | all | 30T | 30 to 60 | | 36–47 | 30 |
| H58 | drawn (general purpose) | all | all | 30T | 30 min | | 36 min | 30 |
| H80 | hard-drawn ^D | up to 4 | 0.020 to 0.250, incl | 30T | 55 min | | 45 min | 40 |
| O62 | heavy anneal | all | 0.015 to 0.035 0.035 and over | 15T ^E F ^E | 60 max 55 max | 0.050 max 0.050 max | 30 min 30 min | 6.5 ^{F, G} 6.5 ^{F, G} |
| O60 | soft anneal | all | 0.015 to 0.035 0.035 and over | 15T F | 60 max 50 max | 0.040 min 0.040 min | 30 min 30 min | 9 9 |
| O50 | light anneal | all | 0.015 to 0.035 0.035 and over | 15T F | 65 max 55 max | 0.040 max 0.040 max | 30 min 30 min | 9 9 |

^A Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the purchaser and supplier.

^B ksi = 1000 psi.

^C Yield strength to be determined at 0.5 % extension under load.

^D Light-drawn and hard-drawn tempers are normally available in round tubes only.

^E Rockwell hardness values shall apply only to tubes having a wall thickness of 0.015 in. or over, to round tubes having an inside diameter of $\frac{5}{16}$ in. or over, and to rectangular, including square, tubes having an inside major distance between parallel surfaces of $\frac{3}{16}$ in. or over. For all other tube, no Rockwell values shall apply. Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the purchaser and supplier.

^F Light-straightening operation is acceptable.

^G Alternative Tensile and Yield values to those listed in Table 2 are acceptable upon agreement between the purchaser and supplier.

TABLE 3 Mechanical Property Requirements of Drawn-Temper and Annealed-Temper Tube (SI Values)

| Temper Designation | | Outside Diameter, or Major Distance Between Outside Parallel Surfaces, mm | Wall Thickness, mm | Rockwell Hardness ^A | | Average Grain Size, mm | Tensile Strength, ^B MPa | Yield Strength, ^B min, MPa |
|--------------------|--------------------------|---|----------------------------------|------------------------------------|------------------|------------------------|------------------------------------|--|
| Standard | Former | | | Scale | Hardness | | | |
| H55 | light-drawn ^C | all | all | 30T | 30 to 60 | | 250–325 | 205 |
| H58 | drawn (general purpose) | all | all | 30T | 30 min | | 250 min | 205 |
| H80 | hard-drawn ^C | up to 102 | 0.508 to 6.35, incl | 30T | 55 min | | 310 min | 275 |
| O62 | heavy anneal | all | 0.381 to 0.889 0.889 and over | 15T ^D F ^D | 60 max 55 max | 0.050 max 0.050 max | 205 min 205 min | 45 ^{E, F} 45 ^{E, F} |
| O60 | soft anneal | all | 0.381 to 0.889 0.889 and over | 15T F | 60 max 50 max | 0.040 min 0.040 min | 205 min 205 min | 62 62 |
| O50 | light anneal | all | 0.381 to 0.889 0.889 and over | 15T F | 65 max 55 max | 0.040 max 0.040 max | 205 min 205 min | 62 62 |

^A Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the purchaser and supplier.

^B Yield strength to be determined at 0.5 % extension under load.

^C Light-drawn and hard-drawn tempers are normally available in round tubes only.

^D Rockwell hardness values shall apply only to tubes having a wall thickness of 0.040 mm or over, to round tubes having an inside diameter of 8.0 or over, and to rectangular, including square, tubes having an inside major distance between parallel surfaces of 5.0 mm or over. For all other tube, no Rockwell values shall apply. Rockwell hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified subject to agreement between the purchaser and supplier.

^E Light-straightening operation shall be permitted.

^F Alternative Tensile and Yield values to those listed in Table 3 are acceptable upon agreement between the purchaser and supplier.

9.2 Acceptance or rejection based upon grain size shall depend only on the average grain size of a test specimen taken from each of two sample portions, and each specimen shall be within the limits prescribed in Table 2 or Table 3 when determined in accordance with Test Methods E112.

10. Physical Property Requirements

10.1 *Electrical Resistivity*—When specified in the contract or purchase order, tube ordered for electrical conductor application produced from Copper UNS No. C10100, C10200,

C10300, or C12000 shall have an electrical mass resistivity, $\Omega \cdot \text{g}/\text{m}^2$, not to exceed the following limit for the specified copper and temper when tested in accordance with Test Method **B193**:

| Temper | Copper UNS No. | | | |
|---------------|----------------|----------|----------|----------|
| | C10100 | C10200 | C10300 | C12000 |
| O60, O50 | 0.151 76 | 0.153 28 | 0.156 14 | 0.170 31 |
| H55, H58, H80 | 0.156 14 | 0.157 37 | 0.159 40 | 0.174 18 |

NOTE 3—Refer to **Appendix X2** for the International Annealed Copper Standard (IACS) electrical conductivity equivalents.

11. Mechanical Property Requirements

11.1 Tensile and Yield Strength Requirements:

11.1.1 The tube furnished under this specification shall conform to the requirements of **Table 2** or **Table 3** for the specified temper and wall thickness when tested in accordance with Test Methods **E8/E8M**.

11.1.2 For any combination of diameter and wall thickness not listed under H80, the requirements for H58 shall apply.

11.1.3 Alternative Tensile and Yield values to those listed in **Table 2** or **Table 3** are acceptable upon agreement between the purchaser and supplier.

11.2 Rockwell Hardness Requirements:

11.2.1 The tube shall conform to the Rockwell hardness requirements of **Table 2** or **Table 3** for the specified temper and wall thickness when tested in accordance with Test Methods **E18**.

11.2.1.1 The Rockwell Hardness values for tube in the H55, H58, and H80 temper shall apply only to the following:

(a) Tubes having a wall thickness of 0.020 in. [0.508 mm] and over,

(b) Round tubes having an inside diameter of $\frac{5}{16}$ in. [8.0 mm] and over,

(c) Rectangular and square tubes having major distances between parallel surfaces of $\frac{3}{16}$ in. [5 mm] and over.

11.2.1.2 The Rockwell Hardness values for tube in the O60 and O50 temper shall apply only to the following:

(a) Tubes having a wall thickness of 0.015 in. [0.38 mm] and over;

(b) Round tubes having an inside diameter of $\frac{5}{16}$ in. [8 mm] and over;

(c) Rectangular and square tubes having inside major distances between parallel surfaces of $\frac{3}{16}$ in. [5 mm] and over.

11.3 *Straightening*—It shall not be prohibited to use light straightening for tube in the O60 and O50 temper.

11.4 When a discrepancy between tensile and Rockwell hardness exists, tensile always takes precedence for acceptance or rejection criteria.

12. Performance Requirements

12.1 Expansion Test for Round Tube:

12.1.1 When specified in the contract or purchase order, annealed tubes shall be capable of withstanding an expansion of the outside diameter of 40 % for tube $\frac{3}{4}$ in. [19.0 mm] and under and 30 % for tube over $\frac{3}{4}$ in. [19.0 mm] when tested in accordance with Test Method **B153**.

12.1.2 The expanded tube shall show no cracking or rupture visible to the unaided eye.

13. Microscopical Examination

13.1 Tubes furnished in Copper UNS No. C10100, C10200, C10300, and C12000 shall be essentially free of cuprous oxide as determined by Procedure A of Test Methods **B577**.

14. Hydrogen Embrittlement

14.1 When specified in the contract or purchase order, tubes produced in all designated copper material shall be capable of conforming to the requirements of Procedure B of Test Methods **B577**.

15. Nondestructive Test

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

15.2 Electromagnetic (Eddy-Current) Test:

15.2.1 Each tube up to and including $\frac{3}{8}$ in. [79 mm] in outside diameter shall be subjected to test.

15.2.2 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.

15.3 *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 6000 psi [41 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.

15.4 *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.

16. Purchases for U.S. Government Agencies

16.1 When the contract or purchase order stipulates that the purchase is for an agency of the U.S. Government, the tubes furnished shall conform to the conditions specified in the Supplementary Requirements of Specification **B251/B251M**.

17. Dimensions, Mass, and Permissible Variations

17.1 The dimensions and tolerances for product described by this specification shall be as specified in the following tables and related sections of the current edition of Specification **B251/B251M**:

17.1.1 *Wall Thickness Tolerances*—Refer to Tables 1 and 2.

17.1.2 *Tolerances for Diameter or Distance Between Parallel Surfaces*—Refer to Tables 3 and 4.

17.1.3 *Length Tolerances*—Refer to Tables 5 and 6.

17.1.4 *Straightness Tolerance*—Refer to Table 7.

17.1.5 *Corner Radius for Rectangular, including Square, Tube*—Refer to Table 8.

17.1.6 *Roundness, Squareness of Cut and Twist Tolerances for Rectangular and Square Tubes*—Refer to titled sections.

17.2 *Length Tolerances for Tube in Coils*—Refer to Table 4, Table 5, Table 6, Table 7, Table 8 and Table 9 of this specification.

18. Sampling

18.1 The lot size, portion size, and selection of sample portions shall be as follows:

18.1.1 *Lot Size*—An inspection lot shall be 10 000 lb [5000 kg] or fraction thereof,

18.1.2 *Portion Size*—Sample pieces shall be selected to be represented of the lot as follows:

| Number of Pieces in Lot | Number of Portions to Be Taken ^A |
|-------------------------|---|
| 1 to 50 | 1 |
| 51 to 200 | 2 |
| 201 to 1500 | 3 |

^A Each test portion shall be taken from a separate tube.

18.2 Chemical Composition:

18.2.1 The composite sample shall be taken in approximate equal weights from each portion piece selected in 18.1.2 and in accordance with Practice E255. The minimum weight of the composite shall be 150 g.

18.2.2 The manufacturer shall have the option of sampling at the time the castings are poured or taken from the semifinished product. The number of samples taken during the course of manufacture shall be as follows:

18.2.2.1 When sampled at the time castings are poured, at least two samples shall be taken, one after the start and one near the end of the pour, for each group of castings poured simultaneously from the same source of molten metal.

18.2.2.2 When samples are taken from the semifinished product, a sample shall be taken to represent each 10 000 lb [5000 kg] or fraction thereof, except that not more than one sample per piece shall be required.

18.2.2.3 When composition is determined during the course of manufacture, sampling and analyses of the finished product is not required.

18.3 *Other Tests*—Specimens for all other tests shall be taken from two of the sample portions taken in 18.1.2. In the event only one sample portion is taken, all specimens shall be taken from the portion selected.

19. Number of Tests and Retests

19.1 Tests:

19.1.1 *Chemical Analysis*—Chemical composition shall be determined in accordance with the element mean of the results from at least two replicate analyses of the sample(s).

19.1.2 *Grain Size, Electrical Resistivity, Tensile and Yield Strength, and Rockwell Hardness*—Results shall be reported as

TABLE 4 Coil Length Tolerances (Specific Lengths) Inch-Pound Values

| Outside Diameter or Major Distance Between Parallel Surfaces, in. | Tolerances, in., All Plus, for Nominal Lengths, ft | |
|---|--|----------------------|
| | Up to 50, incl | Over 50 to 100, incl |
| Up to 2, incl | 12 | 24 |

TABLE 5 Coil Length Tolerances (Specific Lengths) SI Values

| Outside Diameter or Major Distance Between Parallel Surfaces, mm | Tolerances, mm, All Plus, for Nominal Lengths, m | |
|--|--|---------------------|
| | Up to 15, incl | Over 15 to 30, incl |
| Up to 50.8, incl | 300 | 610 |

the average obtained from two test specimens, each taken from a separate test piece, where possible.

19.1.3 *Other Tests*—At least two specimens shall be prepared for each of the other tests and each shall conform to test requirements.

19.2 Retests:

19.2.1 When requested by the manufacturer or supplier, a retest shall be permitted when results of tests obtained by the purchaser fail to conform to the requirements of the product specification.

19.2.2 The retest shall be as directed in the product specification for the initial test, except for the number of test specimens shall be twice that normally required for the specified test.

19.2.3 All test specimens shall conform to the product specification requirement(s) in retest. Failure to conform shall be cause for rejection.

20. Specimen Preparation

20.1 *Chemical Analysis*—Preparation of the analytical specimens shall be the responsibility of the reporting laboratory.

20.2 *Tensile and Yield Strength Test*—The test specimens shall be of the full section of the tube and shall conform with the requirements of the Test Specimen section of Test Methods E8/E8M, unless the limitation of the testing machine precludes the use of such specimens in which case test specimens conforming to Type No. 1 of Fig. 13 in Test Methods E8/E8M shall be used.

20.3 Rockwell Hardness:

20.3.1 The test specimen shall be of a size and shape to permit testing by the available test equipment.

20.3.2 The surface of the test specimen shall be sufficiently flat and smooth so as to permit the accurate determination of hardness.

20.3.3 The test specimen shall be free from scale and foreign matter and care shall be taken to avoid any change in condition (for example, heating or cold working).

20.4 *Grain Size*—Test specimens shall be prepared in accordance with the appropriate procedure in Test Methods E112

20.5 Electrical Resistivity:

20.5.1 The test specimen shall be full size and shall be the full cross section of the material it represents when possible.

20.5.2 When the test specimen is taken from material in bulk, care shall be taken that the properties are not appreciably altered in the preparation.

NOTE 4—Plastic deformation tends to work harden a material and raise its resistivity, while heating tends to anneal the material with a subsequent reduction in resistivity.

**TABLE 6 Coil Length Tolerances (Mill Lengths) Inch-Pound Values
(Applicable Only to Full-Length Pieces)**

| Tube Outside Diameter or Major Distance Between Parallel Surfaces, in. [mm] | Tolerances, %, for Nominal Lengths, ft [mm] | |
|--|--|--|
| | Up to 100 [30 480], incl | Over 100 to 2000 [30 480 to 609 600], incl |
| Up to 1 [25], incl | 5 ^A or 2 ft, whichever is greater | 10 ^A |
| Over 1 to 2 [25 to 51], incl | 5 ^A or 2 ft, whichever is greater | no tolerances established |

^A Expressed to the nearest 1 ft.

**TABLE 7 Coil Length Tolerances (Mill Lengths) SI Values
(Applicable Only to Full-Length Pieces)**

| Tube Outside Diameter or Major Distance Between Parallel Surfaces, mm | Tolerances, %, for Nominal Lengths in mm | |
|--|---|------------------------------|
| | Up to 30 000, incl | Over 30 000 to 600 000, incl |
| Up to 25, incl | 5 ^A or 600, whichever is greater | 10 ^A |
| 25 to 50, incl | 5 ^A or 600, whichever is greater | no tolerances established |

^A Expressed to the nearest 300 mm.

TABLE 8 Coil Schedule of Mill Lengths with Ends, Inch-Pound Values

| Tube Outside Diameter or Major Distance Between Parallel Surfaces, in. | Nominal Length, ft | Shortest Permissible Length, % of Nominal Length | Maximum Permissible Weights of Ends, % of Lot Weight |
|---|------------------------|--|---|
| Up to 1, incl | up to 100, incl | 70 ^A | 10 |
| Over 1 to 2, incl | up to 100, incl | 60 ^A | 20 |
| Up to 1, incl | over 100 to 2000, incl | 50 | 50 ^B |

^A Expressed to the nearest 1 ft.

^B Short pieces of lengths between 50 ft and one-quarter of full length shall not exceed 10 % of lot weight. Short pieces of lengths between one-quarter of a full length and full length shall not exceed 40 % of lot weight.

TABLE 9 Coil Schedule of Mill Lengths with Ends, SI Values

| Tube Outside Diameter or Major Distance Between Parallel Surfaces, mm | Nominal Length, mm | Shortest Permissible Length, % of Nominal Length | Maximum Permissible Mass of Ends, % of Lot Weight |
|--|------------------------------|--|--|
| Up to 25, incl | up to 30 000, incl | 70 ^A | 10 |
| Over 25 to 50, incl | up to 30 000, incl | 60 ^A | 20 |
| Up to 25, incl | over 30 000 to 600 000, incl | 50 | 50 ^B |

^A Expressed to the nearest 300.

^B Short pieces are permitted to be included as follows: up to 10 % of lot weight between 15 200 and one quarter of full length and up to 40 % between one quarter and full length.

20.6 Expansion (Pin) Test—Test specimens shall conform to the requirements of the Specimen Preparation section of Test Method **B153**.

20.7 Microscopical Examination—The test specimen shall be prepared in accordance with Procedure A of Test Methods **B577** and the specimen surface shall approximate a radial longitudinal section of round tube or a longitudinal section of rectangular and square tube perpendicular to, and bisecting, the major dimensional surface.

20.8 Hydrogen Embrittlement—The test specimen shall conform to the appropriate requirements of Procedure B of Test Methods **B577**.

21. Test Methods

21.1 Chemical Analyses—In case of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. The following table is a list of published methods, some of which may no longer be viable, which, along with others not listed, may be used subject to agreement.

| Element | Test Method |
|------------|-------------|
| Copper | E53 |
| Phosphorus | E62 |

21.1.1 The test methods for the determination of composition for Coppers C10100 and C10200 shall be as described in Annex of Specification **B170**.

21.1.2 Test method(s) for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon between the manufacturer and the purchaser.

21.2 The tubes furnished shall conform to the physical and mechanical properties and other requirements of this specification when tested or examined in accordance with the following appropriate test method or practice:

| Test | Test Method |
|------------------------|---------------|
| Tensile strength | E8/E8M |
| Yield strength | E8/E8M |
| Rockwell Hardness | E18 |
| Grain size | E112 |
| Electrical resistivity | B193 |
| Expansion (pin test) | B153 |

| | |
|--|------------------|
| Electromagnetic examination (eddy current) | E243 |
| Microscopical examination, Procedure A | B577 |
| Hydrogen embrittlement, Procedure B | B577 |
| Hydrostatic pressure | B75/B75M, 21.2.8 |
| Pneumatic pressure | B75/B75M, 21.2.9 |

21.2.1 Whenever test results are obtained from both full-size and machined specimens and they differ, the test results from the full-size specimens shall prevail.

21.2.2 Rockwell hardness shall be determined on the inside surface of the tube and a minimum of three readings shall be taken on each specimen, each at a different location.

21.2.2.1 When suitable equipment is not available for determining the specified Rockwell hardness, other Rockwell scales and values shall be specified by agreement between the manufacturer and the purchaser.

21.2.3 Grain size shall be determined, in case of dispute, by the intercept method.

21.2.4 *Electrical Resistivity*—The limit of measurement uncertainty shall be ±0.30 % as a process control method and ±0.15 % as an umpire method.

21.2.5 *Microscopical Examination*—Cuprous oxide content shall be determined in accordance with Procedure A, or, in case of dispute, Procedure C, Closed Bend Test, of Test Methods B577 shall be followed.

21.2.6 *Hydrogen Embrittlement*—Procedure B shall be followed, or, in case of dispute, Procedure C, Closed Bend Test, of Test Methods B577 shall be followed.

21.2.7 *Electromagnetic (Eddy-Current) Test*—Each tube up to and including 3 1/8 in. [79 mm] in outside diameter shall be subjected to an eddy-current test. Testing shall follow the procedures in Practice E243.

21.2.7.1 Either notch depth or drilled hole standards shall be used.

(a) Notch depth standards, rounded to the nearest 0.001 in. [0.025 mm] shall be 22 % maximum of the wall thickness. The notch depth tolerance shall be ±0.0005 in. [±0.013 mm].

(b) Drilled holes shall be drilled radially through the wall using a suitable drill jig that has a bushing to guide the drill, care being taken to avoid distortion of the tube while drilling. The diameter of the drilled hole shall be in accordance with the following and shall not vary by more than +0.001, –0.000 in. [+0.025 mm, –0.000 mm] of the hole diameter specified.

| Tube Outside Diameter, in. [mm] | Diameter of Drilled Holes, in. [mm] | Drill Number |
|---|---|-----------------|
| 1/4 to 3/4, incl [6.0 to 19, incl.] | 0.025 [0.635] | 72 |
| Over 3/4 to 1, incl [Over 19.0 to 25, incl] | 0.031 [0.787] | 68 |
| Over 1 to 1 1/4, incl [Over 25 to 32, incl] | 0.036 [0.915] | 64 |
| Over 1 1/4 to 1 1/2, incl [Over 32 to 38, incl] | 0.042 [1.07] | 58 |
| Over 1 1/2 to 1 3/4, incl [Over 38 to 45, incl] | 0.046 [1.17] | 56 |
| Over 1 3/4 to 2, incl [Over 45 to 50, incl] | 0.052 [1.32] | 55 |

21.2.7.2 Alternatively, at the option of the manufacturer, using speed-insensitive eddy-current units that are equipped to select a fraction of the maximum imbalance signal, the following percent maximum imbalance signals shall be used:

| Standard Tube Size, in. [mm] | Maximum Percent Imbalance Signal Magnitude |
|---|---|
| Up to 3/8, incl [Up to 9, incl] | 0.2 |
| Over 3/8 to 2, incl [Over 13 to 50, incl] | 0.3 |
| Over 2 to 3, incl [Over 50 to 76, incl] | 0.4 |

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

21.2.8 *Hydrostatic Test*—The internal hydrostatic pressure necessary to produce the required 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 [or MPa];
- t = thickness of tube wall, in. [or mm];
- D = outside diameter of tube, in. [or mm]; and
- S = allowable fiber stress of the material, psi [MPa].

21.2.8.1 The tube need not be tested at a pressure gauge reading over 1000 psi [6.9 MPa] unless so specified.

21.2.9 *Pneumatic Test*—The test method shall permit easy visual detection of leakage, such as having the material under water or by the pressure differential method.

22. Rejection and Rehearing

22.1 Rejection:

22.1.1 Product that fails to conform to the specification requirements when tested by the purchaser or purchaser’s agent shall be subject to rejection.

22.1.2 Rejection shall be reported to the manufacturer or supplier promptly. In addition, a written notification of rejection shall follow.

22.1.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer or supplier shall have the option to make claim for a rehearing.

22.2 Rehearing:

22.2.1 As a result of product rejection, the manufacturer or supplier shall have the option to make claim for a retest to be conducted by the manufacturer or supplier and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and subjected to test by both parties using the test method(s) specified in the product specification, or alternately, upon agreement of both parties, an independent laboratory may be selected for the test(s) using the test method(s) specified in the product specification.

23. Certification

23.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been tested and inspected as directed in this specification and requirements have been met.

23.2 When specified in the purchase order or contract that product is purchased for ASME Boiler and Pressure Vessel Code applications, certification to this specification is mandatory.

24. Test Report

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

25. Keywords

25.1 seamless copper tube; seamless tube; tube; C10100; C10200; C10300; C10800; C12000; C12200

APPENDIXES

(Nonmandatory Information)

X1. RECOMMENDED APPLICATIONS

X1.1 Tube in the H55 temper is recommended when a tube of some stiffness is required yet capable of being bent when necessary.

X1.2 Tube in the H58 temper is recommended for general applications in which there is no specific need for high strength or bending qualities.

X1.3 Tube in the H80 temper is recommended for applications in which there is a need for a tube as strong as technically feasible for the size indicated.

X2. INTERNATIONAL ANNEALED COPPER STANDARD (ELECTRICAL CONDUCTIVITY EQUIVALENTS)

| Electrical Resistivity, $\Omega\cdot\text{g}/\text{m}^2$ | Conductivity, % |
|--|-----------------|
| 0.151 76 | 101.00 |
| 0.153 28 | 100.00 |
| 0.156 14 | 98.16 |
| 0.157 37 | 97.40 |
| 0.159 40 | 96.16 |
| 0.170 31 | 90 |
| 0.174 18 | 88 |

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B75/B75M – 11) that may impact the use of this standard. (Approved April 1, 2019.)

- (1) Added temper O62 in **Table 2** and **Table 3** and in **8.2** with average grain size “0.050 max.”
- (2) Revised the standard to reflect current form and style changes.
- (3) Made editorial changes to correct grammar/spelling.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; http://www.copyright.com/



Contact ASTM

Call Us

Monday through Friday 8:30am-6:00pm Eastern US
Standard Time

Sales & Support

1-877-909-2786 (USA & Canada)

International

001-610-832-9585 (Customer Service)

001-610-832-9578 (Technical Support)

ASTM Headquarters

100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA
19428-2959, USA
Tel: +1.610.832.9500
Fax: +1.610.832.9555
service@astm.org
[Directions](#)

Washington Office

1850 M Street, NW
Suite 1030
Washington, DC 20036
[Jeffrey Grove](#)
Tel: +1.202.223.8505

Latin America Office

EnginZone
Monterosa 233
of. 402 Chacarilla del Estanque
Surco, Lima 33
PERU
[Maria Isabel Barrios](#)
Tel: +51 (1) 205-5502



Contact ASTM

Call Us

Monday through Friday 8:30am-6:00pm Eastern
US Standard Time

Sales & Support

1-877-909-2786 (USA & Canada)

International

001-610-832-9585 (Customer Service)

001-610-832-9578 (Technical Support)

Canada Office

171 Nepean Street, Suite 400
Ottawa, ON K2P 0B4

[Diane Thompson](#)

Tel: +1.613.751.3409

Brussels Office

Rue de la Loi 67
B-1040 Brussels,
Belgium

[Sara Gobbi](#)

Tel +32.(0)2.8405127

China Office

Suite EF-09, Twin Towers East,
B-12 Jianguomenwai Ave.
Chaoyang District, Beijing, P.R. China
100022

[Liu Fei](#)

Tel: +86.10.5109.6033

Fax: +86.10.5109.6039



Contact ASTM

Call Us

Monday through Friday 8:30am-6:00pm Eastern
US Standard Time

Sales & Support

1-877-909-2786 (USA & Canada)

International

001-610-832-9585 (Customer Service)

001-610-832-9578 (Technical Support)

Media Contact

[Nathan Osburn](#), Director,
Corporate Communications
Tel: +610.832.9603