Designation: B75/B75M – 20

Standard Specification for Seamless Copper Tube[1]

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 specification[2] 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.*

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.

[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, refer to related Specification SB-75 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.

[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.

TABLE 1 Chemical Requirements

Element	Composition, %					
	Copper UNS No.					
	C10100[A, B]	C10200[C, D]	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] Cu value not including Ag.
[C] Refer to Table 1, Chemical Requirements, Grade 2, of Specification B170 for impurity limits for Copper UNS No. C10200.
[D] Cu value includes Ag.

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	15T[E]	60 max	0.050 max	30 min	6.5[F, G]
			0.035 and over	F[E]	55 max	0.050 max	30 min	6.5[F, G]
O60	soft anneal	all	0.015 to 0.035	15T	60 max	0.040 min	30 min	9
			0.035 and over	F	50 max	0.040 min	30 min	9
O50	light anneal	all	0.015 to 0.035	15T	65 max	0.040 max	30 min	9
			0.035 and over	F	55 max	0.040 max	30 min	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 5⁄16 in. or over, and to rectangular, including square, tubes having an inside major distance between parallel surfaces of 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	15T[D]	60 max	0.050 max	205 min	45[E, F]
			0.889 and over	F[D]	55 max	0.050 max	205 min	45[E, F]
O60	soft anneal	all	0.381 to 0.889	15T	60 max	0.040 min	205 min	62
			0.889 and over	F	50 max	0.040 min	205 min	62
O50	light anneal	all	0.381 to 0.889	15T	65 max	0.040 max	205 min	62
			0.889 and over	F	55 max	0.040 max	205 min	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. Grain Size Requirements

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

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