Designation: B 75 – 02

Standard Specification for Seamless Copper Tube[1]

This standard is issued under the fixed designation B 75; 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 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 The values stated in inch-pound units are the standard except for grain size values which are given in SI units.

1.3 This specification is the companion to SI Specification B 75M; therefore no SI equivalents are presented in this specification.

1.4 The following hazard statement pertains only to the test method described in Sections 20.5.2.1, 21.2.9, and 21.2.10 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 75M Specification for Seamless Copper Tube [Metric][3]

B 153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing[3]

B 170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes[3]

B 193 Test Method for Resistivity of Electrical Conductor Materials[4]

B 251 Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube[3]

B 577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper[3]

B 601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast[3]

E 3 Guide for Preparation of Metallographic Specimens[5]

E 8 Test Methods for Tension Testing of Metallic Materials[5]

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[5]

E 53 Test Methods for Determination of Copper in Unalloyed Copper by Gravimetry[6]

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)[6]

E 112 Test Methods for Determining the Average Grain Size[5]

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes[7]

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition[6]

E 527 Practice for Numbering Metals and Alloys (UNS)[8]

3. Terminology, Specific

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *capable of*—the test need not be performed by the producer of the material. However, if subsequent testing by the purchaser establishes that the material does not meet these requirements, the material shall be subject to rejection.

3.1.2 *unaided eye, n*—visual inspection without the use of special equipment or enhancement excepting the use of corrective lenses.

4. Ordering Information

4.1 Include the following information in orders for products.

[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] *Annual Book of ASTM Standards*, Vol 02.01.

[4] *Annual Book of ASTM Standards*, Vol 02.03.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] *Annual Book of ASTM Standards*, Vol 03.06.

[7] *Annual Book of ASTM Standards*, Vol 03.03.

[8] *Annual Book of ASTM Standards*, Vol 01.01.

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

4.1.1 ASTM designation and year of issue (for example, B 75 – 99),

4.1.2 Copper UNS No. (for example, C10100),

4.1.3 Temper (Section 7),

4.1.4 Dimensions; diameter or distance between parallel surfaces, and wall thickness (Section 16),

4.1.5 How furnished; coils or straight lengths,

4.1.6 Number of pieces or footage; each size and type,

4.1.7 Total weight,

4.1.8 When product is purchased for ASME Boiler and Pressure Vessel Code application, and

4.1.9 When product is purchased for agencies of the U.S. Government.

4.2 The following options are available and shall be specified at the time of placing the order, when required:

4.2.1 Electrical mass resistivity test,

4.2.2 Hydrogen embrittlement test,

4.2.3 Hydrostatic test,

4.2.4 Pneumatic test,

4.2.5 Certification, and

4.2.6 Test report.

5. Material and Manufacture

5.1 *Material*—The material of manufacture shall be billets, bars, or tube of Copper UNS[9] 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.

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

6. Chemical Composition

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

6.1.1 These specification limits do not preclude the presence of other elements. When included in the contract or purchase order, and agreed upon by the manufacturer or supplier and the purchaser, limits shall be established and analysis required for unnamed elements.

[9] Refer to Practice E 527 for explanation of unified numbering system (UNS).

7. Temper

7.1 The requirements and size availability of tube in the cold-drawn tempers H55, H58, and H80, as defined in Classification B 601, are specified in Table 2.

7.1.1 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 shall be supplied in H55 or H58 temper.

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

7.2 The requirements and size availability of tube in the annealed tempers O50 and O60, as defined in Classification B 601, are specified in Table 2.

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.

8. Grain Size Requirements

8.1 Tube in the annealed temper shall conform to the grain size specified in Table 2.

9. Physical Property Requirements

9.1 *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, $\Omega \cdot g/m^2$, not to exceed the following limit for the specified copper and temper when tested in accordance with Test Method B 193:

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.

10. Mechanical Property Requirements

10.1 *Tensile and Yield Strength*:

10.1.1 The tube shall conform to the requirements of Table 2 for the specified temper and wall thickness.

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

10.2 *Rockwell Hardness*:

10.2.1 The tube shall conform to the requirements of Table 2 for the specified temper and wall thickness.

10.2.1.1 The Rockwell Hardness values for tube in the H55,

TABLE 1 Chemical Requirements

Element	Composition, %						
	Copper UNS No.						
	C10100[A]	C10200[B]	C10300	C10800	C12000	C12200	C14200
Copper[C], min	99.99	99.95	...	...	99.90	99.9	99.40
Copper[C] + phosphorus, min	...	...	99.95	99.95	...	...	...
Phosphorus	...	...	0.001–0.005	0.005–0.012	0.004–0.012	0.015–0.040	0.015–0.040
Arsenic	...	...	...	...	...	...	0.15–0.50

[A] Refer to Table 1, Chemical Requirements, Grade 1, of Specification B 170 for impurity limits for Copper UNS No. C10100.
[B] Refer to Table 1, Chemical Requirements, Grade 2, of Specification B 170 for impurity limits for Copper UNS No. C10200.
[C] Copper (including silver).

TABLE 2 Mechanical Property Requirements of Drawn-Temper and Annealed-Temper Tube

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

[A] ksi = 1000 psi.
[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 0.020 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. 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 purchaser and supplier.
[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 purchaser and supplier.
[F] Light-straightening operation is acceptable.

H58, and H80 temper shall apply only to the following:

(*a*) Tubes having a wall thickness of 0.020 in. and over,

(*b*) Round tubes having an inside diameter of 5⁄16 in. and over,

(*c*) Rectangular and square tubes having major distances between parallel surfaces of 3⁄16 in. and over.

10.2.1.2 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. and over;

(*b*) Round tubes having an inside diameter of 5⁄16 in. and over;

(*c*) Rectangular and square tubes having inside major distances between parallel surfaces of 3⁄16 in. and over.

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

11. Performance Requirements

11.1 *Expansion Test for Round Tube*—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 3⁄4 in. and under and 30 % for tube over 3⁄4 in. The tube shall show no cracking or rupture visible to the unaided eye.

12. Microscopical Examination

12.1 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 B 577.

13. Hydrogen Embrittlement

13.1 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 B 577.

14. Purchases for U.S. Government Agencies

14.1 When the contract or purchase order stipulates 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 B 251.

15. Nondestructive Test

15.1 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.

15.2 *Electromagnetic (Eddy-Current) Test*:

15.2.1 Each tube up to and including 3⅛ in. in outside diameter shall be subjected to test.

15.2.2 When tested in accordance with Practice E 243, 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 without leakage. The tube need not be subjected to a pressure gage reading over 1000 psi 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, minimum, for 5 s without leakage.

16. Dimensions, Mass, and Permissible Variations

16.1 The dimensions and tolerances for product furnished to this specification shall be as specified in the following tables and related sections of the current edition of Specification B 251:

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

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

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

16.1.4 *Straightness Tolerance*—Refer to Table 7.

16.1.5 *Corner Radius for Rectangular Including Square Tube*—Refer to Table 8.

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

16.2 *Length Tolerances for Tube in Coils*—Refer to Table 3, Table 4, and Table 5 of this specification.

17. General Requirements

17.1 The following sections of Specification B 251 are a part of this specification.

17.1.1 Terminology, General,

17.1.2 Material and Manufacture,

17.1.3 Workmanship, Finish, and Appearance,

17.1.4 Significance of Numerical Limits,

17.1.5 Inspection,

17.1.6 Rejection and Rehearing,

17.1.7 Certification,

17.1.8 Mill Test Reports,

17.1.9 Packaging and Package Marking, and

17.1.10 Supplementary Requirements.

17.2 In addition, when a section with an identical title to those referenced in 17.1 appears in this specification, and is in conflict with the section appearing in Specification B 251, the section in this specification shall prevail.

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 lbs 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 E 255. 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:

TABLE 3 Coil Length Tolerances (Specific Lengths)

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

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 lbs 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 Composition*—Chemical composition shall be determined as the arithmetic mean of results from at least two replicate determinations for each specified element.

19.1.2 *Grain Size, Electrical Resistivity, Tensile and Yield Strength, and Rockwell Hardness*—These tests shall be reported as the average of results from two test specimens and each specimen shall conform to specification requirements.

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 test results obtained by the purchaser fail to conform with the product specification requirement(s), the manufacturer or supplier shall have the option to perform a retest.

19.2.2 Retesting shall be as directed in this specification for the initial test except for the number of test specimens which shall be twice that normally required for the test.

19.2.3 Test results for all specimens shall conform to this specification's requirement(s) in retest and failure to conform shall be cause for lot 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 E 8, unless the limitation of the testing machine precludes the use of such specimen in which case test specimen conforming to Type No. 1 of Fig. 13 in Test Methods E 8 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.

TABLE 4 Coil Length Tolerances (Mill Lengths) (Applicable Only to Full-Length Pieces)

Tube Outside Diameter or Major Distance Between Parallel Surfaces, in.	Tolerances, %, for Nominal Lengths, ft	
	Up to 100, incl	Over 100 to 2000, incl
Up to 1, incl	5[A] or 2 ft, whichever is greater	10[A]
Over 1 to 2, incl	5[A] or 2 ft, whichever is greater	no tolerances established

[A] Expressed to the nearest 1 ft.

TABLE 5 Coil Schedule of Mill Lengths with Ends

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.

20.4 *Grain Size*—Test specimens shall be prepared in accordance with the appropriate procedure in Guide E 3.

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.

20.5.2.1 When necessary, products are to be rolled or cold drawn to a wire approximately 0.080 in. in diameter (12-gage AWG) and of a convenient length. At least two specimens of a length sufficient to accommodate the testing equipment shall be cut from one end of the wire and annealed at approximately 935 ± 10°F for 30 min in an inert atmosphere and rapidly cooled to ambient temperature without undue exposure to air.

20.6 *Expansion (Pin) Test*—Test specimens shall conform to the requirements of the Specimen Preparation section of Test Method B 153.

20.7 *Microscopical Examination*—The test specimen shall be prepared in accordance with Procedure A of Test Methods B 577 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 B 577.

21. Test Methods

21.1 *Chemical Composition*—The copper composition shall be determined, in case of disagreement, as follows:

Element	Test Method
Copper	E 53
Phosphorus	E 62
Arsenic	E 62

21.1.1 The test methods for the determination of composition for Coppers C10100 and C10200 shall be as described in Annex of Specification B 170.

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 with 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	E 8
Yield strength	E 8
Rockwell Hardness	E 18
Grain size	E 112
Electrical resistivity	B 193
Expansion (pin test)	B 153
Electromagnetic examination (eddy current)	E 243
Microscopical examination Procedure A	B 577
Hydrogen embrittlement Procedure B	B 577
Hydrostatic pressure	B 75, 21.2.9
Pneumatic pressure	B 75, 21.2.10

21.2.1 Tensile strength shall be determined in accordance with Test Methods E 8.

21.2.1.1 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 Yield strength shall be determined at 0.5 % extension under load.

21.2.3 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.

21.2.3.1 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.

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

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

21.2.6 *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

B 577 shall be followed.

21.2.7 *Hydrogen Embrittlement*—Procedure B shall be followed, or, in case of dispute, Procedure C, Closed Bend Test, of Test Methods B 577 shall be followed.

21.2.8 *Electromagnetic (Eddy-Current) Test*—Each tube up to and including 3⅛ in. in outside diameter shall be subjected to an eddy-current test. Testing shall follow the procedures in Practice E 243. Tubes shall be passed through an eddy-current test unit adjusted to provide information on the suitability of the tube for the intended application.

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

(*a*) Notch depth standards, rounded to the nearest 0.001 in. shall be 22 % of the wall thickness. The notch depth tolerance shall be ±0.0005 in.

(*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. of the hole diameter specified.

Tube Outside Diameter, in.	Diameter of Drilled Holes, in.	Drill Number
¼ to ¾, incl	0.025	72
Over ¾ to 1, incl	0.031	68
Over 1 to 1¼, incl	0.036	64
Over 1¼ to 1½, incl	0.042	58
Over 1½ to 1¾, incl	0.046	56
Over 1¾ to 2, incl	0.052	55

21.2.8.2 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.	Maximum Percent Imbalance Signal Magnitude
Up to ⅜, incl	0.2
½ to 2, incl	0.3
Over 2 to 3, incl	0.4

21.2.8.3 Tubes that do not activate the signalling 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.

21.2.9 *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).

21.2.9.1 The tube need not be tested at a pressure gage reading over 1000 psi unless so specified.

21.2.10 *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. Certification

22.1 Certification is mandatory when product is ordered for ASME Boiler and Pressure Vessel Code applications.

23. Keywords

23.1 seamless copper tube; seamless tube; tube

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

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B 75 – 99) that may impact the use of this standard.

(*1*) Section 3.1.1, Table 2, footnote F, and Table 5, footnote B, were modified to replace nonmandatory language with mandatory language.