Designation: B1003 – 16

Standard Specification for Seamless Copper Tube for Linesets[1]

This standard is issued under the fixed designation B1003; 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.

1. Scope

1.1 This specification establishes the requirements for seamless copper tube for linesets intended for use in air conditioning units. The pressure rating established is 700 psi at 250 °F and incorporates fully annealed and brazed copper tubing.

1.2 The tube shall be produced from the following copper alloy:

Copper UNS No.	Previously Used Designation	Description
C12200	DHP	Phosphorus deoxidized, high residual phosphorus

1.3 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.

1.4 The following safety hazard caveat pertains only to the test methods described in this specification:

1.4.1 *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:*[2]

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

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

B900 Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies

E3 Guide for Preparation of Metallographic Specimens

E8/E8M Test Methods for Tension Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]

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:*[4]

B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

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 *insulating material, n*—any material used to impart insulating properties to the copper coil provided the material does not cause corrosion of the copper.

3.2.2 *lineset, n*—a set of two (2) coils consisting of a suction line and a liquid line.

3.2.2.1 *liquid line, n*—a specified length of coiled tube with or without a sleeved insulating material.

3.2.2.2 *suction line, n*—a specified length of coiled tube with a sleeved insulating material.

3.2.3 *R-value, n*—the quantity determined by the temperature difference, at steady state, between two defined surfaces of a material or construction that induces a unit heat flow rate through a unit area.

[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 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

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, B1003–16),

4.1.2 Copper UNS No. (or other internationally recognized copper alloy designation) - not necessary unless a specific copper is desired,

4.1.3 Dimensions; diameter,

4.1.4 Standard Size (Table 1),

4.1.5 Length,

4.1.6 Quantity (total pieces of each size and type),

4.1.7 Insulation Type (Section 5),

4.1.8 Insulation Thickness or R-Value, or both (Section 5),

4.1.9 End Bend/Fittings/Refrigerant Charge (Section 5), and

4.1.10 If product is purchased for agencies of the U.S. Government (Section 11).

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

4.2.1 Expansion test (10.1),

4.2.2 Cleanness test (Sections 10.2 and 17.2.5),

4.2.3 Microscopical Examination for Hydrogen Embrittlement, Procedure B (10.3.2),

4.2.4 Certification (Section 21),

4.2.5 Test report (Section 22),

4.2.6 Tensile test (9.1),

4.2.7 If the specification number must be shown in the package marking (23.1.1), and

4.2.8 Tubing with pressure ratings other than 700 psi.

5. Materials and Manufacture

5.1 *Materials:*

5.1.1 The material of manufacture shall be billets, bars, or tube and shall be of such soundness as to be suitable for processing into the tubular products described.

5.1.2 The material of insulation shall be agreed upon between the purchaser and manufacturer. The thickness or R-Values, or both, shall also be agreed upon by the purchaser and manufacturer. The insulating material shall be chemically compatible with copper and shall not cause corrosion of the copper.

5.2 *Manufacture:*

TABLE 1 Standard Dimensions and Tolerances in Diameter for Coils

Standard Size, in.	Outside Diameter, in. (mm)	Tolerances
		Average,[A] Outside Diameter, Plus and Minus, in. (mm)
¼	0.250 (6.35)	0.002 (0.051)
5⁄16	0.312 (7.92)	0.002 (0.051)
⅜	0.375 (9.53)	0.002 (0.051)
½	0.500 (12.7)	0.002 (0.051)
⅝	0.625 (15.9)	0.002 (0.051)
¾	0.750 (19.1)	0.0025 (0.064)
⅞	0.875 (22.2)	0.003 (0.076)
1⅛	1.125 (28.6)	0.0035 (0.089)

[A] The average outside diameter of a tube is the average of the maximum and minimum outside diameters as determined at any one cross section of the tube.

5.2.1 The tube shall be manufactured by such hot- or cold-working processes as to produce a uniform wrought structure in the finished product.

5.2.2 The tube shall be cold drawn to the finished diameter and wall thickness and subsequently bright annealed. The tube can be in the form of a level-wound coil, bunch coil, straight length, or other form depending upon the manufacturer's processing capabilities.

5.2.3 After annealing, the insulating material shall be applied to the suction line and the liquid line as specified. Re-coiling of the insulated tube may be performed upon the specified lengths, as required.

5.2.4 Bends, fittings, and refrigerant charges may be applied to the material after application of the insulating material.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements in Table 2.

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

7. Temper

7.1 Tubes produced under this specification shall be furnished in O60 (soft annealed) as defined in Classification B601.

8. Grain Size

8.1 Tubes shall have a recrystallized grain size of 0.030 mm minimum and 0.070 mm maximum when determined in accordance with Test Methods E112.

9. Mechanical Property Requirements

9.1 *Tensile Requirements*—The tube shall conform to the tensile requirements prescribed in Table 3.

9.1.1 Tensile requirements shall be made prior to re-coiling.

9.1.2 Tensile tests need not be performed except when specified in the contract or purchase order.

9.1.3 Acceptance or rejection based upon mechanical properties shall depend only on tensile strength.

9.2 *Straightening*—It shall not be prohibited to use light straightening for tube.

10. Performance Requirements

10.1 *Expansion Test:*

10.1.1 Tube shall be capable of being expanded in accordance with Test Method B153 to the following extent:

10.1.1.1 The expanded tube shall show no cracking or other defects visible to the unaided eye.

TABLE 2 Chemical Composition—Weight %

Element	Copper UNS No. C12200
Copper,[A] min	99.9
Phosphorus	0.015–0.040

[A] Copper + silver.

TABLE 3 Mechanical Property Requirements of Annealed-Temper Tube (Inch-Pound Values)

Temper Designation		Outside Diameter, or Major Distance Between Outside Parallel Surfaces, in.	Average Grain Size, mm	Tensile Strength, ksi[A] (MPa)	Elongation in 2 in. min %
Code	Name				
O60	soft anneal	all	0.030 min–0.070 max	30 min (207 min)	40

[A] ksi = 1000 psi.

10.1.2 Expansion tests need not be performed except when specified in the contract or purchase order.

10.2 *Cleanness of Interior Surface:*

10.2.1 Tube shall have the capability of meeting an internal cleanliness test described in 17.2.5.

10.2.2 Cleanliness tests need not be performed except when specified in the contract or purchase order.

10.2.3 After evaporation of the cleaning solvent, the residue weight from the tube shall not exceed 0.0035 g/ft^2 (0.038 g/m^2) of the interior surface.

10.3 *Microscopical Examination for Susceptibility to Hydrogen Embrittlement:*

10.3.1 Tubes shall be essentially free of cuprous oxide as determined by Procedure A of Test Methods B577.

10.3.2 Tubes furnished in all coppers shall be capable of passing the embrittlement test specified in Procedure B of Test Methods B577. Hydrogen Embrittlement testing need not be performed except when specified in the contract or purchase order. In case of a dispute, Procedure C of Test Methods B577 shall be used as the referee method.

10.4 *Pressure Ratings:*

10.4.1 Tubing shall be capable of handling pressures up to 700 psi according to the tests described in 17.3.

10.4.2 Upon agreement between supplier and purchaser, tubing with pressure ratings other than 700 psi may be produced. Proof of the design shall be determined in accordance with the procedures described in 17.3.

11. Other Requirements

11.1 *Nondestructive Testing Requirements:*

11.1.1 *Electromagnetic (Eddy-Current) Examination:*

11.1.1.1 Each length of tube shall be subjected to examination.

11.1.1.2 Tubes that do not actuate the signaling device on the testing unit, after having been adjusted to provide information on the suitability of the tube for the intended application, shall conform to the requirements of this test. Testing shall be in accordance with Practice E243 and 17.2.4.

11.1.1.3 Any tube which actuates the signaling device on the testing unit is to be removed or scrapped from the finished linesets. Marked defects are not allowed.

11.1.2 When specified in the contract or purchase order, product purchased for agencies of the U.S. Government shall conform to the requirements stipulated in the Supplementary Requirements.

12. Dimensions, Mass, and Permissible Variations

12.1 The standard dimensions for the various nominal sizes are given in Table 1.

12.2 *Outer Diameter*—The tolerances for diameter shall conform to the requirements specified in Table 1.

12.3 *Lengths and Tolerances:*

12.3.1 *Standard Lengths and Tolerances*—The length tolerances for coils shall be +12 in. (305 mm) and –0 in.

12.4 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 shall be subject to rejection.

12.5 Tubes supplied with end bend shall be in accordance with requirements established by agreement between the manufacturer or supplier and the purchaser.

12.6 Tubes supplied with end fitting or connector, or both, shall be in accordance with requirements established by agreement between the manufacturer or supplier and the purchaser.

12.7 Tube supplied with refrigerant charges shall be in accordance with the requirements established by agreement between the manufacturer or supplier and the purchaser.

13. Workmanship, Finish, and Appearance

13.1 The finished tube shall be smooth, free of internal and external mechanical imperfections, and shall have a clean, bright appearance at the time of manufacture. Blemishes of a nature that do not interfere with the intended application are acceptable.

13.2 The insulating material shall be smooth and free from tears or splits, or both, porous areas, weak sections, bubbles, foreign matter, or other defects which directly affect serviceability.

13.2.1 Insulation shall have no more than one mend joint, using suitable tape or other joining methods.

14. Sampling

14.1 The lot size, portion size, and selection of sample pieces shall be as follows:

14.1.1 *Lot Size*—An inspection lot shall be 10 000 lb (5000 kg), or less, of the same alloy, temper, and nominal dimensions, subject to inspection at one time. Alternatively, a lot shall be the product of one cast bar from a single melt charge, or one continuous casting run whose weight does not exceed 40 000 lb (20 000 kg) that has been continuously processed and subject to inspection at one time.

14.1.2 *Portion Size*—Sample pieces shall be selected to be representative of the lot as shown in Table 4.

TABLE 4 Sampling Schedule

NOTE 1—Each sample piece shall be taken from a separate tube.

Number of Pieces in Lot	Number of Sample Pieces to be Taken
1 to 50	1
51 to 200	2
201 to 1500	3
Over 1500	0.2 % of total number of pieces in the lot, but not to exceed 10 pieces

14.2 *Chemical Composition:*

14.2.1 The sample shall be taken in approximately equal weight from each piece selected in 14.1.2 and prepared in accordance with Practice E255. The minimum weight of the composite sample shall be 150 g.

14.2.2 Instead of sampling in accordance with Practice E255, the manufacturer shall have the option of sampling at the time castings are poured or from the semi-finished product. When the composition is determined during the course of manufacture, sampling of the finished product is not required.

14.3 *Other Tests*—Specimens for all other tests shall be taken from two of the sample pieces selected in 14.1.2. In the event only one sample piece is selected, all specimens shall be taken from that piece.

15. Number of Tests and Retests

15.1 *Tests:*

15.1.1 Chemical composition shall be reported as the average of results from at least two replicate determinations for each specified element and each determination must meet specification requirements.

15.1.2 Tensile and grain size shall be reported as the average of results from the specimens tested and all specimens must conform to specification requirements.

15.1.3 Specimens for all other tests must meet specification requirements.

15.2 *Retest:*

15.2.1 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.

15.2.2 The retest shall be as directed in the product specification for the initial test except the number of test specimens shall be twice that normally required for the specified test. All test specimens shall conform to the product specification requirement(s) in retest. Failure to conform shall be cause for rejection.

16. Specimen Preparation

16.1 *Chemical Analysis*—Preparation of the analytical specimens for the determination of chemical composition shall be the responsibility of the reporting laboratory.

16.2 *Grain Size and Microscopical Examination:*

16.2.1 The specimen(s) shall be prepared in accordance with Guide E3.

16.2.2 The surface of the specimen shall approximate a radial longitudinal section of the tube.

16.3 *Tensile*—Tensile 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 specimen in which case test specimen conforming to Type No. 1 of Fig. 13 in Test Methods E8/E8M shall be used.

16.4 *Electromagnetic (Eddy-Current) Test*—Tubes for this test require no special preparation.

16.5 *Expansion Test*—Test specimens shall be prepared in accordance with the Test Specimen section of Test Method B153.

16.6 *Pressure Rating Test*—Tube assembly shall consist of two (2) 6 in. (+3/-1 in.) lengths of copper lineset tube, joined in the middle by a standard copper coupling meeting the requirements of ASME B16.22. The coupling shall be joined to the tube sections by brazing.

17. Test Methods

17.1 *Chemical Analyses:*

17.1.1 In cases 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

17.1.2 The test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and purchaser.

17.2 *Other Tests:*

17.2.1 The tubes furnished shall conform to the specified requirements when subjected to test in accordance with the following table:

Test	Test Method
Grain size	E112
Tensile strength	E8/E8M
Expansion (pin test)	B153
Electromagnetic (eddy-current) test	E243 and 17.2.4
Cleanness	17.2.5
Microscopical Examination, Procedure A	B577
Microscopical Examination, Procedure B	B577

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

17.2.3 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.

17.2.4 *Electromagnetic (Eddy-Current) Test*—Each tube up to and including 1⅛ in. (28.6 mm) in outside diameter, shall be subjected to an eddy-current test. Testing shall follow the procedures in Practice E243. Tubes shall be passed through an eddy-current test unit adjusted to provide information on the suitability of the tube for the intended application.

17.2.4.1 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

Tube Outside Diameter, mm	Diameter of Drilled Holes, mm	Drill Number
6.0 to 19.0, incl	0.635	72
Over 19.0 to 25, incl	0.785	68
Over 25 to 32, incl	0.915	64

17.2.4.2 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

Standard Tube Size, mm	Maximum Percent Imbalance Signal Magnitude
Up to 9, incl	0.2
13 to 50, incl	0.3

17.2.4.3 Tubes that do not activate the signaling device of the eddy-current tester shall be considered as conforming to the requirements of this test. At the option of the manufacturer, tubes with discontinuities indicated by the testing unit are not prohibited 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.

17.2.5 *Cleanness Test:*

17.2.5.1 In performing this test, care must be exercised to clean the outside surface of the end of the sample to be immersed in the solvent. The sample must be prepared in such a manner as to prevent the inclusion in the residue of copper chips or dust resulting from cutting of the sample. Testing may be performed on less than full lengths, minimum of 5 ft (1524 mm), with a corresponding reduced maximum permissible residue limit based upon 0.0035 g/ft^2 (0.038 g/m^2) of sample interior surface.

17.2.5.2 Cap, or plug, one end of the tube and fill with solvent to one eighth of its capacity. Cap, or plug, the filling end and roll tube on horizontal supports to thoroughly wash the inside surface. A minimum quantity of 100 ml shall be used for diameters up to ½ in. (12.7 mm) and shall be increased proportionally for the larger sizes.

17.2.5.3 Remove a cap, or plug, and pour the solvent into a suitable clean weighed container. With adequate exhaust, the solvent in the container shall be evaporated to near dryness at a low temperature on a hot plate or sand bath. (**Warning—** Overheating is likely to cause charring of the residue.)

17.2.5.4 Place the container in a drying oven with the temperature set at 105 ± 5 °C for 10 min to complete the drying process. When dry, remove the container, cool in a desiccator, and weigh.

17.2.5.5 A blank determination with the same volume of solvent as that poured from the cleaned tube shall be made.

17.2.5.6 Subtract the weight of the blank residue from the weight of the tube cleaning solvent residue. The corrected weight shall then be calculated to grams of residue per internal area of the tube as follows:

$$C = A - B \tag{1}$$

where:

A = weight of blank container plus residue,
B = net weight of empty container, and
C = weight of solvent residue from blank, g.

$$G = [(E - F) - C]/D \tag{2}$$

where:

E = weight of container plus residue from tube,
F = net weight of container,
C = weight of residue from solvent blank,
D = internal area of sample tube, ft^2,
G = weight of residue from tube, g.

17.3 *Pressure Rating*—Tube assemblies tested to comply with the requirements of either 17.3.1 or 17.3.2 shall not rupture, burst, or leak. Tests shall be conducted at ambient temperatures.

17.3.1 *Burst Method*—The tube assembly shall withstand without failure a pressure equal to three times the design pressure marked on the component.

17.3.2 *Fatigue Method*—The tube assembly shall be tested in accordance with 17.3.2.1 and 17.3.2.2.

17.3.2.1 Two assemblies shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a hydraulic pump system. The pressure shall be raised gradually and maintained for 1 min to three times the design pressure marked on the component ±10 psig.

17.3.2.2 Three assemblies shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a hydraulic pump system. Assemblies shall be tested for a minimum of 250 000 cycles according to the following:

(1) Upper pressure test value shall be equal to the design pressure marked on the component ±5 psig.

(2) Lower pressure test value shall be equal to 0 ± 5 psig.

(3) Pressure within each sample shall be raised and lowered such that the full specified upper and lower pressure cyclic values are maintained for at least 0.1 s.

17.3.2.3 Following the specified number of test cycles, the test pressure shall be increased and maintained for 1 min

without rupture, burst, or leak at one and one-half times the design pressure marked on the component ±5 psig.

18. Significance of Numerical Limits

18.1 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Practice E29:

Property	Rounded Unit for Observed or Calculated Value
Chemical composition	Nearest unit in the last right-hand place of figures of the specified limit
Tensile strength	Nearest ksi (5 MPa)
Elongation	Nearest 1 %
Grain size:	
Up to 0.055 mm, incl	Nearest multiple of 0.005 mm
Over 0.055 to 0.160 mm, incl	Nearest 0.01 mm

19. Inspection

19.1 The manufacturer or supplier shall inspect and make tests necessary to verify the product furnished conforms to specification requirements.

19.2 Source inspection of the product by the purchaser shall be agreed upon between the manufacturer or supplier and the purchaser as part of the purchase order. In such case, the nature of the facilities needed to satisfy the inspector representing the purchaser that the product is being furnished in accordance with the specification shall be included in the agreement. All testing and inspections shall be conducted so as not to interfere unnecessarily with the operations of the works.

19.3 When mutually agreed upon, the manufacturer or supplier and purchaser shall conduct the final inspection simultaneously.

20. Rejection and Rehearing

20.1 Product that fails to conform to the requirements of this specification may be rejected. Rejections should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a hearing.

21. Certification

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

22. Test Report

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

22.2 Test reports may be transmitted to the purchaser by electronic services. The content of the electronically transmitted document shall conform to any existing agreement between the purchaser and the seller.

23. Product Marking

23.1 The name or trademark of the manufacturer and ASTM B1003 shall not be prohibited from being permanently incised on each tube, ¼-in. diameter and larger, at intervals not greater than 1½ ft (0.455 m).

23.1.1 The insulation shall not be prohibited from including a legend or a label, or both, indicating the name or trademark of the assembler of the lineset, or both, ASTM B1003, and the country of assembly of the lineset.

23.1.2 The visible component of each line – whether tube or insulation – shall be marked with the design pressure of the product as established in 17.3 if other than 700 psi.

NOTE 1—Other information is not prohibited from inclusion in marking at the option of the manufacturer.

24. Packaging and Package Marking

24.1 *Packaging*—The product shall be separated by size and composition. The product shall be prepared for shipment in such a manner as to ensure acceptance by common carrier for transportation and to afford protection from normal hazards of transportation.

24.2 *Package Marking*—Each shipping unit shall be legibly marked with the size, total length, or piece count, or both, and name of the supplier. The product order number and specification number shall be shown when specified.

25. Keywords

25.1 air conditioning tube; field service tube; linesets; refrigeration tube; seamless copper tube; UNS No. C12200

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order, for agencies of the U.S. Government.

S1. Referenced Documents

S1.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

S1.1.1 *ASTM Standard:*

Practice B900 Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies

S1.1.2 *Federal Standards:*[5]

Fed. Std. No. 102 Preservation, Packaging and Packing Levels

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

Fed. Std. No. 185 Identification Marking of Copper and Copper-Base Alloy Mill Products

S1.1.3 *Military Standard:*[5]

MIL-STD-129 Marking for Shipment and Storage

S2. Quality Assurance

S2.1 *Responsibility for Inspection:*

S2.1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the manufacturer has the option to use his own or any suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections or tests set forth when such inspections and tests are deemed necessary to ensure that the material conforms to prescribed requirements.

S3. Identification Marking

S3.1 All material shall be properly marked for identification in accordance with Fed. Std. No. 185 except that the ASTM specification number and the alloy number shall be used.

S4. Preparation for Delivery

S4.1 *Preservation, Packaging, Packing:*

S4.1.1 *Military Agencies*—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, Level A or C, packed, Level A, B, or C, as specified in the contract or purchase order, in accordance with the requirements of Practice B900.

S4.1.2 *Civil Agencies*—The requirements of Fed. Std. No. 102 shall be referred for definitions of the various levels of packaging protection.

S4.2 *Marking:*

S4.2.1 *Military Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with MIL-STD-129.

S4.2.2 *Civil Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

[5] Available from DLA Document Services, Bldg. 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil/.

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.