Designation: B919 – 12

Standard Specification for Welded Copper Heat Exchanger Tubes With Internal Enhancement[1]

This standard is issued under the fixed designation B919; 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 welded, internally enhanced copper tube, in straight lengths or coils, suitable for use in refrigeration and air conditioning products or other heat exchangers.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The product shall be produced of the following coppers. Unless otherwise specified, tubes made from any one of these coppers may be supplied:

Copper UNS No.	Type of Metal
C10200	Oxygen-free without residual deoxidants
C12200	Phosphorized, high residual phosphorus (DHP)

1.4 The following pertains to the test method described in 18.4 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 requirements 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

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E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]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

E2575 Test Method for Determination of Oxygen in Copper and Copper Alloys

3. Terminology

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

3.2 *Definitions:*

3.2.1 *bottom wall, n*—the wall thickness measured from the base of the enhancement to the outside surface.

3.2.2 *coil, n*—a length of the product wound into a series of connected turns.

3.2.3 *enhancement, n*—a geometrical feature intentionally formed on a tube I.D. surface to improve heat transfer.

3.2.4 *level wound, adj*—a type of coil in which the turns are wound into layers parallel to the axis of the coil such that successive turns in a given layer are next to one another.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *roundness tolerance, n*—the roundness tolerance is defined as the maximum OD at a point minus the minimum OD, at the same plane of intersection of the tube, divided by the specified OD × 100 %.

3.3.2 *squareness of cut, n*—the maximum deviation of one side of a cross section from the opposite side, when measured

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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.

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

against the projected perpendicularity of the plane of the projected center of the tube at the ends.

4. Classification

4.1 The following types of welded tube are manufactured under the scope of this specification:

4.1.1 *As-Welded*—Welded tube without subsequent heat treatment or cold work.

4.1.2 *Welded Tube, Subsequently Annealed*—Welded tube annealed to produce a uniform grain size appropriate to the specified annealed temper.

5. Ordering Information

5.1 Include the following information when placing orders for product under this specification:

5.1.1 ASTM designation number and year of issue,

5.1.2 Copper UNS No.,

5.1.3 Tube type (Section 4),

5.1.4 Temper (Section 8),

5.1.5 Length, diameter, bottom-wall thickness, and enhancement dimensions. Configuration of the enhanced surface shall be as agreed upon between the manufacturer, or supplier, and purchaser,

5.1.6 How furnished: straight or coils,

5.1.7 Quantity,

5.1.8 Cuprous oxide test, if required (12.3 and 16.1.4),

5.1.9 Certification, when required (Section 22), and

5.1.10 Mill test report, if required (Section 23).

6. Materials and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture shall be sheet or strip, of the required alloy, and may be either cold worked or annealed.

6.1.2 The material shall be of such purity and soundness as to be suitable for processing into the product prescribed herein.

6.2 *Manufacture:*

6.2.1 The welded tube shall be manufactured from either cold rolled or annealed sheet or strip. The sheet or strip shall be formed into a tubular shape on a suitable forming mill.

6.2.2 Welding shall be accomplished by any process that produces forge or fusion welds leaving no crevice visible to the unaided eye in the weld seam.

6.2.2.1 *Forge—Welded Tube*—The edges of the strip shall be heated to the required welding temperature, usually by a high frequency electric current, and be pressed firmly together causing a forged-type joint to be formed with internal and external flash.

6.2.2.2 *Fusion—Welded Tube*—The edges of the tube shall be brought together and welded, usually by a GTAW welding process, without the addition of filler metal, causing a fusion-type joint to be formed with no internal or external flash.

6.2.2.3 *Flash Removal*—The external flash of forge welded tubes, if present, shall be removed by scarfing. The internal flash shall be treated by one of the following techniques: (*1*) IFI—internal flash to remain in the as-welded condition, (*2*) IFR—internal flash to be removed by scarfing, and (*3*) IFD—internal flash displaced by rolling or drawing.

6.2.3 The internal enhancement shall be produced by cold forming.

6.2.4 The longitudinal seam from welding shall be free of filler metal.

7. Chemical Composition

7.1 The material shall conform to the requirements in Table 1 for the copper specified in the contract or purchase order.

7.2 These compositional limits do not preclude the possible presence of other unnamed elements. When required, limits and analysis for unnamed elements shall be established by agreement between the manufacturer and the purchaser.

8. Temper

8.1 Tempers, as defined in Classification B601, of the various tube types are as follows:

8.1.1 *As-Welded:*

8.1.1.1 Annealed strip WM50, subsequently internally enhanced by cold working and welded.

8.1.2 *Welded and Annealed:*

8.1.2.1 Annealed strip, internally enhanced by cold working, welded and soft annealed W060, and

8.1.2.2 Annealed strip, internally enhanced by cold working, welded and light annealed W050.

NOTE 1—By agreement with the purchaser and manufacturer, product in special tempers may be supplied with properties as agreed upon between the purchaser and the manufacturer.

9. Grain Size for Annealed Tempers

9.1 Samples of annealed temper tubes shall be examined at a magnification of 75 diameters. The grain size shall be determined in the wall beneath the internal enhancement. The microstructure shall show complete recrystallization and shall have an average grain size within the limits specified in Table 2.

9.2 The surface of the test specimen for the microscopical examination shall approximate a radial longitudinal section of the tube.

10. Mechanical Properties

10.1 WM (as-welded) and WO (annealed) temper shall conform to the mechanical properties as specified in Table 2.

10.2 If disagreement arises between the grain size requirement and the mechanical property requirements for annealed tempers, the mechanical property requirements take precedent.

11. Performance Requirements

11.1 *Expansion Requirements:*

TABLE 1 Chemical Requirements

UNS Alloy Number	Copper, wt %	Phosphorus, wt %
C10200[A]	99.95 min	
C12200	99.9 min	0.015 - 0.040

[A] Oxygen in C10200 shall be 10 ppm max.

TABLE 2 Mechanical Property Requirements of As-Fabricated and Annealed Tube

Temper	Average Grain Size, mm	Tensile Strength, ksi[A] (MPa)	Yield Strength, ksi[B] (MPa)	Elongation in 2 in. (51 mm), min %
WM	. . .	30 min (205 min)	. . .	. . .
WO60	0.040 min.	30 min (205 min)	6 (40) min	35
WO50	0.040 max	30 min (205 min)	9-15 (60 - 105)	35

[A] ksi = 1000 psi.
[B] Yield strength to be determined at 0.5 % extension under load.

11.1.1 The annealed material shall be capable of being expanded in accordance with Test Method B153 with an expansion of the outside diameter in the following percentage:

Outside Diameter, in. (mm)	Expansion of Outside Diameter, %
0.750 in. (19.0) and under	30
Over 0.750 in. (19.0)	20

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

12. Other Requirements

12.1 *Nondestructive Examination for Defects:*

12.1.1 Each tube shall be subjected to an eddy-current test. Tubes shall normally be tested in the fabricated temper; however, they may be tested in the annealed temper at the option of the manufacturer.

12.1.2 *Electromagnetic (Eddy-Current) Test:*

12.1.2.1 The testing shall follow the procedures specified in Practice E243. Unless otherwise agreed upon between the manufacturer, or supplier, and the purchaser, the manufacturer shall have the option of calibrating the test equipment using either notches or drilled holes. Notch depth standards rounded to the nearest 0.001 in. (0.025 mm) shall be 22 % max. of the nominal, bottom-wall thickness. Drilled hole standards shall be 0.025-in. (0.635-mm) max. diameter for tubes up to and including ¾-in. (19.05-mm) specified diameter and 0.031-in. (0.785-mm) max. diameter for tubes over ¾-in. (19.05-mm) specified diameter.

12.1.2.2 Tubes that do not actuate the signaling device on the eddy-current tester shall be considered in conformance to the requirements of this test.

12.1.2.3 Tubes, rejected for irrelevant signals because of moisture, soil, and or minor, mechanical damage, shall, at the option of the manufacturer, be reconditioned and retested.

12.1.2.4 Tubes that are reconditioned and retested (see 12.1.2.3) shall be considered to conform to the requirements of this specification, if they do not cause output signals beyond the acceptable limits.

12.1.2.5 Unless otherwise specified, eddy-current discontinuities will be identified on coils in excess of 200 ft. (6096 cm) in length for subsequent removal by the purchaser.

12.1.2.6 When required, the customer shall specify the permissible number of identified eddy-current discontinuities.

12.2 *Cleanness Requirements:*

12.2.1 The tube shall be capable of meeting the following cleanness requirement:

12.2.1.1 The inside of the tube with closed ends shall be sufficiently clean so that when tested in accordance with the method given in 18.4, the residue remaining upon evaporation of the solvent shall not exceed 0.0035 g/ft^2 (0.038 g/m^2) of interior surface.

12.2.1.2 The term “capable of” in the context of this requirement shall mean that the testing and reporting of individual lots need not be performed by the producer of the product, if capability of the manufacturing process to meet this requirement has previously been established. However, should subsequent testing by either the producer or purchaser establish that the product does not meet this requirement, the product shall be subject to either rejection, or recall or both. See 18.4 for the test method.

12.3 *Cuprous Oxide Requirement:*

12.3.1 Product manufactured from Copper UNS Alloy C10200 shall be significantly free of cuprous oxide as determined by Procedure A of Test Methods B577.

13. Dimensions, Mass, and Permissible Variations

13.1 The standard method for specifying tube diameters and walls shall be decimal fractions of an inch.

13.2 Tolerances on a given tube are permitted to be specified with respect to any two but not all three of the following: outside diameter, inside diameter, and bottom-wall thickness.

13.3 For the purposes of determining conformance with the dimensional requirements in this specification, any measured value outside the specified limiting values for any dimension shall be cause for rejection.

13.4 *Bottom-Wall Thickness Tolerances:*

13.4.1 Bottom-wall thickness tolerances shall conform to the tolerances listed in Table 3 (See Fig. 1).

13.4.2 The wall thickness tolerances, listed in Table 3 for tube furnished IFI, shall not apply to that portion of the tube wall that contains the interior flash and weld upset.

NOTE 2—The weld thickness shall not exceed the summation of the bottom- wall thickness and the enhancement height.

13.4.3 The tolerances of Table 3 shall be increased by 100 % for tube furnished IFR and IFD for the portion of the tube wall that contains the weld zone.

13.5 *Diameter Tolerances:*

13.5.1 The average diameter tolerances in Table 4 shall apply to both coils and straight lengths of product:

13.5.2 For product furnished IFI, IFD, or IFR, the inside diameter shall not be taken so as to include the flash or flash-treated areas.

13.6 *Lengths:*

TABLE 3 Bottom-Wall Tolerance

Bottom-Wall Thickness, in. (mm)	Tolerance (Plus and Minus) Outside Diameter, in. (mm)	
	0.125 to 0.625 (3 to 16), incl	Over 0.625 to 1.000 (16 to 25), incl
Up to 0.017 (0.43), incl.	0.001(0.025)	0.0015 (0.038)
Over 0.017 to 0.024 (0.43 to 0.61), incl	0.002 (0.050)	0.002 (0.050)

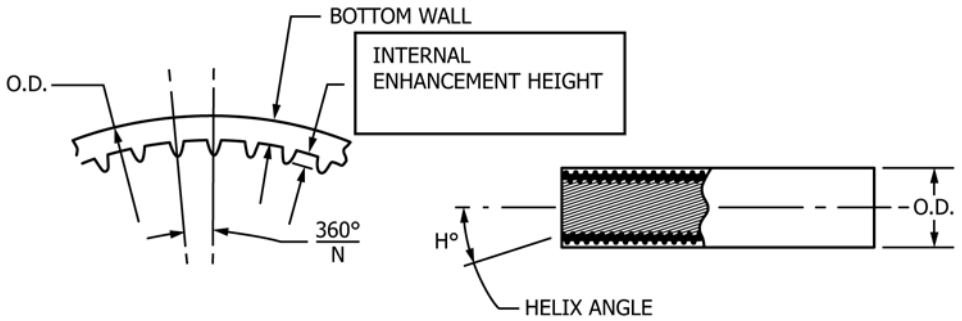

FIG. 1 Bottom-Wall Thickness Tolerances

TABLE 4 Average Diameter Tolerances

Specified Diameter, in. (mm)	Tolerance, Plus and Minus, in. (mm)
0.125 to 0.625 (3 to 16), incl	0.002 (0.050)
Over 0.625 to 1.000 (16 to 25), incl	0.0025 (0.063)

13.6.1 For coil lengths, see Table 5 of this specification. If coils are produced to a specified nominal weight, no coil shall weigh less than 40 % of the nominal weight, and no more than 20 % of the coils in a lot shall weigh less than 65 % of nominal weight unless otherwise agreed upon between the manufacturer, or supplier, and purchaser.

13.6.2 The tolerances for tubes furnished in straight lengths shall be in accordance with Table 6.

13.7 *Roundness:*

13.7.1 The roundness tolerance for material in straight lengths shall be 1.5 % of the OD expressed to the nearest 0.001 in. (0.025 mm).

13.7.2 The roundness tolerance for material in coils shall be 6.5 % of the OD expressed to the nearest 0.001 in. (0.025 mm).

13.8 *Squareness of Cut:*

13.8.1 For tube in straight lengths, the departure from squareness of the end of any tube shall not exceed the following:

Specified Outside Diameter, in. (mm)	Tolerance
Up to 0.625 (15.9 mm), incl.	0.010 in. (0.25 mm)
Over 0.625 (15.9 mm)	0.016 in./in. (0.406 mm/mm)

13.9 *Straightness:*

13.9.1 For tubes in any as-welded temper, the straightness tolerance shall be in accordance with Table 7.

14. Workmanship, Finish, and Appearance

14.1 The product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.

TABLE 5 Coil Length Tolerances (Specific Lengths)

Tube Outside Diameter, in. (mm)	Nominal Length, ft (m)	Shortest Permissible Length, % of Nominal Length	Maximum Permissible Weight of Ends, % of Lot Weight	Tolerance All Plus, ft (m)
All sizes	up to 100 (30.5), incl.	100	0	1 (0.3)
All sizes	over 100 (30.5)	40	20	...

TABLE 6 Length Tolerances for Straight Lengths

NOTE 1—Tolerances are all plus; if all minus tolerances are desired, use the same values; if tolerances of plus and minus are desired, halve the values given.

Length	Tolerance, in. (mm)
Up to 6 in (152 mm), incl.	0.063 in. (1.6)
Over 6 in. (152 mm) to 2 ft. (610 mm), incl.	0.063 in. (1.6)
Over 2 ft (610 mm) to 6 ft (1.83 m), incl.	0.094 in. (2.38)
Over 6 ft (1.83 m) to 14 ft (4.27 m)	0.250 in. (6.3)
Over 14 ft (4.27 m)	0.500 in. (12.7)

TABLE 7 Straightness Tolerance

Length, ft (m)	Maximum Curvature (Depth of Arc), in. (mm)
Over 3 (0.914) to 6 (1.83), incl.	0.188 in. (4.8)
Over 6 (1.83) to 8 (2.44), incl.	0.313 in. (7.9)
Over 8 (2.44) to 10 (3.05), incl.	0.500 in. (13)
Over 10 (3.05)	0.500 in. (13) in any 10 ft (3.05 m) section

15. Sampling

15.1 The lot size and portion size of the finished product shall be as follows:

15.1.1 *Lot Size*—An inspection lot shall be 10 000 lb (4540 kg) or fraction thereof, subject to inspection at one time.

15.1.2 *Portion Size*—A portion shall be taken for test purposes from each lot according to the following schedule:

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

15.2 *Chemical Analysis:*

15.2.1 Sampling for chemical analysis by the manufacturer shall be performed by one of the following methods:

15.2.1.1 The sample shall be taken in approximately equal weight from each portion piece selected in 15.1.2 and in accordance with Practice E255. The minimum weight of the composite sample shall be 150 g.

15.2.1.2 Instead of sampling in accordance with Practice E255, the manufacturer shall have the option of determining composition by analyzing samples taken at the time castings are poured or taken from semifinished product. When the

manufacturer determines chemical composition during the course of manufacture, sampling of the finished product is not required.

15.2.1.3 In case of compositional dispute, the sample shall be taken in accordance with 15.2.1.1.

15.2.2 The number of samples taken for determining composition shall be as follows:

15.2.2.1 When samples are taken at the time the castings are poured, at least two samples shall be taken for each group of castings poured simultaneously from the same source of molten metal.

15.2.2.2 When samples are taken from the semifinished product, a sample shall be taken to represent each 10 000 lb (4540 kg) or fraction thereof, except that not more than one sample per piece is required.

15.3 *Other Tests:*

15.3.1 Specimens for all other tests shall be taken from two of the sample pieces taken in 15.1.2 and be of a convenient size to accommodate the test(s) and comply with the requirements of the product specification and test method(s).

15.3.2 In the event only one sample piece is required, all specimens shall be taken from the piece selected.

15.3.3 In the case of tube furnished in coils, a length sufficient for all necessary tests shall be cut from each coil selected for purpose of testing. The remaining portion of these coils shall be included in the shipment, and the permissible variations in length on such coils shall be waived.

16. Number of Tests and Retests

16.1 *Tests:*

16.1.1 *Chemical Analysis*—Chemical composition shall be determined as the per element mean of results from at least two replicate analyses of the sample(s), and the results of each replication must meet the requirements of Table 1 for the specified copper.

16.1.2 *Grain Size*—The average grain size of each specimen shall be the arithmetic average of at least three different fields.

16.1.3 *Mechanical Properties*—Mechanical properties shall be reported as individual test results from each of two pieces selected in 15.1.2, and each specimen must meet the requirements of the product specification.

16.1.4 *Cuprous Oxide Requirement:*

16.1.4.1 When specified, one test of each sample selected in 15.1.2 shall be performed and each specimen must meet the requirement in 12.3.

16.1.5 When only one piece is to be sampled, all specimens shall be taken from the piece selected.

16.2 *Retests:*

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

16.2.2 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.

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

17. Specimen Preparation

17.1 *Chemical Analysis:*

17.1.1 Preparation of the analytical test specimen shall be the responsibility of the reporting laboratory.

17.2 *Grain Size:*

17.2.1 Test specimen shall be prepared in accordance with Practice E3.

17.3 *Tensile Test:*

17.3.1 The test specimen shall be of the full section of the tube and shall conform to the requirements of the section titled Specimens for Pipe and Tube in Test Methods E8/E8M.

17.3.2 Because some internal enhancement configurations may cause breakage of the specimen in the grips, specimen ends may be flattened and tested using wedge or sheet metal grips.

17.4 *Electromagnetic (Eddy-Current) Test:*

17.4.1 Specimen preparation shall be in accordance with Practice E243.

17.5 *Cleanness Test:*

17.5.1 A section of a straight tube specimen, or a straightened tube specimen from the outside end of a coil, not less than 5 ft. (1.5 m) shall be selected.

17.6 *Cuprous Oxide Requirement:*

17.6.1 Sample preparation shall be in accordance with Test Methods B577.

18. Test Methods

18.1 In the case of disagreement, the properties enumerated in this specification shall be determined in accordance with the ASTM International test methods listed in Table 8.

18.2 *Tension Tests:*

18.2.1 Tensile specimens shall normally be tested as shown in Fig. 11 of Test Methods E8/E8M. Tension test specimens shall be of the full section of the tube unless the limitations of the testing machine precludes the use of such specimen. Determination of cross-sectional area shall be determined by using the weight of the tube as described in Test Methods E8/E8M.

18.2.2 Whenever different tension test results are obtained from both full-size and from machined test specimens, the results obtained from full-size test specimens shall be used to determine conformance to the requirements of this specification.

18.2.3 Tension test results on product within the scope of this specification are not seriously affected by variations in

TABLE 8 Methods of Test

Test	ASTM Designation
Cuprous oxide requirement	B577, Method C
Tension	E8/E8M
Grain size	E112
Expansion (pin test)	B153
Eddy current	E243
Chemical analysis	
Copper	E53
Phosphorus	E62
Oxygen	E2575

speed of testing. A considerable range of testing speed is permissible; however, the rate of stressing to the yield strength shall not exceed 100 ksi/min (690 MPa/min). Above the yield strength, the movement per minute of the testing-machine head under load should not exceed 0.5 in./in. (0.5 mm/mm) of gage length (or distance between grips for full-section specimens).

18.3 *Grain Size*—In case of dispute, the intercept method shall be followed.

18.4 *Cleanness Test:*

18.4.1 One end of the tube specimen, selected per 17.5 shall be closed and the tube specimen shall be filled with solvent to one-eighth of capacity. The opposite end shall be sealed and the tube shall be rolled back and forth on horizontal supports to thoroughly wash the inside surface. The seal shall be removed and the solvent shall be poured into a suitable weighed-container. The solvent in the container shall be evaporated to dryness on a low-temperature hot plate or sand bath. Overheating of the container shall be avoided to prevent charring of the residue. The container shall then be dried in an oven at 100 to 110°C for 10 min, cooled in a desiccator, and weighed. A blank determination shall be run on the determined quantity of solvent and the gain in weight for the blank shall be subtracted from the weight of the residue sample. The corrected weight shall then be calculated in grams of residue per internal area of the tube in square feet (g/m^2).

18.4.2 The quantity of the solvent used will vary with the size of the tube being examined. The quantity of solvent used for the blank run shall be the same as that discharged from the tube specimen.

18.4.3 The specimen must be prepared in such a manner as to prevent the inclusion in the residue of copper chips or dust resulting form the cutting of the sample.

19. Significance of Numerical Limits

19.1 For purpose of determining compliance with the specified limits for requirements of the properties listed in Table 9, an observed or calculated value shall be rounded as indicated, in accordance with the rounding method of Practice E29.

20. Inspection

20.1 The manufacturer shall inspect and make the necessary tests to verify that the tubes furnished conform to the specification requirements.

TABLE 9 Rounding Units

Property	Rounded Unit for Observed or Calculated Value
Chemical composition and hardness	Nearest unit in the last right-hand place of figures of the specified limit
Tensile strength	Nearest ksi (nearest 5 MPa)
Expansion	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

20.2 If, in addition, the purchaser elects to perform his, or her, own inspection, the manufacturer shall afford the inspector all reasonable facilities without charge to satisfy the purchaser that the tubes are being furnished in accordance with this specification.

21. Rejection and Rehearing

21.1 *Rejection:*

21.1.1 Material that fails to conform to the requirements of this specification when inspected or tested by the purchaser or his agent may be rejected.

21.1.2 Rejection shall be reported to the manufacturer or supplier promptly.

21.1.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer, or supplier, may make claim for a rehearing.

21.2 *Rehearing:*

21.2.1 As a result of product rejection, the manufacturer, or supplier, may 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 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.

22. Certification

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

23. Mill Test Report

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

24. Packaging and Package Marking

24.1 The material shall be separated by size, composition, and temper and prepared for shipment in such a manner as to insure acceptance by common carrier for transportation.

24.2 Each shipping unit shall be legibly marked with the purchase order number, metal or alloy designation, temper, size, gross and net weight, total length or piece count, or both, and name of supplier. The specification number shall be shown when specified.

25. Keywords

25.1 coils; copper tubes; C10200; C12200; heat exchanger; internally enhanced; straight lengths; tube; welded

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength is shown in accordance with the International System of Units (SI). The derived SI unit for force is the Newton (N), which is defined as the force that 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 megapascals (MPa), which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B919 – 01 (2006)) that may impact the use of this standard. (Approved April 1, 2012.)

(1) 2. Referenced Documents: E8/E8M is now a combined document. Also corrected in 18.2.1.
(2) 2. Referenced Documents: E2575 was added since oxygen concentration is shown in footnote A in Table 1 (also added to Table 8 Methods of Test)
(3) 12.1.2.1 Nondestructive Examination: Notch depth and drilled hole "Max." was designated to allow more sensitive testing.
(4) Table 2, 9, and Appendix: Typo (Mpa) was corrected in four places to MPa.