



Designation: **B837—18 B837 – 19**

## Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems<sup>1</sup>

This standard is issued under the fixed designation B837; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification establishes the requirements for Type GAS seamless Copper UNS No. C12200 tube for use in above ground natural gas and liquefied petroleum (LP) gas fuel distribution systems, commonly assembled with flared fittings or brazed joints.

NOTE 1—Tube temper, size, and joining method are determined by installation code requirements.

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 ~~which~~that are provided for information only and are not considered standard.

1.3 The following safety hazard caveat pertains only to the test method(s) portion, Section 17, 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, 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:<sup>2</sup>

- 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
- B968/B968M Test Method for Flattening of Copper and Copper-Alloy Pipe and Tube
- E3 Guide for Preparation of Metallographic Specimens
- E8/E8M Test Methods for Tension Testing of Metallic Materials
- E18 Test Methods for Rockwell Hardness 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)<sup>3</sup>
- 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
- E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

<sup>1</sup> 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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<sup>2</sup> 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.

<sup>3</sup> 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

### 3. Terminology

3.1 For definitions of terms relating to copper and copper alloys, refer to Terminology **B846**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *liquefied petroleum (LP) gas, n*—any of the following hydrocarbons or mixtures of them: propane, propylene, butane (normal butane or isobutane) and butylene.

### 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,
- 4.1.2 Copper [Alloy] UNS No. (or other internationally recognized copper [alloy]) designation,
- 4.1.3 Temper (Sections **5** and **7**),
- 4.1.4 Dimensions (Standard Size), diameter, and wall thickness (**Table 1**),
- 4.1.5 How furnished: straight lengths or coils,
- 4.1.6 Length—(**Table 2** and **12.5**),
- 4.1.7 Quantity—total weight or total length or number of pieces of each size, and
- 4.1.8 Intended application.

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

- 4.2.1 Tensile test (Section **9**),
- 4.2.2 Electromagnetic (eddy-current) examination (Section **11**),
- 4.2.3 Embrittlement test (Section **10**),
- 4.2.4 Expansion test (Section **10**),
- 4.2.5 Flattening test (Section **10**),
- 4.2.6 Certification (Section **21**),
- 4.2.7 Test report (Section **22**), and
- 4.2.8 If product is purchased for agencies of the U.S. Government (see the Supplementary Requirements section of {this specification or the general requirements section} for additional requirements, if specified).

### 5. Materials and Manufacture

5.1 *Materials:*

5.1.1 The material of manufacture shall be a tube of Copper UNS No. C12200 of such purity and soundness as to be suitable for processing into the products prescribed herein. The finished tube shall have the properties and characteristics prescribed in this specification and shall be cold drawn to size.

5.1.2 When specified in the contract or purchase order that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 2—Because of the discontinuous nature of the processing of castings into wrought products, it is not practical to identify a specific casting analysis with a specific quantity of finished material.

5.2 *Manufacture:*

5.2.1 The product shall be manufactured by such hot-working, cold-working, and annealing processes as to produce a uniform wrought structure in the furnished product.

5.2.2 The product shall be hot- or cold-worked to the finished size and subsequently annealed, when required, to meet the temper properties specified.

5.2.3 Tube, when furnished in coils, shall be annealed after coiling.

**TABLE 1 Dimensions, Mass and Tolerances in Diameter and Wall Thickness for Standard Sizes of Type GAS Seamless Copper Tube for Natural Gas and Propane Fuel Distribution Systems (All Tolerances in This Table Are Plus and Minus)**

Standard Size, in.	Actual Outside Diameter		Average Outside Diameter <sup>A</sup> Tolerances				Wall Thickness and Tolerance				Theoretical Mass	
	in.	(mm)	Annealed		Drawn		Wall Thickness		Tolerance <sup>B</sup>		lbs/ftlb/ft	(kg/m)
			in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)		
3/8	0.375	(9.52)	0.002	(0.051)	0.001	(0.025)	0.030	(0.762)	0.003	(0.076)	0.126	(0.187)
1/2	0.500	(12.7)	0.0025	(0.064)	0.001	(0.025)	0.035	(0.889)	0.004	(0.10)	0.198	(0.146)
5/8	0.625	(15.9)	0.0025	(0.064)	0.001	(0.025)	0.040	(1.02)	0.004	(0.10)	0.285	(0.424)
3/4	0.750	(19.1)	0.0025	(0.064)	0.001	(0.025)	0.042	(1.07)	0.004	(0.10)	0.362	(0.539)
7/8	0.875	(22.3)	0.003	(0.076)	0.001	(0.025)	0.045	(1.14)	0.004	(0.10)	0.455	(0.677)
1 1/8	1.125	(29)	0.0035	(0.07)	0.0015	(0.038)	0.050	(1.27)	0.005	(0.13)	0.655	(0.975)

<sup>A</sup> The average outside diameter of a tube is the average of the maximum and minimum outside diameter, as determined at any one cross section of the tube.

<sup>B</sup> Maximum permissible deviation at any one point.

**TABLE 2 Standard Lengths<sup>A</sup> and Tolerances**

Standard Size, in.	Standard Length		Tolerance, all plus	
	ft.	(m)	in.	(mm)
Tubes Furnished in Straight Lengths				
3/8 – 1 1/8	12	(3.7)	1	(25)
	20	(6.1)	1	(25)
Tubes Furnished in Coils				
3/8 – 1 1/8	60	(18)	24	(600)
	100	(30.5)	24	(600)

<sup>A</sup> Longer lengths are subject to agreement between the manufacturer or supplier and purchaser.

5.2.4 Tube, when furnished in straight lengths, shall be normally furnished in the H58 (Drawn General Purpose) temper, except when the O60 (Soft Anneal) temper is specified in the purchase order or contract.

## 6. Chemical Composition

6.1 The chemical composition shall conform to the following chemical requirements of Copper UNS No. C12200:

Copper (incl. silver)	99.9 % min.
Phosphorus	0.015 to 0.040 %

6.2 These composition 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.

## 7. Temper

7.1 Type GAS copper tube shall be furnished in either of the following tempers as defined in Classification **B601**.

Soft anneal	O60
Drawn general purpose	H58

## 8. Grain Size for Annealed Tempers

8.1 Grain size shall be the standard requirement for all product in the annealed tempers.

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

## 9. Mechanical Property Requirements

9.1 *Tensile Strength Requirement:*

9.1.1 When specified in the contract or purchase order, the product shall conform to the tensile strength requirements in **Table 3**, when tested in accordance with Test Methods **E8/E8M**. Actual testing need not be performed unless specified at time of order placement.

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

9.2 *Rockwell Hardness Requirement:*

9.2.1 When specified in the contract or purchase order, the product shall conform to the Rockwell Hardness requirement prescribed in **Table 3**, when tested in accordance with Test Methods **E18**.

## 10. Performance Requirements

10.1 *Expansion Test:*

10.1.1 When specified in the contract or purchase order, tube furnished in the soft-anneal (O60) shall withstand expansion in accordance with Test Method **B153** to the following extent:

**TABLE 3 Mechanical Property Requirements**

Temper Designation		Tensile Strength		Average Grain Size, mm	Rockwell Hardness <sup>A</sup>	
Standard	Former	ksi, <sup>B</sup> min.	MPa min.		Scale	Hardness Value
O60	Soft anneal	30	(205)	0.035 min.	F	50 max
H58	Drawn general purpose	36	(250)	...	30T	30 min

<sup>A</sup> Rockwell Hardness tests shall be made on the inside surface of the tube.

<sup>B</sup> ksi = 1000 psi.

Standard Size (Actual Outside Diameter) in. (mm)	Expansion of Outside Diameter %
0.625 (15.9) and under	40
Over 0.625 (15.9)	30

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

10.2 *Flattening Test:*

10.2.1 When specified in the contract or purchase order, the flattening test in accordance with Test Method B968/B968M shall be performed.

10.2.1.1 During inspection, the flattened areas of the test specimen shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.

10.3 *Microscopical Examination for Susceptibility to Hydrogen Embrittlement:*

10.3.1 Tubes furnished in all coppers shall be capable of passing the embrittlement test specified in Procedure B of Test Methods B577. In case of a dispute, Procedure C of Test Methods B577 shall be used as the referee method.

11. **Nondestructive Testing**

11.1 Each tube up to and including 1.125 in. (28.6 mm) outside diameter shall be subjected to an eddy-current test. Testing shall follow the procedures of Practice E243, except for the determination of “end effect.” Tubes shall be passed through an eddy-current test unit adjusted to provide information on the suitability of the tube for the intended application.

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

11.1.1.1 Notch depth standards, rounded to the nearest 0.001 in. (0.025 mm), shall be 22 % of the standard wall thickness. The notch depth tolerance shall be plus and minus 0.0005 in. (0.013 mm). Alternatively, at the option of the manufacturer, using speed-insensitive eddy-current units that are equipped so that a fraction of the maximum unbalance signal can be selected, the following percent maximum unbalance signals may be used:

Standard Size, in. (mm)	Unbalanced Signal Magnitude, max. %
Up to 0.500 (12.7) incl.	0.2
0.625 (15.9) to 1.125 (29) incl.	0.3

11.1.1.2 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 Table and shall not vary by either more than +0.001 in. (+0.025(+0.025 mm) or -0.000 in. (-0.000 mm) of the hole diameter specified.

Tube Outside Diameter, in.	Diameter of Drilled Holes, in.	Drill No.
3/8 to 3/4, incl	0.025	72
Over 3/4 to 1, incl	0.031	68
Over 1 to 1 1/8, incl	0.036	64

  

Tube Outside Diameter, mm	Diameter of Drilled Holes, mm	Drill No.
9.0 to 19.0, incl	0.64	72
Over 19.0 to 25, incl	0.79	68
Over 25 to 29, incl	0.92	64

11.1.2 Tubes that do not actuate the signaling device of the eddy-current tester shall be considered in conformance with the requirements of this test. Tubes with discontinuities indicated by the testing unit may, at the option of the manufacturer, be re-examined or retested to determine whether the discontinuity is cause for rejection. Signals that are found to have been caused by minor mechanical damage shall not be cause for rejection of the tubes, provided the tube dimensions are still within the specified limits and the tube is suitable for its intended application.

12. **Dimensions, Mass, and Permissible Variations**

12.1 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 make the tube subject to rejection at the option of the purchaser.

12.2 *Standard Dimensions, Wall Thickness, and Diameter Tolerances*—The standard dimensions, wall thickness, and diameter tolerances shall be in accordance with Table 1.

12.3 *Mass*—For purposes of calculating mass, cross sections, etc., the density of copper shall be taken as 0.323 lb/in.<sup>3</sup> (8.94 g/cm<sup>3</sup>). The theoretical weight per foot is given in Table 1.

12.4 *Roundness*—For drawn unannealed tube in straight lengths, the roundness tolerance shall be as specified in [Table 4](#). The deviation from roundness is measured as the difference between major and minor diameters as determined at any one cross section of the tube. No roundness tolerance has been established for annealed tube in straight lengths or for tube furnished in coils.

12.5 *Lengths and Tolerances:*

12.5.1 *Standard Lengths and Tolerances*—The standard lengths and tolerances shall be as specified in [Table 2](#).

12.5.2 Tube supplied in other than standard lengths and tolerances shall be in accordance with requirements established by agreement between the manufacturer or supplier and the purchaser.

12.6 *Squareness of Cut*—For tubes in straight lengths, the departure from squareness of the end of any tube shall not exceed 0.010 in./in. (0.25 mm/mm) of outside diameter for tube up to and including 0.625 in. (15.9 mm) standard size; and not more than 0.016 in./in. (0.016 mm/mm) of outside diameter for tube larger than 0.625 in. (15.9 mm) standard size.

**13. Workmanship, Finish, and Appearance**

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

**14. Sampling**

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

14.1.1 *Lot Size*—Lot size shall be 5000 lb (2275 kg) or fraction thereof.

14.1.2 *Portion Size*—Sample pieces shall be selected according to the following schedule:

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

14.1.3 *Coiled Tube*—A length sufficient for all necessary tests shall be cut from each coil. The remaining portion of these coils shall be identified and included in the shipment. The permissible variation in lengths of such coils shall be waived.

14.2 *Sampling for Chemical Analysis:*

14.2.1 The sample shall be taken in approximately equal weight from each portion piece selected in [14.1.2](#) and 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.

14.2.3 The number of samples taken during the course of manufacture shall be as follows:

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

14.2.3.2 When samples are taken from the semi-finished product, a sample shall be taken to represent each 10 000 lb (4550 kg) or fraction thereof, except that not more than one sample per piece shall be required.

14.2.4 When the material is sampled during the course of manufacture, sampling of the finished product is not required.

14.3 *Sampling for Other Tests:*

14.3.1 Specimens for all other tests shall be taken from two of the sample pieces taken in [14.1.2](#). In the event only one sample piece is required, all specimens shall be taken from the piece selected.

**15. Number of Tests and Retests**

15.1 *Tests:*

15.1.1 *Chemical Analysis*—Chemical composition shall be determined in accordance with the element mean of the results from at least two replicate analyses of the sample(s) selected in [14.1.2](#).

15.1.2 *Mechanical Properties*—Mechanical properties shall be determined as the average of results from two test specimens; one taken from each of the two sample pieces selected in [14.1.2](#).

**TABLE 4 Roundness Tolerance**

<i>t/d</i> (Ratio of Wall Thickness to Outside Diameter)	Roundness Tolerance—% of Outside Diameter (Expressed to Nearest 0.001 in. or 0.025 mm)
0.01 to 0.03, incl	1.5
Over 0.03 to 0.05, incl	1.0
Over 0.05 to 0.10, incl	0.8

## 15.2 Retests:

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. Should one or more of the determinations fail to conform with the requirements of this specification a retest may be made on a new composite made up from the pieces originally selected.

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.

15.2.3 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 specimen shall be the responsibility of the reporting laboratory.

16.2 *Tensile Test*—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 limitations of the testing machine precludes the use of such specimen in which case a test specimen conforming to Type No. 1 of Fig. 13 in Test Methods **E8/E8M** shall be used.

16.3 *Rockwell Hardness*—The test specimen shall be of a size and shape to permit testing by the available test equipment and shall be taken to permit testing in a plane parallel or perpendicular to the direction of deformation given to the product.

16.3.1 The surface of the test specimen shall be sufficiently smooth and even to permit the accurate determination of hardness.

16.3.2 The specimen shall be free from scale and foreign matter and care shall be taken to avoid any change in condition, that is, heating or cold working.

16.4 *Grain Size and Microscopical Examination:*

16.4.1 The test specimen shall be prepared in accordance with Guide **E3**.

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

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

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

## 17. Test Methods

17.1 Test methods used for quality control shall be discretionary.

17.2 *Chemical Composition Analysis:*

17.2.1 Chemical composition, in case of disagreement, shall be determined as follows: 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	ASTM Test Methods
Copper	<b>E53</b>
Phosphorus	<b>E62</b>

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

17.3 The material furnished shall conform to specified requirements when subjected to test in accordance with the following methods:

Test	ASTM Designation
Tensile	<b>E8/E8M</b>
Rockwell Hardness	<b>E18</b>
Expansion (pin test)	<b>B153</b>
Electromagnetic (eddy-current)	<b>E243</b>
Grain Size	<b>E3, E112</b>
Microscopical Examination	<b>E3, B577</b>
Flattening Test	<b>B968/B968M</b>

17.3.1 Tensile strength shall be determined in accordance with Test Methods **E8/E8M**.

17.3.1.1 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.

17.3.1.2 Test results are not seriously affected by variations in speed of testing. A considerable range of testing speed is permitted; however, the rate of stressing to the yield strength should not exceed 100 ksi (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 gauge length (or distance between grips for full section specimens).

17.3.2 *Rockwell Hardness*—A minimum of three readings shall be taken on each specimen.

17.3.3 *Grain Size*—In case of dispute, shall be determined by the intercept method of Test Methods **E112**.