



Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems¹

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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.

1.2 O60 (soft annealed) temper gas tube is produced in the range of standard sizes $\frac{3}{8}$ – to 1 $\frac{1}{8}$ –in. outside diameter; H58 (drawn general purpose) temper gas tube is produced in the range of standard sizes $\frac{3}{8}$ – to 1 $\frac{1}{8}$ –in. outside diameter.

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

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.

2. Referenced Documents

2.1 ASTM Standards:²

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

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.

- E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)³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

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.

3.2.2 *tube, gas, n*—tube specifically intended for use in above ground and natural gas and liquefied petroleum gas fuel distribution systems and conforming to the particular dimensions known as Type GAS.

4. Ordering Information

- 4.1 Include the following information in orders for product.
 - 4.1.1 Type GAS tube (Table 1),
 - 4.1.2 Standard size (Table 1),
 - 4.1.3 Temper (Sections 5 and 7),
 - 4.1.4 Whether tension tests, Rockwell Hardness tests, and grain size determinations are required (Section 8),
 - 4.1.5 Whether an expansion test is required (Section 9),
 - 4.1.6 Length (11.5—Table 2),
 - 4.1.7 Whether the tube is to be furnished in coils or straight lengths,
 - 4.1.8 Quantity: number of straight lengths or coils required,
 - 4.1.9 Certification, if required (Section 20), and
 - 4.1.10 Mill test report, if required (Section 21).

4.2 In addition, when material is purchased for agencies of the U.S. government, it shall conform to the Supplementary Requirements as defined herein, when specified in the contract or purchase order.

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

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 ^A Tolerances				Wall Thickness and Tolerance				Theoretical Mass	
	in.	(mm)	Annealed		Drawn		Wall Thickness		Tolerance ^B		lbs/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)

^A 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.

^B Maximum permissible deviation at any one point.

TABLE 2 Standard Lengths^A 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)

^A Longer lengths are subject to agreement between the manufacturer or supplier and purchaser.

5. Materials and Manufacture

5.1 The material shall be of such quality and purity that the finished tube shall have the properties and characteristics prescribed in this specification and shall be cold drawn to size.

5.2 The tube shall be finished by such cold-working and annealing operations as are necessary to produce the required temper and surface finish.

5.3 Tubes furnished in coils shall be annealed after coiling.

5.4 Tubes in straight lengths shall be 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 material shall conform to the following chemical requirements of Copper UNS No. C12200:

Copper (incl. silver), Phosphorus	99.9 % min. 0.015 to 0.040 %
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6.2 These composition limits do not preclude the presence of other elements. Limits for unnamed elements may be established by agreement between the manufacturer or supplier and the purchaser.

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. Mechanical Property Requirements

8.1 The tube shall conform to the mechanical property requirements specified in Table 3. Tension tests and grain size determination need not be made except when requested by the purchaser in the ordering document. Where agreement on Rockwell Hardness tests cannot be reached, the tensile strength and grain size requirements of Table 3 shall be the basis for acceptance or rejection.

9. Expansion Test

9.1 The soft anneal (O60) temper tube shall be capable of being expanded in accordance with Test Method B153 with expansion of the outside diameter in the following amount:

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

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

10. Nondestructive Testing

10.1 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.

TABLE 3 Mechanical Property Requirements

Temper Designation		Tensile Strength		Average Grain Size, mm	Rockwell Hardness ^A	
Standard	Former	ksi, ^B 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

^A Rockwell Hardness tests shall be made on the inside surface of the tube.

^B ksi = 1000 psi.

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

10.1.1.1 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

10.1.1.2 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. (+0.026 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

10.1.2 Tubes that do not actuate the signalling 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.

11. Dimensions, Mass, and Permissible Variations

11.1 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 may be cause for rejection.

11.2 *Standard Dimensions, Wall Thickness, and Diameter Tolerances*—The standard dimensions, wall thickness, and diameter tolerances shall be in accordance with [Table 1](#).

11.3 *Mass*—For purposes of calculating mass, cross sections, etc., the density of copper will be 0.323 lbs/in.³ (8.94 g/cm³). The theoretical mass per foot is given in [Table 1](#).

11.4 *Roundness*—For drawn 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

TABLE 4 Roundness Tolerance

t/d (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

cross section of the tube. No roundness tolerance has been established for annealed tube in straight lengths or for tube furnished in coils.

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

11.6 *Squareness of Cut*—For tubes in straight lengths, the departure from squareness of the end of any tube shall not exceed 0.010 in. (0.25 mm) 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.

12. Workmanship, Finish, and Appearance

12.1 The tubes shall be clean and free from scale, adherent dirt, and defects of a nature that interfere with the intended purpose of the tubes.

13. Sampling

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

13.1.1 Lot size shall be 5000 lb (2275 kg) or fraction thereof.

13.1.2 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

13.1.3 *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.

13.2 Sampling for Chemical Analysis:

13.2.1 The sample shall be taken in approximately equal weight from each portion piece selected in [13.1.2](#) and in accordance with Practice [E255](#). The minimum weight of the composite sample shall be 150 g.

13.2.2 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.

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

13.2.3.1 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.

13.2.3.2 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.

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

13.3 *Sampling for Other Tests:*

13.3.1 Specimens for all other tests shall be taken from two of the sample pieces taken in 13.1.2. In the event only one sample piece is required, all specimens shall be taken from the piece selected.

14. Number of Tests and Retests

14.1 *Tests:*

14.1.1 Chemical composition shall be determined as the average of at least two replicate determinations for each specified element.

14.1.2 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 13.1.2.

14.2 *Retests:*

14.2.1 *Chemical Composition*—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.

14.2.2 *Mechanical Properties*—Should the results of tests on any specimen fail to meet the prescribed requirements, two additional specimens shall be taken from different sample pieces and tested and the results of both of these tests shall comply with the specified requirements.

14.2.3 *Eddy Current Test*—Tubes with discontinuities indicated by the testing unit may, at the option of the manufacturer, be reexamined or retested to determine whether the discontinuity is cause for rejection.

14.2.4 Failure to conform with the prescribed requirements upon retesting shall be cause for rejection.

15. Specimen Preparation

15.1 *Chemical Composition*—Preparation of the analytical specimen shall be the responsibility of the reporting laboratory.

15.2 *Tensile Test*—The test specimen shall be of the full section of the tube and shall conform to the requirements specified in the Specimens for Pipe and Tube section in Test Methods E8, unless the limitations of the testing machine preclude the use of such specimens.

15.2.1 Test specimens conforming to Specimen No. 1 in Fig. 13, Tension Test Specimens for Large-Diameter Tubular Products, of Test Methods E8 may be used when a full-section specimen cannot be used.

15.3 *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.

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

15.3.2 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.

15.4 *Grain Size*—The test specimen shall be prepared in accordance with Practice E3.

16. Test Methods

16.1 Test methods used for quality control shall be discretionary.

16.2 *Chemical Composition*—Shall be determined as follows:

Element	ASTM Test Methods
Copper	E53
Phosphorus	E62

16.3 The material furnished shall be capable of conforming with the mechanical properties and other test requirements prescribed in this specification when tested in accordance with the following methods:

Test	ASTM Designation
Tension	E8
Rockwell Hardness	E18
Expansion (pin test)	B153
Eddy current	E243

16.3.1 Yield strength, in case of dispute, shall be determined by the extension-under-load method.

16.3.1.1 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.

16.3.1.2 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 gage length (or distance between grips for full section specimens).

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

16.3.3 *Grain Size*—The intercept method of Test Methods E112 shall be used in case of dispute.

17. Significance of Numerical Limits

17.1 For purpose of determining compliance with the specified limits for requirements of the properties listed in Table 5,

TABLE 5 Rounding Units

Property	Rounded Unit for Observed or Calculated Value
Chemical composition Hardness values	Nearest unit in the last right-hand place 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

an observed value or calculated value shall be rounded as indicated in accordance with the rounding method of Practice E29.

18. Inspection

18.1 The manufacturer shall provide to the inspector representing the purchaser, all reasonable facilities without charge, to satisfy the inspector that the tubes are being furnished in accordance with the specified requirements.

19. Rejection and Rehearing

19.1 Material which fails to conform to the requirements of this specification shall be cause for rejection. Rejection shall be reported promptly to the manufacturer or supplier. Written notification of rejection shall follow. In case of dissatisfaction with the results of any test, the manufacturer or supplier may make claim for rehearing.

20. Certification

20.1 When specified on the purchase order, the manufacturer shall furnish to the purchaser a certificate of compliance or conformance stating that each lot has been sampled, tested, and inspected in accordance with this specification, and has met the requirements of this specification.

21. Mill Test Report

21.1 When specified on the purchase order, the manufacturer or supplier shall furnish to the purchaser a test report showing the results of tests required by this specification.

22. Packaging and Package Marking

22.1 The material shall be separated by size and temper, and prepared for shipment in a manner to ensure acceptance by

common carrier for transportation, and to provide protection from the normal hazards of transportation.

22.2 Each shipping unit shall be legibly marked with the purchase order number, temper, size, gross and net mass, and name of supplier. The specification number shall also be shown.

23. Product Identification

23.1 The name or trademark of the manufacturer and the mark “Type GAS” tube shall be permanently marked (incised) on each tube at intervals not greater than 18 in. (0.46 m). Tubes in drawn temper straight lengths shall be further identified throughout their lengths by a continuous yellow colored stripe, symbol, or logo not less than $\frac{3}{16}$ in. (4.70 mm) in height, including a legend repeated at intervals not greater than 36 in. (910 mm). The legend shall include the type of the tube, name or trademark of the manufacturer or both, and the country of origin. Other information may be included at the option of the manufacturer.

23.2 The color used is “YELLOW” for Type GAS. Such color marking is not applicable to tube furnished in annealed straight lengths or coils.

24. Keywords

24.1 brazed joints; C12200; flared fittings; fuel distribution systems; liquified petroleum (LP) gas; natural gas; seamless copper tube

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 the date of material purchase form part of this specification to the extent referenced herein:

S1.1.1 ASTM Standard B900, Packaging of Copper and Copper-Alloy Mill Products for the U.S. Government²

S1.1.2 *Federal Standards:*

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:*

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 may use his own or any other 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 assure 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 and Delivery

S4.1 *Preservation, Packaging, and Packing:*

S4.1.1 *Military Agencies*—The material shall be separated by size 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 ASTM B900.

S4.1.2 *Civil Agencies*—The requirements of Fed. Std. No. 102 shall be referenced 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 will be in accordance with Fed. Std. No. 123.

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the 2009 issue as follows:

(1) Size range of coils increased to 1 $\frac{1}{8}$ in.

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