



Designation: **B 302 – 002**

Standard Specification for Threadless Copper Pipe, Standard Sizes¹

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This standard has been approved for use by agencies of the Department of Defense.

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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1. Scope *

1.1 This specification establishes requirements for threadless, seamless, deoxidized copper pipe (TP) in straight lengths, in all nominal or standard pipe sizes, for piping systems that are assembled with brazed-joint pipe fittings. The pipe shall be produced from either of coppers UNS Nos. C10300 or C12200.

1.2 The values stated in inch-pound units are the standard. The values given in parentheses are provided for information only.

1.3 The following safety hazard caveat pertains only to the test methods described Section 16 of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to its use.*

2. Referenced Documents

2.1 ASTM Standards:

~~B 601 Practice 601 Classification~~ for Temper Designations for Copper and Copper Alloys—Wrought and Cast²

B 846 Terminology for Copper and Copper Alloys²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

~~E 53 Test Methods for Chemical Analysis Determination of Copper in Unalloyed Copper by Gravimetry~~⁵

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁵

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes⁶

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition⁵

3. Terminology

3.1 *Definitions*—Refer to Terminology B 846 for definitions of terms related to copper and copper alloys.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *threadless pipe (TP)*—seamless tube conforming to the particular dimensions commercially known as “Threadless Pipe (TP).”

4. Ordering Information

4.1 Orders for products under this specification shall include the following information:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper UNS No. designation,

4.1.3 Nominal or standard size (Table 1), and

4.1.4 Total length, total weight, or number of pieces of each size.

² *Annual Book of ASTM Standards*, Vol 02.01.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 03.05~~6~~.

⁶ *Annual Book of ASTM Standards*, Vol 03.03.

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

TABLE 1 Dimensions and Weights and Tolerance in Diameter and Wall Thickness for Copper Threadless Pipe (TP) Sizes

Nominal or Standard Pipe Size, in.	Outside Diameter, in. (mm)	Inside Diameter, in. (mm),	Wall Thickness, in. (mm)	Cross-Sectional Area of Bore, in. ² (cm ²)	Theoretical Weight, lb/ft (kg/m)	Tolerances, in. (mm)	
						Average Outside Diameter, ^A All Minus	Wall Thickness Plus and Minus
¼	0.540 (13.7)	0.410 (10.4)	0.065 (1.65)	0.132 (0.852)	0.376 (0.559)	0.004 (0.10)	0.0035 (0.089)
⅜	0.675 (17.1)	0.545 (13.8)	0.065 (1.65)	0.233 (1.50)	0.483 (0.719)	0.004 (0.10)	0.004 (0.10)
½	0.840 (21.3)	0.710 (18.0)	0.065 (1.65)	0.396 (2.55)	0.613 (0.912)	0.005 (0.13)	0.004 (0.10)
¾	1.050 (26.7)	0.920 (23.4)	0.065 (1.65)	0.665 (4.29)	0.780 (1.16)	0.005 (0.13)	0.004 (0.10)
1	1.315 (33.4)	1.185 (30.1)	0.065 (1.65)	1.10 (7.10)	0.989 (1.47)	0.005 (0.13)	0.004 (0.10)
1¼	1.660 (42.2)	1.530 (38.9)	0.065 (1.65)	1.84 (11.9)	1.26 (1.87)	0.006 (0.15)	0.004 (0.10)
1½	1.900 (48.3)	1.770 (45.0)	0.065 (1.65)	2.46 (15.9)	1.45 (2.16)	0.006 (0.15)	0.004 (0.10)
2	2.375 (60.3)	2.245 (57.0)	0.065 (1.65)	3.96 (25.5)	1.83 (2.72)	0.007 (0.18)	0.006 (0.15)
2½	2.875 (73.0)	2.745 (69.7)	0.065 (1.65)	5.92 (38.2)	2.22 (3.30)	0.007 (0.18)	0.006 (0.15)
3	3.500 (88.9)	3.334 (84.7)	0.083 (2.11)	8.73 (56.3)	3.45 (5.13)	0.008 (0.20)	0.007 (0.18)
3½	4.000 (102)	3.810 (96.8)	0.095 (2.41)	11.4 (73.5)	4.52 (6.73)	0.008 (0.20)	0.007 (0.18)
4	4.500 (114)	4.286 (109)	0.107 (2.72)	14.4 (92.9)	5.72 (8.51)	0.010 (0.25)	0.009 (0.23)
5	5.562 (141)	5.298 (135)	0.132 (3.40)	22.0 (142)	8.73 (13.0)	0.012 (0.30)	0.010 (0.25)
6	6.625 (168)	6.309 (160)	0.158 (4.01)	31.3 (202)	12.4 (18.5)	0.014 (0.36)	0.010 (0.25)
8	8.625 (219)	8.215 (209)	0.205 (5.21)	53.0 (342)	21.0 (31.2)	0.018 (0.46)	0.014 (0.36)
10	10.750 (273)	10.238 (260)	0.256 (6.50)	82.3 (531)	32.7 (48.7)	0.018 (0.46)	0.016 (0.41)
12	12.750 (324)	12.124 (308)	0.313 (7.95)	115 (742)	47.4 (70.5)	0.018 (0.46)	0.020 (0.51)

^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.

4.2 The following options are available and are to be specified in the contract or purchase order at the time of placing of the order:

- 4.2.1 Tension test (Section 8),
- 4.2.2 Hydrostatic test (10.2),
- 4.2.3 Pneumatic test (10.3),
- 4.2.4 Heat identification or traceability requirements,
- 4.2.5 Certification (Section 20), and
- 4.2.6 Mill test report (Section 21).

5. Materials and Manufacture

5.1 *Material*—The material of manufacture shall be cast billets, bars, or tubes of copper UNS No. C10300 or C12200 and shall be of such quality and soundness as to be suitable for processing into finished lengths of pipe to meet the properties prescribed herein.

5.2 *Manufacture*:

5.2.1 The pipe shall be manufactured by such hot extrusion or piercing and subsequent cold working as to produce a uniform, seamless wrought structure in the finished product.

5.2.2 The product shall be cold worked to the finished size so as to meet the temper properties specified.

6. Chemical Composition

6.1 The product shall conform to the chemical composition requirements specified in Table 2 for the copper UNS number designation specified in the ordering information.

6.2 These composition limits do not preclude the presence of other elements. Limits for unnamed elements shall be established and analysis required by agreement between the manufacture or supplier and purchaser.

7. Temper

7.1 The product shall be furnished in the H58 (drawn general purpose) temper as defined in Practice Classification B 601.

8. Mechanical Properties

8.1 *Tensile Strength*:

TABLE 2 Chemical Requirements

Copper UNS No.	Composition, %	
	Copper (Incl Silver), min	Phosphorus
C10300	99.95 ^A	0.001 to 0.005
C12200	99.9	0.015 to 0.040

^A Copper + silver + phosphorus.

8.1.1 Product in all sizes and coppers shall have a minimum tensile strength of 36 ksi (250 MPa) when tested in accordance with Test Methods E 8.

8.1.2 The tension test need not be performed except when specified by the purchaser in the ordering information at the time of placing of the order.

8.2 *Rockwell Hardness*—Product in all sizes and coppers shall have a minimum Rockwell F hardness of 55 when tested in accordance with Test Methods E 18.

9. Microscopical Examination

9.1 The pipe shall be made from copper free from cuprous oxide, as determined by microscopical examination at a magnification of 75 diameters. When copper UNS No. C12200 is supplied, microscopical examination for cuprous oxide is not required.

10. Nondestructive Test Requirements

10.1 *Electromagnetic (Eddy-Current) Test:*

10.1.1 Each tube up to and including 2½-in. nominal pipe size shall be subjected to an eddy-current test. Testing shall follow the procedures of Practice E 243 and 15.2.

10.1.1.1 The provisions for the determination of “end-effect” in Practice E 243 shall not apply.

10.1.1.2 *Hydrostatic Test Alternative*—As an alternative to the eddy-current test for tubes of diameters above 1.25 in. (32 mm), the manufacturer shall perform the hydrostatic test to the requirements of 10.2.

10.1.2 The tested tubes, which do not actuate the signaling device of the testing unit, shall be considered as conforming to the requirements of the test.

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

10.1.3.1 Notch depth standards shall be 10 % of the nominal wall thickness.

10.1.3.2 The sizes of drilled hole standards shall be determined in accordance with Table X1.2 of Practice E 243.

10.2 *Hydrostatic Test:*

10.2.1 When specified in the contract or purchase order, or as an alternative to the eddy-current test for tubes above 1.25 in. (32 mm) in diameter (see 10.1.1.2), each tube shall stand, without showing evidence of leakage, an internal hydrostatic pressure sufficient to produce a fiber stress of 6000 psi (41 MPa) as determined by the following equation for thin hollow cylinders under tension:

$$P = 2St/(D - 0.8t) \quad (1)$$

where:

P = hydrostatic pressure, psi (MPa);

t = wall thickness of the material, in. (mm);

D = outside diameter of the material, in. (mm); and

S = allowable stress of the material, psi (MPa).

10.2.1.1 The tube need not be subjected to a pressure gage reading over 1000 psi (6.9 MPa) unless specifically stipulated in the contract or purchase order.

10.3 *Pneumatic Test*—When specified in the contract or purchase order, each tube shall be subjected to a minimum internal air pressure of 60 psig (415 kPa) for 5 s without showing evidence of leakage.

11. Dimensions, Mass, and Permissible Variations

11.1 *General*—The standard method of specifying wall thickness shall be in decimal fractions of an inch. 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 cause for rejection.

11.2 *Dimensions and Weights*—Dimensions and weights for the various nominal or standard sizes, together with tolerances in diameter and wall thickness, shall be in accordance with Table 1.

11.3 *Wall Thickness and Diameter Tolerances*—Wall thickness and diameter tolerances shall be in accordance with Table 1.

11.4 *Roundness Tolerance*—The roundness tolerances shall be in accordance with Table 3.

11.5 *Length and Length Tolerance*—The standard length of the material shall be 20 ft (6.10 m) except for the 12-in. (305-mm) size, which shall be 15 ft (4.57 m). The length tolerances shall be plus 1 in. (25 mm), minus 0.

11.6 *Squareness of Cut*—The departure from squareness of the end of any pipe shall not exceed the following:

Outside Diameter, in. (mm)	Tolerance
Up to ⅝ (15.9) incl	0.010 in. (0.25 mm)
Over ⅝ (15.9)	0.016 in./in. (0.016 mm/mm) of diameter

12. Workmanship, Finish and Appearance

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

TABLE 3 Roundness Tolerances

#D, Ratio of Wall Thickness to Outside Diameter	Diameter Roundness Tolerances, ^A
	% of Outside Diameter (Expressed to the Nearest 0.001 in.) (Nearest 0.01 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
Over 0.10	0.7

^A The deviation from roundness is measured as the difference between major and minor outside diameters as determined at any one cross section of the tube.

13. Sampling

13.1 The lot size, portion size, and sample size of the finished product shall be as follows:

13.1.1 *Lot Size*—An inspection lot shall be 5000 lbs (2270 kg) or fraction thereof, subject to inspection at one time.

13.1.2 *Portion Size*—A portion shall be taken to represent an inspection lot according to the following schedule:

Number of Pieces in Lot	Number of Samples to be Taken ^A
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.

^A Each test portion shall be taken from a separate tube.

13.2 *Chemical Analysis*—Samples for chemical analysis shall be taken in accordance with Practice E 255. Drillings, millings, and so forth shall be taken in approximately equal weight from each of the sample pieces selected in accordance with 13.1 and combined into one composite sample. The minimum weight of the composite sample that is to be divided into three equal parts shall be 150 g.

13.2.1 As an alternative to sampling in accordance with Practice E 255, the manufacturer shall determine conformance to chemical composition as follows: Conformance shall be determined by the manufacturer by analyzing samples taken at the time the castings are poured or samples taken from the semifinished product. If the manufacturer determines the chemical composition of the material during the course of manufacture, the manufacturer shall not be required to sample and analyze the finished product. The number of samples taken for determination of chemical composition shall be as follows:

13.2.1.1 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.

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

13.2.1.3 In the event that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Because of the discontinuous nature of the processing of castings into wrought products, it is not practical to identify specific casting analysis with a specific quantity of finished material.

14. Number of Tests and Retests

14.1 *Tests*:

14.1.1 *Chemical Analysis*—Chemical composition shall be determined as per the element mean of the results from at least two replicate analyses of the samples.

14.1.2 *Mechanical Properties*—The required tests for mechanical properties shall be made on specimens taken from each sample piece selected.

14.2 *Retests*:

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

14.2.2 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.

14.2.3 All test specimens shall conform to the product specification requirements in retest. Failure to conform shall be cause for rejection.

15. Specimen Preparation

15.1 *Chemical Analysis*—Analytical specimen preparation shall be the responsibility of the reporting laboratory.

15.2 *Tensile Testing*—Tension test specimens shall be of the full section of the tube and shall conform to the requirements of Test Methods E 8, unless the limitations of the testing machine preclude the use of such a specimen. Test specimens, conforming to Type No. 1 of Fig. 13, Tension Test Specimens for Large-Diameter Tubular Products, of Test Methods E 8, are to be used when a full-section specimen cannot be tested.

16. Test Methods

16.1 Chemical Analysis:

16.1.1 Composition shall be determined, in case of disagreement, as follows:

Element	Test Methods
Copper	E 53
Phosphorus	E 62

16.1.2 Test methods for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon by the manufacturer and the purchaser.

16.2 Other Tests:

16.2.1 The tubes furnished shall conform with the mechanical properties when tested or examined in accordance with the following appropriate test method or practice:

Test	Test Method or Section
Tensile strength	E 8
Rockwell hardness	E 18
Electromagnetic examination (eddy current)	E 243
(Eddy Current)	E 243
Hydrostatic pressure	Section 16.2.4
Pneumatic pressure	Section 16.2.5

16.2.1.1 Whenever tension test results are obtained from both full-size and machined specimens and they differ, the test results from the full-size specimens shall prevail.

16.2.2 Tension test results on material covered by this specification are not seriously affected by variations in speed of testing. A considerable range of testing speed is possible; however, the rate of stressing to the yield strength is not to exceed 100 ksi (690 MPa)/min. Above the yield strength, the movement per minute of the testing machine head under load is not to exceed 0.5 in./in. (0.5 mm/mm) of gage length (or distance between grips for full-section specimens).

16.2.3 *Electromagnetic (Eddy-Current) Test*—Testing shall follow the procedures in Practice E 243, except for the determination of “end-effect.”

16.2.3.1 Notch-depth standards shall be rounded to the nearest 0.001 in. (0.025 mm). The notch depth tolerance shall be ± 0.0005 in. (0.013 mm).

16.2.3.2 Drilled hole standards shall be rounded to the nearest 0.001 in. (0.025 mm). The drilled hole tolerance shall be ± 0.0005 in. (0.013 mm).

16.2.3.3 Alternatively, if using speed-insensitive eddy current testing units that are equipped so that to select a percentage of the maximum imbalance signal can be selected, signal, a maximum imbalance signal of 0.3 % shall be used.

16.2.3.4 Tubes that do not activate the signaling device of the eddy-current tester shall be considered as conforming to the requirements of this test. If reexamined or retested, tubes with 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.

16.2.4 *Hydrostatic Test*—The test method used shall provide for easy visual detection of any leakage or by pressure differential. Any evidence of leakage shall be cause for rejection.

16.2.5 *Pneumatic Test*—The test method used shall provide for easy visual detection of any leakage or by pressure differential. Any evidence of leakage shall be cause for rejection.

17. Significance of Numerical Limits

17.1 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 E 29.

Property	Rounded Unit for Observed or Calculated Value
Chemical composition	nearest unit in the last right-hand significant digit used in expressing the limiting value
Tensile strength	nearest ksi (nearest 5 MPa)

18. Inspection

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

18.2 When required, 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 a 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 tests and the inspection shall be conducted so as not to interfere unnecessarily with the operation of the works.

18.3 By mutual agreement between the manufacturer or supplier and purchaser, the final inspection shall be conducted simultaneously.

19. Rejection and Rehearing

19.1 *Rejection:*

19.1.1 Product that fails to conform to the requirements of this specification when tested by the purchaser or purchaser's agent shall be subject to rejection.

19.1.2 Rejection shall be reported to the manufacturer, or supplier, promptly, and in writing.

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

19.2 *Rehearing*—If product rejection is disputed, the manufacturer, or supplier, shall not be prohibited from making 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, alternately, specification. Or, upon agreement of both parties, an independent laboratory may the manufacturer, or supplier, and purchaser, samples of the rejected product shall be selected for taken in accordance with the test(s) product specification and subjected to test by an independent laboratory, using the test method(s) specified in the product specification.

20. Certification

20.1 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 requirements have been met.

21. Test Report

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

22. Packaging and Package Marking

22.1 The product shall be separated by size, composition, and temper and prepared for shipment in such a manner as to ensure acceptance by common carrier for transportation and to afford protection from the normal hazards of transportation.

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

23. Product Identification

23.1 *Product Identification*—The name or trademark of the manufacturer and “TP” shall be permanently marked (incised) on each length at intervals not greater than 1½ ft (0.457 m).

23.2 Threadless pipe is further identified throughout its length by a continuous gray colored marking not less than 3/16 in. (4.76 mm) in height, including a legend repeated at intervals not greater than 3 ft (0.914 m). The legend includes “TP,” the name or trademark or both of the manufacturer, and the country of origin.

24. Keywords

24.1 brazed-joint pipe fittings; threadless copper pipe; threadless pipe; threadless pipe (TP)

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 1 kg gives it an acceleration of 1 m/s² (N = kg·m/s²). The derived SI unit for pressure or stress is the newton per square metre (N/m²), 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/m² and N/mm².

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the ~~publication of B 302 – 98 last issue (B 302 – 00) that may impact the use of this standard.~~

~~(1) Mandatory language was incorporated. Sections 10, 13, 14, 16, 18, 19, standard.~~

(I) Sections 16.2.3.3 and 23 19.2 were a modified to replace nonmandatory language with mandatory language.

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