



Standard Specification for Copper Drainage Tube (DWV)¹

This standard is issued under the fixed designation B 306; 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.

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

1. Scope *

1.1 This specification establishes the requirements for seamless copper tube (DWV) produced from Copper UNS No. C12200 and intended for sanitary drainage, waste, and vent piping.

NOTE 1—Fittings used for soldered or brazed connections in drainage, waste, or vent systems are described in ASME Standards B16.23 and B16.29 and CSA Standard B158.1.

NOTE 2—The assembly of copper drainage, waste, and vent systems by soldering is described in Practice B 828.

NOTE 3—Solders for joining copper drainage, waste, or vent systems are described in Specification B 32. The requirement for acceptable fluxes for these systems are described in Specification B 813.

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

1.3 The following hazard statement pertains only to the test method described in Section 16.2.3 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 use.*

2. Referenced Documents

2.1 ASTM Standards:

B 32 Specification for Solder Metal²

B 601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast³

B 813 Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube³

B 828 Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings³

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵

E 53 Test Methods for Determination of Copper in Unalloyed Copper by Gravimetry⁶

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁶

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Seamless Copper and Copper-Alloy Tubes⁷

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition⁸

E 527 Practice for Numbering Metals and Alloys (UNS)⁹

2.2 ASME Standards:¹⁰

B16.23 Cast Copper Alloy Solder Joint Drainage Fittings—DWV

B16.29 Wrought Copper and Copper Alloy Solder Joint Drainage Fittings—DWV

2.3 CSA Standards:¹¹

B158.1 Cast Brass Solder Joints Drainage, Waste, and Vent Fittings

3. Terminology

3.1 Definitions:

3.1.1 *tube, DWV, n*—seamless copper tube intended for sanitary drainage, waste, and vent piping and other nonpressure applications and conforming to the particular dimensions for tube commonly known as copper drainage tube.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *capable of*—the test need not be performed by the producer of the material. However, if subsequent testing by the purchaser establishes that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Include this information for contracts or purchase orders for products furnished to this specification.

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 *Annual Book of ASTM Standards*, Vol 02.04.

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

⁶ *Annual Book of ASTM Standards*, Vol 03.06.

⁷ *Annual Book of ASTM Standards*, Vol 03.03.

⁸ *Annual Book of ASTM Standards*, Vol 03.05.

⁹ *Annual Book of ASTM Standards*, Vol 01.01.

¹⁰ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

¹¹ Available from CSA, 178 Rexdale Rd., Rexdale, ON, Canada M9W 1R3.



4.1.1 ASTM designation and year of issue (for example, B 306 – 99),

4.1.2 Dimensions (Section 11 and Table 1),

4.1.3 Total length, each size, and

4.1.4 When product is purchased for agencies of the U.S. Government.

4.2 The following options are available and shall be specified in the contract or purchase order when required:

4.2.1 Electromagnetic (eddy-current) test (Section 9.2),

4.2.2 Pneumatic test (Section 9.3),

4.2.3 Certification (Section 20),

4.2.4 Test report (Section 21).

5. Material and Manufacture

5.1 Materials:

5.1.1 The material of manufacture shall be billets, bars, or tube of the Copper UNS¹² No. C12200 and shall be of such soundness as to be suitable for processing into the tubular products described.

5.2 Manufacture:

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

NOTE 4—Tubes are normally joined with soldered fittings.

6. Chemical Composition

6.1 The material shall conform to the following requirements for UNS No. C12200:

Copper; incl silver, %	99.9
Phosphorous, %	0.015–0.040

6.1.1 These 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 Tube shall be furnished in the H58 temper as defined in Classification B 601.

8. Mechanical Property Requirements

8.1 Tensile Strength:

8.1.1 The tubes shall have a minimum tensile strength of 40 ksi (275 MPa) when tested in accordance with Test Methods E 8.

8.2 Rockwell Hardness:

8.2.1 The Rockwell hardness test, Test Methods E 18, is a quick and convenient method of checking for general conformity to the tensile strength requirement. For general information and assistance in testing, the approximate minimum hardness value is 30 as measured on the 30-T scale.

9. Nondestructive Testing

9.1 The tubes furnished shall be capable of conforming with the test requirements of any one of the following tests.

9.2 Electromagnetic (Eddy-Current) Test:

9.2.1 Each tube up to and including 3⅞-in. (79.4-mm) outside diameter shall be subjected to examination and the testing shall follow the procedures of Practice E 243.

9.2.1.1 Tubes that do not actuate the signaling device, after it has been adjusted to detect discontinuities that would be unacceptable for this application, shall have met requirements of this test.

9.2.2 This test is not required unless specified in the contract or purchase order.

9.3 Pneumatic Test:

9.3.1 Each tube shall withstand a minimum internal air pressure of 60 psi (400 kPa) for 5 s without leakage.

9.3.2 This test is not required unless specified in the contract or purchase order.

10. Purchases for U.S. Government Agencies

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

11. Dimensions, Mass, and Permissible Variations

11.1 *General*—For the purpose of determining conformance with the dimensional requirements given in this specification, any measured value outside the specified limiting values for any dimension is subject to rejection at the option of the purchaser.

¹² Refer to Practice E 527 for explanation of Unified Numbering System (UNS).

TABLE 1 Standard Dimensions, Weights, and Tolerances for Diameter and Wall Thickness

NOTE 1—All tolerances in this table are plus and minus except where otherwise noted.

Nominal or Standard Drainage Tube Size, in.	Outside Diameter, in. (mm)	Tolerance in Average Outside Diameter, ^A in. (mm)	Wall Thickness, in. (mm)		Theoretical Weight, lb/ft (kg/m)
			Actual	Tolerance	
1¼	1.375 (34.9)	0.0015 (0.038)	0.040 (1.02)	0.003 (0.076)	0.650 (0.967)
1½	1.625 (41.3)	0.002 (0.051)	0.042 (1.07)	0.003 (0.076)	0.809 (1.20)
2	2.125 (54.0)	0.002 (0.051)	0.042 (1.07)	0.004 (0.10)	1.07 (1.59)
3	3.125 (79.4)	0.002 (0.051)	0.045 (1.14)	0.004 (0.10)	1.69 (2.51)
4	4.125 (105)	0.002 (0.051)	0.058 (1.47)	0.007 (0.18)	2.87 (4.27)
5	5.125 (130)	0.002 (0.051)	0.072 (1.83)	0.008 (0.20)	4.43 (6.59)
6	6.125 (156)	0.002 (0.051)	0.083 (2.11)	0.008 (0.20)	6.10 (9.08)
8	8.125 (206)	+0.002 (0.051) –0.004 (0.10)	0.109 (2.77)	0.011 (0.28)	10.6 (15.8)

^A The average outside diameter is the average, at any one cross section, of the maximum and minimum measured diameters (usually at or very close to 90° to each other).

11.2 *Weights*—Theoretical weights for the nominal or standard dimensions given in Table 1 are for information only. Actual weights will vary in accordance with the dimensional tolerances given in the table.

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

11.4 *Roundness Tolerance*—The difference between the major and minor outside diameters as determined at any one cross section of the tube shall not exceed $1\frac{1}{2}\%$, expressed to the nearest 0.001 in. (0.025 mm), of the outside diameter of the tube.

11.5 *Lengths and Tolerances*:

11.5.1 *Standard Length and Tolerances*—The standard length of the material shall be 20 ft (6.10 m). The length tolerance shall be plus 1 in. (25 mm), minus 0 in.

11.5.2 Tubes 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.

11.6 *Squareness of Cut*—The departure from squareness of the end of any tube shall not exceed 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.

13. Sampling

13.1 Lot size, portion size, and selection of sample pieces shall be as follows:

13.1.1 *Lot Size*—An inspection lot shall be 10 000 lbs (5000 kg) or fraction thereof.

13.1.2 *Portion Size*—The number of pieces selected to be representative of the lot shall be as indicated in the following schedule:

Number of Pieces in Lot	Number of Pieces to be Selected
1 to 50	1
51 to 200	2
201 to 400	3

13.2 *Chemical Composition*:

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 E 255. The minimum weight of the composite shall be 150 g.

13.2.2 Instead of sampling in accordance with Practice E 255, the manufacturer shall have the option of sampling at the time casting are poured or from the semifinished 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 semifinished product, a sample shall be taken to represent each 10 000 lbs (5000 kg) or fraction thereof, except that not more than one sample per piece shall be required.

13.2.4 When the material composition has been determined during the course of manufacture, sampling of the finished product by the manufacturer is not required.

13.3 *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 Analysis*—Composition shall be determined as the average of results from at least two replicate determinations for each specified element with a limiting value.

14.1.2 *Tensile Strength*—The test results shall be reported as the average of results obtained from two test specimens taken from each of the sample pieces selected in 13.1.2 and each test specimen must conform to specification requirements.

14.1.2.1 In the event only one piece was selected for test, both test specimens shall be taken from the piece selected.

14.2 *Retests*:

14.2.1 When requested by the manufacturer or supplier, he shall have the option to perform a retest when the test results obtained by the purchaser fail to conform with the product specification requirement(s).

14.2.2 Retesting shall be as directed in this specification for the initial test except for the number of test specimens which shall be twice that normally required for the test. Test results for all specimens shall conform to the specification requirement(s) in retest and failure to comply shall be cause for lot rejection.

15. Specimen Preparation

15.1 *Chemical Analysis*:

15.1.1 Preparation of the analytical specimens shall be the responsibility of the reporting laboratory.

15.2 *Tensile Test*:

15.2.1 The test specimen shall be of the full section of the tube and shall conform to the requirements specified in the section Specimens for Pipe and Tube in Test Methods E 8, unless the limitations of the testing machine precludes the use of such specimens.

15.2.2 Test specimens conforming to Specimen No. 1 in Fig. 13, Tension Test Specimens for Large-Diameter Tubular Products, of Test Methods E 8 shall be used when a full-section specimen cannot be tested.

16. Test Methods

16.1 *Chemical Composition*:

16.1.1 In case of dispute, chemical composition shall be determined as follows:

Element	Test Method
Copper	E 53
Phosphorus	E 62

16.1.2 Test method(s) used for the determination of element(s) required by contractual or purchase order agreements shall be as agreed upon between the manufacturer or supplier and the purchaser.



16.2 The finished product shall conform with the mechanical properties and other requirements of this specification when tested or examined in accordance with the following appropriate test method or practice:

Test	Test Method
Tensile	E 8
Pneumatic	Section: 16.2.3
Electromagnetic examination (eddy current)	Practice E 243

16.2.1 Tensile strength shall be determined in accordance with Test Methods E 8.

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

16.2.1.2 Test results 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 shall not exceed 100 ksi (690 MPa)/min. Above the yield strength, the movement per minute of the testing machine head under load shall not exceed 0.5 in./in. (12.7 mm/mm) of gage length (or distance between grips for full-section specimens).

16.2.2 *Electromagnetic (Eddy-Current) Test*—Each tube up to and including 3½-in. (79.4-mm) outside diameter, shall be subjected to an eddy-current test. Testing shall follow the procedures in Practice E 243. Tubes shall be passed through an eddy-current test unit adjusted to provide information on the suitability of the tube for the intended application.

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

(a) Notch depth standards, rounded to the nearest 0.001 in., shall be 22 % of the wall thickness. The notch depth tolerance shall be ± 0.0005 in.

(b) Drilled holes shall be drilled radially through the wall using a suitable drill jig that has a bushing to guide the drill, care being taken to avoid distortion of the tube while drilling. The diameter of the drilled hole shall be in accordance with the following and shall not vary by more than +0.001, –0.000 in. of the hole diameter specified.

Tube Outside Diameter, in.	Diameter of Drilled Holes, in.	Drill Number
¼ to ¾, incl	0.025	72
Over ¾ to 1, incl	0.031	68
Over 1 to 1¼, incl	0.036	64
Over 1¼ to 1½, incl	0.042	58
Over 1½ to 1¾, incl	0.046	56
Over 1¾ to 2, incl	0.052	55
Tube Outside Diameter, mm	Diameter of Drilled Holes, mm	Drill Number
6.0 to 19.0, incl	0.635	72
Over 19.0 to 25, incl	0.785	68
Over 25 to 32, incl	0.915	64
Over 32 to 38, incl	1.07	58
Over 38 to 45, incl	1.17	56
Over 45 to 50, incl	1.322	55

16.2.2.2 Alternatively, at the option of the manufacturer, using speed insensitive eddy-current units that are equipped to select a fraction of the maximum imbalance signal, the following percent maximum imbalance signals shall be used:

Standard Tube Size, in.	Maximum Percent Imbalance Signal Magnitude
Up to ¾, incl	0.2
½ to 2, incl	0.3
Over 2 to 3, incl	0.4
Standard Tube Size, mm	Maximum Percent Imbalance Signal Magnitude
Up to 9, incl	0.2
13 to 50, incl	0.3
Over 50 to 76, incl	0.4

16.2.2.3 Tubes that do not activate the signalling device of the eddy-current tester shall be considered as conforming to the requirements of this test. At the option of the manufacturer, tubes with discontinuities indicated by the testing unit are not prohibited from being reexamined or retested to determine whether the discontinuities are cause for rejection. Signals that are found to have been caused by minor mechanical damage, soil, or moisture shall not be cause for rejection of the tubes provided the tube dimensions are still within prescribed limits and the tube is suitable for its intended application.

16.2.3 *Pneumatic Test:*

16.2.3.1 The test method shall permit easy visual detection of leakage, such as having the tube under water or by the pressure differential method.

17. Significance of Numerical Limits

17.1 For the purpose 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 place of figures of the specified limit
Hardness	
Tensile strength	nearest ksi (5 MPa)

18. Inspection

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

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

18.3 By mutual agreement, the manufacturer, or supplier, has the option of conducting the final inspection simultaneously.

19. Rejection and Rehearing

19.1 *Rejection:*

19.1.1 Product that fails to conform to the requirements of the product specification when inspected or tested by the purchaser, or purchaser's agent, is subject to rejection at the option of the purchaser.

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

19.1.3 When requested by the manufacturer or supplier, a rehearing shall be granted.

19.2 Rehearing:

19.2.1 As a result of product rejection, the manufacturer or supplier has the option to make claim for 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 tested by both parties as directed in the product specification, or, alternatively, upon agreement by both parties, an independent laboratory shall be selected for the tests using the test methods prescribed 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 the requirements have been met.

21. Test Report (Mill)

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

22. Product Marking

22.1 The name or trademark of the manufacturer and “DWV” shall be permanently incised on each length at intervals not greater than 1½ ft (0.457 m). DWV tube is further identified throughout its length by a continuous yellow colored marking not less than ⅜ in. (4.76 mm) in height, including a legend repeated at intervals not greater than 3 ft (0.914 m). The legend includes “DWV,” the name or trademark or both, of the manufacturer, and the country of origin. The manufacturer has the option to include other information.

23. Packaging and Package Marking

23.1 *Packaging*—The material 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.

23.2 *Package Marking*—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.

24. Keywords

24.1 drainage tube; sanitary tube; seamless copper tube; vent tube; waste 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 date of material purchase form a part of this specification to the extent referenced herein:

S1.1.1 *Federal Standards*:¹³

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

S1.1.2 *Military Standard*:¹³

MIL-STD-129 Marking for Shipment and Storage

S1.1.3 *Military Specification*:¹³

MIL-C-3993 Packaging of Copper and Copper-Base Alloy Mill Products

S2. Quality Assurance

S2.1 *Responsibility for Inspection*:

S2.1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the

manufacturer has the option to use his own or any 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 for Delivery

S4.1 *Preservation, Packaging, Packing*:

S4.1.1 *Military Agencies*—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, Level A or C, packed, Level A, B, or C as specified in the contract or purchase order, in accordance with the requirements of MIL-C-3993.

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

¹³ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, ATTN: NPODS.



shipment shall be in accordance with MIL-STD-129.

S4.2.2 *Civil Agencies*—In addition to any special marking

required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = \text{kg} \cdot \text{m}/\text{s}^2$). 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 $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$, the metric equivalents are expressed as megapascal (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 (B 306 – 99) that may impact the use of this standard.

(1) Sections 3.2.1, 15.2.2, 16.2.1.2, and 22.1 have been modified to replace nonmandatory language with mandatory language.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

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