



Designation: B 42 – 02

## Standard Specification for Seamless Copper Pipe, Standard Sizes<sup>1</sup>

This standard is issued under the fixed designation B 42; 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.

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

### 1. Scope \*

1.1 This specification<sup>2</sup> covers seamless copper pipe in all nominal or standard pipe sizes, both regular and extra-strong, suitable for use in plumbing, boiler feed lines, and for similar purposes.<sup>3</sup>

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

### 2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

#### 2.2 ASTM Standards:

- B 153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing<sup>4</sup>
- B 170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes<sup>4</sup>
- B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast<sup>4</sup>
- E 8 Test Methods for Tension Testing of Metallic Materials<sup>5</sup>
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>6</sup>
- E 53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry<sup>7</sup>
- E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition<sup>7</sup>
- E 62 Test Methods for Chemical Analysis of Copper and

Copper Alloys (Photometric Method)<sup>7</sup>

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes<sup>8</sup>

E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>7</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>9</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *lengths*—straight pieces of the product.

3.1.1.1 *standard*—uniform lengths recommended in a Simplified Practice Recommendation or established as a Commercial Standard.

3.1.2 *tube, seamless*—a tube produced with a continuous periphery in all stages of the operations.

3.1.2.1 *pipe*—a seamless tube conforming to the particular dimensions commercially known as Nominal or Standard Pipe Sizes.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *capable of*—as used in this specification, the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements the material shall be subject to rejection.

### 4. Ordering Information

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

4.1.1 Type of copper, if required,

4.1.2 Temper (see 6.1),

4.1.3 Pipe size, regular or extra-strong, (see 10.2),

4.1.4 Length (see 10.3),

4.1.5 Total length of each size,

4.1.6 If material is required to meet *ASME Boiler and Pressure Vessel Code*,

4.1.7 Certification, if required (see 18.1),

4.1.8 Mill test report, if required (see 20.1),

4.1.9 Hydrostatic test, if required, and

<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.

Current edition approved Apr. 10, 2002. Published June 2002. Originally published as B 42 – 22 T. Last previous edition B 42 – 98.

<sup>2</sup> For *ASME Boiler and Pressure Vessel Code* applications, see related Specification SB-42 in Section II of that Code.

<sup>3</sup> The UNS system for copper and copper alloys (see Practice E 527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix “C” and a suffix “00.” The suffix can be used to accommodate composition variations of the base alloy.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 02.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 03.03.

<sup>9</sup> *Annual Book of ASTM Standards*, Vol 01.01.

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

4.1.10 Pneumatic test, if required.

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.

## 5. Chemical Composition

5.1 The material shall conform to the following chemical requirements:

Copper (incl silver), min, %	99.9
Phosphorus, max, %	0.04

5.2 The pipe shall be produced from one of the following coppers, and unless otherwise specified, anyone of them is permitted to be furnished:

Copper UNS No.	Previously Used Designation	Type of Copper
C10200	OF	Oxygen-free without residual deoxidants
C10300		Oxygen-free, extra-low phosphorus
C10800		Oxygen-free, low phosphorus
C12000	DLP	Phosphorized, low residual phosphorus
C12200	DHP	Phosphorized, high residual phosphorus

5.3 When the copper is specified, the material shall conform to the chemical requirements specified in Table 1.

5.4 These specification limits do not preclude the possible presence of other elements. When required, limits for unnamed elements are to be established by agreement between manufacturer or supplier and purchaser.

5.4.1 The major element that is not analyzed shall be determined by difference between the sum of those elements analyzed and 100 %. By agreement between manufacturer and purchaser, it is permitted to establish limits and required analysis for elements not specified.

## 6. Temper

6.1 All pipe shall normally be furnished in the O61 (annealed), H55 (light drawn), or H80 (hard drawn) temper, as prescribed in Practice B 601, and shall have the properties shown in Table 2.

6.2 When pipe is required for bending, it shall be so specified in the purchase order, and the pipe shall be furnished in the temper agreed upon between the manufacturer or supplier and the purchaser.

## 7. Expansion Test

7.1 Pipe ordered in the annealed (O) condition, selected for test, shall withstand an expansion of 25 % of the outside diameter when expanded in accordance with Test Method

**TABLE 1 Chemical Requirements**

Copper UNS No.	Copper (incl Silver), min, %	Phosphorus, %
C10200 <sup>A</sup>	99.95	...
C10300	99.95 <sup>B</sup>	0.001 to 0.005
C10800	99.95 <sup>B</sup>	0.005 to 0.012
C12000	99.90	0.004 to 0.012
C12200	99.9	0.015 to 0.040

<sup>A</sup> Oxygen in C10200 shall be 10 ppm max.

<sup>B</sup> Copper + silver + phosphorus.

**TABLE 2 Tensile Requirements**

Temper Designation	Pipe Size Nominal or Standard, in.	Tensile Strength, min, ksi <sup>A</sup> (MPa) <sup>B</sup>	Yield Strength, min, ksi <sup>A</sup> (MPa) <sup>B</sup>
O61	annealed	all	30 (294)
H80	hard drawn	1/8–2, incl	45 (310)
H80	hard drawn	over 2	38 (260)
H55	light drawn	2–12, incl	36 (250)

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

<sup>B</sup> See Appendix X1.

<sup>C</sup> At 0.5 % extension under load.

<sup>D</sup> Light-straightening operation is permitted.

B 153. The expanded pipe shall show no cracking or rupture visible to the unaided eye. Pipe ordered in the drawn (H) condition is not subject to this test.

NOTE 1—The term “unaided eye,” as used herein, permits the use of corrective spectacles necessary to obtain normal vision.

7.2 As an alternative to the expansion test for pipe over 4 in. (102 mm) in diameter in the annealed condition, a section 4 in. in length shall be cut from the end of one of the lengths for a flattening test. This 4-in. specimen shall be flattened so that a gage set at three times the wall thickness will pass over the pipe freely throughout the flattened part. The pipe so tested shall develop no cracks or flaws visible to the unaided eye (Note 1) as a result of this test. In making the flattening test, the elements shall be slowly flattened by one stroke of the press.

## 8. Microscopical Examination

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

## 9. Nondestructive Testing

9.1 The material shall be tested in the final size but is permitted to be tested before the final anneal or heat treatment, when these thermal treatments are required, unless otherwise agreed upon by the manufacturer or supplier and purchaser.

9.2 *Eddy-Current Test*—Each piece of material from 1/8-in. up to and including 2 1/2-in. nominal outside diameter, or within the capabilities of the eddy-current tester, shall be subjected to an eddy-current test. Testing shall follow the procedures of Practice E 243, except for determination of “end effect.” The material shall be passed through an eddy-current testing unit adjusted to provide information on the suitability of the material for the intended application.

9.2.1 Notch-depth standards rounded to the nearest 0.001 in. (0.025 mm) shall be 10 % of the nominal wall thickness. The notch depth tolerance shall be ±0.0005 in. (0.013 mm). Alternatively, when a manufacturer uses speed-insensitive equipment that allows the selection of a maximum imbalance signal, a maximum imbalance signal of 0.3 % is permitted to be used.

9.2.2 Material that does not actuate the signaling device of the eddy-current test shall be considered as conforming to the requirements of this test. Material with discontinuities indicated by the testing unit is permitted to be reexamined or

retested, at the option of the manufacturer, to determine whether the discontinuity is 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 material provided the dimensions of the material are still within prescribed limits and the material is suitable for its intended application.

9.3 *Hydrostatic Test*—When specified, the material shall stand, without showing evidence of leakage, an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 6000 psi (41 MPa), determined by the following equation for thin hollow cylinders under tension. The material need not be tested at a hydrostatic pressure of over 1000 psi (6.9 MPa) unless so specified.

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

where:

- $P$  = hydrostatic pressure, psi (or MPa);
- $t$  = wall thickness of the material, in. (or mm);
- $D$  = outside diameter of the material in. (or mm); and
- $S$  = allowable stress of the material, psi (or MPa).

9.4 *Pneumatic Test*—When specified, the material shall be subjected to an internal air pressure of 60 psi (415 kPa) minimum for 5 s without showing evidence of leakage. The test method used shall permit easy visual detection of any leakage, such as by having the material under water or by the pressure-differential method. Any evidence of leakage shall be cause for rejection.

## 10. Dimensions and Permissible Variations

10.1 For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the limiting values for any dimensions shall be sufficient cause for rejection.

10.2 *Standard Dimensions, Wall Thickness, and Diameter Tolerances*—The standard dimensions, wall thickness, and diameter tolerances shall be in accordance with Table 3.

10.3 *Length and Length Tolerances*—The standard length of copper pipe is 12 ft (3.66 m) with a tolerance of  $\pm 1/2$  in. (13 mm).

### 10.4 Roundness:

10.4.1 For drawn unannealed pipe in straight lengths, the roundness tolerances shall be as follows:

$t/d$ (ratio of Wall Thickness to Outside Diameter)	Roundness Tolerances as Percent of Outside Diameter (Expressed to the Nearest 0.001 in. (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
Over 0.10	0.7

10.4.2 Compliance with the roundness tolerance shall be determined by taking measurements on the outside diameter only, irrespective of the manner in which the pipe dimensions are specified.

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

10.5 *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 $5/8$ (15.9), incl	0.010 in. (0.25 mm)
Over $5/8$ (15.9)	0.016 in./in. (0.016 mm/mm) of diameter

10.6 *Straightness Tolerance*—For pipe of H (drawn) tempers of Nominal Pipe Sizes from  $1/4$  to 12 in. inclusive, the maximum curvature (depth of arc) shall not exceed  $1/2$  in. (13 mm) in any 10-ft (3048-mm) portion of the total length. For H temper pipe of other sizes, and for the O611 (annealed) temper, no numerical values are established, however, the straightness of the pipe shall be suitable for the intended application.

## 11. Workmanship, Finish, and Appearance

11.1 The material shall be free of defects of a nature that interfere with normal commercial applications. It shall be well cleaned and free of dirt.

## 12. Sampling

12.1 *Sampling*—The lot size, portion size, and selection of sample pieces shall be as follows:

12.1.1 *Lot Size*—The lot size shall be as follows:

Pipe Size, in.	Lot Weight, lb (kg)
Up to $1 1/2$ , incl	5 000 (2270) or fraction thereof
Over $1 1/2$ to 4, incl	10 000 (4550) or fraction thereof
Over 4	40 000 (18 100) or fraction thereof

12.1.2 *Portion Size*—Sample pieces shall be taken for test purposes from each lot according to the following schedule:

Number of Pieces in Lot	Number of Sample Pieces to be Taken <sup>A</sup>
1 to 50	1
51 to 200	2
201 to 1500	3
Over 1500	0.2 % of total number of pieces in the lot, but not to exceed ten sample pieces

<sup>A</sup> Each sample piece shall be taken from a separate tube.

## 13. Number of Tests and Retests

13.1 *Chemical Analysis*—Samples for chemical analysis shall be taken in accordance with Practice E 55. Drillings, millings, and so forth shall be taken in approximately equal weight from each of the sample pieces selected in accordance with 12.1.2 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.

13.1.1 Instead of sampling in accordance with Practice E 55, the manufacturer shall have the option of determining 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