



Designation: **B42-96** Designation: **B 42 – 02^{€1}**

Standard Specification for Seamless Copper Pipe, Standard Sizes¹

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 (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} NOTE—Referenced Documents were editorially corrected in November 2003.

1. Scope*

1.1 This specification² 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.³

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 Tubing⁴

B 170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes⁴

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast⁴

E 8 Test Methods for Tension Testing of Metallic Materials⁵

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁶

E 53 Test Methods for Chemical Analysis of Copper

E 53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry⁷

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁷

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁷ 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)⁷

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes⁸

E 478 Test Methods for Chemical Analysis of Copper Alloys⁷

E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition⁷

E 478 Test Methods for Chemical Analysis of Copper Alloys⁷

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

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.

¹ This specification is under the jurisdiction of ASTM Committee B-5B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.04 on Pipe and Tube.

Current edition approved April 10, 1996-2002. Published June 1996-2002. Originally published as B 42 – 22 T. Last previous edition B 42 – 938.

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

³ 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.

⁴ Annual Book of ASTM Standards, Vol 02.01.

⁵ Annual Book of ASTM Standards, Vol 03.01.

⁶ Annual Book of ASTM Standards, Vol 14.02.

⁷ Annual Book of ASTM Standards, Vol 03.05.

⁸ Annual Book of ASTM Standards, Vol 03.03.

⁹ Annual Book of ASTM Standards, Vol 01.01.

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

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
- 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

TABLE 1 Chemical Requirements

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

^A Oxygen in C10200 shall be 10 ppm max.

^B Copper + silver + phosphorus.

TABLE 2 Tensile Requirements

Standard	Temper Designation Former	Pipe Size Nominal or Standard, in.	Tensile Strength, min,	Yield Strength, ^c min,
			ksi ^A (MPa) ^B	ksi ^A (MPa) ^B
O61	annealed	all	30 (294)	9 (88) ^D
H80	hard drawn	1/8 – 2, incl	45 (310)	40 (280)
H80	hard drawn	over 2	38 (260)	32 (220)
H55	light drawn	2–12, incl	36 (250)	30 (210)

^A ksi = 1000 psi.
^B See Appendix X1.
^C At 0.5 % extension under load.
^D Light-straightening operation is permitted.

when expanded in accordance with Test Method 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 ~~prior to~~ 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. **b42-02e1**

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.

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

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

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 $\pm \frac{1}{2}$ in. (13 mm).

10.4 *Roundness*:

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

<i>t/d</i> (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 $\frac{5}{8}$ (15.9), incl	0.010 in. (0.25 mm)
Over $\frac{5}{8}$ (15.9)	0.016 in./in. (0.016 mm/mm) of diameter

TABLE 3 Standard Dimensions, Weights, and Tolerances

NOTE 1—All tolerances plus and minus except as otherwise indicated.

Nominal or Standard Pipe Size, in.	Outside Diameter, in. (mm)	Average Outside Diameter Tolerance, ^A in. (mm) All Minus	Wall Thickness, in. (mm)	Tolerance, ^B in. (mm)	Theoretical Weight, lb/ft (kg/m)
Regular					
$\frac{1}{8}$	0.405 (10.3)	0.004 (0.10)	0.062 (1.57)	0.004 (0.10)	0.259 (0.385)
$\frac{1}{4}$	0.540 (13.7)	0.004 (0.10)	0.082 (2.08)	0.005 (0.13)	0.457 (0.680)
$\frac{3}{8}$	0.675 (17.1)	0.005 (0.13)	0.090 (2.29)	0.005 (0.13)	0.641 (0.954)
$\frac{1}{2}$	0.840 (21.3)	0.005 (0.13)	0.107 (2.72)	0.006 (0.15)	0.955 (1.42)
$\frac{3}{4}$	1.050 (26.7)	0.006 (0.15)	0.114 (2.90)	0.006 (0.15)	1.30 (1.93)
1	1.315 (33.4)	0.006 (0.15)	0.126 (3.20)	0.007 (0.18)	1.82 (2.71)
$1\frac{1}{4}$	1.660 (42.2)	0.006 (0.15)	0.146 (3.71)	0.008 (0.20)	2.69 (4.00)
$1\frac{1}{2}$	1.900 (48.3)	0.006 (0.15)	0.150 (3.81)	0.008 (0.20)	3.20 (4.76)
2	2.375 (60.3)	0.008 (0.20)	0.156 (3.96)	0.009 (0.23)	4.22 (6.28)
$2\frac{1}{2}$	2.875 (73.0)	0.008 (0.20)	0.187 (4.75)	0.010 (0.25)	6.12 (9.11)
3	3.500 (88.9)	0.010 (0.25)	0.219 (5.56)	0.012 (0.30)	8.76 (13.0)
$3\frac{1}{2}$	4.000 (102)	0.010 (0.25)	0.250 (6.35)	0.013 (0.33)	11.4 (17.0)
4	4.500 (114)	0.012 (0.30)	0.250 (6.35)	0.014 (0.36)	12.9 (19.2)
5	5.562 (141)	0.014 (0.36)	0.250 (6.35)	0.014 (0.36)	16.2 (24.1)
6	6.625 (168)	0.016 (0.41)	0.250 (6.35)	0.014 (0.36)	19.4 (28.9)
8	8.625 (219)	0.020 (0.51)	0.312 (7.92)	0.022 (0.56)	31.6 (47.0)
10	10.750 (273)	0.022 (0.56)	0.365 (9.27)	0.030 (0.76)	46.2 (68.7)
12	12.750 (324)	0.024 (0.61)	0.375 (9.52)	0.030 (0.76)	56.5 (84.1)
Extra Strong					
$\frac{1}{8}$	0.405 (10.3)	0.004 (0.10)	0.100 (2.54)	0.006 (0.15)	0.371 (0.552)
$\frac{1}{4}$	0.540 (13.7)	0.004 (0.10)	0.123 (3.12)	0.007 (0.18)	0.625 (0.930)
$\frac{3}{8}$	0.675 (17.1)	0.005 (0.13)	0.127 (3.23)	0.007 (0.18)	0.847 (1.26)
$\frac{1}{2}$	0.840 (21.3)	0.005 (0.13)	0.149 (3.78)	0.008 (0.20)	1.25 (1.86)
$\frac{3}{4}$	1.050 (26.7)	0.006 (0.15)	0.157 (3.99)	0.009 (0.23)	1.71 (2.54)
1	1.315 (33.4)	0.006 (0.15)	0.182 (4.62)	0.010 (0.25)	2.51 (3.73)
$1\frac{1}{4}$	1.660 (42.2)	0.006 (0.15)	0.194 (4.93)	0.010 (0.25)	3.46 (5.15)
$1\frac{1}{2}$	1.900 (48.3)	0.006 (0.15)	0.203 (5.16)	0.011 (0.28)	4.19 (6.23)
2	2.375 (60.3)	0.008 (0.20)	0.221 (5.61)	0.012 (0.30)	5.80 (8.63)
$2\frac{1}{2}$	2.875 (73.0)	0.008 (0.20)	0.280 (7.11)	0.015 (0.38)	8.85 (13.2)
3	3.500 (88.9)	0.010 (0.25)	0.304 (7.72)	0.016 (0.41)	11.8 (17.6)
$3\frac{1}{2}$	4.000 (102)	0.010 (0.25)	0.321 (8.15)	0.017 (0.43)	14.4 (21.4)
4	4.500 (114)	0.012 (0.30)	0.341 (8.66)	0.018 (0.46)	17.3 (25.7)
5	5.562 (141)	0.014 (0.36)	0.375 (9.52)	0.019 (0.48)	23.7 (35.3)
6	6.625 (168)	0.016 (0.41)	0.437 (11.1)	0.027 (0.69)	32.9 (49.0)
8	8.625 (219)	0.020 (0.51)	0.500 (12.7)	0.035 (0.89)	49.5 (73.7)
10	10.750 (273)	0.022 (0.56)	0.500 (12.7)	0.040 (1.0)	62.4 (92.9)

^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 pipe.

^B Maximum deviation at any one point.