



Designation: B42 – 20

Standard Specification for Seamless Copper Pipe, Standard Sizes¹

This standard is issued under the fixed designation B42; 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.

1. Scope*

1.1 This specification² establishes the requirements for 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 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.3 The following safety hazard caveat pertains only to the test methods described in this specification.

1.3.1 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:⁴

- B153** Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing
- B170** Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes

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.

Current edition approved April 1, 2020. Published April 2020. Originally approved in 1922. Last previous edition approved in 2015 as B42–15a. DOI: 10.1520/B0042–20.

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 E527) 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 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.

- B577** Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper
- B601** Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast
- B846** Terminology for Copper and Copper Alloys
- B968/B968M** Test Method for Flattening of Copper and Copper-Alloy Pipe and Tube
- E8/E8M** Test Methods for Tension Testing 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
- E62** Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁵
- 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
- E478** Test Methods for Chemical Analysis of Copper Alloys
- E527** Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 ASME Code:⁶

- ASME Boiler and Pressure Vessel Code—B42-20

3. Terminology

3.1 Definitions:

- 3.1.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

4. Ordering Information

4.1 Include the following specified choices when placing orders for product under this specification as applicable:

- 4.1.1 ASTM designation and year of issue;
- 4.1.2 Copper UNS No. designation, if required, (see Chemical Composition section);
- 4.1.3 Temper (see Temper section and Table 2);

⁵ The last approved version of this historical standard is referenced on www.astm.org.

⁶ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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

4.1.4 Pipe size, regular or extra-strong (see Dimensions section and Table 3);

4.1.5 Length (see 10.3) if different than standard; and

4.1.6 Quantity—total weight, or total length or number of pieces of each size.

4.2 The following options are available, but may not be included unless specified at the time of placing of the order when required:

4.2.1 If product is ordered for ASME Boiler and Pressure Vessel Code Application (See Certification Section);

4.2.2 If product is required for bending (see 6.2) and the temper to be furnished;

4.2.3 Certification, if required (see Certification section);

4.2.4 Test report, if required (see Test Report section);

4.2.5 Hydrostatic test, if required (see Nondestructive Testing section);

4.2.5.1 If hydrostatic test pressure above 1000 psi is required;

4.2.6 Pneumatic test, if required (see Nondestructive Testing section);

4.2.7 If product is purchased for agencies of the U.S. Government (see the Other Requirements section of this specification); and

4.2.8 If specification number is required to be shown on each shipping unit (see Packaging and Package Marking section).

5. Chemical Composition

5.1 The material shall conform to the following chemical requirements:

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

5.1.1 Results of analysis on a product (check) sample shall conform to the composition requirements within the permitted analytical variance specified in Table 1.

5.2 The pipe shall be produced from one of the following coppers, and unless otherwise specified, any one 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

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.

5.3 When the copper UNS No. designation is specified, the material shall conform to the chemical requirements specified in Table 1.

5.4 These composition limits do not preclude the presence of other elements. By agreement between manufacturer or supplier and purchaser, limits may be established and analysis required for unnamed elements.

6. Temper

6.1 The standard tempers as prescribed in Classification B601, for products described in this specification are:

- 6.1.1 Annealed O61,
- 6.1.2 Light Drawn H55, and
- 6.1.3 Hard Drawn H80.

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. Mechanical Property Requirements

7.1 Tensile Strength Requirements:

7.1.1 Product furnished under this specification shall conform to the tensile requirements prescribed in Table 2, when tested in accordance with Test Methods E8/E8M.

8. Performance Requirements

8.1 Expansion Test:

8.1.1 Pipe ordered in the annealed (O61) temper, selected for test, shall withstand an expansion of 25 % of the outside diameter when expanded in accordance with Test Method B153. The expanded pipe shall show no cracking or rupture visible to the unaided eye. Pipe ordered in the drawn tempers H55 or H80 are 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.

8.2 Flattening Test:

8.2.1 As an alternative to the expansion test for pipe over 4 in. (102 mm) in diameter in the annealed temper, a flattening test in accordance with Test Method B968/B968M shall be performed.

8.3 Microscopical Examination:

8.3.1 The pipe shall be made from copper that is free of cuprous oxide as determined by microscopical examination in accordance with Method A of Test Methods B577 at a 75x magnification.

TABLE 2 Tensile Requirements

Temper Designation Code	Pipe Size Nominal or Standard, in.	Tensile Strength, min, ksi ^A (MPa) ^B	Yield Strength, min, ksi ^A (MPa) ^B
O61 annealed	all	30 (205)	9 (60) ^D
H80 hard drawn	1/8 –2, incl	45 (310)	40 (275)
H80 hard drawn	over 2	38 (260)	32 (220)
H55 light drawn	2–12, incl	36 (250)	30 (205)

^A ksi = 1000 psi.

^B See Appendix X1.

^C At 0.5 % extension under load.

^D Light-straightening operation is permitted.

8.3.2 When Copper UNS No. C12200 is supplied, microscopical examination for cuprous oxide is not required.

9. Other Requirements

9.1 Nondestructive Testing:

9.1.1 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 E243, 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 re-examined 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.

9.5 *Purchases for U.S. Government*—If the product is purchased for agencies of the U.S. Government, when specified in the contract or purchase order, the product furnished shall conform to the conditions specified in the Supplementary Requirements of this specification.

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 ±1/2 in. (13 mm).

10.4 Roundness:

10.4.1 For pipe of H (drawn) tempers 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 portion of the total length. For H temper pipe of other sizes, and for the O61 (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 product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable. 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: