



Designation: B43 – 09

Standard Specification for Seamless Red Brass Pipe, Standard Sizes¹

This standard is issued under the fixed designation B43; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope*

1.1 This specification² establishes requirements for seamless red brass (Copper Alloy UNS No. C23000)³ pipe in nominal pipe sizes, both regular and extra-strong. In the annealed temper (O61), the pipe is suitable for use in plumbing, boiler feed lines, and for similar purposes. In the drawn general purpose temper (H58), the pipe is suitable for architectural applications, such as guard railings and stair hand railings.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following hazard caveat pertains only to the test method portion, Section 9.1.1, 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.*

1.4 **Warning**—Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney, and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury-containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website (<http://www.epa.gov/mercury/faq.htm>) for additional information. Users should be aware that selling mercury or mercury-containing products, or both, in your state may be prohibited by state law. (See 9.2.)

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 For ASME Boiler and Pressure Vessel Code applications see related Specification SB-43 in Section II of that Code.

³ The 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.

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:⁴

B153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing

B154 Test Method for Mercurous Nitrate Test for Copper Alloys

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B846 Terminology for Copper and Copper Alloys

B858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys

E8 Test Methods for Tension Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E112 Test Methods for Determining Average Grain Size

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)

3. Terminology

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

4. Ordering Information

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

4.1.1 ASTM designation and year of issue,

4.1.2 Temper (see Temper section.),

4.1.3 Pipe size, regular or extra-strong (see Table 2),

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.

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

- 4.1.4 Length (see 11.3),
- 4.1.5 Total length of each size, and
- 4.1.6 If product is purchased for agencies of the U.S. Government (see the Supplementary Requirements section of this specification) for additional requirements, if specified.

4.2 The following options are available and should be specified at the time of placing the order when required:

- 4.2.1 When product is ordered for *ASME Boiler and Pressure Vessel Code Application* (see 8.1),
- 4.2.2 Certification, if required (see 20),
- 4.2.3 Mill test report, if required (see 21),
- 4.2.4 Hydrostatic test, if required (see 10.3),
- 4.2.5 Pneumatic test, if required (see 10.4), and
- 4.2.6 Residual stress test, if required (Performance Requirements section),
 - 4.2.6.1 Ammonia Vapor Test or Mercurous Nitrate Test,
 - 4.2.6.2 For Ammonia Vapor Test, pH value other than 10.

5. Chemical Composition

5.1 The material shall conform to the chemical composition requirements:

| | |
|--------------|--------------|
| Copper, % | 84.0 to 86.0 |
| Lead, max, % | 0.05 |
| Iron, max, % | 0.05 |
| Zinc | remainder |

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

5.2.1 For copper alloys in which zinc is listed as “remainder”, either copper or zinc may be taken as the difference between the sum of results of all other elements determined and 100 %.

5.2.1.1 When all the elements in the table in 5.1 are determined, the sum of the results shall be 99.8 % minimum.

6. Temper

6.1 All pipe shall normally be furnished in the O61 (annealed) (see Classification B601) temper.

6.2 The pipe is permitted to be furnished in the H58 (drawn general purpose) temper, if agreed upon between the manufacturer and the purchaser. (See Table 1.)

7. Grain Size for Annealed Temper

7.1 In the O61 (annealed) temper, the degree of annealing shall be sufficient to produce complete recrystallization with an average grain size not in excess of 0.050 mm.

7.2 The surface of the test specimen for grain size determination shall approximate a radial longitudinal section and shall be prepared and examined in accordance with Test Methods E112.

8. Mechanical Properties

8.1 Product in the O61 (annealed) temper specified to meet the requirements of the *ASME Boiler and Pressure Vessel Code* only shall have tensile properties as prescribed in Table 1.

8.2 All H58 (drawn general purpose) product shall have the tensile properties as prescribed in Table 1.

9. Performance Requirements

9.1 Expansion Test—

9.1.1 Specimens in the O61 (annealed) temper 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 (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.

9.1.2 As an alternative to the expansion test for pipe over 4 in. (102 mm) in diameter in the O61 (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 (see 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.

9.2 Residual Stress Test:

9.2.1 When specified in the contract or purchase order, product of the O61 (annealed) shall be tested for residual stress according to the requirements of Test Method B154 or Test Method B858, and show no signs of cracking.

Warning—Mercury is a definite health hazard. With the Mercurous Nitrate Test, equipment for the detection and removal of mercury vapor produced in volatilization, and the use of protective gloves is recommended.

9.2.2 When the Ammonia Vapor Test is used, the test pH value appropriate for the intended application shall be 10 unless otherwise specified by the purchaser.

9.2.3 Residual stress test specimens shall be of the full size of the product, and tested without bending, springing, polishing or any other preparation, except as allowed by the test method.

NOTE 2—A residual stress test provides information about the adequacy of the stress relief of the material. Bar straightening is a method of mechanical stress relief. Stress relief annealing is a method of thermal stress relief.

10. Other Requirements

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

TABLE 1 Tensile Requirements

| Temper Designation Code Name | Tensile Strength, min. ksi (MPa) | Yield Strength ^A min. ksi (MPa) | Elongation in 2-in. min. % |
|---------------------------------|-------------------------------------|---|-------------------------------|
| O61 Annealed | 40.0 (276) | 12.0 (83) | 35 |
| H58 Drawn general purpose | 44.0 (303) | 18.0 (124) | ... |

^A At 0.5 % extension under load.

10.2 *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.

10.2.1 Notch-depth standards rounded to the nearest 0.001 in. (0.025 mm) shall be 10 % of the nominal wall thickness. The notch depth tolerances 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.

10.2.2 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.

10.3 *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.

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

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).

10.3.1 For material less than 1/2 in. (12.7 mm) in outside diameter and less than 0.060 in. (1.5 mm) in wall thickness, the test is permitted to be made at the option of the manufacturer by pneumatically testing to the requirements of 10.4.

10.4 *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.

11. Dimensions and Permissible Variations

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

11.2 *Standard Dimensions, Wall Thickness, and Diameter Tolerances*—The standard dimensions, wall thickness, and diameter tolerances shall be in accordance with Table 2.

11.3 *Length and Length Tolerances* —The standard length of red brass pipe is 12 ft (3.66 m) with a tolerance of ±1/2 in. (13 mm).

11.4 *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 |

11.5 *Roundness*—The roundness tolerance for straight length tubes with a wall thickness to outside diameter ratio of 0.01 to 0.05 (inclusive) shall be 6 % of the nominal outside diameter. For tubes with a wall thickness to outside diameter ratio over 0.05, the roundness tolerance shall be 3 % of the nominal outside diameter.

11.5.1 The measurement for roundness shall be made from the outside diameter. The deviation from roundness is measured as the difference between the major and minor diameters as determined at any one cross section of the tube. The major and minor diameters are the diameters of two concentric circles just enclosing the outside surface of the tube at the cross section.

11.6 *Straightness Tolerance*—For pipe of H58 (drawn general purpose) temper 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 H58 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.

12. Workmanship, Finish, and Appearance

12.1 The product shall be free of defects, but blemishes of a nature that do not interfere with normal commercial applications are acceptable. It shall be well cleaned and free of dirt.

13. Sampling

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

13.1.1 *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 |

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