



Designation: **B43—15 B43 – 20**

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

1.4 **Warning**—Mercury has been designated by many regulatory agencies as a hazardous material substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. ~~Caution should be taken~~ Use caution when handling mercury and mercury-containing mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. ~~Users should be aware~~ The potential exists that selling mercury and/or mercury-containing products into your state or country may be prohibited by law or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location. (See 9.2.)

1.5 *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](#)

[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](#)

[B900 Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies](#)

[B950 Guide for Editorial Procedures and Form of Product Specifications 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](#)

[E112 Test Methods for Determining Average Grain Size](#)

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 Oct. 1, 2015 April 1, 2020. Published October 2015 April 2020. Originally approved in 1922. Last previous edition approved in 2014 2015 as B43-14-15. DOI: 10.1520/B0043-15.10.1520/B0043-20.

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.

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

- [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:⁵

[ASME Boiler and Pressure Vessel Code](#)

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 specified choices when placing orders for product under this specification as applicable:

- 4.1.1 ASTM designation and year of ~~issue~~; issue;
- 4.1.2 Temper (see Temper ~~section~~; section);
- 4.1.3 Pipe size, regular or extra-strong (see [Table 1](#));
- 4.1.4 Length (see [11.3](#));
- 4.1.5 ~~Total Quantity—total weight or total length~~ of each ~~size~~; size; and
- 4.1.6 Intended application.

4.2 The following options are available but may not be included unless 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 [Section 20](#));
- 4.2.3 Test report, if required (see [Section 21](#));
- 4.2.4 Hydrostatic test, if required (see [10.3](#));
- 4.2.5 Pneumatic test, if required (see [10.4](#));
- 4.2.6 Residual stress test, if required ([Performance Requirements section](#));
- 4.2.6.1 Ammonia Vapor Test or Mercurous Nitrate ~~Test~~; Test;
- 4.2.6.2 For Ammonia Vapor Test, pH value other than ~~4.0~~; 10;
- 4.2.7 Inclusion of the specification number on the packaging unit (see [19.2](#)); and
- 4.2.8 If product is purchased for agencies of the U.S. Government (see the Supplementary Requirements section of this specification) for additional requirements, if specified.

5. Chemical Composition

5.1 The material shall conform to the following chemical composition requirements:

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

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

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 2](#).)

7. Grain Size for Annealed Temper

7.1 Grain size shall be the standard requirement for all product in the annealed temper.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

TABLE 1 Standard Dimensions, Weights, and Tolerances

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

Nominal or Standard Pipe Size, in.	Outside Diameter, in. (mm)	Average Outside Diameter Tolerances, ^A in. (mm) All Minus	Wall Thickness, in. (mm)	Tolerance, ^B in. (mm)	Theoretical Weight, lb/ft (kg/m)
Regular					
1/8	0.405 (10.3)	0.004 (0.10)	0.062 (1.57)	0.004 (0.10)	0.253 (0.376)
1/4	0.540 (13.7)	0.004 (0.10)	0.082 (2.08)	0.005 (0.13)	0.447 (0.665)
3/8	0.675 (17.1)	0.005 (0.13)	0.090 (2.29)	0.005 (0.13)	0.627 (0.933)
1/2	0.840 (21.3)	0.005 (0.13)	0.107 (2.72)	0.006 (0.15)	0.934 (1.39)
3/4	1.050 (26.7)	0.006 (0.15)	0.114 (2.90)	0.006 (0.15)	1.27 (1.89)
1	1.315 (33.4)	0.006 (0.15)	0.126 (3.20)	0.007 (0.18)	1.78 (2.65)
1 1/4	1.660 (42.2)	0.006 (0.15)	0.146 (3.71)	0.008 (0.20)	2.63 (3.91)
1 1/2	1.900 (48.3)	0.006 (0.15)	0.150 (3.81)	0.008 (0.20)	3.13 (4.66)
2	2.375 (60.3)	0.008 (0.20)	0.156 (3.96)	0.009 (0.23)	4.12 (6.13)
2 1/2	2.875 (73.0)	0.008 (0.20)	0.187 (4.75)	0.010 (0.25)	5.99 (8.91)
3	3.500 (88.9)	0.010 (0.25)	0.219 (5.56)	0.012 (0.30)	8.56 (12.7)
3 1/2	4.000 (102)	0.010 (0.25)	0.250 (6.35)	0.013 (0.33)	11.2 (16.7)
4	4.500 (114)	0.012 (0.30)	0.250 (6.35)	0.014 (0.36)	12.7 (18.9)
5	5.562 (141)	0.014 (0.36)	0.250 (6.35)	0.014 (0.36)	15.8 (23.5)
6	6.625 (168)	0.016 (0.41)	0.250 (6.35)	0.014 (0.36)	19.0 (28.3)
8	8.625 (219)	0.020 (0.51)	0.312 (7.92)	0.022 (0.56)	30.9 (46.0)
10	10.750 (273)	0.022 (0.56)	0.365 (9.27)	0.030 (0.76)	45.2 (67.3)
12	12.750 (324)	0.024 (0.61)	0.375 (9.52)	0.030 (0.76)	55.3 (82.3)
Extra Strong					
1/8	0.405 (10.3)	0.004 (0.10)	0.100 (2.54)	0.006 (0.15)	0.363 (0.540)
1/4	0.540 (13.7)	0.004 (0.10)	0.123 (3.12)	0.007 (0.18)	0.611 (0.909)
3/8	0.675 (17.1)	0.005 (0.13)	0.127 (3.23)	0.007 (0.18)	0.829 (1.23)
1/2	0.840 (21.3)	0.005 (0.13)	0.149 (3.78)	0.008 (0.20)	1.23 (1.83)
3/4	1.050 (26.7)	0.006 (0.15)	0.157 (3.99)	0.009 (0.23)	1.67 (2.48)
1	1.315 (33.4)	0.006 (0.15)	0.182 (4.62)	0.010 (0.25)	2.46 (3.66)
1 1/4	1.660 (42.2)	0.006 (0.15)	0.194 (4.93)	0.010 (0.25)	3.39 (5.04)
1 1/2	1.900 (48.3)	0.006 (0.15)	0.203 (5.16)	0.011 (0.28)	4.10 (6.10)
2	2.375 (60.3)	0.008 (0.20)	0.221 (5.61)	0.012 (0.30)	5.67 (8.44)
2 1/2	2.875 (73.0)	0.008 (0.20)	0.280 (7.11)	0.015 (0.38)	8.66 (12.9)
3	3.500 (88.9)	0.010 (0.25)	0.304 (7.72)	0.016 (0.41)	11.6 (17.3)
3 1/2	4.000 (102)	0.010 (0.25)	0.321 (8.15)	0.017 (0.43)	14.1 (21.0)
4	4.500 (114)	0.012 (0.30)	0.341 (8.66)	0.018 (0.46)	16.9 (25.1)
5	5.562 (141)	0.014 (0.36)	0.375 (9.52)	0.019 (0.48)	23.2 (34.5)
6	6.625 (168)	0.016 (0.41)	0.437 (11.1)	0.027 (0.69)	32.2 (47.9)
8	8.625 (219)	0.020 (0.51)	0.500 (12.7)	0.035 (0.89)	48.4 (72.0)
10	10.750 (273)	0.022 (0.56)	0.500 (12.7)	0.040 (1.0)	61.1 (90.9)

^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.

TABLE 2 Tensile Requirements

Temper Designation		Tensile Strength, min. ksi (MPa)	Yield Strength ^A min. ksi (MPa)	Elongation in 2-in. min. %
Code	Name			
O61	Annealed	40.0 (275)	12.0 (85)	35
H58	Drawn general purpose	44.0 (300)	18.0 (125)	...

^A At 0.5 % extension under load.

7.2 Acceptance or rejection based upon grain size shall depend only on the average grain size of a test specimen taken from each of two sample portions, and each specimen shall be within the limits prescribed in 7.3 when determined in accordance with Test Methods E112.

7.3 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 Property Requirements

8.1 Product in the O61 (annealed) temper when specified to meet the requirements of the furnished under this specification shall conform to the tensile, yield, ASME Boiler and Pressure Vessel Code and elongation requirements (where only, shall have required) prescribed in [Table 2](#) tensile properties as prescribed in, when tested in accordance [Table 2](#) with Test Methods [E8/E8M](#).

8.2 All H58 (drawn general purpose) product shall have the tensile properties as prescribed in [Table 2](#).

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.–4 in. (102 mm) in diameter in the O61 (annealed) condition, a flattening test in accordance with Test Method [B968/B968M](#) shall be performed.

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. Tube 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.

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);

\bar{P} = hydrostatic pressure, psi (or MPa);

t = wall thickness of the material, in. (or mm);

\bar{t} = wall thickness of the material, in. (or mm);

- \bar{D} = ~~outside diameter of the material in. (or mm), and~~
- 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 1.

11.3 *Length and Length Tolerances*—The standard length of red brass pipe is 12 ft (3.66 m) with a tolerance of $\pm 1/2$ 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)~~ 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:

Number of Pieces in Lot	Number of Sample Pieces to be Taken ^A
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 10 sample pieces

^A Each sample piece shall be taken from a separate tube.

13.1.3 *Sampling for Visual and Dimensional Examination*—Minimum sampling for visual and dimensional examination shall be as follows:

Lot size (Pieces/lot)	Sample size
2 to 8	Entire lot
9 to 90	8
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1200	27
1201 to 3200	35
3201 to 100 000	38
10 001 to 350 000	46

In all cases, the acceptance number is zero and the rejection number is one. Rejected lots are permitted to be screened and resubmitted for visual and dimensional examination. All defective items shall be replaced with acceptable items prior to lot acceptance.

14. Number of Tests and Retests

14.1 *Chemical Analysis*—Samples for chemical analysis shall be taken in accordance with Practice E255. Drillings, millings, etc., shall be taken in approximately equal weight from each of the sample pieces selected in accordance with 13.1.2 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.

14.1.1 Instead of sampling in accordance with Practice E255, 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 semi-finished product. If the manufacturer determines the chemical composition of the material during the course of manufacture, he shall not be required to sample and analyze the finished product. The number of samples taken for determination of chemical composition shall be as follows:

14.1.1.1 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.

14.1.1.2 When samples are taken from the semi-finished product, a sample shall be taken to represent each 10 000 lb (4550 kg) or fraction thereof, except that not more than one sample shall be required per piece.

14.1.1.3 Due to the discontinuous nature of the processing of castings into wrought products, it is not practical to identify specific casting analysis with a specific quantity of finished material.

14.1.1.4 In the event that heat identification or traceability is required, the purchaser shall specify the details desired.

14.2 Retests:

14.2.1 ~~If any test specimen shows defective machining or develops flaws, it shall be discarded and another specimen substituted. When requested by the manufacturer or supplier, a retest shall be permitted when results of tests obtained by the purchaser fail to conform to the requirements of the product specification.~~

14.2.2 The retest shall be as directed in the product specification for the initial test, except the number of test specimens shall be twice that normally required for the specified test.

14.2.3 ~~If the results of the test on one of the specimens fail to meet the specified requirements, two additional specimens shall be taken from different sample pieces and tested. The results of the tests on both of these specimens shall meet the specified requirements. Failure of more than one specimen to meet the specified requirements for a particular property. All test specimens shall conform to the product specification requirement(s) in retest. Failure to conform shall be cause for rejection of the entire lot.~~ rejection.

14.2.4 If the chemical analysis fails to conform to the specified limits, analysis shall be made on a new composite sample prepared from additional pieces selected in accordance with 13.1. The results of this retest shall comply with the specified requirements.

15. Test Methods

15.1 Chemical Analysis:

15.1.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser.

15.1.2 The test methods listed below and others not listed may be used, subject to agreement to determine the composition:

Element	Method
Copper	E478
Lead	E478
Iron	E478
Zinc	E478

15.1.3 Test methods to be followed for the determination of elements resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and purchaser.

15.2 Residual Stress Tests: