



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

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 U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> establishes requirements for seamless red brass (Copper Alloy UNS No. C23000)<sup>3</sup> 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 many regulatory agencies as a hazardous material 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 when handling mercury and mercury containing products. See the applicable product Safety Data Sheet (SDS) for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law. (See 9.2.)

<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.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SB-43 in Section II of that Code.

<sup>3</sup> 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 ASTM Standards:<sup>4</sup>

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

<sup>4</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

- 4.1.1 ASTM designation and year of issue,
- 4.1.2 Temper (see Temper section.),
- 4.1.3 Pipe size, regular or extra-strong (see [Table 1](#)),
- 4.1.4 Length (see [11.3](#)),
- 4.1.5 Total length of each 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 [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](#)),
- 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.
- 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 chemical composition requirements:

**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, <sup>A</sup> in. (mm)<br>All Minus | Wall Thickness, in. (mm) | Tolerance, <sup>B</sup> 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)                      |

<sup>A</sup> 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.

<sup>B</sup> Maximum deviation at any one point.

|              |              |
|--------------|--------------|
| 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 2.)

## 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 Property Requirements

8.1 Product in the O61 (annealed) temper when specified to meet the requirements of the *ASME Boiler and Pressure Vessel Code* only, shall have tensile properties as prescribed in Table 2.

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. (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  $\pm 0.0005$  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.

**TABLE 2 Tensile Requirements**

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

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

**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 ½ 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 ± ½ 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,<br>in. (mm) | Tolerance                                  |
|-------------------------------|--------------------------------------------|
| Up to ⅝ (15.9), incl          | 0.010 in. (0.25 mm)                        |
| Over ⅝ (15.9)                 | 0.016 in./in. (0.016 mm/mm)<br>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 ¼ to 12 in. inclusive, the maximum curvature (depth of arc) shall not exceed ½ 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 1½, incl     | 5 000 (2270) or fraction thereof    |
| Over 1½ 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<br>in Lot | Number of Sample Pieces<br>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<br>in the lot, but not to exceed<br>10 sample pieces |

<sup>A</sup> 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.

14.2.2 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 shall be cause for rejection of the entire lot.

14.2.3 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   |

#### 15.2 Residual Stress Tests:

15.2.1 Unless otherwise agreed upon between the manufacturer, or supplier, and the purchaser, the manufacturer

shall have the option of using either the mercurous nitrate test or the ammonia vapor test.

15.2.2 *Mercurous Nitrate Test*—The material shall be subjected to test in accordance with Test Method B154.

15.2.3 *Ammonia Vapor Test*—The material shall be subjected to test in accordance with Test Method B858. If the pH value is not specified in the product specification, it shall be established in accordance with agreement between the supplier and purchaser.

#### 15.3 Other Tests:

15.3.1 The product furnished shall conform to specified requirements when subjected to test in accordance with the following table:

| Test                 | ASTM Designation<br>(Section 2) |
|----------------------|---------------------------------|
| Grain Size           | E112                            |
| Tension              | E8/E8M                          |
| Expansion (pin test) | B153                            |

15.4 *Tensile Test*—Tension test specimens shall be of the full section of the pipe and shall conform to the requirements of the section, Specimens for Pipe and Tube, of Test Methods E8/E8M, unless the limitations of the testing machine preclude the use of such a specimen. Test specimens conforming to Type No. 1 of Fig. 13, Tension Test Specimens for Large-Diameter Tubular Products, of Test Methods E8/E8M is permitted to be used when a full section specimen cannot be tested.

15.4.1 Whenever tension test results are obtained from both full size and from machined test specimens and they differ, the results obtained from full size test specimens shall be used to determine conformance to the specification requirements.

15.4.2 Tension test results on material covered by this specification are not seriously affected by variations in speed of testing. A considerable range of testing speed is permissible; however, it is recommended that the rate of stressing to the yield strength not exceed 100 ksi (690 MPa)/min. Above the yield strength it is recommended that the movement per minute of the testing machine head under load not exceed 0.5 in./in. (0.5 mm/mm) of gage length (or distance between grips for full-section specimens).

### 16. Significance of Numerical Limits

16.1 For purpose of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Practice E29.

| Property                           | Rounded Unit for<br>Observed or Calculated Value                                  |
|------------------------------------|-----------------------------------------------------------------------------------|
| Chemical composition               | nearest unit in the last<br>right-hand place of figures<br>of the specified limit |
| Tensile Strength<br>Yield Strength | nearest ksi (nearest 5 MPa)                                                       |

### 17. Inspection

17.1 The manufacturer, or supplier, shall inspect and make tests necessary to verify the furnished product conforms to specification requirements.

17.2 Source inspection of the product by the purchaser may be agreed upon between the manufacturer or supplier and the purchaser as part of the purchase order. In such case, the nature of the facilities needed, to satisfy the inspector that the product is being furnished in accordance with the specification, shall be included in the agreement.

## **18. Rejection and Rehearing**

18.1 Product that fails to conform to the specification requirements when tested by the purchaser or purchaser's agent shall be subject to rejection.

18.2 Rejection shall be reported to the manufacturer or supplier promptly. In addition, a written notification of rejection shall follow.

18.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer or supplier shall have the option to make claim for a rehearing.

## **19. Packaging and Package Marking**

19.1 The product shall be separated by size and temper, and prepared for shipment by common carrier, in such a manner to afford protection from the normal hazards of transportation.

19.2 Each shipping unit shall be legibly marked with the purchase order number, metal or alloy designation, temper, size, total length or piece count or both, and name of supplier. The specification number shall be shown, when specified.

## **20. Certification**

20.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been tested and inspected as directed in this specification and requirements have been met.

20.2 When identified in the ordering information that product is purchased for *ASME Boiler and Pressure Vessel Code* applications, certification to this specification is mandatory.

## **21. Mill Test Report**

21.1 When specified in the contract or purchase order, a report of test results shall be furnished.

## **22. Keywords**

22.1 copper alloy UNS No. C23000; red brass pipe

# **SUPPLEMENTARY REQUIREMENTS**

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order, for agencies of the U.S. Government.

## **S1. Referenced Documents**

S1.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

S1.1.1 *Federal Standards*:<sup>5</sup>

Fed. Std. No. 102 Preservation, Packaging and Packing Levels

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

Fed. Std. No. 185 Identification Marking of Copper and Copper-Base Alloy Mill Products

S1.1.2 *Military Standard*:<sup>5</sup>

MIL-STD-129 Marking for Shipment and Storage

S1.1.3 *ASTM Standards*:<sup>4</sup>

**B900** Practice for Packaging of Copper and Copper-Base Alloy Mill Products for U.S. Government Agencies

## **S2. Quality Assurance**

S2.1 *Responsibility for Inspection*:

S2.1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the manufacturer shall use his own or any other suitable facilities for the performance of the inspection and test requirements

unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections or tests set forth when such inspections and tests are deemed necessary to assure that the material conforms to prescribed requirements.

## **S3. Identification Marking**

S3.1 All material shall be properly marked for identification in accordance with Fed. Std. No. 185 except that the ASTM specification number and the alloy number shall be used.

## **S4. Preparation for Delivery**

S4.1 *Preservation, Packaging, Packing*:

S4.1.1 *Military Agencies*—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, Level A or C, and packed, Level A, B, or C, as specified in the contract or purchase order, in accordance with the requirements of MIL-C-3993.

S4.1.2 *Civil Agencies*—The requirements of Fed. Std. No. 102 shall be referenced for definitions of the various levels of packaging protection.

S4.2 *Marking*:

S4.2.1 *Military Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with MIL-STD-129.

S4.2.2 *Civil Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

<sup>5</sup> Available from DLA Document Services, Bldg. 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil/>.

## APPENDIX

### (Nonmandatory Information)

#### X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ( $N = \text{kg}\cdot\text{m}/\text{s}^2$ ). The derived SI unit for pressure or

stress is the newton per square metre ( $\text{N}/\text{m}^2$ ), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since  $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$  the metric equivalents are expressed as megapascal (MPa), which is the same as  $\text{MN}/\text{m}^2$  and  $\text{N}/\text{mm}^2$ .

#### SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the 2009 issue as follows (Approved April 1, 2014):

- (1) Editorial revision in accordance with Guide **B950**.
- (2) The Flattening Test Method **B968/B968M** has been added as an alternate to the Expansion Test.

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