



Designation: B360 – 20

# Standard Specification for Hard-Drawn Copper Capillary Tube for Restrictor Applications<sup>1</sup>

This standard is issued under the fixed designation B360; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification establishes the requirements for hard-drawn, seamless capillary tube made from Copper Alloy UNS Nos. C10800, C12000, or C12200.

1.2 This tube is commonly supplied in straight lengths intended for restrictor applications such as metering lines for liquids and gases where close control over smoothness and diameter of the bore is required to insure uniform flow characteristics between tubes.

1.3 *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.

1.4 *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.*

1.5 *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*:<sup>2</sup>

[B251/B251M Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube](#)

[B577 Test Methods for Detection of Cuprous Oxide \(Hydrogen Embrittlement Susceptibility\) in Copper](#)

<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.

Current edition approved April 1, 2020. Published April 2020. Originally approved in 1960. Last previous edition approved in 2015 as B360–15. DOI: 10.1520/B0360–20.

<sup>2</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.

[B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast](#)

[B846 Terminology for Copper and Copper Alloys](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry](#)

[E62 Test Methods for Chemical Analysis of Copper and Copper Alloys \(Photometric Methods\) \(Withdrawn 2010\)](#)<sup>3</sup>

[E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition](#)

2.2 *ASHRAE Standard*:

[No. 28 Method for Testing Capillary Tubes](#)<sup>4</sup>

## 3. General Requirements

3.1 The following sections of Specification [B251/B251M](#) are a part of this specification:

3.1.1 Terminology;

3.1.2 Workmanship, Finish and Appearance;

3.1.3 Significance of Numerical Limits;

3.1.4 Inspection;

3.1.5 Rejection and Rehearing;

3.1.6 Certification;

3.1.7 Test Reports; and

3.1.8 Package and Package Marking.

3.2 In addition, when a section with a title identical with those referenced in 3.1, above, appears in this specification, it contains additional requirements which supplement those appearing in Specification [B251/B251M](#).

## 4. Terminology

4.1 For the definitions of terms related to copper and copper alloys, refer to Terminology [B846](#).

## 5. Ordering Information

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

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

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

**TABLE 1 Chemical Requirements**

| Element, Percent | C10800             | C12000             | C12200            |
|------------------|--------------------|--------------------|-------------------|
| Copper           | 99.95 <sup>A</sup> | 99.90 <sup>B</sup> | 99.9 <sup>B</sup> |
| Phosphorus       | 0.005–0.012        | 0.004–0.012        | 0.015–0.040       |

<sup>A</sup> Copper + Silver + Phosphorus.

<sup>B</sup> Silver is counted as Copper.

5.1.1 ASTM designation and year of issue;

5.1.2 Copper Alloy UNS No. designation;

5.1.3 Dimensions: inside and outside diameter (**Table 2**);

5.1.4 Air Flow requirements (ft<sup>3</sup>/min or cfm), (see **10.3**), if required;

NOTE 1—Product is specified to air flow requirements for capillary applications.

5.1.5 Quantity—total length, number of pieces or total weight of each size; and

5.1.6 Length per piece of each size.

5.2 The following options are available and should be specified in the contract or purchase order when required:

5.2.1 Heat Identification or traceability details;

5.2.2 Embrittlement test, (see **10.1**);

5.2.3 Certification, (see **3.1.6**); and

5.2.4 Mill test report (see **3.1.7**).

## 6. Material and Manufacture

### 6.1 Material:

6.1.1 The material of manufacture shall be from a cast and extruded tube of Copper Alloy UNS No. C10800 (oxygen free, low phosphorus), C12000 (phosphorus deoxidized, low re-

sidual phosphorus), or C12200 (phosphorus deoxidized, high residual phosphorus) of such purity and soundness as to be suitable for processing in to the product prescribed herein.

6.1.2 When specified in the contract or purchase order that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 2—Due to the discontinuous nature of processing castings into wrought products, it is not always practical to identify a specific casting analysis with a specific quantity of finished material.

### 6.2 Manufacture:

6.2.1 The product shall be manufactured by cold-drawing processes as to produce a uniform wrought structure in the finished product.

6.2.2 The tube shall be finished by degreasing or other cleaning operations to meet the stringent requirements for cleanness of the inner diameter.

6.2.3 The outside and inside of both ends of straight lengths shall be made free of burrs that could restrict flow, by burr-free cutting, brushing, or chamfering.

6.2.4 The maximum allowable residue as determined by the cleanness test described in **16.4** shall not exceed the value given in **Table 2** for the tube size tested.

## 7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in **Table 1** for the Copper UNS Alloy No. designation specified in the ordering information.

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

**TABLE 2 Standard Dimensions and Residue Limits of Interior Surfaces for Capillary Tubes**

| Outside Diameter, in. (mm) | Inside Diameter, in. (mm) | Mean Wall Thickness, in. (mm) | Cross-Sectional Area of Tube Bore, in. <sup>2</sup> (mm <sup>2</sup> ) <sup>A</sup> | Weight, lb/ft (kg/m) | Maximum Allowable Residue, g/linear ft (g/linear m) |
|----------------------------|---------------------------|-------------------------------|---|----------------------|---|
| 0.072 (1.83)               | 0.026 (0.660)             | 0.023 (0.584)                 | 0.0005309 (0.343)   | 0.01373 (0.0204)     | 0.00020 (0.000656)                                  |
| 0.072 (1.83)               | 0.028 (0.711)             | 0.022 (0.558)                 | 0.0006158 (0.397)   | 0.01340 (0.0199)     | 0.00021 (0.000689)                                  |
| 0.081 (2.06)               | 0.031 (0.787)             | 0.025 (0.635)                 | 0.0007548 (0.487)   | 0.01705 (0.0254)     | 0.00023 (0.000754)                                  |
| 0.081 (2.06)               | 0.033 (0.838)             | 0.024 (0.606)                 | 0.0008553 (0.552)   | 0.01666 (0.0248)     | 0.00025 (0.000820)                                  |
| 0.087 (2.21)               | 0.036 (0.914)             | 0.0255 (0.648)                | 0.001018 (0.657)  | 0.01910 (0.0284)     | 0.00027 (0.000886)                                  |
| 0.087 (2.21)               | 0.039 (0.991)             | 0.024 (0.606)                 | 0.001195 (0.771)  | 0.01842 (0.0239)     | 0.00029 (0.000951)                                  |
| 0.093 (2.36)               | 0.042 (1.07)              | 0.0255 (0.648)                | 0.001385 (0.893)  | 0.02096 (0.0312)     | 0.00032 (0.00105)                                   |
| 0.097 (2.47)               | 0.046 (1.17)              | 0.025 (0.648)                 | 0.001662 (1.07)   | 0.02221 (0.0331)     | 0.00035 (0.00115)                                   |
| 0.099 (2.51)               | 0.049 (1.24)              | 0.025 (0.635)                 | 0.001886 (1.22)   | 0.02253 (0.0335)     | 0.00037 (0.00121)                                   |
| 0.106 (2.69)               | 0.054 (1.37)              | 0.026 (0.660)                 | 0.002290 (1.48)   | 0.02533 (0.0377)     | 0.00041 (0.00134)                                   |
| 0.112 (2.84)               | 0.059 (1.50)              | 0.0265 (0.673)                | 0.002734 (1.76)   | 0.02760 (0.0411)     | 0.00044 (0.00144)                                   |
| 0.125 (3.18)               | 0.064 (1.63)              | 0.0305 (0.775)                | 0.003217 (2.07)   | 0.03511 (0.0522)     | 0.00048 (0.00157)                                   |
| 0.125 (3.18)               | 0.070 (1.78)              | 0.0275 (0.698)                | 0.003848 (2.48)   | 0.03266 (0.0486)     | 0.00053 (0.00174)                                   |
| 0.125 (3.18)               | 0.075 (1.91)              | 0.025 (0.635)                 | 0.004418 (2.85)   | 0.03054 (0.0454)     | 0.00057 (0.00187)                                   |
| 0.145 (3.68)               | 0.080 (2.03)              | 0.0325 (0.826)                | 0.005027 (3.24)   | 0.04453 (0.0663)     | 0.00060 (0.00197)                                   |
| 0.145 (3.68)               | 0.085 (2.16)              | 0.030 (0.762)                 | 0.005674 (3.66)   | 0.04202 (0.0625)     | 0.00064 (0.00210)                                   |
| 0.145 (3.68)               | 0.090 (2.29)              | 0.0275 (0.698)                | 0.006362 (4.10)   | 0.03936 (0.0586)     | 0.00068 (0.00223)                                   |
| 0.160 (4.06)               | 0.100 (2.54)              | 0.030 (0.762)                 | 0.007854 (5.07)   | 0.04750 (0.0707)     | 0.00075 (0.00246)                                   |
| 0.160 (4.06)               | 0.110 (2.79)              | 0.025 (0.635)                 | 0.009503 (6.13)   | 0.04111 (0.0611)     | 0.00083 (0.00272)                                   |
| 0.188 (4.78)               | 0.120 (3.03)              | 0.034 (0.864)                 | 0.01131 (7.29)  | 0.06377 (0.0949)     | 0.00090 (0.00295)                                   |
| 0.188 (4.78)               | 0.130 (3.30)              | 0.029 (0.737)                 | 0.01327 (8.56)  | 0.05616 (0.0836)     | 0.00098 (0.00321)                                   |
| 0.200 (5.08)               | 0.145 (3.68)              | 0.0275 (0.698)                | 0.01651 (10.7)  | 0.05779 (0.0860)     | 0.00109 (0.00358)                                   |
| 0.220 (5.59)               | 0.160 (4.06)              | 0.030 (0.762)                 | 0.02011 (13.0)  | 0.06943 (0.103)      | 0.00121 (0.00397)                                   |
| 0.240 (6.10)               | 0.175 (4.45)              | 0.0325 (0.826)                | 0.02405 (15.5)  | 0.08107 (0.121)      | 0.00132 (0.00433)                                   |

<sup>A</sup> Cross-section area of tube bore in.<sup>2</sup> = (π)(ID)<sup>2</sup>/4 where: π = 3.1416 and ID = inside diameter.