



Designation: B360 – 01

# 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 reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 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 The values stated in inch pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.4 The following safety hazard caveat pertains only to the test method described in section 16.4 (Cleanness Test) 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.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

**B251** Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube<sup>3</sup>

**B577** Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper<sup>2</sup>

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

B 846 Terminology for Copper and Copper Alloys<sup>2 4</sup>

**E8** Test Methods for Tension Testing of Metallic Materials<sup>5</sup>

**E53** Test Method for Determination of Copper in Unalloyed Copper by Gravimetry<sup>5</sup>

**E62** Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)<sup>5</sup>

**E255** Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition

2.2 *ASHRAE Standard:*

**No. 28-88** Method for Testing Capillary Tubes<sup>6</sup>

## 3. General Requirements

3.1 The following sections of Specification **B251** 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 Reheating,

3.1.6 Certification,

3.1.7 Test Reports,

3.1.8 Package and Package Marking, and

3.2 In addition, when a section with a title identical with those referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specification **B251**. In case of conflict this specification shall prevail.

## 4. Terminology

4.1 For the definition of terms related to copper and copper alloys refer to Terminology B846.

4.2 *Definitions of Terms Specific to This Standard:*

4.2.1 *capable of, adj*—possessing the required properties or characteristic, or both, necessary to conform to specification requirements when subjected to specified test(s).

## 5. Ordering Information

5.1 The contract or purchase order for product under this specification shall include the following information, as applicable:

5.1.1 ASTM designation and year of issue (for example, B360 – XX),

5.1.2 Copper Alloy UNS No. (for example, C10800, Section 7 and Table 1),

<sup>6</sup> Available from the American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329.

\*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.

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

5.1.4 Air Flow requirements (ft<sup>3</sup>/min), (see **10.3**),

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,

5.1.6 Length per piece of each size, and

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 tube shall be from Copper UNS No. C10800 (oxygen free, low phosphorus), C12000 (phosphorus deoxidized, low residual phosphorus), or C12200 (phosphorus deoxidized, high residual phosphorus) and of such purity and soundness as to be suitable for processing in to the product prescribed herein.

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

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

### 6.2 Manufacture:

6.2.1 The product shall be finished by cold drawing.

6.2.2 The tube shall be finished by degreasing or other cleaning operations to meet the stringent requirements for cleanliness 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 cleanliness 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 product shall conform to the specified Copper UNS No. designation as in **Table 1**.

7.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for un-named elements by agreement between the manufacturer and purchaser.

## 8. Temper

8.1 The tubes shall be furnished in the H80<sup>7</sup> (hard drawn) condition.

## 9. Mechanical Property Requirements

### 9.1 Tensile Strength:

9.1.1 The tubes shall have a tensile strength of 45 ksi (310 MPa) minimum.

## 10. Other Requirements

### 10.1 Embrittlement Requirement:

10.1.1 Samples of product produced from Coppers UNS Nos. C10800 and C12000 shall be capable of passing the embrittlement test of Procedure B of Test Methods **B577**. The actual performance of this test is not mandatory under the terms of this specification unless specified in the ordering information. In case of a dispute, a referee method in accordance with Procedure C shall be employed.

### 10.2 Cleanliness Requirement:

10.2.1 The residue attributable to the tubes shall not exceed 0.0002 g/in.<sup>2</sup> (0.310 g/m<sup>2</sup>) of internal surface of the tube when subjected to test as directed in **16.4** (Refer to **Table 2**)

### 10.3 Air Flow Requirement:

10.3.1 The tubes shall conform to the air flow requirements, in ft<sup>3</sup>/min [cfm] stipulated at the time of order placement, when tested in accordance with the test in **16.5**.

## 11. Dimensions, Mass, and Permissible Variations

### 11.1 Outside Diameter Tolerance:

11.1.1 The average outside diameter tolerance shall be ±0.002 in. (0.051 mm).

### 11.2 Inside Diameter Tolerance:

11.2.1 The average inside diameter tolerance shall be ±0.001 in. (0.025 mm) which shall be determined by the air flow test. 4f-9324-516ec7Ba9e8/astm-b360-01

### 11.3 Straightness:

11.3.1 The straightness tolerance shall be in accordance with **Table 3**.

## 12. Workmanship, Finish and Appearance

12.1 The inside and outside edges of both ends of straight lengths of tube shall be free of burrs (see **6.2.2**).

## 13. Sampling

13.1 The lot size, portion size, and selection of pieces shall be as follows:

13.1.1 *Lot Size*—1000 pieces, or minimum of 100 lb, or fraction thereof.

13.1.2 *Portion Size*—0.2 % of the pieces in the lot, or a minimum of four pieces, whichever is greater.

### 13.2 Chemical Composition:

13.2.1 The sample shall be taken in approximately equal weight from each portion piece selected in **13.1.2** and prepared in accordance with Practice **E255**. The minimum weight of the composite sample shall be 150 g.

<sup>7</sup> Refer to Practice **B601** for definition of temper designations.