Designation: B956 – 19ε1

Standard Specification for Welded Copper and Copper-Alloy Condenser and Heat Exchanger Tubes with Integral Fins[1]

This standard is issued under the fixed designation B956; 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.

ε[1] NOTE—Footnote 1 was editorially corrected in November 2019.

1. Scope*

1.1 This specification establishes the requirements for heat exchanger tubes manufactured from forge-welded copper and copper alloy tubing in straight lengths on which the external or internal surface, or both, has been modified by cold forming process to produce an integral enhanced surface for improved heat transfer.

1.2 The tubes are typically used in surface condensers, evaporators, and heat exchangers.

1.3 The product shall be produced of the following coppers or copper alloys, as specified in the ordering information.

Copper or Copper Alloy UNS No.	Type of Metal
C12000[A]	DLP Phosphorized, low residual phosphorus
C12200[A]	DHP Phosphorized, high residual phosphorus
C19200	Phosphorized, 1 % iron
C19400	Copper-Iron Alloy
C23000	Red Brass
C44300	Admiralty, arsenical
C44400	Admiralty, antimonial
C44500	Admiralty, phosphorized
C68700	Aluminum Brass
C70400	95-5 Copper-Nickel
C70600	90-10 Copper-Nickel
C70620	90-10 Copper-Nickel (Modified for Welding)
C71000	80-20 Copper-Nickel
C71500	70-30 Copper-Nickel
C71520	70-30 Copper-Nickel (Modified for Welding)
C72200	Copper-Nickel

[A] Copper UNS Nos. C12000 and C12200 are classified in Classification B224.

NOTE 1—Designations listed in Classification B224.

1.4 *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.

1.5 The following safety hazard caveat pertains only to the test methods described in 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.*

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

1.7 *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:*[2]

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

B224 Classification of Coppers

B359/B359M Specification for Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes With Integral Fins

B543/B543M Specification for Welded Copper and Copper-Alloy Heat Exchanger Tube

[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, 2019. Published October 2019. Originally approved in 2007. Last previous edition approved in 2010 as B956/B956M–10ε1 which was withdrawn January 2019 and reinstated in October 2019. DOI: 10.1520/B0956–19E01.

[2] 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**

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
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
E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry
E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]
E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]
E112 Test Methods for Determining Average Grain Size
E118 Test Methods for Chemical Analysis of Copper-Chromium Alloys (Withdrawn 2010)[3]
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

2.2 *ASME Code:*[4]

ASME Boiler and Pressure Vessel Code

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *enhanced tube*—tube having a series of metallic ribs on the outside or inside surface, or both, either parallel to the longitudinal axis or circumferentially extended from the tube to increase the effective surface for heat transfer (Figs. 1-3).

3.2.2 *unenhanced tube*—tube made by processing strip into a tubular shape and forge welding the edges to make a longitudinal seam with no enhancements on the O.D. or I.D.

4. Types of Welded Tube

4.1 Reference Specification B543/B543M for the types of forge welded tube products that will be supplied for the enhancing operation (Section 6).

5. Ordering Information

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

5.1.1 ASTM designation and year of issue;

5.1.2 Copper UNS No. designation (for example, Copper UNS No. C12000);

5.1.3 Tube type (Section 4);

5.1.4 Temper (Section 8);

5.1.5 Dimensions, the diameter, wall thickness, whether minimum or nominal wall, and length (Section 14);

5.1.6 Configuration of enhanced surfaces shall be agree upon between the manufacturer and the purchaser (Figs. 1-3); and

5.1.7 Quantity.

5.2 The following options are available but may not be included unless specified at the time of placing of the order when required:

5.2.1 Heat identification or traceability details (6.1.2);

5.2.2 Electromagnetic (eddy current) examination;

5.2.3 Embrittlement test (12.1);

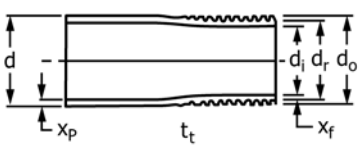
5.2.4 Expansion test (11.1);

5.2.5 Flattening test (11.2);

5.2.6 Reverse bend test (11.3);

5.2.7 Certification (Section 23);

5.2.8 Mill Test Reports;



d - Outside Diameter of Unenhanced Section

d_o - Outside Diameter of the Enhanced Section

d_r - Root Diameter of the Enhanced Section

d_i - Inside Diameter of the Enhanced Section

x_p - Wall Thickness of the Unenhanced Section

x_r - Wall Thickness of the Unenhanced Section

t_t - Transition Taper

NOTE 1—The outside diameter over the enhanced section will not normally exceed the outside diameter of the unenhanced section.

FIG. 1 Outside Diameter Enhanced Tube Nomenclature

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

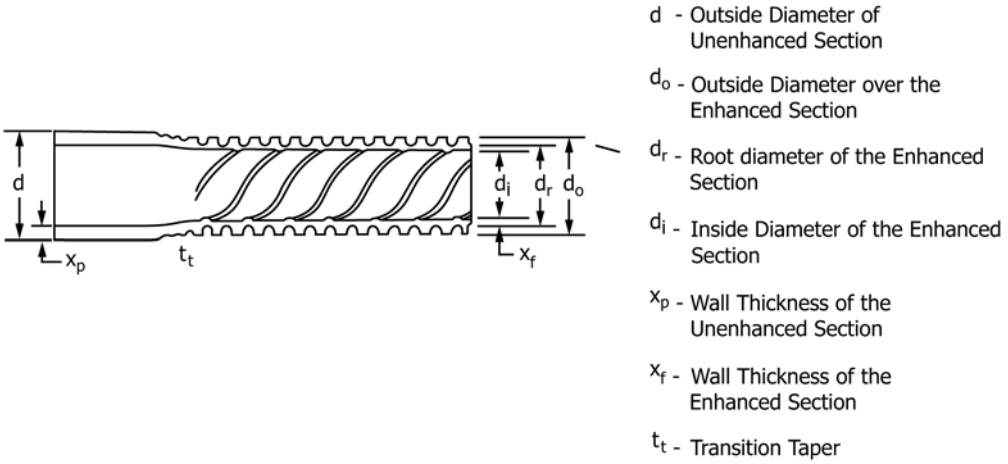


FIG. 2 Outside Diameter and Inside Diameter Enhanced Tube Nomenclature

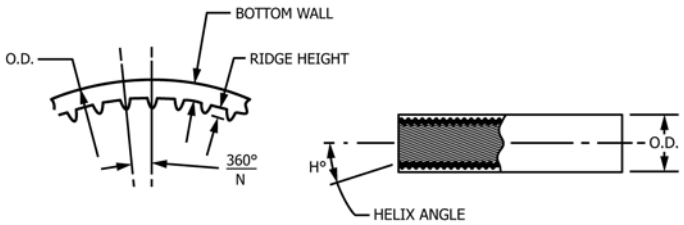


FIG. 3 Inside Diameter Enhanced Tube Nomenclature

5.2.9 If product is purchased for agencies of the U.S. Government (see the Supplementary Requirements section of {this specification or the general requirements section} for additional requirements, if specified); and

5.2.10 If product is ordered for ASME Boiler and Pressure Vessel Code Application (see Certification Section 23).

6. Materials and Manufacture

6.1 *Material:*

6.1.1 The material of manufacture shall be welded tube of one of the Copper Alloy UNS Nos. listed in 1.1 of such purity and soundness as to be suitable for processing into the products 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.

6.2 *Manufacture:*

6.2.1 The product shall be manufacture by cold forming the enhancement of the heat transfer surfaces.

6.3 Product described by this specification shall typically be furnished with unenhanced ends, but may be furnished with enhanced ends or stripped ends from which the O.D. enhancement has been removed by machining.

6.3.1 The enhanced sections of the tube in the as-fabricated temper are in the cold formed condition produced by the enhancing operation.

6.3.2 The unenhanced sections of the tube shall be in the annealed or as-welded temper, and shall be suitable for rolling-in operations.

7. Chemical Composition

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

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

7.2.1 *Copper Alloy C19200 and C19400*—Copper may be taken as the difference between the sum of results for all specified elements and 100 %. When all elements specified, including copper, are determined, their sum shall be 99.8 % minimum.

7.2.2 For alloys in which copper is specified as the remainder, copper may be taken as the difference between the sum of the results for all specified elements and 100 % for the particular alloy.

7.2.2.1 When analyzed, copper plus the sum of results for specified elements shall conform with the requirements shown in the following table:

Copper Alloy UNS No.	Copper Plus Named Elements, % min
C70400	99.5
C70600	99.5
C70620	99.5
C71000	99.5
C71500	99.5
C71520	99.5
C72200	99.8