



Designation: B944 – 22

Standard Specification for Copper-Beryllium Welded Heat Exchanger and Condenser Tube (UNS No. C17510)¹

This standard is issued under the fixed designation B944; 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.

1. Scope*

1.1 This specification establishes the requirements for copper-beryllium alloy UNS No. C17510 welded tube in straight lengths.

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 safety hazard caveat pertains only to the test method(s) described in this specification.

1.3.1 *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 *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

B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

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

B846 Terminology 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

E18 Test Methods for Rockwell Hardness of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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

E1004 Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy Current) Method

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,

4.1.2 Copper Alloy UNS No. designation,

4.1.3 Temper (Section 7),

4.1.4 Dimensions, diameter, and wall thickness (Section 12). For tube or pipe, specify either OD/wall, ID/wall, or OD/ID,

4.1.5 Minimum wall thickness or average (nominal) wall thickness,

4.1.6 Tube length, specific or random, and

4.1.7 Quantity - Total weight or total length or number of pieces of each size.

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

4.2.1 Expansion test,

4.2.2 Flattening test,

4.2.3 Reverse Bend test,

4.2.4 Eddy Current test,

4.2.5 Hydrostatic test,

4.2.6 Pneumatic test,

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.

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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

- 4.2.7 Weld bead conditioning, and
4.2.8 Certification.

5. Materials and Manufacture

5.1 *Materials*—The material of manufacture shall be sheet or strip of UNS Alloy No. C17510 of such purity and soundness as to be suitable for processing into the products prescribed herein.

5.2 *Manufacture*—The product shall be manufactured from cold rolled strip which is subsequently formed and welded by an automatic welding process without the addition of filler metal.

6. Chemical Composition

6.1 Material shall conform to the chemical composition requirements in **Table 1** for Copper Alloy UNS No. C17510.

6.2 These 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.

6.3 For alloys in which copper is listed as “Remainder,” copper is the difference between the sum of results of all elements determined and 100 %. When all elements in **Table 1** are determined, the sum of results shall be 99.5 % min.

7. Temper

7.1 The standard temper for products described in this specification is TF00 (Precipitation Hardened (AT)) as defined in Classification **B601**.

8. Physical Property Requirements

8.1 *Electrical Conductivity Requirement:*

8.1.1 Product furnished to this specification shall conform to the electrical conductivity requirement given in **Table 2**, when tested in accordance with Test Method **E1004**.

9. Mechanical Property Requirements

9.1 *Tensile Strength Requirements:*

9.1.1 Product furnished under this specification shall conform to the tensile and yield strength requirements prescribed in **Table 2**, when tested in accordance with Test Methods **E8/E8M**.

9.2 *Rockwell Hardness Requirements:*

9.2.1 When specified in the contract or purchase order, the product shall conform to the Rockwell hardness requirement prescribed in **Table 2** when tested in accordance with Test Methods **E18**.

9.2.2 The approximate Rockwell hardness values given in **Table 2** are for general information and assistance in testing and shall not be used as a basis for product rejection.

10. Performance Requirements

10.1 *Expansion Test:*

10.1.1 When specified in the contract or purchase order, tube specimens selected for test shall withstand an expansion of 15 % when expanded in accordance with Test Method **B153**.

10.1.2 Upon inspection, the expanded tube shall show no cracking or other defects visible to the unaided eye, but blemishes of a nature that do not interfere with the intended application are acceptable.

10.2 *Flattening Test:*

10.2.1 When specified in the contract or purchase order, the flattening test shall be performed in accordance with Test Method **B968/B968M**.

10.2.2 Upon inspection, the flattened areas of the test specimens shall be free of cracking or other defects visible to the unaided eye, but blemishes of a nature that do not interfere with the intended application are acceptable.

10.3 *Reverse Bend Test:*

10.3.1 When specified in the contract or purchase order, a reverse bend test shall be performed.

10.3.2 A section 4 in. (102 mm) in length shall be split longitudinally 90° on each side of the weld. The sample shall then be opened and bent around a mandrel with a diameter four times the wall thickness, with the mandrel parallel to the weld and on the outside of the tube. The weld when visible or identifiable shall be at the point of maximum bend.

10.3.3 Upon inspection, there shall be no evidence of cracks, or lack of penetration in the weld.

11. Other Requirements

11.1 *Eddy Current Test:*

11.1.1 Each tube shall be subjected to an eddy-current test in accordance with the procedures of Practice **E243**, except as modified in **11.1.2**. The purchaser may specify either of the tests in **11.2** or **11.3** as an alternative to the eddy-current test.

11.1.2 The depth of the round-bottom transverse notches and the diameters of the drilled holes in the calibrating tube used to adjust the sensitivity of the test unit are shown in **Table 3** and **Table 4**, respectively.

11.1.2.1 The discontinuities used to calibrate the test system may be placed in the strip from which the tube will be manufactured. These calibration discontinuities will pass through the continuous operations of forming, welding, and eddy-current testing. The test unit sensitivity required to detect the resultant discontinuities shall be equivalent to or greater than that required to detect the notches or drilled holes of **Table 3** and **Table 4** respectively, or other calibration discontinuities that may be used by mutual agreement between the manufacturer or supplier and the purchaser. Calibration discontinuities may be on the outside tube surface, the internal tube surface, or

TABLE 1 Chemical Requirements

Composition, %	
Element	UNS No. C17510
Beryllium	0.2–0.6
Cobalt, max	0.3
Nickel	1.4–2.2
Iron, max	0.10
Aluminum, max	0.20
Silicon, max	0.20
Copper	Remainder