



## Designation: B 876 – 96

AMERICAN SOCIETY FOR TESTING AND MATERIALS  
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# Standard Specification for Borated Dispersion Strengthened Copper Plate, Sheet, Strip, and Rolled Bar for Nuclear Application<sup>1</sup>

This standard is issued under the fixed designation B 876; 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 plate, sheet, strip, and rolled bar of copper alloy UNS No. C15815, dispersion strengthened copper (DSC), which has been modified by the addition of natural or enriched boron for absorption of neutrons.

1.1.1 The products made to this specification are under consideration for use in storage containers for spent nuclear fuel.

NOTE 1—Dispersion strengthened copper is a thermally stable high-strength copper which retains a high percentage of its strength at elevated temperature. In addition, it does not recrystallize or soften after exposure to high temperatures almost to the melting point of copper. Since dispersion strengthened copper uses inert aluminum oxide particles to strengthen the copper matrix, the thermal conductivity of the copper is not significantly decreased.

NOTE 2—Borated dispersion strengthened coppers covered by this specification, because of their particular structure and specialized properties, may require special care in their fabrication and welding.

1.2 The values stated in inch-pound units are the standard. SI units are provided for information only.

## 2. Referenced Documents

2.1 The following documents in the current issue of the Book of Standards form a part of this specification to the extent referenced herein:

### 2.2 ASTM Standards:

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar<sup>2</sup>

B 249 Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes<sup>2</sup>

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast<sup>2</sup>

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

E 8 Test Methods of Tension Testing of Metallic Materials<sup>3</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 02.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.01.

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition<sup>4</sup>

E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>5</sup>

## 3. Terminology

3.1 For definitions of terms related to copper and copper alloys refer to Terminology B 846.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bursts, n*—surface breaks caused by pressure from within.

3.2.2 *copper, dispersion strengthened, n*—a material consisting of copper and a finely dispersed, substantially insoluble, metallic or nonmetallic phase such as aluminum oxide.

3.2.3 *cracks, n*—narrow breaks or opening in the surface.

3.2.4 *laps, n*—surface defects, appearing as seams, caused by folding over hot metal, fins, or sharp corners and then rolling or forging them into the surface, but not welding them.

## 4. Ordering Information

4.1 The purchase order or contract for product under this specification should include the following information:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper UNS designation,

4.1.3 Temper (Section 7) or condition (Section 10),

4.1.4 Dimensions: thickness and width, or diameter,

4.1.5 Type of edge, if required (Section 9),

4.1.6 Length,

4.1.7 How furnished: straight lengths or coils,

4.1.8 Quantity, and

4.1.9 Total weight, each size.

4.2 The following options are available under this specification and should be specified in the purchase order or contract when required:

4.2.1 Stress relief treatment, (5.3),

4.2.2 Certification (Specification B 248),

4.2.3 Mill test report (Specification B 248),

4.2.4 Condition or finish requirement (10.2), and

4.2.5 The composition, thickness, and condition of the

<sup>4</sup> Annual Book of ASTM Standards, Vol 03.05.

<sup>5</sup> Annual Book of ASTM Standards, Vol 03.06.

copper jacket or its removal shall be determined by agreement between the supplier and the purchaser.

## 5. Materials and Manufacture

5.1 Dispersion strengthened copper is made by a powder metallurgical process. A copper-aluminum alloy is prepared by atomization, and the alloy powder is processed under oxidizing conditions to selectively oxidize the aluminum in situ (within the copper matrix). Boron powder is mixed with the copper-aluminum oxide powder product. The mix is sealed in a pure copper container. The powder is consolidated into fully dense shapes by hot extrusion, and the container becomes part of the extrusion, a layer of pure copper jacket on the extruded shape. Some applications require that this jacket be removed.

5.2 The consolidated shapes can be further reduced in section size by cold rolling or cold drawing, or both.

5.3 Stress-relief heat treatment is also available.

NOTE 3—Inquiry should be made to the supplier concerning the properties available after stress relief.

## 6. Chemical Composition

6.1 The product shall conform to the chemical composition in Table 1 after removal of the copper jacket.

6.2 These composition limits do not preclude the presence of other elements. Limits may be established for unnamed elements and analysis required, by agreement between the manufacturer or the supplier and the purchaser.

6.3 Copper may be determined as remainder, and taken as the difference between the sum of results for all elements analyzed and 100 %.

## 7. Temper

7.1 The tempers, as defined in Practice B 601, available under this specification are as designated in Table 2.

## 8. Mechanical Property Requirements

### 8.1 Tensile Requirement:

8.1.1 The product shall conform to the tensile strength, yield strength, and elongation requirements in Table 2 when tested in accordance with Test Methods E 8.

8.1.2 The preparation of specimens for tensile testing shall include the removal of all of the copper jacket so that only the core material is tested.

### 8.2 Rockwell Hardness:

8.2.1 Typical hardness values are given in Table 2 for information only and shall not be used as a basis for product rejection.

## 9. Dimensions, Mass, and Permissible Variations

9.1 *Length*— +  $\frac{3}{8}$  in. (9.5 mm), - 0.

9.2 *Straightness*:

9.2.1  $\frac{1}{2}$  in. (12.7 mm) in 6 ft (1.83 m), up to and including 1 in. (25.4 mm) thick.

9.2.2  $\frac{3}{8}$  in. (9.5 mm) in 6 ft (1.83 m), over 1 in. (25.4 mm) thick.

9.3 *Edges*—Edge requirements shall be a matter of agreement between the supplier and the customer.

9.4 The dimensions and tolerances for product shall be as prescribed in the current edition of Specification B 248 and the following tables of that specification.

9.4.1 *Thickness*—Table 2.

9.4.2 *Width*:

9.4.2.1 *Rolled Edges*—Table 4.

9.4.2.2 *Sheared Edges*—Table 5.

9.4.2.3 *Sawed Edges*—Table 6.

9.5 *Diameter*—Tables 2 and 5 of Specification B 249.

## 10. Workmanship, Finish, and Appearance

10.1 The product shall be of uniform quality and condition and shall not have laps, cracks, bursts, or other defects that interfere with normal applications.

10.2 The purchaser shall specify in the order the condition or finish required, such as, hot extruded, cold rolled, or stress relieved.

## 11. General Requirements

11.1 The following sections of Specification B 248 form a part of this specification:

11.1.1 Dimensions, Weights, and Permissible Variations, specifically Tables 2, 4, 5, and 6,

11.1.2 Inspection,

11.1.3 Rejection and Rehearing,

11.1.4 Certification,

11.1.5 Mill Test Report, and

11.1.6 Packaging and Package Marking.

## 12. Sampling

12.1 Samples for chemical analysis shall be taken in accordance with Practice E 255.

12.2 Samples for mechanical properties shall be taken subject to agreement between the supplier and the purchaser.

## 13. Specimen Preparation

### 13.1 Chemical Analysis:

13.1.1 Preparation of the analytical specimen shall be the responsibility of the reporting laboratory and shall include the removal of the copper jacket.

### 13.2 Mechanical Properties:

13.2.1 Tensile and yield test specimens shall be prepared in accordance with Test Methods E 8.

13.2.1.1 The tensile test specimen for hot-extruded and cold-rolled products shall be taken from finished product and shall be selected either in the longitudinal or transverse direction as agreed upon at the time the order is placed.

13.2.1.2 Full cross section specimens shall be used whenever possible, but any copper jacket, if present, shall be removed so that only the core material is tested.

## 14. Test Methods

14.1 *Chemical Analysis*:

TABLE 1 Chemical Composition

| Element               | Composition, % |         |
|-----------------------|----------------|---------|
|                       | Minimum        | Maximum |
| Copper (incl. silver) | 97.82          |         |
| Boron                 | 1.2            | 1.8     |
| Aluminum              | 0.13           | 0.17    |
| Iron                  |                | 0.01    |
| Lead                  |                | 0.01    |