



Standard Specification for Electrodeposited Copper for Engineering Uses¹

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1. Scope

1.1 This specification covers requirements for electrodeposited coatings of copper used for engineering purposes. Examples include surface hardening, heat treatment stop-off, as an underplate for other engineering coatings, for electromagnetic interferences (EMI) shielding in electronic circuitry, and in certain joining operations.

1.2 This specification is not intended for electrodeposited copper when used as a decorative finish, or as an undercoat for other decorative finishes.

1.3 This specification is not intended for electrodeposited copper when used for electroforming.

2. Referenced Documents

2.1 ASTM Standards:

- B 183 Practice for Preparation of Low-Carbon Steel for Electroplating²
- B 242 Practice for Preparation of High-Carbon Steel for Electroplating²
- B 254 Practice for Preparation of and Electroplating on Stainless Steel²
- B 320 Practice for Preparation of Iron Castings for Electroplating²
- B 322 Practice for Cleaning Metals Prior to Electroplating²
- B 374 Terminology Relating to Electroplating²
- B 487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section²
- B 499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals²
- B 504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method²
- B 507 Practice for Design of Articles to Be Electroplated on Racks²
- B 555 Guide for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test²
- B 567 Test Method for Measurement of Coating Thickness by the Beta Backscatter Method²

- B 568 Test Method for Measurement of Coating Thickness by X-Ray Spectrometry²
 - B 571 Test Methods for Adhesion of Metallic Coatings²
 - B 588 Test Method for Measurement of Thickness of Transparent or Opaque Coatings by Double-Beam Interference Microscope Technique²
 - B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings²
 - B 659 Guide for Measuring Thickness of Metallic and Inorganic Coatings²
 - B 678 Test Method for Solderability of Metallic-Coated Products²
 - B 697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings²
 - B 762 Method of Variables Sampling of Metallic and Inorganic Coatings²
 - B 765 Guide for Selection of Porosity Tests for Electrodeposits and Related Metallic Coatings²
 - B 832 Guide for Electroforming with Nickel and Copper²
 - B 849 Specification for Pre-treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement²
 - B 850 Specification for Post-Coating Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement²
 - B 851 Specification for Automated Controlled Shot Peening of Metallic Articles Prior to Nickel, Auto Catalytic Nickel, or Chromium Plating, or as a Final Finish²
 - D 3951 Practice for Commercial Packaging³
 - F 519 Method for Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals²
- #### 2.2 Military Standard:
- MIL-R-81841 Rotary Flap Peening of Metal Parts⁴
 - MIL-S-13165 Shot Peening of Metal Parts⁴
 - MIL-W-81840 Rotary Flap Peening Wheels⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *significant surfaces*—those surfaces normally visible (directly or by reflection) that are essential to the appearance or serviceability of the article when assembled in a normal position; or which can be the source of corrosion products that

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² *Annual Book of ASTM Standards*, Vol 02.05.

³ *Annual Book of ASTM Standards*, Vol 15.09.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Attn: NPODS.

deface visible surfaces on the assembled article. When necessary, the significant surface shall be indicated on the drawing of the article, or by the provision of suitably marked samples.

NOTE 1—When significant surfaces are involved on which the specified thickness of coating cannot readily be controlled, such as threads, holes, deep recesses, and bases of angles, it will be necessary to apply thicker coatings on the more accessible surfaces, or to use special racking or both.

3.1.2 *inspection lot*—a collection of coated articles that; are of the same type; have been produced to the same specifications; have been coated by a single supplier at one time, or at approximately the same time, under essentially identical conditions; and are submitted for acceptance or rejection as a group.

3.2 *Definitions*—For definitions of the technical terms used in this specification see Terminology B 374.

4. Classification

4.1 The electrodeposited copper is classified according to thickness of the electrodeposit in the following table:

Class	Minimum Thickness, μm
25	25
20	20
12	12
5	5
x	Thickness specified

NOTE 2—For electroforming applications, that require much thicker applications, see Guide B 832.

5. Ordering Information

5.1 The buyer shall supply to the producer in the purchase order or engineering drawings; marked samples or other governing documents the following information:

5.1.1 Title, ASTM designation number (Specification B 734), and date of issue.

5.1.2 Classification or thickness of electrodeposited copper (see 4.1),

5.1.3 Significant surfaces if other than defined in 3.1.1,

5.1.4 Sampling plan (Section 7),

5.1.5 Number of test specimens for destructive testing (Section 8), and

5.1.6 Thickness, adhesion, solderability, porosity and number of pores acceptable, or hydrogen embrittlement tests and methods required (Section 8).

5.2 Where required, dimensional tolerances allowed for the specified electroplated copper thickness shall be specified.

5.3 In addition to the requirements of 5.1 and when the parts to be electroplated are supplied to the electroplater by the buyer, the buyer shall also supply the following information as required.

5.3.1 Identity of the base material by alloy identification such as ASTM, AISI, or SAE numbers, or equivalent composition information,

5.3.2 Hardness of the parts, and

5.3.3 Heat treatment for stress relief, whether it has been performed or is required.

5.4 If required by either party, the manufacturer of the parts to be electroplated shall provide the electroplating facility with separate test specimens (see section 8.1).

6. Coating Requirements

6.1 *Appearance*—The coating on the significant surfaces of the product shall be smooth and free of visual defects such as blisters, pits, roughness, cracks, flaking, burned deposits, and uncoated areas. The boundaries of electroplating that cover only a portion of the surface shall, after finishing as indicated in the drawing, be free of beads, nodules, jagged edges and other detrimental irregularities. Imperfections and variations in appearance in the coating that arise from surface conditions of the basis metal (scratches, pores, roll marks, inclusions, etc.) and that persist in the finish despite the observance of good metal finishing practices shall not be cause for rejection.

NOTE 3—Electroplated finishes generally perform better when the substrate over which they are applied is smooth and free of deep scratches, torn metal, pores, inclusions, and other defects. It is recommended that the specifications covering the unfinished product provide limits for these defects. A metal finisher can often remove defects through special treatments such as grinding, polishing, abrasive blasting, and special chemical treatments. However, these are not normal treatment steps. When they are desired, they must be agreed upon between the buyer and the producer.

6.2 *Thickness*—The thickness of the copper coating on the significant surfaces shall conform to the requirements of the specified class as defined in Section 4.

NOTE 4—Variation in the coating thickness from point-to-point on a coated article is an inherent characteristic of electroplating processes. Therefore, the coating thickness will have to exceed the specified value at some points on the significant surfaces to ensure that the thickness equals or exceeds the specified value at all points. As a result, the average coating thickness on an article will usually be greater than the specified value; how much greater is largely determined by the shape of the article (see Practice B 507) and the characteristics of the electroplating process. Additionally, the average coating thickness on an article will vary from article to article within a production lot. Therefore, if all of the articles in a production lot are to meet the thickness requirement, the average coating thickness of the production lot as a whole will be greater than the average necessary to ensure that a single article meets the requirements.

NOTE 5—When electroplating threaded parts such as machine screws, care is required to avoid too much plate buildup on the crest of the thread. In such applications a maximum plate thickness allowable on the crests may require that thicknesses in other areas be thinner.

6.3 *Porosity*—When specified, the coating shall be sufficiently free of pores to pass the porosity test specified in 8.4.

6.4 *Solderability*—When specified, the coating shall meet the requirements of Test Method B 678.

6.5 *Pretreatment of Iron and Steel for Reducing the Risk of Hydrogen Embrittlement*—Parts for critical applications that are made of steels with ultimate tensile strengths of 1000 MPa, hardness of 31 HRC or greater, that have been machined, ground, cold formed, or cold straightened subsequent to heat treatment, shall require stress relief heat treatment when specified by the purchaser, the tensile strength to be supplied by the purchaser. Specification B 849 may be consulted for a list of pretreatments that are used widely.

6.6 *Post Coating Treatment of Iron and Steel for Reducing the Risk of Hydrogen Embrittlement*—Parts for critical applications that are made of steels with ultimate tensile strengths of 1000 MPa, hardness of 31 HRC or greater, as well as surface hardened parts, shall require post coating hydrogen embrittlement relief baking when specified by the purchaser, the tensile