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## Standard Specification for Electrodeposited Copper for Engineering Uses<sup>1</sup>

This standard is issued under the fixed designation B734; 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 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.

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:*<sup>2</sup>

B320 Practice for Preparation of Iron Castings for Electroplating

B374 Terminology Relating to Electroplating

B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

B499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

B504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method

B507 Practice for Design of Articles to Be Electroplated on Racks

B568 Test Method for Measurement of Coating Thickness by X-Ray Spectrometry

B571 Practice for Qualitative Adhesion Testing of Metallic Coatings (2018)

B588 Test Method for Measurement of Thickness of Transparent or Opaque Coatings by Double-Beam Interference Microscope Technique (Withdrawn 2016)<sup>3</sup>

B602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings

B678 Test Method for Solderability of Metallic-Coated Products

B697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings

B762 Test Method of Variables Sampling of Metallic and Inorganic Coatings

B765 Guide for Selection of Porosity and Gross Defect Tests for Electrodeposits and Related Metallic Coatings

B832 Guide for Electroforming with Nickel and Copper

B849 Specification for Pre-Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement

B850 Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement

B851 Specification for Automated Controlled Shot Peening of Metallic Articles Prior to Nickel, Autocatalytic Nickel, or Chromium Plating, or as Final Finish

D3951 Practice for Commercial Packaging

F519 Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.03 on Engineering Coatings.

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<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

## 2.2 Military Standard:

**MIL-R-81841 Rotary Flap Peening of Metal Parts**<sup>4</sup>

**MIL-S-13165 Shot Peening of Metal Parts**<sup>4</sup>

**MIL-W-81840 Rotary Flap Peening Wheels**<sup>4</sup>

## 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 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 **B374**.

## 4. Classification

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

Class	Minimum Thickness, $\mu\text{m}$
25	25
20	20
12	12
5	5
x	Thickness specified

NOTE 2—For electroforming applications, that require much thicker applications, see Guide **B832**.

## 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 B734), 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.

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

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 B507) 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 B678.

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 B849 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 strength to be supplied by the purchaser. Specification B850 may be consulted for a list of post treatments that are used widely.

6.7 *Peening of Metal Parts*—If peening is required before electroplating to induce residual compressive stress to increase fatigue strength and resistance to stress corrosion cracking of the metal parts, refer to MIL-S-13165, MIL-R-81841, MIL-W-81840, and Specification B851.

6.8 *Supplementary Requirements:*

6.8.1 *Packaging*—If packaging requirements are to be met under this specification, they shall be in accordance with Practice D3951, or as specified in the contract or order. (**Warning**—Some contemporary packaging materials may emit fumes that are deleterious to the surface of the coating.)

## 7. Sampling

7.1 The sampling plan used for the inspection of a quantity of the coated articles shall be as agreed upon between the purchaser and the seller.

NOTE 6—Usually, when a collection of coated articles, the inspection lot (7.2), is examined for compliance with the requirements placed on the articles, a relatively small number of the articles, the sample, is selected at random and is inspected. The inspection lot then is classified as complying or not complying with the requirements based on the results of the inspection of the sample. The size of the sample and the criteria of compliance are determined by the application of statistics. The procedure is known as sampling inspection. Three standards, Test Method B602, Guide B697, and Method B762 contain sampling plans that are designed for the sampling inspection of coatings. Test Method B602 contains four sampling plans, three for use with tests that are non-destructive and one when they are destructive. The buyer and seller may agree on the plan or plans to be used. If they do not, Test Method B602 identifies the plan to be used. Guide B697 provides a large number of plans and also gives guidance in the selection of a plan. When Guide B697 is specified, the buyer and seller need to agree on the plan to be used. Methods B762 can be used only for coating requirements that have numerical limit, such as coating thickness. The test must yield a numerical value and certain statistical requirements must be met. Methods B762 contains several plans and also gives instructions for calculating plans to meet special needs. The buyer and the seller may agree on the plan or plans to be used. If they do not, Methods B762 identifies the plan to be used.

NOTE 7—When both destructive and non-destructive tests exist for the measurement of a characteristic, the purchaser needs to state which is to be used so that the proper sampling plan is selected. A test may destroy the coating but in a non-critical area; or, although it may destroy the coating, a tested part can be reclaimed by stripping and recoating. The purchaser needs to state whether the test is to be considered destructive or non-destructive.

7.2 An inspection lot shall be defined as a collection of coated articles that are of the same kind, that have been produced to the same specifications, that have been coated by a single supplier at one time, or at approximately the same time under essentially identical conditions, and that are submitted for acceptance or rejection as a group.

7.3 If special test specimens are used to represent the coated articles in a test, the number used shall be that required in 8.1.1.

## 8. Test Methods

8.1 The permission or the requirement to use special test specimens, the number to be used, the material from which they are to be made, and their shape and size shall be stated by the purchaser.