Designation: B840 – 22

Standard Specification for Electrodeposited Coatings of Zinc Cobalt Alloy Deposits[1]

This standard is issued under the fixed designation B840; 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 covers the requirements for electrodeposited zinc cobalt alloy coatings on metals.

1.2 The following precautionary caveat pertains to the test method portion only, Section 8, of 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.*

1.3 *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]

B117 Practice for Operating Salt Spray (Fog) Apparatus
B183 Practice for Preparation of Low-Carbon Steel for Electroplating
B242 Guide for Preparation of High-Carbon Steel for Electroplating
B320 Practice for Preparation of Iron Castings for Electroplating
B322 Guide for Cleaning Metals Prior to 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
B602 Guide for Attribute Sampling of Metallic and Inorganic Coatings
B697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings
B762 Guide of Variables Sampling of Metallic and Inorganic Coatings
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
D3951 Practice for Commercial Packaging

3. Terminology

3.1 *Definitions*—Many terms used in this specification are defined in Terminology B374.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *significant surface, n*—that portion of a coated article's surface where the coating is required to meet all the requirements of the coating specification for that article. Significant surfaces are usually those that are essential to the serviceability or function of the article or can be a source of corrosion products or tarnish films that interfere with the function or desirable appearance of the article. Significant surfaces are those surfaces that are identified by the purchaser by, for example, indicating them on an engineering drawing of the product or marking a sample item of the product.

4. Classification

4.1 There is one coating class, and it is defined as Class 1—a zinc cobalt alloy that is approximately 99 % by mass zinc and at minimum 0.5 % by mass cobalt.

4.2 There are five coating types and they are defined as follows:

4.2.1 *Type A*—With colorless (blue bright) chromate conversion coatings.

[1] This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.06 on Soft Metals.

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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

4.2.2 *Type B*—With yellow chromate conversion coating.
4.2.3 *Type C*—With bronze chromate conversion coating.
4.2.4 *Type D*—With black chromate conversion coating.
4.2.5 *Type E*—Any of the above types plus organic topcoat.

NOTE 1—Whereas colored chromate conversion coatings are usually meant to include various shades of yellow to bronze when used with non-alloyed zinc, yellow and bronze chromate conversion coatings are considered distinctly different when applied to alloyed zinc coatings and are formulated specifically to produce the desired coating.

4.3 There are three grades according to thickness, and they are defined as follows:

Minimum Thickness, µm	New ASTM Grade	Old ASTM Grade
6	6	1
12	12	2
18	18	3

5. Ordering Information

5.1 In order to make the application of this specification complete, the purchaser needs to supply the following information to the seller in the purchase order and drawings.

5.1.1 Title, ASTM designation number, and date of issue of this specification.

5.1.2 Deposit by classification including class, type, and grade (see 4.1, 4.2, 4.3).

5.1.3 Composition and metallurgical condition of the substrate to be coated.

5.1.4 Location of significant surfaces (3.2.1).

5.1.5 Basis metal alloy designation and ultimate tensile strength of the steel.

5.1.6 Whether the part underwent cold forming or cold straightening subsequent to heat treatment (see Note 2).

5.1.7 Exception to heat treatment for stress relief prior to plating (6.7).

5.1.8 Baking requirements after electroplating, if required (6.8).

5.1.9 Whether or not location of rack marks is to be defined (6.3.1).

5.1.10 Any requirement for special test specimens (8.1.1).

5.1.11 Acceptance inspection procedure to be used (Section 7).

5.1.12 Any requirement for certification (Section 10).

5.1.13 Any other items needing agreement. For the purposes of this specification, prior agreement on the nature of the finish is required as items plated in bulk may differ in appearance from those that are rack plated.

NOTE 2—Information in 5.1.5 and 5.1.6 is necessary for proper pretreatment (6.7) and post coating treatment (6.8), if applicable.

6. Coating Requirements

6.1 *Substrate*—The metal to be plated shall be free of flaws and defects that will be detrimental to the zinc alloy coating. It shall be subjected to such cleaning, pickling, and electroplating procedures as are necessary to yield deposits with the desired quality.

NOTE 3—Proper preparatory procedures and thorough cleaning are essential to ensure satisfactory adhesion and corrosion resistance performance of the coating. Materials used for cleaning should not damage the basis metal, for example, by causing defects such as pits, intergranular attack, or stress corrosion cracking. It is recommended that the following ASTM practices for cleaning, where appropriate, be used: Practices B183, B320, and B322 and Guide B242.

6.1.1 The electroplating shall be applied after all basis metal heat treatments have been completed.

6.2 *Nature of Coating:*

6.2.1 The coating shall consist of a zinc cobalt alloy that is approximately 99 % by mass zinc and at minimum 0.5 % by mass cobalt.

6.2.2 The coating shall be produced from an aqueous electroplating system, either alkaline or acid, and may be specified at the discretion of the purchaser.

6.2.3 The coating shall have such supplementary conversion coatings as defined in 4.2 and specified in the purchase order.

6.3 *Appearance:*

6.3.1 The coating on all readily visible surfaces shall have an acceptable and characteristic appearance as agreed upon by the purchaser and seller. The coating shall be uniform insofar as the basis metal will permit. When the article is to be plated on a rack, contact marks may be unavoidable. Location of such mark(s) shall be indicated on the article or its drawing.

6.3.2 Defects and variations in appearance that arise from surface conditions of the substrate (scratches, pores, roll marks, inclusions, and the like) and that persist in the coating despite the observance of good metal finishing practices, shall not be cause for rejection. The coating shall be adherent, free from blisters, pits, or discontinuities, and shall be free of cracks in the as plated state. Flaking shall be cause for rejection in either the as plated state or after subsequent operations.

NOTE 4—These coatings are commonly used in automotive applications where subsequent forming, bending, and crimping operations are commonly performed. These operations will necessarily detract from the performance of the coatings. While some cracking of coatings will be unavoidable, flaking of the coatings after these subsequent operations shall be cause for rejection.

NOTE 5—Coatings generally perform better in service when the substrate over which they are applied is smooth and free of torn metal, inclusions, pores, and other defects. The specifications covering the unfinished product should provide limits for these defects. A metal finisher can often remove defects through special treatments, such as grinding, polishing, abrasive blasting, chemical etches, and electropolishing. However, these are not normal in the treatment steps preceding the application of the coating. When they are desired, they are the subject of special agreement between the purchaser and the seller.

6.4 *Thickness*—The thickness of the coating everywhere on the significant surfaces as defined in 3.2.1 and shall conform to the requirements of the specified grade as defined in 4.3.

NOTE 6—The thickness of electrodeposited coatings varies from point to point on the surfaces of a product (see Practice B507). The thickness is less in interior corners and in holes. Such surfaces are often exempt from thickness requirements. If the full thickness is required in those locations, the electroplater will have to use special techniques that will probably raise the cost of the process.

NOTE 7—The coating requirement of this specification is a minimum. Variation in the thickness from point to point on an article and from article to article in a production lot is inherent in electroplating. Therefore, if all of the articles in a production lot are to meet the thickness requirement, the average coating thickness for the production lot as a whole will be greater than the specified minimum.

6.5 *Adhesion*—The coating shall withstand normal handling and storage conditions without chipping, flaking, or other

coating damage and shall conform to the minimum requirements set forth in Section 8.

6.6 *Corrosion Resistance*—The corrosion resistance of the coating may be evaluated using the method in Appendix X1.

6.7 *Pretreatment of Iron and Steel for Reducing the Risk of Hydrogen Embrittlement:*

6.7.1 Steel parts having an ultimate tensile strength greater than 1000 MPa (31 HRC) that contain tensile stresses caused by cold forming or cold straightening which have not been heat treated after the cold forming process, shall be heat treated for stress relief to reduce the risk of hydrogen embrittlement in the part before clean and electroplate processes. If these heat treatments are not required, the purchaser shall specify in the ordering information their exception. If the purchaser does not specify an exception to heat treatment, then the plater shall use Table 1 in Specification B849 to determine the appropriate heat treatment for the steel based on its tensile strength.

6.8 *Post-Coating Treatments of Iron and Steel for Reducing the Risk of Hydrogen Embrittlement:*

6.8.1 Electroplated steel parts having a tensile strength greater than 1200 MPa (39 HRC), as well as surface hardened parts, shall be baked to reduce the risk of hydrogen embrittlement. Baking of electroplated steel parts with tensile strength 1200 MPa (39 HRC), or less, is not mandatory.

6.8.2 Steel parts having a tensile strength greater than 1200 MPa (39 HRC), as well as surface hardened parts, shall be baked to reduce the risk of hydrogen embrittlement. For such parts, purchasers shall specify the baking requirements in the ordering information. Purchasers are directed to the appropriate ER Class in Guide B850 Table 1.

6.8.3 A purchaser wishing to specify baking requirements, irrespective of tensile strength, shall specify such requirements in the ordering information. Purchasers are directed to Guide B850 Table 1.

6.8.4 Any baking treatment done under this section shall begin within 4 h of removal from the electroplating process.

6.8.5 Electroplated springs and other parts subject to flexure shall not be flexed before the hydrogen embrittlement relief treatment.

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 8—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 is then 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 Test 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 nondestructive 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. Test Method B762 can be used only for coating requirements that have a numerical limit, such as a coating thickness. The test must yield a numerical value and certain statistical requirements must be met. Test Method 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, Test Method B762 identifies the plan to be used.

NOTE 9—When both destructive and nondestructive 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 noncritical 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 nondestructive.

7.2 An inspection lot shall be defined as a collection of coated articles that are of the same kind, have been produced to the same specification, 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.

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 *Special Test Specimens:*

8.1.1 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.

NOTE 10—Test specimens often are used to represent the coated articles in a test if the articles are of a size, shape, or material that is not suitable for the test or if it is preferred not to submit articles to a destructive test because, for example, the articles are expensive or few in number. The specimen should duplicate the characteristics of the article that influences the property being tested.

8.1.2 Special test specimens used to represent articles in an adhesion, porosity, corrosion resistance, or appearance test shall be made of the same material, shall be in the same metallurgical condition, and shall have the same surface condition as the articles they represent. They shall be placed in the production lot of and be processed along with the articles they represent.

8.1.3 Special test specimens used to represent articles in a coating thickness test may be made of a material that is suitable for the test method even if the represented article is not of the same material. For example, a low-carbon steel specimen may represent a brass article when the magnetic thickness test is used (Test Method B499). The thickness specimen need not be carried through the complete process with the represented article. If not, it shall be introduced into the process at the point where the coating is applied and it shall be carried through all steps that have a bearing on the coating thickness. In rack plating, the specimen shall be racked in the same way with the same distance from and orientation with the anodes and other items in the process as the article it represents.

NOTE 11—When special test specimens are used to represent coated articles in a thickness test, the specimens will not necessarily have the same thickness and thickness distribution as the articles, unless the specimens and the articles are of the same general size and shape. Therefore, before finished articles can be accepted on the basis of a thickness test performed on special test specimens, the relationship