
Standard Specification for

Coatings of Cadmium Mechanically Deposited

AASHTO Designation: M 299-05

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Standard Specification for Coatings of Cadmium Mechanically Deposited¹

This standard is issued under the fixed designation B 696; 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.

This standard has been approved for use by agencies of the Department of Defense.

^{ε1} NOTE—The Warning notes in 1.5 and 1.6 were editorially updated in October 2004.

1. Scope

1.1 This specification covers the requirements for a coating of cadmium mechanically deposited on metal products. The coating is provided in various thicknesses up to and including 12 μm.

1.2 Mechanical deposition greatly reduces the risk of hydrogen embrittlement and is suitable for coating bores and recesses in many parts that cannot be conveniently electroplated (see Appendix X3).

1.3 Cadmium coatings are usually applied to provide engineering properties and corrosion resistance. The performance of a cadmium coating depends largely on its thickness and the kind of environment to which it is exposed. Without proof of satisfactory correlation, accelerated tests such as the salt spray (fog) test cannot be relied upon to predict performance in other environments, nor will these serve as comparative measures of the corrosion resistance afforded by coatings of different metals. Thus, although there is a marked superiority of cadmium coatings over zinc coatings of equal thickness in the salt spray test, this is often not the case under conditions of use, so that further testing in the service environment should be conducted.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use. For specific precautionary statements, see 1.5 and 1.6.*

1.5 **Warning**—Cadmium is toxic and must not be used in a coating for articles that can come into contact with food or beverages, or for dental or other equipment that can be inserted into the mouth. Consult appropriate agencies for regulations in this connection.

1.6 **Warning**—Because of the toxicity of cadmium vapors and cadmium oxide fumes, cadmium-coated articles must not

be used at temperatures of 320°C and above. They must not be welded, spot-welded, soldered, or otherwise strongly heated without adequate ventilation that will efficiently remove all toxic fumes.

2. Referenced Documents

2.1 ASTM Standards:²

- B 117 Practice for Operating Salt Spray (Fog) Apparatus
- B 183 Practice for Preparation of Low-Carbon Steel for Electroplating
- B 242 Practice for Preparation of High-Carbon Steel for Electroplating
- B 322 Practice for Cleaning Metals Prior to Electroplating
- B 487 Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
- B 499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
- B 567 Test Method for Measurement of Coating Thickness by the Beta Backscatter Method
- B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings
- B 697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings
- B 762 Test Method of Variables Sampling of Metallic and Inorganic Coatings
- F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

3. Classification

3.1 **Classes**—Cadmium coatings are classified on the basis of thickness, as follows:

Class	Minimum Thickness, μm
12	12
8	8
5	5

¹ This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.08.04 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.

3.2 *Types*—Cadmium coatings are identified by types on the basis of supplementary treatment required, as follows:

Type I—As coated without supplementary chromate treatment (Appendix X2.1).

Type II—With colored chromate conversion treatment (Appendix X2.2).

4. Ordering Information

4.1 To make the application of this standard complete, the purchaser should supply the following information to the seller in the purchase order or other governing document:

4.1.1 Class, including a maximum thickness, if appropriate, Type, and for Type II, color and need for supplemental lubricant (see 3.1, 3.2, and 6.2.4.2),

4.1.2 Nature of substrate (for example, high-strength steel), needed for stress relief (6.2.1), and cleaning precautions to be followed 6.2.2 and 6.2.3),

4.1.3 Significant surfaces (6.3),

4.1.4 Requirements for and methods of testing for one or more of the following, if required: need for and type of test specimens (8.1), thickness (6.3 and 8.3), adhesion (6.4 and 8.4), corrosion resistance (6.5 and 8.5), absence of hydrogen embrittlement, and the waiting period before testing and testing loads (6.6 and 8.6),

4.1.5 Inspection responsibility (Supplementary Requirement S1) and sampling plan for each inspection criterion (Section 7).

4.1.6 Requirements for certified report of test results (Section 10).

5. Workmanship

5.1 The coating shall be uniform in appearance and free of blisters, pits, nodules, flaking, and other defects that can adversely affect the function of the coating. The coating shall cover all surfaces as stated in 6.3 including roots of threads, thread peaks, corners, recesses, and edges. The coating shall not be stained or discolored throughout to an extent that would adversely affect appearance as a functional requirement. However, superficial staining that results from rinsing or drying and variations in color or luster shall not be cause for rejection.

NOTE 1—The nature of the mechanical plating process is such that coatings characteristically will not be as smooth or as bright as some electroplated coatings.

6. Requirements

6.1 *Appearance*—The coating as deposited shall have a uniform silvery appearance, and a matte to medium-bright luster.

6.2 *Process*:

6.2.1 *Stress-Relief Treatment*—All steel parts that have ultimate tensile strength of 1000 MPa and above and that contain tensile stresses caused by machining, grinding, straightening, or cold-forming operation shall be given a stress relief heat treatment prior to cleaning and metal deposition. The temperature and time at temperature shall be $190 \pm 15^\circ\text{C}$ for a minimum of 3 h so that maximum stress relief is obtained without reducing the hardness below the specified minimum.

6.2.2 High-strength steels that have heavy oxide or scale shall be cleaned before application of the coating in accordance

with Practice B 242. In general, nonelectrolytic alkaline, anodic-alkaline, and some inhibited acid cleaners are preferred to avoid the risk of producing hydrogen embrittlement from the cleaning procedure.

6.2.3 For low-carbon steels see Practice B 183. Useful guidelines are also given in Practice B 322.

6.2.4 *Supplementary Treatments*:

6.2.4.1 *Colored Chromate Conversion Treatments (Type II)*—Chromate treatment for Type II shall be done in a solution containing hexavalent chromium. This solution shall produce a bright or semi-bright continuous, smooth, protective film with a uniform color that may range from yellow through bronze and olive drab to brown and black including olive drab and that may be dyed to a desired color. Post treatments that do not contain salts that yield films containing hexavalent chromium are not permitted as treatments for producing Type II coatings.

6.2.4.2 Waxes, lacquers, or other organic coatings may be used to improve lubricity, and the need for them shall be supplied in the purchase order or other governing document (4.1.1). Supplemental lubrication treatment shall not be used to ensure conformance to the salt spray corrosion resistance requirements.

6.2.5 *Surface Defects*—Defects and variations in appearance in the coating that arise from surface conditions of the substrate (scratches, pores, roll marks, inclusions, and so forth) and that persist in the finish despite the observance of good metal finishing practices shall not be cause for rejection.

NOTE 2—Applied finishes 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. 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, chemical treatments, and electropolishing. However, these are not normal in the treatment steps preceding the application of the finish. When desired they must be specified on the purchase order (4.1.2).

6.3 *Thickness*:

6.3.1 The thickness of the coating everywhere on the significant surfaces shall be at least that of the specified class as defined in 3.1.

6.3.2 Significant surfaces are defined as those normally visible (directly or by reflection) that are essential to the appearance or serviceability of the article when assembled in normal position; or that can be the source of corrosion products that deface visible surfaces on the assembled article. When necessary, the significant surfaces shall be indicated on the drawing for the article, or by the provision of suitably marked samples.

NOTE 3—The thickness of mechanically-deposited coatings varies from point-to-point on the surface of a product, characteristically tending to be thicker on flat surfaces and thinner at exposed edges, sharp projections, shielded or recessed areas, interior corners and holes, with such thinner areas often being exempted from thickness requirements.

6.3.3 When significant surfaces are involved on which the specified thickness of deposit cannot readily be controlled, the purchaser and manufacturer should recognize the necessity for either thicker or thinner deposits. For example, to reduce buildup in thread roots, holes, deep recesses, bases of angles,