



Designation: **B679–98 (Reapproved 2009) B679 – 98 (Reapproved 2015)**

Standard Specification for Electrodeposited Coatings of Palladium for Engineering Use¹

This standard is issued under the fixed designation B679; 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 requirements for electrodeposited palladium coatings containing at least 99.7 mass % of palladium metal. Composite coatings consisting of palladium with a thin gold overplate for applications involving electrical contacts are also covered.

1.2 *Properties*—Palladium is the lightest and least noble of the platinum group metals. It has a specific gravity of 12.0, which is substantially less than gold (19.3) and platinum (21.5). This yields a greater volume or thickness of coating and, consequently, some saving of metal weight accompanied by a small sacrifice in corrosion resistance and reflectivity. The following table compares the hardness range of electrodeposited palladium with other electrodeposited noble metals and alloys **(1,2)**.²

	Approximate Hardness (HK ₂₅)
Gold	50–250
Palladium	75–600
Platinum	150–550
Palladium-Nickel	300–650
Rhodium	750–1100
Ruthenium	600–1300

1.3 The values stated in SI units are the preferred values. Values provided in parentheses are for information only.

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.*

2. Referenced Documents

2.1 The following standards form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:³

- [B183 Practice for Preparation of Low-Carbon Steel for Electroplating](#)
- [B242 Guide for Preparation of High-Carbon Steel for Electroplating](#)
- [B254 Practice for Preparation of and Electroplating on Stainless Steel](#)
- [B281 Practice for Preparation of Copper and Copper-Base Alloys for Electroplating and Conversion Coatings](#)
- [B322 Guide for Cleaning Metals Prior to Electroplating](#)
- [B343 Practice for Preparation of Nickel for Electroplating with Nickel](#)
- [B374 Terminology Relating to Electroplating](#)
- [B481 Practice for Preparation of Titanium and Titanium Alloys for Electroplating](#)
- [B482 Practice for Preparation of Tungsten and Tungsten Alloys for Electroplating](#)
- [B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section](#)
- [B488 Specification for Electrodeposited Coatings of Gold for Engineering Uses](#)
- [B489 Practice for Bend Test for Ductility of Electrodeposited and Autocatalytically Deposited Metal Coatings on Metals](#)

¹ This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.04 on Precious Metal Coatings.

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² The boldface numbers in parentheses refer to the list of references at the end of this specification.

³ 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.

- B499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
- B507 Practice for Design of Articles to Be Electroplated on Racks
- B542 Terminology Relating to Electrical Contacts and Their Use
- B558 Practice for Preparation of Nickel Alloys for Electroplating
- B567 Test Method for Measurement of Coating Thickness by the Beta Backscatter Method
- B568 Test Method for Measurement of Coating Thickness by X-Ray Spectrometry
- B571 Practice for Qualitative Adhesion Testing of Metallic Coatings
- B602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings
- B689 Specification for Electroplated Engineering Nickel Coatings
- B697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings
- B741 Test Method for Porosity In Gold Coatings On Metal Substrates By Paper Electrography (Withdrawn 2005)⁴
- B748 Test Method for Measurement of Thickness of Metallic Coatings by Measurement of Cross Section with a Scanning Electron Microscope
- 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
- B799 Test Method for Porosity in Gold and Palladium Coatings by Sulfurous Acid/Sulfur-Dioxide Vapor
- B809 Test Method for Porosity in Metallic Coatings by Humid Sulfur Vapor (“Flowers-of-Sulfur”)
- D1125 Test Methods for Electrical Conductivity and Resistivity of Water
- D3951 Practice for Commercial Packaging

3. Terminology

3.1 *Definitions*—Many terms used in this specification are defined in Terminology B374 or B542.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *underplating*—a metallic coating layer between the basis metal or substrate and the topmost metallic coating. The thickness of an underplating is usually greater than 1 μm (40 μin.), in contrast to a strike or flash.

4. Classification

4.1 Orders for articles to be plated in accordance with this specification shall specify the plating system, indicating the basis metal, the thickness of the underplatings, the thickness of the palladium coating, and the grade of the gold overplating according to Tables 1 and 2.

5. Ordering Information

5.1 In order to make the application of this standard complete, the purchaser needs to supply the following information to the seller in the purchase order or other governing document:

- 5.1.1 The name, designation, and date of issue of this standard.
- 5.1.2 The coating system including basis metal, thickness class and gold overplate grade (see 4.1 and Tables 1 and 2).
- 5.1.3 Presence, type, and thickness of underplating (see 3.2.1).
- 5.1.4 Significant surfaces shall be defined (see 3.1).
- 5.1.5 Requirements, if any, for porosity testing (see 9.5):
- 5.1.6 Requirement, if any, for bend ductility testing (see 9.6):
- 5.1.7 Sampling plan employed (see Section 8), and

⁴ The last approved version of this historical standard is referenced on www.astm.org.

TABLE 1 Thickness Class^A

Thickness Class	Minimum Thickness of Pd (μm)
0.08	0.08
0.15	0.15
0.25	0.25
0.50	0.50
0.75	0.75
1.00	1.00
1.25	1.25
1.5	1.5
2.5	2.5
3.0	3.0
5.0	5.0

^A See Appendix X4 for specific applications of the various thickness classes.

TABLE 2 Gold Overplate^A

Grade	Type	MIL-G-45204	Hardness (Code)	Thickness Range
0	No Overplate
1	1 (99.9 % Au min)	III	90 HK ₂₅ max (A)	0.05-0.12 μm
2	2 (99.7 % Au min)	I	130-200 HK ₂₅ (C)	0.05-0.25 μm

^A See Specification [B488](#) and [Appendix X1](#).

5.1.8 Requirement, if any, for surface coating cleanliness (absence of residual salts). See [Appendix X3](#).

6. Manufacture

6.1 Any process that provides an electrodeposit capable of meeting the specified requirements will be acceptable.

6.2 Substrate:

6.2.1 The surface condition of the basis metal should be specified and should meet this specification prior to the plating of the parts.

6.2.2 Defects in the surface of the basis metal, such as scratches, porosity, pits, inclusions, roll and die marks, laps, cracks, burrs, cold shuts, and roughness may adversely affect the appearance and performance of the deposit, despite the observance of the best plating practice. Any such defects on significant surfaces should be brought to the attention of the supplier and the purchaser.

6.2.3 Clean the basis metal as necessary to ensure a satisfactory surface for subsequent electroplating in accordance with [Practices B183, B254, B281, B322, B343, B481, B482, and B558](#), and [Guide B242](#).

6.2.4 Proper preparatory procedures and thorough cleaning of the basis metal are essential for satisfactory adhesion and performance of these coatings. The surface must be chemically clean and continuously conductive, that is, without inclusions or other contaminants. The coatings must be smooth and as free of scratches, gouges, nicks, and similar imperfections as possible.

NOTE 1—A metal finisher can often remove defects through special treatments such as grinding, polishing, abrasive blasting, chemical treatments, and electropolishing. However, these may not be normal in the treatment steps preceding the plating, and a special agreement is indicated.

6.3 Apply the coating after all basis metal preparatory treatments and mechanical operations on significant surfaces have been completed.

6.4 Racking:

6.4.1 Position parts to allow free circulation of solution over all surfaces. The location of rack or wire marks in the coating should be agreed upon between the producer and supplier.

6.5 Plating Process:

6.5.1 *Nickel Underplating*—Apply a nickel underplating before the palladium when the product is made from copper or copper alloy. Nickel underplatings are also applied for other reasons. See [Appendix X2](#).

NOTE 2—In certain instances where high frequency analog signals are employed, such as wave guides, the magnetic properties of nickel may attenuate the signal. Palladium itself is non-ferromagnetic.

6.5.2 *Strikes*—Standard practice calls for a gold or palladium strike to follow any underplate or substrate (other than silver or platinum) immediately prior to applying the palladium.

6.5.3 *Plating*—Good practice calls for the work to be electrically connected when entering the bath. A minimum of 0.5 V is suggested. During electroplating it is extremely important to maintain the voltage, current density, or both beneath the value for hydrogen evolution. (See [7.2](#))

6.5.4 *Stress Cracking*—Problems associated with the incorporation of hydrogen in the palladium, which can lead to stress cracking of the coating, shall be controlled by choosing plating baths and plating conditions that minimize the H/Pd deposition ratio (3). The presence of stress-induced microcracks that penetrate to the underlying substrate or underplating can be detected with one of the porosity tests specified in [9.5](#).

6.5.5 *Gold Overplating*—Apply a thin gold overplating after the palladium in any application in which palladium plated electrical connectors are mated together in a contact pair. This process is necessary to preserve the performance of the contact surface. See [Appendix X1](#) for other reasons for using a gold overplate.

NOTE 3—When using Type 1 gold, the thickness of the gold overplate shall not exceed 0.12 μm (5 μin.) due to increased risk of degrading durability and increasing the coefficient of friction.

6.5.6 *Residual Salts*—For rack and barrel plating applications, residual plating salts can be removed from the articles by a clean, hot (50 to 100°C) water rinse. A minimum rinse time of 2.5 min (racks) or 5 min (barrel) is suggested. Best practice calls for a minimum of three dragout rinses and one running rinse with dwell times of 40 s in each station when rack plating and 80 s when barrel plating. Modern high-velocity impingement type rinses can reduce this time to a few seconds. This is particularly useful in automatic reel-to-reel applications where dwell times are significantly reduced. See [Appendix X3](#).