



Designation: B 904 – 00

## Standard Specification for Autocatalytic Nickel over Autocatalytic Copper for Electromagnetic Interference Shielding<sup>1</sup>

This standard is issued under the fixed designation B 904; 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

This specification presents the requirements for multilayer coatings of autocatalytic nickel-phosphorus over autocatalytic copper on metallic and polymeric substrates. The coating system is intended to provide electromagnetic interference (EMI) protection properties or electrostatic discharge (ESD) protection to parts fabricated from either polymeric or metallic materials.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- A 919 Terminology Relating to Heat Treatment of Metals<sup>2</sup>
- B 183 Practice for Preparation of Low-Carbon Steel for Electroplating<sup>3</sup>
- B 242 Practice for Preparation of High-Carbon Steel for Electroplating<sup>3</sup>
- B 252 Guide for Preparation of Zinc Alloy Die Castings for Electroplating and Conversion Coatings<sup>3</sup>
- B 253 Guide for Preparation of Aluminum Alloys for Electroplating<sup>3</sup>
- B 320 Practice for Preparation of Iron Castings for Electroplating<sup>3</sup>
- B 322 Practice for Cleaning Metals Prior to Electroplating<sup>3</sup>
- B 374 Terminology Related to Electroplating<sup>3</sup>
- B 504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method<sup>3</sup>
- B 532 Specification for the Appearance of Electroplated Plastic Surfaces<sup>3</sup>
- B 533 Test Method for Peel Strength of Electroplated Plastics<sup>3</sup>
- B 553 Test Method for Thermal Cycling of Electroplated Plastics<sup>4</sup>
- B 554 Practice for Measurement of Thickness of Metallic Coatings on Nonmetallic Substrates<sup>5</sup>

- B 567 Test Method for Measurement of Coating Thickness by the Beta Backscatter Method<sup>3</sup>
  - B 568 Test Method for Coating Thickness by X-Ray Spectrometry<sup>3</sup>
  - B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings<sup>3</sup>
  - B 697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings<sup>3</sup>
  - B 727 Practice for Preparation of Plastics Materials for Electroplating<sup>3</sup>
  - B 733 Specification for Autocatalytic Nickel-Phosphorus Coatings on Metals<sup>3</sup>
  - D 3330/D 3330M Test Methods for Peel Adhesion of Pressure-Sensitive Tape at 180° Angle<sup>6</sup>
  - D 3359 Test Methods for Measuring Adhesion by Tape Test<sup>7</sup>
  - D 4935 Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Materials<sup>8</sup>
- #### 2.2 Military Standard:
- MIL-STD-461 Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference<sup>9</sup>

### 3. Terminology

3.1 *Definitions*—Many of the terms used in this specification can be found in Terminologies A 919 or B 374.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *significant surfaces, n*—these surfaces are classified as primary, secondary, nonsignificant, and coating-free surfaces.

3.2.1.1 *coating-free areas, adj*—areas specified on part drawings or suitably marked samples.

3.2.1.2 *nonsignificant surfaces, adj*—all holes, recesses, and other areas where a controlled deposit cannot be obtained under normal coating conditions and that cannot be touched with a 20-mm diameter ball shall be considered nonsignificant surfaces unless otherwise specified on part drawings or suitably marked samples.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.08.01 on Engineering Coatings.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 02.05.

<sup>4</sup> Discontinued 1992; see *1991 Annual Book of ASTM Standards*, Vol .

<sup>5</sup> Discontinued 1987; Replaced by B 659.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 06.01.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 10.02.

<sup>9</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave. Philadelphia, PA 19111-5094, Attn: NPODS.

3.2.1.3 *primary significant surface, adj*—all mating surfaces and those other surfaces specified on part drawings or suitably marked samples.

3.2.1.4 *secondary significant surfaces, adj*—all surfaces, other than primary significant surfaces, that can be touched with a 20-mm diameter ball shall be considered secondary significant surfaces unless otherwise specified on part drawings or suitably marked samples.

#### 4. Classification

4.1 This classification system provides for the following:

4.1.1 Types of coating based on thickness and testing requirements, and

4.1.2 Grades of coating based on alloy composition.

4.2 *Coating Type:*

4.2.1 The coating type indicates the type of application and tests to be used in determining the acceptance of the coating.

4.2.2 *Coating Type Definitions:*

4.2.2.1 *Type 1*—Coatings intended to shield devices for FCC/VDE Class B service.

4.2.2.2 *Type 2*—Coatings intended to shield devices for FCC/VDE Class B service in harsh environments.

4.2.2.3 *Type 3*—Coatings intended to shield devices for MIL-STD-461 requirements.

4.2.2.4 *Type 4*—Coatings intended to shield devices for FCC/VDE Class A requirements.

4.2.3 The description of Types 1, 2, 3, and 4 is summarized in Table 1.

4.3 *Coating Grade:*

4.3.1 The coating grade is based upon phosphorus content.

NOTE 1—The coating grade indicates the relative contact impedance and the relative corrosion resistance of the nickel-phosphorus coating and tests to be used in determining the acceptance of the coating

4.3.2 *Coating Grade Definitions:*

4.3.3 Grade 1 coatings have a phosphorus content between 3 and 5 %.

NOTE 2—Low phosphorus coatings exhibit low electrical contact impedance. High phosphorus contents exhibit somewhat higher contact impedance, however, the coating is more corrosion resistant.

4.3.4 Grade 2 coatings have a phosphorus content between 6 and 11 %.

NOTE 3—The adhesion and resistance to blistering are improved on some polymeric substrates by an initial flash deposit of autocatalytic nickel.

**TABLE 1 Autocatalytic Nickel-Phosphorus Over Autocatalytic Copper Coating Descriptions Summary**

Type	Thickness		Shielding Effectiveness (Typical) per Test Method D 4935	Application
	Autocatalytic Copper	Autocatalytic Nickel-Phosphorus		
1	1 µm min	0.25 µm min	80-100 dB	FCC/VDE Class B
2	1 µm min	1.5 µm min	80-100 dB	Harsh Environment
3	2.5 µm min	0.25 µm min	90-110 dB	MIL-STD-461B
4	Optional/Not required	1.0 µm min	50-70 dB	FCC/VDE Class A

#### 5. Ordering Information

5.1 To avoid misunderstanding between contractual parties, purchase orders or contracts for autocatalytic nickel over autocatalytic copper coatings under this specification should include the designation, issue date, and the following information:

5.1.1 Type of substrate.

5.1.1.1 Metallic substrates should state the composition and metallurgical condition. Assemblies of dissimilar materials should be identified.

5.1.1.2 Polymeric substrates should state the polymer type and should be of a plating grade.

5.1.2 Classification of the deposit by type and grade.

5.1.3 Primary significant surfaces and coating-free surfaces must be indicated on drawings.

5.1.4 Any special requirements.

5.1.5 Test methods for coating adhesion, thickness, porosity.

5.1.6 Sampling program.

#### 6. Surface Preparation

6.1 *Surface Contamination*—Surfaces of polymeric parts must be free of all mold release agents, dirt, oil, grease, and contamination detrimental to the final finish. Surfaces of metallic parts must be free of all scale, oxidation, and contamination detrimental to the final finish. A clean surface is essential to the adhesion and electrical conductivity requirements of the subsequent coated part.

6.2 *Cleaning, Conditioning, and Activating*—Any adequate method of cleaning, conditioning, and activating is acceptable provided the coated parts meet the inspection requirements and are free of distortion. Examples of adequate methods of cleaning can be found in 10.2.

6.2.1 *Base Material Suitability*—The parts to be coated shall be inspected by the coater prior to any processing to determine their suitability for coating. Unsuitable parts shall be returned to the fabricator or molder.

6.3 *Mechanical Roughening*—Mechanical roughening of polymer surfaces, to promote adhesion, may only be used when specified on the part drawing.

#### 7. In-Process Storage and Handling

7.1 Following cleaning, conditioning, and activating, all parts shall be immediately coated with copper and then nickel-phosphorus to the thickness specified in Table 1. The parts processing cycle shall be a continuous operation without any interruption.

7.2 *Handling*—The parts shall be suitably racked so as to prevent gas entrapment and to avoid physical handling of the primary significant surfaces.

7.3 *Drying*—Following coating, the parts may be dried with warm air currents. Drying temperature shall not exceed the heat distortion temperature of the substrate. Wetting agents may be used to enhance water shedding provided they do not interfere with subsequent paint adhesion.

7.4 *Storage*—Following drying, all parts shall be stored in a clean dry area, protected from corrosive fumes and humidity prior to packaging and shipment.