Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2413B
Superseding AMS 2413A
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SILVER AND RHODIUM PLATING

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for electrodeposition of silver and rhodium and the properties of the deposit.

1.2 Application: Primarily to provide a conductive surface for electrical contacts or microwave surfaces for parts operating below 300°F (150°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B117 - Salt Spray (Fog) Testing
ASTM B487 - Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B499 - Measurement of Coating Thicknesses by the Magnetic Methods: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B504 - Measurement of the Thickness of Metallic Coatings by the Coulometric Method
ASTM B529 - Measurement of Coating Thicknesses by the Eddy-Current Test Method: Non-conductive Coatings on Nonmagnetic Basis Metals
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

2.4 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All forming, machining, heat treating, brazing, and welding shall be completed before parts are plated.

3.1.2 Texture of surfaces to be plated, prior to cleaning, shall be not rougher than 32 microin. (0.8 μm), Ø determined in accordance with ANSI B46.1.

3.1.3 Parts shall have chemically clean surfaces, prepared with minimum abrasion, erosion, or pitting, Ø prior to immersion in the plating solution. Treatments which may produce hydrogen embrittlement shall be avoided.

3.1.4 Electrical contacts between the parts and the power source shall be made in such a manner as will ensure that neither chemical or immersion deposition nor electrical arcing or overheating will Ø occur. If parts are to be plated all over, contact points shall be located where specified or where agreed upon by purchaser and vendor. If parts are not required to be plated all over, contact points shall be located in areas on which plating is not required or is optional.

3.2 Procedure: Parts shall be plated in the following sequence, using the solution specified; parts shall be immersed in each plating solution with the current on:

3.2.1 Copper Flash or Copper Strike: A copper flash or copper strike shall be electrodeposited from a copper cyanide bath.

3.2.1.1 When parts to be plated are made of corrosion-resistant steels or alloys, a nickel flash or nickel strike may be electrodeposited from a Watt's type nickel solution or from a nickel chloride solution instead of the copper flash or copper strike.

3.2.2 Silver Plating: Parts shall be plated by electrodeposition of silver from a silver cyanide solution directly onto the flash or strike surfaces.

3.2.3 Rhodium Plating: Parts shall be plated by electrodeposition of rhodium from a rhodium sulfate or rhodium phosphate solution onto the silver plated surfaces.

3.2.4 Rinsing: The plated parts shall be removed from the plating solution, thoroughly rinsed by immersion for not less than 15 min. in hot (not lower than 180°F (82°C) water, and dried.

3.3 Post Treatment: After plating, rinsing, and drying, and within 30 min. after completion of the hot water rinse, parts shall be post treated as in 3.3.1, 3.3.2, or 3.3.3, as applicable.

3.3.1 Steel Parts:

3.3.1.1 Parts having hardness of 33 HRC or higher, except as specified in 3.3.1.2 and 3.3.1.3, shall be heated to 375°F ± 10 (190°C ± 6) and held at heat for not less than 3 hours.

3.3.1.2 Parts which will decrease in hardness or be otherwise deleteriously affected by heating to 375°F ± 10 (190°C ± 6) shall be heated to 275°F ± 10 (135°C ±6) and held at heat for not less than 5 hours.

3.3.1.3 Parts requiring special handling shall be post treated as agreed upon by purchaser and vendor.

3.3.2 Copper Alloys: Parts having hardness higher than 29HRC shall be heated in air, preferably in a circulating-air furnace, to 275°F ± 10 (135°C ± 6) and held at heat for not less than 2 hours.

3.3.3 When permitted or specified by purchaser, other methods of rinsing and embrittlement relief may be employed.

3.4 Properties:

3.4.1 Thickness: Shall be as follows, unless otherwise specified, determined in accordance with ASTM B487, ASTM B499, ASTM B504, ASTM B529, or other method agreed upon by purchaser and vendor:

3.4.1.1 Copper or Nickel Flash or Strike: Not less than 0.0001 in. (2.5 μm).

3.4.1.2 Silver Plate Including Strike: Not less than 0.0005 in. (13 μm).

3.4.1.3 Rhodium Flash: Not less than 0.00002 in. (0.5 μm).

3.4.1.4 No requirements are established for minimum plating thickness on surfaces of holes, recesses, internal threads, contact areas of parts plated all over, and other areas where a controlled deposit cannot be obtained under normal plating conditions but such areas shall not be masked to prevent plating. Unless otherwise specified, the resultant thickness shall be considered only when such surfaces of parts can be touched by a sphere 0.75 in. (19.0 mm) in diameter.

3.4.2 Adhesion: Parts or specimens as in 4.3.3 shall not show separation of the plating from the basis metal, when examined at up to 6X magnification, after being bent in accordance with ASTM E290 through an angle of 180 deg around a diameter equal to the nominal thickness of the specimen. Formation of cracks which do not result in flaking or blistering of the plating is acceptable.

3.4.2.1 If parts are not suitable for bend testing, adhesion may be determined, prior to hydrogen embrittlement relief, by heating parts to 350°F ± 10 (177°C ± 6) and holding at heat for 1 hr ± 0.1. After heating, there shall be no evidence of blistering of the plating visible under 4X magnification.

3.4.3 Corrosion Resistance: Parts or specimens as in 4.3.3 shall show no visual evidence of corrosion of the basis metal after being subjected for not less than 100 hr to continuous salt spray corrosion test conducted in accordance with ASTM B117. Corroded areas not greater than 1/32 in. (0.8 mm) in diameter are acceptable.

3.5 Quality: Plated metal shall be smooth, continuous, adherent to the basis metal, and uniform in appearance and shall be essentially free from pin holes, porosity, blisters, nodules, pits, and other imperfections detrimental to performance of plated parts. Slight staining or discoloration is permissible. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5.1 Double plating and spotting-in after plating are not permitted, unless otherwise authorized by purchaser.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to thickness (3.4.1) and quality (3.5) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to adhesion (3.4.2) and corrosion resistance (3.4.3) requirements and of cleaning and plating solutions to ensure that the deposited metal will conform to the requirements of this specification are classified as periodic tests.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be not less than the following:

4.3.1 Acceptance Tests:

4.3.1.1 Thickness: Three parts for each consecutive 8 hr of operation of the same set of solutions, except as specified in 4.3.3.

4.3.1.2 Quality: As agreed upon by purchaser and vendor.

4.3.2 Periodic Tests and Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.3 When plated parts are of such configuration or size as to be not readily adaptable to the specified tests, separate test specimens cleaned, plated, and post-treated with the parts represented may be used. For thickness, adhesion, and quality tests, such specimens shall be panels of annealed, low-carbon steel approximately 0.032 x 4 x 1 in. (1 x 100 x 25 mm). For corrosion resistance tests, specimens shall be panels of copper 0.062 - 0.125 in. (1.5 - 3 mm) in nominal thickness and not less than 4 in. (100 mm) long by 3 in. (75 mm) wide.

4.4 Approval:

4.4.1 Plated parts shall be approved by purchaser before parts for production use are supplied, unless such approval be waived. Results of tests on production parts shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If any change is necessary in type of equipment or in established composition limits and operating conditions of process solutions, vendor shall submit for reapproval of the process a statement of the proposed changes in processing and, when requested, sample plated parts, test panels, or both. Production parts plated by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Reports: The vendor of plated parts shall furnish with each shipment three copies of a report stating that the parts have been processed and tested in accordance with the requirements of this specification and that they conform to the acceptance test requirements. This report shall include the purchase order number, this specification number and its revision letter, part number, and quantity.