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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2413D

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Submitted for recognition as an American National Standard

Superseding AMS 2413C

PLATING, SILVER-RHODIUM

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:

This electrodeposit has been used typically to provide a conductive surface for electrical contacts or microwave surfaces for parts operating up to 300 ºF (149 ºC), but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extend specified herein. The applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 117 Salt Spray (Fog) Testing
ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B 499 Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B 504 Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B 571 Adhesion of Metallic Coatings
ASTM E 376 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All fabrication type operations, such as forming, machining, heat treating, brazing, and welding, shall be completed before parts are plated.

3.1.2 Parts shall be within drawing dimension limits before plating.

3.1.3 (R) Steel parts having hardness of 40 HRC or higher and which have been roll threaded or ground after heat treatment shall be cleaned to remove surface contamination and stress relieved before cleaning for plating. Temperatures to which parts are heated shall be such that maximum stress relief is obtained without reducing hardness of parts below drawing limits, but, unless otherwise specified, not less than 275 ºF (135 ºC) for five hours for parts 55 HRC or over; for other parts, use 375 ºF (191 ºC) for four hours.

3.1.4 Parts shall have clean surfaces, free from water break, prior to immersion in the plating solution.

3.1.4.1 Steel parts having hardness of 33 HRC or higher and parts roll threaded after heat treatment shall not be cleaned with inorganic acids (e.g., hydrochloric or sulfuric) unless specifically approved. Cleaning of other parts with inorganic acids is not prohibited but permission to use such method on a particular part shall first be obtained from purchaser. In either case, a dip in acid for activation purposes or neutralization after alkaline cleaning is permissible.

3.1.5 Electrical contact between parts and power source shall be made to prevent chemical or immersion deposition, electrical arcing, and overheating. 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: Except as specified in 3.2.1.1, a copper flash or copper strike shall be electrodeposited from a suitable copper plating solution.

3.2.1.1 When parts to be plated are made of a corrosion-resistant alloy, a nickel flash or nickel strike shall be electrodeposited instead of the copper flash or copper strike.

3.2.2 Silver Plating: Parts shall be plated by electrodeposition of silver from a suitable silver plating 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, rhodium phosphate, or other suitable rhodium plating solution onto the silver plating surfaces.

3.3 After plating, rinsing, and drying, steel parts shall be post treated as in 3.3.1, 3.3.2, or 3.3.3, as applicable, to remove hydrogen embrittlement; heating shall be in air, preferably in a circulating-air oven. Post treatment shall follow the plating operation with a maximum delay time of four hours between removal of parts from the plating bath and start of post treatment.

3.3.1 Parts having specified hardness of 33 to 45 HRC shall be heated to 375 ºF ± 25 (191 ºC ± 14) and held at heat for not less than three hours. Parts having a specified hardness of 46 HRC or higher shall be held at heat for not less than 23 hours.

3.3.2 Parts, including carburized parts, which will decrease in hardness or be otherwise deleteriously affected by heating to 375 ºF (191 ºC) shall be heated to 275 ºF ± 25 (135 ºC ± 14) and held at heat for not less than five hours or for parts over 46 HRC held at heat not less than 23 hours.

3.3.3 Parts requiring special handling shall be post treated as specified by purchaser.

3.4 Properties:

The silver-rhodium plating shall conform to the following requirements:

3.4.1 Thickness: Shall be as follows, unless otherwise specified, determined on representative parts or on test panels as in 4.3.3 in accordance with ASTM B 487, ASTM B 499, ASTM B 504, ASTM E 376, or other method acceptable to purchaser.

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

3.4.1.2 Silver Plate: Not less than 0.0005 inch (12.7 µm).

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

3.4.2 Adhesion: Plating shall be firmly and continuously bonded to the underlying metal, determined on representative parts or test panels in accordance with a method described in ASTM B 571. A test shall be selected from ASTM B 571 from those specified for silver electroplates.

3.4.3 (R) Corrosion Resistance: Representative parts or specimens as in 4.3.3 shall no evidence of corrosion of the basis metal, determined by exposure for 100 hours to salt spray corrosion test conducted in accordance with ASTM B 117.

3.5 Quality:

Plating, as received by purchaser, shall be sound, smooth, continuous, adherent to the basis metal, uniform in color, and free from blisters and other imperfections detrimental to usage of the plating. There shall be no evidence of double plating and spotting-in.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processing vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Where actual parts are to be tested, such parts shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for thickness (3.4.1), adhesion (3.4.2), and quality (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests for corrosion resistance (3.4.3) and tests of cleaning and plating solutions to ensure that the deposited metal will conform to specified requirements are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of plated parts to a purchaser, when a change in material and/or processing requires reapproval by the cognizant engineering organization (See 4.4.2), and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be not less than the following: a lot shall be all parts of the same part number, made of the same alloy, plated to the same range of plate thickness in the same set of solutions within a consecutive 24-hour period of operation, and presented for processors inspection at one time. Where practical, tests shall be performed on actual parts.

4.3.1 (R) For Acceptance Tests: Test samples shall be selected randomly from all parts in a lot. Unless purchaser specifies a sampling plan, the minimum number of samples shall be as shown in Table 1.

TABLE 1 - Sampling for Acceptance Tests

Number of Parts in Lot	Quality	Thickness and Adhesion
1 to 6	all	3
7 to 15	7	4
16 to 40	10	4
41 to 110	15	5
111 to 300	25	6
301 to 500	35	7
501 to 700	50	8
701 to 1200	75	10
Over 1200	125	15

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

4.3.3 When destructive tests are required and plated parts are of such configuration or size as to be not readily adaptable to the specified tests, separate tests specimens, made of the same generic class of alloy as the parts, cleaned, plated, and post-treated with the parts represented may be used. Specimens shall be either panels approximately 0.032 x 4 x 1 inch (0.81 x 102 x 25 mm) or bars approximately 0.5 inch (13 mm) in diameter and 4 inches (102 mm) long.

4.4 Approval:

4.4.1 The process and control factors, a preproduction sample, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 The processor of plated parts shall make no significant change to materials, processes, or control factors from those on which the approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the plated parts.

4.4.3 Control factors shall include, but not be limited to, the following:

Current density
Bath types and composition limits
Bath temperature/time limits
Stripping procedure
Periodic test plan
Type of adhesion test