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

AEROSPACE MATERIAL SPECIFICATION

AMS 2399

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Revised

ELECTROLESS NICKEL-BORON PLATING

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for electroless deposition of nickel-boron on various materials and the properties of the deposit.

1.2 Application: Primarily to provide mar-resistant and corrosion-resistant surfaces with good solderability using a mildly activated rosin flux. For other applications where solderability and low contact resistance are not required, AMS 2404 should be considered.

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
AMS 4027 - Aluminum Alloy Sheet and Plate, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6)
AMS 4117 - Aluminum Alloy Bars and Rings, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6)

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 B253 - Preparation of and Electroplating on Aluminum Alloys by the Zincate Process
ASTM B487 - Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

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

2.3.1 Military Standards:

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Welding, brazing, forming, and heat treatment shall be completed before parts or assemblies are plated.

3.1.2 Surfaces of metal parts to be plated shall be smooth and substantially free from blemishes, pits, tool marks, and other irregularities.

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3.1.3 Parts, prior to immersion in the plating solution, shall have chemically clean surface prepared with minimum abrasion, erosion, or pitting.

3.2 Procedure:

3.2.1 Plating shall be performed by chemical deposition of an amorphous, high-nickel, low-boron metallic compound on an activated surface from a chemical nickel bath. Unless otherwise specified, parts made of aluminum alloy shall be zincated and copper plated in accordance with ASTM B253 immediately prior to nickel deposition.

3.2.2 The plated parts shall be removed from the plating solution, thoroughly rinsed, and forced-air dried.

3.3 Properties: The deposited plating shall conform to the following requirements:

3.3.1 Thickness: Shall be as specified on the drawing, determined on representative parts or test panels by microscopic method in accordance with ASTM B487 or other method agreed upon by purchaser and vendor.

3.3.2 Adhesion: Specimens shall show no separation of plating from the basis metal, when examined at up to 6X magnification, after being bent rapidly at room temperature, in accordance with ASTM E290, through an angle of 180 deg around a diameter equal to the requirement of the applicable material specification. If the material specification does not include bend test requirements, the specimen shall withstand bending, without cracking, around the minimum diameter that the basis alloy can withstand. Formation of cracks which do not result in flaking or blistering of the plating is acceptable.

3.3.2.1 As a referee test, plating shall show no blisters or cracks on representative aluminum or aluminum alloy parts or test panels after being heated in a circulating-air oven to 375° F ± 15 (190° C ± 8) and held at heat for not less than 3 hours.

3.3.3 Corrosion Resistance: Aluminum alloy parts or representative test panels having specified minimum plate thickness of not less than 0.0005 in. (13 µ m) shall show no visual evidence of corrosion of the basis metal after being subjected for not less than 48 hr to continuous salt spray corrosion test conducted in accordance with ASTM B117.

3.3.4 Solderability: Plating shall be wetted by solder with not less than 95% coverage when tested in accordance with MIL-STD-202, Method 208, in the as-plated condition using the specified type RMA flux. The solder coating shall be continuous with no evidence of pinholes or voids in one area and not to exceed 5% of the total area.

3.3.5 Contact Resistance: The contact resistance of aluminum alloy panels plated to a thickness not less than 0.0005 in. (13 µ m) and under an applied electrode pressure of 50 psi (345 kPa) shall be not greater than 3 milliohms, determined in accordance with 4.5.1. Individual readings not greater than 20% higher than the specified maximum shall be acceptable, provided that the average of all determinations does not exceed the specified maximum resistance.

3.4 Quality: Plating shall be smooth, continuous, adherent to basis metal, uniform in appearance and essentially free from pinholes, porosity, blisters, nodules, pits, and other imperfections detrimental to performance of the plating. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and 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 requirements for thickness (3.3.1) and quality (3.4) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for adhesion (3.3.2) and corrosion resistance (3.3.3) 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 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 to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the initial shipment of plated parts to a purchaser, when a change in material or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

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; a lot shall be all parts plated to the same range of thickness in the same set of solutions in 8 consecutive hours of operation and presented for vendor's inspection at one time:

4.3.1 For Acceptance Tests:

4.3.1.1 Thickness: Three parts from each lot.

4.3.1.2 Quality: As agreed upon by purchaser and vendor.

4.3.2 For 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 and plated with the parts they represent, may be used. Such specimens shall be as follows:

4.3.3.1 For Adhesion Tests: AMS 4027 aluminum alloy approximately 0.032 x 1 x 4 in. (1 x 25 x 100 mm).

4.3.3.2 For Contact Resistance Tests: AMS 4027 aluminum alloy approximately 0.032 x 3 x 6 in. (1 x 75 x 150 mm).

4.3.3.3 For Thickness and Quality Tests: As in 4.3.3.1 or AMS 4117 aluminum alloy bars approximately 0.5 in. (10 mm) in diameter by 4 in. (100 mm) long.

4.3.3.4 For Corrosion Resistance Tests: AMS 4027 aluminum alloy 0.062 - 0.125 in. (1.5 - 3 mm) in nominal thickness and not less than 3 in. (75 mm) wide by 4 in. (100 mm) long.

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 necessary to make any change 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 Test Method:

4.5.1 Contact Resistance: Test equipment and circuitry similar to, or the equivalent of, that shown in Fig. 1 and Fig. 2 shall be used for measuring the electrical resistance of the plating on panels as in 4.3.3. The applied load shall be within 1% of the calculated 50 psi (345 kPa) applied pressure. The contacting electrodes shall be silver plated copper with a finish not rougher than that obtained by the use of 000 metallographic abrasive paper. The electrodes shall be sufficiently flat so that when the load is applied without a specimen between them, light will not be visible through the contacting surface. The area of the upper electrode shall be 1 sq. in. (645 mm^2) with the area of the lower electrode somewhat larger. Six measurements shall be made on each panel in different areas.

4.6 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, AMS 2399, part number, and quantity.

4.7 Resampling and Retesting: If any part or specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional parts or specimens for each original nonconforming part or specimen. Except as specified in 4.7.1, failure of any retest part or specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

4.7.1 If any part or specimen fails to meet the specified requirements, either on the original sampling as in 4.3 or upon resampling as in 4.7, the parts in that lot may be stripped by a method approved by purchaser which does not roughen, pit, or embrittle the basis metal, replated, and retested.

5. PREPARATION FOR DELIVERY:

5.1 Parts shall be handled and packaged in such a manner as will ensure that the required physical characteristics and properties of the plating are preserved.

5.2 Package of parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the plated parts to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts on which plating does not conform to this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

8.1 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Plate thickness desired
Quantity of pieces to be plated
Quality standards (See 3.4)
Applicable level of packaging (See 5.3).