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AEROSPACE MATERIAL SPECIFICATION

AMS 2404C
Superseding AMS 2404B

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ELECTROLESS NICKEL PLATING

1. SCOPE:

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

1.2 Application: Primarily to provide hard, ductile, wear-resistant, and corrosion-resistant surfaces for operation in service up to 1000°F (540°C) and to provide uniform build-up on complex shapes.

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

2.1 SAE Publications: Available from SAE, 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 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-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Welding and brazing shall be completed before parts are plated, unless surfaces are plated to aid in joining by brazing.

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

3.1.3 Surfaces of nonmetallic parts shall show no marks other than those necessary to provide a freshly abraded surface.

3.1.4 Parts having hardness higher than 40 HRC and which have been machined or ground after heat treatment shall be suitably 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.

3.1.5 Parts, prior to immersion in the plating solution, shall have chemically clean surfaces, 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-phosphorus metallic compound on a catalytic or catalyzed surface from a chemical nickel bath. The nickel-phosphorus plate shall be deposited directly on the basis metal without a prior flash coating of other metal, unless otherwise specified.

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

3.3 Post Treatment:

3.3.1 After plating, rinsing, and drying, parts shall be heat treated as in 3.3.1.1, 3.3.1.2, or 3.3.1.3 unless they are to be post treated as in 3.3.2 or unless otherwise permitted to remove hydrogen embrittlement; heating shall be in air, preferably in a circulating-air furnace.

3.3.1.1 Parts, including roll-threaded parts, cold worked after being heat treated by hardening and tempering, springs, and other parts having hardness of 33 HRC and over, shall be heated to 375°F ± 15 (190°C ± 8) and held at heat for not less than 3 hours.

3.3.1.2 Parts, including carburized parts, which will decrease in hardness or be otherwise deleteriously affected by heating to 375°F (190°C) shall be heated to 275°F ± 15 (135°C ± 8) and held at heat for not less than 5 hours.

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

3.3.2 When specified on the drawing, parts, after plating, rinsing, and drying, shall be heated for 30 - 60 min., preferably in an inert atmosphere, at 750°F ± 15 (400°C ± 8) except that parts made of aluminum or aluminum alloy shall be heated at 450°F ± 15 (230°C ± 8) for not less than 4 hours.

3.4 Properties: Plating shall conform to the following requirements:

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

3.4.2 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 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 As a referee test, plating shall show no blisters or cracks on representative steel parts or test panels after being heated in air, preferably in a circulating-air furnace, at 700°F ± 15 (370°C ± 8) for 23 hr ± 1 followed by heating at 1000°F ± 15 (540°C ± 8) for 60 min. ± 5.

3.4.3 Corrosion Resistance: Steel parts or representative test panels having specified minimum plating thickness of 0.001 in. (25 µm) or more, shall, after plating and embrittlement-relieving, 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.

3.5 Quality: Plated surfaces shall be smooth, continuous, and uniform in Ø appearance and shall be free from frosty areas, pinholes, blisters, and other imperfections detrimental to usage of the plate.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all Ø 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 4.5. 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 to determine conformance to requirements for thickness (3.4.1) and quality (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for Ø adhesion (3.4.2) and corrosion resistance (3.4.3) 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 Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of plated parts to a purchaser, when a change in material or processing, or both, 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 of Ø the same part number or configuration processed in a continuous operation to the same plate thickness and presented for vendor's inspection at one time:

4.3.1 For 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 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, plated, and post treated with the parts represented may be used. For adhesion tests, such specimens shall be panels of annealed low-carbon steel approximately 0.032 x 1 x 4 in. (1 x 25 x 100 mm) and for thickness and quality tests shall be panels of the same size and type or shall be bars approximately 0.5 in. (10 mm) in diameter and 4 in. (100 mm) long. For corrosion resistance tests, specimens shall be panels 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.