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AEROSPACE MATERIAL SPECIFICATION

AMS 2427
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Revised

ALUMINUM PLATING
Ion Vapor Deposition

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for ion vapor deposition (IVD) of aluminum on steel, titanium, and aluminum alloys and the properties of the deposit.

1.2 Application: Primarily to provide a corrosion-resistant coating to parts operating at service temperatures up to 925° F (495° C) and requiring freedom from hydrogen embrittlement and solid metal embrittlement.

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 2473 - Chemical Treatment, Aluminum Alloys, General Purpose Coating

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 Method: Nonmagnetic Coatings on Magnetic Basis Metals
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 All forming, heat treating, brazing, and welding shall be completed before parts or assemblies are plated.

3.1.2 All ferrous parts having tensile strength of 220,000 psi (1517 MPa) or greater shall not be exposed to hydrogen contamination processes such as pickling, cathodic cleaning, and etching, or to corrosive environments.

3.1.3 Aluminum or corrosion-resistant steel foil or specially configured aluminum or corrosion-resistant steel masking or plugs shall be used to mask areas where the coating is not desired. Aluminum tape may be used where it is not practical to use foils. The quantity of aluminum tape used shall be minimized.

3.2 Procedure:

3.2.1 The plating process shall consist of deposition of vaporized metallic aluminum from wire of 99.0% minimum aluminum on parts which are made the cathode of a high voltage system within a suitable vacuum. The coating shall be applied directly to the basis metal.

3.2.2 The equipment and processes employed shall be adequate to completely cover all visible surfaces, including roots of threads, recesses, and sharp corners.

3.2.2.1 Parts which require plating to two or more thicknesses in different areas shall be plated using a procedure agreed upon by purchaser and vendor.

3.2.3 The temperature of the parts during deposition of the plate shall be controlled so as not to reduce hardness of titanium and aluminum alloy parts by more than 2 units on the Rockwell B scale and of steel parts to below the minimum of the specified range (See 8.1).

3.3 Post Treatment: Plated parts shall receive a supplementary chromate treatment in accordance with AMS 2473, unless otherwise specified.

3.4 Properties: The deposited aluminum shall conform to the following requirements:

3.4.1 Thickness: Shall be as specified on the drawing, determined on representative parts or test panels in accordance with ASTM B487, ASTM B499, micrometer measurements, or other method agreed upon by purchaser and vendor.

3.4.1.1 Plate thickness may be specifed by AMS 2427 and a suffix number normally designating the minimum thickness in ten-thousandths of an inch as indicated in Table I. The maximum thickness shall be 0.0005 in. (12.5 µm) greater than the minimum, unless otherwise specified by purchaser.

3.4.1.2 Holes, recesses, internal threads, and other areas where a controlled deposit cannot be obtained shall not be subject to a thickness requirement. However, there shall be visual evidence of coating in the holes and recesses down to a depth of at least the diameter of the hole or recess. Unless specified on the drawing for external surfaces, the resultant thickness shall be considered only when such surfaces of parts can be touched by a sphere 0.75 in. (19 mm) in diameter.

3.4.1.2.1 If internal surfaces as defined in 3.4.1.2 are required to be plated to a specified thickness, notes on the drawing will so specify.

3.4.2 Adhesion: Specimens as in 4.3.3 shall not show separation of the plating from the basis metal, when examined at approximately 4X magnification, after being bent rapidly, 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.

3.4.3 Corrosion Resistance: Except as specified in 3.4.3.1, ferrous metal parts or representative test panels shall show no visual evidence of corrosion of the basis metal after being subjected for a time not less than specified in Table I to continuous salt spray corrosion test conducted in accordance with ASTM B117.

3.4.3.1 Salt spray corrosion tests shall not apply to plated parts made of austenitic corrosion-resistant steels or to parts made of any corrosion-resistant steel or alloy when not plated all over.

3.5 Quality: Plated aluminum shall be continuous, adherent to basis metal, uniform in appearance, and essentially free from pin holes, porosity, blisters, nodules, pits, and other imperfections detrimental to performance of the plating. Slight staining or discoloration is permissible. 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 4.5. 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 loss of hardness (3.2.3), thickness (3.4.1), adhesion (3.4.2), 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 corrosion-resistance (3.4.3), and of equipment and process controls 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 processing 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 of essentially the same size, shape, and basis metal processed in a single load 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 from each lot.

4.3.1.2 Adhesion: Three parts from each lot.

4.3.1.3 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 they represent may be used. For adhesion 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) 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.

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, in established composition limits, or in vacuum chamber operating conditions, 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, AMS 2427, lot number, part number, and quantity.

4.6 Resampling and Retesting: If any 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 specimens for each original nonconforming specimen. Except as specified in 4.6.1, failure of any retest 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.

4.6.1 If any part fails to meet the specified requirements, either on the original sampling as in 4.3 or upon resampling as in 4.6, 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, post treated, 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 Packages 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 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.