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AEROSPACE MATERIAL SPECIFICATION

AMS 2471D
Superseding AMS 2471C

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ANODIC TREATMENT OF ALUMINUM ALLOYS
Sulfuric Acid Process, Undyed Coating

1. SCOPE:

1.1 Purpose: This specification establishes the engineering requirements for producing undyed anodic coatings on aluminum alloys and the properties of such coatings.

1.2 Application: To increase corrosion resistance on aluminum alloy parts and to provide surfaces which will ensure satisfactory adherence of paint and other organic finishes. For coatings to be colored by dyeing, AMS 2472 should be specified. This process is not suitable for parts which contain joints or recesses in which the anodizing solution may be retained.

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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate)

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 B137 - Measurement of Weight of Coating on Anodically Coated Aluminum

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 Solutions:

3.1.1 Electrolyte: Shall be an aqueous solution of sulfuric acid of suitable concentration (nominal concentration is 15% by weight). The anodizing solution shall be maintained at a selected temperature within the range 64° - 75°F (18° - 24°C); the selected temperature shall be maintained within ±2°F (±1°C).

3.1.2 Sealer: Shall be an aqueous solution containing 5 - 6% by weight of sodium or potassium dichromate. The sealer solution shall be maintained at a pH of 4.5 - 6.0 and a temperature of 190° - 210°F (85° - 100°C). Adjustments in the pH of the solution shall be made by addition of chromic acid.

3.2 Procedure:

3.2.1 Preparation: All heat treatment, machining, forming, brazing, welding, and perforating operations shall, insofar as practicable, be completed before parts are anodized, unless otherwise specified.

3.2.2 Cleaning: Parts, prior to being coated, shall have clean surfaces, free from water-breaks, prepared with minimum abrasion, erosion, or pitting. Cleaning by a process giving a slightly etched surface is desirable.

3.2.3 Coating: The cleaned parts shall be made the anode in the electrolyte contained in a suitable tank which, if made of a metal resistant to the electrolyte or if lined with lead, may also serve as the cathode. Direct current shall be applied as required to produce an anode current density of 10 - 15 amp per sq ft (110 - 160 A/m^2), for 15 - 30 min. to produce an anodic coating conforming to the requirements of 3.3. Other conditions of time, temperature, and amperage may be used when approved by purchaser. After anodizing, all parts shall be rinsed thoroughly in cold, running tap water.

3.2.4 Sealing: Parts shall be immersed in the sealer solution for not less than 20 minutes. After sealing, all parts shall be rinsed thoroughly in clean, cold, running tap water, rinsed in clean hot water, and dried.

3.3 Properties: Coated parts shall conform to the following requirements:

3.3.1 Coating Weight: Shall be not less than 600 mg per sq ft (6.5 g/m^2). Coating weight shall be determined in accordance with ASTM B137 on parts or specimens as in 4.3.1 which have been anodized and rinsed but not sealed.

3.3.1.1 If small parts, such as rivets and machine screws, are anodized in bulk in a container, the specified coating weight shall apply to not less than 75% of the parts anodized together, determined by random sampling, but in no case shall any part show uncoated areas except at contact points.

3.3.2 Corrosion Resistance:

3.3.2.1 For control purposes, samples of AMS 4037 aluminum alloy sheet, treated in accordance with 3.2, shall withstand exposure for 336 hr to salt spray without showing more than a total of 15 scattered spots or pits, none larger than 1/32 in. (1 mm) in diameter, in a total of 150 sq in. (1000 cm^2) of test area grouped from five or more test pieces, or more than 5 scattered spots or pits, none larger than 1/32 in. (1 mm) in diameter, in a total of 30 sq in. (200 cm^2) from one or more test pieces, except those areas within 1/16 in. (2 mm) from identification markings and at electrode contact marks remaining after processing. Salt spray corrosion tests shall be conducted in accordance with ASTM B117 except that the significant surface shall be inclined approximately 6 deg from the vertical.

3.3.2.2 Parts that are anodized and not subsequently painted shall withstand exposure for 336 hr to salt spray test conducted in accordance with ASTM B117 without showing more than a few scattered corrosion pits visible without magnification.

3.3.2.2.1 Corrosion test is not required when parts, treated in accordance with 3.2, are subsequently to be painted.

3.4 Quality: Anodic coating shall be continuous, smooth, adherent, and uniform in appearance and shall be free from powdery areas, loose films, discontinuities such as breaks or scratches, except at contact points, or other damage or imperfections detrimental to appearance or to performance of the coating.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The coating 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 Ø coating weight (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 Ø corrosion resistance of representative parts and separate panels (3.3.2) and of cleaning and processing solutions to ensure that the anodic coating will conform to the requirements of this specification are classified as periodic tests and, except as specified in 4.3.2 and 4.3.3, 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 processed 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 Ø 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 processed in a continuous series of operations and presented for vendor's inspection at one time:

4.3.1 Coating Weight: Shall be determined on representative parts when size and shape permit accurate determination of surface area. If parts are of such size and shape that surface area cannot be determined readily, coating weight determinations shall be made on separate test specimens 0.025 - 0.063 in. (0.6 - 1.6 mm) thick and not less than 3 x 3 in. (75 x 75 mm) in length and width made of any alloy of the same class as the parts represented, as follows:

Class 1. Alloys of Aluminum Association designations 1100, 3003, 3004, 5052, 6053, 6061, 6063, and all alclad alloys.

Class 2. All wrought alloys not listed as Class 1 and all casting alloys.

4.3.1.1 Separate specimens, if used, shall be processed with the work they represent.

4.3.2 Corrosion Resistance: Shall be determined at least monthly on Ø representative parts and on separate panels 0.025 - 0.063 in. (0.6 - 1.6 mm) thick and not less than 3 x 10 in. (75 x 250 mm) in width and length.

4.3.3 Process Solution Control: Shall be performed at least weekly. Ø

4.4 Approval:

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

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 coated parts, test panels, or both. Production parts coated by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Reports: The vendor of coated parts shall furnish with each shipment three Ø 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 2471D, part number, and quantity.

4.6 Resampling and Retesting: If any part or specimen used in the above tests Ø 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. 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.

5. PREPARATION FOR DELIVERY:

5.1 Coated parts shall be handled and packaged in such a manner as will ensure Ø that the required physical characteristics and properties of the coating are preserved.

5.2 Packages of coated parts shall be prepared for shipment in accordance with Ø 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 Ø MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1 and 5.2 will be acceptable if it meets the requirements of Level C.

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